

XVIIth World Congress of the International Commission of Agricultural and Biosystems Engineering

Convention Centre
Québec City, Canada
June 13-17, 2010

Book of Abstracts

"Sustainable Biosystems Through Engineering"



TABLE OF CONTENTS

General Information	2
Hosts and Organizing Committee	3
CIGR Section Chairs and Scientific Committee Coordinators	3
List of Abstract by Participating Group	
American Ecological Engineering Society 10 th Annual Meeting	4
ASABE's 9 th International Drainage Symposium	5
Symposium on Nanotechnologies Applied to Biosystems Engineering and the Environment	8
Special Interdisciplinary Session on Education	8
INFITA and 8 th World Congress on Computers in Agriculture (joint with Section VII)	24
CIGR Section I: Land and Water Engineering	8
CIGR Section II: Farm Buildings, Equipment, Structures and Environment	10
CIGR Section II-B: Aquacultural Engineering	13
CIGR Section III: Equipment Engineering for Plants	14
CIGR Section IV: Energy in Agriculture	17
CIGR Section V: Management, Ergonomics and Systems Engineering	18
CIGR Section VI: Postharvest Technology and Process Engineering	19
CIGR Section VII: Information Systems	24
Abstracts	27
Sponsors	404 (back cover)

GENERAL INFORMATION

The Book of Abstracts contains a summary provided by authors of presentations made during the XVIIth World Congress of the International Commission of Agriculture and Biosystems Engineering (CIGR). The Congress was held under the general theme of "Sustainable Biosystems through Engineering". Several specialized symposia were organized by participating groups listed in the Table of Contents. The Canadian Society for Bioengineering (CSBE/SCGAB) is publisher of the Book of Abstracts.

EDITORS

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The Editors acknowledge the assistance of several contributors to the revision and editing of abstracts and full length papers : Nathalie Guesneau, Héloïse Bastien, Pierre-Luc Lizotte, Pierre Luc Hébert and François-Simon Robert. The Editors received useful advice from the CIGR Section Chairs and the participating group coordinators whose names are on the next page. Several other people acted as reviewers of abstracts and papers to improve the quality of presentations; their work is appreciated.

ABSTRACTS AND FULL PAPERS

To find an abstract, first identify its CSBE number (10XXXX). Papers can be found by technical themes in the List of Abstracts by Participating Group on pages 4 to 26. Abstracts are published in numerical order in the subsequent pages. Some abstracts have been shortened for reasons of space. Complete abstracts and full papers that were submitted will be available on the CSBE/SCGAB web site after the Congress. For updates on paper availability and downloading, visit: www.bioeng.ca

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HOSTS AND ORGANIZING COMMITTEE

CIGR

CIGR was founded in 1930 in Belgium as a non-governmental, non-profit professional organization. The International Commission of Agricultural and Biosystems Engineering (CIGR) is a world-wide federation regrouping - in form of a networking system - national, regional and multinational associations, societies, corporations and individuals working in science and technology applied to the different fields of agricultural engineering.

www.cigr.org

CSBE/SCGAB

The Canadian Society for Bioengineering / Société canadienne de génie agroalimentaire et de bioingénierie (CSBE/SCGAB) is an educational and scientific organization dedicated to the advancement of engineering applicable to agricultural, food, and biological systems. The Society was founded in 1958 in Wolfville, Nova Scotia.

www.bioeng.ca

Organizing Committee



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CIGR Section Chairs and Scientific Committee Coordinators

CIGR Section I: Land and Water Engineering (Chair: **Jose M. Tarjuelo** [Spain]); Coordinator: **Guanhua Huang** (China)

CIGR Section II: Farm Buildings, Equipment, Structures and Environment (Chair: **Daniel Berckmans** [Belgium]); Coordinators: **Hisamitsu Takai** (Denmark) and **Stéphane P. Lemay** (Canada)

CIGR Section II-B: Aquacultural Engineering; Coordinators: **Eiko Thiessen** (Germany) and **Ed Aneshansley** (USA)

CIGR Section III: Equipment Engineering for Plants (Chair: **John K. Schueller** [USA]); Coordinator: **Bernard Panneton** (Canada)

CIGR Section IV: Energy in Agriculture (Chair: **Mikio Umeda** [Japan]); Coordinator: **Philippe Savoie** (Canada)

CIGR Section V: Management, Ergonomics and Systems Engineering (Chair: **Pietro Piccarolo** [Italy]); Coordinator: **Remigio Berruto** (Italy)

CIGR Section VI: Postharvest Technology and Process Engineering (Chair: **Jozef Grochowicz** [Poland]); Coordinator: **Cristina Ratti** (Canada)

CIGR Section VII: Information Systems (Chair and Coordinator: **Antonio Saraiva** [Brazil])

INFITA and 8th World Congress on Computers in Agriculture jointly organized with CIGR Section VII; Coordinator **Fedro Zazueta** (USA)

ASABE's 9th International Drainage Symposium; Coordinators: **Ali Madani** (Canada), **Chip Chescheir** (USA) and **Gary Sands** (USA)

American Ecological Engineering Society 10th Annual Meeting (President: **Cully Hession** [USA]); Coordinator: **Stacy Hutchinson** (USA)

Symposium on Nanotechnologies Applied to Biosystems Engineering and the Environment; Coordinator: **Khaled Belkacemi** (Canada)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

American Ecological Engineering Society 10th Annual Meeting

Monday, June 14 – 10:15 to 12:00

1	AEES	Stream Water and Wetland Interactions (I)
Time	Paper #	Moderator: Greg Jennings (USA) Room: 206A
10:15		Session Opening
10:20	100255	Purlear Creek habitat restoration case study G. Jennings, M. Shaffer, K. Hall et al. (United States)
10:40	101195	Riparian constructed wetlands for improving water quality in a polluted river in southeastern Mexico M.E. Hernández, P. Ruiz-Enzástiga (Mexico)
11:00	101493	Predicting dynamic equilibrium in streams in the Olentangy River Watershed, Ohio, USA J. Witter, A. Ward, J.L. D'Ambrosio (United States)
11:20	101526	Flume analysis of in-channel restoration structures and impacts to secondary circulation flows T. Zhou, T. Endreny (United States)
11:40	101532	Characterizing surface-ground water exchange rates and hydraulic transport processes in a cascading stream T. Endreny, M. Fabian (United States)

Monday, June 14 – 13:35 to 15:20

16	AEES	Stream Water and Wetland Interactions (II)
Time	Paper #	Moderator: Cully Hession (USA) Room: 206A
13:35		Session Opening
13:40	101604	Patterns in groundwater hydrology of a small constructed floodplain wetland A.L. Ludwig, W.C. Hession (United States)
14:00	101585	Quantifying and utilizing uncertainty in stream restoration design J.P. Resop, W.C. Hession, T.M. Wynn (United States)
14:20	101528	Meander bend regulation of surface-ground water exchange and impacts for restoration design B. Han, T. Endreny (United States)
14:40	101519	Aquatic macroinvertebrate diversity in constructed stormwater wetlands T. L. Moore, W.F. Hunt III (United States)

Monday, June 14 – 15:35 to 17:00

31	AEES	Climate and Watershed Ecology
Time	Paper #	Moderator: Dan Hitchcock (USA) Room: 206A
15:35		Session Opening
15:40	101590	Climate change, energy scarcity, and Mississippi Delta restoration J.W. Day, P. Kemp (United States)
16:00	101620	Defining sustainable development targets for coastal hydrology, water quality, and ecology in South Carolina, USA D.R. Hitchcock, A.D. Jayakaran, D.M. Rogers et al. (USA)
16:20	101595	Design and implementation of a forebay-pond-wetland system for urban stormwater treatment in south Texas X. Pan, K.D. Jones, S. Wang et al. (United States)
16:40	100450	Update on setting the global temperature using ecological engineering A. J. Horne (United States)

Tuesday, June 15 – 10:15 to 12:00

46	AEES	Water Management and Crop Production
Time	Paper #	Moderator: Stacy Hutchinson (USA) Room: 206A
10:15		Session Opening
10:20	101591	Water use and sustainability in global corn production J.P. Resop, M.D. Matlock, W.C. Hession et al. (USA)
10:40	101593	Greywater irrigation: Antibacterial agents as barriers to greywater reuse D.I. Harrow, R.J. Currer, R.E. Templin et al. (USA)

11:00	101608	Rain garden networks: Impacts on water quality C.G. Eger, D.A. Schlea, J.F. Martin (USA)
11:20	101612	Using USGS NAWQA and EPA WSA data to assess the impact of agricultural practices on aquatic biodiversity, in-stream water quality, and habitat parameters affecting benthic macroinvertebrates E. Cummings, M. Matlock, R.Z. Johnston (USA)
11:40	101384	Spatial and temporal variation in the biodegradation of organophosphate pesticides in agricultural drains and riparian wetlands M.E. Karpuzcu, J. Hanlon, D. Sedlak et al. (USA)

Tuesday, June 15 – 14:00 to 15:20

61	AEES	Ecological Engineering – POSTERS
Poster #	Paper #	Moderator: Grant Clark (Canada) Room: 2000D
22	101082	Maximizing the hydrological impact of street trees through sidewalk design S. Lingwood, O.G. Clark, P. Jutras et al. (Canada)
23	101600	The landscape dynamics in Pirai da Serra, Brazil C.H. Rocha, D. Almeida, P.H.W. Neto et al. (Brazil)
24	100455	Emission of CH₄, CO and NH₃ during composting of synthetic food waste in a controlled pilot-scale compost reactor E. Phillip, G. Clark (Canada)
25	100652	Harvesting from our food waste - Ecological treatment system for anaerobic digested food waste slurry H. Lin, S. A.W. Diemont, D. L. Johnson (United States)
26	101609	Biomass production, green house gas abatement and inter-row cropping in a constructed wetland M. Duteau (Canada)
27	101529	SAD-RH: a generic decision support system for water resource management M.D.A.G.M. da Hora, E. Marques, A.F. da Hora (Brazil)
28	101589	Reducing environmental vulnerability and enhancing community resiliency along the Louisiana coast through the coastal sustainability studio J. W. Day, R. Twilley, L. Carter et al. (United States)
29	101472	A methodology to manage environmental effects of crop-shelter coverage C. Arcidiacono, S.M.C. Porto (Italy)
30	101603	Load estimations using LOADEST within agriculturally dominated watersheds across the continental United States R.Z. Johnston, E. Cummings, M. Matlock (United States)
31	101617	Evaluation of attached periphytic algal communities for biofuel feedstock generation H. N. Sandefur, M. D. Matlock, T. A. Costello (United States)
32	100379	Comparison of different plantation modes in ecological restoration in Antaibao opencast mining sites in Shanxi Province, North China J.-T. Zhang, M. Li (China)

Tuesday, June 15 – 15:35 to 17:20

75	AEES	Ecological Engineering Principles and Practices
Time	Paper #	Moderator: Stephanie Lansing (USA) Room: 206A
15:35		Session Opening
15:40	100711	Investigating case-based reasoning for ecosystem design T. R. Lanphere, O. G. Clark (United States)
16:00	101225	Design challenges to the integration of ecosystem services into agricultural landscapes in arid ecosystems W.T. Stringfellow (United States)
16:20	101192	Creating renewable energy using ecological engineering principles S. Lansing (United States)
16:40	100339	Development of a framework for sustainable remediation decision making (SRDSS) I. S. Dunmade (Canada)

17:00 101613 **Engineering autonomy in an algal turf scrubber techno-ecosystem.**
D. M. Biersch, P. Kangas (United States)

Wednesday, June 16 – 8:15 to 10:00

90 AEES Trees and Crops for Sustainability (I)
Time Paper # Moderator: Stewart Diemont (USA)
Room: 205C
8:15 **Session Opening**
8:20 101550 **Modeling city tree growth with artificial intelligence and multivariate statistics for sustainable urban ecosystems**
P. Jutras, S.O. Prasher (Canada)
8:40 101087 **Biodiversity of managed forests surrounding the Calakmul Biosphere Reserve in Mexico**
J. Bohn, S.A.W. Diemont, J. Mendoza (USA / Mexico)
9:00 101040 **Short rotation woody biomass production as option for the restoration of post-mining areas in Lower Lusatia**
C. Böhm, A. Quinkenstein, D. Freese et al. (Germany)
9:20 101480 **How to manage legume-rhizobia N₂-fixing symbioses as ecological engineers?**
J.-J. Drevon, H. Hamza, B. Jaillard et al. (France/Egypt/Spain)
9:40 101602 **Role of tao (Belotia mexicana) in the traditional Lacandon Maya shifting cultivation ecosystem**
K. Cheng, S. Diemont, A. Drew (United States)

Wednesday, June 16 – 10:15 to 12:00

104 AEES Trees and Crops for Sustainability (II)
Time Paper # Moderator: Dave Tilley (USA)
Room: 204B
10:15 **Session Opening**
10:20 100800 **Mopan and Que'chi Maya ecological engineering: Design strategies for sustainable ecosystem restoration and human subsistence**
D. D. Rayome, S. A.W. Diemont (United States)
10:40 100788 **Linking traditional agroforestry practices of the Tsotsil Maya in Santo Domingo Las Palmas, Chiapas, Mexico to ecosystem biodiversity, land management sustainability, and community well-being**
S. J. Kelsen, S. A. W. Diemont, B. G. Ferguson (Mexico/United States)
11:00 101326 **Short rotation coppice with Robinia pseudoacacia L. -A land use option for carbon sequestration on reclaimed mine sites**
A. Quinkenstein, C. Böhm, D. Freese et al. (Germany)
11:20 101565 **The contribution of agroforestry systems to ecosystem services**
D. Freese, C. Böhm, A. Quinkenstein et al. (Germany)
11:40 100792 **Emergy synthesis for valuing the ecosystem services of green walls and other vegetated building envelope technologies**
D. R. Tilley, J. Price, E. Campbell (United States)

Wednesday, June 16 – 13:35 to 15:20

119 AEES Treatment Wetlands and Lagoon Management
Time Paper # Moderator: Christina Toms (USA) Room: 204B
13:35 **Session Opening**
13:40 101176 **Influence of hummocks and emergent vegetation on hydraulic performance in a surface-flow wastewater-treatment wetland**
J.S. Daniels, S.H. Keefe, L.B. Barber (United States)
14:00 101518 **Green manure production as a value-added component of treatment wetlands for livestock wastewater**
S.D. McLennan, D. Reinhold (United States)
14:20 101569 **An interdisciplinary ecological engineering approach to the assessment and enhancement of lagoons in California's central coast**
C. Toms (United States)
14:40 101575 **In-lake algal bloom removal and ecological restoration using modified local soil technology**
G. Pan (China)

15:00 101610 **Evaluation of toxicity metrics and the toxicity of different production methods in the US**
Z. Clayton-Niederman, L.L. Nalley, M.D. Matlock (USA)

Abstract only 101529 **Sad-rh: a generic decision support system for water resource management**
M.De A.G.M. Da Hora, E. Marques, A.F. Da Hora

ASABE's 9th International Drainage Symposium

Monday, June 14 – 10:15 to 12:00

2 IDS Drainage and Water Quality
Time Paper # Moderator: Ali Madani (Canada)
Room: 205C
10:15 **Session Opening**
10:20 100082 **Nitrogen and phosphorus losses in surface runoff water from various cash cropping systems**
P. Jiao, T. Zhang, D. Xu et al. (China/Canada)
10:40 100130 **Drainage on the Delmarva Peninsula: past history and future challenges**
W. F. Ritter (United States)
11:00 100157 **Nitrate-N loads to subsurface drains as affected by drainage intensity and agronomic management practices**
E. J. Klavivko, L.C. Bowling, V. Poole (United States)
11:20 100224 **Effects of drain depth on nitrate-N and phosphorus losses from drained agricultural lands receiving nitrogen and phosphorus from organic sources**
C.A. Poole, R.W. Skaggs, G.M. Chescheir et al. (USA)

Monday, June 14 – 10:15 to 12:00

3 IDS Evaluating Drainage Models and Drainpipe Envelopes
Time Paper # Moderator: Mohamed Youssef (USA)
Room: 204B
10:15 **Session Opening**
10:20 100175 **Measured effect of agricultural drainage water management on hydrology, water quality, and crop yield**
M. Sunohara, M. A. Youssef, E. Topp, D.R. Lapen (United States/Canada)
10:40 100170 **Assessing the feasibility of DRAINMOD application using soil hydraulic properties estimated by pedotransfer functions**
A. M. Abdelbaki, M. A. Youssef (United States)
11:00 100217 **Mathematical modelling on the operation of water control structures in a secondary block**
F. X. Suryadi, P. H. J. Hollanders, R. H. Susanto (Netherlands/Indonesia)
11:20 100177 **Laboratory study of the soil clay percent influence on the need for subsurface drainage system envelopes**
T. Sohrabi, H. Ojaghloo, H. Rahimi et al. (Iran)
11:40 101667 **Machines for wrapping drainage pipes with a defined voluminous synthetic fiber filter**
W. Hevert (Germany)

Monday, June 14 – 13:35 to 15:20

17 IDS Drainage Modeling in Saline Conditions
Time Paper # Moderator: Matt Helmers (USA)
Room: 205C
13:35 **Session Opening**
13:40 100199 **Evaluation of DRAINMOD in predicting water table fluctuations and yield of canola in paddy fields (case study: Rasht, Iran)**
M. Parsinejad, B. Hassanpour, M.R. Yazdani et al. (Iran)
14:00 100055 **Determining optimized distance and depth of subsurface drains under unsteady flow conditions at multiple cropping pattern**
F. Vahdat, A. Sarraf, E. Pazira et al. (Iran)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

14:20	100027	Evaluation of two drainage models in south-west Iran F. Samipour, M. Rabie, K. Mohammadi et al. (Iran)
14:40	100103	Drainage in heavy clay soil and sugar beet yield in eastern North Delta M. M. Moukhtar, A. I.N. Abdel-Aal And, M.A. B. El-Shewikh (Egypt)

Monday, June 14 – 13:35 to 15:20

18	IDS	Impact of Organic Fertilizers on Drained Land
Time	Paper #	Moderator: Larry Geohring (USA) Room: 204B
13:35		Session Opening
13:40	100139	Occurrence of tylosin-resistant enterococci in swine manure and tile drainage stems under no-till management T.T. Hoang, M. L. Soupir (United States)
14:00	100149	Phosphorus losses through subsurface drainage in a loamy soil of Iowa: effects of rates, timing and method of swine manure and fertilizer application C. Hoang, R. Kanwar, C. Pederson (United States)
14:20	100201	Subsurface drainage nitrogen discharges following manure application: measurements and model analyses J. Melkonian, L.D. Geohring, H.M. V. Es et al. (United States)
14:40	100096	The effects of treated wastewater on soil nitrogen dynamics and winter wheat growth under different groundwater depth X. Qi, Z. Huang, P. Li et al. (China)

Monday, June 14 – 15:35 to 17:00

32	IDS	Drainage and Salinity
Time	Paper #	Moderator: Gary Sands (USA) Room: 205C
15:35		Session Opening
15:40	100109	Salt leaching efficiency of subsurface drainage systems at presence of diffusing saline water table boundary: A case study in Khuzestan Plains, Iran E. Pazira, M. Homaei (Iran)
16:00	100133	Estimating reclamation water requirement and predicting final soil salinity for soil desalinization A. Sarraf, F. Vahdat, E. Pazira et al. (Iran)
16:20	100164	Soil salinity change detection in irrigated area under Qazvin Plain irrigation network using satellite imagery P. D. Arasteh (Iran)

Monday, June 14 – 15:35 to 17:00

33	IDS	Water Treatment with Wetland and Drainage Systems
Time	Paper #	Moderator: Shiv Prasher (Canada) Room: 204B
15:35		Session Opening
15:40	100232	Establishing a relationship between hydraulic efficiency and treatment performance in constructed wetlands M. Wahl, L. C. Brown, A. O. Soboyejo et al. (USA/China)
16:00	101626	Understanding the removal mechanisms of pharmaceutical compounds in a constructed wetland setup S.A. Hussain, S. Prasher (Canada)
16:20	100169	Temperature effects on shallow water infiltration rates in an underground rock bed BMP M. Horst (United States)
16:40	100231	Lessons gained from French R&D programs for pesticides dissipation by use of constructed wetlands J. Tournebize, B. Vincent, C. Chaumont et al. (France)

Tuesday, June 15 – 10:15 to 12:00

47	IDS	Performance of Drainage Water Management Systems
Time	Paper #	Moderator: Larry Brown (USA) Room: 205C
10:15		Session Opening
10:20	100206	DRAINMOD-simulated performance of drainage water management across the U.S. Midwest M. A. Youssef, R. W. Skaggs, K.R. Thorp et al. (USA/Egypt)
10:40	100084	Potential water quality impact of drainage water management in the Midwest USA D. B. Jaynes, K. R. Thorp, D. E. James (USA)
11:00	100138	Water table response to drainage water management in southeast Iowa M. Helmers, R. Christianson, G. Breneman et al. (USA)
11:20	100154	Controlled drainage to improve edge-of-field water quality in southwest Minnesota, USA S.E. Feser, J.S. Strock, G.R. Sands et al. (USA)
11:40	100222	Methods to estimate effects of drainage water management on annual N losses to surface waters R. W. Skaggs, M. A. Youssef, G.M. Chescheir (USA)

Tuesday, June 15 – 13:35 to 15:20

62	IDS	Application of Drainage Models
Time	Paper #	Moderator: Ali Madani (Canada) Room: 205C
13:35		Session Opening
13:40	100137	Potential watershed nitrate load reduction with drainage water management under varied implementation options S. Ale, L. Bowling, M. Youssef et al. (United States)
14:00	100214	Modeling runoff from a small artificially drained agricultural catchment in Norway, using the DRAINMOD model. J. Deelstra, C. Farkas, M. Youssef (Norway/United States)
14:20	100143	Impact of climate change on drainage outflow and water quality in eastern Canada S. Dayyani, S. Prasher, A. Madani et al. (Canada)
14:40	100205	Predicted impacts of climate change on crop production on drained lands in Sweden M. A. Youssef, I. Weststrom (United States/Sweden)
15:00	100218	Application of SWAP to assess performance of subsurface drainage system under semi-arid monsoon climate A. K. Verma, S. K. Gupta, R. K. Isaac (India)

Tuesday, June 15 – 15:35 to 17:20

76	IDS	Modeling Drainage Systems
Time	Paper #	Moderator: Ramesh Rudra (Canada) Room: 205C
15:35		Session Opening
15:40	100241	The relationship between watershed physiography, tile flow, and streamflow characteristics R. P. Rudra, S. I. Ahmed, M. Khayer et al. (Canada)
16:00	100258	Hydrologic modelling of an agricultural drained micro-watershed: Performance analysis of coupled surface water/groundwater models M. Muma, A.N. Rousseau, C. Paniconi et al. (Canada/France)
16:20	101372	Empty drain and the water level at midway between the drains. Aspects regarding management P. Castanheira (Portugal)
16:40	101429	New software for the optimal design of drainage network in steady-state sub-irrigation case study: Greoni-Ticvanu Mare drainage arrangement M.T. Eugen, B. Marinela, C. Laura et al. (Romania)
17:00	100147	Surface runoff and soil physical properties as affected by subsurface drainage improvement of a heavy clay soil L. Alakukku, E. Turtola et al. (Finland)

Tuesday, June 15 – 15:35 to 17:20

77	IDS	Drainage Topics – POSTERS
Poster #	Paper #	Moderator: Gary Sands (USA) Room: 2000D
50	100071	A comparison of DRAINMOD and SWAT for surface runoff and subsurface drainage flow prediction at the field scale for a cold climate M. Chikhaoui, C. Madramootoo, A. Gollamudi (Canada)
51	100086	Performance of DRAINWAT model in assessing the drainage discharge from a small watershed in the Po valley (Northern Italy) M. Borin, T. Bisol, D. M. Amatya (Italy)
52	100072	Assessment of climate change impact on the subsurface drainage flow in the Pike River watershed using the SWAT model M. Chikhaoui, C. Gombault, C. Madramootoo et al. (Canada)
53	100116	Performance of biodrainage systems in arid and semiarid areas with salt accumulation in soils S. Akram, H. Liaghat (Iran)
54	100155	Nutrient load from two drainage systems on clay soil P. Vakkilainen, L. Alakukku, M. Myllys et al. (Finland)
55	100161	The role of curli and cellulose in the transport and survival of Escherichia coli on a central New York dairy farm A. E. Salvucci, M. Elton, J. D. Siler et al. (United States)
56	100204	Mapping soil moisture content variability using electromagnetic induction method A.A.Farooque, Q. Zaman, A. Schumann et al. (Canada/USA)
57	101484	Impact of shallow water table depths on surface irrigation requirements and crop performance Z. Ulhaque (Pakistan)
58	100129	Sustainability of biodrainage systems considering declining of evapotranspiration rate of trees due to soil salinization H. Liaghat, M. Mashal (Iran)
59	100219	Impact on drainage water quality from amending agricultural soils in Nova Scotia with an alkaline stabilized biosolid G.W.Price, A. Madani, J.D. Gillis (Canada)
60	100095	Water balance and corn yield under different water table management scenarios in southern Québec A. Singh, C. A. Madramootoo, D. L. Smith (Canada)
61	100192	An initial assessment of a wetland-reservoir wastewater treatment and reuse system receiving agricultural drainage water in Nova Scotia M. Haverstock, A. Madani, R. Gordon et al. (Canada)
62	100145	Suitable buffer strip width along rivers for nitrate N removal from paddy field drainage Z. Zhan-Yu 1, C. Yi-Xia, Z. Cheng-Li et al. (China)
63	100253	Implications of agricultural drainage water reuse: I. crop yield and water productivity A. A.-A. Aboukeira, A. El-Shafie, M. H. Rady et al. (United States/Egypt)
64	100191	Implications of agricultural drainage water reuse: II. soil properties A. A.-A. Aboukeira, A. El-Shafie, M. H. Rady (USA/Egypt)
65	101668	Drainage control system (DCS) V. Machabee (Canada)

Wednesday, June 16 – 10:15 to 12:00

106	IDS	Drainage From Forested Lands and other Land Uses
Time	Paper #	Moderator: Devendra Amatya (USA) Room: 204B
10:15		Session Opening
10:20	100261	A comparison of mike she and DRAINMOD for modeling forested wetland hydrology in coastal south Carolina, USA Z. Dai, D. M. Amatya, G. Sun et al. (United States)
10:40	100185	Field evaluations of a forestry version of DRAINMOD-N II model S. Tian, M. A. Youssef, R.W. Skaggs et al. (USA)

11:00	100188	Streamflow characteristics of a naturally drained forested watershed in southeast Atlantic coastal plain D. M. Amatya, C. C. Trettin (United States)
11:20	100215	The effect of sampling frequency on the accuracy of nitrogen load estimates from drained loblolly pine plantations in eastern North Carolina G. M. Chescheir, F. Brigand, S. Tian et al. (USA)
11:40	100162	Advances in sportsturf drainage D. B. Shelton (United Kingdom)

Wednesday, June 16 – 10:15 to 12:00

107	IDS	Maps and Tools for Decision Makers
Time	Paper #	Moderator: Robert Lagacé (Canada) Room: 206A
10:15		Session Opening
10:20	100078	National inventory of artificially drained lands in Germany B. Tetzlaff, P. Kuhr, F. Wendland (Germany)
10:40	100271	Using earth observation data for soil drainage classification and mapping M.A. Niang, M.C. Nolin, S. Perrault et al. (Canada)
11:00	100301	Certification of drainage contractor enterprises - experience in Québec R. Lagacé, D. Laberge, F. Lambert (Canada)
11:20	100243	Preliminary study of the WRSIS concept at the paddy-upland crops rotation area in southern China S. Xiaohou J. Qiu H. XiuJun et al. (China)
11:40	100093	Impacts of the Chashma Right Bank Canal on land use and cropping pattern in D.I.Khan district (Pakistan) A.-U. Rahman, A. N. Khan (Pakistan)

Wednesday, June 16 – 13:35 to 15:20

120	IDS	Treatment of Drainage Water
Time	Paper #	Moderator: William Ritter (USA) Room: 206A
13:35		Session Opening
13:40	100073	Bioreactor design geometry effects on nitrate removal L. Christianson, A. Bhandari, M. Helmers (United States)
14:00	100171	Nitrate removal of drainage water with barley straw as a bioreactor filter S. E. Hashemi, M. Heidarpour, B. Mostafazadeh-Fard et al. (Iran)
14:20	100207	Beyond the field: A look at agricultural ditch floodplains as a water quality BMP S. Kallio, A. Ward, J. L. D'Ambrosio et al. (United States)
14:40	100209	A decade later: the establishment, channel evolution, and stability of innovative two-stage agricultural ditches in the Midwest region of the United States R. Kallio, A. Ward, J. L. D'Ambrosio et al. (United States)
15:00	100229	Minnesota agricultural ditch reach assessment for stability (MADRAS): A decision support tool J. Magner, B. Hansen, C. Anderson et al. (United States)

Wednesday, June 16 – 13:35 to 15:20

121	IDS	Drainage of Irrigated Lands
Time	Paper #	Moderator: George "Chip" Chescheir (USA) Room: 205C
13:35		Session Opening
13:40	100037	Drainage of irrigated lands C. B. Dandekar , B. A. Chougule (India)
14:00	100104	Environmental and economic multi-objective model for managing irrigation and drain water H. Noory, A.-M. Liaghat, M. Parsinejad et al. (Iran)
14:20	100225	Water redistribution within the potato root zone following irrigation S. Satchithanatham, M.R.C. Cordeiro et al. (Canada)
14:40	100227	Assessment of rootzone water redistribution in corn following irrigation M. R. C. Cordeiro, S. Satchithanatham et al. (Canada)
15:00	100228	Drainage design practices in irrigated agriculture; new concepts gained from recent experiences in three countries of Maghreb, North Africa B. Vincent, I. B. Aissa, A. Belouazni et al. (France/Tunisia/Algeria/Morocco)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

Abstract only	100087	Comparison of drainmod and artificial neural network for predicting water table depth and drain discharge in a subsurface drainage system H. Ebrahimi, H. Ojaghlou, A. Liaghat, M. Parsinejad, B. Nazari, H. Noory (Iran)
Abstract only	100106	Application of drainmod-n model for predicting nitrate-n in paddy rice fields under controlled drainage in a coastal region of Iran H. Noory, H.Z. Abyaneh, H. Noory, A.-M. Liaghat (Iran)

Symposium on Nanotechnologies Applied to Biosystems Engineering and the Environment

Wednesday, June 16 – 8:15 to 10:00

91	Nano	Nanotechnologies for Food Treatments
Time	Paper #	Moderator: Suresh Neethirajan (Canada) Room: 205A
8:15		Session Opening
8:20	100287	Conjugated linoleic acid formation by hydrogenation/isomerization of safflower oil over bifunctional novel structured catalyst N. Chorf, S. Hamoudi, J. Arul et al. (Canada)
8:40	100304	Convergence – big potential: Microfluidics for food, agriculture and biosystems industries S. Neethirajan, F. Lin (Canada)
9:00	100661	Separation of benzoic acid from cranberry juice by use of nanofiltration membranes D. Q. Lai, N. Tagashira, S. Hagiwara et al. (Japan)
9:20	101402	Improvement of nutritional benefits in foods by incorporation of starch-antioxidant assemblies P. Le Bail (France)
9:40	101357	Stability of nano-emulsified lycopene under thermal processing J. Shi, S.J. Xue (Canada)

Wednesday, June 16 – 10:15 to 12:00

108	Nano	Nanotechnologies for Environment and Seeds
Time	Paper #	Moderator: Safia Hamoudi (Canada) Room: 205A
10:15		Session Opening
10:20	100850	Alkanolamine/ionic liquid microemulsions: Enhanced CO₂ capture ability with curbed corrosion behaviour M. Hasib-Ur-Rahman, M. Siaz, F. Larachi (Canada)
10:40	101305	Adsorptive removal of phosphate anions from aqueous solutions using functionalized SBA-15: Effects of the organic functional group S. Hamoudi, A. El-Nemr, K. Belkacemi (Canada)
11:00	100368	Development of carbon dioxide (CO₂) sensor using polymer nanoparticles for grain quality monitoring S. Neethirajan, M. Freund, D. Jayas et al. (Canada)
11:20	101351	Effect of silver nanoparticles for protection of seeds in different soils N. Karimi, S. Minaei, A.R. Shahverdi et al. (Iran)
11:40	101456	A variable rate grain drill for planting seeds treated with silver nanoparticles N. Karimi, S. Minaei, M. Almasi et al. (Iran)

Wednesday, June 16 – 13:35 to 15:20

122	Nano	Production and Application of Nanoparticles – POSTERS
Poster #	Paper #	Moderators: Khaled Belkacemi and Joseph Arul (Canada) Room: 2000D
57	100213	Synthesis of CaCO₃ nanoparticles by controlled precipitation from saturated sodium carbonate and calcium nitrate aqueous solutions R. B. Babou-Kammoe, S. Hamoudi, K. Belkacemi (Canada)

58	100559	Determination of the optimum combination of processes in nano-sizing flax fibres for use as sustainable reinforcement in bionanocomposites B.A.C. Siao, S. Panigrahi, L. Tabil (Canada)
59	101201	Effect of addition of different types of modified clays in the properties of opacity and solubility of zein biofilm J.F. Lopes-Filho, L.L. Tavares, C.B. Almeida et al. (Brazil)
60	101360	A facile solvothermal route to shape-controlled titania nanocrystals C.-T. Dinh, T.-D. Nguyen, F. Kleitz et al. (Canada)

Special Interdisciplinary Session on Education

Wednesday, June 16 – 10:15 to 12:00

105	Edu	Engineering Education for Agriculture, Food Systems, Ecology and Biosystems
Time	Paper #	Moderator: Omar Ulloa (Costa Rica) Room: 2102B
10:15		Session Opening
10:20	100058	A dean's perspective on the future of agricultural engineering education in Canada Claude Laguë (Canada)
10:40	101663	Biosystems engineering curricula in Europe P. Febo, A. Comparetti (Italy)
11:00	-	Engineering Education in Latin America Irenilza Alencar Naas (Brazil)

SECTION I Land and Water Engineering (including EnviroWater 2010)

Monday, June 14 – 10:15 to 12:00

4	Section I	Irrigation and Crop Response
Time	Paper #	Moderator: Shaoyuan Feng (China) Room: 207
10:15		Session Opening
10:20	100883	Response of spring-maize and soil to saline irrigation in northwest China J. Jiang, S. Feng, Y. Wang (China)
10:40	100561	Investigating the potential for rice production with sprinkler irrigation E. Vories, W. Stevens, P. Tacker et al. (United States)
11:00	101118	Searching for improved irrigation scheduling alternatives for horticultural crops in the humid tropics Y. Chaterlán, M. León, C. Duarte et al. (Cuba/Portugal)
11:20	100292	Safflower (carthamus tinctorius L.) water use from shallow good quality and saline water tables in lysimetric experiment in a semiarid region of Iran H. Ghamamia, M. Golamian, S. Sepehri (Iran)
11:40	100254	Deficit irrigation as an agricultural water management system for corn: a review A. A. – A. Aboukeira (United States)

Monday, June 14 – 10:15 to 12:00

5	Section I	Water Management and Soil Properties – POSTERS
Poster #	Paper #	Moderator: Jose Fernando Ortega Alvarez (Spain) Room: 2000D
1	100552	Confined and semi-confined compression curves of highly calcareous soil amended with organic manures N. Aghilinategh, A. Hemmat, M. Sadeghi (Iran)
2	100556	Stress relaxation behaviour of a highly calcareous soil amended with long-term application of three organic manures A. Hemmat, N. Aghilinategh, M. Sadeghi (Iran)

3	100809	Environmental assessment for defining new management strategies for the conservation of soil and water resources R. F. B. Silva, P. I. R. De Moraes, A. A. Da Conceição Sartori et al. (Brazil)
4	100968	Effects of the crop root on the soil physic properties and soil water transport environment K. Yuge, M. Anan (Japan)
5	101085	Effects of mechanical aeration on the compaction and permeability of a grassy sward S. Chehaibi, M. Khelifi, K. Abrougui (Tunisia/Canada)
6	101639	Wastewater reclamation and reuse practices for agriculture in Korea E.J. Lee, S.W. Park, C.H. Seong et al. (Republic Of Korea)
7	100759	Farmers mitigation and adaptation options to salinity in Sicily N. Colonna, D. Rapti- Caputo, F. Lupia et al. (Italy)
8	100256	The potential of using a new agricultural system for improving water productivity of wheat A. A.- A. Aboukeira (United States)

Monday, June 14 – 13:35 to 15:20

19	Section I	Irrigation System Design
Time	Paper #	Moderator: Peilin Yang (China) Room: 207
13:35		Session Opening
13:40	100986	Use of two drippers spacing in the same lateral line and theirs effects on the wetted bulb formation, yield and quality of radish (<i>Raphanus sativus</i> L.) L. P. De Azevedo, J. C. C. Saad (Brazil)
14:00	101153	Improving the performance of landscape sprinkler irrigation through field evaluations and modelling G.C. Rodrigues, P. Paredes, M.I. Valin et al. (Portugal)
14:20	100509	Characterization of energy requirements in pressurized irrigation networks and evaluation of potential energy saving measures in southern Spain J.A. R. Diaz, E. C. Poyato, T. C. Cobo (Spain)
14:40	101047	Optimal hydraulic and energy design of pivots directly fed with groundwater M. A. Moreno, J.F.Ortega, D. Medina et al. (Spain)
15:00	101042	Design and evaluation of an automated short furrow irrigation system N. Lecler, D. Mills, J. Smithers (South Africa)

Monday, June 14 – 15:35 to 17:00

34	Section I	Equipment for Irrigation and Soil Monitoring
Time	Paper #	Moderator: Luis Santos Pereira (Portugal) Room: 207
15:35		Session Opening
15:40	101545	Sensors for effective irrigation scheduling and improved water use efficiency of cotton cultivars C. Bellamy, A. Khalilian, H. Farahani et al. (United States)
16:00	101017	Effect of the type of sprinkler and height above the soil on onion (<i>Allium cepa</i> L.) crop J.A. De Juan Valero, A. Domínguez, J.M. Tarjuelo et al. (Spain)
16:20	101170	Advanced technologies applied to hose reel rain-gun machines: New perspectives towards sustainable sprinkler irrigation G. Ghinassi (Italy)
16:40	101339	A triple-sensor horizontal penetrometer for on-the-go measuring soil moisture content, electrical conductivity and mechanical resistance Q. Zeng, Y. Sun, P.S. Lammers (China/Germany)

Tuesday, June 15 – 10:15 to 12:00

48	Section I	Impact of Climate Change on Watersheds
Time	Paper #	Moderator: Juan Antonio Rodríguez Díaz (Spain) Room: 207
10:15		Session Opening
10:20	101332	Impact assessment of climate change on irrigation by a distributed water circulation model T. Masumoto, R. Kudo, T. Yoshida et al. (Japan)

10:40	100790	Climate change impact assessment for a small river basin using a process-based numerical model of coupled surface water/groundwater flow M. Sulis, C. Paniconi, C. Rivard et al. (Canada)
11:00	100979	Sustainable planning of land use changes in farming areas under ecological protection F.Montero-García, F.Montero-Riquelme, A. Brasa-Ramos et al. (Spain/Netherlands)
11:20	101184	Forecasting hydrological time series in the face of climate change J. Adamowski (Canada)

Tuesday, June 15 – 13:35 to 15:20

63	Section I	Irrigation and Development
Time	Paper #	Moderator: Antonio Brasa Ramos (Spain) Room: 207
13:35		Session Opening
13:40	101003	Evaluation of irrigation systems by using benchmarking techniques J.I.Córcoles, J.M. Tarjuelo, M.A.Moreno et al. (Spain)
14:00	100670	Revitalizing smallholder irrigation schemes in Limpopo Province of South Africa P. G. De Witt (Africa)
14:20	100176	Use of agricultural census data for the estimation of irrigation water consumption at farm level F. Lupia, I. Namdarian, F. D. Santis (Italy)
14:40	100901	Fostering irrigation practices in the humid tropics of (southwestern) Nigeria to sustain life and development M.O. Alatise (Nigeria)
15:00	101288	Overcoming food shortage through improved irrigation strategy Z. Ul-Haque (Pakistan)

Tuesday, June 15 – 13:35 to 15:20

64	Section I	Water and Crop Response – POSTERS
Poster #	Paper #	Moderator: Jose Manuel Monteiro Gonçalves (Portugal) Room: 2000D
33	100210	Effect of water stress on yield and yield components of two wheat cultivars M. Najmaei, A. Soleymani, A. R. Golparvar (Iran)
34	100294	Effect of water stress on water use efficiency and yield of nigella sativa in Kermanshah Province in the west of Iran H. Ghamarnia (Iran)
35	100376	Crop coefficient of cowpea bean in Piauí State, Brazil E. A. Bastos, A. S. A. Júnior, V. M. Ferreira et al. (Brazil)
36	100567	Method to suppress or remove blue-green algae in the pond of large area by micro bubbles T. Nakashima, Y. Hirata (Japan)
37	101126	Irrigation system management assisted by thermal imagery and spatial statistics S.J. Thomson, C.M. Ouellet-Plamondon, S.L. Defauw et al. (United States/United Kingdom)
38	101127	Cut chrysanthemum (<i>Chrysanthemum morifolium</i> Ramat.) irrigation scheduling under greenhouse conditions M.F. De Farias, J.C.C. Saad (Brazil)
39	100715	Irrigation management in real time for arugula crop in Sergipe A. N. Do Vasco, A. De O. A. Netto, R. Silva-Mann et al. (Brazil)
40	101637	Several groundwater levels affecting sorghum plants in protected environment A.E. Klar, A.A. Tanaka (Brazil)
41	100562	Effects of super absorbent polymers application methods on carrot germination and growth J. Yu, H. Liu, J. Shi et al. (China/Israel)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

Tuesday, June 15 – 15:35 to 17:20

78	Section I	Modeling Water Use for Crop Production
Time	Paper #	Moderator: Mario Falciai (Italy) Room: 207
15:35		Session Opening
15:40	101193	Application of mathematic models of water in irrigated bean crop under no-tillage system D.R. Bizari, E.E. Matsura, M. Mesquita (Brazil)
16:00	101050	Development of reference evapotranspiration models with limited data by using artificial neural networks structures A. Martinez, M.A. Moreno, J.F. Ortega et al. (Spain)
16:20	101164	The dual crop coefficient approach: Application of the SimDualKc model to winter wheat in North China Plain Z. Nana, L. Yu, C. Jiabing et al. (China/Portugal)
16:40	100501	Simulation of site-specific irrigation control strategies with sparse input data A. C. McCarthy, N. H. Hancock, S. R. Raine (Australia)
17:00	100362	The relation between non-irrigated planting at sandy land and micrometeorological alleviation in Ningxia, China T. Maki (Japan)

Wednesday, June 16 – 8:15 to 10:00

92	Section I	Management of Flood, Drainage and Ground Water (joint with IDS*)
Time	Paper #	Moderator: Mauro Greppi (Italy) Room: 206A
8:15		Session Opening
8:20	100549	Mathematical models for flood management: Efficiency and reliability D. Dewrachen, V. Garattini, S. Mambretti (Italy)
8:40	100627	Soil bioengineering techniques in flood risk mitigation in Friuli Venezia Region S. Sanna (Italy)
9:00	100159*	Storage and reuse of drainage water I. Wesström, A. Joel (Sweden)
9:20	100684	Modelling the groundwater dynamics as influenced by water management in Hetao irrigation district, Upper Yellow River basin, and predicting impacts of foreseen water use and savings Xu Xu, G. Huang, Z. Qu et al. (China)

Wednesday, June 16 – 8:15 to 10:00

93	Section I	Modeling Water in Soils and Crops – POSTERS
Poster #	Paper #	Moderator: Robert Broughton (Canada) Room: 2000D
1	100622	Assessing different leaching models in SE Iran F. A. Pour (Iran)
2	100654	Prediction of the max flow for the model SASIS: Sensibility to the empirical parameters of the form of the furrow R. V. Pordeus, C. A. V. De Azevedo et al. (Brazil)
3	100666	Studying different type of leaching models in two pilots located at South East of Khoozestan Province F. Allahyari, K. Mohsenifar, S. Haghighat et al. (Iran)
4	100695	Simulation of the irrigation for furrow for the model SASIS: Sensibility to the factors of space consideration and storm R. V. Pordeus, C. A. V. De Azevedo et al. (Brazil)
5	100746	A meta-analysis of weather effects on corn nitrogen fertilization requirements Min Xie, Nicolas Tremblay, Zhanmin Wei (Canada/China)
6	100890	Monitoring of dust emission and development of a CFD model to predict the dispersion of fugitive dust at a reclaimed land H.-S. Hwang, I.-B. Lee, I.-H. Seo et al. (Korea)
7	101378	Affect of drought on pollution of Lenj station of Zayandehrood River by artificial neural network (ANN) K. Mohsenifar, E. Pazira, N. Mohsenifar et al. (Iran)

Wednesday, June 16 – 10:15 to 12:00

109	Section I	Changes in Water and Land Uses
Time	Paper #	Moderator: Guanhua Huang (China) Room: 207
10:15		Session Opening
10:20	100363	Geographical shift in livestock production: Consequences for land use planning and policy making G. J. Carsjens, P. Gerber (Netherlands/Italy)
10:40	100466	Agriculture, population and their impact on the global environment P. Roy, T. Orikasa, N. Nakamura et al. (Japan)
11:00	100546	Grid based rainfall-runoff GIS modelling to study the anthropogenic effect on the hydrology of a small watershed M. Greppi, G. Senes (Italy)
11:20	100331	Development of a model for estimating current and future irrigation water demand in Canada O. Aladenola, C. Madramootoo (Canada)
11:40	101228	Technical, economic and legal aspects of management of transboundary water resources - A case study of Indus Waters Treaty 1960 S.J.A. Shah (Pakistan)

Wednesday, June 16 – 13:35 to 15:20

123	Section I	Assessment of Water Pollution and Salinity
Time	Paper #	Moderator: Gerrit-Jan Carsjens (Netherlands) Room: 207
13:35		Session Opening
13:40	100081	Modelling phosphorus inputs from diffuse and point sources with MEPHOS in Germany - a contribution to the implementation of the EU water legislation B. Tetzlaff (Germany)
14:00	101220	Effect of nonionic surfactant Brij 35 on the fate of metribuzin in a sandy soil E. Elsayed, S.O. Prasher, R.M. Patel (Canada)
14:20	101468	Phosphorus removal and recovery from high calcium hog lagoon supernatant using a gravity settled struvite reactor J.N. Ackerman, N. Cicek (Canada)
14:40	100739	Mapping of soil salinity and clay content based on electromagnetic induction measurements by EM38 S. Zia, D. Wenying, W. Spreer et al. (Germany/China)
15:00	100127	Studies on appropriate depth of leaching water along with reclamation-rotation program (a case study in mid-part of Khuzestan, Iran) F. Rajabzadeh, E. Pazira, M. H. Mahdian (Iran)

Abstract only	100152	Ground water recharge in wagarwadi watershed through recharge process and ground water flow models K.P. Gore, V.V.S. Gurunadharao, B.S. Naik, D. Barman (India)
Abstract only	100520	Integrated water supply management at watershed scale for agricultural purposes in a perspective of adaptation to climate change Jean-François Cyr, Richard Turcotte, Charles Poirier, Diane Chaumont (Canada)

SECTION II Farm Buildings, Equipment, Structures and Environment

Monday, June 14 – 10:15 to 12:00

6	Section II	Field Measurements, CFD and Abatement Techniques (I)
Time	Paper #	Moderator: Eileen Fabian Wheeler (USA) Room: 204A
10:15		Session Opening

10:20	100696	Numerical simulation of a pit exhausts system for reduction of ammonia emission from a naturally ventilated cattle building B. Bjerg, M. Andersen (Denmark)
10:40	100762	Measurements of air ventilation rates in naturally ventilated dairy cattle buildings W. Berg, M. Fiedler, A. Kiwan et al. (Germany)
11:00	101059	Gas emission rate from different Japanese open type pig houses with natural ventilation A. Ikeguchi (Japan)
11:20	101131	Measuring concept for determining ammonia emissions from naturally ventilated dairy housing with an outdoor exercise area S. Schrader, M. Keck, K. Zeyer et al. (Switzerland/Germany)
11:40	101117	Comparison of ammonia emissions from a naturally ventilated dairy loose housing with solid floor surfaces over two seasons S. Schrader, M. Keck, K. Zeyer et al. (Switzerland/Germany)

Monday, June 14 – 10:15 to 12:00

7	Section II Poultry	
Time	Paper #	Moderator: Qiang Zhang (Canada) Room: 205B
10:15		Session Opening
10:20	100320	Application of slightly acidic electrolyzed water for disinfection in a broiler farm X. Hao, B. Li, Y. Ji et al. (China)
10:40	100361	Activity analysis in broiler chickens with different gait scores A. Aydin, O. C. Cangar, S. E. Ozcan et al. (Belgium)
11:00	101114	Radiant heat distribution in broiler housing using infrared thermometry M.S. Baracho, G.R. Nascimento, I.A. Nääs et al. (Brazil)
11:20	100841	Thermal environment inside broiler housing using distinct lateral membrane structure G. R. Nascimento, M.S. Baracho, I.A. Nääs (Brazil)

Monday, June 14 – 13:35 to 15:20

20	Section II Field Measurements, CFD and Abatement Techniques (II)	
Time	Paper #	Moderator: Werner Berg (Denmark) Room: 204A
13:35		Session Opening
13:40	101254	Preliminary study of ammonia emissions from naturally ventilated fattening pig houses in the South-East China K. Wang, Z. Ye, H. Li (China)
14:00	101322	Measurement of ammonia emissions from three ammonia emission reduction systems for dairy cattle using a dynamic flux chamber H.J.C. Van Dooren, J. Mosquera (Netherlands)
14:20	101366	Air pollution and livestock production A.C. Watt, S.M. Aziz, T.M. Banhazi (Australia)
14:40	101392	Reduction of gas and odour emissions from a swine building using a biotrickling filter M. Belzile, S.P. Lemay, D. Zegan et al. (Canada)
15:00	101478	Evaluation of the effectiveness of an antimicrobial air filter to avoid porcine reproductive and respiratory syndrome virus (PRRSv) aerosol transmission, after 16 months of exposure to a commercial swine environmental conditions L. Batista, F. Pouliot, L. Urizar (United States/Canada)

Monday, June 14 – 13:35 to 15:20

21	Section II Swine (I)	
Time	Paper #	Moderator: John Feddes (Canada) Room: 205B
13:35		Session Opening
13:40	100300	Maintaining the pre-slaughter enthalpy chain improves animal welfare in pigs M. Villarroel, P. Barreiro, P. Kettlewell et al. (Spain/UK)
14:00	100921	Effect of a water-cooled cover on the thermal comfort of pregnant sows in hot and humid climate Z. Pang, B. Li, H. Xin et al. (China/Korea/United States)

14:20	101074	Modelling the stress responses of livestock to the thermal loads experienced on transcontinental, export journeys M.A. Mitchell, P.J. Kettlewell, M. Villarroel et al. (United Kingdom/Spain)
14:40	101119	Pathogen removal from pig manure by full-scale psychrophilic anaerobic digestion in sequencing batch reactors Y. Gilbert, D. Massé, E. Topp (Canada)
15:00	101391	Impact of temperature control strategies on animal performance, gas emissions and energy requirements for grower-finisher pigs S.P. Lemay, J. Feddes, F. Pouliot et al. (Canada)

Monday, June 14 – 15:35 to 17:00

35	Section II Swine (II)	
Time	Paper #	Moderator: Stéphane Godbout (Canada) Room: 205B
15:35		Session Opening
15:40	101415	New building concepts for sustainable swine production in Québec: A systematic review S. Godbout, N. Turgeon, S.P. Lemay et al. (Canada)
16:00	100445	Influence of water sprinkling on the amount of dust particles in a house for fattening pigs S. Nimmermark (Sweden)
16:20	100478	Heating and cooling performance of an under floor earth tube air tempering system in a mechanical ventilated farrowing house E. F. Hessel, C. Zurhake, H. F. A. V. D. Weghe (Germany)
16:40	100425	Gait and force analysis of provoked pig gait on clean and fouled rubber mat surface H. V. Wachenfelt, C. Nilsson, S. Pinzke (Sweden)

Monday, June 14 – 15:35 to 17:00

36	Section II Greenhouses and Horticulture	
Time	Paper #	Moderator: Daniel Massé (Canada) Room: 204A
15:35		Session Opening
15:40	101221	Development of bioengineering processes to transform greenhouse waste into energy, fertilizer and tomato D. Brisson, D.I. Massé, P. Juteau et al. (Canada)
16:00	101277	Influence of insect nets and thermal screens on climate conditions of commercial scale greenhouses: A CFD approach A.A. Sapounas, S. Hemming, H.F. de Zwart et al. (Netherlands)
16:20	100407	Energy consumption and commercial applications of liquid foam insulation technology for greenhouses J. Villeneuve, D. De Halleux, K. Aberkani et al. (Canada)
16:40	101227	Generating usable and safe CO2 for enrichment of greenhouses from the exhaust gas of a biomass heating system L.-M. Dion, M. Lefsrud (Canada)

Tuesday, June 15 – 10:15 to 12:00

50	Section II Cattle (I)	
Time	Paper #	Moderator: Joahn Palacios (Canada) Room: 205B
10:15		Session Opening
10:20	100252	An expert system for planning and designing milking parlour constructions M. Hatem, M. Samer, H. Grimm et al. (Egypt/Germany)
10:40	100276	How to rectify design flaws of dairy housing in hot climates? M. Samer (Egypt)
11:00	100370	Housing for replacement heifers and dairy cows J. Flaba, H. Georg, R.E. Graves et al. (Belgium/Germany/USA)
11:20	100645	Effect of temperature and physico-chemical characteristics on the efficiency of coagulation flocculation pretreatment of water on dairy farms L. Masse, D. I. Massé, É. Pariseau et al. (Canada/USA)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

11:40 100690 **Effects of different cluster types on teat condition and milk release parameters**
S. Sagkob, H.-J. Rudovsky, S. Pache et al. (Germany)

Tuesday, June 15 – 10:15 to 12:00

51 Section II Energy, Greenhouses and Materials–POSTERS
Moderator: Heiko Georg (Germany) Room: 2000D
Poster # Paper #
1 100754 **Simulation models to optimize input energy in Mediterranean greenhouse production**
A. Marucci, A. Gusman, B. Pagnello et al. (Italy)
2 101226 **Effects of photoselective shade nets on the meteorological elements, growth and radiation use efficiency of cucumber**
R. de C. Ferreira, N. F. Da Silva, R. de S. Bezerra (Brazil)
3 101502 **A model for the evaluation of building sustainability in agri-food industry**
F. Barreca, G. Cardinali, S. Di Fazio (Italy)
4 101507 **The natural material in bioconstruction between tradition and innovation: The use of giant reed Arundo donax L. in the rural constructions**
F. Barreca (Italy)
5 101021 **Bedding materials for cattle barns and their thermo-technical properties in different climatic conditions**
J. Lendelova, Š. Mihina, Š. Pogran (Slovakia)
6 101662 **Countermeasure of energy conservation of farm buildings in rural areas of cold region in China**
L. Mao, G. Li, D. Tian et al. (China)
7 100884 **Development of a solar thermal storage system suitable for the farmhouse heating in northeast China**
M.-K. Jang (China)

Tuesday, June 15 – 13:35 to 15:20

65 Section II Methods to Quantify Emissions in Naturally Ventilated Buildings (II)
Moderator: Daniel Berckmans (Belgium) Room: 204A
Time Paper #
13:35 Session Opening
13:40 100773 **Intermittent measurement technique to estimate ammonia emission from manure storage**
A. Youssef, S. E. Özcan, F. Guizhou et al. (Belgium/France)
14:00 100974 **Tracer gas technique in comparison with other techniques for ventilation rate measurements through naturally ventilated barns**
A. Kiwan, R. Brunsch, S. E. Özcan et al. (Germany/Belgium)
14:20 101061 **Measurement method of ventilation rate with tracer gas method in open type livestock houses**
A. Ikeguchi, H. Moriyama (Japan)
14:40 100624 **Development and testing of technical measures for the abatement of PM10 emissions from poultry housing**
N. Ogink, A. Aarnink, J. Mosquera et al. (Netherlands)
15:00 – **Open discussion – Emissions from natural ventilated buildings**
Atsuo Ikeguchi (Japan)

Tuesday, June 15 – 13:35 to 15:20

66 Section II Cattle (II)
Moderator: Alfred Marquis (Canada) Room: 205B
Time Paper #
13:35 Session Opening
13:40 100764 **Potential soil contamination under free stall dairy barn using earthen base stalls with sand bedding**
Y. Choinière (Canada)
14:00 101055 **A farm system approach to analyze greenhouse gas (GHG) mitigation strategies for ruminant production systems**
A. Meyer-Aurich, W.K. Berg, S. Schattauer et al. (Germany)
14:20 101187 **Evaluation of injection sites of thermal sensing transponders in cattle for automatic body core temperature recording**
H. Georg, A. Schwalm, G. Ude (Germany)

14:40 101506 **Automatic and frequency-programmable systems for feeding TMR: State of the art and available technologies**
C. Bisaglia, F. Nydegger, A. Grothmann et al. (Italy/Switzerland/Netherlands)
15:00 100963 **Milking technology on modern dairy farms -assessment from the user's perspective**
M. Kauke, F. Korth, P. Savary et al. (Switzerland)

Tuesday, June 15 – 15:35 to 17:20

79 Section II Reduction of Ammonia and Odour Emissions (I)
Moderator: Theo Demmers (UK) Room: 204A
Time Paper #
15:35 Session Opening
15:40 100443 **Reducing ammonia release in a floor housing system for laying hens by daily removal of manure below a perforated floor**
G. Gustafsson (Sweden)
16:00 100616 **Impact of the manure removal from slatted floor in a dairy barn on the ammonia emission**
S.K. Retz, H. Georg, S. Godbout et al. (Germany/Canada)
16:20 100644 **Dairy manure amendment effects on odor and gas emissions**
E.F. Wheeler, M.A.A. Adviento-Borbe, R.C. Brandt et al. (USA)
16:40 100747 **Odour control on pig farms by biofiltration**
G. Buelna, N. Turgeon, R. Dubé (Canada)
17:00 101025 **A new design for highly efficient partial pit ventilation**
P. Pedersen, T. L. Jensen (Denmark)

Tuesday, June 15 – 15:35 to 17:20

80 Section II Manure Handling
Moderator: Frederic Pelletier (Canada) Room: 205B
Time Paper #
15:35 Session Opening
15:40 100442 **Flush systems for dairy manure removal: the Alley roughness value**
E. Bresci, P. Ferrari, A. Giacomini, M. Barbari (Italy)
16:00 100528 **Managing residual phosphorus and nitrogen from treated swine slurry using a disposal field: Behaviour over four years of on-site operation**
R. Dubé, G. Bellemare, G. Buelna et al. (Canada)
16:20 100547 **Electro-separation process for treating liquid animal manures**
S.-P. Guertin, D. Massé, F. Lamarche (Canada)
16:40 101517 **Environmental impacts of manure management strategies in pig production**
F. Pelletier, S. Godbout, S.P. Lemay et al. (Canada)
17:00 101057 **Evaluating the performance of vegetative treatment systems on open beef feedlots in the Midwestern United States**
B. J. Bond, R. T. Burns, C. Henry et al. (United States)

Wednesday, June 16 – 8:15 to 10:00

94 Section II Simulation of Aerosol, Gas and Emission
Moderator: Bjarne Bjerg (Denmark) Room: 204A
Time Paper #
8:15 Session Opening
8:20 100430 **Performance simulation of high volume low speed fans in a free stall barn**
W. Yan, D. Barker, Y. Sun, Y. Zhang et al. (United States)
8:40 100548 **A simulation model to predict the internal climatic conditions in livestock houses as a tool for improving the building design and management**
P. Liberati, P. Zappavigna (Italy)
9:00 100870 **CFD modeling of livestock odor dispersion on complex topography**
S.-H. Kwon, S.-W. Hong, I.-B. Lee et al. (Korea)
9:20 100888 **Aerodynamic analysis of air pollutants in pig farms using CFD technology**
J.-S. Choi, I.-B. Lee, S.-W. Hong et al. (Korea)
9:40 100908 **Methodology of analyzing ventilation efficiencies based on "age of air" theory using CFD technology**
K.-S. Kwon, I.-B. Lee, H.-S. Hwang et al. (Korea/Philippines)

Wednesday, June 16 – 8:15 to 10:00

95	Section II	Reduction of Ammonia and Odour Emission (II)
Time	Paper #	Moderator: Larry Dean Jacobson (USA) Room: 205B
8:15		Session Opening
8:20	101163	Ammonia reduction and maintenance costs for old air cleaning systems and slurry acidification systems M. Lyngbye (Denmark)
8:40	101260	Biofilter combined with a biotrickling filter and a chemical air scrubber A.L. Riis (Denmark)
9:00	101262	Reducing odour and ammonia emission by cooling inlet air in a farrowing facility A.L. Riis, T.L. Jensen, P. Pedersen (Denmark)
9:20	101416	Reduction of odour emissions from swine buildings: Comparison of three reduction techniques S. Godbout, L. Hamelin, S.P. Lemay et al. (Canada/Denmark)
9:40	101640	A sequential wet scrubber using re-circulated and biological processed water for purification of discharge air from pig houses P. Kai, H. Takai, P.J. Dahl et al. (Denmark/Japan)

Wednesday, June 16 – 10:15 to 12:00

110	Section II	Field Measurements for Aerosol and Gas
Time	Paper #	Moderator: Sven Nimmermark (Sweden) Room: 204A
10:15		Session Opening
10:20	100659	Broiler gas spatial variability on different minimum ventilation systems D.J. Moura, T.M.R. Carvalho, Z.M. Souza et al. (Brazil)
10:40	100942	Dust and ammonia emissions from UK poultry houses T. Demmers, A. Saponja, R. Thomas et al. (UK)
11:00	101015	Ammonia emissions from broiler housing facility: Influence of litter properties and ventilation M. Knížatová, Š. Mihina, J. Brouček et al. (Slovakia)
11:20	101211	Measuring emissions from a naturally ventilated turkey grow-out building L.D. Jacobson, B.P. Hetchler, S.L. Noll (United States)
11:40	101135	Assessing odour plumes surrounding swine operations Q. Zhang, X. Zhang (Canada)

Wednesday, June 16 – 10:15 to 12:00

111	Section II	Building Design and Materials
Time	Paper #	Moderator: Yves Choinière (Canada) Room: 205B
10:15		Session Opening
10:20	100462	Minimum distance separation (MDS) formulae: 40 years (1970-2010) - Successes and lessons learned H. W. Fraser, J. Turvey (Canada)
10:40	100615	Sustainable building with concrete: how long do containers last? J.-G. Krentler (Germany)
11:00	100628	Usage of concrete for farm buildings and manure storages; specifications, durability and practical considerations Y. Choinière (Canada)
11:20	100936	An instrument for measuring the skid resistance of floors in livestock housing P. Liberati, P. Zappavigna (Italy)
11:40	101469	Treatment of dairy soiled water using a woodchip filter E. Ruane, P.N.C. Murphy, E. Clifford et al. (Ireland)

Wednesday, June 16 – 13:35 to 15:20

124	Section II	Methods to Quantify Aerosol, Gas and Emissions
Time	Paper #	Moderator: Anders Feilberg (Denmark) Room: 204A
13:35		Session Opening
13:40	100401	The influence of animal activity and litter on carbon dioxide balances to determine ventilation flow in broiler production S. Calvet, M. Cambra-López, F. Estellés et al. (Spain/Germ.)

14:00	101079	Effects of air exchange, temperature and slurry management on odorant emissions from pig production units and slurry tanks studied by proton-transfer-reaction mass spectrometry (PTR-MS) A. Feilberg, A.P.S. Adamsen, D. Liu et al. (Denmark)
14:20	101523	Identification of key odour components from pig buildings for modelling purposes M. Martel, S.P. Lemay, M. Belzile et al. (Canada)
14:40	100932	Use of carbon dioxide balances to determine ventilation rates from fattening rabbits farms F. Estellés, O. Blumetto, S. Calvet et al. (Spain/Uruguay)
15:00	-	Open discussion - Aerosol, gas and odor emission Larry Dean Jacobson (USA)

Wednesday, June 16 – 13:35 to 15:20

125	Section II	Grain Storage Issues
Time	Paper #	Moderator: Thomas Banhazi (Australia) Room: 205B
13:35		Session Opening
13:40	100685	Rough rice storage below freezing point by using renewable energy from fresh chilly air in winter S. Kawamura, K. Takekura (Japan)
14:00	100864	Low-temperature brown rice storage by using renewable energy from snow S. Fujikawa, S. Kawamura, H. Fujita et al. (Japan)
14:20	100899	Equipment for dust reduction in grain handling: evaluation of dust and chaff extractor and aspirator Q. Geng, G. Lundin (Sweden)

Abstract only	101373	Anaerobic co-fermentation process using the swine manure with organic byproduct In Hwan Oh, W.G. Kim (Korea)
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SECTION II-B Aquacultural Engineering

Tuesday, June 15 – 10:15 to 12:00

52	Section II-B	Aquaculture Systems
Time	Paper #	Moderator: Ed Aneshansley (USA) Room: 205A
10:15		Session Opening
10:20	101364	Wolffishes, ideal species for intensive aquaculture: Rearing density and welfare assessment N.R. Le François, S. Tremblay-Bourgeois, T. Benfey et al. (Canada/Iceland)
10:40	101356	A fully integrated marine environmental aquaculture recirculation system (MEARS™) in conjunction with the environmental recirculation of waste R.J. Bishop (United States)
11:00	100995	Modelling baffles in water aquaculture ponds E. Bresci, A. Giacomini, M. Falciai et al. (Italy)
11:20	100662	Intensive culture of Amur sturgeon (<i>Acipenser schrenckii</i>) fingerlings in a recirculating aquaculture system C. Guangbin, H. Shicheng, J. Shuyi et al. (China)
11:40	101477	Inshore recirculating system for the production of marine finfish Z.T.J. Pfeiffer, P.S. Wills (United States)

Tuesday, June 15 – 13:35 to 15:20

67	Section II-B	Monitoring and Technology for Aquaculture
Time	Paper #	Moderator: Ed Aneshansley (USA) Room: 205A
13:35		Session Opening
13:40	100303	The importance of fish neurohormonal response reared under recirculating water systems: a review S. E. Papoutsoglou (Greece)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

14:00	101460	The "virtual-cage culture": Controlling and harvesting fish using behavioural conditioning B. Zion, A. Barki, Y. Grinshpon et al. (Israel)
14:20	101551	In vivo flatfish size and weight monitoring by image analysis E. Thiessen, E. Hartung (Germany)
14:40	101615	Effects of ozone and water exchange rates on water quality and rainbow trout, <i>Oncorhynchus mykiss</i>, performance in replicated water reuse aquaculture systems J. Davidson, S. Summerfelt, C. Good et al. (United States)
15:00	101056	Sustainable environmental management for tropical floating net cage mariculture, a modelling approach S. A. Van Der Wulp, K. R. Niederndorfer, K-J Hesse et al. (Germany/Indonesia)

Tuesday, June 15 – 15:35 to 17:20

81	Section II-B	Aquaculture – POSTERS
Poster #	Paper #	Moderator: Eiko Thiessen (Germany) Room: 2000D
66	100955	Aquaculture in greenhouse M.C.G. Quiles, G. L. Diaz, M.C.M. Rodriguez (Spain)
67	101054	An innovative colorimetric calibration method used to quantify differences among wild and reared gilthead seabream (<i>Sparus Aurata</i>, Linnaeus 1758) C. Costa, F. Antonucci, F. Pallottino et al. (Italy)
68	101592	Québec driven pilot-scale cultivation of spotted wolffish (<i>Anarhichas minor</i>) N.R. Le François, F. Dufresne, D. Chabot et al. (Canada)
69	101657	Monitoring and modeling phosphorus contributions in a freshwater lake with cage-aquaculture J.E. Milne, R.D. Moccia (Canada)

SECTION III Equipment Engineering for Plants

Monday, June 14 – 10:15 to 12:00

8	Section III	Soil Tillage Equipment and Analysis (I)
Time	Paper #	Moderator: Carol Plouffe (USA) Room: 203
10:15		Session Opening
10:20	100536	Soil failure mode in front of a multiple– tip horizontally-operated penetrometer affected by depth/width ratio of its tip and shank A. Hemmat, A. Khorsandi, V. Shafaie (Iran)
10:40	100613	Soil bin investigations of the effects of tillage tool width on draught and soil disturbance parameters in sandy clay loam soil S.I. Manuwa, O. C. Ademosu, L.A.S. Agbetoye et al. (Nigeria)
11:00	100791	Comparison of cleaning performance for row cleaners on a strip tillage implement R.C. Roberge, T.G. Crowe, M. Roberge (Canada)
11:20	100975	Reducing friction by ultrasonic vibration exemplified by tillage R. Kattenstroth, H.– H. Harms, W. Wurpts et al. (Germany)
11:40	101409	Effect of long term crop rotation and fertilization on moldboard plow draft in a clay– loam soil N.B. McLaughlin, C.F. Drury, W.D. Reynolds et al. (Canada)

Monday, June 14 – 10:15 to 12:00

9	Section III	Precision Agriculture and Monitoring
Time	Paper #	Moderator: Qamar Zaman (Canada) Room: 205A
10:15		Session Opening
10:20	101306	How to integrate multi– sensor data for precision agriculture A. Castrignanò, M.T.F. Wong, D. de Benedetto et al. (Italy/Australia)

10:40	100378	Evaluation of a variable rate liquid fertilizer for site specific application A. Javadi, B. B. Mackvandi (Iran)
11:00	101105	Assessment of real time variable application of nitrogen using remote sensing sensors: perspectives in Slovakia V. Rataj, J. Galambošová, M. Ingeli et al. (Slovakia)
11:20	101007	Comparison of tractor-rotary tiller combination and power tiller in terms of energy expenditure of operators B. Eminoglu, A. Beyaz, O. Orel et al. (Turkey)
11:40	100500	Measurement of dilation of root crops M. Shimazu, Y. Shibata, H. Araki et al. (Japan)

Monday, June 14 – 13:35 to 15:20

22	Section III	Soil Tillage Equipment and Analysis (II)
Time	Paper #	Moderator: Carol Plouffe (USA) Room: 203
13:35		Session Opening
13:40	101350	Application of discrete element method (DEM) simulations as a tool for predicting tillage tool wear L. Graff, M. Roberge, T. Crowe (Canada)
14:00	101375	DEM analysis of the soil-tool (sweep) interaction K. Tamás, I.J. Jóri (Hungary)
14:20	101414	Tillage and planting energies for corn production under three tillage systems on a clay-loam soil N.B. McLaughlin, C.F. Drury, W.D. Reynolds et al. (Canada)
14:40	101143	Development of below-floor level soil bin system for soil tillage dynamics research at the Federal University of Technology Akure, Nigeria L.A.S. Agbetoye, S.I. Manuwa et al. (Nigeria)
15:00	100514	Tillage effects on soil and production management for winter wheat in southwest Turkey Z. B. Barut, S. Aykanat, M. M. Turgut (Turkey)

Monday, June 14 – 13:35 to 15:20

23	Section III	Cutting and Threshing Mechanisms
Time	Paper #	Moderator: Martin Roberge (Canada) Room: 205A
13:35		Session Opening
13:40	100897	Development of a water catcher for high pressure water jet cutting of agricultural goods D. Juenemann, H.-H. Harms (Germany)
14:00	101031	Qualitative and quantitative aspects on field drying of sorghum and evaluating the mower conditioner prototype devised by Cra-Ing - Cressoni L. Pari, A. Assirelli, A. Suardi (Italy)
14:20	100851	Effect of various operational and design parameters on the performance of a rotary feeding and cutting system E. Veikle, M. Roberge, V. Meda (Canada)
14:40	101122	Effects of some cutting blade and plant factors on specific cutting energy of sugarcane stalk J. Razavi, M. Kardany, A. Masoumi (Iran)
15:00	100316	Comparative analysis of the threshing cylinders performance on sorghum K. J. Simonyan, I. S. Dunmade (Nigeria/Canada)

Monday, June 14 – 13:35 to 15:20

24	Section III	Field Equipment – POSTERS
Poster #	Paper #	Moderator: Roger Thériault (Canada) Room: 2000D
23	101428	Velocity of conveyed seeds in an inclined transition tube P. Binsirawanich, S. Noble (Canada)
24	101349	Modeling of soil flow for tillage tools, seeders and planters M. Roberge (Canada)
25	101355	Modeling of crop flow in combine chopper and spreader M. Roberge, J. Benes, H. Isaac (Canada/United States)
26	100239	Influential parameters for designing and power consumption calculating of cumin mower E. Mahmoodi, A. Jafari, S. Rafiee (Iran)

27	101362	Mechanically-aided harvesting of artichoke with an electrically propelled prototype R. Tomasone, M. Pagano, C. Cedrola et al. (Italy)	11:20	100755	Electronic canopy characterization and real-time variable rate dosing for crop protection in precision fructiculture: Efficiency increase and drift reduction A. Escolà, R. Sanz, J.R. Rosell et al. (Spain)
28	100999	An innovative apparatus provided with a cutting auger for producing short logs for biomass energy from fast-growing tree species G. Colorio, R. Tomasone, C. Cedrola et al. (Italy)	11:40	100673	The effect of fan frequency on the droplet spraying swath of air blast sprayer S. Song (China)
29	100240	Design and manufacturing of a new and simple mechanism for transmission of power between crossover shafts up to 135 degrees M. Yaghoubi, S. Saeid Mohtasebi, A. Jafari et al. (Iran)	Tuesday, June 15 – 13:35 to 15:20		
30	100034	The design and experimental study of a testing stand for pneumatic seed metering device Z. Manquan, L. Wenzhong, W. Wenming et al. (China)	68	Section III	Crop Protection and Weed Control (II)
31	100796	Design and development of a cutter and feeder mechanism for a chick pea harvester H. Mostafavand, S. Kamgar (Iran)	Time	Paper #	Moderator: Cristiano Baldoin (Italy) Room: 203
Monday, June 14 – 15:35 to 17:00			13:35		Session Opening
38	Section III	Crop Management	13:40	100785	UV-induced fluorescence for discriminating weeds from maize B. Panneton, S. Guillaume, G. Samson et al. (Canada/France)
Time	Paper #	Moderator: Hubert Landry (Canada) Room: 203	14:00	100473	Technical approach for row crop seeding in square to improve mechanical weed control efficiency P. S. Lammers, H. Kam, O. Schmittmann (Germany)
15:35		Session Opening	14:20	100794	Development of a machine vision system for weed mapping M. C. Da Silva Júnior, F. D. A. De Carvalho Pinto, G. R. Ruiz et al. (Brazil/Spain)
15:40	100476	Best management practices for operating wind machines for minimizing cold injury in Ontario H. W. Fraser, K. Slingerland, K. Ker (Canada)	14:40	101091	Innovative strategies for physical weed control on hard surfaces in Central Italy: Results achieved in two different cities A. Peruzzi, L. Lulli, M. Fontanelli et al. (Italy)
16:00	100891	Review of technological advances and technological needs in ecological agriculture (organic farming) H. Chaoui, C. G. Sørensen (Canada/Denmark)	15:00	100427	Weed control by water steam using a self-propelled machine equipped with a condensation chamber C. Baldoin, I. Sartorato, D. Friso et al. (Italy)
16:20	101106	Controlled traffic farming and minimum tillage: Results of initial experiments and a layout of a long term experiment J. Galambošová, V. Rataj, M. Macák et al. (Slovakia)	Tuesday, June 15 – 13:35 to 15:20		
16:40	101284	Harvesting canbus data to improve soil compaction management N. Dubuc, V. Raghavan, R. Recker (Canada/USA)	69	Section III	Sensors and Precision Agriculture – POSTERS
Monday, June 14 – 15:35 to 17:00			Poster #	Paper #	Moderator: Noboru Noguchi (Japan) Room: 2000D
39	Section III	Sensors and Measurement	42	100428	Mapping of soil variability for increasing precision with managed drought stress phenotyping G. Romano, W. Spreer, J. Cairns et al. (Germany/Mexico)
Time	Paper #	Moderator: Noboru Noguchi (Japan) Room: 205A	43	101136	Management zone definition for coffee production system by using soil apparent electrical conductivity D.S.M. Valente, D.M. de Queiroz et al. (Brazil)
15:35		Session Opening	44	101419	Remote sensor networks for protected chrysanthemum production H.K. Noh, S.O. Chung (Republic Of Korea)
15:40	100043	Monitoring of grain quality and segregation of grain according to protein concentration threshold level on an operating combine harvester H. Risius, J. Hahn, H. Korte (Germany)	45	101147	Development of a new system for measuring the coefficient of dynamic friction of agricultural crops J. Razavi, E. Bagvand, A. Hemmat (Iran)
16:00	100344	Field evaluation and comparison of two silage corn mass flow rate sensors developed for yield monitoring M. Loghavi, M. M. Maharlouie, S. Kamgar (Iran)	46	101150	Coefficient of restitution of sugarcane billets measurement using an instrumented pendulum system J. Razavi, E. Bagvand, A. Hemmat (Iran)
16:20	101188	The development of a standard test method for measuring the evenness of flow off meter rollers J. Gervais, S. Noble (Canada)	47	101397	Nitrogen estimation of oilseed rape using spad and Vis/NIR spectroscopy Y. Shao, Y. He (China)
16:40	101060	A device for extracting 3D information of fertilizer trajectories B. Hijazi, J. Baert, F. Cointault et al. (France)	48	100504	Effects of different tillage systems on some soil properties, crop yield and time/fuel consumption for sesame Z. B. Barut, M. M. Turgut, A. Özmerzi (Turkey)
Tuesday, June 15 – 10:15 to 12:00			49	101261	High voltage electric field effects on structure and biological characteristics of barley seeds J. Khazaei, E. Aliabadi, A.A. Shayegani (Iran)
53	Section III	Crop Protection and Weed Control (I)	Tuesday, June 15 – 15:35 to 17:20		
Time	Paper #	Moderator: Bernard Panneton (Canada) Room: 203	82	Section III	Planting, Seeding and Crop Quality
10:15		Session Opening	Time	Paper #	Moderator: Neil McLaughlin (Canada) Room: 205A
10:20	100076	Liquid distribution of air induction and off-center spray nozzle used to apply agrochemicals in special condition R. G. Viana, J. R. Rosell, L. R. Ferreira et al. (Brazil/Spain)	15:35		Session Opening
10:40	101144	Characterizing ambient and spray mixture effects on droplet size represented by water sensitive paper (WSP) S.J. Thomson, M.E. Lyn (United States)	15:40	101037	Design and evaluation of a jab planter J. Smithers, L. Lagrange, B. Fraser et al. (South Africa)
11:00	100931	Development of on-site emulsifying device for production of cooking-oil-based pesticides G.-M. Samuel, M. Amos, E. Yigal et al. (Israel)	16:00	101142	Determination of forward speed effect on planting uniformity in a sugarcane billet planter J. Razavi, M. Namjoo (Iran)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

16:20	101280	Reducing the dispersion of seed coating particles containing neonicotinoids in maize seeding D. Pessina, D. Facchinetti (Italy)
16:40	100422	The design and experimental study of a testing stand for pneumatic seed metering device W. Z. Liu (China)
17:00	101043	Determination of crop quality with different types of sugar beet harvesters A. Beyaz, A. Colak, B. Eminoglu et al. (Turkey)

Tuesday, June 15 – 15:35 to 17:20

83	Section III	Crop Protection and Weed Control (III)
Time	Paper #	Moderator: Bernard Panneton (Canada) Room: 203
15:35		Session Opening
15:40	100458	Variable rate technology for herbicide application on railways U. R. Antuniassi, E. D. Velini, H. C. Nogueira et al. (Brazil)
16:00	100947	An approach for pesticide loss estimation adapted to field crops in Mediterranean conditions H. Bahrouni, C. Sinfort, E. Hamza (Tunisia/France)
16:20	100295	Spot-application of pesticide using variable rate sprayer in wild blueberry Q. U. Zaman, A. W. Schumann et al. (Canada/USA)
16:40	100077	Evaluation of backpack sprayers in the herbicide application in a Brazilian forest R. G. Viana, M. S. Machado, L. R. Ferreira et al. (Brazil)
17:00	100789	Weed cover on and between corn rows implications for real-time weed detection L. Longchamps, B. Panneton, M.-J. Simard et al. (Canada)

Wednesday, June 16 – 8:15 to 10:00

97	Section III	Harvest of Fruits and Seeds
Time	Paper #	Moderator: Roger Chagnon (Canada) Room: 203
8:15		Session Opening
8:20	100348	The effects of shaking frequency and amplitude on detachment of Estahban dried fig (Ficus carica cv. Sabz) M. Loghavi, F. Khorsandi, S. Kamgar et al. (Iran)
8:40	100465	Efficient harvesting of haskap berries in Japan L. Fu, H. Okamoto, Y. Hoshino et al. (Japan)
9:00	100714	Determination of the damping coefficient of coffee branches using image processing techniques D. M. De Queiroz, G. P. Villibor, F. De A. C. Pinto et al. (Brazil)
9:20	101499	Red apple juice – development of a new, innovative product R.H.P. Scheyer, H.-P. Schwarz, P. Braun (Germany)

Wednesday, June 16 – 10:15 to 12:00

112	Section III	Harvest of Biomass (I)
Time	Paper #	Moderator: Mark Lefsrud (Canada) Room: 203
10:15		Session Opening
10:20	101026	Quality of wooden chips produced by Claas Jaguar fitted with experimental CRA-ING rotor L. Pari, V. Civitarese, A. Del Giudice (Italy)
10:40	101656	Anderson introduces a new biomass baler L. D'Amour, F. Lavoie (Canada)
11:00	100100	Spring harvest of corn stover P.-L. Lizotte, P. Savoie (Canada)
11:20	100515	Machinery management data for willow harvest with a Bio-baler P. Savoie, P. L. Hébert, F.-S. Robert (Canada)
11:40	100516	Harvest of woody crops with a bio-baler in eight different environments in Minnesota D. Current, P. Savoie, P.L. Hébert et al. (United States/Canada)

Wednesday, June 16 – 10:15 to 12:00

113	Section III	Crop Management and Protection – POSTERS
Poster #	Paper #	Moderator: John K. Schueller (USA) Room: 2000D
30	100799	Comparison of energy requirements of traditional and conservative soil tillage for maize cultivation in central Italy R. Fanigliulo, C. Cervellini, G. Brannetti et al. (Italy)
31	100577	Development of peach harvesting end-effector with function for estimation of degree of ripeness K. Kito, W.X. Lun, H. Goto (Japan)
32	100620	Using artificial neural networks for discrimination the corn plants from the weeds S. Kiani, A. Jafari, Z. Azimifar (Iran)
33	100650	Design of a mechanical release system of Perillus bioculatus to control the Colorado potato beetle, Leptinotarsa decemlineata (SAY) S. De Ladurantaye, M. Khelifi (Canada)
34	100726	Thermal control of hazelnut suckers R. Tomasone, G. Colorio, C. Cedrola et al. (Italy)
35	101089	Mechanical control of quackgrass in grassland R. Khorchani, M. Khelifi, M. Bournival (Canada)
36	101390	Test bench for mechanical distribution of predators to control insect pests M. Khelifi, F. Paré, Y. De Ladurantaye (Canada)
37	100535	Automatic weed control system for processing tomatoes D.C. Slaughter, M. Pérez, C. Gliever et al. (USA/Spain)
38	101083	Innovative strategies and machines for physical weed control in vegetable crops in central and southern Italy A. Peruzzi, M. Fontanelli, C. Frascioni et al. (Italy)
39	101088	Innovative strategies for physical weed control on hard surfaces in urban area in central Italy: Development of new flaming operative machines A. Peruzzi, L. Lulli, M. Fontanelli et al. (Italy)
40	100944	Effects of the machine wheel load on grass yield O. Green, R. N. Jørgensen, K. Kristensen et al. (Denmark)
41	100961	Development of a distribution system for measuring nozzle integrative parameter X. Xue, J. Liang, P. Liu et al. (China/United States)
42	101336	The effect of fan frequency on the droplet spraying swath of air-aided sprayer S. Song, T. Hong, D. Sun et al. (China)

Wednesday, June 16 – 13:35 to 15:20

126	Section III	Harvest of Biomass (II)
Time	Paper #	Moderator: Mark Lefsrud (Canada) Room: 203
13:35		Session Opening
13:40	100098	Corn stover fractions as a function of hybrid, maturity, site and year P.-L. Lizotte, P. Savoie, M. Lefsrud (Canada)
14:00	101005	Simultaneous harvesting of straw and chaff for energy purposes - influence on bale density, yield, field drying process and combustion characteristics G. Lundin, M. Rönnbäck (Sweden)
14:20	101024	Evaluation of chips quality by the analysis of two different harvesting methodologies L. Pari, V. Civitarese, A. Del Giudice (Italy)
14:40	100767	Simulation of hemp fibre bundle and cores using discrete element method M. A.-A. Sadek, Y. Chen, C. Laguë et al. (Canada)
15:00	100981	Economic production and processing of agricultural fibre plants for high quality applications in automotive, building and furniture industry R. Pecenka, C. Füll, H.-J. Gusovius (Germany)

Wednesday, June 16 – 13:35 to 15:20

127	Section III	Design and Modeling
Time	Paper #	Moderator: Claude Laguë (Canada) Room: 205A
13:35		Session Opening
13:40	100238	Dynamic analysis of a tractor engine crankshaft in knocking phenomenon E. Mahmoodi, A. Jafari, S. Rafiee (Iran)
14:00	100768	Decortication of hemp (<i>Cannabis sativa</i>) fibers using drop weight impact: Fiber yield and properties Md. M. R. Khan, Y. Chen, C. Laguë et al. (Canada)
14:20	100769	Theoretical analysis of energy requirement for hemp decorticators J. Xu, Y. Chen, C. Laguë et al. (Canada)
14:40	101065	Aerodynamic properties of hemp fibre and core S. Parvin, Y. Chen, C. Laguë et al. (Canada)
15:00	100266	Development of a system for pattern operations M. Gebben, G. Kormann (Germany)

Abstract only	100240	Design and manufacture of a new and simple mechanism for transmission of power between crossover shafts up to 135 degrees for farm machinery M. Yaghoubi, S.S. Mohtasebi, A. Jafari, H. Khaleghi (Iran)
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SECTION IV Energy in Agriculture

Monday, June 14 – 10:15 to 12:00

10	Section IV	Analysis of Biogas Production
Time	Paper #	Moderator: Jay Martin (USA) Room: 2102B
10:15		Session Opening
10:20	100688	Life cycle assessment of agricultural biogas production systems J. Lansche, J. Müller (Germany)
10:40	101095	Anaerobic digestion and related best management practices: Utilizing life cycle assessment M.Z. Venczel, S.E. Powers (United States)
11:00	101515	Positioning anaerobic digestion systems in the swine sector in Québec: A technical and economic study M.-A. Ricard, C.B. Laflamme, C. Charest et al. (Canada/France)
11:20	101132	Biogas production from separated slurry as a slurry management strategy: A consequential life cycle assessment L. Hamelin, M. Wesnæs, H. Wenzel et al. (Denmark)
11:40	101633	Techno-economic assessment of anaerobic digestion systems for agri-food wastes A. Lau, S. Baldwin, M. Wang (Canada)

Monday, June 14 – 13:35 to 15:20

25	Section IV	Design Issues for Biogas Production
Time	Paper #	Moderator: Zoltán Sibalszky (Hungary) Room: 2102B
13:35		Session Opening
13:40	100658	Optimization and control of a novel upflow anaerobic solid-state (UASS) reactor J. Mumme, B. Linke, R. Tölle (Germany)
14:00	100724	Drying characteristics and nitrogen loss of biogas digestate during drying process C. Maurer, J. Müller (Germany)
14:20	101041	Biodrying of animal slaughterhouse residues and heat production Yves Bernard (Canada)
14:40	101578	Transforming anaerobic digestion with the 'Model T' of digesters J.F. Martin, R. Ciotola, J. Castano et al. (United States)
15:00	101311	Bioreactors E. Jamaledine (Canada)

Monday, June 14 – 15:35 to 17:00

40	Section IV	Management and Biogas Production (joint with AEES*)
Time	Paper #	Moderator: Frédéric Pelletier (Canada) Room: 2102B
15:35		Session Opening
15:40	101387*	Microbial community analysis of ambient temperature anaerobic digesters R. Ciotola (United States)
16:00	101597*	Gas production analysis of a fixed-dome digester operated under temperate climates in central Ohio J. Castano, J. Martin, R. Ciotola et al. (United States)
16:20	101113	Impact of harvesting time on ultimate methane yield of switchgrass grown in Eastern Canada Y. Gilbert, D. Massé, P. Savoie et al. (Canada)
16:40	101052	Farm-scale anaerobic digestion of beef and dairy cattle manure for energy cogeneration at two farms in Canada N. Patni, C. Monreal, X. Li et al. (Canada)

Tuesday, June 15 – 10:15 to 12:00

54	Section IV	Biofuels
Time	Paper #	Moderator: Guillaume Pilon (Canada) Room: 2102B
10:15		Session Opening
10:20	100337	Potentials of biofuels A. Munack, J. Krah, O. Schröder et al. (Germany)
10:40	100880	Numerical investigation of a bubble-column photo-bioreactor design for biodiesel production from microalgae I.-H. Seo, I.-B. Lee, H.-S. Hwang et al. (Korea)
11:00	101073	Energy and CO₂ eq analysis of the agricultural phase in the sunflower biodiesel chain P. Spugnoli, R. Dainelli, L. D'Avino et al. (Italy)
11:20	101214	Energy analysis of biochemical conversion processes of biomass to bioethanol M.D. Bakari, M. Ngadi, T. Berghthorson (Canada)
11:40	101283	Cultivation and utilization of specific wood biomass for synthesis of cellulose based bioethanol L. Fara, C. Cincu, G. Hubca et al. (Romania)

Tuesday, June 15 – 13:35 to 15:20

70	Section IV	Combustion and GHG
Time	Paper #	Moderator: Amit Kumar (Canada) Room: 2102B
13:35		Session Opening
13:40	100457	A review of standards related to biomass combustion J. Villeneuve, P. Savoie (Canada)
14:00	100459	Handling of corn stover bales for combustion in small and large furnaces R. Morissette, P. Savoie, J. Villeneuve (Canada)
14:20	100804	Power from triticale straw M. Dassanayake, A. Kumar (Canada)
14:40	100941	Greenhouse gas mitigation potential of short-rotation-coppice based generation of electricity in Germany A. Hansen, A. M.-A., J. Kern et al. (Germany)
15:00	100434	Energy and greenhouse gas emissions of Australian cotton: from field to fabric B. G. Khabbaz, G. Chen, C. Baillie (Australia)

Tuesday, June 15 – 15:35 to 17:20

84	Section IV	Biochar and Energy
Time	Paper #	Moderator: Axel Munack (Germany) Room: 2102B
15:35		Session Opening
15:40	100296	Utilization of residual biochar produced from the pyrolysis of energy crops for soil enrichment G. Pilon, J.-M. Lavoie (Canada)
16:00	100429	Material and operating variables affecting the physical quality of biomass briquettes Y. Song, J. S. Tumuluru, K. L. Iroba et al. (China/Canada)
16:20	100827	Biochar production for carbon sequestration J. Thakkar, A. Kumar (Canada)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

16:40	101374	Vacuum pyrolysis of swine manure: Biochar production and characteristics M. Verma, S. Godbout, J.P. Larouche et al. (Canada)
17:00	101421	Characteristics of paddy operations with biodiesel fuelled tractor Y. Kim, S.H. Park, C. K. Kim et al. (Republic Of Korea)

Wednesday, June 16 – 8:15 to 10:00

98	Section IV	Renewable Energy and Assessment
Time	Paper #	Moderator: Guangnan Chen (Australia) Room: 2102B
8:15		Session Opening
8:20	101116	Investigating design criteria to build a performing microbial fuel cell running on swine liquid manure D.Y. Martin, R. Hogue, P. Dubé et al. (Canada)
8:40	101564	Continuous fermentative hydrogen production in different process conditions N. Nasirian, M. Almassi, S. Minaee et al. (Iran/Germany)
9:00	101636	Centrifugal potential energy: An astounding renewable energy concept I.A. Oduniyi (Nigeria)
9:20	100776	Evaluation of an earth heat storage system in a solar energy greenhouse Q. Zhang, J. Langrell, R. Boris (Canada)
9:40	100435	Energy usage for cotton ginning in Australia S.A. Ismail, G. Chen, C. Baillie et al. (Malaysia/Australia)

Wednesday, June 16 – 10:15 to 12:00

114	Section IV	Biofuels and Biogas – POSTERS
Poster #	Paper #	Moderator: Naveen Patni (Canada) Room: 2000D
43	100404	Different purification methods and quality of sunflower biodiesel A.L.M.T. Pighinelli, R.A. Ferrari, A.M.R.O Miguel et al. (Brazil)
44	100982	Using pre-heated sunflower oil as fuel in a diesel cycle engine H. C. Delalibera, P. H. W. Neto, J. Martini (Brazil)
45	101467	Production of microscopic algae for its consequent use as aviation fuel T. Maekawa, J. Jia, K. Intabon et al. (Japan)
46	100646	Use of farm waste biomass in the process of gasification for energy production J. Piechocki (Poland)
47	100839	Gasification of waste from furniture industries for generation of sustainable energy J. L. Oliveira, J. N. Silva, E. G. Pereira et al. (Brazil)
48	100492	Development of a biogas purifier for rural areas in Japan Y. Kimura, S. Yasui, T. Hinata et al. (Japan)
49	101302	Design of a 60MW CFB gasification system (CGAS) for Uganda- Utilising rice husks as input fuel F. Amanyire, D.B. Bagamuhunda (Uganda)

Wednesday, June 16 – 13:35 to 15:20

128	Section IV	Biomass, Compost and Energy Assessment - POSTERS
Poster #	Paper #	Moderator: Yannick de la Durantaye (Canada) Room: 2000D
66	100447	Preliminary investigation into the pressing process of sweet pearl millet and sweet sorghum biomass for ethanol production M. Crépeau, M. Khelifi, A. Vanasse (Canada)
67	100527	Engineering developments for small-scale harvest, storage and combustion of woody crops in Canada P. Savoie, C. Ouellet-Plamondon, R. Morissette et al. (Canada)
68	100576	Food and biomass production in small oil expression facilities H. Kato, G. Kanai, K. Yakushido (Japan)
69	101133	Electrical energy use in different heating systems for early weaned piglets J. Sarubbi, L.A. Rossi, D.J. Moura et al. (Brazil)

70	100778	Determination of pressure distribution in an aerated bed in a controlled pilot-scale compost reactor P. Solowiej (Poland)
71	100779	Controlling the process of composting farm biomass with the use of fuzzy logic M. Neugebauer (Poland)
72	101186	Efficiency of the heat pump cooperating with various heat sources in monovalent and bivalent systems S. Kurpaska, H. Latala (Poland)
73	101661	Integration of PV modules in existing Romanian buildings from rural areas S. Fara, D. Finta, L. Fara et al. (Romania)
74	100987	Experiences on the integration of thin film photovoltaic modules in a Mediterranean greenhouse R. Ureña, J. Pérez, M. Pérez et al. (Spain)
75	100991	Energy use in legume cultivation over Turkey C. Ertekin, M. Canakci, R. Kulcu et al. (Turkey)

SECTION V

Management, Ergonomics and Systems Engineering

Monday, June 14 – 10:15 to 12:00

11	Section V	Ergonomics and Agriculture – POSTERS
Poster #	Paper #	Moderator: Katja Heitkampfer (Switzerland) Room: 2000D
9	100815	“APR System”, a new design to increase workers safety in greenhouses maintenance operations A. Carreño, J. Perez, A. Callejon et al. (Spain)
10	101197	Postural analysis and biomechanics of workers in poultry slaughterhouse C. da C.S. Carvalho, C. de F. Souza, I. de F.F. Tinôco et al. (Brazil)
11	101243	The role of the web in the effective detection of serious and fatal tractor overturning accidents D. Pessina, D. Facchinetti (Italy)
12	100994	Approach to heat stress management in the construction industry Mediterranean greenhouses J. Pérez, A. Carreño, A. J. Callejón et al. (Spain)

Monday, June 14 – 13:35 to 15:20

26	Section V	Ergonomics and Safety
Time	Paper #	Moderator: Ladislav Nozdrovicky (Slovakia) Room: 2105
13:35		Session Opening
13:40	100263	Ergonomic aspects of operation of IT systems in precision agriculture T. Juliszewski, M. Walczykova (Poland)
14:00	100312	Work economics and ergonomics in dairy farming K. Heitkampfer, M. Riegel, M. Schick (Switzerland)
14:20	101064	A predictive model for the vibration risk evaluation in agricultural machinery use D. Pessina, V. Bonalume (Italy)
14:40	101482	Definition of unambiguous criteria to evaluate tractor ROPS equivalence D. Pessina, D. Facchinetti, M. Belli (Italy)
15:00	101510	Effectiveness of agricultural tractors cabs for protection against hazardous substances in accordance with EN 15695 part 1 E. Cavallo (Italy)

Monday, June 14 – 15:35 to 17:00

41	Section V	Technology for Improved Management – POSTERS
Poster #	Paper #	Moderator: Remigio Berruto (Italy) Room: 2000D
62	100948	Power spectral analysis of agricultural field surfaces M. Cutini, C. Bisaglia, S. A. Bertinotti (Italy)
63	101086	Radio frequency identification technologies for traceability of potted flowering plants C. Tortia, P. Barge, P. Gay et al. (Italy)

64	101038	First approach to correlate the tire contact area to traction force in the field E. Romano, M. Cutini, C. Bisaglia et al. (Italy)
65	100972	A new approach for in situ poultry carcasses disposal: A closed semi-continuous composter A. C. Guimaraes, M. S. Bascones, L. M. Navas Gracia et al. (Spain)
66	100498	Comparison of useful life of tractors by condition monitoring and breakdown maintenance in Iran H. M. Meighani, A. Mohammadi (Iran)
67	101549	Use of electronic devices in combine harvesters: A case study for Antalya Region in Turkey D. Yilmaz, M. Canakci, I. Akinci (Turkey)
68	100740	Power and energy requirements of agricultural machinery driven by tractor used on greenhouse vegetable production in Turkey M. Canakci, I. Akinci (Turkey)
69	100497	Investigating JD3140 tractor breakdowns and their reasons H. M. Meighani, A. Mohammadi, M. Raoufi (Iran)
70	100499	Design and manufacturing a new platform for rapeseed harvesting in Iran H. M. Meighani, A. H. Mohseni, S. Ebrahimi (Iran)

Tuesday, June 15 – 10:15 to 12:00

55	Section V	Human Workload in Agriculture
Time	Paper #	Moderator: Tadeusz Juliszewski (Poland) Room: 204B
10:15		Session Opening
10:20	100950	Using the CUELA system to study workload in agriculture M. Kauke, I. Hermanns, U. Hoehne-Hückstädt et al. (Switzerland/Germany)
10:40	100313	Workload assessment in agriculture – integration in a work budget system K. Heitkampfer, M. Schick, R. Stark et al. (Switzerland)
11:00	100956	Analysis and assessment of workload in different types of milking parlours using the CUELA-System M. Kauke, U. Hoehne-Hückstädt, I. Hermanns et al. (Switzerland/Germany)
11:20	100946	Calculation and planning farm management tasks in pig and dairy farming C. Moriz (Switzerland)
11:40	101008	Development of an experimental system for agricultural work process measurement A. Bechar, A. Ronen (Israel)

Tuesday, June 15 – 13:35 to 15:20

71	Section V	Crop and Biomass Logistics (I)
Time	Paper #	Moderator: Elisabeth Quendler (Austria) Room: 204B
13:35		Session Opening
13:40	100962	Calculation of transportation energy for biomass collection G. Kanai, K. Takekura, H. Kato et al. (Japan)
14:00	100905	Agricultural fleet management: An operational research approach D. D. Bochtis, C. G. Sørensen (Denmark)
14:20	101347	Interfacing feedstock logistics with bioenergy conversion S. Sokhansanj (Canada)
14:40	100374	Energy expense by logistics within sugarcane's energy production chain -two case studies T.L. Romanelli, R. Berruto, P. Busato et al. (Brazil/Italy)
15:00	101018	Technological and organizational development potentialities for grain logistic in Germany H. Bernhardt, W. Lixfeld, D. Engelhardt (Germany)

Wednesday, June 16 – 8:15 to 10:00

99	Section V	Logistics and Knowledge Transfer
Time	Paper #	Moderator: Claus Gron Soerensen (Denmark) Room: 204B
8:15		Session Opening

8:20	101097	Online model predictive monitoring for controlling and optimizing the performance of agricultural production processes K. Mertens, B. De Ketelaere, J. De Baerdemaeker (Belgium)
8:40	100700	Tractor based services and related support policies in developing countries J. Kienzie, W. Hancox, J. Ashburner (Italy/UK)
9:00	100526	Dynamic role of reverse logistic cycle with in life cycle analysis for sustainability Z. Ali-Qureshi (Canada)
9:20	100315	Development of criteria and indicators for monitoring progress towards sustainable remediation I. S. Dunmade (Canada)
9:40	100471	Knowledge transfer model for agricultural engineering E. Quendle, J. Boxberger (Austria)

SECTION VI Postharvest Technology and Process Engineering

Monday, June 14 – 10:15 to 12:00

12	Section VI	Food Processing (I)
Time	Paper #	Moderator: Shujun Li (China) Room: 2104AB
10:15		Session Opening
10:20	100069	Development of model equations for selecting optimum parameters for dry process of shea butter extraction A. M. Olaniyan, K. Oje (Nigeria)
10:40	100336	Acrylamide mitigation in fried potato slices by using commercial asparaginase F. Pedreschi, K. Granby, J. Risum (Chile/Denmark)
11:00	100630	Microwave-assisted separation of eggshell and membrane A. Hussain, S. Dev, Y. Garipey et al. (Canada)
11:20	101048	Prediction of lactic-bacteria growth in turkey ham processed by high hydrostatic pressure S.P. Mathias, A. Rosenthal, A. Gaspar et al. (Brazil/France)
11:40	100200	Combined effects of freezing and storage conditions on the staling of cooked rice S. F. Yu, Y. Ma, D. Tian et al. (China/Ireland)

Monday, June 14 – 10:15 to 12:00

13	Section VI	Nutraceuticals and Functional Foods (I)
Time	Paper #	Moderator: Valérie Orsat (Canada) Room: 2105
10:15		Session Opening
10:20	100555	Microwave extraction of myrtillin from blueberry W. Routray, V. Orsat (Canada)
10:40	100558	Radio frequency assisted extraction of nutraceutical compounds Y.M. Jusoh, V. Orsat, Y. Gariépy (Canada)
11:00	101304	Continuous and pulsed ultrasound-assisted extractions of antioxidants from pomegranate peel W. Qu, Z. Pan, H. Ma et al. (United States/China)
11:20	101320	Antioxidant enrichment of cranberry juice by electrodialysis with filtration membrane : Impact of process on juice composition L. Bazinet, S. Brianceau, Y. Desjardins (Canada)
11:40	100862	A novel technique for producing zanthoxylum oil particles based on supercritical CO₂ extraction and microencapsulation methods I. Chen (China)

Monday, June 14 – 13:35 to 15:20

27	Section VI	Food Processing (II)
Time	Paper #	Moderator: Alain Le-Bail (France) Room: 2104AB
13:35		Session Opening
13:40	101376	Migration of perfluorinated compounds from antistick coating to food products during cooking processes A. Le-Bail, B. Veyrand, S. Durand et al. (France)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

14:00	101078	Study the effect of two different edible coating on walnut kernel shelf life R. Bastani, M. Rahemi, N. Mafoonazad et al. (Iran/Canada)
14:20	101290	Effect of microwave radiation on starch digestibility and physico-chemical properties of three barley types S. Emami, A. Perera, V. Meda et al. (Canada)
14:40	101344	Mango (<i>Mangifera indica</i>) and ambarella (<i>Spondias cytherea</i>) peel extracted pectins improve viscoelastic properties of derived jams G. Kansci, B.B. Koubala, C. Garnier et al. (Cameroon/France)
15:00	101206	Development and commercialization of emerging infrared radiation food processing technologies Z. Pan, G.G. Atungulu, G. Bingol et al. (United States)

Monday, June 14 – 13:35 to 15:20

28	Section VI	Spectroscopy and Image Analysis – POSTERS
Poster #	Paper #	Moderator: Da-Wen Sun (Ireland) Room: 2000D
32	100967	Testing of a NIR system for the optimization of stored apples management R. Beghi, E. Casiraghi, N. Sinelli et al. (Italy)
33	100601	A novel computer vision system for specifically detecting rotten citrus J. Blasco-Ivars (Spain)
34	100602	Analysis of the movement of fruits during mechanical harvesting with shakers using computer vision and a slow motion camera J. Blasco, A. Torregrosa, N. Aleixos et al. (Spain)
35	100631	Determination of metals in organic pulp and juices by fluorescence X-ray G. A. Camargo (Brazil)
36	100917	Investigation on fatty acid composition of Japanese black wagyu beef by ATR-FTIR spectroscopy and chemometric analysis X. Hu, K. Toyoda, M. Yamanoue, I. Ihara et al. (Japan)
37	100978	Identification and classification of out of control measurements of a NIR spectrometer under industrial use for onion quality determination J. Ortiz-Cañavate, A. Moya-González, P. Barreiro (Spain)
38	101092	Browning kinetics evaluation using image processing techniques L. Comba, P. Gay, P. Piccarolo et al. (Italy)
39	101134	Application of hyperspectral imaging technique for determination of pork quality attributes D.F. Barbin, G. Elmasry, D.-W. Sun et al. (Ireland)
40	101148	Use of hyperspectral imaging for the quality classification of cooked turkey hams A. Iqbal, G. Elmasry, D.-W. Sun et al. (Ireland)
41	101173	Adjusted methodology for determining residence time by image analysis on a vibro-fluidized dryer R.A. De Oliveira, K.J. Park, B.S. Oliveira (Brazil)
42	101473	Prediction of melon fruit firmness using Vis/NIR diffuse reflectance spectroscopy S.H. Yu, S.R. Suh, K.H. Lee et al. (Republic Of Korea)
43	101492	Discrimination of lamb muscles by NIR hyperspectral imaging M. Kamruzzaman, G. Elmasry, D.-W. Sun et al. (Ireland)
44	100265	Non-destructive measurement of SSC, pH, firmness and density of 'Dangshan' pear using FT-NIR spectrometry K. J. Chen, L. Yang, X. Sun (China)
45	100264	Classification of pre-sliced ham images with quaternionic singular values using an adaptive multilayer perceptron N. A. Valous, D.-W. Sun (Ireland)

Monday, June 14 – 13:35 to 15:20

29	Section VI	Food Properties (I) – POSTERS
Poster #	Paper #	Moderator: Satyanarayan R.S. Dev (Canada) Room: 2000D
46	100433	Dimension characteristics evaluation of coffee berries during drying G.H.H. Oliveira, P.C. Corrêa, F.M. Botelho et al. (Brazil)
47	100493	Thermal characteristics of gelatin extracted from emperor (shaari) skin: effects of acid concentration and temperature of extraction G. Al-Saidi, M. S. Rahman, A. Al-Alawi et al. (Oman)
48	100710	Rheological characteristics of assai and passion fruit smoothies fortified with unripe banana pulp G. A. Camargo, J. Mieli, S. C. S. R. De Moura et al. (Brazil)
49	100733	Water vapor permeability, contact angle and water solubility of zein biofilms J.F. Lopes-Filho, C.B. Almeida, L.L. Tavares et al. (Brazil)
50	101069	Orange fruit rheometrical characterization using stress-relaxation tests F. Pallottino, M. Moresi, S. Giorgi et al. (Italy)
51	101109	Analysis of thermodynamic properties of coffee berries during drying G.H.H. Oliveira, P.C. Corrêa, F.M. Botelho et al. (Brazil)
52	101111	Monitoring of coagulation process of soymilk by an integrated electrical sensing and control system K. Toyoda, X. Li (Japan/China)
53	100618	Modeling and statistical characterization of the size and mass distribution of raisin berries A. Arabhosseini, N. Karimi, M. H. Kianmehr et al. (Iran)

Monday, June 14 – 15:35 to 17:00

42	Section VI	Food Processing (III)
Time	Paper #	Moderator: Martin Mondor (Canada) Room: 2104AB
15:35		Session Opening
15:40	100742	Solvent recovery by membrane filtration from extract of raspberry marc Z. Molnár, K. Özdemir, E. Békássy-Molnár et al. (Hungary)
16:00	101303	Applications of membrane technologies for today and tomorrow M. Mondor, F. Lamarche, D. Ippersiel et al. (Canada)
16:20	101205	Fermenters with magnetic fields for agriculture. Technological and practical issues S.M.M. Diego, C.M. Manrique, F.S. Ricardo et al. (Cuba/Brazil)
16:40	101062	Enhancement of extraction efficiency of citrus juice and sacs by twin oblique air jet moves in 3D space M. R. Mirian, J. Khazaei (Iran)

Monday, June 14 – 15:35 to 17:00

43	Section VI	Nutraceuticals and Functional Foods (II)
Time	Paper #	Moderator: Vijaya Raghavan (Canada) Room: 2105
15:35		Session Opening
15:40	100694	Using plant macromolecules to produce flavor microcapsules by spray-drying multilayered oil/water emulsions A. Gharsallaoui, O. Chambin, R. Saurel (France)
16:00	100781	Microwave-assisted methodology for quantitative analysis of lignans in foods S. M. Nemes, V. Orsat, G. S. V. Raghavan (Canada)
16:20	101279	Diversity of fruit origin by using 26S rDNA fingerprinting of yeast communities by PCR-DGGE: An application to shea tree fruits A.F. El Sheikh, J.-M. Bouvet, D. Montet (Egypt/France)
16:40	100612	Aroma properties of selected local spices in Akwa Ibom State of Nigeria A. F. Alonge, E. U.U. Ituen et al. (Nigeria)

Monday, June 14 – 15:35 to 17:00

44	Section VI	Drying, Dehydration and Deactivation – POSTERS
Poster #	Paper #	Moderator: Sébastien Villeneuve (Canada) Room: 2000D
71	100267	Effect of different variables on microwave osmotic dehydration under spray mode (MWODS) of apple cylinder using response surface methodology E. Azarpazhooh, H. S. Ramaswamy (Canada)
72	101272	Effect of packaging and preservation methods on the qualitative and sensory characteristics of dehydrated Jujuba fruit E. Azarpazhooh, S. Nikkhah (Iran)
73	100965	Quality of the pulped cherry coffee subjected to continuous and intermittent drying J. N. Da Silva, S. Martin, S.M. Lopes Donzeles et al. (Brazil)
74	101103	Thin-layer drying behaviour of coffee berries A.L.D. Goneli, P.C. Corrêa, G.H.H. Oliveira et al. (Brazil)
75	101317	Effect of drying temperature on structure of pasta enriched with pea protein isolate S. Mercier, S. Villeneuve, L.-P. Des Marchais et al. (Canada)
76	101329	Experimental study of banana drying energy costs in a prototype electric drier A. Talla, Y. Jannot, G.E. Nkeng (Cameroon/France)
77	100463	Pulsed electric fields and microfiltration hurdle treatment for the implementation of microbial safety in milk M. Walkling-Ribeiro, O. Rodríguez-González et al. (Canada)
78	101209	Use of a novel in-package ozonation process for reducing Salmonella enteritidis on chicken meat J. Jensen, A. Donner, K.M. Keener (United States)
79	101316	Modelling and simulation of processes by smart sensing: A solar dryer for plant material E.C. Correa, B. Diezma, M. Ruiz-Altisent (Spain)
80	101029	Thin layer drying of sliced squash by forced convection C. Ertekin, O. Yaldiz (Turkey)
81	101658	Drying of dates in Oman using a solar tunnel dryer M.A. Basunia, H.H. Handali, M.I. Al-Balushi et al. (Oman)

Tuesday, June 15 – 10:15 to 12:00

56	Section VI	Food Processing (IV)
Time	Paper #	Moderator: Michael Ngadi (Canada) Room: 2104AB
10:15		Session Opening
10:20	101218	Effect of thermal pretreatment and batter composition on fat absorption in deep-fat fried batter N. Abdel-Nour, M. Ngadi, A.A. Adedeji (Canada)
10:40	101217	Modelisation of pulsed electric fields for tropical liquid food industrial processing A. Youmssi, G.J. Kayem, F. Sirois et al. (Canada)
11:00	101377	Impact of bread making process on quality parameters, nutrition, parameters and energy demand; key results from the EU-FRESHBAKE project A. Le-Bail (France)
11:20	101183	Shelf-life determination of “queso doble crema” by means of electronic nose D.P. Osorio, C.F. Novoa, L.-F. Gutiérrez (Colombia/Canada)
11:40	101343	Nutritional quality and lipid oxidation of plantain chips from small scale producers in Cameroon: Correlation with frying procedures G. Kansci, E. Fokou, J. Mekoue et al. (Cameroon/France)

Tuesday, June 15 – 10:15 to 12:00

57	Section VI	Food Properties (I)
Time	Paper #	Moderator: Cristina Ratti (Canada) Room: 2105
10:15		Session Opening
10:20	100242	Thermo-physical and textural properties of meat and carrot alginate particles fabricated for biological validation studies H. F. Hassan, H. S. Ramaswamy (Canada)

10:40	100482	Physico-chemical characteristics of wheat distiller's grains with solubles M. R. Mosqueda, L. G. Tabil (Canada)
11:00	100491	Quality assessment of microwave pasteurized in-shell eggs S.R.S. Dev, Y. Gariépy, V. Orsat (Canada)
11:20	100522	Establishing moisture sorption isotherms of wild mushroom varieties using a dynamic vapor sorption method D. Argyropoulos, A. Rainer, J. Mueller (Germany)
11:40	100581	Prediction of total soluble solids and firmness of carrot based on carrot water content M. Rashidi, B.G. Khabbaz (Iran/Australia)

Tuesday, June 15 – 10:15 to 12:00

58	Section VI	Nutraceutical and Functional Foods– POSTERS
Poster #	Paper #	Moderator: Laurent Bazinet (Canada) Room: 2000D
8	100553	Enhancing the polyphenolic content of elderberries by pulsed ultraviolet treatments R. Murugesan, V. Orsat (Canada)
9	100557	Bioactive gouda cheese powders obtained by spray and freeze-drying H. Ben Abdelkader, C. Ratti (Canada)
10	100614	Microwave assisted drying of flax straw and fibre at controlled temperatures G. R. Nair, K. Eggie, Y. Gariépy et al. (Canada)
11	100819	Optimization of microwave assisted extraction of antioxidants from potato peel A. Singh, K. Sabally, S. Kubow et al. (Canada)
12	100828	Agave juice as an agent for probiotic encapsulation by spray drying C. Cortés-Arminio, A. López-Malo, E. Palou et al. (Mexico)
13	101120	Influence of conjugated linoleic acid (CLA) supplementation on probiotic bacteria viability and sensory properties of stirred yogurt M.R. Barón, R.D. Godoy-Silva, L.-F. Gutiérrez (Colombia)
14	101321	Effect of process unit operation and long term storage on EGCG-enriched tea drink catechin stability L. Bazinet, M. Araya-Farias, A. Doyen et al. (Canada)
15	101108	Microencapsulation of fish oil into cross-linked whey protein matrix R. Safari, R. Kadkhodaei, R. Valizadeh et al. (Iran)

Tuesday, June 15 – 13:35 to 15:20

72	Section VI	Drying and Dehydration (I)
Time	Paper #	Moderator: Paolo Menesatti (Italy) Room: 2104AB
13:35		Session Opening
13:40	100446	Dryer evaluation to optimize small-scale litchi processing in northern Thailand M. Precoppe, M. Nagle, S. Janjai et al. (Germany/Thailand)
14:00	100464	Drying characteristics and lysine content of wheat distillers grains with solubles under three drying methods M. R. P. Mosqueda, L. G. Tabil, jr (Canada)
14:20	100540	Reducing fossil energy consumption of a belt dryer by using biogas waste heat M. Böhner, P. Senckenberg, A. Heindl et al. (Germany)
14:40	100664	Shrinkage effect on moisture diffusivity calculation during superheated steam drying of distiller's spent grain M. Zielinska, S. Cenkowski (Canada)
15:00	100935	Evaluation of operative aspects of a heat pump to dry chestnuts R. Guidetti, M. Fiala, R. Beghi et al. (Italy)

Tuesday, June 15 – 13:35 to 15:20

73	Section VI	Food Properties (II)
Time	Paper #	Moderator: Damien de Halleux (Canada) Room: 2105
13:35		Session Opening

LIST OF ABSTRACTS BY PARTICIPATING GROUP

13:40	100665	Shrinkage, density and porosity changes during superheated steam drying of distiller's spent grain M. Zielinska, S. Cenkowski (Canada)
14:00	100843	Moisture-dependent color characteristics of walnuts R. Khir, Z. Pan, G. G. Atungulu et al. (USA/Egypt/China)
14:20	101536	Sensory evaluation of standard hard cheese minas added with Brazil nut – a high antioxidant delicacy C. Pereira, C.A.P. Schmidt, R.Y. Ishihara et al. (Brazil)
14:40	100534	Preliminary study on the preparation of a new flocculant and the application on treatment of potato starch wastewater X. An, L. Shujun, L. Yaling et al. (China)
15:00	100609	Properties of coconut (Cocos nucifera L.) relevant to its dehushing A.F. Alonge, W.B. Adetunji (Nigeria)

Tuesday, June 15 – 15:35 to 17:20

86	Section VI	Drying and Dehydration (II)
Time	Paper #	Moderator: Michèle Marcotte (Canada) Room: 2104AB
15:35		Session Opening
15:40	100966	Evaluation of coffee drying costs: Pre-drying on a concrete terrace and complementary drying in a concurrent and countercurrent flow dryer S. Martin, J. N. Da Silva, S. F. Soria Galvarro et al. (Brazil)
16:00	101172	Reconditioning by filtration with earth diatomaceous and reusing the sucrose syrup for osmotic dehydration of peaches S.P.M. Germer, M.R. Queiroz, J.M. Aguirre et al. (Brazil)
16:20	101231	Effects of microwave drying and cooking on the hardness and stickiness of red lentils A. Opoku, L. Tabil, V. Meda (Canada)
16:40	101498	Skim milk cryoconcentration and assessment of its physico-chemical, thermal and functional properties M. Aider (Canada)
17:00	101030	Study on the parameters of high pulsed electrical field on fruit and vegetable as pre-processing for the vacuum freeze-drying Y. Wu, Y. Guo (China)

Tuesday, June 15 – 15:35 to 17:20

87	Section VI	Spectroscopy and Image Analysis (I)
Time	Paper #	Moderator: Muhammad Shahin (Canada) Room: 2105
15:35		Session Opening
15:40	100280	Laser light backscattering for monitoring changes in moisture content during drying of apples G. Romano, D. Argyropoulos, J. Müller (Germany)
16:00	100448	Estimation of tomato nutritional status by Vis-NIR portable spectrophotometric system V. Ulissi, P. Benincasa, M. Guiducci et al. (Italy)
16:20	100437	Estimation of egg weight by machine vision and neural networks techniques M. H. Raoufat, V. Asadi (Iran)

Tuesday, June 15 – 15:35 to 17:20

88	Section VI	Post Harvest and Fresh Produce – POSTERS
Poster #	Paper #	Moderator: Clément Vigneault (Canada) Room: 2000D
70	101232	Effects of roasting temperatures and storage on the quality of red lentil A. Opoku, L. Tabil (Canada)
71	101233	Storage and quality features of carrots and corn grown under organic and conventional agricultural practices A. Opoku, V. Meda, J. Wahab (Canada)
72	100580	A simple method for measurement of Poisson's ratio for tissue of agricultural products Y. Ogawa, M. Matsuura, N. Yamamoto et al. (Japan)
73	100786	Modeling of rough rice drying kinetics using artificial neural network M. Tohidi, M. Sadeghi, S. R. Mousavi (Iran)
74	100795	Conceptualization design and evaluation of a hyperbaric respirometer B. Goyette, C. Vigneault, N. Wang et al. (Canada)

75	101115	Texture evaluation affected by physical characteristics of carrots during storage P.C. Corrêa, L.R.L. Farinha, G.H.H. Oliveira et al. (Brazil)
76	101628	Investigation of shelled corn drying in a microwave assisted fluidized bed dryer using artificial neural network A. Zomorodian, L. Momenzadeh, D. Mowla (Iran)
77	100826	Intelligent control based on expert system for grain drying H. Zhu, W. Wu, Y. Lan et al. (China)

Wednesday, June 16 – 8:15 to 10:00

100	Section VI	Post Harvest and Fresh Produce (I)
Time	Paper #	Moderator: Lope Tabil (Canada) Room: 2104AB
8:15		Session Opening
8:20	100410	Detection of salmonella on spinach leaf using phage-based magnetoelastic biosensors S. Li, S. Huang, H. Chen et al. (United States/China)
8:40	100451	Transmission of E. coli O157:H7 biofilm from contact surfaces to fresh produce Y. M. Lo (United States)
9:00	100523	Enhancing compaction characteristics of barley straw by microwave/chemical pretreatment M. Kashaninejad, B. Kashaninejad, L.G. Tabil (Iran/Canada)
9:20	100603	Comparison of mechanical properties of two apple varieties under compression loading A.G. Chakespari, A. Rajabipour, H. Mobli (Iran)
9:40	100579	Design, fabrication and evaluation of a moisture-based fig sorter D. Zare, S. Sour, M. Loghavi et al. (Iran)

Wednesday, June 16 – 8:15 to 10:00

101	Section VI	Spectroscopy and Image Analysis (II)
Time	Paper #	Moderator: Scott Noble (Canada) Room: 2105
8:15		Session Opening
8:20	101447	Fast detection of crude protein content in fish feeds based on infrared transmission spectroscopy and chemometrics F. Zhu, P. Nie, Y. He (China)
8:40	101174	Use of hyperspectral imaging to improve the safety of food A. Lefcourt (United States)
9:00	101481	Grade classification and protein content determination in matcha based on Vis/NIR X. Zhang, R. He, Y. He (China)
9:20	100808	Quantitative assessment of maple syrup properties by means of fluorescence spectroscopy A. Clément, B. Panneton, L. Lagacé (Canada)
9:40	100836	Fast adulterant quantification in Chinese yam powder using visible, near and mid-infrared spectroscopy D. Wu, P. Nie, Y. Shao et al. (China)

Wednesday, June 16 – 8:15 to 10:00

102	Section VI	Processing of Food and Beverages – POSTERS
Poster #	Paper #	Moderator: Michael Ngadi (Canada) Room: 2000D
19	101382	Ohmic heating behavior and electrical conductivity of solid foods using low and high frequency power supply R. Zareifard, S. Zhu, M. Marcotte et al. (Canada/China)
20	100513	Application of response surface methodology for optimisation of in vitro enzymatic digestion of soy protein isolate using high hydrostatic pressure processing Z. Lanfang, S. Dan, L. Shujun et al. (China)
21	100992	A new approach of rice processing for control of compound contents and eating quality of cooked rice M. Tamura, Y. Ogawa (Japan)

22	101323	Effect of low anode/cathode voltage difference application on redox potential modulation during milk electroreduction and storage L. Bazinet, A. Schreyer, J. Lessard (Canada)
23	101216	Sustainability of rice processing in rural sub-Saharan Africa M. Bakari, M. Ngadi, R. Kok et al. (Canada)
24	101324	Large scale bioseparation of an antihypertensive peptide from alfalfa white protein hydrolysate by electrodialysis with ultrafiltration membrane L. Firdaous, P. Dhulster, J. Amiot et al. (Canada/France)
25	100706	Winery design criteria for the production of valuable wine (DOC) A. Gusman, A. Marucci, B. Pagnello (Italy)
26	100852	Influence of polyglycerol esters of fatty acid on in vitro digestibility of soybean oil-in-water by pancreatic lipase L. Yin (China)
27	101313	Application of response surface methodology to the optimisation of in vitro enzymatic digestion of soy protein isolate of high hydrostatic pressure processing S. Dan, L. Shu-Jun, H.M. Chan et al. (China/Canada)
28	101072	Process optimization of water jet extraction of pomegranate arils using response surface methodology M.R. Mirian, J. Khazaei (Iran)
29	101125	Factors influencing formation and stability of orange-flavoured beverage emulsion S.V. Baygi, R. Kadkhodaei (Iran)

Wednesday, June 16 – 10:15 to 12:00

115	Section VI	Post Harvest and Fresh Produce (II)
Time	Paper #	Moderator: Clément Vigneault (Canada) Room: 2104AB
10:15		Session Opening
10:20	100636	Design and performance of a lab scale controlled environment chamber (CEC) used for determination of horticultural produce quality deterioration J. Boutin, D. I. Leblanc, C. Vigneault et al. (Canada)
10:40	100940	In-field measurement of fruit respiration for determining climacteric activity and harvest maturity of mango M. Nagle, W. Spreer, B. Mahayothee et al. (Germany/Thailand)
11:00	101123	Effect of drying and tempering conditions on milling quality in multi-pass drying of rough rice E. Nasrnia, M. Sadeghi, A.A. Masoumi (Iran)
11:20	101219	Impact of the age of laying chicken on mechanical strength of eggs N Abdel-Nour, M. Ngadi, V. Raghavan (Canada)
11:40	101275	Energy saving during bulb storage applying modeling with computational fluid dynamics (CFD) A.A. Sapounas, J.B. Campen, J. Wildschut et al. (Netherlands)

Wednesday, June 16 – 10:15 to 12:00

116	Section VI	Spectroscopy and Image Analysis (III)
Time	Paper #	Moderator: Da-Wen Sun (Ireland) Room: 2105
10:15		Session Opening
10:20	101385	Combination of near infrared spectroscopy and multivariate analysis to detect valine (C5H11NO2) in oilseed rape leaves W. Kong, F. Liu, H. Fang et al. (China)
10:40	101207	Confocal laser scanning microscopy imaging of deep-fat fried batter coating A.A. Adedeeji, L. Liu, M.O. Ngadi (Canada)
11:00	101287	Application of near infrared spectroscopy and least squares-support vector machine to determine soluble protein in oilseed rape leaves F. Liu, Y. Zhao, G. Sun et al. (China)
11:20	101107	Near infrared hyperspectral imaging for classification of beef muscles G. Elmasry, D.-W. Sun, P. Allen (Ireland)

11:40	100751	Evaluation of novel high intensity pulsed UV sources for processing food beverages T. Koutchma, M. Orlowska (Canada)
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Wednesday, June 16 – 13:35 to 15:20

129	Section VI	Microbiological Inactivation
Time	Paper #	Moderator: Tatiana Koutchma (Canada) Room: 2104AB
13:35		Session Opening
13:40	100909	Effect of aluminium cookware on microbial inactivation during pasteurization of milk N. Ruangthip, S. Kawamura, Y. Uchida et al. (Japan)
14:00	100748	Characterization of low UVT liquid foods and ingredients for ultraviolet preservation T. Koutchma, C. Defelice (Canada)
14:20	100914	Antimicrobial activity of novel packaging material made from biomass plastics and shell (scallop) powder Y. Hasegawa, T. Kimura (Japan)
14:40	101045	Thermal inactivation of <i>Byssoschlamys nivea</i> in pineapple nectar combined with preliminary high pressure treatments E.H.R. Ferreira, A. Rosenthal, V. Calado et al. (Brazil)
15:00	101215	Ultraviolet depuration of <i>Escherichia coli</i> from the juvenile clam, <i>Cyclina sinensis</i> in China M. Yu-Ping, Q. Qing-Lin (China)

Wednesday, June 16 – 13:35 to 15:20

130	Section VI	Spectroscopy and Image Analysis (IV)
Time	Paper #	Moderator: Jochen Hemming (Netherlands) Room: 2105
13:35		Session Opening
13:40	100411	Role of infrared thermal imaging in stored products protection V. Rajagopal, D. S. Jayas, N. D.G. White (Canada)
14:00	101446	The successive projections algorithm for variable selection in alien invasive weeds classification based on Vis/WNIR P. Nie, J. Yu, Y. Zhao et al. (China)
14:20	100647	Application of infrared spectromicroscopy to characterize and determine the spatial distribution of lignocellulosic components in agricultural straw pellets P. K. Adapa, C. Karunakaran, L. G. Tabil et al. (Canada)
14:40	100653	Detection of internal defect in pickling cucumbers using laser scattering image analysis D. P. Ariana, R. Lu (United States)
15:00	101474	Melon soluble solids content measurement using Vis/NIR diffuse reflectance spectroscopy H. S. Shin, S. R. Suh, K. H. Lee et al. (Republic Of Korea)

Wednesday, June 16 – 13:35 to 15:20

131	Section VI	Food Properties (II) - POSTERS
Poster #	Paper #	Moderator: Valérie Orsat (Canada) Room: 2000D
76	101149	Fluid-dynamic properties and pressure loss of black beans in a packed bed R.A. De Oliveira, K.J. Park, A.M. Vivas et al. (Brazil)
77	101167	Methods for the assessment of candy gum elasticity G. Csima, V. Biczó, T. Kaszab et al. (Hungary)
78	101475	Color texture feature analysis for estimation of melon internal quality S.R. Suh, K.H. Lee, S.H. Yu et al. (Republic Of Korea)
79	101553	Moisture adsorption isotherms of castor beans A.L.D. Goneli, P.C. Corrêa, G.H.H. Oliveira et al. (Brazil)
80	101642	Rheological properties of processed liquid egg white products C. Németh, R. Juhász, L. Friedrich et al. (Hungary)
81	101190	Mass modeling of pomegranate fruits: Artificial neural networks method J. Khazaei, S.A. Hosseini, Z.M. Jafari (Iran)
82	100506	Physical properties of cumin (<i>Cuminum cyminum</i>) and caraway (<i>Carum carvi</i>) seeds D. Zare, A. Bakhshipour, A. Zomorodian (Iran)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

83 100983 **The effect of paddy moisture content on milling losses and post-milling crack development in rice kernel, under different storage conditions**
N. Sadeghi, S. M. Nassiri (Iran)

Abstract only 100753 **Effect of high hydrostatic pressures on drying kinetics of blueberries variety o'neil**
Antonio Vega-Gálvez, Margarita Miranda, Gipsy Tabilo-Munizaga, Mario Pérez-Won (Chili)

SECTION VII Information Systems and 8th World Congress on Computers in Agriculture

Monday, June 14 – 10:15 to 12:00

14 Section VII Image Analysis and WCCA

Time	Paper #	Moderator: Renfu Lu (USA) Room: 2101
10:15		Session Opening
10:20	100364	Image analysis, 3D geometry modeling and inverse FEA in investigating properties of agri-food and forest products J. Weres, S. Kujawa, K. Nowakowski et al. (Poland)
10:40	100777	Detection of fusarium damaged kernels in wheat using hyperspectral imaging M. A. Shahin, S. J. Symons (Canada)
11:00	101337	Hyperspectral character analysis of rice leaves infested by brown plant-hopper (Nilaparvata lugens) Z. Zhou, Z. Zhao, X. Luo et al. (China)
11:20	100934	Automatic grading of anthurium cut flowers using 3D computer vision J. Hemming, E. J. Pekkeriet, R. Van Der Schoor (Netherlands)
11:40	100250	A hybrid wavelet transform-based agricultural image de-noising algorithm Y. F. Zeng (China)

Monday, June 14 – 10:15 to 12:00

15 Section VII Modelling and Simulation – POSTERS and WCCA

Poster #	Paper #	Moderator: Antonio M Saraiva (Brazil) Room: 2000D
17	101485	Production process evaluation of wastewater-irrigated plant biomass through life cycle assessment C. Arcidiacono, S.M.C. Porto (Italy)
18	100399	Simulation of creep process of processed alfalfa based on virtual prototype technology C. G. Wang, G. Z. Zhao, Z. Wang (China)
19	101110	Prediction of process and product parameters in deep bed drying of rough rice using artificial neural network M. Tohidi, M. Sadeghi, S.R. Mousavi (Iran)
20	101471	Conceptual modeling for the design of a computer-based traceability system G. Cascone, C. Arcidiacono, S.M.C. Porto et al. (Italy)
21	101488	From the construction of an ecological network to the definition of an environmentally sustainable planning model for periurban space C.R. Fichera, L. Laudari, G. Modica (Italy)
22	101359	Comparison of fuzzy logic and classic controllers' performance in guiding of a greenhouse applications robot H. Masoudi, M. Omid, R. Alimardani et al. (Iran)

Monday, June 14 – 13:35 to 15:20

30 Section VII Robotics and Automation (I) and WCCA

Time	Paper #	Moderator: Fedro Zazueta (USA) Room: 2101
13:35		Session Opening

13:40	100984	Development of a remote control system for autonomous agricultural vehicles X. Zhang, Dr. P. O. Noack, L. Grandt et al. (Germany)
14:00	101157	Rice plant detection in heading term for autonomous robot navigation R. Masuda, K. Nakayama, K. Nomura (Japan)
14:20	101358	Design, fabrication and evaluation of a mobile robot for greenhouse spraying H. Masoudi, R. Alimardani, M. Omid et al. (Iran)
14:40	101278	Test and evaluation of two process control strategies for adapting direct injection pesticide application to small scale farms A. El Aissaoui, F. Lebeau, M.-F. Destain (Morocco/Belgium)

Monday, June 14 – 15:35 to 17:00

45 Section VII Robotics and Automation (II) and WCCA

Time	Paper #	Moderator: Omar Ulloa (Costa Rica) Room: 2101
15:35		Session Opening
15:40	101182	Developing a framework based database (or as a central tool for) mapping and analysing research and development on ICT and robotics in agriculture and environmental related businesses J. Vangeyte, S. Ms Van Weyenbergh, J. Baert et al. (Belgium/Denmark)
16:00	100761	Vision-based weed identification with farm robots Kishore C. Swain, Michael Nørremark, D. Bochtis et al. (Denmark)
16:20	101012	Design of an autonomous spraying robot for greenhouse L. Livne, Y. Edan, A. Bechar (Israel)

Tuesday, June 15 – 10:15 to 12:00

59 Section VII Information and Communication Technologies (I) and WCCA

Time	Paper #	Moderator: Miguel Castro Neto (Portugal) Room: 2101
10:15		Session Opening
10:20	100633	A unified pest scouting for area-wide IPM A. Hetzroni, L. Shealtiel-Harpaz, Y. Cohen (Israel)
10:40	101166	The development of tools for managing, monitoring and assessing water stressed conditions in Jamaica J. Richards, C. Madramootoo, A. Trotman (Canada)
11:00	100479	Advanced web outreach techniques: capitalizing on social media, live blogging, and mobile technology to connect with agricultural clientele A. Kleinschmidt (United States)
11:20	101199	Assessing biomass chains feasibility at local level N. Colonna, F. Lupia, V. Pignatelli et al. (Italy)

Tuesday, June 15 – 10:15 to 12:00

60 Section VII Wireless Technology, Sensors and Image Analysis – POSTERS and WCCA

Poster #	Paper #	Moderator: Fedro Zazueta (USA) Room: 2000D
16	100519	Automatic on-line depth control of seeding units using a non-contacting ultrasonic sensor S. Kiani, S. Kamgar, M. Raoufat (Iran)
17	100929	Wireless sensor system for process monitoring of tree seed storage O. Green, J. J. Larsen, O. J. Jørgensen et al. (Denmark)
18	101075	Utilizing a vast and complex wireless communication network in a sustainable "biosystem" for the production of fiber for use in bioenergy, paper and solid wood production N. Mohamed (United States)

19	101222	Development of a SCADA system for access, processing and supervision of data coming from a wireless sensors network in agro-environmental applications L.M.N.Gracia,E.M.Bravo, G.R. Ruiz et al. (Spain/Portugal)
20	100699	Crop rows tracking by detecting individual plants using computer vision to guide farming vehicles G. Ruiz-Ruiz, J. Gómez-Gil, L. M. Navas-Gracia et al. (Spain/Brazil)
21	100916	Automated monitoring of variations of drying conditions in a seed drying facility O. Green, J. J. Larsen, E. F. Kristensen et al. (Denmark)

Tuesday, June 15 – 13:35 to 15:20

74	Section VII and WCCA	Information and Communication Technologies (II)
Time	Paper #	Moderator: Elsa S. Sepulveda Bustos (USA) Room: 2101
13:35		Session Opening
13:40	100741	Utilization of plug-in and content management system (CMS) as tools for developing National Biosafety Clearing House (BCH) applications: Cases in Asia-Pacific and Latin American countries R. V. Maningas (Philippines)
14:00	100970	Formal representation of agricultural production standards E. Nash, J. Wiebensohn, R. Nikkilä et al. (Germany/Finland/Greece)
14:20	101196	Towards a framework for planning and designing of rural knowledge centres G. Dileepkumar, S. Chaudhary, K.A. Sai et al. (India/USA)
14:40	101200	Reusing content with reusable learning objects (RLOs): An approach for addressing content issues of agricultural education and extension G. Dileepkumar, S. Chaudhary, K.A. Sai et al. (India/USA)
15:00	101638	A multi-lingual translation engine for translating ration formulation programs from English to Spanish, Portuguese, Italian, German, and French languages A. Ahmadi, P.H. Robinson, P. Chilbroste (United States)

Tuesday, June 15 – 15:35 to 17:20

89	Section VII and WCCA	Wireless Technology (I)
Time	Paper #	Moderator: Margarita Ruiz Altisent (Spain) Room: 2101
15:35		Session Opening
15:40	100502	Remote access of ISOBUS workbench for the IsoAgLib study and implementation R. R. D. Pereira, A. J. V. Porto, R. Y. Inamasu (Brazil)
16:00	100712	Exploitation of wireless telemetry for livestock condition monitoring C. Di, T.-T. Wu, H. G. Goh et al. (United Kingdom)
16:20	100698	Wireless sensor networks for environmental monitoring in precision viticulture A. B. Ramos, F. M. Riquelme, F. M. Garcia et al. (Spain)
16:40	100922	A model to predict calves' lying time with wireless 3-dimensional accelerometer collar P.Tamminen,L. Hänninen, A.-H. Hokkanen et al. (Finland)

Wednesday, June 16 – 8:15 to 10:00

103	Section VII and WCCA	Geographical Information Systems (GIS) and Web Based Services
Time	Paper #	Moderator: Silvia M. F. S. Massruha (Brazil) Room: 2101
8:15		Session Opening
8:20	100584	Rest-based web services for the discovery and distribution of agricultural production standards R. Nikkilä, E. Nash, I. Seilonen et al. (Finland/Germany)
8:40	100887	Developing web-based irrigation models and services J. M. Gonçalves, A. Muga, P. Teodoro et al. (Portugal)
9:00	101154	RU-SLIMS development of Rutgers University's web-based soils laboratory information management system R.S. Muldowney, S. Murphy (Canada)

9:20	101398	Development and use of a Web-GIS-Based Information System for the management and supply of hickory environment condition data J. Yu, P. Nie, Y. He (China)
9:40	101618	Decision support systems for environmental management and conservation: A GIS-based model E. Ferrer (United States)

Wednesday, June 16 – 10:15 to 12:00

117	Section VII and WCCA	Modeling, Simulation and Data Mining (I)
Time	Paper #	Moderator: Antonio M Saraiva (Brazil) Room: 2101
10:15		Session Opening
10:20	101162	Quantitative analyses aspect of vibrational spectroscopy and its applications in agriculture W. Wang, J. Paliwal (Canada)
10:40	100677	Aerodynamic modeling of windbreaks in Saemangum reclaimed land J. P. Bitog, I-B. Lee, S-W. Hong et al. (Korea)
11:00	100823	Comparison of different methods for sensitivity analysis of composting modelling P. Courvoisier, G. Clark (Canada)
11:20	101090	Fourier filtering for wheat detection in a context of yield prediction L. Jourmaux, A. Marin, F. Cointault et al. (France)
11:40	101191	Machine learning models for prediction of added water in milk as a function of milk temperature and some other physical characteristics J. Khazaee, M. Nikousiar, N. Mohammadi (Iran)

Wednesday, June 16 – 10:15 to 12:00

118	Section VII and WCCA	ICT, GIS and Web Services – POSTERS
Poster #	Paper #	Moderator: Jiannong Xin (USA) Room: 2000D
50	101034	Radio frequency interactions with air cargo container materials for real time cold chain monitoring M. Laniel, I. Uysal, J.-P. Émond (United States)
51	101080	Spatio-temporal variability of soil moisture at the field scale using remote and proximal sensing K. Labrecque, M. Bernier, M.C. Nolin et al. (Canada)
52	101495	Claw and foot health: Early diagnostics and prevention of foot lesions in dairy cattle P. Tamminen, M. Pastell, J. Häggman et al. (Finland)
53	101486	Remote sensing and GIS for rural/urban gradient detection C.R. Fichera, G. Modica, M. Pollino (Italy)
54	100365	Advanced technologies in developing web-based decision support systems for agriculture J. Weres, W. Mueller, R. Kozłowski et al. (Poland)
55	101464	The development of whole process mechanization production and technical specification of the whole process mechanization of rape in eastern China K. Zhou (China)
56	100837	Quantitative analysis supported in SNA of the production milk chain in Brazil M.N. Mollo, I.A. Nääs, O. Vendrametto et al. (Brazil)

Wednesday, June 16 – 13:35 to 15:20

132	Section VII and WCCA	Modeling, Simulation and Data Mining (II)
Time	Paper #	Moderator: Stanley Best (Chile) Room: 2101
13:35		Session Opening
13:40	101224	DiagData: A tool for generation of fuzzy inference system S.M.F.S. Massruhá, R.F. Riccieti, H.P. Lima et al. (Brazil)
14:00	100657	Using data mining to evaluate different minimum ventilation systems in broiler houses D.J. Moura, T.M.R. Carvalho, I.A. Nääs (Brazil)
14:20	101644	Challenges in ecological niche modelling F.S. Santana, A.M. Saraiva (Brazil)

LIST OF ABSTRACTS BY PARTICIPATING GROUP

14:40	101457	Structural plant modelling based on real 3D structural parameters, resulting simulation system and rule-based language XL R. He, J. Hu, Y. He et al. (China)
15:00	100824	A numerical integrated model of composting processes using finite elements methods P. Courvoisier, G. Clark (Canada)

Wednesday, June 16 – 13:35 to 15:20

133 Section VII Wireless Technology (II) and WCCA

Time	Paper #	Moderator: Seishi Ninomiya (Japan) Room: 2102B
13:35		Session Opening
13:40	101159	Refrigerated fruit storage monitoring using RFID and WSN L. Ruiz-Garcia, J. Garcia-Hierro, P. Barreiro et al. (Spain)
14:00	101270	Three-tier wireless sensor network for environmental monitoring N. Zhang, W. Han (United States)
14:20	100477	Development of RFID temperature tracking systems for combat feeding logistics C. Amador, J.-P. Emond (United States)
14:40	100679	Research on WSN design and formation for drought monitoring in a tea plantation W. Wang, D. Sun (China)

Abstract only	100563	Development of an automatic control management system for a greenhouse Yutaka Sasaki, Noe Velazquez Lopez, Kazuhiro Nakano (Japan)
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EVALUATION OF TWO DRAINAGE MODELS IN SOUTH-WEST IRAN

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CSBE100027 – Selecting the correct drain spacing and depth is an important decision in designing a drainage system. Drainage simulation models can be used to determine the combination of depth and spacing to optimize the performance of the system. In this research, two widely used drainage simulation models, DRAINMOD and SWAP, were used in a sugarcane farm in south-west of Iran (Khozestan Province). Soil characteristics as well as climatological data, irrigation depths and schedules, and water table information for 2000 and 2001 were used to calibrate and validate both models. The validated models were used to find the optimum drain spacings and depths based on crop production and drainage water volume. Maximum crop production and minimum drainage water were the objectives of the design. Simulated water tables for both models were satisfactory with the regression coefficient of 0.95 and 0.90 and RMSE between simulated and observed water tables were 18.1 and 19.2 cm for DRAINMOD and SWAP, respectively. DRAINMOD underestimated the drainage water but SWAP overestimated it. A relative yield of 80 % was achieved when drain spacing and depth were set to 25 m and 1.60 m, respectively using SWAP. For DRAINMOD, these values were 15 m and 1.15 m, respectively.

THE DESIGN AND EXPERIMENTAL STUDY OF A TESTING STAND FOR PNEUMATIC SEED METERING DEVICE

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CSBE100034 – A testing stand for seed metering device was designed in accordance with the seed metering theory of pneumatic seed metering device, the feature of its achieved the goal of minimizing pollution and saving seed, and the testing effectiveness is confirmed to be favourable and able to satisfy the requirement of experiment. Taking the rotation speed of seed metering disk and the vacuum degree in suction chamber as experimental factors, a single factor experiment with the influence of these factors on seed metering performance of soybean was conducted and the result shows that: The rotation speed of seed metering disk is suited to the vacuum degree in suction chamber obtained by theoretical calculation. However, when the rotation speed of seed metering disk exceeds the one of seed metering disk suited to the vacuum degree obtained theoretical calculation, the seeding quality will get worse and the miss seeding rate increases prominently and comes up to the maximum value of 29.63%. When the vacuum degree in suction chamber is 2.5 kPa, the miss seeding rate will go up and the seeding rate up to standard tends to decrease with the rotation speed of seed metering disk enhances. When the rotation speed of seed metering disk is fixed at 54 rpm, the seeding rate up to standard varies in a range from 76.11% to 80.65% under the condition of the vacuum degree being 1.5 kPa in suction chamber, when the vacuum degree in suction chamber being lower than 1.5 kPa, the seeding rate up to standard will decrease evidently, and when the vacuum degree in suction chamber is 1.0 kPa, the seeding rate up to standard merely reaches to 52.07%, and the miss seeding rate, however, goes up to 40.83%.

DRAINAGE OF IRRIGATED LANDS

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CSBE100037 – Salinity affects millions of hectares of once productive land in many countries. Besides economic losses, rapid salinization of land and water resources is inflicting environmental damage, particularly in irrigated areas where salinity increase has charted a parallel path with irrigation development. However, irrigated land use as such is not responsible for salinization, but it is the faulty irrigation practices, inadequate provision of drainage and lopsided economic incentives that play a major role. Different measures including surface, subsurface and bio-drainage systems have been adopted to prevent/mitigate and reclaim the affected areas. Large scale adoption of mechanized subsurface drainage (SSD) systems is at its inception stage. Experiences from large scale SSD installations in the northern states of Haryana, Rajasthan and Maharashtra have evidenced that the technology can be successfully adopted in reclaiming saline and waterlogged lands while surface drainage and bio-drainage have limitations and do not show improvement in soil and crop productivity. Two large scale SSD projects were installed on 2165 ha at Dudhgaon and Kasabe Digraj in Sangli district of Maharashtra (India) in the year 2005 to 2008. There is good improvement in the soil properties of affected lands within one year due to SSD installation in the fields. The pH decreased from 8.11 to 7.63, the soil conductivity EC from 8.11 to 4.60 dS/m, SAR from 7.10 to 3.94 and ESP from 9.31 to 4.60; which shows improvement in salt affected soils. Yield of sugarcane increased from 75 T/ha to 172 T/ha within a year.

MONITORING OF GRAIN QUALITY AND SEGREGATION OF GRAIN ACCORDING TO PROTEIN CONCENTRATION THRESHOLD LEVEL ON AN OPERATING COMBINE HARVESTER

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CSBE100043 – Quality has become an essential attribute of agricultural products and production processes in particular as a result of European Commission Regulations. Moreover, sorting of grain based on protein concentration could enable growers to realise price premiums in value-added markets. The variability of soils, topography and fertility are known to influence grain yield and quality. Interdependency of these factors has also been considered as limitation for site-specific nitrogen management strategies. The aim of this collaborative research project is to monitor protein concentration variability and to segregate grain into quantities of high or low protein content on a combine harvester. Near-infrared spectrometry (NIRS) was used to determine protein concentration of winter wheat and spring barley in both diffuse reflection and diffuse transmission in field trials in Brandenburg and Thuringia. Performance characteristics were obtained during the 2008 and 2009 field trials, a total of 300 ha of wheat and 60 ha of barley were harvested. Protein predictions correlated well with reference measurements (Barley: $R^2 = 0.94$, SEP = 0.31 %; Wheat: $R^2 = 0.96$, SEP = 0.33 %). Deviations of NIRS analysis results beyond the calibration error were logged constantly and helped to ensure correct grain tank filling. Process data were also classified using principal component analysis (PCA), the prediction range of protein values, their standard deviation as well as the hotelling T²-statistics. Segregation results are accurate and promising for implementation as a tool to improve grain marketing. [...].

DETERMINING OPTIMIZED DISTANCE AND DEPTH OF SUBSURFACE DRAINS UNDER UNSTEADY FLOW CONDITIONS AT MULTIPLE CROPPING PATTERN

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CSBE100055 – The study area was located in central part of Khuzestan province, Iran. Soil survey and land classification conducted in the area indicated that from total area of 41,855 hectares, about 36,430 hectares (87.0%) was affected by water logging as well as poor internal drainage conditions. These problems were usually associated with shallow and saline to extremely saline groundwater tables. Also, about 14,100 hectares (33.7%) of the studied area was faced with soil Salinity and Alkalinity. The pre-request of soil desalinization and land reclamation of such problematic conditions, are subsurface drainage installation and soils salt leaching, by making use of suitable and available surface water resources of the area. The main objective of this study was to obtain the optimal subsurface drain spacing and depth, considering the new suggested idea for decreasing the installation depth. Calculation and optimizations were done with “Dynamic Equilibrium Method”, by making use of computer simulation technique, for unsteady drainage conditions. The obtained results indicated that the optimum tile drain spacing of 35-50 meters, together with 2.0 meter depth of installations, is the most effective, practical and economical alternative. The mentioned condition responds properly for application of 1.0 meter depth for leaching water in four 0.25 meter intervals intermittently. Also a cropping pattern with 100% intensity for irrigated crops production and with 53% irrigation efficiency is suggested to be practiced after soil desalinization in the same study area.

A DEAN’S PERSPECTIVE ON THE FUTURE OF AGRICULTURAL ENGINEERING EDUCATION IN CANADA

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CSBE100058 – This presentation draws from the author's expertise and 20-year experience in three Canadian universities as a professor and as an academic leader. It first addresses the following contextual issues: recent trends in engineering education in North America; evolving expectations associated to the recent revision of the professional accreditation criteria by the Canadian Engineering Accreditation Board (CEAB); agricultural engineering in Canada. On the basis of the data collected and analyzed, the author estimates that agricultural engineering currently accounts for about 1% of both the engineering education systems and of the engineering profession in Canada. In order to optimize the use of the public and private resources that are required to support the delivery of agricultural engineering education programs, the author proposes to create four regional Canadian Agricultural Engineering Institutes that would be responsible for post-secondary education programs in agricultural engineering (at the college and university levels) as well as for agricultural engineering R&D and for public services activities to various stakeholders. The undergraduate agricultural engineering programs that would be offered by these institutes would include the desirable features that have been identified by various engineering education leaders in recent years: outcome-based assessment of graduates, increased emphasis on ‘non-engineering’ disciplines, less specialization.

DEVELOPMENT OF MODEL EQUATIONS FOR SELECTING OPTIMUM PARAMETERS FOR DRY PROCESS OF SHEA BUTTER EXTRACTION

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CSBE100069 – Shea butter is the fat content of the kernel of shea nut (*Vitellaria paradoxa*) which grows naturally in the wild and uncultivated in most parts of Africa. The fat is used as edible oil and for raw material in the production of soaps, pomade, drugs and medicinal ointments. Traditional wet extraction process is the method used in shea butter processing industry, among women, in African rural and urban communities. Apart from the low yield (below 20 %) and poor quality, this traditional wet extraction process has no place in the modern vegetable oil industry. Experiments on dry extraction of shea butter from shea kernel were carried out using an instrumented piston-cylinder rig in conjunction with the TESTOMETRIC Universal Testing Machine (Model M500–50 KN). Shea butter was mechanically expressed when pressures of 1.5, 2.9, 5.8 and 8.8 MPa were applied at the rate of 2.50, 5.00, 7.50 and 10.00 mm/min on crushed shea kernel heated at 50, 70, 90 and 110°C. Measurements of oil yield, oil recovery efficiency and process loss during the mechanical expression process were taken. The measured effects of heating temperature, applied pressure and loading speed on oil yield, oil recovery efficiency and process loss were examined using a 43 factorial experiment in Randomized Complete Block Design. Model equations were developed by employing multiple regression analysis using SPSS 11.0 package. Further analysis by optimization process revealed optimum heating temperature, applied pressure and loading rate of 82.24 °C, 9.69 MPa and 2.50 mm min⁻¹ respectively. [...].

A COMPARISON OF DRAINMOD AND SWAT FOR SURFACE RUNOFF AND SUBSURFACE DRAINAGE FLOW PREDICTION AT THE FIELD SCALE FOR A COLD CLIMATE

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CSBE100071 – Tile drainage reduces surface runoff, soil erosion and improves crop yields, but contributes to the loss of nutrients from agricultural fields. Therefore, it is important to accurately predict the field-scale hydrology in order to better manage water resources and ensure environmental sustainability. In this study, two widely used models, DRAINMOD and the Soil and Water Assessment Tool (SWAT), were calibrated and validated for hydrology of two tile-drained agricultural fields in the Pike River watershed of Southern Quebec. The hydrologic performance of DRAINMOD and SWAT was compared for cold-climate conditions and evaluated at seasonal and monthly time scales. Three years of hydrologic data served to calibrate and validate the model, with the year 2002/03 being used for calibration and 2004 for validation. Model predictions of surface runoff and subsurface drainage flow were compared with the measured surface runoff and subsurface drainage flow values from the two instrumented study sites. The comparison of two models was established based on their prediction accuracy. In the calibration period, DRAINMOD overestimated cumulative subsurface drainage outflow by 5 %, and SWAT underestimated cumulative subsurface drainage outflow by 26%. In the validation period, DRAINMOD was found more successful than SWAT in subsurface drainage flow prediction with R² greater than 0.82 for both sites. [...].

ASSESSMENT OF CLIMATE CHANGE IMPACT ON THE SUBSURFACE DRAINAGE FLOW IN THE PIKE RIVER WATERSHED USING THE SWAT MODEL

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CSBE100072 – Climate change can significantly affect the design of drainage systems and the management of water resources. Hydrologic models are essential to conceptualize the relationships between climate and water management as well as for the protection of the natural environment. The objective of this study was to assess the impact of climate change on subsurface drainage flow in the Pike river watershed using the SWAT-Q (Soil and Water Assessment Tool – Quebec) model. Three climate change scenarios projected by Canadian Regional Climate Model (CRCM) based on SRES (Special Report on Emissions Scenarios) A2 were applied. The daily precipitation and temperature projections were used for the periods of 1971-2000 and 2041-2070. The SWAT-Q was calibrated and validated using six years (2001-2006) and validated a second time by using measured data from 1979 to 2000. The performance of SWAT-Q was evaluated by comparing the observed and the model-predicted values. The results indicated that SWAT-Q performed satisfactorily for predicting total water yield in cold climatic conditions, with a coefficient of determination (R^2) and Nash-Sutcliffe efficiency ranging from 0.67 to 0.85 and 0.61 to 0.84, respectively, during the calibration and validation periods. The CRCM projected that average annual precipitation during 2041-2070 would increase by 9 to 22%. [...].

BIOREACTOR DESIGN GEOMETRY EFFECTS ON NITRATE REMOVAL

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CSBE100073 – Denitrification bioreactors for nitrate removal in agricultural drainage have recently gained attention for their low cost and effectiveness. While research continues to investigate the optimal sizing of these systems, little work has been done on the optimal design geometry (Length to width ratio and cross sectional shape). To address this lack, pilot-scale (1/10th scale) work performed in Iowa during the summer of 2009 explored three shapes of potential bioreactor designs. The objective was to study the nitrate removal effectiveness of each design at various retention times. The pilot bioreactors had a standard volume (0.71 m³) and depth (0.61 m) and different dimensions of 0.76 m x 1.5 m (rectangle), 0.38 m x 3.0 m (channel), and 1.5 m x 1.2 m (trapezoidal). Steady state experiments consisted of the bioreactors being allowed to run at a given retention time for several days/weeks before being changed to a different retention time. A hydrograph flush experiment simulated a drainage hydrograph moving through the bioreactor over the course of a few days. Preliminary results indicated little significant difference between the designs though the channel design seems to provide the most consistent results between the two experiments. Further analysis of this data is expected to guide future full-scale denitrification bioreactor designs.

LIQUID DISTRIBUTION OF AIR INDUCTION AND OFF-CENTER SPRAY NOZZLE USED TO APPLY AGROCHEMICALS IN SPECIAL CONDITION

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CSBE100076 – An off-center spray nozzle was utilized in specific conditions, to apply agrochemicals in plant production, such as positioned at the end of the spray boom, spray products under the crop leaves and two nozzles combined to apply herbicides in a uniform application over seedlings or small plants. Technical information regarding this nozzle is needed for the proper selection. The objective of this study was to evaluate the distribution of air induction and off-center nozzle AIUB 8502 under different operating conditions. We evaluated the individual profile, spray nozzle outflow, spray angle, spray width and simulated the distribution profile for two AIUB 8502 nozzles at working pressures of 200, 300, 400 and 500 kPa, heights of 30, 40 and 50 cm from the target and spacing from 30 to 100 cm. All tests were performed following the ISO 5682-1 with some adaptations. The nozzle presented an eccentric distribution of liquid with a discontinuous side and eccentric opposing end, with sharp decrease in the volume of liquid. Increases in the height and working pressure extended the profile distribution. The largest number of uniform configurations was obtained at a height of 50 cm, decreasing heights from 40 to 30 cm. The angle and flow rate of the off-center nozzle increased with the increase in pressure, with no differences between discontinuous and total angles between 400 and 500 kPa, and 200 and 300 kPa pressure ranges.

EVALUATION OF BACKPACK SPRAYERS FOR HERBICIDE APPLICATION IN A BRAZILIAN FOREST

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CSBE100077 – The backpack sprayer is the most widely used sprayer for herbicide application in Brazilian eucalyptus production. However, the maintenance, repair and replacement of parts and accessories, is a relatively uncommon practice. The objective of this study was to evaluate the operational conditions of backpack sprayers used for herbicide application in the culture of eucalyptus. The study was performed in Alagoinhas-Brazil in Copener Forestry/Bahia Pulp. 362 sprayers were evaluated for the following factors: leaks in the tank and spray boom; the presence of sharp edges; handle condition; presence, absence and position of pressure regulating valve; suitable clamps to support the spray boom; the spray nozzle conditions; presence and adequacy of the nozzle filter. The levels of irregularities observed for sharp edges, damaged handles and the lack of suitable clamps to support the boom at the pump, were 35, 19 and 32% respectively. To spray nozzles, pressure regulating valve and the nozzle filter the levels of irregularities were 12, 14 and 11% respectively. It is concluded the application of herbicides with the backpack sprayer in Copener Forestry/Bahia Pulp, presents operational errors, which must be corrected to reduce possible environmental contaminations, and increase the efficiency of weed control and operator safety.

NATIONAL INVENTORY OF ARTIFICIALLY DRAINED LANDS IN GERMANY

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CSBE100078 – With regard to the creation of river basin plans and programmes of measures according to the EU-Water Framework Directive, the importance of model-supported analyses of nutrient inputs into aquatic systems and the localization of source areas is increasing. Especially in lowland regions artificial drainage installations play a major role, but little information exists about their location within larger river basins. Therefore, artificially drained lands were identified by interpreting aerial photographs and typical site conditions of the drained plots were derived. Then, a GIS-based approach was developed, which allows the delineation of artificially drained lands by combining various site conditions like soil properties and land use type. The approach has been applied to Germany (357000 km²) and validity has been checked with small-scale drainage installation maps.

CHEMICAL CHARACTERISTICS AND ITS IRRIGATION EFFECT OF DRAINAGE WATER IN DITCHES, YINBEI IRRIGATION DISTRICTS, NINGXIA

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CSBE100080 – Taking five drainage reuse sites in Yinbei irrigation districts, Ningxia for example, this paper analyzed the chemical characteristics of drainage water in ditches, saline-alkaline hazard and its impact of drainage reuse on soil. The result showed that the hydro-chemical type of drainage water is CNa at Nuanquan farm and ClNa at other four pilots. Every alkaline index in the drainage water was obviously smaller during the middle-late irrigation than those during the early irrigation. Except Qianjin Farm, the saline-alkaline hazard of drainage reuse for irrigation was relatively slight. The dominant soluble salt in the soil was the Chloride-sulfate bearing sodium and calcium. The soil texture had an obvious impact on soil saline-alkaline after irrigation. Salt was not easy to accumulate the lightly textured soils, such as sandy loam. In the area where the rice was planted for a long term, the groundwater level was higher and the better choice was to adopt the paddy-upland rotation system in order to maintain the effect of soil improvement. Adopting rotation systems with anti-saline crops, soil flushing with fresh water, paddy-upland rotation and so on would play an important role in controlling soil water-salt and improving the soil. The effects of drainage reuse for irrigation were good.

MODELLING PHOSPHORUS INPUTS FROM DIFFUSE AND POINT SOURCES WITH MEPHOS IN GERMANY - A CONTRIBUTION TO THE IMPLEMENTATION OF THE EU WATER LEGISLATION

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CSBE100081 – The fundamental objectives of the European Union-Water Framework Directive are to achieve a good status of surface water and groundwater resources by 2015. The implementation of measures requires spatially detailed data about sources, pathways and levels of nutrient inputs to receiving water bodies. In this context, water resource managers have great demand in distributed model results. The MEPhos model has been developed at the Research Centre Jülich to quantify mean annual P-inputs from artificial drainage, wash-off, groundwater outflow, soil erosion, rainwater sewers, combined sewer overflows, municipal waste water treatment plants and industrial effluents. Effects of measures can be predicted and scenario analyses can be performed. In an oral contribution the approach and model results for Germany will be presented. This will be done by comparing three typical meso-scale watersheds (River Ems, River Lahn and River Wupper) with different land use patterns. The effects of selected management measures on phosphorus inputs will be demonstrated in scenario runs.

NITROGEN AND PHOSPHORUS LOSSES IN SURFACE RUNOFF WATER FROM VARIOUS CASH CROPPING SYSTEMS

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CSBE100082 – Nitrogen (N) and phosphorus (P) losses from agricultural soils have been identified as a major contributor to declining surface water quality. Field experiments were conducted to evaluate the effects of cash crops on surface runoff N and P concentrations and loadings in the north part of Huaihe River Basin, China. The treatments comprised three cropping systems including soybean, cotton, and corn, with a bare plot as control. Runoff volume, sediment yield, runoff N and P loadings were significantly affected by the cash cropping system, in the order of bare plot < corn plot < cotton plot < soybean plot. The variation of runoff and sediment yield from different cash cropping systems correlated to the Leaf Area Index (LAI). The factors affecting the loadings of N and P were also closely related to LAI and surface runoff volume. Dissolved N and dissolved P were the main forms of N and P losses for cotton and soybean plots, whereas the particulate N and dissolved P were the main forms of N and P losses for corn plot. Soybean and cotton production can be the cropping systems that reduce the N and P surface losses during the peak-flow production period, if economically feasible.

POTENTIAL WATER QUALITY IMPACT OF DRAINAGE WATER MANAGEMENT IN THE MIDWEST USA

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CSBE100084 – Drainage water management (DWM) is a promising technology for reducing nitrate losses from artificially drained fields. While there is an extensive history for the practice in North Carolina, U.S., little is known about the efficacy or cost effectiveness of the practice under Midwest U.S. conditions where artificial subsurface drainage is widely used. In an earlier study, we used a calibrated version of the Root Zone Water Quality Model (RZWQM) coupled with the Decision Support System for Agrotechnology Transfer (DSSAT) family of crop growth models to simulate the impact of DWM on reducing nitrate losses from drained fields across the Midwest. In this study, we use soil and land cover spatial databases to estimate that 4.8 million ha of land used to grow corn within the Midwest would be suitable for DWM. If DWM were adopted on all of this land, nitrate losses in drainage would be reduced by approximately 83 million kg yr⁻¹. Within just the Upper Mississippi River basin and Ohio/Tennessee River basins, DWM has the potential to reduce nitrate losses from drained fields by 52 million kg yr⁻¹. We estimate that with the cost of control structures, redesign of new drainage systems, and payments to farmers to adjust the control structures to reduce nitrate losses, that the cost per kg of nitrate reduced in drainage water for DWM would be US\$2.71.

PERFORMANCE OF DRAINWAT MODEL IN ASSESSING THE DRAINAGE DISCHARGE FROM A SMALL WATERSHED IN THE PO VALLEY (NORTHERN ITALY)

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CSBE100086 – Evaluation of potential nitrogen (N) losses from individual fields is not sufficient to provide an estimate of the actual nitrogen loads reaching the main watercourses and, therefore, it is becoming a relevant source of pollution. Along the travel path from a field to the outlet of a watershed several biogeochemical processes may occur, leading to significant changes in the N amount actually leaving the watershed. These processes can be described using models of various complexities including lumped exponential decay model, which uses travel (residence) time from predicted velocities in the ditch-canal network. However, hydrology is a driving variable for accurate predictions of nutrient loadings. A case study was conducted on Longhrola watershed, located in the Mantova province, Po valley, Northern Italy, where hydrologic measurements and N input at field level, N harvested with crops and N lost at the outlet of the basin were recorded during 2002-2005. The 65 hectares watershed has its land use as crops for livestock. Liquid manure and farm-yard manure are available in abundance and are the main source of nitrogen for crop fertilisation. At basin scale, in the three years of monitoring, the average yearly N input was 130 kg ha⁻¹, the losses at the outlet of the basin ranged 8 to 24 kg ha⁻¹ year⁻¹ depending upon the rainfall amount and distribution. A watershed-scale hydrology model, DRAINWAT, applied to predict the stream outflows for this watershed showed results (522 mm) consistent with the measured data (549 mm), which was only a 4% underprediction for calibration [...].

COMPARISON OF DRAINMOD AND ARTIFICIAL NEURAL NETWORK FOR PREDICTING WATER TABLE DEPTH AND DRAIN DISCHARGE IN A SUBSURFACE DRAINAGE SYSTEM

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CSBE100087 – Drainage is an effective way to control water table in the farm fields with high groundwater level in the north of Iran. This study is carried out in the Ran Behshahr field under subsurface drainage system. Artificial Neural Network and DRAINMOD model were evaluated for predicting water table depth in midpoint between two laterals designated as S3PD14 and S3PD15 and drain discharge. Depth of water table and drain discharge were measured for rainfall seasons of 2004 and 2006 years. In this study the feed-forward back propagation model of ANN was used in MATLAB Software. For evaluation of these two models, the value of absolute error (AE), standard error (SE) and R2 were calculated. For the best ANN model, these values were obtained 4.4cm, 5.8cm, and 0.57 for prediction of water table depth and 0.08 mm/day, 0.1 mm/day and 0.59 for drain discharge, respectively. For DRAINMOD model, these values were obtained 15.6 cm, 18.1 cm and 0.42 and 0.27 mm/day, 0.32mm/day and 0.71, respectively. Results indicated that the ANN model more accurate than DRAINMOD in prediction of water table depth and drain discharge.

IMPACT OF BIOSOLID APPLICATION ON PERCOLATED WATER QUALITY

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CSBE100089 – Application of municipal biosolids as a fertilizer source on agricultural land not only provides essential nutrients to the plants but also improves the physical and chemical properties of soil. An experiment was conducted at the Wild Blueberry Research Institute, Debert, NS to investigate the agronomic and environmental impact of N-Viro (biosolids) application on wild blueberry fields under rainfed and irrigated conditions. There were four treatments (i.e. commercial fertilizer, N-Viro, commercial fertilizer with irrigation, and N-Viro with irrigation) and each treatment was replicated four times. Suction lysimeters were installed at 20 cm and 40 cm depths in each plot and samples of leachate percolated through the soil profile were collected after each irrigation and or rainfall throughout the experiment. Samples were analyzed for the nutrients and heavy metals. The results will be presented in this paper.

IMPACTS OF THE CHASHMA RIGHT BANK CANAL ON LAND USE AND CROPPING PATTERN IN D.I.KHAN DISTRICT (PAKISTAN)

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CSBE100093 – This paper attempts to determine the ex post impact of Chashma Right Bank Canal (CRBC) on the land use and cropping pattern of D.I.Khan district. CRBC commands 250,000 ha and spread over two provinces. The CRBC project was completed in three stages. Stage I was commissioned in 1987-1988, whereas stage II and III in 1989 and 2001, respectively. CRBC brought radical changes in the land use and cropping pattern of D.I.Khan district. For this study, three variables were selected including land use, cropping pattern and land values. To determine these changes at micro-level, five sample villages were randomly selected, four from within the CRBC command area and one off the command area. The analysis found that after commissioning of CRBC, prime cultivable land was brought under non-agricultural use. The area under net sown was also enhanced. The dry farming crops were replaced by water intensive cash crops, which in effect caused the twin problem of waterlogging and salinity, particularly in stage I. Likewise, the land values increased considerably. This study is a sort of ex post evaluation of CRBC and provides policy guidelines for decision makers not to repeat the weaknesses of Chashma Right Bank Irrigation Project. The guidelines will be valuable for the proposed Chashma Right Bank 1st Lift Irrigation Project

WATER BALANCE AND CORN YIELD UNDER DIFFERENT WATER TABLE MANAGEMENT SCENARIOS IN SOUTHERN QUEBEC

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CSBE100095 – Corn is one of the major crops of North America. It is one of the major source of food for both humans and livestock. Water and nitrogen are two important components that affect the yield of all crops. This study looks at the total water use of the plant under different nitrogen application. Nitrogen was applied at the rate of 125, 180 and 245 kg/ha. The different water table management system maintained were water table at 60 cm from the soil surface with the help of sub-irrigation and free drainage plots with variable water table as determined only by rainfall. The soil type was sandy-loam. The study was conducted in 2008 and 2009 on a farm at Coteau-du-lac, 40 km west of Montreal.

THE EFFECTS OF TREATED WASTEWATER ON SOIL NITROGEN DYNAMICS AND WINTER WHEAT GROWTH UNDER DIFFERENT GROUNDWATER DEPTH

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CSBE100096 – The reuse of treated wastewater for irrigation has become increasingly common in some areas of China due to water scarcity. Treated wastewater has high nitrogen and phosphorus content, which have negative impacts on soil and may pollute groundwater. Lysimeter studies were conducted with different groundwater depths (2m, 3m and 4m) and irrigation water (90mm and 120mm) to assess the effects of irrigation with treated wastewater on soil nitrogen dynamics and winter wheat growth. The results indicated that the nitrate nitrogen (NO₃-N) concentration in both soil and groundwater increased substantially after irrigation. The increment of NO₃-N concentration in groundwater depended on groundwater depth and irrigation water. When 90mm wastewater was applied, NO₃-N concentrations observed in groundwater at three groundwater depths (2m, 3m and 4m) increased separately by 34.7%, 24.9% and 20.9%; while when irrigation water increased to 120mm, the values were 58.4%, 39.0% and 27.2% respectively. This reveals that groundwater depth had a significant influence on accumulation of NO₃-N in groundwater, and smaller groundwater depth resulted in a higher risk of NO₃-N pollution. Our study also reveals that treated wastewater encouraged winter wheat growth and improved the yield.

CORN STOVER FRACTIONS AS A FUNCTION OF HYBRID, MATURITY, SITE AND YEAR

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CSBE100098 – Corn stover represents typically between 40 and 50% of the dry matter (DM) contained in the aerial biomass of corn plants. After corn grain is harvested, the stover is traditionally left on the ground where part is incorporated in the soil as organic matter and protects against erosion; another part is oxidized in the atmosphere. Recent soil-crop models have indicated that 50% of the stover could be harvested sustainably on low-sloping land under no-till practice. This means that 4 to 5 t DM of corn stover could be harvested annually from about half the corn fields. In Quebec where 400 000 ha are planted each year into corn, stover could provide one million t DM of currently neglected biomass. Over a three-year period (2007, 2008 and 2009), various hybrids of corn were monitored from early September to late November at four different sites. Whole plants cut at 100 mm above the ground were collected weekly and separated into seven fractions: the grain, the cob, the husk, the stalk below the ear, the stalk above the ear, the leaves below the ear and the leaves above the ear. In 2007, corn ears were at 0.96 m above the ground on average at a site with low crop heat units (CHU). Hybrids grown in a warmer site (higher CHU) were taller and their ears were 1.21 m above the ground. The DM partitioned in seven components was: 54% grain, 14% bottom stalk (below the ear), 6% top stalk, 5% bottom leaves, 7% top leaves, 5% husk and 9 % cob. During the harvest period, the total mass of fibre decreased from 8.9 to 6.6 t DM/ha for a low CHU hybrid and from 9.3 to 8.3 t DM/ha for a high CHU hybrid. In 2008, grain yield increased from 3.8 to 7.6 t DM/ha over the 12-week period [...].

SPRING HARVEST OF CORN STOVER

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CSBE100100 – Corn stover is an abundant biomass generally left in the field after grain harvest. Part of the stover should remain in the field for soil organic matter renewal and erosion protection. However, soil-crop simulation models indicate that 50% of the stover could be removed sustainably. This represents about one million t dry matter (DM) of stover per year in the province of Quebec. Stover harvested in the fall is very wet, between 40 and 60% moisture on average, with some parts such as the bottom stalks as wet as 75% moisture. While there are applications for wet stover (as a ruminant feed after ammonia enrichment, as a feedstock for cellulosic ethanol), the currently available markets (animal bedding, combustion fuel) require a dry product. Preliminary measurements indicated that stover left in the field throughout the winter would become very dry and a substantial amount would still be harvestable in the springtime. Corn stover was harvested at two sites in spring 2009. Each site was subdivided into two parcels. The first parcel was cut and raked in fall 2008 (fall parcel). The second parcel was cut and raked in spring 2009. Fibre from both parcels was baled in spring 2009. At the first site, a large square baler was used in late April to produce bales measuring 0.8 m x 0.9 m x 1.8 m. On the second site a round baler was used in late May to produce bales of 1.2 m in width by 1.45 m in diameter (+/- 0.15 m). On the second site, a small square baler was also used to produce bales of 0.35 m x 0.45 m x 0.60 m (spring cutting only). With the large square baler, an average of 3.9 t DM/ha was harvested equally on the fall parcel and the spring parcel (48% recovered biomass based on stover yields measured [...]).

DRAINAGE IN HEAVY CLAY SOIL AND SUGAR BEET YIELD IN EASTERN NORTH DELTA

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CSBE100103 – Sugar beet (Tribal variety) was cultivated in the winter season of 2004/05 in a previously established experimental drainage field at El-Serw Farm, Agricultural Research Station northeastern delta of Egypt near El-Manzala Lake. The experiment included three drain spacing treatments 15, 30, and 60m. The aim was to assess and evaluate the effects of drainage treatments and soil conditions and the extent of their impact on sugar beet yield. The results reveal that, five days after irrigation, the water table levels were 69, 44 and 39 cm and reached 110, 92 and 75 cm before the next irrigation for 15, 30 and 60 m drain spacing treatments, respectively. The water table depth varies depending on the drain spacing. In all layers, the hydraulic conductivity values were higher in 15 m drain spacing treatment than those in 30 or 60 m drain spacing treatments. Soil salinity (EC_e) values were relatively affected by drain spacing treatments. In surface layer, the soil salinity value was 3.4, 4.1 and 5.3 dS/m for 15 m, 30 m and 60 m drain spacing treatments, respectively. Results indicate that spacing treatments highly affect sugar beet root diameters and lengths and consequently crop yield. Root diameters increased with decreasing drain spacing; average maximum root diameter was 32 cm, 26 cm and 20 cm for 15 m, 30 m and 60 m drain spacing treatments, respectively. There was an increment in sugar beet production with narrow drains spacing treatments; the yield being 34, 30 and 25 ton/feddan for 15 m, 30 m and 60 m drain spacing, respectively. (1 feddan= 4200m²)

ENVIRONMENTAL AND ECONOMIC MULTI-OBJECTIVE MODEL FOR MANAGING IRRIGATION AND DRAIN WATER

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CSBE100104 – To maximize total net benefits, farmers often tend to increase the area under cash crops production. Such crops may include water-intensive or salt sensitive crops. Restrictions on available water and drain water disposal conditions in the arid and semi-arid region could limit adoption of high value cropping pattern. Production of huge amounts of saline drainage waters threatens environmental sustainability of downstream water resources. A multi-objective model is presented for simultaneous management of crop yield, irrigation and drain water. The proposed model is an environmental economic model, at irrigation district-scale, that integrates agronomic, irrigation, drainage and economic aspects of irrigated agriculture. Source reduction strategies for irrigation water management are considered because they affect management of drainage water, crop yield and net profits. The recent MOPSO technique was applied to solve the multi-objective problem. Distributed soil-water-atmosphere-plant model (SWAP) was set up for regional simulation of soil salinity, crop yield and drain water. The developed model was applied to Voshmgir irrigation and drainage network in north eastern IRAN. It was found that using a multi-objective model makes feasible a flexible balance between environmental and economic benefits of irrigation and drainage scheme management. The proposed model obtained the optimized irrigation water allocation and cropping area to different crops which resulted in the reduction of drainage salt load to downstream while ensuring the net benefit function in the satisfactory level. The model results showed that variety in the physical and water allocation policy within different [...].

APPLICATION OF DRAINMOD-N MODEL FOR PREDICTING NITRATE-N IN PADDY RICE FIELDS UNDER CONTROLLED DRAINAGE IN A COSTAL REGION OF IRAN

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CSBE100106 – In this study, DRAINMOD-N, a mathematical model for simulation of nitrate-nitrogen (NO₃-N) concentration in water outflows (runoff and subsurface drain water) and shallow ground water, has been tested based on the field data collected from paddy rice fields consisting of a controlled drainage (CD) system in north of Iran during 2008 and 2009. The model performance was evaluated first by comparing the observed and simulated water table depth (WTD), that is an essential prerequisite for the model to obtain a proper prediction of NO₃-N movement, and then by comparing the observed and simulated NO₃-N concentration in shallow groundwater using two statistical indices, lowest root mean square error and the highest correlation coefficient. The lowest root mean square error and the highest correlation coefficient were determined to be 94.4 mm and 0.8 for water table differentiations, and 1.32 (mg/l) and 0.93 for NO₃-N concentration, respectively. Therefore, it was found that DRAINMOD-N can be used to simulate soil hydrology and NO₃-N concentration in shallow ground water of paddy rice field under controlled drainage CD management practices in north of Iran.

SALT LEACHING EFFICIENCY OF SUBSURFACE DRAINAGE SYSTEMS AT PRESENCE OF DIFFUSING SALINE WATER TABLE BOUNDARY: A CASE STUDY IN KHUZESTAN PLAINS, IRAN

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CSBE100109 – To design subsurface drain spacings and depths, the main efforts are usually focused on so-called equivalent depth as well as selecting a steady/unsteady drainage model. These models have been used widely for half a century and some software are developed to design the drainage systems. In spite of recent developments in drainage such as dry-drainage, bio-drainage and controlled drainage, the main concern remains on subsurface water quality and its harmful impacts on environment. In regions where the drainage system is most needed for salt leaching at reclamation stage as well as agricultural reclamation rotations, the main concern is salt concentration of drainage outflows. There are some examples in Iran that demonstrate irrigation and drainage networks that are well equipped with open and subsurface drainage systems. Application of suitable irrigation water provides an overall irrigation efficiency of 35-40%. As a result, in surface irrigation practices, the deep percolation is larger than leaching fraction and leaching requirements of the properly arranged cropping patterns in the crop rotation programs. Such conditions are observed in some projects for which the initial/capital salt leaching was well managed, but still after a long time salt concentration in drainage water is much larger than the applied water salinity of the same soil profile. Detail studies indicate that this can be attributed to existence of Salic/Natric horizons below the field laterals and/or sub main drainage canals,[...].

INTEGRATION OF CROPS, LIVESTOCK AND FORESTRY EDUCATIONAL PROGRAMS IN ZONA DA MATA IN MINAS GERAIS, BRAZIL

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CSBE100111 – With 65% of the area occupied by pastures, the Zona da Mata in Minas Gerais (Brazil) has many dairy farms, although most of the pastures are degraded. The Integration of Crops, Livestock and Forestry (ICLF) is an interesting alternative for the recovery of these pastures. The technique consists in planting corn or beans with grass and eucalyptus, via no-tillage. In the first year, the producer has the income from corn or beans. Grass is also available to support animals and provide income from livestock. In the seventh year, the producer has extra income from wood, with minimal environmental impact (no soil disturbance, increased water infiltration, reduced erosion and siltation of streams and rivers). The methodology is to use experimental units and educational programs (2nd circuit ICLF). Producers can follow the phases of deployment of this technology in different regions from Zona da Mata. The objective of the 2nd circuit ICLF is to disclose this technique in Zona da Mata from Minas Gerais. The demonstration units were installed in 2008/09, in partnership with the EMATER, UFV, SEAPA, CNPq and local authorities in 21 municipalities. The choice of areas, collection of samples for soil analysis, planting, and all cultural treatments were carried out by producers who were supervised by staff from EMATER, UFV teachers and trainees of the project. Field days (one in each county) totalling about 1,900 producers were conducted. [...].

PERFORMANCE OF BIODRAINAGE SYSTEMS IN ARID AND SEMIARID AREAS WITH SALT ACCUMULATION IN SOILS

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CSBE100116 – Biodrainage is the use of vegetation to manage water fluxes through evapotranspiration. It is an alternative technique that has recently attracted interest in drainage and environmental management. Sometimes "drainage" has become a "dirty word" and its implementation has been restricted. Biodrainage is one of the alternative options. The absence of effluent makes the system attractive. However, biodrainage systems must be sustainable in the long-term. Biodrainage theory does not go back too far. The relationship between soil, climate, irrigation management and salinity is not yet well defined. In this research the SAHYSMOD mathematical model was used with two different approaches. 1) Evapotranspiration rate of plantation strips does not change because of increased salinity with the passage of time (S. Akram et al., 2009); and 2) Evapotranspiration rate decreases due to salt accumulation in the soil. While the first approach showed that in most cases the system can perform for about 15 to 20 years, the second approach showed that the life time of the system may not exceed 10 years. In the second system water table draws down during the first 3 to 4 years; however, it rises afterwards due to lower evapotranspiration rate caused by salt accumulation in the soil of plantation strips. This, however, shows that the system may not be considered sustainable in arid and semi arid areas especially where the irrigation water is saline. The result agrees with Heuperman et al. [...].

STUDIES ON APPROPRIATE DEPTH OF LEACHING WATER ALONG WITH RECLAMATION-ROTATION PROGRAM (A CASE STUDY IN MID-PART OF KHUZESTAN, IRAN)

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CSBE100127 – The objective of this research was to study the desalinization and desodification of sugarcane fields in Khuzestan plain. Leaching experiments were conducted on seven sites and intermittent ponding method was implemented for an applied water depth of 100 cm. Among four models fitted to desalinization and desodification estimations, an exponential model with a correlation coefficient of 0.735 and significance level at 1% was selected. In the second model, initial, final and equilibrium salinity, leaching efficiency and moisture content were considered and the fitted exponential model with $R^2=0.758$ was determined as the best desodification. A simulation model called 'leaching process' was developed to determine the amount of water and time needed for reclamation of the whole soils of the study area. Two scenarios were presented: scenario I contained initial leaching, barely cultivation and leaving plant residual during warm seasons, scenario II proposed initial leaching and heavy disk operation and then a pre-irrigation operation. Considering lowering consumed water depth for the soil reclamation and also higher yield in the first scenario, scenario I was selected as a best choice.

SUSTAINABILITY OF BIODRAINAGE SYSTEMS CONSIDERING DECLINING OF EVAPOTRANSPIRATION RATE OF TREES DUE TO SOIL SALINIZATION

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CSBE100129 – Biodrainage is a natural system in which tree plantation strips absorb deep percolation losses of irrigation water applied to neighbouring crops. Loss of excess water through evapotranspiration maintains water table at a desired level. It is doubtful, however, if biodrainage can maintain soil salinity to an extent that crops could be grown economically (Heuperman et al. 2002). According to Kapoor and Denecke (2001) biodrainage could be used in various regions ranging from humid to semi arid areas, except when the ground water EC is greater than 12 dS m⁻¹. The main constraints of biodrainage are salt accumulation in plantation strips, the need for salt removal and extra land for tree plantation. The sustainability of the system, however, is questionable except where the irrigation water is quite suitable and/or in humid regions with high annual precipitation. In saline environments, hybrid system that combines biodrainage and conventional drainage technology will be needed to achieve sustainability. The purpose of this research is to determine the sustainability of biodrainage systems in low hydraulic conductivity soils with moderate water salinity and different barrier depths. SAHYSMOD, a known drainage and ground water mathematical model was used to simulate ground water level and the soil salinity simultaneously at the end of each year. Plant evapotranspiration decreases annually due to salt accumulation in the root zone and increasing osmotic pressure. The results showed that the system life could not be more than 5 to 6 years, while it is around 10 years when the depth to the barrier increases to 10 meters. The main conclusion of the study is that biodrainage could not be considered as a sustainable technique in arid and semi arid regions without availability of good quality irrigation water and/or used in conjunction with conventional drains.

DRAINAGE ON THE DELMARVA PENINSULA: PAST HISTORY AND FUTURE CHALLENGES

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CSBE100130 – Drainage construction on the Delmarva Peninsula was started in colonial times in the 1700's. Most of the drainage is open ditch drainage with very little tile drainage. Environmental issues became a concern in drainage projects in the 1970's. Some controlled drainage was installed in the late 1980's and 1990's in some of the tax ditches. A number of drainage water quality studies have been reported. Ritter and Chirnside (1986) in a three year study, found phosphorus concentrations were increased by drainage construction. In another study herbicides were leached rapidly to shallow groundwater shortly after they were applied in both controlled and uncontrolled drainage sites. The Soil Conservation Service evaluated the effect of drainage on sediment yield over a 16 year period. Drainage decreased sediment yield. Several more recent studies have shown drainage ditches may release ortho phosphorus from bottom sediments and transport it to the estuaries along with high nitrate loads in baseflow.

ESTIMATING RECLAMATION WATER REQUIREMENT AND PREDICTING FINAL SOIL SALINITY FOR SOIL DESALINIZATION

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CSBE100133 – The study area was located at central part of Khuzestan province, Iran. Soil survey and land classification of the area showed that from total surveyed area of about 41,855 hectares, an area of about 14,100 hectares (33.7%) were Saline/Saline –Sodic soils, in different extents. Also about 36,430 hectares (87.0 % of the total area) was subjected to water logging and poor internal drainage conditions. To study the possibilities of Desalinization and Desodification, six different sites were selected in the most Saline – Sodic parts of the study area for which eight treatments (six for leaching water applications and two with gypsum as soil amendment) by means of 1.0 meter depth of leaching water application in four 0.25 meter intervals. Soil samples were taken before, during and after each leaching water application interval. The collected soil and water samples were then analyzed in the laboratory. Based on the collected data from salt leaching experiments, the Desalinization and Desodification leaching curves were obtained. Different theoretical models were also tested by comparing the calculated and experimental Desalinization and Desodification data. Reasonable agreements between theoretical and typical experimental leaching curves were observed. Some empirical exponential relationships were then obtained, enabling users to insert leaching efficiency coefficient and volumetric soil water content and depths to predict both final soil salinity and sodicity [...].

POTENTIAL WATERSHED NITRATE LOAD REDUCTION WITH DRAINAGE WATER MANAGEMENT UNDER VARIED IMPLEMENTATION OPTIONS

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CSBE100137 – The potential impact of drainage water management (DWM) on the nitrate load from subsurface drainage in the Hoagland watershed in west central Indiana was assessed using the DRAINMOD 6.0 model. The watershed was divided into 6460 grid cells of 180 x 180 m size and the drain spacing, soil parent material and cropping pattern in each of the grid cells were identified from the analysis of high resolution aerial photographs and from the GIS-based analysis of soil, crop land and land cover datasets. The DRAINMOD model was applied to each cell and the nitrate loss through subsurface drains was estimated for the conventional and DWM cases. The delivery ratio (DR), which is the fraction of the nitrate load delivered from the field edge to the watershed outlet, was estimated for each of the grid cells using measured nitrate attenuation rates and calculated travel times. A 44% reduction from the current average (1987-2006) annual nitrate load of 155 metric tons was predicted with the implementation of DWM in all subsurface drained fields in the watershed. The effects of multiple management scenarios of DWM implementation based on drain spacing, soil parent material, DR and distance from the ditches/streams were evaluated with respect to the percent reduction in annual nitrate load at the watershed outlet. The highest percent reduction in average annual nitrate load, on a per unit area basis, was predicted from implementation of DWM in the grid cells formed from the Eolian sand parent [...].

WATER TABLE RESPONSE TO DRAINAGE WATER MANAGEMENT IN SOUTHEAST IOWA

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CSBE100138 – A key component in managing subsurface drainage is controlling water table depth to limit excess drainage off site. The objectives of this work were to evaluate the impact of drainage water management through controlled drainage and shallow drainage on subsurface drainage volumes, water table depths, and crop yields. This research was conducted at the Iowa State University Southeast Research Farm and consisted of four paired management schemes for a total of eight plots. Plots consisted of a corn-soybean rotation with half of the plot planted in corn and half planted in soybeans each year. Preliminary findings for three years show undrained plots had a high occurrence of elevated water tables. Controlled and shallow plots had elevated water tables in the early spring and early fall in accordance with the rainfall and management protocols for controlled drainage. Water table response was quick with drawdown to tile depth within 2 to 3 days after significant rain events. Total annual drainage from the shallow and controlled plots was approximately equal and ranged from 20 to 40% of rainfall, while the conventional plots typically drained greater than 40% of the rainfall. There was no statistically significant difference between drained plots in terms of corn and soybean yield for the study period. Undrained plots, however, had slightly lower yields for both corn and soybeans. Overall, during the period of the study drainage water management through controlled drainage or shallow drainage reduced overall drainage volume while maintaining crop yield.

OCCURRENCE OF TYLOSIN-RESISTANT ENTEROCOCCI IN SWINE MANURE AND TILE DRAINAGE SYSTEMS UNDER NO-TILL MANAGEMENT

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CSBE100139 – Tylosin is an antibiotic commonly used in swine industry at subtherapeutic levels to improve growth rates and efficiency of feed utilization. When manure is applied to subsurface drained agricultural fields, antibiotic residues in manure provide selective pressure for the development of microbial resistance. Transport of these microorganisms through soils into tile drainage lines and ultimately into surface waters is a serious threat for public health. This study was performed to investigate the occurrence and transport of tylosin-resistant enterococci from tile drained agricultural fields receiving semi-annual swine waste applications. The field study was conducted at the Iowa State University Northeast research farm at Nashua, Iowa in April and November of 2009. Liquid swine slurry from an operation feeding tylosin at subtherapeutic levels was injected into no-till field plots. Samples collected from field were assayed for total enterococci concentration and enterococci exhibiting resistance to tylosin at an MIC of 35 mg/L. All the enterococci in manure samples were found to be resistant to tylosin. Concentrations of total and tylosin resistant enterococci in soil samples was 6.84×10^5 cfu/100ml and 5.25×10^5 cfu/100ml, respectively. There was a statistically significant difference between the total and tylosin-resistant enterococci concentrations in water samples ($p \leq 0.05$). Total enterococci concentrations in water samples ranged from 1.3×10^1 to 5.0×10^3 cfu/100mL while tylosin resistant enterococci concentrations ranged from 1.3×10^1 to 1.2×10^3 cfu/100mL. [...].

IMPACT OF CLIMATE CHANGE ON DRAINAGE OUTFLOW AND WATER QUALITY IN EASTERN CANADA

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CSBE100143 – The potential effects of climate change on the drainage outflow and nitrogen pollution of a 4.2 ha tile-drained experimental field research facility located at St. Emmanuel, Quebec are predicted using the latest version of the DRAINMOD 6.0 model. Under the assumption of no change in land cover and land management, the model is applied in order to simulate annual, seasonal and monthly changes in flow and NO₃-N loads under current and future climate conditions. The climate scenario under consideration in this study (1961 to 2100) is based on projections from the Canadian Regional Climate Model (CRCM). The simulation results from the CRCM model suggest an increase in temperature and precipitation in the region being studied. Those changes result in a considerable increase in simulated mean annual subsurface flow in the study area.

SUITABLE BUFFER STRIP WIDTH ALONG RIVERS FOR NITRATE N REMOVAL FROM PADDY FIELD DRAINAGE

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CSBE100145 – The buffer strip play an important role in removal non-point source pollution and improvement of the water quality of the river. Nitrate N in paddy field drainage can lead to the soil and underwater pollution caused the eutrophication of rivers too. Based on discussing of the function of buffer strips and the removal mechanism of nitrate nitrogen, the mathematical model for simulation of solute transport and the suitable width in buffer strips was established, the model accuracy was validated by the field experiment data. The distribution of nitrate nitrogen concentration in buffer alfalfa strips under different paddy field drainage conditions was calculated, and the buffer strips width was confirmed. The results showed that when the nitrate nitrogen concentration of paddy drainage is 10mg/l, the suitable minimum width of buffer alfalfa strips is 7.3m, for 20mg/l is 15.0m for the removal rate of nitrate nitrogen in buffer strips reached 90%.

SURFACE RUNOFF AND SOIL PHYSICAL PROPERTIES AS AFFECTED BY SUBSURFACE DRAINAGE IMPROVEMENT OF A HEAVY CLAY SOIL

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CSBE100147 – The percent of total runoff as surface runoff is an indicator of soil structure and functioning of subsurface drainage system in clay soils. Water logging due to low infiltration and low hydraulic conductivity of wet soil increases the risk of surface runoff, and thereby the risk of soil erosion and phosphorus leaching. Lowering groundwater table by efficient subsurface drainage has been found to enhance physical and biological processes that improve the structure of clayey soils. The effects of drainage improvement on surface runoff and soil physical properties have seldom been reported. We have studied the long-term effects of subsurface drainage improvement on soil physical properties and surface runoff on a heavy clay soil under boreal conditions. The runoff determinations were carried out for five years before and nine years after the drainage improvement. During the study period, the soil was autumn ploughed annually to 20 cm depth and spring cereals were grown. Before the drainage improvement, surface runoff constituted 60–80% of the total runoff but it declined to 10–40% after improvement. Mean values of macroporosity and saturated hydraulic conductivity for subsoil (20–60 cm layer) measured ten years after drainage improvement were higher than the mean values measured two years before drainage improvement, indicating that the processes relevant to the formation of clay soil structure were enhanced.

PHOSPHORUS LOSSES THROUGH SUBSURFACE DRAINAGE IN A LOAMY SOIL OF IOWA: EFFECTS OF RATES, TIMING AND METHOD OF SWINE MANURE AND FERTILIZER APPLICATION

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CSBE100149 – Phosphorus is one of the most important and essential mineral nutrients for corn and soybean production. Phosphorus is primarily transported to surface water bodies with surface runoff from agricultural fields as it is strongly absorbed to the soil particles. However, small amounts of dissolved phosphorus lost with subsurface drainage water can be immediately available for accelerating eutrophication in surface water bodies at critical phosphorus concentrations of 10 to 20 µg L⁻¹. A long-term subsurface drainage water quality study was conducted at the Nashua research site located in the Northeast part of Iowa, USA. The overall goal of this study was to investigate the effects of the application of swine manure and commercial fertilizer (ammonium nitrate, UAN) on phosphorus leaching to subsurface drainage water under a corn-soybean rotation. Effects of different application timings and rates were also evaluated in this long-term study (2001-2006). The results of this study indicated that phosphorus concentrations in subsurface drain water, from all experimental treatments, were highly variable and not consistent with the amount of phosphorus applied from swine manure and/or fertilizer. Manure applications at higher rates however, resulted in significantly higher phosphorus concentrations ($p=0.05$) in subsurface drain water in comparison to other treatments in the soybean year. Spring manure applications generally showed lower phosphorous concentration in subsurface drain water [...].

GROUND WATER RECHARGE IN WAGARWADI WATERSHED THROUGH RECHARGE PROCESS AND GROUND WATER FLOW MODELS

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CSBE100152 – The Wagarwadi watershed covering 324 ha in Parbhani District, Maharashtra, India is in the semi tropics and receives a mean annual rainfall of 900 mm. The recharge of the aquifer, due mainly to rainfall during the monsoon season, was modeled using daily rainfall and pan evaporation data for 11 years. The recharge water balance accounts for interception loss, surface runoff, evapotranspiration and soil moisture status. Aquifer parameters viz., transmissivity and specific yield were estimated through pump tests. The aquifer system was modeled as a single weathered leaky aquifer using integrated finite technique on a nested square grid. Steady state conditions were simulated assuming an equilibrium condition during May 1997 which was considered as the initial water level. During steady state calibration, the transmissivity values were modified in some pockets to match the computed and observed water level contours. Irrigation return seepage was found to be contributing significantly to the groundwater regime. The monthly recharge estimates of the model were fed as input to the aquifer model in transient condition. The aquifer model was refined and the monthly recharge estimates were found to be adequate for simulation of water table behaviour. The monthly recharge estimates are very helpful in determining the magnitude of time – variant input due to rainfall to the aquifer system. The soil and water conservation practices in the watershed have increased the soil moisture status [...].

CONTROLLED DRAINAGE TO IMPROVE EDGE-OF-FIELD WATER QUALITY IN SOUTHWEST MINNESOTA, USA

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CSBE100154 – Wet, poorly drained soils throughout the northern Cornbelt are often artificially drained to improve field conditions for timely field operations, decrease crop damage resulting from excess water conditions, and improve crop yields. Drainage has also been identified as a contributing factor to water quality impairments in surface waters. Our objective was to quantify drain flow volume, nitrogen and phosphorus loss, and grain yield from a conventional free-drainage (FD) compared to a controlled drainage (CD) system in Minnesota, USA. A field study was conducted from 2006-2009 on a tile-drained Millington loam soil (fine-loamy, mixed, calcareous, mesic Cumulic Haplaquoll). The field site consisted of two independently drained management zones, 15 and 22ha, respectively. The project used a paired design approach to statistically evaluate treatment effects. During the calibration period (2006-2007) each zone was managed the same. The treatment phase of the experiment began in 2008 with one zone managed in FD mode and the other managed in CD mode. During the two year treatment period (2008-2009) drain flow volume was reduced on average 63%, 141 to 52 mm. There was also evidence that annual nitrate-nitrogen, total phosphorus, and ortho-phosphorus loads were reduced by 61, 50, and 63%, respectively. However, the reasons for a 33% increase in flow weighted mean total phosphorus concentration under controlled drainage are unclear. [...].

NUTRIENT LOAD FROM TWO DRAINAGE SYSTEMS ON CLAY SOIL

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CSBE100155 – In the southern and the south-western parts of Finland 75% of the arable land has subsurface drainage. The Finnish state subsidizes subsurface drainage on certain conditions including for example different envelope materials, drain depth and total drain length per hectare. The typical drain depth is 1.0-1.2 m and the drain spacing varies mostly between 12 and 26 meters depending on the soil type. Gravel is the most common envelope, but also synthetic and semisynthetic textile, cocos fibre and wood chips are used. The aim of this study is to find out how two different kind of drainage methods affect crop production and nutrient load in both drainage waters and surface runoff. In the method I gravel is used as an envelope and the drain spacing is 8 m. In the method II very thin textile (<1 mm) is used as an envelope and drain spacing is 6 m. The research is carried out on a field at Jokioinen in south-western Finland. The soil is heavy clay and the mean slope is 1%. The existing tile drainage pipes were laid in 1954 using 16 m spacing and an average depth of 1 m. The size of the field is 6 ha and it consists of 3 field sections each with a separate drainage system. In the summer of 2008, the additional drainage systems were built into two of the field sections using the methods I and II. The third one was left as a control plot. Runoff volume and water quality of subsurface and surface waters and crop yield from each field section have been measured. [...].

NITRATE-N LOADS TO SUBSURFACE DRAINS AS AFFECTED BY DRAINAGE INTENSITY AND AGRONOMIC MANAGEMENT PRACTICES

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CSBE100157 – Few field studies have documented the impact of subsurface drainage intensity on nitrate loads in drainage waters. A long-term (23-yr) study has been conducted on a silt loam soil in southeastern Indiana, USA, to determine the impacts of drainage intensity (5-, 10-, and 20-m drain spacings) and changes in crop production system on nitrate loads to drainage water. Annual rainfall, drainflow, and drainage efficiency were higher in the 2000-2007 period compared to the 1985-99 time period. Average drainflow per unit area was 72% greater for the 5-m spacing compared with the 20-m spacing during the 1985-99 time period and 24% greater during the 2000-2007 period. The greater drainflow per unit area with the narrow spacing compared to wider spacings led to proportionately greater N loads to surface waters. The relative differences in drainflow among spacings has become smaller with time, possibly due to improved soil structure and permeability with time after drain installation or resulting from the no-till cropping system. No consistent differences in nitrate-N concentrations between corn and soybean years were evident except during the month or two following sidedress urea ammonium nitrate fertilizer application. Nitrate-N concentrations have generally remained below 10 mg/liter for most of the year during the past 12 years of the study. Nitrate loads were higher in 2000-2007 than in 1997-99, however, due to higher drainflow. Addition of a winter cover crop along with lower fertilizer N rates, have significantly reduced the nitrate concentrations and loads in drainflow over the experimental period.

STORAGE AND REUSE OF DRAINAGE WATER

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CSBE100159 – The effects of drainage water storage in ponds on nutrient leaching and water resource management were examined in a three-year (2006-2008) field experiment in a 163 km² study area in southern Sweden. The land use in the area is mainly intensive agriculture and approximately 2.5 million m³ of groundwater are used for irrigation every summer. In 2004, 27 small water storage ponds were constructed in the area. The total storage capacity of these ponds is 355 000 m³ and if they were to be refilled e.g. 1.5 times per season, the groundwater use for irrigation could be decreased by 20%. This study examined the effects of the ponds on nutrient transport and water resource management and developed an index for risk assessment of drainage water quality. Weather parameters and changes in water storage were recorded in the field and samples of water entering and leaving the ponds were collected. Analyses of the water revealed that the ponds acted as a trap for transported nitrogen and phosphorus within the catchment. Digital data on land use, soil type, drainage network and slope gradients were used to identify watershed boundaries and to evaluate the impact of watershed properties on water quality. The potential non-point pollution indicator method (PNPPI) developed for assessing catchment potential as a contributor of nitrogen and phosphorus leaching proved useful. However, the temporal variability was not fully considered and a procedure for including point sources of pollution should be added.

THE ROLE OF CURLI AND CELLULOSE IN THE TRANSPORT AND SURVIVAL OF ESCHERICHIA COLI ON A CENTRAL NEW YORK DAIRY FARM

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CSBE100161 – Enterobacterial pathogens such as *Escherichia coli* are persistently deposited in the environment through the spreading of manure wastes onto agricultural soils, representing serious water quality and human health concerns. In this experiment, *E. coli* isolates were collected from a dairy farm in Central New York at three distinct locations: (i) cow housing, (ii) calf housing, and (iii) field drain (tile) effluent. These environmental *E. coli* isolates were analyzed for the cell surface components cellulose and curli, traits that have been linked to increased environmental survival and transport through soil. Our results showed a high amount of diversity amongst *E. coli* isolates at each spatial location. Isolates collected from cow housing and calf housing displayed highly variable curli and cellulose-producing community profiles from one sampling week to another. However, isolates collected from the drain tile effluent consistently displayed similar curli and cellulose production communities over all sampling dates. These results indicate that the subsurface soil and presence of drain tiles tend to select for a certain subset of *E. coli* strains, perhaps better adapted for environmental survival and/or transport.

ADVANCES IN SPORTSTURF DRAINAGE

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CSBE100162 – Sportsmen and sportswomen the world over enjoy playing on well-drained turf. Almost all soils drain naturally but in the majority of cases natural drainage is insufficient to meet today's sporting requirements. Sportsturf drainage differs markedly from agricultural drainage; sportsturf is a permanent “crop” and relatively delicate and needs to be treated as such. Other differences are highlighted. The latest techniques of sportsturf drainage are explored and a comparison of cost and effectiveness of three approaches to intensive drainage systems made. The latest machinery to undertake this drainage is considered with examples of costings and the productivity improvements resulting. The approaches to research and development of both drainage systems and machinery are outlined together with the role that universities can play in commercial developments. Manufacturing techniques will be considered.

SOIL SALINITY CHANGE DETECTION IN IRRIGATED AREA UNDER QAZVIN PLAIN IRRIGATION NETWORK USING SATELLITE IMAGERY

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CSBE100164 – Qazvin Plain Irrigation Network (QPIN) is one of the first modern irrigation networks constructed in Iran and supplies irrigation water for about 60,000 ha of agricultural area. QPIN is a conjunctive type network with about 28 percent of surface water from Taleghan Dam and remaining supplies from groundwater resources. Groundwater quality is decreasing from over exploitation and it is expected that soil is being salinized gradually. In this research, soil salinity change was detected using satellite images as well as measurement and analysis of soil extract electrical conductivity (ECe). Landsat-TM/ETM+ images of the years 1999 and 2004 were used with more than 130 ground control points of salinity analysis. Relationships between ECe and image bands were investigated. The results showed that soil salinity class varied by an average of about 3 percent on the farmlands under QPIN during these 5 years.

TEMPERATURE EFFECTS ON SHALLOW WATER INFILTRATION RATES IN AN UNDERGROUND ROCK BED BMP

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CSBE100169 – Infiltration Best Management Practices (BMPs) are becoming more readily acceptable as a means of reducing post-development runoff volumes and peak flow rates to pre-construction levels, while simultaneously increasing recharge. Sizing BMPs to hold and store a predetermined volume of runoff, typically called the Water Quality Volume, has become a widely accepted practice. This method of sizing BMPs does not account for the infiltration that is occurring in the BMP during the storm event; which could result in significantly oversized BMPs. The objective of this study was to develop a methodology to simulate varying infiltration rates observed from a large scale rock infiltration basin BMP. The system consists of three infiltration beds filled with coarse aggregate, lined with geotextile filter fabric, overlain with pervious concrete and underlain by undisturbed silty sand. Recorded data indicates a wide variation of linear infiltration rates for smaller storm events. A model was developed using the Green-Ampt formula to illustrate the infiltration occurring in the basin for small storm events characterized by an accumulated depth of water of less than 10 cm. The effectiveness and accuracy of the model were determined by comparing the model outputs with observed bed water elevation data recorded from instrumentation on site. Results show that hydraulic conductivity is the most sensitive parameter, and that the storm event measured infiltration rate is substantially less than the measured saturated hydraulic conductivity of the soil. The governing factor affecting hydraulic conductivity and, subsequently, infiltration rate is water temperature.

ASSESSING THE FEASIBILITY OF DRAINMOD APPLICATION USING SOIL HYDRAULIC PROPERTIES ESTIMATED BY PEDOTRANSFER FUNCTIONS

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CSBE100170 – DRAINMOD is one of the widely used computer simulation models for drainage water management. Direct and indirect methods are available to feed DRAINMOD with the required inputs. Direct measurements of soil parameters are time consuming and costly compared with indirect methods such as the use of pedotransfer functions (PTFs). The goal of this study is to assess the feasibility of running DRAINMOD using saturated hydraulic conductivity (Ksat) and soil water characteristics (SWC) data estimated by PTFs. In previous research, we have identified the best performing PTFs for estimating the Ksat and SWC data for US soils of different textural classes. Data from Four U.S. agricultural drained sites, having different soils, crops, drainage systems, and climatological conditions, were used in the analysis. For each of the four sites Ksat and SWC data have been estimated using the best performing PTFs according to the soil textural class. The model was run using both calibrated and PTF-estimated Ksat and SWC data. Measured annual drainage was compared to predicted drainage using estimated and calibrated soil hydraulic properties. The Normalized Root Mean Square Error and Modeling Efficiency were used to assess the model performance. As expected, predicted annual drainage using the calibrated soil parameters (NRMSE=9-24%, EF=0.62-0.91) was more accurate than predicted drainage using PTF-estimated soil parameters (NRMSE=21-33%, EF=0.29-0.70). The errors in DRAINMOD predictions induced by using PTF-estimated soil parameters appear to have a small impact [...].

NITRATE REMOVAL OF DRAINAGE WATER WITH BARLEY STRAW AS A BIOREACTOR FILTER

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CSBE100171 – Nitrate is a widespread groundwater contaminant, which can cause pollution of receiving waters. Some of the highest losses of nitrate to surface waters come from drained agricultural land. Bioreactor filters are a useful approach for removing nitrate from drainage waters, but these systems require an external carbon supply to sustain denitrification. The ability of barley straw to serve as a carbon substrate for biofilters was evaluated in a laboratory model. In this study the effect of two heads (100 and 200 cm) and two thicknesses of bioreactor (300 and 600 mm) were also evaluated. The experiment was conducted in the polyethylene columns with 90 mm internal diameter. The influent nitrate concentration was 40 mg L⁻¹. Addition of barley straw as a carbon source decreases significantly effluent nitrate concentrations. The rate of denitrification was affected by the water velocity and decreased at velocity about 0.04 m h⁻¹. In the columns with 300 mm height, the average nitrate reduction at 100 and 200 cm heads were 63.49% and 60.22%, respectively. The average nitrate reduction at the 600 mm height columns with 100 and 200 cm heads were 69.97% and 67.1%, respectively.

MEASURED EFFECT OF AGRICULTURAL DRAINAGE WATER MANAGEMENT ON HYDROLOGY, WATER QUALITY, AND CROP YIELD

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CSBE100175 – A field scale experiment has been initiated in 2006 to study the effects of controlled drainage on drain flow, nutrient export, and crop yield for a subsurface drained site in eastern Ontario, Canada. Eight paired fields of comparable size (2 to 7 ha), soil (Bainsville silt loam), crop rotation (corn-soybean), and drainage system (subsurface drains 100 cm deep and spaced 15 m apart) were evaluate in the study. For each field pair, controlled drainage (CD) is implemented on one field and conventional (uncontrolled) drainage (UCD) is implemented on the other field. The results of the study showed that controlled drainage substantially reduced subsurface drainage and nutrient (nitrogen and phosphorus) export with drain flow, compared with conventional drainage. On average over the four field pairs and the three-year period, controlled drainage reduced the May-to-November drain flow by 50%, nitrate-nitrogen export by 47% and total phosphorus export by 56%. These results support the contention that nutrient reductions are controlled primarily by reduced drain flow. The results suggest the May-to-November nutrient mass losses were, overall, modest. A very modest increase in crop yield was observed with implementing drainage water management, although results were not statistically significant. Nevertheless, the results do show that controlled drainage does not have an adverse effect on crop yield.

USE OF AGRICULTURAL CENSUS DATA FOR THE ESTIMATION OF IRRIGATION WATER CONSUMPTION AT FARM LEVEL

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CSBE100176 – Agriculture is the main driving force in the management of water use. In the EU as a whole, 24% of abstracted water is used in agriculture and, in some regions of southern Europe, agriculture water consumption rises to more than 80% of the total national abstraction. Overexploitations of water resources along with conflicts among different water uses, due to water scarcity problems, are becoming a pressing issue for environmental stewardship in various areas. Climate change is expected to intensify irrigation requirements and water scarcity in the Mediterranean region. Accurate estimation of irrigation demands (and other water uses as well) is therefore a key requirement for more precise water management and, an overview on European water use can contribute to develop suitable policies and management strategies. The paper analyses the methodology for the estimation of the irrigation water consumption at farm level by using information from the 2010 Italian Agriculture Census. The methodology will be applied after the Census to estimate the water consumption for the entire Italian farm sector answering the requirements of the regulation established by European Statistical Office (Eurostat). Three models have been developed and integrated to account the main aspects considered significant for irrigation water consumption at farm level: crop irrigation requirement, irrigation systems efficiency and farmer irrigation strategy. Each model requires specific information about farm, crops, meteorology and soil. These data often have low quality, low resolution and different standard and in addition their collection at national level is problematic since they are scattered among different institutions. The paper describes the strategy adopted to tackle the issues [...].

LABORATORY STUDY OF THE SOIL CLAY PERCENT INFLUENCE ON THE NEED FOR SUBSURFACE DRAINAGE SYSTEM ENVELOPES

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CSBE100177 – The necessity of the use of subsurface drainage envelopes is one of the major concerns which are brought up in the first stages of design and construction of a drainage project. Clay percentage of soil is the first index to predict this requirement. In this study, in order for the calculation of gradient ratio (GR) and the assessment of clogging potential and soil particles movement into the drainpipe, the permeameter test was carried out on three samples with clay and clay loam textures. Treatments in this experiment were drainage systems with and w/o envelopes. In system with envelope, two types of envelopes (granular and fiber) were used. Through conducting this experiment, discharge variation, system permeability, gradient ratio and exit gradient were investigated. The results showed that the values of gradient ratio in the systems without envelope in most cases were greater than one which indicates high particle movement potentials. Nevertheless, soil particles movement happened when the values of this index exceeded 3. The ratio of outflow from the systems with mineral and synthetic envelopes to the ones without envelope ranged 2.0-3.5 and 1.4-1.8, respectively. As hydraulic gradient was increased, system hydraulic conductivity decreased, greater decrease happened in the system without envelope. [...].

USE OF WATER IN SWINE PRODUCTION IN CATALONIA-SPAIN

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CSBE100182 – The objective of this work was to evaluate the use of water in the swine production in the region of Catalonia, Spain. The evaluation was realized through a questionnaire with 200 producers using different production systems. The water source, type of fountain, frequency of maintenance and repair of the fountain as well as cleaning frequency of swine housing was evaluated. The data obtained were expressed in percentage and presented in graphs for better characterization of the study. In relation to water source, 49% of water used in pig farms was from an irrigation system, 26% from the municipal system and 15% was from groundwater sources. Most of the fountains used were nipple bowl fountains that represented 77%, constant valve fountains (10%), trough (10%) and nipple fountains (3%). The frequency of maintenance and repair was daily (95%), weekly (4%) and monthly (1%). The frequency of cleaning of swine housing was 89.4% after the production cycle, 7.1% monthly, 3.2% weekly and 0.3% daily. The water uses in pig farms in Catalonia are adequate for production purposes, but there are some factors that could be improved to optimize water usage within an environmental perspective.

MANAGEMENT OF RESOURCE, WASTE AND IMPLEMENTATION OF STRATEGIES IN PIG PRODUCTION IN CATALONIA-SPAIN

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CSBE100183 – The objective of this work was to evaluate the management of resources, waste and application of environmental strategies in the region of Catalonia, Spain. The evaluation was realized through a questionnaire with 200 producers with different production systems. The following items were evaluated; the control of resources (quantity of feed and quantity and quality of water), waste (control the slurry production and pollutants gaseous) and application of slurry management strategies (segregation of rainwater, use of additives in sewage, aeration of slurry and transportation of slurry to a treatment plant. The data obtained was expressed in percentage and presented in graphics for better characterization of the study. All respondents controlled the amount of food; and only 21% controlled the quantity of water and almost all controlled the quality of water. Everyone controlled the production of slurry but no one controlled the production of gaseous pollutants, regardless of mandatory legislation in some cases. In the case of strategies of slurry management: 48% separated rainwater, 7% use additives in the sewage, 4% aerate the slurry and 59% transport the slurry to a treatment plant. Based on the data, it can be seen that the variables related to amount of feed, quantity and water quality are better monitored when compared to environmental variables.

FIELD EVALUATIONS OF A FORESTRY VERSION OF DRAINMOD-NII MODEL

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CSBE100185 – This study evaluated the performance of the newly developed forestry version of DRAINMOD-NII model using a long term (21-year) data set collected from an artificially drained loblolly pine (*Pinus taeda* L.) plantation in eastern North Carolina, U.S.A. The model simulates the main hydrological and biogeochemical processes in drained forested lands. The model was calibrated using observed data during 1988-1997 and validated during 1998-2008. Predicted subsurface drainage, water table fluctuation, annual net primary production, leaf area index, and nitrate export were compared with measured values. Goodness-of-fit statistics include Nash-Sutcliffe coefficient (NSE), degree of agreement (d) and mean absolute error (MAE). Both annual and monthly drainage predictions were in very good agreement with measured values (NSE = 0.95, d = 0.95, and MAE = 53 mm yr⁻¹ for yearly predictions and NSE = 0.91, d = 0.96 and MAE = 8.8 mm mo⁻¹ for monthly predictions). Predicted daily water table depths closely followed observed values with goodness-of-fit statistics: NSE = 0.90, d = 0.96 and MAE = 0.10m. Predicted mean annual NPP was 18.7 t DM ha⁻¹, which was very close to estimated value of 18.6 t DM ha⁻¹. The goodness-of-fit statistics of the annual NPP predictions were: NSE = 0.66, d = 0.78, and MAE = 1.46 t ha⁻¹yr⁻¹. The model well predicted both the magnitude and dynamics of LAI. Predicted mean annual nitrate loss was 2.59±1.64kg ha⁻¹, which was very close to observed value of 2.64±1.50kg ha⁻¹. The goodness-of-fit statistics for predicted annual nitrate loss were: NSE = 0.88, MAE = 0.46kg ha⁻¹ yr⁻¹ and d = 0.93. The goodness-of-fit statistics for monthly nitrate [...].

STREAMFLOW CHARACTERISTICS OF A NATURALLY DRAINED FORESTED WATERSHED IN SOUTHEAST ATLANTIC COASTAL PLAIN

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CSBE100188 – Information about streamflow characteristics e.g. runoff-rainfall (R/O) ratio, rate and timing of flow, surface and subsurface drainage (SSD), and response time to rainfall events is necessary to accurately simulate fluxes and for designing best management practices (BMPs). Unfortunately, those data are scarce in the southeastern Atlantic coastal plain, a highly urbanizing region characterized by poorly drained low-gradient forested landscape where runoff is dominated by shallow SSD and saturation excess overland flow. In this paper we evaluate these characteristics using four years (2005-08) of streamflow data measured on a 72 km² naturally drained forested watershed on the Francis Marion National Forest in coastal South Carolina. The calculated average event peak flow rate, time to peak, event duration, SSD as % of streamflow, and R/O ratio were 4.2 m³ sec⁻¹ km⁻², 14.6 hrs, 13.9 days, 29%, and 20%, respectively, for 12 events with rainfall amount varying from 153 mm to 34 mm. The events were similar to those from the historic data (1964-73) indicating a hydrologic recovery of forest since its regeneration after Hurricane Hugo in 1989. The average drainage response time to the rain was 7.8 hours. Results suggested that the runoff and peak flow rate of storm events are dependent upon both the rainfall and its intensity as well as the antecedent conditions described better by initial water table positions than the initial flow rate. [...].

IMPLICATIONS OF AGRICULTURAL DRAINAGE WATER REUSE: II. SOIL PROPERTIES

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CSBE100191 – Reuse of agricultural drainage water is applying worldwide in many regions in the world, in order to alleviate the water crisis, as well as to control the environmental pollution. The overall goal of this study was to explore the impacts of using agricultural drainage water on the chemical and physical properties of soil. Moreover, to study the possibility of saving water and fertilizer by using agricultural drainage water for irrigating field crops. The study was carried out at King Maryout, Egypt on Egyptian clover and wheat crops, these crops were irrigated by different mixing ratios of Fresh Water (FW) and Drainage Water (DW) (100: 0 (T1), 75: 25 (T2), 50: 50 (T3), 25: 75 (T4) and 0: 100 (T5)). Laboratory analysis for all soil samples was carried out for measuring the pH, electrical conductivity (EC), cations, anions, heavy metals (Cu, Cd, Pb and Zn) before planting and after harvesting of Egyptian clover and wheat. NPK fertilizers and hydraulic conductivity were measured, as well. The results concluded that, with increasing the percentage of drainage water in irrigation seemed to be harmful on chemical properties of the cultivated soil, especially on increasing the EC in the soil, therefore, it is recommended to add more irrigation water than required by consumptive use of crops to meet leaching requirements. Apparently, mixing fresh water with drainage water may overcome the problem of the irrigation water shortage. However, a proper mixing ratio is the preeminent practice to avoid the hazards of soil salinity.

AN INITIAL ASSESSMENT OF A WETLAND-RESERVOIR WASTEWATER TREATMENT AND REUSE SYSTEM RECEIVING AGRICULTURAL DRAINAGE WATER IN NOVA SCOTIA

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CSBE100192 – A wetland-reservoir wastewater treatment and reuse systems is an integrated water management system constructed on farms to conserve water and to help mitigate water pollution from agricultural drainage. This research assesses such a system in Nova Scotia and provides recommendations for adapting its location, design, construction, and operation to a cold climate. Water quality, hydraulic, and meteorological data was collected between November 2007 and January 2009. The system collected approximately 15500 m³ (8700 m³ ha⁻¹ of drained land) annually, potentially enough water to irrigate more than the drained area. A tracer study was conducted in the constructed treatment wetland to assess residence time. Little difference was observed between the actual residence time (15.0 d) and the nominal residence time (14.5 d). This is attributed to a high length to width ratio (10:1). Annual nitrate-nitrogen and *E. coli* reductions by the constructed treatment wetland were 52% and 33%, respectively. Significant monthly variation was observed, and is attributed to the dynamic hydraulic and pollutant loading of tile drainage water. Total phosphorus and soluble reactive phosphorus concentrations were typically below detectable levels (0.10 mg L⁻¹ and 0.05 mg L⁻¹ respectively) at all sampling locations. Reservoir water quality exceeded irrigation water quality guidelines for *E. coli* (100 CFU 100 mL⁻¹) during summer months and is attributed to environmental factors. [...].

EVALUATION OF DRAINMOD IN PREDICTING WATER TABLE FLUCTUATIONS AND YIELD OF CANOLA IN PADDY FIELDS (CASE STUDY: RASHT, IRAN)

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CSBE100199 – A hydrological simulation model, DRAINMOD, was used to predict the performance of surface drainage and yield of canola as post-rice cultivation during wet growing season of 2004-2005 in Rasht-Iran. The DRAINMOD model was evaluated on performance of surface drainage with 2 m spacings and 15 cm drain depth as compared with 4×10 m² plots having no drainage. The results showed that DRAINMOD model was well able to predict water table fluctuations. Evaluation of predicted daily water table depths as compared with measured values shows that the root mean square error (RMSE) was about 8 cm for both treatments. Predicted water table depth was, on average about 4% less than the measured water table depths for the surface drainage treatment and 17% less for the no drainage treatment. Accurate measurement of deep seepage is required to improve performance of the model. Results also showed DRAINMOD was capable of predicting relative yield of canola for both treatments. Poor aeration as a result of excess soil moisture could be related as the main reason for yield reduction.

COMBINED EFFECTS OF FREEZING AND STORAGE CONDITIONS ON THE STALING OF COOKED RICE

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CSBE100200 – The effects of freezing and storage temperatures on starch retrogradation and textural properties of cooked rice were evaluated. Cooked rice was frozen with different freezing rates and then stored at 4°C for 14 days or -18 °C for up to 7 months. Starch retrogradation enthalpy (ΔH_r) of cooked rice was determined by a differential scanning calorimetry, and textural properties were determined by a texture analyser. The results showed that the ΔH_r and hardness values had a negative correlation with freezing rate, however, a positive correlation was found between adhesiveness and freezing rate. On the other hand, the advantages (lower hardness and higher adhesiveness, less starch retrogradation) of cooked rice gained by rapid freezing, were lost quickly in the first 3 days of storage at 4°C. However, rapid freezing combined with -18°C frozen storage can effectively retard starch retrogradation and maintain the textural properties of cooked rice for at least 7 months. Therefore, high quality cooked rice can be produced by combined rapid freezing with frozen storage.

SUBSURFACE DRAINAGE NITROGEN DISCHARGES FOLLOWING MANURE APPLICATION: MEASUREMENTS AND MODEL ANALYSES

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CSBE100201 – Increasing concentrations of nitrate-nitrogen (NO_3^- -N) in surface and groundwater resources are a major water quality concern. A five year experiment to examine NO_3^- -N leaching losses to subsurface drains under continuous maize (*Zea mays* L.) was carried out, where mineral N and two separate liquid dairy manure applications under different conditions were applied following current agronomic N management guidelines. Yearly cumulative drainage and mass of NO_3^- -N leached varied from 118 mm – 353 mm, and 10.9 – 30.9 kg ha⁻¹, respectively, over the five years. The timing and extent of N losses were associated with antecedent soil moisture conditions, soil temperature, preferential flow, precipitation, tillage and timing/rate/method of manure application. Well-calibrated dynamic simulation models can be used to integrate these factors, and predict the impact of different manure N management practices for maize production on N losses. We have developed such a model, the Precision Nitrogen Management (PNM) model, composed of LEACHN, the N module of LEACHM linked to a maize N uptake, growth and yield model. We compared PNM model predictions of daily drainage, mass of NO_3^- -N leached and NO_3^- -N concentration exiting the root zone with measured values in subsurface drains over the course of the study. The model predictions provided a good fit to the observed data. The adjusted R^2 were 0.82 and 0.80, and the [...].

MAPPING SOIL MOISTURE CONTENT VARIABILITY USING ELECTROMAGNETIC INDUCTION METHOD

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CSBE100204 – In agricultural fields, large spatial variations in soil water content are associated with soil heterogeneities, topography, land cover, evapotranspiration, and precipitation. Detailed georeferenced maps would be useful to manage soil moisture according to soil variability to assess drainage and sub-irrigation requirements within wild blueberry fields. Two fields were selected in central Nova Scotia and a grid pattern of sampling points was established at each experimental site based on the geostatistical analysis of the ground conductivity survey data. The volumetric moisture content was determined for each grid point (n=86 for field 1 and n=56 for field 2) from both fields using TDR. The ground conductivity was measured and recorded with Dual EM at same selected grid points. Two comprehensive surveys were conducted in those fields to measure ground conductivity for moisture estimation in real-time using DualEM and a differential global positioning system. Linear regression analysis showed that ground conductivity was significantly correlated with the measured moisture content (R^2 ranged from 0.85 to 0.90) in both fields. The accuracy of the estimated values from the DualEM data was calculated as root mean square error (RMSE: 2.66 and 3.63 for F1 and F2, respectively). The estimated soil moisture maps showed substantial variation in selected fields. The slope of both fields was also mapped using automated slope mapping system. [...].

PREDICTED IMPACTS OF CLIMATE CHANGE ON CROP PRODUCTION ON DRAINED LANDS IN SWEDEN

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CSBE100205 – We have conducted a simulation study using the hydrologic model, DRAINMOD, and the carbon and nitrogen model, DRAINMOD-N II, to assess the potential impacts of climate change on crop production on drained lands in Sweden. Simulated system include a loamy sand topsoil underlain by a poorly drained clay layer, a winter wheat-sugar beet-spring barley-spring barley crop rotation, and a drainage system composed of subsurface drains (depth=1.0 m, spacing=10, 20 m) managed using conventional and controlled drainage. Two sets of 49-year climate data were used: measured historic climate data for the period 1961-2009 and predicted future climate data for the period 2011-2059 (based on the regional model, RCA3, and the global model, ECHAM4/OPYC3). Climate models predicted an increase in average annual temperature by 1.9°C and a 9% increase in average annual precipitation, both occurring during winter and early spring. In response, DRAINMOD/DRAINMOD-N II predicted a moderate increase in average annual evapotranspiration (approximately 10%) and a slight increase in average annual drainage (less than 4%). Over the 49-years, a 3% reduction in soil organic carbon was predicted because of faster decomposition during warmer winter and spring. The increase in predicted drainage and mineralization of organic nitrogen caused an increase in predicted N drainage losses. The predicted increase in denitrification during the warmer winter and spring improved the [...].

DRAINMOD-SIMULATED PERFORMANCE OF DRAINAGE WATER MANAGEMENT ACROSS THE U.S. MIDWEST

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CSBE100206 – Drainage water management (DWM) is currently being proposed as a BMP for reducing nutrient export from drained cropland in the US Midwest to the Mississippi River and the Gulf of Mexico. The effectiveness of the practice in the Midwest has not been well documented. We conducted a simulation study using the hydrologic model, DRAINMOD, and the carbon and nitrogen model, DRAINMOD-N II, to evaluate the performance of DWM across the US Midwest. Thorp et al (2008), used the RZWQM-DSSAT models, calibrated for a corn and soybean production system on a subsurface drained IOWA soil, to simulate the performance of DWM using 25-year climatological data from 48 locations across the Midwest. We used DRAINMOD-DRAINMOD-N II models, calibrated for the same conditions, to simulate the performance of DWM at the same 48 locations. Simulation results showed that DWM reduced annual subsurface drainage by 30% and annual N drainage losses by 32%, on average over the 48 sites. DWM was most effective in reducing drain flow and N drainage losses for the south and southeast locations. Highest simulated reductions in drain flow (45%) and N drainage losses (47%) occurred in Memphis, Tennessee. DWM was least effective for the northwest locations. Lowest simulated reduction in drain flow of 19% occurred in both Sioux City, Iowa and Sioux Falls, South Dakota. Lowest simulated reduction in N drainage loss of 12% occurred in Fargo, North Dakota. Simulated crop yields RZWQM-DSSAT showed a similar trend but predicted substantially higher reductions in both drain flow (35-68%) and N drainage losses (33-51%). DRAINMOD-simulated crop [...].

BEYOND THE FIELD: A LOOK AT AGRICULTURAL DITCH FLOODPLAINS AS A WATER QUALITY BMP

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CSBE100207 – Agricultural fields, subsurface drainage, and a network of modified headwater systems dominate the landscape in the Midwest region of the United States. These systems are often the main conduits that export sediment and nutrients downstream, but very little is known about how these systems function. While most agricultural Best Management Practices (BMPs) focus on landscape measures to reduce sediment loss and water pollution little research has been performed on in-stream processes and channel system floodplains as agricultural BMPs. An important step in quantifying nutrient reduction capacities on floodplains is to predict discharges occurring on floodplains. This paper evaluates methods to predict the recurrence interval of discharges at ungaged sites and the annual exceedances of different discharge thresholds. Also presented is a study to evaluate the benefits of modifying channels to two-stage geometries that provide connection to floodplains and more bank storage. Preliminary results indicate that benches (small floodplains) should be located at elevations associated with about 25-35% of the 2-year discharge and they will usually flood about 10-60 days annually. Nitrate-N removal, in systems with flooded width ratios of 4 to 5 times the bankfull width, might be 5-20% of exports from fields if the treatment area (surface of the benches and inset channel) is about 1% of the watershed [...].

A DECADE LATER: THE ESTABLISHMENT, CHANNEL EVOLUTION, AND STABILITY OF INNOVATIVE TWO-STAGE AGRICULTURAL DITCHES IN THE MIDWEST REGION OF THE UNITED STATES

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CSBE100209 – Much of the landscape in the Midwest region of the United States has been converted to agricultural use and with this conversion has come greatly altered hydrologic functioning. The elimination of wetland storage and installation of subsurface drainage systems and agricultural ditches has caused water to drain from agricultural watersheds at greatly accelerated rates. In some cases, these hydrologic alterations have led to severe water quality problems, including stream bank erosion, sedimentation, and inadequate processing of nutrients, each of which pose dire consequences for aquatic biota. Research by the authors has led to the modification of some trapezoidal agricultural ditches to two-stage geometries that are sized based on geomorphic concepts. A procedure for sizing these systems has been developed by the authors. Most of these innovative systems are located in Indiana, Michigan and Ohio. The main objective of the paper is to present details on how these systems have evolved since construction. The paper addresses issues that require further consideration. Channel evolution, determined by the assessment and analysis of physical condition, includes tracking changes in form by repeated surveys of channel dimension, pattern and profile. Pre-construction and post-construction properties are compared. Channel dimensions are also compared to regional curves. Analysis will include computing the hydrology and hydraulics for the range of recurrence intervals using the computer simulation models HEC-HMS, HEC GeoHMS, and HEC-RAS.[...].

EFFECT OF WATER STRESS ON YIELD AND YIELD COMPONENTS OF TWO WHEAT CULTIVARS

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CSBE100210 – A field study was conducted at an Agricultural Research station, Azad University, Khorasgan, Isfahan, Iran, during 2006-2007 to evaluate the effect of irrigation regimes on grain yield components and grain yield of two wheat cultivars. In order to determine the most tolerant cultivar five drought tolerance indices comprising, adjusted based on grain yield under drought (Ys) and normal (Yp) conditions were used. A split plot layout with a randomized complete block design with four replications was used. Irrigation regimes (irrigation after 80 (I1), 100 (I2) and 120 (I3) mm cumulative evaporation from class A evaluation pan) were considered as the main plots and two wheat genotypes (M7318 and Line 4) as subplots. The (I1) and (I2) did not differ significantly for grain yield components, grain yield excepting total dry matter and peduncle length. Delay in irrigation from (I2) to (I3) significantly reduced grain yield components, grain yield and total dry matter. I2 has the maximum water used efficiency and harvesting index. The responses to irrigation regimes appeared to differ between the two wheat cultivars. M7318 gave the highest grain yield, grain weight and total dry matter. The responses to irrigation regimes appeared to differ between the two wheat cultivars. The calculated correlation coefficients reveal that TOL and SSI are superior criteria for selection of high yielding genotypes both under non-stress and stress conditions. The comparison of cultivars with above criteria indicated, line 4 is more [...].

SYNTHESIS OF CaCO₃ NANOPARTICLES BY CONTROLLED PRECIPITATION FROM SATURATED SODIUM CARBONATE AND CALCIUM NITRATE AQUEOUS SOLUTIONS

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CSBE100213 – Ultrafine nanoparticles of CaCO₃ (NPCC) whose size does not exceed 100 nm can find their use in a broad spectrum of applications. Indeed, the NPCC appear to be important as an effective additive for the making of paper with special and new characteristics. The NPCC are also used as a filling additive in plastic industries for which studies on polymer cleavage energy proved that the addition of nanometric fillers such as NPCC favor the increase the homopolymers and copolymers rigidity. The nanosized NPCC are suitable for applications requiring an excellent control of the rheology and the reinforcement of mechanical properties such as shock resistance or elongation. Recently, NPCC opened the way to the controlled release of bioactive molecules, and constituted a hot topic of research receiving a special attention. The development of tailored NPCC specifically for particular needs is a new innovative research area which reinforces the already attractive field of nanotechnology. The aim of this work focuses in the synthesis of NPCC by controlled precipitation from saturated sodium carbonate and calcium nitrate aqueous solutions. The effects of stirring speed, mixing time, and calcium/carbonate concentrations on the particle size have been investigated. Increasing the mixing time from 30 to 180 minutes resulted in a decrease in particles size. Stirring speed variation between 300 and 14000 rpm decreases particle size. Calcium and carbonate ion concentrations are key parameters controlling the NPCC particle size. Calcite is the main polymorph obtained as revealed by X- ray diffraction (XRD) analysis.

MODELING RUNOFF FROM A SMALL ARTIFICIALLY DRAINED AGRICULTURAL CATCHMENT IN NORWAY, USING THE DRAINMOD MODEL

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CSBE100214 – The Skuterud catchment is a small artificially drained agricultural catchment, located in south eastern Norway. The total area of the catchment is 4.5 km² of which agriculture covers 2.7 km², forest 1.3 km² while the rest is occupied by urban area. The main agricultural crops are wheat, barley and oat. Climate change can potentially lead to an increase in the number of freeze/thaw cycles which in addition to the predicted increase in precipitation during the period after the growing season from September – April, might lead to an increase in both the amount of runoff and its intensity, with subsequent adverse effects on erosion and nutrient loss. Models are indispensable tools in the prediction of climate change effects on runoff generation. In this respect, the Drainmod model has been tested on the Skuterud catchment concerning its ability to predict runoff from an artificially drained agricultural catchment under prevailing winter conditions. The results are presented in this paper. If proven successful, the model can be used to predict the long term hydrologic impacts of climate change for the Norwegian conditions.

THE EFFECT OF SAMPLING FREQUENCY ON THE ACCURACY OF NITROGEN LOAD ESTIMATES FROM DRAINED LOBLOLLY PINE PLANTATIONS IN EASTERN NORTH CAROLINA

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CSBE100215 – Nutrient loading in drainage outflow is estimated from measured flows and nutrient concentrations in the drainage water. The loading function is ideally continuous, representing the product of continuously measured outflows and nutrient concentrations in drainage water. However, loading is often estimated as the product of continuously measured outflow and nutrient concentrations measured at different time intervals (weekly, monthly etc.). Depending upon the experimental design, concentration can be measured using discrete samples taking at different frequency or flow proportional samples. In this study we investigate the effects of sampling frequency and method on estimating the loading of nitrate-nitrogen (NO₃-N) and dissolved organic nitrogen (DON) from a drained loblolly pine plantation in Eastern North Carolina. The loading of NO₃-N and DON computed from continuous flows and daily concentrations will be compared to loadings computed from weekly, bi-weekly, and monthly discrete samples. Loadings computed from flow proportional samples will also be compared to loadings estimated from discrete samples. Results of this study will provide better understanding of the temporal dynamics of both NO₃-N and DON concentrations in drained forested lands and their impacts on the accuracy of estimating the loading of these species to receiving surface waters. The results of the study can be used as a guide for setting the sampling frequency to achieve a desired accuracy in estimating NO₃-N and DON loading within economic constraints.

MATHEMATICAL MODELLING ON THE OPERATION OF WATER CONTROL STRUCTURES IN A SECONDARY BLOCK

CASE STUDY: DELTA SALEH, SOUTH SUMATRA

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CSBE100217 – The project Land and Water Management of Tidal Lowlands (LWMTL) was set forth in Indonesia to reclaim vast areas of waterlogged tidal land for agricultural exploitation. The objective of this study was to simulate water management systems near the farmers' field by controlling flap gate culverts in secondary canals (SDU) and stop logs in tertiary canals under different scenarios of irrigation, drainage and flushing. Based on data (hydraulic and hydrometric) collected during a field survey in August 2005, a 1D mathematical model (DUFLOW) for the canal system was developed and calibrated. For boundary conditions of the model, tidal water level fluctuations in the primary canals were used. Different rainfall intensities (10 mm/day, 30 mm/day and 80 mm/day) and evaporation of 3 mm/day were modelled in order to evaluate the hydraulic response of the system. Water normally flows from the secondary canals to the tertiary canals. Water level is kept and maintained as high as possible. The model shows that water level in the tertiary canals increases in time; the level also depends on tidal water level outside and rainfall intensity. In the case of 80 mm/day rainfall, water level in tertiary canals will reach around 2.00 m above median sea level (+MSL, more or less the ground surface elevation) after one day. At this level, water can be utilized for agricultural production. Flushing can be done by [...].

APPLICATION OF SWAP TO ASSESS PERFORMANCE OF SUBSURFACE DRAINAGE SYSTEM UNDER SEMI-ARID MONSOON CLIMATE

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CSBE100218 – SWAP (Soil-Water-Atmosphere-Plant) was evaluated for its capability to predict groundwater table behaviour under drained condition with a semi-arid monsoon climate in Haryana (India). The performance of the model was tested using data for water table, drainage discharge rate and cumulative discharge. A close agreement was observed between the measured data and simulated value. SWAP simulated values ranged within absolute deviations of 0.17-0.18 m for water table, 0.87-1.07 mm day⁻¹ for discharge rate and 7.8-39.4 mm for cumulative drain discharge rate when compared to observed values. The calibrated and validated model was used to predict excess water stress utilizing SEW₃₀ index for different spacing under three rainfall situations. The results revealed that SEW₃₀ exceeding 100 cm day⁻¹ could be encountered with drains spaced at 75 m while it would remain within 50 cm day⁻¹ with drains spaced at 50 m during normal and/ or above normal rainfall years. No excess water stress problems occurred with drains spaced at 25 m or in years with below normal rainfall in any of the test spacing. Long-term simulations revealed that residual effect of one year do not affect the water table during the next year under drained condition.

IMPACT ON DRAINAGE WATER QUALITY FROM AMENDING AGRICULTURAL SOILS IN NOVA SCOTIA WITH AN ALKALINE STABILIZED BIOSOLID

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CSBE100219 – A study was conducted in Nova Scotia, Canada examining the impact of land applying an alkaline stabilized biosolid (ASB) on surface and subsurface drainage water quality. The site has six plots (83 m by 96 m), each with a subsurface drainage system. Drains (100 mm in diameter) are located at a depth of 80 cm on a uniform slope of 0.4%. In addition to subsurface drains, each plot has a surface drainage ditch with a hickenbottom surface inlet at its bottom end to collect surface runoff water. Buffer drains hydrologically separate all plots. All twelve drains (6 surface and 6 subsurface) flow into a propane heated sampling hut equipped with tipping buckets and a datalogger. The study site was established to examine the impact on water quality from organic amendments using two management practices (conventional vs no-tillage) common to the region. No significant differences were observed in either *E.coli* (CFU/100mL) or total coliform (CFU/100mL) levels in surface or subsurface drainage water after application of the N-Viro biosolids. Preliminary results suggest that the N-Viro biosolids actively contribute to the overall mineralized nitrogen pool in soil. Drainage loss of mineralized nitrate was not considered to be a major concern based on current results. Further research is needed before final recommendations can be made regarding the impact on water quality from using alkaline treated biosolids on agricultural soils in Atlantic Canada.

METHODS TO ESTIMATE EFFECTS OF DRAINAGE WATER MANAGEMENT ON ANNUAL NITROGEN LOSSES TO SURFACE WATERS

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CSBE100222 – A method for estimating the effects of drainage water management (DWM) or controlled drainage (CD) on nitrogen (N) losses in drainage water was evaluated using a DRAINMOD simulation analysis. The method assumes that the effect of DWM on N losses is proportional to its effect on drainage volume. The analysis was conducted for a Portsmouth sandy loam (sl) in eastern North Carolina. DRAINMOD-NII simulations predicted that DWM would reduce 35-yr average N losses to surface waters by 37% for continuous corn and 34% for a corn-wheat-soybean rotation. The effectiveness of DWM on reducing annual N losses varied from 18 to 58% over the 35 year period. Results showed that the approximate method could be used to estimate the effect of DWM on annual N loads. The method estimated the annual effect of DWM on N losses within 3 kg/ha of that predicted by DRAINMOD-NII in 18 of 35 years. Over-estimated effects in some years were balanced by under-estimated effects in others, so that the method accurately predicted the effect of DWM in the long run. However, the accuracy of the approximate method is dependent on determining the average flow weighted N concentration of the drainage water. Overall, the approximate method appears to be a promising means of assessing impacts of DWM for purposes of nutrient trading.

EFFECTS OF DRAIN DEPTH ON NITRATE-N AND PHOSPHORUS LOSSES FROM DRAINED AGRICULTURAL LANDS RECEIVING NITROGEN AND PHOSPHORUS FROM ORGANIC SOURCES

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CSBE100224 – Nitrate and phosphorus losses from drained agricultural lands are an important environmental concern. Installation of subsurface drainage systems at depths more shallow than typical depths has been proposed as a method for reducing nitrate nitrogen (NO₃--N) losses in a manner similar to that of controlled drainage. Data were collected from two drainage systems near Plymouth, NC to determine the effect of drain depth on losses of NO₃--N and orthophosphate (OP). Drains in the deep system were 1.5 m deep and 25 m apart while drains in the shallow system were 0.75 m deep and 12.5 m apart. Both plots received swine wastewater applications during the first 31 months of the study (October 2002 to April 2005). Overall, the shallow drain system reduced outflows by 17.1% for this period. No significant differences were observed in the NO₃--N concentration of the drainage water between the plots; however, the OP concentration in the drainage water of the shallow plot was significantly higher. NO₃--N export was reduced by 9.8% at the shallow drain plot during the course of the study. Results of this study were complicated by the application of N and P as swine wastewater which apparently resulted in preferential flow immediately after applications causing relatively high loads of N and P directly to the shallow drains. This phenomenon would not likely occur in cropland where N and P are applied as inorganic fertilizer. This study was continued on the same site for 36 more months (July 2005 through June 2008) using inorganic N and P as fertilizer. This paper reports the effects of drain depth on NO₃- -N and OP losses from the study site when organic N and P fertilizer was used.

WATER REDISTRIBUTION WITHIN THE POTATO ROOT ZONE FOLLOWING IRRIGATION

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CSBE100225 – Monitoring crop water uptake and soil water movement within the root zone is critical for designing drainage systems. The objective of this study was to monitor the water movement within the root zone after the soil was fully saturated by irrigation. This experiment was conducted in Winkler, Manitoba, in a potato field instrumented with 15 Time Domain Reflectometry (TDR) miniprobes embedded in a vertical plane within the root zone for each replicate. The TDR miniprobes were installed at five different depths (0.1, 0.2, 0.4, 0.6, and 0.8 m) and at three different radial distances (0.15, 0.3, 0.45 m) from the base of the potato plant. Three such replicates of TDR probes were installed at vertical planes located one meter apart. A 5 m by 5 m area was blocked off, and 50 mm depth of water was applied to bring the soil to saturation within this area. The initial water content measurement prior to this irrigation event and at periodic intervals thereafter was carried out over a four-day period. In general, the volumetric water content showed an increasing trend with depth during the four-day period. However, with time, the water content decreased in every layer except the deepest layer indicating upward movement of water from below the root zone. The results also showed that moisture depletion in the upper layers of soil was replenished overnight. The overnight increase in water content within the root zone can be attributed to capillary rise of water from below the root zone [...].

ASSESSMENT OF ROOTZONE WATER REDISTRIBUTION IN CORN FOLLOWING IRRIGATION

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CSBE100227 – An understanding of the water redistribution pattern within the corn rootzone will help design better irrigation and drainage systems. The objective of this research was to use time-domain reflectometry (TDR) miniprobes to measure water content within the rootzone of corn at different locations within the rootzone as a function of time. Forty-five TDR miniprobes were installed, in three vertical planes, for measuring volumetric water content and salinity within the rootzone of a corn field located in Winkler, Manitoba. The probes were inserted at 0.1, 0.2, 0.4, 0.6, and 0.8 m depths from the ground surface and at 0.12, 0.24, and 0.36 m radial distances from the base of the corn plant. The soil was thoroughly wetted by applying 50 mm of water within the experimental site. The volumetric water content was measured before and at periodic intervals after the irrigation event. The evening following the irrigation event showed an increase in water content within the entire soil profile. The water content started to decline as the days progressed. However, during the mornings, the soil within the root zone seemed to show an increase in water content when compared to the previous afternoon. An examination of the water content distribution within the root zone indicated an upward migration of water from soil layers located below 0.8 m.

DRAINAGE DESIGN PRACTICES IN IRRIGATED AGRICULTURE; NEW CONCEPTS GAINED FROM RECENT EXPERIENCES IN THREE COUNTRIES OF MAGHREB, NORTH AFRICA

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CSBE100228 – Subsurface drainage is a current of irrigated agriculture under arid and semi arid climates. Most of Magherb (Maroc, Tunisia, Algeria) large schemes have been installed in the 70-80's. These three countries are preparing "green plans" meaning plans for agriculture intensification and promotion of irrigation re-engineering for both existing and future schemes. The background of these plans is to reduce to nil the water losses, that implicates to apply less irrigation water than required by crops. In this context what should be the place of drainage: are existing drainage to be rehabilitated and future systems likely to be equipped with tiles ? if yes, according to which design criteria and environmental stakes? here are the basic questions of the paper. In first place the aim of drainage and the current design criteria are reviewed in the three countries. After what we will highlight the issues of the re-ingeneering from an analysis of the current situation the irrigation schemes; for this purpose we will issue monographies of three irrigation schemes, the choice of which being based on a typology. The monographies will report of more than 10 years of north/south cooperation including performance assessment, gray literature, results of on farm experimentation, farmer's practices. The three choosen schemes browse various climatic conditions from Humid Mediterranéan (Gharb, Morocco) to arid (Bas Chelif, Algeria) and Saharian (Fatnassa oasis, Tunisia) and various sizes from 100000 ha, 7 000 ha, 300 ha respectively.

MINNESOTA AGRICULTURAL DITCH REACH ASSESSMENT FOR STABILITY (MADRAS): A DECISION SUPPORT TOOL

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CSBE100229 – Selected ditches in Minnesota and throughout the upper Midwestern USA have become morphologically unstable via geotechnical failure, channel enlargement and/or aggradation. Most ditches adjust channel form over time; some remain stable whereas other ditches unravel and require thousands of dollars worth of maintenance. Unstable ditch channels in Minnesota have also resulted in loss of biotic habitat and excessive sediment transport to downstream water bodies resulting in an impaired waters designation under the Clean Water Act, Section 303(d). There are climatic, geologic and land use reasons why ditch channels become unstable over time. We provide an assessment tool for evaluating channel and bank processes occurring within a given ditch reach. The tool systematically considers factors driving ditch channel instability and offers potential remediation actions related to nutrient attenuation. MADRAS is a relatively rapid assessment tool that considers both channel hydraulics and geotechnical factors associated with channel instability. A ditch reach must be walked by an evaluator to gather field evidence and determine processes such as toe slope erosion, bank seepage, bank angle, vegetation, slumping and the relative in-channel sediment storage and transport. Observations of physical processes and hydrologic pathways are documented and then interpreted to diagnosis the ditch condition. Localized ground water seepage induced slumps require a different solution compared to bank slumping induced by systematic hydrologic changes within a watershed. Ditch reach assessment offers the local drainage authority a means to [...].

LESSONS GAINED FROM FRENCH R&D PROGRAMS FOR PESTICIDES DISSIPATION BY USE OF CONSTRUCTED WETLANDS

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CSBE100231 – Pesticide pollution is a major threat of surface water quality in France. To comply with the European Water Framework Directive (2000/60/EC), authorities have decided to implement a Phyto-Pharmaceutic Products or pesticide reduction plan. It targets a 50% reduction of pesticide inputs by 2018. This plan only considers actions on farming practices and does not foresee any actions on transfers through catchments, assuming that pre-existing buffer strips are efficient. This assumption is not verified on a significant part of the territory for which complementary solutions for the control of pesticide transfer have to be found. Thanks to two R&D research programs regarding constructed wetlands, we got the opportunity to improve the state of the art, assess the performance of constructed wetlands and find economical, legal and social incentives for further nationwide extension. Two constructed wetlands were tested at both pilot and field scales. On-site wetlands were located at the outlet of sub-surface artificially drained catchments. Two contrasting regions have been chosen as well. In all cases climatic parameters, and water and pesticide flows in and out have been measured and monitored. We also recorded the conditions of implementation since we were very close to real conditions. For this [...].

ESTABLISHING A RELATIONSHIP BETWEEN HYDRAULIC EFFICIENCY AND TREATMENT PERFORMANCE IN CONSTRUCTED WETLANDS

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CSBE100232 – Best practices for managing drainage water quality include the use of constructed wetlands for reducing nutrient loads. Nutrient reduction can be related to the hydraulic performance of a wetland. Hydraulic indexes used for quantifying the hydraulic efficiency of a wetland have more value when they can be used to predict treatment ability. This paper evaluates a number of common indexes describing hydraulic efficiency and relates them to the expected treatment derived from time dependant first order nutrient reductions. There is a need for a hydraulic index demonstrating strong correlation to pollutant reduction in order to identify the optimal wetland configuration for maximizing residence time. Such an index should quantify the effects of the various wetland parameters that influence the residence time distribution and supply the bounds for pollutant reduction.

DYNAMIC ANALYSIS OF A TRACTOR ENGINE CRANKSHAFT IN KNOCKING PHENOMENON

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CSBE100238 – Knocking phenomenon is an important problem in engine body, connecting rod and crankshaft design in engines. If knocking continues, all of parts of the engine may be destroyed. While the pressure peak in combustion chamber is closing to head dead center (HDC), the knocking phenomenon occurs in a transient manner. Decreasing crank angle between pressure peak and HDC point and increasing pressure peak value due to the decreasing peak angle are the reasons of knocking failure. In this research, the effects of decreasing crank angle between pressure peak and HDC on transient response (maximum stress) of a in-line four-cylinder diesel tractor (MF285) engine crankshaft were considered while the pressure peak values were kept constant to clean its effects. For this reason, a virtual model of the crankshaft was modeled in Catia engineering software. [...] The pressure peaks of each journal loads were shifted from natural crank angle (18 degrees after HDC) to HDC point using a linear function to shrink and expand the crank angles. The results were shown which the strength of the crankshaft increases when the pressure peak angle is closing to HDC. Namely if the peak angle is closing to HDC, the transient response stress decreases. Therefore, increasing the pressure peak value due to decreasing the peak crank angle is the reason of crankshaft failure in knocking phenomenon. In this research, also, it has been tried to present a logical method to do a complete transient analysis on crankshafts.

INFLUENTIAL PARAMETERS FOR DESIGNING AND POWER CONSUMPTION CALCULATING OF CUMIN MOWER

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CSBE100239 – Cumin mower is under study and it doesn't market yet because of spatial conditions such as short height, harvest moisture content et cetera of cumin plant. For this reason, in this study, different tests were performed to measure parameters required for calculating power consumption and designing cumin mowers. Hence, some mechanical properties of cumin stems were measured. They included shearing and bending tests on cumin stem and specifying the coefficient of friction between mower knives and cumin stem. After that, relationships between static and dynamic friction forces being exerted on mower runners (soles) by soil with normal load on them and important factor of soil moisture content were found out. Harvest moisture content, maximum and average of cumin stem diameter, were calculated [...]. Also, maximum bio-yield point force in cutting cumin stem, maximum ultimate point force in cutting cumin stem, maximum elasticity module, average energy require to cut a cumin stem, maximum bending rupture force, average energy for bending a cumin stem, friction coefficient between the stem and knife edge were calculated [...]. Relation between bio-yield force, failure force, elasticity and diameter in cutting cumin stem, relation between rupture forces and diameter in bending a cumin stem and relation between pulling force against soil friction and mower weight are also some of [...].

DESIGN AND MANUFACTURING OF A NEW AND SIMPLE MECHANISM FOR TRANSMISSION OF POWER BETWEEN CROSSOVER SHAFTS UP TO 135 DEGREES FOR FARM MACHINERY

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CSBE100240 – In this paper we present a new mechanism developed for transmission of power between crossover shafts. The mechanism consists of one drive shaft and one driven shaft, 6 guide arms, and 3 connecting arms. In this mechanism, the angle between the input and output shafts (crossover shafts) can be varied up to 135 degrees, while the velocity ratio between input and output shafts remains constant and equal for all angle of rotation, and the maximum input speed is 2000 rpm. We first present the kinematics diagrams and then the equations of design. Simulation results using Visual NASTRAN, Autodesk Inventor Dynamic, and COSMOS motion software showed that this mechanism could transmit constant velocity ratios at all angles formed between the shafts. Finally, tension analysis of the mechanism at 2000 rpm and input shaft torque of 1000 N.m, using ANSYS software, showed that the highest tension occurred in the connecting arms.

THE RELATIONSHIP BETWEEN WATERSHED PHYSIOGRAPHY, TILE FLOW, AND STREAMFLOW CHARACTERISTICS

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CSBE100241 – The slow (base flow) and the quick (surface runoff and tile flow) responses of the stream flow are key components to characterize a watershed for its physiographic and geological features. The overall objective of this study is to separate baseflow from streamflow and its relationship to physiographic characteristics of a watershed. A computer program was developed to quantify the amount of base flow index (BFI, base flow/stream flow) using six methods for 161 watersheds in Ontario. The lowest amount of baseflow is generated by digital filter method and the highest by base sliding method. Out of 115 watersheds in southern Ontario, 30 can be classified as slow response watersheds, 9 as rapid response watersheds, and 66 as medium response watersheds. For the 46 watersheds in northern Ontario, all the watersheds can be classified as slow response watersheds. The analysis of effect of tile drains on base flow showed that tile drainage reduces the amount of baseflow contribution to streamflow. Results also showed that base flow index and runoff coefficient are affected by hydrologic soil group, soil drainage class, and percent of tile drained area. It was also observed that when percentage of heavy textured soil increases, most of the streamflow contribution to the stream is as a rapid flow.

THERMO-PHYSICAL AND TEXTURAL PROPERTIES OF MEAT AND CARROT ALGINATE PARTICLES FABRICATED FOR BIOLOGICAL VALIDATION STUDIES

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CSBE100242 – Aseptic processing & continuous rotary autoclaving of particulate foods are facing challenges for process establishment since conventional temperature gathering techniques cannot be used for these products. A potential alternative is the biological validation concept where bacterial spores are dispensed in firm and thermally stable food simulated particles. Simulated particles can be prepared by adding sodium alginate to the material base & then dispensing the microbial spore culture into the puree, molding the puree to the desired shape & allowing the particle to shape in a solution of sterile calcium chloride. The objective of the study was to investigate the thermophysical and textural properties of meat and carrot alginate fabricated particles as influenced by the process variables. A response surface methodology (RSM) was used to study the effect of sodium alginate concentration (1.5-6.5%), calcium chloride concentration (1.0-3.0%) & dipping time (4-44 h) on the thermophysical and textural properties of the fabricated particles. The results showed that increasing sodium alginate concentration and dipping time significantly ($p < 0.05$) increased the hardness and decreased the adhesiveness values. Increasing sodium alginate concentration resulted in a significant ($p < 0.05$) decrease in the heat capacity, thermal conductivity and thermal diffusivity values. Optimal conditions for fabricating food simulated particles that are thermally stable and have similar thermophysical properties to the real foods were 5.5% sodium alginate, 2.4% calcium chloride and 33.8 h immersion time for the carrot/alginate vs. 4.9% sodium alginate, 1.7% calcium chloride and 36 h immersion time for the meat/alginate reconstituted particles. These data are of potential value to fabricate food/alginate particles for the biological validation studies.

PRELIMINARY STUDY OF THE WRSIS CONCEPT AT THE PADDY-UPLAND CROPS ROTATION AREA IN SOUTHERN CHINA

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CSBE100243 – The central demonstration zone of the 16.47 acre Wetland Reservoir Sub-irrigation System (WRSIS) concept field is summarized based on current conditions including irrigation and drainage systems with subsurface drain pipe, constructed wetland, water supply reservoir, monitoring system and other related facilities. The irrigation water is imported from the reservoir to the underground pipeline network by pumping. The drainage waters are routed to the constructed wetland system under gravity through the drainage pipe network. The constructed wetland system consists of three components for drainage water treatment; a ditch wetland, a subsurface vertical flow component, and a surface flow component. Treated water is then routed to the reservoir by pumping. The purpose of the study is to study the effect of the WRSIS concept in increasing crop yields and improving water quality, to study how to link the constructed wetland and irrigation/drainage systems, to identify the best type and size of a constructed wetland and identify the optimum local wetland vegetation, and to reduce the agricultural non-point source pollution by using water-saving irrigation technology and controlled drainage technology. These goals are under study as potential modifications of the WRSIS concept as applied to China. A two-year preliminary study showed that the hydraulic structure used to control the outlet water level is appropriate to control water table in paddy field, and helps increase the use of irrigation water and rainfall. The structure has proven useful to drain rice and upland crops and increase the yields. A reduction in total nitrogen (TN), total phosphorus (TP), NH₃-N and NO₃-N [...].

A HYBRID WAVELET TRANSFORM-BASED AGRICULTURAL IMAGE DE-NOISING ALGORITHM

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CSBE100250 – In order to solve a problem that conventional de-noising methods do not address regarding agricultural images for their diversity and biology characteristics, a new de-noising method based on Generic Algorithm (GA) is proposed in this article. Wavelet de-noising has the advantage to keep the image details information and Wiener Filter can obtain an optimal solution. This algorithm synthesizes the advantages of Wavelet de-noising and Wiener Filter. Firstly, using the image de-noised by Wavelet de-noising as male parent of the Hybrid Wavelet Transformed initial population, and image de-noised by Wiener Filter as female parent. Then the individual images were evaluated with fitness function of maximum between-cluster variance. Through the hybrid and mutate operation to realize gene recombination, and then extracting the superior gene of the two images de-noised by Wavelet de-noising and Wiener Filter. Lastly, with the finite order hereditary algebra to obtain an offspring image which has both advantages of male parent (Wavelet de-noising) and female parent (Wiener Filter). The performance of this algorithm was tested for Red jujube images and wheat images. The results show that images de-noised by the proposed method in this paper have a higher PSNR (77.83 for red jujube and 79.89 for wheat) than those processed by conventional methods, and have both the characters for lower noise and clearer edge feature for the viewer.

AN EXPERT SYSTEM FOR PLANNING AND DESIGNING MILKING PARLOUR CONSTRUCTIONS

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CSBE100252 – To plan and design milking parlours, several calculations should be made such as: the dimensions of cow platform, parlour pit, entry and exit alleys, collecting yard, and milk rooms. These items are calculated from input information such as: parlour size, layout, and design. This process requires time and effort, with the possibility of making mistakes. The objective of this paper is to develop a tool to assist the designers in planning and designing milking parlours, to save time and effort, and to provide a new design model. A mathematical model was developed to plan and design milking parlours and their concrete constructions. Subsequently, an electronic spark map (decision tree) was developed, and then the mathematical model was integrated into the electronic spark map. Afterwards, C# (C Sharp) programming language was used to develop an expert system via the electronic spark map, and to make the user interface. The developed expert system represents the main innovation of this paper, where it is able to plan and design the milking parlour, specify its dimensions, and compute the required amounts of construction materials to build the required concrete layers. Furthermore, it calculates the capital investment and the fixed, variable, and total costs. Data of 5 milking parlours were used to carry out the validation, evaluation, and calibration of the expert system. The differences between actual and calculated values were determined, and the standard deviations were calculated. The coefficients of variation range between 3% and 7%.

IMPLICATIONS OF AGRICULTURAL DRAINAGE WATER REUSE: I. CROP YIELD AND WATER PRODUCTIVITY

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CSBE100253 – Global water scarcity and crisis, especially in arid and semi-arid regions, necessitate reuse of agricultural drainage water for irrigation as a non-conventional water source. Egypt is one of the leading countries in the reuse of drainage water for irrigation. This study aims to assess the impacts of agricultural drainage water reuse for irrigation on the quantity and quality of crop yield and water productivity. In addition, to investigate the suitable ratios of mixing fresh with drainage water that will be safe in using agricultural drainage water for irrigating field crops. The study was carried out at King Maryout, Egypt on Egyptian clover and wheat crops, these crops were irrigated by different mixing ratios of Fresh Water (FW) and Drainage Water (DW) (100: 0 (T1), 75: 25 (T2), 50: 50 (T3), 25: 75 (T4) and 0: 100 (T5)). The results revealed that the germination percentages of clover and wheat were decreased from 100% to 85% and 100% to 78%, respectively, with increasing DW ratio in the mixed irrigation water from 0% to 100%, respectively. Furthermore, water productivity (Wp) of clover decreased with increasing DW with exception to T2 and T3. The decreasing of Wp was (13.64, 20.74, 25.66, and 36.15 % for wheat plant as a whole), (7.05, 10.97, 16.48, and 30.96% for wheat grains) and (8.88, 16.83, 20.95, 28.26 % for wheat straw) for T2, T3, T4, T5 compared with T1.

DEFICIT IRRIGATION AS AN AGRICULTURAL WATER MANAGEMENT SYSTEM FOR CORN: A REVIEW

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CSBE100254 – Traditional irrigation practices in many areas of the world are designed to maximize yields by avoiding crop water stress. This fundamental precept of irrigation management will probably be forsaken. Maximizing total benefits rather than yields will be the new strategy that replaces this precept. Deficit irrigation can be defined as an agricultural water management system in which less than 100% of the potential evapotranspiration can be provided by a combination of stored soil water, rainfall, and irrigation during the growing season. Deficit irrigation is not only strategy to save water or to increase water use efficiency, but is becoming the pattern in water scarce areas. The stakeholders need guidance from the scientific, economic or engineering communities. This article is a widely literature review to present a broad guidelines to the stakeholders including deficit irrigation definitions and concepts, practices, economics, management, and with the focus on deficit irrigation as a water management system for corn (maize) based on crop water use, yield and yield components, water-yield relations, and water productivity. The optimization models and the tools for implementing the scenarios, strategies, and policies of deficit irrigation management also presented. The potential benefits of deficit irrigation derive from three factors: reduced costs to production, greater irrigation water use efficiency, and the opportunity costs of water. Optimum water use implies deficit irrigation. Crop yield is usually linearly related to crop evapotranspiration from the yield threshold up to the point of maximum yield. Crop yield can be reduced by plant water stress that is caused by limited soil [...].

PURLEAR CREEK HABITAT RESTORATION CASE STUDY

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CSBE10255 – Beginning in 2005, North Carolina State University and the North Carolina Division of Forest Resources implemented a comprehensive stream restoration project on Purlear Creek on the Rendezvous Mountain Educational State Forest property in Northwestern North Carolina, USA. The goals were to improve water quality and habitat in mountain streams to provide recreational fisheries. Purlear Creek serves as a public demonstration and research site to promote best management practices for restoring and maintaining natural stream functions in watersheds with excessive stream sedimentation resulting from forestry and agricultural land uses. The restoration project included several components: (1) stream channel realignment and floodplain vegetation planting for a 200-m tributary in 2006; (2) restoration of a 2-ha wetland by ditch-plugging and planting in 2006; (3) streambank stabilization and in-stream structure installation in a 500-m reach of Purlear Creek in 2007; (4) stream channel realignment and floodplain vegetation planting for a 600-m reach of Purlear Creek in 2007; and (5) stream channel realignment and floodplain vegetation planting for a 500-m reach of Purlear Creek in 2009. During each phase, engineered plans were created based on reference streams to restore natural physical and ecological stream functions. During construction, educational workshops were conducted to teach contractors, consultants, and agency representatives about natural stream construction techniques. Comprehensive project site monitoring includes hydrology, morphology, vegetation, and in-stream habitat. [...].

THE POTENTIAL OF USING A NEW AGRICULTURAL SYSTEM FOR IMPROVING WATER PRODUCTIVITY OF WHEAT

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CSBE100256 – Wheat is one of the preeminent cereal crops in the world; it supplies much of the world's dietary protein and food supply, especially in Egypt, because it is the main source of food. In the last few decades, there has been a great interest from scientists and researchers to explore new agricultural systems in order to increase crop yield and water productivity, save irrigation water, decrease the risk and the associated hazards of late wheat cultivation, and to avoid early harvest of long season crops that precede wheat season. In addition, taking advantage of cultivating a short season crop between summer and winter seasons such as Egyptian clover, vegetables, fodder crops...etc. This study was carried out at Enshas Experiment Station, Water Management Research Institute, Sharkiya, Egypt. The study mainly aimed to investigate the possibility of transplanting wheat as a new agricultural system and its impact on water use, crop yield, and water productivity compared with the traditional sowing method. Three treatments of plant populations (4, 6, and 8 rows/bed) (T1, T2, and T3), respectively, were applied with both planting methods. Both wheat nursery and treatments of traditional method were planted on November 15. But the transplanting treatments were planted on January 15, two months late. The preliminary results revealed that the transplanting method saved 21% of total water applied compared with the traditional method. On the other hand, crop yields were 5.0, 5.7, and 7.1 t/ha and 3.7, 4.7, and 5.0 t/ha for T1, T2, and T3 with new and traditional planting methods, respectively. Crop water productivity (CWP) of the transplanting method was greater than the traditional method by 3.82% for T2. On the contrary, CWP of the traditional method was higher than the transplanting method by 4.8 and 10.9% for T1 and T2, respectively. [...].

HYDROLOGIC MODELLING OF AN AGRICULTURAL DRAINED MICRO-WATERSHED: PERFORMANCE ANALYSIS OF COUPLED SURFACE WATER/GROUNDWATER MODELS

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CSBE100258 – The objective of this study is to quantitatively assess the impact of subsurface drainage and soil properties on the hydrological behaviour of a headwater micro-watershed located in the Bras d'Henri watershed, Quebec (Canada). The studied 2.4-km² micro-watershed is characterized by intensive livestock production supported by forages and annual crops such as corn grain or soybeans. It is one of Agriculture and Agri-Food Canada's WEBs watersheds (Water Evaluation of Beneficial management practices). Hydrometeorological monitoring has shown that soil properties and subsurface drainage could negatively affect the expected behaviour of beneficial management practices at the watershed scale. Therefore there is a need to understand the influence of these properties on hydrology and one way to study this problem is to set up a physically-based hydrological modelling investigation. Specifically, this project focuses on evaluating the ability of two or three coupled hydrological models (surface flow/subsurface flow) to simulate flows at the micro-watershed outlet and water table depth fluctuations while quantifying the surface and subsurface contributions to flows. [...].

A COMPARISON OF MIKE SHE AND DRAINMOD FOR MODELING FORESTED WETLAND HYDROLOGY IN COASTAL SOUTH CAROLINA, USA

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CSBE100261 – Models are widely used to assess hydrologic impacts of land-management, land-use change and climate change. Two hydrologic models with different spatial scales, MIKE SHE (spatially distributed, watershed-scale) and DRAINMOD (lumped, field-scale), were compared in terms of their performance in predicting stream flow and water table depth in a first-order forested watershed in coastal South Carolina. The model performance was evaluated using the coefficient of determination (R²) and Nash-Sutcliffe's model efficiency (E). Although both models performed reasonably well in predicting monthly and annual average water table depths and stream flow with acceptable E values (0.55-0.99) for the five-year period (2003-2007), MIKE SHE yielded better results than DRAINMOD for daily hydrologic dynamics. Both models, however, showed relatively large uncertainty in simulating stream flow for dry years. The subsurface drainage predicted by MIKE SHE was lower than simulated by DRAINMOD for dry years, higher for extremely wet years and similar for normal climate years. The differences were likely that MIKE SHE employed distributed physical characteristics of the watershed, especially of soil and topography which can substantially affect the subsurface flow, but the spatial average condition was only used by DRAINMOD; the results from both models were, thus, similar for those average (e.g., normal climate) conditions, and different for varying conditions. This study suggests a lumped parameter model could perform equally well at the monthly temporal scale for modeling stream flow under average climatic conditions; however a distributed hydrological model provides more accurate prediction of daily stream flow and water table depth across varying climatic conditions.

ERGONOMIC ASPECTS OF OPERATION OF IT SYSTEMS IN PRECISION AGRICULTURE

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CSBE100263 – The operation of IT systems is a *sine qua non* condition in precision agriculture. In the traditional approach, professional competencies of a farmer comprise the ability to operate machines and technical equipment in production technologies for biological raw materials. Precision agriculture increases this range of professional competencies with the ability to use computer IT systems that are complex and, by their very nature, much differing in their content and scope from typical farming knowledge. The ergonomic problem can be brought down to determining whether the operation of IT systems in precision agriculture is adjusted to the predispositions, needs and skills of the farmers. Generally, in the IT system of precision agriculture, three phases can be differentiated: data collection, processing and application. To what extent should they be operated by the farmer, and to what extent by the IT specialist, is the problem that determines effective functioning of precision farming. The ergonomic assessment of some software for equipment operation, generation of harvesting maps and applications points to: (1) the need for standardisation in construction and operation of IT systems, (2) the division of the function – farmer and IT specialist (e.g. from an agriculture consulting institution) in the precision agriculture system.

CLASSIFICATION OF PRE-SLICED HAM IMAGES WITH QUATERNIONIC SINGULAR VALUES USING AN ADAPTIVE MULTILAYER PERCEPTRON

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CSBE100264 – The quaternionic representation of ham images, treating RGB colour components as a single unit instead of as separate components, is very effective. The advantage of using quaternion arithmetic is that the perceptually richer colour images can be represented and analyzed as a single entity, improving the accuracy of pattern recognition models. The quaternionic singular value decomposition (SVD) is a technique to decompose a quaternion matrix into quaternion singular vector and singular value component matrices exposing useful properties. [...] The objective was to use a small portion of uncorrelated singular values, as robust features for the classification of sliced ham images, using a supervised artificial neural network classifier. Images were acquired from four qualities of sliced cooked pork ham typically consumed in Ireland (90 slices/quality), having similar appearances. Mahalanobis distances and Pearson product moment correlations were used for feature selection. The dimensionality reduction procedure excluded atypical features and discarded the redundant information. An adaptive multilayer perceptron classifier was successfully employed, using a reduced feature space of six singular values. The overall correct classification performance for the test set was 86.1%. Results confirmed that the classification performance was satisfactory. Using the most informative features as input to the multilayer perceptron classifier led to the recognition of a set of different but visually quite similar textural patterns.

NON-DESTRUCTIVE MEASUREMENT OF SSC, pH, FIRMNESS AND DENSITY OF ‘DANGSHAN’ PEAR USING FT-NIR SPECTROMETRY

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CSBE100265 – This research aims to investigate the feasibility to rapidly determine the quality characteristics of Chinese ‘Dangshan’ pear by using near infrared (NIR) spectroscopy. A total of 151 ‘Dangshan’ pears with various ripen stages were used in this study. The NIR spectrum from each fresh intact sample was calibrated against four major physiological properties: soluble solid content (SSC), pH, firmness and density. The calibration models for these parameters were developed using the partial least square (PLS) based on the original and the four preprocessed spectra, respectively. The optimum spectral regions, the best pretreatment method and the fewest number of regression factors in the PLS-models were decided according to the minimum standard error in cross-validation (SECV). Finally, the proposed calibration models were validated using an independent sample set to evaluate their predicting ability. The best models for SSC, pH and firmness showed good predictability with the lowest standard error of prediction (SEP) of 0.349⁰Brix, 0.081 and 0.310N, and corresponding correlation coefficients of 0.985, 0.910 and 0.905, respectively, indicating that it is possible to measure SSC, pH and firmness of Chinese ‘Dangshan’ pear by using NIR spectroscopy. However, validation results also showed that no satisfactory NIR calibration equation for the density could be obtained.

DEVELOPMENT OF A SYSTEM FOR PATTERN OPERATIONS

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CSBE100266 – Global and Local Positioning Systems are becoming more and more standard on agricultural vehicles mainly for vehicle and implement guidance. In addition to that automation systems are also being integrated. In this field an increasing need is visible to perform field tasks using certain patterns instead of performing broad acre operations. For example, orchard operations and seed plots require planting, spraying and fertilizing with respect to certain patterns. Therefore a system including hardware, algorithms and user interface was developed to allow a vehicle with automatic steering capability to also perform operations for patterns based on GPS positions. To prove the concept and accuracy of a John Deere 6000 series tractor with an automated steering system AutoTrac was equipped with a controller on the implement to trigger pattern tasks. For these tests a high speed vision system was used in combination with a self-designed geo-referenced test track. As a second step the system was tested in field operations using a John Deere 4000 series tractor with a plot seeder which delivered promising results. The results from the measurement showed, that planting and other operations can be triggered with accuracies greater than ± 3 cm. It was also possible to document the position of the plants employing the standardized ISO 11783 Task Controller documentation system. More tests with further implements will be needed to demonstrate capabilities of the system for other applications.

EFFECT OF DIFFERENT VARIABLES ON MICROWAVE OSMOTIC DEHYDRATION UNDER SPRAY MODE (MWODS) OF APPLE CYLINDER USING RESPONSE SURFACE METHODOLOGY

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CSBE100267 – Microwave osmotic dehydration under continuous flow medium spray (MWODS) condition is an innovative concept with the potential for enhancing the process mass transfer kinetics as well as improved product quality. The effect of different osmotic variables on mass transfer kinetics and process modeling are important for managing the osmotic dehydration process. A response surface methodology was used for quantifying and modeling the moisture loss and solids gain kinetics of apples during of MWODS process. Experiments were designed according to a central composite rotatable design with all independent variables included at five levels (sucrose concentration, 33.3 - 66.8 °B; temperature, 33.3 - 66.8 °C; flow rate, 2120-3480 ml/min and contact time, 5-55 min). The process responses were moisture loss (ML), solids gain (SG) and weight reduction (WR) and were related to process variables using second order polynomial regression models. The lack of fit was not significant ($p > 0.05$) for any of the developed models. Contact time and temperature of the solution were the most significant factors affecting the ML during MWODS process followed by sucrose concentration. For SG, the effect of contact time was more pronounced than sucrose concentration and temperature. The effect of flow rate was significant with only ML. A rate factor to describe the drying behavior was chosen in the form of ML and SG over a 30 min treatment (typical of osmotic pre-treatments in most applications). These rates were responsive to the osmotic treatments increasing with concentration, flow rate and temperature of osmotic medium.

USING EARTH OBSERVATION DATA FOR SOIL DRAINAGE CLASSIFICATION AND MAPPING

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CSBE100271 – The potential of earth observation (EO) data for soil drainage classification and mapping has been investigated in a series of research projects using various EO data at different scale. First, soil drainage classification models are developed for specific land use types using optical EO data (ASTER, LANDSAT or IKONOS) for the segmentation of the study area. Afterwards, the relationship between soil drainage classes and EO data (radar and optical) is integrated into statistical models (discriminant analysis, multiple regression, and decision tree) using soil survey information (soil map and soil profile description and analysis). In a study conducted in the Bras d'Henri watershed (167 km²) to update and upgrade old soil survey maps, a set of five RADARSAT-1 images, with different SAR configuration, and an ASTER image were used for soil drainage mapping. A supervised maximum likelihood classification was applied on ASTER bands for land use segmentation. Backscattering coefficients from RADARSAT-1 data and spectral indices from ASTER data were evaluated in stepwise procedures using the 1612 soil profiles classified by soil survey experts. Classification accuracy was higher (75-88 %) with the decision tree classifier (DTC) compared to the discriminant analysis classifier (DAC). The soil drainage map produced with the DTC method was more similar to the conventional soil drainage map than the one derived from the DAC method. A study on the digital soil drainage mapping was also conducted in a broader agricultural area (Monteregie, near Montreal, QC) at the regional [...].

HOW TO RECTIFY DESIGN FLAWS OF DAIRY HOUSING IN HOT CLIMATES?

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CSBE100276 – Small dairy farms in hot climates are encountering several problems caused by design flaws of the implemented housing designs. Consequently, heat stress increase and milk yield dramatically decreases, which leads to economic deficiency of the farm. One key issue is to develop simple means to rectify the design flaws with minimum costs. In order to develop feasible means, design flaws were detected in 14 small dairy farms in Egypt to exemplify the flaws of housing designs in arid and semi-arid zones. A package of interconnected solutions is suggested to rectify the design flaws. Subsequently, the maximum temperature, dry-bulb temperature, black-globe temperature, dew point, relative humidity, shaded area, and air velocity were measured inside the rectified vs. non-rectified cowsheds and compared after conducting the statistical analysis. On the other hand, the Temperature-Humidity Index (THI) and Black Globe Humidity Index (BGHI) were calculated to find out the level of heat stress affecting the dairy cows. Furthermore, the milk yield, respiration rate, skin temperature, feed intake were recorded and compared. Moreover, the costs of the developed means were calculated and a feasibility study was carried out. The results showed that the developed means are effective and feasible, where the heat stress decreased (THI decreased from 94.6 to 83.7; dry-bulb temperature decreased from 42.7 to 33.6 °C) and the average milk production increased from 18 to 26 kg/day.cow. [...].

LASER LIGHT BACKSCATTERING FOR MONITORING CHANGES IN MOISTURE CONTENT DURING DRYING OF APPLES

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CSBE100280 – Measuring and controlling the moisture content of a product during processing is essential in the food industry. The present investigation proposes the use of laser diode sensors at 635 and 785 nm wavelengths as a novel approach for monitoring changes in moisture of apple slices (*Malus domestica*) during drying. We hypothesized that changes in backscattering profiles during drying would allow prediction of changes in moisture content via the mechanism of altered light propagation in the fruit tissue. To test this hypothesis, apple slices were dried in a high precision through-flow laboratory dryer at air temperatures of 60 and 70 °C, with 10 g/kg absolute humidity and air velocity of 0.9 m/s. The moisture content was determined by the standard oven method. Backscattering images of ten slices were acquired every 30 minutes over three hours of drying, with a digital CCD camera connected to a PC. Laser parameters (backscattering area and luminescence) were highly correlated with the moisture content with Pearson coefficients of 0.95 and 0.96, at 635 nm wavelength and of 0.74 and 0.87 at 785 nm wavelength. A multi-factor ANOVA test showed a significant effect of moisture content on the entire scattering profile. In conclusion, light propagation inside the tissue may represent an innovative and reliable technique for rapid and contactless evaluation of apple drying.

CONJUGATED LINOLEIC ACID FORMATION BY HYDROGENATION ISOMERIZATION OF SAFFLOWER OIL OVER BIFUNCTIONAL NOVEL STRUCTURED CATALYST

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CSBE100287 – Directed isomerization of safflower oil under very low hydrogen partial pressure of 7 psi over novel bifunctional and bimetallic highly structured catalysts, having narrow pore size distribution ranging from 4 to 8 nm, and BET-specific surface of 710-1000 m²/g, was investigated as a new chemocatalytic approach for vegetable oil hardening and simultaneously producing health-beneficial conjugated linoleic acids (CLA). Time course profiles of (cis-9, trans-11)-; (cis-10, trans-12)-; (trans-10, cis-12)-; (cis,cis)- and (trans,trans)-octadecadienoic isomers (CLAs) as well as the other fatty acids traditionally encountered during the hydrogenation of vegetable oils are presented for a non-optimized catalyst under selected process conditions. Preliminary results show that it is possible to tailor characteristics of the hydrogenation catalyst in a such way to confer it bi-functional activity: hydrogenation and conjugation isomerization.

SAFFLOWER (*CARTHAMUS TINCTORIUS* L.) WATER USE FROM SHALLOW GOOD QUALITY AND SALINE WATER TABLES IN LYSIMETRIC EXPERIMENT IN A SEMIARID REGION OF IRAN

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CSBE100292 – Lysimetric studies were conducted to describe soil water fluxes in the presence of good and saline, shallow groundwater under a safflower (*Carthamus tinctorius* L.) crop to measure groundwater contribution. Safflower (*Carthamus tinctorius* L.) plants were grown in twenty columns. For each treatment four columns with diameters of 40 cm packed with Silty Clay soil were used. The variety of safflower grown was Sina names (PI-537598). In each treatment, ground water-table was maintained at 80cm depth. In one treatment ground water was tap water quality equivalent with EC 1000 (μ mohs/cm) and in the other treatments groundwater salinities were 2, 5, 8 and 10 dS/m respectively. Groundwater use as a part of crop evapotranspiration was characterized by using daily measurements of the water level in a ground water supply tank (Mariotte bottle). During all experiments, the magnitude of irrigation water requirement for each treatment was applied with good tap water quality with EC 1000 (μ mohs/cm) based on daily evaporation values from the Class A pan and daily crop water requirement. For each treatment, groundwater contribution was measured by mariotte siphons separately. The results of all experiments showed that increasing salinity reduced total root water uptake. The results of experiments also showed that for different treatments with good ground water quality, 2, 5, 8 and 10 dS/m, the groundwater contribution achieved 59, 51, 38, 32 and 19% of total plant water requirement respectively.

EFFECT OF WATER STRESS ON WATER USE EFFICIENCY AND YIELD OF *NIGELLA SATIVA* IN KERMANSHAH PROVINCE IN THE WEST OF IRAN

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CSBE100294 – Irrigation water is the most important limiting factor for agriculture during the hot and dry summer period of specific regions. Limited availability of irrigation water requires fundamental changes in irrigation management and urges the application of water saving methods. A generally applicable procedure is to assess the benefits of changing irrigation water management based on deficit irrigation, which is the practice of deliberately under irrigating field crops. Under these conditions, there is one way for farmers to maximize their profit. The way is to determine the water-yield relationships to choose the most appropriate irrigation scheduling for saving irrigation water. In this study drip irrigation tape and furrow irrigation methods for water use efficiency and the response of *Nigella sativa* to water deficit were investigated. This experiment conducted at the Agricultural Research Station, Water engineering department, Razi University of Kermanshah in April 2008. For this purpose an experiment a completely randomized block design with three replications was used. Treatments were a combination of furrow irrigation (100%), drip irrigation tape (100%), drip irrigation tape (75%) and drip irrigation tape (50%). Criteria such as seed yield, straw yield, plant height, follicles diameter, follicles per plant, seeds per follicle, 1000 seeds weight, harvest index, number of plants and water use efficiency parameter were measured. The result of experiment indicated that water use efficiency, seed and straw yield, seed per follicle and harvest index were significantly affected by irrigation treatments ($p < 0.01$). [...].

SPOT-APPLICATION OF PESTICIDE USING VARIABLE RATE SPRAYER IN WILD BLUEBERRY

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CSBE100295 – A cost-effective automated prototype variable rate (VR) sprayer was developed for spot-application (SA) of agrochemicals in a specific section of the sprayer boom where the weeds have been detected. The 6.1 m sprayer boom was divided into 8 sections and mounted behind an all-terrain vehicle (ATV) at 76.2 cm above the ground. . The variable-rate control system consisted of 8 ultrasonic sensors (one per spray section) mounted on a separate boom in front of the ATV, Dickey John Land Manager II controller and flow valve, solenoid valves and an 8-channel variable rate controller interfaced to a Pocket PC (PPC) using wireless Bluetooth® radio with Windows Mobile® compatible software. This type of VR sprayer does not use prescription maps, but relies on sensors to provide real-time weed detection information which is used to dispense correct agrochemical rates for the weeds. The sprayer can be used for in-season, spot application (SA) of agrochemicals by activating specific boom sections where the weeds have been detected. Two wild blueberry fields have been selected in Central Nova Scotia to evaluate the accuracy of the VR sprayer. Water sensitive papers (targets) were stapled to weeds randomly selected in two tracks of each field. The papers were parallel to the ground. The percentage area covered (PAC) of the sprayed targets with both SA and uniform application was estimated using an imaging system. Non significance of the t-test for uniform versus SA targets PAC indicated that there was no significant bias in the SA and that the SA was accurate. Based on these results, the VR sprayer was cost-effective, efficient and accurate enough for spot-application of agrochemicals usage in wild blueberry fields

UTILIZATION OF RESIDUAL BIOCHAR PRODUCED FROM THE PYROLYSIS OF ENERGY CROPS FOR SOIL ENRICHMENT

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CSBE100296 – The utilization of energy crops as well as residual biomass for the production of biofuels is gaining interest both at a national and international levels. Even though many cultures and techniques can be considered for the conversion processes, one of the main concerns is that the production and transportation of these energy crops should not require more energy that they are providing and should not leave the soil uncovered and reduced its organic content and nutrients. As a result, concerns such as fertilization of the soil becomes of outmost importance. A technique for biomass pre-conversion known as pyrolysis-torrefaction consists in the production of char and bio-oil from biomass. This processing method is gaining interest because the char obtained could be beneficial for several applications such as a fuel, soil conditioner and carbon sequestration. An appropriate distribution of the applications of biochar could be potentially beneficial for the sustainability of biomass utilization in the upcoming “biomarket”. In this study, biochar produced from switchgrass (*panicum virgatum*) was prepared and characterized to verify its potential as a soil enhancer as well as a potential solid fuel. Using custom-made bench scale, batch-type fixed bed pyrolysis-torrefaction reactor, biochar was prepared under varying reacting conditions. Residence times were varied in order to partially or completely release volatiles [...].

MAINTAINING THE PRE-SLAUGHTER ENTHALPY CHAIN IMPROVES ANIMAL WELFARE IN PIGS

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CSBE100300 – High environmental temperatures affect animal welfare during transport, however, less is known about the role of humidity in influencing the degree of thermal stress imposed or the effects on integrated indices of thermal stress such as enthalpy. In this study temperature and humidity sensors were installed on commercial vehicles on seven long-distance (70 hours) livestock transport journeys that carried pigs from Scotland to Spain. Psychometric charts indicated an approximate overlap in air enthalpy (kg water/kg dry air) at the farm, during transport and at the abattoir, while the relative changes in temperature (°C/second) and humidity (%RH/second) were much higher during transport and appeared to impose more stress upon the pigs (evaluated as the amount of time they spent resting or drinking post-transport). Thus, relative changes in enthalpy can be used as a non-invasive welfare indicator during transport and appears to be more useful than absolute values of temperature or relative humidity.

CERTIFICATION OF DRAINAGE CONTRACTOR ENTERPRISES – EXPERIENCE IN QUEBEC

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CSBE100301 – In 2003, AEDAQ (Association des entrepreneurs en drainage agricole du Québec Inc. - Quebec agricultural drainage contractors association) decided that the certification of drainage contractors would be a way to improve the drainage services offered by its members. AEDAQ asked the BNQ (Bureau de normalisation du Québec) to lead the process. The BNQ created a balanced committee of contractors, representatives of farmers and specialists from government, universities and private consultant to develop a consensual standard for services offered by drainage contractors. By 2005, the committee produced the BNQ-3624-540 standard describing the general requirements (insurances, permits, responsibilities, etc.) for each enterprise, the qualifications of its personnel, drainage equipment requirements, contracts specifications, litigation process and documents conservation. Based on that standard, a protocol was developed for the certification of drainage contractor enterprises. Ten (10) enterprises have been certified up to this date. This paper will present the process of writing the standard, the content of the standard, the certification protocol and the certification process which has been lived through by contractors and difficulties. The paper will also discuss the impacts of this standard.

THE IMPORTANCE OF FISH NEUROHORMONAL RESPONSE REARED UNDER RECIRCULATING WATER SYSTEMS: A REVIEW

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CSBE100303 – Fish farming prospects depend on the type of production system and the level of management. Therefore, the level of fish homeostasis and stress are important factors during their rearing period. Fish receive environmental stimuli mainly by their body receptors and react to them by an infinite number of outcomes influenced by various neurohormonal-biochemical processes. Using Recirculating Water Systems (RWSs), a notable reduction of undesirable hormonal and metabolic-biochemical functions could be easily achieved by preserving a proper combination of rearing water characteristics with tank size, fish rearing density, feeding practice and fish living ethology demands. These results could be further enhanced by combining the above mentioned parameters with rearing tank color and certain lighting conditions (photoperiod, spectrum, intensity). Also, by transmission of classical music into the fish rearing tanks, RWS facilities and proper rearing management can considerably contribute towards enhancing most fish anti-stress neurohormonal functions. That means that fish can feel closer to the way they should by living in their natural environment, without, however, facing its difficulties (e.g. enemies, water pollution, climate change). So, RWSs can provide for fish an excellent artificial “natural” living environment, while their construction and operation costs could be remarkably reduced not only by their low water requirements but also by using proper material, renewable energy resources and integration with aquaponics practices. Under these rearing conditions fish, being almost “happy”, can show the highest possible levels of growth rate, final product quality and welfare, ensuring the [...].

CONVERGENCE – BIG POTENTIAL: MICROFLUIDICS FOR FOOD, AGRICULTURE AND BIOSYSTEMS INDUSTRIES

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CSBE100304 – Microfluidics, a rapidly emerging enabling technology has the potential to revolutionize food, agriculture and biosystems industries. The principles of eletrokinetics, electrohydrodynamics, and thermo-capillarity of microfluidic devices help solve important scientific problems that are difficult using conventional technologies. Microfluidic devices allow real-time temporal and spatial sensing in food safety. Nano particle encapsulation of fish oil by spray drying through efficient emulsification; detection of the presence of residues, trace chemicals, antibiotics, pathogens and toxins in the food and water supply monitoring; in micro and nano-filtration to improve food quality; analysis of antibiotics in dairy food products by chip based diagnostic system are few examples of potential applications of microfluidics in food industry. Microfluidics also has the potential to generate novel food structures by changing the way the food processing will be done through emulsions and foams, fluid mixings and dispersions. Monitoring nutrients and sorting plant cells to increase crop quality and production; effective delivery of biopesticides by agricultural spray equipments are emerging applications of microfluidics in agriculture. Applications of microfluidics in the animal science sector include simplifying traditional in-vitro fertilisation procedures in animal breeding, animal health monitoring, therapeutic intervention, and nucleic acid delivery systems using DNA molecules for animal vaccines and animal control agents. The objective of this review is to synthesize information on microfluidic systems and [...].

WORK ECONOMICS AND ERGONOMICS IN DAIRY FARMING

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CSBE100312 – For modern dairy farms, having accurate work-economics planning data for each individual labour process is of the greatest importance. Such data enable the deliberate use of the available rationalization potential, thereby allowing the greatest possible mileage to be derived from the ever-expensive and scarce ‘work’ factor. The process routines in milking and feeding are crucial for determining the time requirement data. In milk-production systems with herd sizes of between 40 and 1000 dairy cows, a total working-time requirement of between 90 and approximately 50 MPh per cow and year is to be expected.

WORKLOAD ASSESSMENT IN AGRICULTURE – INTEGRATION IN A WORK BUDGET SYSTEM

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CSBE100313 – The use of a contemporary model-based work budget allows the comparison of work and production processes up to total-farm level under otherwise equal conditions. The inclusion of physical load is ensured via expanded OWAS codes with a mass-related load index as well as with the average physically strenuous working-time requirement. Consequently, sectoral statements on manpower potential and workload in farming are also possible. The continuous traceability of the data is ensured, so that expansions and corrections of errors are easily carried out. Data may be exported from the program via interfaces. The software, which is modular in design, is available in four languages. The computer-based work budget therefore represents an internationally applicable tool both for the improvement of work organisation and time planning, as well as for the measurement of workload.

DEVELOPMENT OF CRITERIA AND INDICATORS FOR MONITORING PROGRESS TOWARDS SUSTAINABLE REMEDIATION

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CSBE100315 – Criteria and indicators have been described as new tools for better definition of sustainable management concepts and for monitoring temporal change in the conditions and outputs of systems that they helped to define. With the ongoing quest for cleaner technology utilization in the remediation industry, a set of criteria and indicators were developed by stakeholders in the Alberta's remediation industry under the aegis of sustainable remediation technologies initiative. The initiative which met mostly on monthly basis for two years consisted of 18 professionals and experts drawn from the academics, environmental consulting companies, manufacturing companies, engineering companies, municipal authority and provincial environmental agencies. The group, using interactive discussion approach, came up with 16 indicators which were grouped into technical, environmental, economic and socio-cultural criteria. Experts agreed that these first set of indicators, with ongoing work for further expansion, will both facilitate the monitoring of our progress towards sustainable remediation and help in measuring the sustainability of commonly used remediation techniques in the province.

COMPARATIVE ANALYSIS OF THE THRESHING CYLINDERS PERFORMANCE ON SORGHUM

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CSBE100316 – Two threshing cylinders were evaluated on sorghum in a conventional thresher. Moisture content of sorghum grain at threshing was 8 % wb while the cylinder – concave clearance was 1.5 cm at inlet, 0.3 cm inside and 0.7 cm at the outlet for the two cylinders. Threshing speed ranged between 3.6 and 6.4 m/s; fan speed 2.1 and 4.6 m/s and the sieve oscillation speed ranged between 1.47 and 2.59 m/s for cylinder I and II respectively. Feed rate ranged between 491 and 720 kg/hr for the two cylinders. Performance test results showed that threshing efficiency averaged 99.9 % for each of the two cylinders. In addition, cleaning efficiency ranged between 94.35 and 96.17 % and 98.06 and 99.8 % while cleaning loss ranged between 9.73 and 27.7 % and 6.5 and 9.91 % for cylinder I and II respectively.

APPLICATION OF SLIGHTLY ACIDIC ELECTROLYZED WATER FOR DISINFECTION IN A BROILER FARM

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CSBE100320 – With the rapid development of intensive animal farms, epidemic diseases in animal farms are more and more severe, it is necessary to develop effective disinfectants for reducing pathogens in animal farms to improve the health of animals. Slightly acidic electrolyzed water (SAEW, pH 5.0-6.5) generated by electrolysis of a dilute NaCl solution or HCl in an electrolytic cell shows promise as an environmentally friendly broad spectrum microbial decontamination agent. The efficiency of SAEW for inactivating aerobic plate counts (APC) in broilers' houses was examined and compared with chemicals which are commonly used. The effect of SAEW on the production performance of broilers was also determined. Results indicate that SAEW with available chlorine of 80 mg/l can effectively reduce the population of APC in broilers' houses. The percent of reduction of APC in the indoor air by SAEW (80.2%) was higher than that of povidonolodine solution (75.2%), glutaraldehyde-containing disinfectant (68.7%) and iodine-containing disinfectant (54.0%). The APC in the disinfection pool treated with SAEW was 0 cfu/ml in the first 6 h, after 12 h the number of bacteria sharply increased. Moreover, the percent reduction in APC on feed carts treated with SAEW and sodium dichloroisocyanurate for 1 min was 92% and 85%, respectively. According to statistical analysis of broiler production performance, the survival rate and feed/gain was 94.5% and 1.85, respectively for using SAEW. Therefore, SAEW is an available option for disinfection in poultry farms with harmless to human and animals and no environmental pollution.

DISINFECTION EFFICIENCY AND PREVENTION OF MASTITIS BY SLIGHTLY ACIDIC ELECTROLYZED WATER IN A DAIRY FARM

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CSBE100321 – Microbial contamination is an important issue in dairy farms. Slightly acidic electrolyzed water (SAEW) with a strong bactericidal activity, low cost and no chemical pollution due to its rapid decomposition is a novel disinfectant. SAEW (pH 5.0-6.5) containing higher hypochlorous acid (HClO) is produced by electrolyzing a mixture of dilute sodium chloride and hydrochloric acid solution in a non-membrane electrolytic cell. The disinfection effect of SAEW on cow's teats, milking cups, towels and hands of the workers was investigated. The prevention of mastitis in dairy cows by SAEW was also examined. Results show the percentage reduction of aerobic plate count (APC) on the cow's teats, towels and the milking cups treated by SAEW with ACC of 40 mg/l achieved 91.2%, 97.1% and 93.3%, respectively. Using ACC of 20 mg/l SAEW to flush the cow's teats, the APC was reduced by 93.6%. The percentage reduction of APC on the towels and hands of workers was 97.1% and 93.9% by SAEW, 91.3% and 89.3% by NaClO at ACC of 20 mg/l, respectively. Moreover, after 15 days disinfection test, cow teats dipped with SAEW at ACC of 20 mg/l before milking and post-milking resulted in the percentage reduction of mastitis positive of 27.8%. But the control (dipped with povidone-iodine solution, PVP-I) had a high number of positive cows with a mastitis positive increase of 21.4%. The finding of this [...].

DEVELOPMENT OF A MODEL FOR ESTIMATING CURRENT AND FUTURE IRRIGATION WATER DEMAND IN CANADA

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CSBE100331 – An increasing competition for water coupled with an unpredictable changing climate will affect future food production. To sustain agriculture, a robust framework for allocating water is essential for promoting efficient use and maximizing the value of this limited resource. To help water managers and decision-makers achieve this objective, an agricultural water demand model that is specific to Canadian climate, soil and crop conditions was designed using a Matlab program with Graphical User Interface (GUI). The model was designed using the Food and Agriculture Organisation's (FAO)-56 Penman-Monteith equations for computing reference evapotranspiration (ET_o) and the crop coefficient (K_c) values were estimated using local data. The model estimates annual net, gross and 10-day irrigation water requirements (IWR) for wet, dry and normal weather conditions. It also estimates future IWR by accounting for expected changes in climate using downscaled data from the Canadian Regional Climate Model (CRCM). The model was tested with bell pepper, tomato, raspberry and peach grown in southern Ontario. Analysis of the 1971-2000 rainfall data for Chatham – Kent, Essex, Niagara and Haldimand Norfolk weather stations showed that 1976, 1990, 1981 and 1985 with rainfall depths of (293mm, 405mm, 335mm and 381mm) respectively were the wet years. The percentage increase in rainfall for 2011-2040 ranged from 20% - 53% despite the projection that rainfall for the study areas will be 10% less. Future water demands by bell pepper, tomato and raspberry are expected to increase by [...]. The percentage difference between future and current IWR for bell pepper ranged from -2 to 2%.

ACRYLAMIDE MITIGATION IN FRIED POTATO SLICES BY USING COMMERCIAL ASPARAGINASE

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CSBE100336 – Acrylamide is a suspected carcinogen that is formed by heat-induced reaction between sugar and an amino acid called asparagine. Asparaginase converts free asparagine into aspartic acid, another amino acid that does not form acrylamide. The nutritional properties of the products are unaffected, and so are the browning and taste aspects. In this research acrylamide formation in potato chips was investigated in relation to blanching and commercial asparaginase (Acrilaway) immersion treatments before final frying. Potatoes slices [...] were fried at 170 °C for 5 minutes [...]. Prior to frying, potato slices were treated in one of the following ways: [...]. Blanching in hot water was almost as effective as asparaginase potato immersion in order to diminish acrylamide formation in potato chips (% of reduction was almost 17%). When potato slices were blanched before aspariganase immersion, the acrylamide content of the resultant potato chips was reduced considerably by almost 90 %. It seems to be that blanching of the potato slices before the immersion in the enzyme solution facilitates the diffusion of asparaginase in the potato tissue leading to potato chips with considerable lower contents of acrylamide.

POTENTIALS OF BIOFUELS

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CSBE100337 – The potentials of biofuels are presented and discussed at the example of the actual situation in Germany and Europe. There exist various different potentials, however, in this article the emphasis is put on technical potentials, like production, utilization and environmental aspects. In particular for evaluation of the environmental impacts the Institute of Agricultural Technology and Biosystems Engineering of the vTI runs an emission test stand for diesel engines. This testing facility is able to drive heavy-duty diesel engines in both stationary and dynamic test cycles, like the European ESC and ETC. Further analyses are applied in order to determine fine and ultra-fine particles, PAH, aldehydes, ketones, and the usual regulated exhaust gas compounds. Through Ames tests also results concerning the mutagenic potential of the tailpipe emissions can be assessed. Former results of our group indicated that neat vegetable oils can lead to a high mutagenic potency of the exhaust. Furthermore it was found that some of the non-regulated exhaust gas compounds vary nonlinearly with the blend composition. In particular, B20 shows an unexpectedly high mutagenic potential and is also found to be subject to sedimentation, if aged biodiesel qualities are brought into use.

DEVELOPMENT OF A FRAMEWORK FOR SUSTAINABLE REMEDIATION DECISION MAKING (SRDSS)

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CSBE100339 – There is an increasing demand for cleaner technology use in remediation. Green remediation and sustainable remediation have been identified as approaches to satisfying the need for cleaner remediation. Sustainable remediation technologies initiative (SRTI) has developed a set of criteria and indicators for sustainable remediation technologies. In this research, a multi-attribute decision analysis based approach is used in developing a support system for sustainable remediation decision making. The methodology requires the user to input data on the sixteen SRTI developed indicators grouped into technical, economic, environmental and socio-cultural criteria to assess the sustainability of any remediation method. The five parts output platform then ranks remediation techniques being assessed according to their technical, economic, environmental, socio-cultural and overall performances. This DSS helps policy makers, consultants, contractors and other stakeholders to choose which of the various remediation methods to use for a remediation project on the basis of their sustainability. In this way, SRDSS fosters the use of economically sound and socio-culturally compatible clean technology in remediation

FIELD EVALUATION AND COMPARISON OF TWO SILAGE CORN MASS FLOW RATE SENSORS DEVELOPED FOR YIELD MONITORING

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CSBE100344 – Scientific efforts for determination of instantaneous crop yield in recent decades have been mostly focused on cereal crops. Similar but more recent investigations have been initiated in order to prepare yield maps for silage crops due to its importance as a major feed stock. The main goal of this investigation was field evaluation and comparison of two newly developed silage corn yield monitoring sensors. The first sensor was based on using the momentum of chopped material impacting a pivoted plate installed at the chopper discharge spout and the other sensor was based on measuring the torque transmitted by the tractor PTO shaft driving the silage corn chopper. To accomplish this goal, a pivoted plate sensor equipped with a computer based data acquisition and processing system and a strain gauge type torque meter equipped with memory card data logger were designed and constructed. Results of calibration tests of the two sensors at specific mass flow rates of 6, 8 and 10 kg/s showed good correlation between electronic circuit's outputs and mass flow rate with R^2 of 0.97 and 0.99 for torque meter and pivoted plate sensors, respectively. Also field tests showed no significant differences between the experimental treatments (two sensors) and control treatment (a platform scale weighing system acting as an accurate reference) at confidence level of 95%. The results showed that the output signals of these two sensors are truly correlated with variations in mass flow rate as detected by an accurate reference scale.

THE EFFECTS OF SHAKING FREQUENCY AND AMPLITUDE ON DETACHMENT OF ESTAHBAN DRIED FIG (FICUS CARICA CV. SABZ)

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CSBE100348 – The aim of this study was to determine the most suitable shaking frequency and amplitude for shake harvesting of Estahban edible fig (*Ficus carica* cv. Sabz). A hand held limb shaker with adjustable shaking frequency and amplitude and powered with a single cylinder gasoline engine was used for this study. A 3×3 factorial experiment with a completely randomized design with three replications was conducted to investigate the effects of shaking frequency and amplitude on fruit detachment. Three levels of oscillating frequency (10, 12 and 14 Hz) and three levels of shaking amplitude (20, 32.5 and 45 mm) were investigated. Analysis of variance and mean comparison showed that the effect of shaking amplitude and shaking frequency on fruit detachment was significant. The percent of unripe fruit detachment was significantly increased at higher levels of shaking amplitude and frequency. Complete ripe fruit detachment (100%) and relatively high unripe fruit detachment (16.92%) was obtained at shaking amplitude of 45 mm and frequency of 14 Hz, but shaking amplitude of 45 mm and shaking frequency of 10 Hz with high ripe fruit detachment (93.33%) and acceptable unripe fruit detachment (9.44%) is recommended. Harvesting rate during 5s of shaking was measured and showed that optimum time needed to harvest a limb is only 4s. The fruit detachment force (FDF) per fruit weight (FDF/W ratio) varied from 119 to 25 N/N when moisture content varied from 75.979 to 23.57 during fig ripening and drying process. [...].

ACTIVITY ANALYSIS IN BROILER CHICKENS WITH DIFFERENT GAIT SCORES

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CSBE100361 – Monitoring the activity of broilers is a potential way for determining gait score level at commercial farms. In this study, a fully-automatic monitoring technique was developed to measure the activity of broiler chickens with different gait score levels. We carried out experiments in order to assess the relationship between gait scores obtained by human experts and activity levels quantified by an automatic image monitoring system. The chickens were scored for their degree of lameness [...]. [...] Five birds were selected in each of six gait score groups (GS0 to GS5). The activity levels were obtained for all gait scores by using an automatic image monitoring system. For this purpose, video surveillance images of broilers with six different predefined gait scores were analysed. In both experiments, there was a significant relation between gait score by experts and activity monitored by image analysis. Similarly, day of experiment in relation to gait score showed significant differences in activity values ($P < 0.05$). The broilers with gait score 3 (GS3) showed significantly higher activities than the other gait scores in both experiments ($P < 0.05$), possibly due to their need for more feed. In experiment 1, there was no significant difference among the activities of other chickens with different gait scores. In the second experiment, GS4 and GS5 showed significantly lower activities. Overall, the results show that automatic camera monitoring system can provide an automatic tool in determination the activity in relation to gait score. This activity information can be used further to identify the effects of gait score on broiler behaviour.

THE RELATION BETWEEN NON-IRRIGATED PLANTING AT SANDY LAND AND MICROMETEOROLOGICAL ALLEVIATION IN NINGXIA, CHINA

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CSBE100362 – Yellow sand comes mainly from the desert area in China and Mongolia. Yellow sand has increased abnormally from 2000 to 2002, and its level remains fairly high. We hope to decrease the transportation of yellow sand. The purpose of the experiment was to determine the effect of yellow sand on the microclimate by planting trees on arid dry land that had no vegetation. Trees were planted for the experiment in Daquan, Lingwu, Ningxia in North-western China. Differences in vertical profiles of micrometeorological elements based on the variety and density of plant vegetation, and micrometeorological elements of modification were affected by the tree form and leaf distribution of the covering vegetation. The author investigated the changes in the surface layer based on the difference of trees in a planted area from 2004 to 2008. The variations of air temperature and relative humidity comprising the microclimate, that affected the surface vegetation of an experimental tree-planting area, were obtained. Meteorological differences were found in the surface vegetation, but it was not clearly identified in the difference of planting trees in 2007. These effects on the microclimate of the planted field were clear. A technique to increase the rates of root taking by planting, even under non-irrigated conditions needs to be developed. It was possible to cultivate a high density of trees and to apply a non-irrigated planting system at Ningxia, China and Mongolia, and this represent an important achievement.

GEOGRAPHICAL SHIFT IN LIVESTOCK PRODUCTION: CONSEQUENCES FOR LAND USE PLANNING AND POLICY MAKING

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CSBE100363 – This paper describes the process of changing agricultural production and the consequences for natural resources and the environment. More specifically, the paper explores the geographical component of these developments, and the use of planning support tools to assist planning and decision making. Some conclusions and recommendations are presented with respect to land use planning and policy making.

IMAGE ANALYSIS, 3D GEOMETRY MODELING AND INVERSE FEA IN INVESTIGATING PROPERTIES OF AGRI-FOOD AND FOREST PRODUCTS

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CSBE100364 – In designing and managing thermal and mechanical processes in the agricultural, food and forest industries, to be able to assess quality, it is important to know product properties at all stages of processing. Recent advances in image analysis, both for neural classification and for 3D geometry data acquisition, enhanced by 3D geometry modeling and inverse finite element analysis, extend our possibilities in predicting product behavior and performing quality classification. In this paper original procedures and software earlier developed by the authors to solve a variety of quality analysis problems were analyzed and integrated into software of higher functionality, usability and efficiency. The problems were as follows: 1) image analysis measurement and product geometry representation in a form of 3D isoparametric finite element meshes, enhanced with NURBS and appropriate textures, 2) identification of unknown model coefficients (inverse FEA) and prediction of heat and moisture transport (direct FEA), 3) visualization of prediction results for 3D objects in time and space, 4) neural classification of products with respect to quality factors based on analysis of selected image features. The procedures were exemplified by analysis of dried vegetables and cereal grain kernels. Effective algorithms of image analysis enhanced with neural modeling procedures, edge detection and 3D geometry modeling approaches, and original inverse and direct finite element analysis software resulted in increased accuracy of prediction of thermal and mechanical behavior of investigated biomaterials and classification of product quality.

ADVANCED TECHNOLOGIES IN DEVELOPING WEB-BASED DECISION SUPPORT SYSTEMS FOR AGRICULTURE

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CSBE10365 – A need for prompt and reliable information dedicated to farmers and institutions involved in the agriculture and food sector results in enhancing Web-based decision support systems with new advanced technologies. Implementation of such advanced and effective technologies is important for a software developer to support software quality standards. Emerging technologies and environments related to the recent version of Microsoft .NET Framework were analyzed and applied to develop several Web applications for the agri-food sector. The methods were based on ASP.NET (versions 3.5 and 4), C++/CLI and C# (versions 3.0 and 4.0) available in Microsoft Visual Studio 2008 and 2010. The approach was enhanced with: AJAX to make Web applications more interactive, LINQ to work with data, CSS to build attractive and consistent web sites, WPF, including Silverlight, to develop and distribute rich Web applications, and WCF for implementing services. The technologies were exemplified with several original web applications selected from a vast ICT repository of information systems developed within Master's and doctoral theses in the Department of Applied Informatics, Institute of Agricultural Engineering, Poznan University of Life Sciences.

DEVELOPMENT OF CARBON DIOXIDE (CO₂) SENSOR USING POLYMER NANOPARTICLES FOR GRAIN QUALITY MONITORING

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CSBE100368 – A carbon dioxide sensor was developed using polyaniline boronic acid (PABA) conducting polymer nanoparticles as the electrically conductive region of the sensor and was demonstrated for use in detecting incipient or ongoing spoilage in stored grain. The developed sensor dynamically detected up to 2455 ppm of CO₂ concentration levels. The developed sensor was evaluated for the influence of temperature and relative humidity. The sensor's response to changes in the gas concentrations at various humidity and temperature levels was stable indicating that the sensor can dynamically detect CO₂ under fluctuating environmental conditions. The response of the PABA film to CO₂ concentration was not affected by the presence of alcohols and ketones, proving that the developed sensor is not cross-sensitive to these compounds which may be present in spoiling grain. The sensor packaging components were selected and built in such a way to avoid contamination of the sensing material and the substrate by undesirable components including grain dust and chaff. The developed conducting polymer CO₂ sensor exhibited dynamic performance in its response, recovery times, sensitivity, selectivity, stability and response slope when exposed to various carbon dioxide levels inside simulated grain bulk conditions.

THE DESIGN OF REPLACEMENT HEIFERS AND DAIRY COWS HOUSING

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CSBE100370 – The CIGR Section II (Farm Buildings, Equipment, Structures and Livestock Environment), Working Group n° 14, Cattle Housing, has been working for several years on the updating of the CIGR recommendations on housing of dairy cows. The housing of replacement heifers has been added to the previous report since it is important to raise young animals in very best conditions to ensure that their productive life will be as efficient as possible. The report is the result of thinking and experience of cattle housing specialist's originated from Europe and United States. It makes the synthesis of the most recent knowledge in the field of replacement heifers, dairy cows and dry cows housing. His goal is not to describe all the numerous design possibilities for these types of animals; it is mainly built on the basis on which the conception of each cattle housing must be made. The design of a building for cattle requires always the participation of a cattle-housing specialist's. The report explains the bases to understand the recommendations that take into account the characteristics of animals, the fundamental aspects of their behaviour, the relationships between animals and their environment, and with the stockperson. Relationships between animals are also considered. Different chapters have been developed: dimensions of the animals, designing to meet animal needs, environmental requirements, sustainability, numerous aspects of design, etc. The report will be put on a web site to be downloaded.

ENERGY EXPENSE BY LOGISTICS WITHIN SUGARCANE'S ENERGY PRODUCTION CHAIN – TWO CASE STUDIES

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CSBE100374 – An energy source is determined by the net energy it provides and this is due to the energy output and energy input within a system. Biofuels have posed as a prosperous alternative to fossil fuels, but unfortunately, it has been driven mostly by political and economical reasons rather than the physics intrinsic to them. Exportation of biofuels have been announced as “green” solutions without checking if the fuels would arrive to the final user as an energy source or drain. Actually, this is not even known in domestic markets such as Brazil, where ethanol has an outstanding development. This study aims to evaluate the energy expenditures of two case studies within the ethanol production chain – ethanol for road transportation and the baled straw, from mechanical harvesting of sugarcane, for electricity cogeneration. For ethanol road transportation, the two most commons tanker-trucks used were evaluated (30 and 45 m³). For the baled straw, two kinds of bale (prismatic and cylindrical) and three kinds of raking (single, double and triple) were evaluated. Although the largest vehicul for ethanol transportation presented higher gross energy consumption, it expended 12.42% less energy per distance and transported mass (0.626 versus 0.715 MJ km⁻¹ t⁻¹), and had proportionally lower CO₂ emission, 12.28% (41.47 versus 47.28 g CO₂ km⁻¹ t⁻¹). The baled straw presented 19.72% lower consumption for prismatic bales, due to the truck loading capacities of these bales. The results provide incite on the selection of alternatives operation within energy production systems.

CROP COEFFICIENT OF COWPEA BEAN IN PIAUI STATE, BRAZIL

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CSBE100376 – The crop coefficient (K_c) is fundamental for estimating the crop water requirement. The objective of this work was to determine the K_c values of the cowpea [*Vigna unguiculata* (L.) Walp.], BR-17 Gurgueia cultivar, for Piaui State, Brazil. Three experiments were carried out in three experimental areas of Embrapa Meio-Norte, localized at Teresina (05°05' S; 42°48' W and 74,4 m), Parnaíba (3°5'S, 41°47'W and 46 m) and Alvorada do Gurgueia (8°26'S, 43°47'W and 281 m) counties. In each place, four weighing lysimeters were used for measuring the crop evapotranspiration (ET_c) in a border area of 1.2 ha. Each lysimeter was composed of a fiber glass box (1.5 m for 1.5 m of width and 1.0 m of depth), mounted over a precision weighing scale, connected to an automatic data logger. The reference evapotranspiration (ET_o) was estimated by Penman-Monteith method from meteorological data obtained by an automated weather station installed at each area. K_c was determined by the relation between ET_c/ET_o . Mean values of K_c for these counties were: 0.6 to 0.7, in the initial phase; 0.7 to 1.1, in the growth phase; 1.1 to 1.3 in reproductive phase and 0.6 in the final phase.

EVALUATION A VARIABLE RATE LIQUID FERTILIZER FOR SITE SPECIFIC APPLICATION

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CSBE100378 – Applying new methods in the management of agricultural products is essential particularly in recent direction of precision farming. The aim of this study was to distribute chemical fertilizer based on site specific requirement. Therefore local data related to the quantity of soil nitrogen was mapped and places with sufficient or lack of nitrogen identified. The sprinkler was set to become active and inactive based on the map. Also sprinkler rate was varied by using encoder shaft. The farm selected for field test was divided into 12 plots of 2*5m² of which six allocated to specific rates and six for even distribution of fertilizer. The results based on acquired data indicated 58% reduction in the fertilizer consumption by variable rate compared to common method with even distribution. Also error rate of sprinkling test was 1.32% and 1.58% in laboratory and farm tests respectively. It was noted there was 8% reduction of fertilizer consumption in speed active status. Hence this method can be considered to significantly reduce fertilizers use.

COMPARISON OF DIFFERENT PLANTATION MODES IN ECOLOGICAL RESTORATION IN ANTAIBAO OPENCAST MINING SITES IN SHANXI PROVINCE, NORTH CHINA

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CSBE100379 – Reestablishment of the vegetation ecosystem is a key approach to ecological restoration of the landscape of mining sites. Antaibao opencast mining area, located at 112°10'–113°30'E, 39°23'–39°37'N, is a typical large-scale restoration mining region in North China. Developing plantations on levelled slagheap covered loess soils is a common solution in ecological restoration in Antaibao. There are various plantation modes used in the restoration. Comparison of ecological efficiency of different plantation modes is useful for future restoration. Six plantation modes of woody species, mode I *Robinia pseudoacacia* + *Pinus tabulaeformis*, mode II *Robinia pseudoacacia* + *Hippophae rhamnoides*, mode III *Ulmus pumila* + *Elaeagnus angustifolia*, mode IV *Elaeagnus angustifolia* + *Hippophae rhamnoides*, mode V *Hippophae rhamnoides* and mode VI *Caragana korshinskii*, were compared over a period of ten years after planting in Antaibao. Based on the analysis of species composition, community structure, life form, species diversity and soil physical and chemical characteristics, we can see that the growth and development speed and efficiency of ecological and environmental improvement in the first ten years followed the order of Mode I > mode II > mode III > mode IV > mode V > mode VI. We can conclude that it is a suitable way to plant woody species directly and develop scrubland and forest in opencast mining area, and that planting trees or trees plus scrubs at the beginning of restoration is better than planting scrubs only. Mode I *Robinia pseudoacacia* + *Pinus tabulaeformis* and mode II *Robinia pseudoacacia* + *Hippophae rhamnoides* are the best species configurations in restoration of Antaibao opencast mining sites in the early stages.

SIMULATION ON CREEP PROCESS OF ALFALFA BASED ON VIRTUAL PROTOTYPE

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CSBE100399 – Based on the ADAMS virtual prototype technology, a virtual prototype model of creep process of alfalfa compressed was established. Through comparing the simulation with experimental results, studying results showed that the creep model established is in accordance with the actual creep process of alfalfa compressed, the value of absolute error between simulation and experimental results was within ± 0.009 , and value of the relative error was within $\pm 1.55\%$.

THE INFLUENCE OF ANIMAL ACTIVITY AND LITTER ON CARBON DIOXIDE BALANCES TO DETERMINE VENTILATION FLOW IN BROILER PRODUCTION

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CSBE100401 – Carbon dioxide (CO₂) balances are useful tools to determine ventilation flows in animal buildings. This method needs an accurate estimation of the average CO₂ production by animals to determine daily average ventilation flows. To estimate the daily variation in ventilation flow, the daily variation in the production of this gas is also necessary, which mainly depends on animal activity. The main objectives of this work were to quantify the amount of CO₂ produced by the litter, to determine the CO₂ produced by broilers as a function of animal weight, and to analyse the influence of animal activity on this emission. Gas concentrations and ventilation flows were simultaneously measured in one experimental and two commercial growing cycles. In the experimental assay, animal activity was determined every 15 minutes by observation of animal behaviour and an activity index was obtained. At the end of the experimental cycle, litter accounted for 20% of total CO₂ production, and the animals produced 3.71 L hour⁻¹ kg^{-0.75}. In the commercial farm, CO₂ production was the same in the two cycles (2.60 L hour⁻¹ kg^{-0.75}). These values are higher than those reported in previous studies, probably because of differences in daily weight gain. Carbon dioxide produced by animals was influenced by animal activity, and using this parameter the CO₂ balance was improved. However, CO₂ and animal activity followed different daily patterns. Therefore, a correction for animal activity is necessary to determine daily variations in ventilation flows for broilers, but particular care should be taken if these corrections are based on observed animal activity.

DIFFERENT PURIFICATION METHODS AND QUALITY OF SUNFLOWER BIODIESEL

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CSBE100404 – Biodiesel is a fuel obtained from triacylglycerides and mostly produced through transesterification, a chemical reaction of vegetable oils with alcohol, methanol or ethanol. Raw material selection should take the costs into account; because 85% of production cost is related to vegetable oil. The objective of this study was to evaluate oil expression of sunflower seed (*Helianthus annuus* L.), the study of sunflower crude oil as raw material for biodiesel by transesterification reaction, in laboratory and pilot scales, and three different biodiesel purification methods. For the best conduction of experiments, an experimental design was used. The best result for oil expelling, 68.4 %, was obtained with screw speed of 114 rpm and for seeds with 25 °C and 6.9 % of moisture content. For biodiesel production at laboratory scale, the best result, 87.5 %, was obtained with molar ratio of 4.7:1 (ethanol:oil) and 4.42 % of catalyst concentration related to the quantity of oil that had to be transesterified. That experimental condition was applied in bigger scale with a batch stirred tank reactor. For purification with washing, the biodiesel yield was 84.2 %. Purification with silica had a yield of 84.6 % and distillation, 92.3 %. Distillation of biodiesel produced a biofuel with better quality in relation to the technical limits of the Brazilian standard.

ENERGY CONSUMPTION AND COMMERCIAL APPLICATIONS OF LIQUID FOAM INSULATION TECHNOLOGY FOR GREENHOUSES

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CSBE100407 – It is well known fact that operating a commercial greenhouse in northern Latitudes requires large amounts of energy. As energy prices continue to fluctuate, it is critically important to provide growers with a tool that gives them greater control of their micro-climate. Sunarc of Canada has developed an energy saving system for commercial greenhouse growers. The liquid foam insulating system was installed at site 1 over an area of 14,700 ft² (Chatam, ON, Canada), as well as at site 2 (Leamington, ON, Canada) over an area of 43,000 ft². Both facilities were monitored for energy use during the 2007 winter period. Night-time energy savings ranged from above 60% to below 10% depending on outdoor temperatures with greater savings occurring during colder outdoor temperatures. Monthly average night-time energy savings resulted in values from February, March and April 2007 of 46.6, 42, and 32.3% respectively. Following initial commercial testing the liquid foam system was reengineered to improve and optimize operations, reduce fill time, and improve liquid foam formulas. The new system was installed at site 3 (Laval, QC, Canada) as a demonstration unit. The company is presently negotiating international distribution with several partners.

DETECTION OF SALMONELLA ON SPINACH LEAF USING PHAGE-BASED MAGNETOELASTIC BIOSENSORS

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CSBE100410 – In 2008, a foodborne illness outbreak associated with tomatoes, led to a confirmed 1442 persons infected with *Salmonella* in 29 of 50 States of the United States. FDA teams collected and tested over 1700 samples of tomatoes and none were found to be the outbreak source. Despite the issuance of an “FDA safe list,” the public ceased buying tomatoes, resulting in an economic loss to growers of over \$100 million. This presentation describes an investigation into the direct detection of *Salmonella* on fresh spinach, using phage-based magnetoelastic (ME) biosensors. The wireless biosensors are composed of a ME resonator platform that is coated with filamentous E2 phage (genetically engineered to bind with *Salmonella*). An alternating magnetic field is used to drive the biosensors into resonance and a pick up coil measures the sensors’ resonance frequencies. Upon contact with a target pathogen, the phage binds the pathogen to the biosensor, causing an increase in the biosensor’s mass and a corresponding decrease in resonance frequency. Spinach surfaces were spiked with a known number of *Salmonella* cells and then allowed to air dry. The biosensors were placed on the spinach leaves and measured after 30 minutes. Shifts in the resonance frequency of the measurement biosensors were observed due to binding of *Salmonella* while reference sensors showed negligible change. The specific binding of *Salmonella* to the biosensors was verified by Scanning Electron Microscopy (SEM). The results indicate that this methodology may provide real-time contamination information on fresh produce in the agricultural field.

ROLE OF INFRARED THERMAL IMAGING IN STORED PRODUCTS PROTECTION

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CSBE100411 – Thermal imaging is a technique to convert the thermal radiation emitted from an object into a visible image which provides the temperature mapping of the object. Thermal imaging has wide applications in various industries such as aerospace, agriculture, military, civil engineering, building maintenance, medicine and veterinary. Temperature measurement is one of the most important and valuable factors in maintaining and preserving the quality of stored products. Since infrared thermal imaging is a non destructive, non invasive method to determine the surface temperature distribution, it could serve as a valuable tool in stored products protection. Many research studies have been conducted and the possibilities of using infrared thermal imaging on stored products protection have been evaluated. Potential of infrared thermal imaging in stored products protection has been tested through studies such as detection of hot spots in grain silos, detection of insect infestation in grain, identification of different wheat classes, detection of fungal infestation in stored grain, sprout damage detection of grain and maintenance of optimum temperature in storage facilities. The results of various studies and the future of thermal imaging in stored products are discussed in this manuscript.

THE DESIGN AND EXPERIMENTAL STUDY OF A BENCH TEST FOR PNEUMATIC SEED METERING DEVICE

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CSBE100422 – A bench test for seed metering device was designed in accordance with a seed metering theory based on pneumatic seed metering. The goal to be achieved is to minimize pollution and save seeds, as well as the test the effectiveness to confirm this device as favorable and capable of satisfying the requirements of the experiment. The rotation speed of the seed metering disk and the vacuum degree in the suction chamber were used as experimental factors. Based on this a single factor experiment, with the influence of the previously mentioned factors, on seed metering performance of soybean was conducted and the result showed the following: The rotation speed of seed metering disk is consistent with the vacuum degree in suction chamber obtained by theoretical calculation. However, when the rotation speed of seed metering disk exceeds the rotation speed of seed metering disk that is adapted to the vacuum degree obtained during theoretical calculations, the seeding quality will diminish and the seeding rate misses increase prominently to the maximum value of 29.63%. When the vacuum degree in the suction chamber is 2.5 kpa, the seeding rate misses increase. Meanwhile, the standard seeding rate tends to decrease when the rotation speed of seed metering disk increases. When the rotation speed of seed metering disk is fixed at 54 rpm, the standard seeding rate varies in the range of 76.11% to 80.65% with a vacuum degree of 1.5 kpa in suction chamber, when the vacuum degree in suction chamber is lower than 1.5 kpa, the standard seeding rate will decrease proportionally, and when the vacuum degree in suction chamber is 1.0 kpa, the standard seeding rate only reaches 52.07%, and the seeding rate misses, however, go up to 40.83%.

GAIT AND FORCE ANALYSIS OF PROVOKED PIG GAIT ON CLEAN AND FOULED RUBBER MAT SURFACE

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CSBE100425 – Materials that increase floor friction forces in absorption of foot pressure could reduce the risk of slipping, i.e. promote walking safety. The effects of fouled rubber mat floor conditions on the gait of 10 pigs walking in a curve, using kinematics and kinetics to record gait parameters and slip frequency are described and compared with clean conditions. Pigs adapted to fouled floor condition through reduced walking speed (10%), prolonged swing and stance time and a higher number of 3-limb support phases, but kept stride length and diagonal constant. This adaptation produced a threefold reduction in lateral horizontal forces and kept breaking and propulsion forces constant, resulting in a constant peak utilised coefficient of friction (UCOF) level in fore limbs but a 31% reduction in UCOF in hind limbs. The better traction for pigs walking on rubber matting compared with concrete is due to a more effective transmission of forces from the limb to the elastomer, dissipating the forces into energy within the material, and thus impeding the effect of centripetal force, with less displacement of the body's centre of gravity and less forward and backward slip. Pig forward slip frequency on fouled rubber matting was 65 and 51% lower for fore and hind limbs respectively compared with pigs walking a curve on fouled concrete. The soft flooring material improved gait adaption and could thus improve walking safety.

WEED CONTROL BY WATER STEAM USING A SELF-PROPELLED MACHINE EQUIPPED WITH A CONDENSATION CHAMBER

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CSBE100427 – In the last years public concern about environmental pollution due to pesticides has been growing and, among other consequences, this situation boosted research on physical weed control methods as an alternative to herbicides. Recent researches have been carried out about the feasibility of the use of water steam as a replacement of chemical weeding in particular conditions where no chemical residues are allowed, e.g. in organic farming. Tests carried out with a steam jet directed on the weeds confirmed its effectiveness in killing weeds, but also showed high energy requirements and very low working speed despite the high thermal contents of steam. To improve weed control efficiency, a chamber where the steam can condense on the surfaces of the plants was developed in order to exploit the high efficiency of latent heat transfer of condensing water steam, as suggested by a theoretical analysis. Preliminary lab test confirmed the validity of this approach, showing higher energy efficiency in respect to the direct application. Following these encouraging results a self-propelled machine was equipped with a condensation chamber specifically designed to perform field tests on 5 species (two dicots and three grasses), to be treated at two different growth stages. The dose-response curves obtained after treating the plots with 5 to 6 different travel velocities showed good effectiveness. The dicots were effectively controlled with doses lower than 500 kJ m⁻² [...], while maize was able to regrow after the treatment, requiring about twice the dose.

MAPPING OF SOIL VARIABILITY FOR INCREASING PRECISION WITH MANAGED DROUGHT STRESS PHENOTYPING

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CSBE100428 – The aim of this study was to identify field variability within a drought phenotyping experimental site using an EM38 sensor, and establish the relationship between apparent electrical conductivity (ECa) and soil physical and chemical properties. Within areas of high spatial variability for ECa, sixty soil core samples were taken at 0-10 cm, 10-50 cm and 50-100 cm soil depth and analysed for soil texture, salinity, field capacity, saturation point, field capacity, permanent wilting point, pH as well as cations and anions in the saturation extract. EM38 measurements revealed soil heterogeneity within the experimental field. ECa ranged from 70 to 103 mS/m. Destructive soil sampling identified this site to be a loam soil, with moderate alkalinity (pH 8.2 ± 0.10) within the upper 50 cm. Correlations between ECa and soil chemical and physical properties revealed calcium content to be the soil property with the highest significant relationship with ECa ($r = 0.70$, $p < 0.001$) between 10-50 cm soil depth. Significant correlations between ECa and soil chemistry were also observed for magnesium, nitrate and bicarbonate at all soil depths. No significant relationship between ECa and soil texture was observed. ECa measurements were positively correlated ($r = 0.58$, $p < 0.01$) with field capacity, permanent wilting point and plant available water close to surface (0-10 cm soil depth). Results of this preliminary study confirm the potential of soil sensors to improve precision within field phenotyping. Further work is required to validate the potential of soil sensors to improve precision within field phenotyping.

MATERIAL AND OPERATING VARIABLES AFFECTING THE PHYSICAL QUALITY OF BIOMASS BRIQUETTES

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CSBE100429 – Biomass is a renewable energy source and environmentally friendly substitute for fossil fuels such as coal and petroleum products. Biomass has low bulk density, which makes it very difficult and costly to transport and handle. One of the very good strategies to overcome these difficulties is to densify the biomass to a high density product like briquettes. Briquetting is influenced by a number of material properties such as moisture content, particle size distribution, and some operating variables such as temperature and densification pressure. In this study, experiments were designed and performed to produce briquettes using barley straw, canola straw, oat straw, and wheat straw. The chopped samples were densified using laboratory hydraulic press briquetting machine under three pressure levels (7.5, 10, 12.5 MPa), three levels of temperature (90, 110, 130°C), at three moisture content levels (9, 12, 15% w.b.), and three levels of particle size (19.1, 25.04, 31.75 mm). For each treatment combination, ten briquettes were manufactured at a residence time of about 30 s. After compression, the dimensions of all the samples were measured; samples were then stored in Ziploc bags at a controlled environment for two weeks. Durability, dimensional stability, and moisture content tests were conducted after two weeks of storage of the briquettes. Results of the analysis indicated that moisture content plays a significant role on briquettes durability, stability, and density. [...].

PERFORMANCE SIMULATION OF HIGH VOLUME LOW SPEED FANS IN A FREE STALL BARN

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CSBE100430 – Results of a study are presented to understand the 3-dimensional airflow pattern created by a high volume low speed (HVLS) stirring fan with multiple blades operating within a free stall barn. The flow fields are simulated using a finite volume based computational fluid dynamics (CFD) package to solve the discretized Navier-Stokes equations coupled with an appropriate turbulence model. Boundary conditions are selected to match the practical application. The simulation results are presented with velocity contours, vector maps, streamline trajectories, and isovelocity surfaces. The simulated data produced in this study are expected to be useful for further enhancement of existing fan design, for use with hybrid particle tracking velocimetry (HPTV) analyses, and could it be helpful in better understanding ventilation rates from naturally ventilated structures.

NANO SILVER FUNCTIONALIZATION ON AGROBACTERIUM-MEDIATED TRANSFORMATION WITH COMPANIONSHIP OF NANOBIO TECHNOLOGY

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CSBE100431 – In genetic transformation studies explants are exposed to antibiotics in the medium for a long time to eradicate their surplus bacteria, that not only loses the explant, but also increases the possible resistance to bacteria because common antibiotics have a single mode of action. In this study, for the first time, the interaction of silver nanoparticle (NS) against *Agrobacterium tumefaciens* strain LBA4404 containing the binary vector pBI121 and *A. rhizogenes* strain K599 containing the binary vector pKGWFS7.0-35Sp, that are the common bacteria in genetic transformation studies, is reported. Transmission electron microscopy (TEM) was assessed to study the biocidal action of this nanoparticle on bacteria after 4 hours. Results confirmed that NS can alternatively be used instead of common antibiotic treatments in genetic transformation experiments. Using the present method resulted in a good *GUS* scorable gene transfer to an ornamental and medicinal plant, *Tecomella* sp. that could be a milestone for future research in the area of genetic engineering.

DIMENSION CHARACTERISTICS EVALUATION OF COFFEE BERRIES DURING DRYING

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CSBE100433 – Surface and volume measurements are important parameters that affect storage and shipping space, spray and gas applications, respiration rates, water loss or absorption data and heat and mass transfer coefficients. Also, drying models usually neglect the volume and surface alterations of agricultural products during the dehydration process, which leads to machinery and handling inefficiency. That being stated, the objective of the present work was to study the dimension alterations of *Coffea Arabica* L., cultivar Catuai Vermelho. Coffee berries were dried at temperatures (T) of 35, 45, 55 and 65 °C, along with relative humidities (ϕ) of 25, 35, 45 and 55 %, totaling 16 different conditions, with initial moisture content of 2.27 dry basis (d.b.), dried until approximately 0.11 d.b. An equation was proposed to describe the relationship among superficial area with weight values of coffee berries. Changes in the product dimensions were measured continuously during drying utilizing a digital caliper. Surface area-to-volume ratio values increased with moisture content decrease. According to statistical parameters, the empirical equation was suitable to predict surface area of coffee berries. With this result, engineers can predict the surface area of coffee through its weight, providing information that can be used to develop adequate machinery to use in harvest and postharvest procedures.

ENERGY AND GREENHOUSE GAS EMISSIONS OF AUSTRALIAN COTTON: FROM FIELD TO FABRIC

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CSBE100434 – Australian cotton production has seen vast changes in the past two decades, in both its on-farm and off-farm activities. The resource inputs include both the direct and indirect inputs. A Life Cycle Assessment (LCA) has been carried out in this project to evaluate the energy usage and greenhouse gas emissions of cotton production from field to fabric, which is from the real beginning i.e. tillage up to export shipping. It is found that on-farm indirect cotton-farming is the most energy consuming component (63%), consuming some 32.36 GJ/ha of energy. It is also found to be the most greenhouse gas emitting component (57%), emitting some 1.64 tonne of CO₂/ha. This research also shows that on-farm direct stage uses 14.07 GJ/ha of energy and emits 0.78 tonne of CO₂/ha. Energy use and the emissions by the off-farm direct section are calculated as 5.09 GJ/ha and 0.14 tonne CO₂/ha respectively. Energy consumed by the off-farm indirect farming section is found to be 0.036 GJ/ha or 0.002 tonne CO₂/ha. The total energy usage and greenhouse gas emissions in the Australian cotton farming system are estimated to be 46.43 GJ/ha and 2.42 tonnes CO₂/ha for on-farm, 5.13 GJ/ha and 0.145 tonne CO₂/ha for the off-farm sections. In total (after including the 300 kgCO₂/ha soil emission caused by nitrogen based fertilisers), 51.57 GJ/ha of energy is used and 2.86 tonnes CO₂/ha is emitted by a typical Australian cotton farming system from field to fabric.

ENERGY USAGE FOR COTTON GINNING IN AUSTRALIA

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CSBE100435 – Ginning is an energy intensive process. This paper evaluates the energy usage inside the cotton gins in Australia. Benchmark electricity use is found to range between 44 and 66 kWh per bale, with average being 52.3 kWh. The electricity consumption for different gins is nearly linearly correlated with bale numbers produced. The electricity network charge is a significant cost in cotton ginning operations. All gins monitored had an overall power factor of higher than 0.85. It is found that drying gas usage is strongly influenced by the cotton moisture reduction and regulated drying temperature. Overall, electricity and gas usage comprises about 61% and 39% respectively of total energy use (GJ/bale). 60.38 kg of CO₂ are emitted for ginning each bale of cotton. A method for detailed monitoring of energy performance in cotton gins is developed and described. Detailed monitoring and analysis are carried out at two gin sites. It is found that changes in trash content in the module, degree of moisture and lint quality produced do not have significant influence on electricity usage, while the cotton variety is shown to affect the energy usage. Overall, cotton handling is found to be the largest energy user and it takes up to nearly 50% of power use in both gins. Packaging and handling together use some 70% of total power required.

ESTIMATION OF EGG WEIGHT BY MACHINE VISION AND NEURAL NETWORKS TECHNIQUES

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CSBE100437 – Egg weight measurement is one of the most important parameters in marketing this product. Information regarding egg weight is not only vital for grading systems based merely on weight, but it is also necessary for assessing quality indices such as yolk-albumen ratio, shell thickness and hatchability. In the present study a machine vision system combined with artificial neural network technique was used for estimating egg weight. The system hardware consists of a CCD camera, a capture video, an illumination system and a mirror. As an egg is introduced into the frame, two perpendicular images are created. These images are then processed in MATLAB and pixel data corresponding to each image edge is extracted. Once the center of gravity of each image edge is obtained, twelve size features can be calculated for each image. These features are then classified into three categories named as input vectors (1-3). Each input vector along with its real weight data (measured) is exported to three parallel training algorithms of a Multi Layer Perceptron (MLP) Network. The training algorithms are variable learning rate (MLP-GDX), resilient back propagation (MLP-RP) and scaled conjugate gradient (MLP-SCG). These training algorithms were optimized to estimate egg weight. Evaluation results showed that MLP-SCG was superior to the other two algorithms in estimating egg weight at high accuracy (R=.96). In other words, MLP-CSG was capable of egg weight estimation with an absolute error of no more than 2.3g for the average egg size of 60 g.

GAIT AND FORCE ANALYSIS METHODS APPLIED IN PIG GAIT RESEARCH

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CSBE100438 – Claw injuries, leg weakness, or locomotor disorders are common problems in pigs. These disorders have been documented in scientific research for many years but the principal cause of the problem has been hard to find. In literature gait and force analysis have proven to be promising methods in linking claw injuries to surface material conditions. In present experiments the objective was to investigate if pig gait in different floor conditions can be characterised by a combination of kinematic and kinetic methods. To determine the relationship between claw disorder and floor physical properties, the factors controlling gait must be characterised. In the studies this was achieved by using kinematics and kinetics to record gait parameters and slip frequency. Kinematics were used to record gait parameters such as walking speed, stride length, swing and stance time, stride elevation together with limb support phases, gait symmetry, diagonality and duty factor. This was done by using two different types of digital video cameras with 25 Hz and 60 Hz frequency respectively. [...] The kinetic method included a force plate which was used to record kinetic gait parameters such as stance time, vertical and horizontal forces, and time of peak vertical force. Ground reaction force (GRF) data were collected during the passage of moving pigs at 1 kHz. In the GRF data acquisition system the force plate was connected to a digital converter and a computer. [...] The kinematic and kinetic methods proved to be reliable techniques for assessment of relevant gait parameters in characterising pig gait. The subject can be used as indicator in finding floor properties that better comply with the biological needs of the pig.

INFLUENCE OF COOLING SYSTEMS ON THE BEHAVIOUR OF DAIRY COWS HOUSED IN CUBICLE BARN

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CSBE100442 – During summer 2009 and winter 2010 experimental trials were arranged to verify the behaviour of dairy cows in a farm located in Po Plain (Italy). The barn was provided with an air-water cooling system, based on the use of fans and sprinklers placed only in the feeding alley. Two different trials were carried out. The first experiment targeted the use of the cubicles by the cows in relation to the availability of the cooling system only in the feeding area. The second trial aimed at testing the effectiveness of zone cooling systems placed in the front of the cubicles. For this purpose three cubicles in the barn were provided with cooling systems, based on the input of high velocity conditioned air streams. The results clearly demonstrate that the behaviour of the animals is greatly influenced by the environmental conditions. With high temperatures the use of the cubicles is deeply reduced and the animals prefer to stay in the feeding area, thus benefiting from the cooling effect of water sprinkled by the showers and the air streams created by the fans. With air temperatures increasing from 21 to 33°C the cows reduce the length of their stay in the cubicles, which gets down from 52.0 to 29.2% ($r^2 = 0.8471$). In regards to the efficacy of zone cooling system in the cubicles, the results are not particularly encouraging. The cows continue using the cubicles without changing the behaviour in relation to the presence of conditioned air flow.

REDUCING AMMONIA RELEASE IN A FLOOR HOUSING SYSTEM FOR LAYING HENS BY DAILY REMOVAL OF MANURE BELOW A PERFORATED FLOOR

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CSBE100443 – The hygienic threshold limit value for ammonia (10 ppm) is often exceeded in floor housing systems for laying hens with long time storage of manure in bins below perforated floors. The major reason for high ammonia concentrations is the large amount of stored and exposed manure. The possibility to reduce ammonia release by reducing the amount of stored manure in bins has therefore been investigated in a climate chamber equipped with a manure removal system with two parallel motor driven conveyors placed below an elevated perforated floor. The conditions when manure is stored in bins below perforated floors were simulated by storing manure on the conveyors for several days at constant ventilation rates and temperatures. The investigations clearly showed that storage of manure in the bin caused a rapid increase in ammonia concentrations. After about 7 days of manure storage in the bin the ammonia concentration exceeded the hygienic threshold limit value. It can be concluded that long time storage of manure in storage bins below perforated floors should not be recommended. It was possible to maintain the ammonia concentration below the hygienic threshold limit value when manure was removed daily with conveyors. Floor housing systems for laying hens with perforated floors should therefore be equipped with manure removal systems that enable daily removal of manure from the bins.

INFLUENCE OF WATER SPRINKLING ON THE AMOUNT OF DUST PARTICLES IN A HOUSE FOR FATTENING PIGS

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CSBE100445 – Dust and particles in the air environment in pig houses most likely contribute to respiratory symptoms in workers and pigs. Measurements were made in order to study the effect of water sprinkling on the occurrence of respirable particles. A barn with 48 fattening pigs in pens with partly slatted floor was used in the study. Nozzles placed over the slatted floor sprinkled water 20-40 seconds during an hour. Particles were counted six times every hour by the help of a Rion KC01B particle counter. Average numbers of particles in millions per m³ during periods without sprinkling were 63 for size fraction 0.3-0.5 µm, 2.2 for 0.5-1 µm, 1.5 for 1-2 µm, 1.5 for 2-5 µm and 0.39 for particles larger than 5 µm. Average numbers in millions per m³ during three periods with water sprinkling were 48 for size fraction 0.3-0.5 µm, 1.8 for 0.5-1 µm, 1.3 for 1-2 µm, 1.2 for 2-5 µm and 0.33 for particles larger than 5 µm. A diurnal variation of the amount of larger particles was likely influenced by the activity in the barn. Variation between concentrations during different days indicates a difficulty to make firm conclusions. However, the result suggests a significant reduction of respirable particles by sprinkling with water.

DRYER EVALUATION TO OPTIMIZE SMALL-SCALE LITCHI PROCESSING IN NORTHERN THAILAND

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CSBE100446 – In Thailand, litchis are produced primarily by smallholders in northern mountainous areas of the country. Currently, the profitability of this crop is jeopardized by unstable farmgate prices and insufficient access to markets. Local production of dried litchis by farmer cooperatives is a promising solution, yet existing drying technology for small-scale food processing yields products with heterogeneous quality and it has low energy performance. Aiming to develop energy-saving technology for producing high-quality dried fruits at an affordable cost, a locally available batch dryer used for litchi was evaluated at a farmer's cooperative. Non-uniform temperature distribution in the drying chamber was identified, resulting in fruits with heterogeneous moisture content, water activity and color. Each batch yielded approximately 15 kg of dried litchi and required about 15 kg of fuel. Specific thermal energy consumption of the dryer was 10.3 MJ per kilogram of evaporated water. Analysis of instantaneous indices, calculated to evaluate energy performance, demonstrated that the main heat loss was via exhaust air and that increasing the dryer's recirculation ratio or reducing the airflow rate could decrease this loss. Installing a frequency-converter to control the speed of the blower would allow an adjustable airflow rate and thus, the gradual reduction of airflow over the drying process. Convective heat loss through the dryer's walls was also high, which might be reduced by insulation. Overall, it is believed that the proposed modifications would produce significant improvements in dryer performance.

PRELIMINARY INVESTIGATION INTO THE PRESSING PROCESS OF SWEET PEARL MILLET AND SWEET SORGHUM BIOMASS FOR ETHANOL PRODUCTION

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CSBE100447 – In North America, biofuels are mostly produced from corn, which has been widely criticised around the world. The use of sweet pearl millet and sweet sorghum for ethanol production is an interesting alternative to corn because of their high biomass yield under a wide range of environmental conditions and high concentration of readily fermentable sugars. Also, coproducts (pressing residues) could be utilized to their maximum potential in different ways so nothing is lost in the process. However, the pressing process of this biomass has to be optimized for a better extraction of juice for ethanol production. Preliminary experiments were carried out on sweet pearl millet and sweet sorghum to optimize the juice extraction with two different presses, a screw press and a hydraulic press manually operated. Sweet pearl millet and sweet sorghum biomasses were either chopped finely or coarsely. They all have undergone various pressures with the hydraulic press. Results showed that, for both crops, the volume of extracted juice increases almost linearly with increasing the pressure. Sweet sorghum seems to be a better feedstock for ethanol production since it produces about 0.03 to 0.06 litre of juice per kilogram of biomass more than sweet pearl millet. The use of the screw press resulted in a better juice extraction. However, only negligible difference was observed between the two chopping modes. [...].

ESTIMATION OF TOMATO NUTRITIONAL STATUS BY VIS-NIR PORTABLE SPECTROPHOTOMETRIC SYSTEM

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CSBE1000448 – Determination of crop nitrogen (N) nutritional status by rapid and non-destructive methods is an essential means to optimize fertiliser-N use and minimize N losses. Spectral reflectance values of tomato leaves obtained by VIS-NIR spectrophotometry are reported to be a powerful tool for diagnosis of plant nutritional and health status. The aim of the study was to evaluate the possibility and the accuracy of the estimation of tomato leaf N content performed through a rapid, portable and non-destructive spectrophotometric VIS-NIR system, in comparison with chemical standard analyses. Nearly 2000 leaves of processing tomato grown in a field experiment with different fertiliser-N rates and forms were collected at three crop stages (from June to August 2008) and analysed for total N. The spectrophotometric acquisition was realised through an instrumental device consisting in a notebook connected to a handy punctual VIS-NIR spectrophotometer (400-1100 nm range, a bandwidth of 3 nm) and a contact probe for solids (optical diameter 3 mm, 45° diffuse illumination without specular component). Mean reflectance leaf values were compared to each reference chemical value by chemometric multivariate methods (Partial Least Squares regression analysis). The prediction ability of the model was high, being a SEP of 0.17 and RMSE of 0.14, the latter corresponding to 3.4% of the average measured values of nitrogen. The correlation between predicted and observed chemical values showed highly significant values with an $R^2=0.97$.

UPDATE ON SETTING THE GLOBAL TEMPERATURE USING ECOLOGICAL ENGINEERING

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CSBE100450 – The proposed solution is permanent long-term and continuous sequestration of enormous amounts of carbon as lignin underwater. The complex, multi-ring compound, lignin which is a major component of terrestrial plants including wood and bark, is normally decomposed by fungi in damp air but they are ineffective when oxygen is low, as in fully oxygenated water. The only site large enough for mass sequestration of lignin that would decrease atmospheric CO₂ is the deep ocean. In this site lignin would eventually re-create coal beds thus cycling CO₂ back to its source completing the cycle desired by most ecologists. In principle, any lignin-rich matter (bark, wood fragments) could make use of the long history of moving entire trees along rivers from distant forest sites to the lumber mill. Water logging of bark needed to sink it varies with species. Lignin-rich bark is currently almost a waste product is easier to move down rivers given the huge amounts of carbon involved. Most commercial trees have thin bark but by emphasizing production of trees such as red pine that have thick bark C-sequestration would be greatly increased with rest of the tree used for houses or furniture. Preliminary calculations indicate that sequestration of 25% of the current US commercial timber industry's C-output could reduce the US CO₂ emissions by 12%. Using bark from the world timber crop may allow setting a global temperature at any level. Using trees with more bark would probably allow any large nation to set the global temperature probably leading to conflicts between cold and warm regions. Ecological [...].

TRANSMISSION OF E. COLI O157:H7 BIOFILM FROM CONTACT SURFACES TO FRESH PRODUCE

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CSBE100451 – Multistate outbreaks of E. coli O157:H7 infections by the consumption of contaminated foods including produce products have brought a great safety concern. It is important to determine implementation strategies to reduce the bacterial contamination of products during processing. It is known that biofilm formation and quorum sensing signals can play an important role on enhancing bacterial attachment on food processing facilities. The objectives of this study were to determine the effect of biofilm production and quorum sensing signals on the attachment of E. coli O157:H7 on food contact surfaces and to evaluate the transmission of the pathogen from food contact surface to fresh produce. Biofilm-forming capability of E. coli O157:H7 was determined by a crystal violet binding assay. Quorum sensing signal, autoinducer-2 (AI-2), in cell-free culture fluids was measured using a *Vibrio harvei* bioluminescence assay. Biofilm formation by E. coli O157:H7 on surfaces of stainless steel and glass and its transmission from contact surface to various types of products were determined by the pour plate method. E. coli O157:H7 produced maximum levels of AI-2 signals in 12 h of incubation in tested meat, poultry, and vegetable broths and subsequently formed strong biofilm in 24 h of incubation. In general, E. coli O157:H7 formed stronger biofilm on stainless steel than glass. Furthermore, E. coli O157:H7 that had attached on the surface of stainless steel was able to transfer to fresh produce. Strong attachment of the transmitted pathogen on produce products (cantaloupe, lettuce, carrot, and spinach) was detected ($>10^3$ CFU/cm²) even after washing these products with water. Our findings suggest that biofilm formation by E. coli O157:H7 on food contact surfaces [...].

EMISSION OF CH₄, CO AND NH₃ DURING COMPOSTING OF SYNTHETIC FOOD WASTE IN A CONTROLLED PILOT-SCALE COMPOST REACTOR

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CSBE100455 – Composting has general acceptance as an inexpensive, simple and environmentally benign process for organic waste disposal. However, when not properly managed, it can result in the emission of toxic and environmentally hazardous gases. Volatile emissions from composting can include methane (CH₄), ammonia (NH₃), nitrous oxide (N₂O) and carbon monoxide (CO). Due to the potential negative consequences of composting, there is a need to gain a better understanding of the physical conditions that affect these volatile emissions in order to better control them. The objective of this project was to construct a pilot-scale compost reactor, as a platform to study the potential impact of temperature, humidity, oxygen concentration and air flow rate on the gaseous emissions from compost. Fourier Transform Infrared (FT-IR) spectrometry was used to quantify the gaseous emissions from the compost reactor under different physical conditions. For the sake of uniformity, a synthetic compost substrate was prepared for the experiments by mixing dog food with wood chips, paper and water. To test the performance of the constructed system, emission rates of methane, ammonia, nitrous oxide and carbon monoxide were measured under several different temperature and oxygen concentration regimes. At the time of the writing of this paper, results for the volatile emissions from compost have yet to be obtained. Results will be presented during the World Congress of the International Commission of Agricultural Engineering in Quebec City, Quebec, June 13-17, 2010; an updated paper will be available from the author.

A REVIEW OF STANDARDS RELATED TO BIOMASS COMBUSTION

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CSBE100457 – Different countries have set up various regulatory frameworks to ensure excellent air quality for general human health. The concentration of particulate matter (PM) per unit of air volume is used to assess air quality. PM₁₀ is defined as all particles with a diameter smaller than 10 micrometers (µm). The acceptable levels of PM₁₀ established by the European Commission are less than 20 µg/m³ annually and less than 50 µg/m³ daily. The rules are less precise when it comes to assess the amount of PM that can be emitted from a furnace's chimney. Quebec province allows up to 340 mg/m³ of PM for large furnaces (> 3 MW) and 600 mg/m³ for smaller furnaces (< 3 MW); it allows burning wood products but forbids all other biomasses (straw, stover, grass). The City of Vancouver has stricter emissions standards for PM: 50 mg/m³ for large furnaces and 35 mg/m³ for smaller furnaces. The large difference is explained because most furnaces in Quebec are used in rural areas whereas the City of Vancouver, a densely populated area, must control emissions at the source. A universal standard on combustion emissions is not feasible because of different socio-economic conditions and population density. However, furnaces should emit levels of PM which decrease as the surrounding area population concentration increases. Technology such as chimney height, bag filters, multicyclones, and precipitators may help to meet stricter regulations.

VARIABLE RATE TECHNOLOGY FOR HERBICIDE APPLICATION ON RAILWAYS

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CSBE100458 – The aim of this study was to develop of a system for variable herbicide application on railways. The sprayer was set up with three lines, one for each of the three track swaths (left and right sides and the central stone ballast). Each line was arranged with electronic control and injection metering to enable the variation of the spray volumes, herbicides types and dose rates. Onboard computers and software were set up to manage the operation. A decision support system was based on a digital camera used to get images from the track before the application while information from a GPS receiver was recorded on the sound track by using a dual-tone multi-frequency (DTMF) interface. The software enabled the operator to decide off-line all the operation parameters (type of herbicide and its dose rates, spray volume rates and on-off procedures) before spraying by watching the video and pressing a keyboard, while position information is sent back to the computer by the DTMF converter. This off-line decision support procedure enabled the treatment map to include data from the weeds, soil variability and local restrictions for application (environmental protected areas). The spray operation was controlled on-line via onboard computer by getting the actual train position and comparing to the treatment map. The results showed that the operational performance, the accuracy of the injection metering and the spatial accuracy of the navigation and the mapping process were adequate. The system enabled an average saving of 20% on herbicide consumption on the railway.

HANDLING OF CORN STOVER BALES FOR COMBUSTION IN SMALL AND LARGE FURNACES

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CSBE100459 – Corn stover was harvested in the spring when it is very dry (moisture content below 10%). Two bale formats were considered for direct combustion in two furnaces: small rectangular bales (0.35 m x 0.45 m x 0.60 m; 10 kg) and large rectangular bales (0.8 m x 0.9 m x 1.8 m; 200 kg). A small 500,000 BTU/h dual chamber log wood furnace was located at a hay growing farm (Neuville, Québec) where the heat was initially transferred to a hot water pipe system and then transferred to a hot air exchanger to dry hay bales. The small stover bales were placed directly into the combustion furnace. The low density of the bales compared to log wood, required filling up to 8 times more frequently. Stover bales produced an average of 6.4% ash on a DM basis and would require an automated system for ash removal. Combustion gas contained levels of particulate matter greater than 1417 mg/m³, this is above the local acceptable maximum of 600 mg/m³ for combustion furnaces. Corn stover bales cannot be used directly without improving combustion or using an exhaust gas filtering system. The second combustion unit was a high capacity 12.5 million BTU/h single chamber furnace used to generate steam for a feed pellet mill (Saint-Philippe-de-Néri, Québec). Large corn stover bales were broken up and fed on a conveyor and through a screw auger to the furnace. Again, the stover was light compared to the wood chips used in this furnace (46 vs. 163 kg DM/m³ for bulk density). The stover could not be fed continuously to the furnace mainly for mechanical reasons: roll up of stover on the walking floor, auger clogging and bridge over the auger. Only a small quantity of stover was actually [...].

MINIMUM DISTANCE SEPARATION (MDS) FORMULAE 40 YEARS YOUNG (1970 – 2010) SUCCESSES AND LESSONS LEARNED

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CSBE100462 – The Minimum Distance Separation (MDS) Formula has a long, successful history of use in Ontario. It was developed by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) to determine minimum setbacks between proposed new or enlarged livestock facilities and/or permanent manure storages and other existing or approved development. It is an empirical formula developed partially on field experience, partially on scientific research. It has been a successful tool to reduce land use conflicts and it has created clear rules about the development and expansion of livestock agriculture in Ontario's rural areas. Neighbours and livestock farmers sometimes do not like the setbacks, but they do like knowing there is a setback. MDS I is applied at the time of planning and/or development review for proposed new development, such as lot creation, building permits for development on a lot, and rezoning or redesignation of agricultural land to permit development in proximity to existing livestock facilities. MDS II is applied at the time of building permit application to build a first or expanded livestock facility. It is estimated that since its inception, there have been at least 110,000 MDS I and 25,000 MDS II applications in Ontario. MDS has gone through a few revisions since its humble beginning in 1970, but the most comprehensive revision occurred in 2006 with the release of OMAFRA Publication 707, *Minimum Distance Separation (MDS) Formulae, Implementation Guidelines*. [...].

PULSED ELECTRIC FIELDS AND MICROFILTRATION HURDLE TREATMENT FOR THE IMPLEMENTATION OF MICROBIAL SAFETY IN MILK

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CSBE100463 – Pulsed electric fields (PEF) and microfiltration (MF), both emerging non-thermal processing technologies, enable ‘cold pasteurization’ of liquid foods, thus, allowing gentle processing without product quality loss due to lower thermal impact compared to conventional pasteurization (CP). Raw skim milk inoculated with native microbiota was PEF-treated at electric field strengths of 16, 20, 30 and 42 kV/cm for treatment times of 2105, 1454, 983, and 612 μ s, and energy densities of 407, 632, 668, and 815 kJ/l, respectively. MF of milk was carried out with a 1.4 μ m pore-size membrane at retentate and permeate flow rates of 120 and 12 l/h, respectively, while CP was applied at 75 °C for 24 s. In a comparison of PEF, MF, and CP reductions of native microorganisms in milk a 4.6 log₁₀ was obtained with CP, which was comparable to 3.7 log₁₀ achieved by MF ($P \geq 0.05$), and more efficient than PEF inactivating up to 2.5 log₁₀ (at 815 kJ/l ($P < 0.05$)). Hurdle treatment with MF followed by PEF (MF/PEF) led to reductions of 4.1 (at 407 and 632 kJ/l), 4.4 (at 668 kJ/l) and 4.8 (at 815 kJ/l) log₁₀ of the native microbes in milk similar to that of CP ($P \geq 0.05$). Changing the processing sequence (PEF/MF) produced comparable microbial reductions of 4.8, 5.3 and 5.7 log₁₀ (at 407, 632 and 668 kJ/l, respectively ($P \geq 0.05$)) and a greater inactivation of 7.1 log₁₀ (at 815 kJ/ml ($P < 0.05$)) in milk than for CP. Overall, combining MF and PEF proved to be a considerable milk processing alternative to CP.

DRYING CHARACTERISTICS AND LYSINE CONTENT OF WHEAT DISTILLERS GRAINS WITH SOLUBLES UNDER THREE DRYING METHODS

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CSBE100464 – The drying characteristics and lysine content of wheat distiller’s grain with solubles were studied under three methods: forced-air drying, microwave drying and microwave-convective drying. For the forced air drying, temperature was set at five levels (40, 60, 80, 100, and 120°C), maintaining air velocity and relative humidity at 0.7 – 0.8 m/s and less than 8%, respectively. Using a domestic microwave oven, four power levels (P4, P6, P8, and P10) were used in microwave drying while four combination settings (Combinations 1, 2, 3 and 4) at 30% power were set-up for microwave convection drying. Experimental data were fitted to four common thin layer drying models, with the Page model found to best describe the drying behaviour of the distiller’s grain under the three methods. Lysine content and the color parameters (L , a , and b) were also determined and assessed for linear correlation with temperature and microwave power. Lysine content and L values decreased with increases in drying air temperature. Lighter coloured DDGS samples have higher lysine content.

EFFICIENT HARVESTING OF HASKAP BERRIES IN JAPAN

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CSBE100465 – As yet, Haskap (blue honeysuckle) is the earliest fresh fruit which can be harvested from late June in Hokkaido, Japan. Compared with highbush blueberry, Haskap varieties ripen all at once, and the Haskap berries are very easy to detach by gentle shaking while blueberries need to be harvested several times. The firmness of blueberries is an advantage for harvesting and processing; instead of that, Haskap berries get broken easily and juice each other. Farmers in Japan have to harvest them manually and carefully. In order to develop a highly efficient harvesting method with low cost for fresh market quality Haskap berries, we developed some fruit picking, collecting and cleaning equipments. Plastic hoses and Jig Saws were modified into fruit picking appliances; buckets, umbrellas and plastic nets were converted into fruit collecting devices; mesh net with the help of water and electric fan were used as fruit cleaning units. We compared the results achieved when various combinations of picking, collecting and cleaning equipment were tested in an experimental orchard. The data show that the picking aids used in the trials increased average per worker production from 1.79 kg (conventional hand picking) to as much as 7.69 kg per hour. This test indicated that when effective methods of separation and collection are combined with adequate cleaning, the fruit is suitable for the fresh market. It also showed that we can remove foreign materials and immature fruit successfully, but additional grading was required to separate large immature, damaged by insects and bruised berries.

AGRICULTURE, POPULATION AND THEIR IMPACT ON THE GLOBAL ENVIRONMENT

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CSBE100466 – Perhaps, the global warming is the most serious problem that humankind faces today. Agriculture not only supplies food, feed and fiber but also is the source of energy. The combination of population growth and economic development with the decreasing per capita land area, growing needs of energy and increasing demand of quality food, especially in the developing countries, puts a great stress on arable land, water, energy and biological resources. The rush toward liquid biofuels affects virtually every aspect of the field crop sectors, ranging from domestic demand and exports to price and the allocation of land area among crops. This study reveals that the global environment is influenced by cropping patterns, dietary choices, food supply and international trade, and population growth might be the main key. Production of genetically modified (GM) crops might be useful in reducing growing pressure on natural resources and on the environment, if that does not conflict with safety and biodiversity. If the population can be stabilized to a 1990-level and food spoilage and other waste limited to 10%, then about 28% of the present world food supply could be conserved. It may facilitate the countries to export their surplus food to the food deficient countries and may play an important role to reduce food insecurity and poverty, and reduce the pressure on land, water and other natural resources, [...].

A CRITICAL EVALUATION OF THE ACCURACY OF TRACER GAS MEASUREMENTS IN VENTILATED SPACES

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CSBE100467 – Since natural ventilation is a more energy efficient approach to provide effective ventilation, this technique is gaining more interest. The major problem of natural ventilation is a lack of an accurate, continuous and online measuring and controlling technique for air exchange rates, which is crucial for the monitoring of the buildings emissions and for the control of indoor air conditions. In a number of studies, several techniques were suggested to measure ventilation rates through naturally ventilated buildings. Both for research and field applications, the proposed techniques should be tested under controlled, laboratory conditions to evaluate their ultimate accuracy. Due to lack of any ‘reference technique’ on field trials, this study aims to test the possible techniques in laboratory test installations. The majority of the studies use tracer gas technique as a reference method. Therefore, the accuracy of the tracer gas method should definitely be studied against a standard measuring technique. Although tracer gas measurements are widely used in literature for comparison, they mostly rely on the assumption that the air and the tracer gas are perfectly mixed in the ventilated volume. Also it is assumed that the measurement point is representative of average ventilation efficiency within the space. In reality, measurement errors are unavoidable due to imperfect mixing of tracer gas in the ventilated volume. Measurements in less ventilated ‘dead zones’ will definitely lead to misleading results for total ventilation rate. In this study, the ventilation rate measured with the tracer gas method was compared with an accurate measurement of the ventilation rate in a laboratory test installation. This research [...].

DAILY PATTERN OF SOUND LEVEL IN A CAGED HENS FACILITY AS AN INDICATOR OF DAILY ACTIVITY VARIATION

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CSBE100469 – The daily variation of animal activity can be used as an indicator of the daily pattern of carbon dioxide emissions. This pattern in CO₂ emissions is crucial to develop accurate carbon dioxide balances to estimate ventilation fluxes from animal facilities. Determining the activity index in commercial farms is a challenge, mainly for caged hen facilities where the number of animals and their distribution in the building make the use of video records or PID systems difficult. The sound level inside a commercial hen farm has two components: part of the sound is linked to the equipment installed in the building (fans, feeding system, manure belts, etc.), the other part is produced by the animals and can be linked to their activity level. The aim of this work is to study the daily pattern of the sound level in a hens housing and to relate it to indirect indicators of animal activity. A sound level meter was installed inside a building with a capacity of 142 000 laying hens during a week. The sound level was registered continuously each 10 minutes. The lighting program of the farm was automatically controlled where the light period of 16 hours went from 5 a.m. to 9 p.m. A clear daily pattern was identified observing higher sound levels during the morning (maximum level of 78 dB at 9 a.m.). Those sound levels decreased constantly (until 73 dB) during the late morning and afternoon. [...].

KNOWLEDGE TRANSFER MODEL FOR AGRICULTURAL ENGINEERING

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CSBE100471 – Farmers need proven and new knowledge of engineering matters to solve technical problems and manage technical investments in their agricultural business. According to recent budget restriction, the state aims in the future to be involved in providing only those goods and services which the private sector is not willing to provide. The overall aim of this paper was the identification of a model which guarantees an effective and undisturbed knowledge transfer, despite restricted resources. An important aspect of knowledge transfer in Agricultural Engineering is the missing availability of advice in engineering for farmers in the private sector. The resources used for identifying adequate transfer models were the literature, existing models of advisory systems, expert panels, and questioning of selected actors in the existing knowledge transfer system. The relevant criteria for developing a model are the limited number of public consultants, the farm-related amount of investments in sustainable farm businesses, key competences of Bavarian farms, the demand in advisory services of the majority of farms, and the possibilities of a work-sharing cooperation between public and private advisory services. In this model, public consultants have to act as supra-regional multipliers, as knowledge engineers. Other identified instruments for efficiency increase in knowledge transfer are the shortening of knowledge transfer ways, application of new information and communication technologies, and reorganisation according to communication channels. External communication can be improved by networks between actors in knowledge transfer and timely consultant profiles, next to the cooperation possibilities with private advisory organisations and the building-up of demand-oriented [...].

A SUMMARY OF VENTILATION RATE MEASURING TECHNIQUES THROUGH VENTILATED BUILDINGS

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CSBE100472 – The measurement of the total air flux through naturally ventilated openings is not straightforward. Direct and indirect measuring techniques are available for determination of ventilation rates in naturally ventilated buildings. Direct measuring methods include measuring fan, propeller gauge, hot wire anemometer, particle image velocimetry, laser Doppler anemometer, and transit time sonic anemometer. Basic disadvantage of direct measuring techniques is that they are generally used for point or local measurements of air velocity. In order to have the total ventilation rate through the whole building, a “system” is required to measure simultaneously the airflow both in magnitude and direction at a number of locations. Indirect measuring techniques include heat balance, CO₂ balance, pressure difference, CFD analysis, tracer gas measurements, multizone modelling, and zonal models. These methods consider the whole system, and therefore, provide a possible tool for determining air flux through the building envelopes. Methods based on computer simulations (CFD, multizone models, etc.) should be validated against experimental data. However, in most cases, those validations are lacking, or do not indicate the accuracy of the method. Tracer gas measurements are mostly used as a reference method in validations. However, accuracy of this technique should also be studied. Most indirect measuring techniques suffer from the problem of imperfect mixing of air within the ventilated structure. [...].

TECHNICAL APPROACH FOR ROW CROP SEEDING IN SQUARE TO IMPROVE MECHANICAL WEED CONTROL EFFICIENCY

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CSBE100473 – Row crops are highly affected by weeds at early stage of growth. The most commonly applied weed control in row crops currently is herbicide field spraying. An alternative is the mechanical weed control by hoeing, which is still not a satisfactory method because of low capacity and the fact that only up to 85% of the soil surface is treated. The space between the plants is not accessible for the weeding tools of conventional hoeing machines. To extend the area of mechanical treatment other cropping systems are required to support the operation of hoeing machines. On an experimental farm seed placements were arranged to allow machine hoeing inter and intra row. An electronic precise steering mechanism was integrated in a conventional seed space drill. To comply with an adequate plant population for sugar beets a seed placement of 33 by 33 cm was chosen. This distance is coincidentally an acceptable clearance between the plants for machine traffic. The aim of the field experiments was to evaluate the weeding efficiency of different methods. Hoeing was applied three times and weeds have been counted before and after operations. As compared to inter-row hoeing by a conventional machine additional intra-row hoeing eliminated 21% more weed plants. The most effective weed control system was the herbicide application eliminating weeds to less than two weed plants per square meter. In the mechanically treated plots more than 12 weed plants per square meter were found after the weed control of the plots was terminated.

BEST MANAGEMENT PRACTICES FOR OPERATING WIND MACHINES FOR MINIMIZING COLD INJURY IN ONTARIO

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CSBE100476 – Cold or frost injury can occur on sensitive perennial crops such as grapevines and tender tree fruits if plant tissue temperatures fall below critical values beyond which there is an irreversible physiological condition causing malfunction or death of plant cells. One method for protecting these crops is to use wind machines, which are tall, fixed-in-place engine-driven fans that pull warm air down from high above ground during strong temperature inversions, raising air temperatures around cold-sensitive crops. Wind machines are relatively new to Ontario, only first used for grapes in Niagara in the late 1990's. Today there are close to 500 in use. They have worked well for growers, but there have been noise complaints from nearby neighbours. A four-year applied research project ended in fall 2009 with the objective to establish best management practices for wind machines and find ways to use them more effectively. After the test wind machine operated 29 times for a total of 141 hours over the research period, the authors learned a great deal about ways to minimize machine operation. This paper summarizes the findings.

DEVELOPMENT OF RFID TEMPERATURE TRACKING SYSTEMS FOR COMBAT FEEDING LOGISTICS

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CSBE100477 – First Strike Rations (FSR) military meals are shelf-stable products able to withstand a wide range of temperatures along their supply chain. Nonetheless, once their temperature thresholds have been surpassed, their expected shelf-life is reduced considerably. If inadequate temperature management of FSR loads is not detected, its consumption could diminish the nutritional status of the military forces deployed and pose a food safety threat for them. Therefore, a reliable temperature tracking system must be in place during combat feeding logistic operations. RFID temperature tracking presents superior performance than conventional monitoring methods in food supply chains; however, cost-efficiency and consistent readings must be obtained. This is achieved by minimizing the number of sensors employed, monitoring only thermally relevant locations and by surpassing the interactions between the systems' radio frequency waves and the product and its environment. The objective of this research was to develop a RFID temperature tracking system for FSR logistics by finding a thermally relevant location able to represent 85% of the temperatures present inside a pallet of FSRs when subjected to conditions similar to the ones faced along its supply chains, and by determining the readability of a commercially available RFID battery assisted passive tag in this particular location. The thermally relevant location pursued was not detected. Thus, a system where instrumentation takes place in the middle point of an interval that gathers the temperature readings of 85% of the locations measured was proposed. Lastly, the outcome of the readability study is reported, and the monitoring system is finalized.

HEATING AND COOLING PERFORMANCE OF AN UNDER FLOOR EARTH TUBE AIR TEMPERING SYSTEM IN A MECHANICAL VENTILATED FARROWING HOUSE

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CSBE100478 – Earth tempering of stable air has attracted great attention as a sustainable air conditioning method in pig houses. During the summer, air cooling of the incoming air strongly reduces heat stress and required ventilation rates, while heating costs can be reduced during the winter. The effect of air conditioning using geothermal energy was investigated in a farrowing house. Underneath the foundations of the farrowing house [...], 88 non-perforated ribbed tubes (diameter: 20 cm) were laid at a depth of 1.6 – 2.0 m. Over a period of 12 months, the following data were recorded at hourly intervals and analyzed: outside air temperature and outside relative humidity, as well as air temperature and relative humidity in the air supply duct and in the four separate rooms of the house. During the winter, the incoming air [...] was heated up to 20°C and in the summer it cooled up to 15°C compared to the outside air temperature. In contrast to diurnal variation of the outside air, the temperature fluctuations of the incoming air were reduced by 90%. Due to cooling of the incoming air during the summer, temperature inside the farrowing house could be limited to a maximal 29°C [...]. In conclusion, earth-tube heat exchangers with non-perforated ribbed tubes are very efficient for air conditioning in farrowing houses. They are a cost-effective supplement for sustainable cooling and heating of farrowing houses.

ADVANCED WEB OUTREACH TECHNIQUES: CAPITALIZING ON SOCIAL MEDIA, LIVE BLOGGING, AND MOBILE TECHNOLOGY TO CONNECT WITH AGRICULTURAL CLIENTELE

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CSBE100479 – Social media websites, such as blogs, Facebook and Twitter are rapidly emerging as popular sources of agricultural and farming information. The advantages of agriculture professionals utilizing these tools for dissemination of information to clientele and peers are many faceted and include: no/low cost, real-time sharing of information, development of community, and direct engagement. The agricultural industry is emerging as a leader in social media. Large, multinational agricultural companies such as Monsanto have developed a strong social media presence. In addition, agricultural advocacy firms as well as individual farmers are using social networks to express opinions on agricultural policy. Agriculture professionals should recognize the importance of social media websites and their potential usefulness for sharing agricultural information. Social networks provide the ability to capture insight into opinion concerning agricultural issues from those with agricultural and non-agricultural backgrounds. The author provides impact that social networks have on the agricultural community, such as addressing H1N1, agriculture sustainability, and local food sources based on surveys from producers who utilize social media tools. An overview is presented on the ability of the user to utilize mobile technologies to disseminate information real-time via blogs and other social networks, as well as participating in a real time agricultural community on Twitter. The author proposes a web-based social success model that is built upon the ability to provide value for users and readers.

PHYSICO-CHEMICAL CHARACTERISTICS OF WHEAT DISTILLER'S GRAINS WITH SOLUBLES

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CSBE100482 – There is very limited information on the physical, flow and chemical properties of dried distiller's grains with solubles (DDGS) derived from wheat-based fuel ethanol production. As wheat distiller's grains become increasingly more available in Western Canada, baseline information on these properties is essential in responding to the problems posed by existing processing, handling, storage, and transportation systems. Aimed as an initial step toward addressing challenges on DDGS flowability and maintenance of product quality, the following properties were quantified before and after drying, using standard laboratory methods: particle morphology and size distribution, bulk and particle densities, friction and flow properties, pneumatic properties, airflow resistance, thermal properties, hygroscopic properties, surface characteristics and chemical composition. Relationships and interactions between these various properties were also examined and their implications discussed.

QUALITY ASSESSMENT OF MICROWAVE PASTEURIZED IN-SHELL EGGS

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CSBE100491 – In-shell eggs were pasteurized using a custom built microwave cavity with a slotted waveguide and conventional hot water bath at 60 °C. The quality of albumen and yolk samples from microwave pasteurized, water bath pasteurized and unpasteurized in-shell eggs (not inoculated) were assessed through visual attributes (turbidity-UV-Spectrometer), viscosity (22 °C), thermal analysis (enthalpy of denaturation), and dielectric spectroscopy (200 MHz to 40 GHz). The microwave pasteurized eggs had superior quality in all the parameters analysed and also had a much longer keeping quality compared the unpasteurized eggs

DEVELOPMENT OF A BIOGAS PURIFIER FOR RURAL AREAS IN JAPAN

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CSBE100492 – Currently, the biogas produced by biogas plants for dairy farms in Japan is a carbon-neutral energy. However, utilization of biogas is restricted solely to farming areas. In particular, because there is no effective method of transporting unused biogas and there is a need for establishing practical methods for biogas removal from operating systems. The purpose of this study was to expand the use of biogas produced from stand-alone biogas plants by employing a gas separation membrane in order to modify biogas to city gas 12A specifications, and to develop a biogas purifier (refining-compression-filling (RCF) facility) equipped with a device to fill high-pressure purified gas into cylinders to be taken outside the farming area. The amount of purified gas produced by the RCF facility we developed was approximately 97.0 Nm³/day, for a raw material amount of approximately 216.0 Nm³/day. The heat quantity of the purified gas was 38.9MJ/Nm³ (9,290kcal/Nm³), which was within city gas 12A specifications. Furthermore, the number of gas cylinders (filled pressure: 14.7 MPa, volume: 46.7 L) filled with the manufactured purified gas was 14.3 cylinders/day. We conducted a simulation that envisioned providing cylinders filled with purified gas from outside the farming area to common households in a town (Town A; 3661 common residential units) located in Northern Japan. Test calculations indicated that it would be possible to provide purified gas to approximately 6% of common residences in town A. From the above results, the RCF facility we developed allowed the modification of carbon-neutral biogas to conform to city gas 12A specifications, and allowed the transport of this gas out of the farming area.

THERMAL CHARACTERISTICS OF GELATIN EXTRACTED FROM EMPEROR (SHAARI) SKIN: EFFECTS OF ACID CONCENTRATION AND TEMPERATURE OF EXTRACTION

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CSBE100493 – This study was conducted in order to evaluate the effects of acid concentration and temperature of extraction on the glass transition temperature of gelatin extracted from the skin of emperor fish. Gelatin extraction yield increased with the increase of acetic acid concentration and temperature. The onset of glass transition temperature decreased with the increase of extraction temperature up to 50 °C and then remained nearly constant, indicating that structural breakdown reached its maximum at 50°C. The decrease in glass transition was more pronounced at 0.01 N compared to the 0.1 and 1.0 N samples. The increase of acid concentration during extraction shifted the curve towards lower temperature indicating increasing concentration decreased the glass transition temperature. More plasticized samples were formed with the increase of acid concentration. Unfolding temperature decreased exponentially with the increase of extraction temperature. Similar to the glass transition, the curves of unfolding temperature also shifted to lower temperature, whereas the decrease was more pronounced in the case of higher (1.0 N) concentrated samples. The extraction concentration and temperature did not show significant effect on the onset solids melting temperature.

INVESTIGATING JD3140 TRACTOR BREAKDOWNS AND THEIR REASONS

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CSBE100497 – Knowing the exact costs of repair and maintenance can lead machinery managers to save money and prevent future breakdowns. This research was done by gathering and classifying the type and occurrence of breakdowns of JD3140 tractors which are commonly used in Markazi province in Iran. Related information was gathered from 7 validated service stations and 40 selected professional users. Data analysis showed that hydraulic systems and hydraulic steering pumps were the most frequently repaired components, 18% and 9.5% respectively. Power take off shafts and water pumps were the next most frequently serviced components (8% each). Neglect of regular servicing, use of improper hydraulic oil and maintenance done by unskilled workers were the main reasons for hydraulic system breakdowns. Other investigations showed that steering pumps and cylinder breakdowns were the main reasons for steering malfunction.

COMPARISON OF USEFUL LIFE OF TRACTORS BY CONDITION MONITORING (CM) AND BREAKDOWN MAINTENANCE (BM) IN IRAN

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CSBE100498 – Repair and maintenance costs are one of the most important factors considered when replacing agricultural machineries. The decision is often based on the useful life of machineries. In this research CM of MF285 and MF399 by engine oil analysis was done to find optimum life time of tractor substitution in comparison with BM method in Iran. All recorded information about fixed and variable costs were selected as base data and analyzed. Data were divided based on period of annual working time. Using power regression analysis lead from mathematical models to optimum life time definition. The model for MF399 was found as $Y=1.7345 X^{1.1123}$; for MF 285, $Y=0.11281 X^{0.96324}$. In this case cumulative working time (X) was selected as independent and cumulative costs based on definite percent of initial price (Y) as dependent variable. Results showed that in CM method estimated a useful life 13 and 11 years for the MF399 and MF285, respectively. The BM method estimated a useful life of 11.5 and 8.5 years for the MF399 and MF 285, respectively.

DESIGN AND MANUFACTURING A NEW PLATFORM FOR RAPESEED HARVESTING IN IRAN

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CSBE100499 – The JD955 series combine which is a conventional combine in Iran does most of the combine harvesting of rapeseed. Because of shape and condition of rapeseed, harvesting losses were very high. This project was done in order to solve that problem. It was made by minimum changes in mechanisms of the JD955 platform and it attached to the platform. Studies were about hydraulic system, stability and exact analysis of power train of blade. The main aspect of design was using new power train of blade. In that case Working Model 3D, SolidWorks 3D CAD Design and NISAII softwares were used. Complementary designs were investigated; checking of chassis firmness and introducing a new method for drive mechanisms for the blade. Using NISA II and a finite element method indicated that the platform chassis was not firm enough and needed some changes in its structure. Static analysis showed that maximum Von Mises stress concentration was 311 MPa. It was reduced to 159 MPa by reinforcement of the chassis. Deflection analysis showed that maximum blade deflection was 12 mm. The new blade was 920 mm in front of the old blade and derived by a 1710 mm rod which was added to the drive mechanism. Natural frequency of rod and transmission motion frequency ratio was 2.65 which satisfied safer operation conditions. Field tests determined that working speed and surface capacity of the combine were improved when using the new platform. It reduces harvesting losses.

MEASUREMENT OF DILATION OF ROOT CROPS

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CSBE100500 – A dilation measurement device for root crops was developed. The device directly measures the dilation of root crops under the soil with a contact-type linear displacement sensor. The amount of dilation was continuously recorded every 60 minutes in the device's voltage loggers. This device can be installed between plants and it operates for about one year without any external power supply. The measurement resolution is less than 0.1 mm. To investigate the measurement performance of the developed device, the dilation of a tap root of a sugar beet (*Beta vulgaris* L.) and a potato tuber (*Solanum tuberosum* L.) was measured with the device. The sugar beet was measured for 84 days and the potato was measured for 29 days. Experimental results showed a small error margin which indicates the possibility of practical applications for both the sugar beet and the potato. It was observed that dilation speed increases after rainfall and dilation halted at harvest time. It is hypothesized that data obtained from the developed device contribute to the clarification of a growth characteristic, allowing a highly precise prediction of the yield and the reduction of growth investigation cost.

SIMULATION OF SITE-SPECIFIC IRRIGATION CONTROL STRATEGIES WITH SPARSE INPUT DATA

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CSBE100501 – Crop and irrigation water use efficiencies may be improved by managing irrigation application timing and volumes using physical and agronomic principles. However, the crop water requirement may be spatially variable due to different soil properties and genetic variations in the crop across the field. Adaptive control strategies can be used to locally control water applications in response to in-field temporal and spatial variability with the aim of maximising both crop development and water use efficiency. A simulation framework 'VARIwise' has been created to aid the development, evaluation and management of spatially and temporally varied adaptive irrigation control strategies (McCarthy et al., 2010). VARIwise enables alternative control strategies to be simulated with different crop and environmental conditions and at a range of spatial resolutions. An iterative learning controller and model predictive controller have been implemented in VARIwise to improve the irrigation of cotton. The iterative learning control strategy involves using the soil moisture response to the previous irrigation volume to adjust the applied irrigation volume applied at the next irrigation event. For field implementation this controller has low data requirements as only soil moisture data is required after each irrigation event. In contrast, a model predictive controller has high data requirements as measured soil and plant data are required at a high spatial resolution in a field implementation. [...] It is concluded that in situations of sparse data, the iterative learning controller performs significantly better than a model predictive controller.

REMOTE ACCESS OF ISOBUS WORKBENCH FOR THE ISOAGLIB STUDY AND IMPLEMENTATION

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CSBE100502 – The number of electronic devices connected to agricultural machinery is increasing to support new agricultural practice tasks related to Precision Agriculture such as spatial variability mapping and variable rate technology. These practices have demanded an increase number of researches in embedded electronics and communication networks for data acquisition and control in the farms fields. Methodologies and devices for on-the-go measures are being developed to equip agricultural machinery to support the required tasks. The Distributed Control System (DCS) is a suitable solution for the decentralization of data acquisition systems and Controller Area Networks (CAN) and is a major trend among the embedded communications protocols. This technology provides significant benefits and has been used as an embedded control network in agricultural machinery and vehicles. The implementation of the ISO 11783 (ISOBUS) standard represents the standardization of the CAN protocol for application in agricultural machinery. The application of soil correctives is a typical problem in Brazil. The efficiency of this correction process is highly dependent on the inputs were soil and the occurrence of errors affect directly agricultural yields. Following this guideline, this paper presents the development of a CAN-based distributed control system for a Variable Rate Technology (VRT) systems for soil correctives in agricultural machinery. The VRT system is attached to a tractor-implement that applies a desired rate of inputs according to the georeferenced prescription map of the farm field to support PA. The distributed system consists in five devices, or Electronic Control [...].

EFFECTS OF DIFFERENT TILLAGE SYSTEMS ON SOME SOIL PROPERTIES, CROP YIELD AND TIME/FUEL CONSUMPTION FOR SESAME

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CSBE100504 – The degradation of soil has become an environmental problem which limits the sustainability of agriculture and decreases soil productivity. The most effective cause of degradation is either over cultivation or the utilization of improper tillage methods. In Turkey, sesame production is done as a second crop in dry or wet conditions after wheat harvest. Farmers generally burn the stubble after harvesting wheat and till the soil under excessive machine traffic. In this study, conventional and conservation tillages was compared in terms of some agricultural mechanization inputs, yield and some physical effects on the soil for second crop sesame after wheat harvesting. The systems consisted of conventional tillage (CT), reduced tillage with unstubble (RT) and reduced tillage with stubble (RTS). As a result, the lowest machine usage was determined as 12.99 h ha⁻¹ in reduced with unstubble tillage method. The most machine usage was 16.1 h ha⁻¹ in conventional tillage method. The lowest and highest fuel consumption were 26.4 l h⁻¹ and 35.2 l h⁻¹ with unstubble tillage and conventional tillage methods respectively. The lowest hydraulic conductivity in 5-10 cm, 15-20 cm and 25-30 cm was determined in reduced tillage with unstubble method. The highest porosity 5-10 cm, 15-20 cm and 25-30 cm was in conventional tillage method. There was no significantly statistical difference regarding yields for both methods.

INFLUENCE OF COOLING SYSTEMS ON THE BEHAVIOUR OF DAIRY COWS HOUSED IN CUBICLE BARN

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CSBE100505 – During summer 2009 and winter 2010 experimental trials were conducted on order to verify the behaviour of dairy cows in a farm located in Po Plain (Italy). The barn was equipped with an air-water cooling system, based on the use of fans and sprinklers placed in the feeding alley only. Two different trials were carried out. The first experiment targeted the verification of cubicle use by cows in relation to the availability of the cooling system in feeding area. The second trial aimed at testing the effectiveness of zone cooling systems placed in the front of the cubicles. For this purpose three cubicles in the barn were provided with cooling systems, based on the input of high velocity conditioned air streams. The results clearly demonstrated that the behaviour of the animals was greatly influenced by the environmental conditions. With high temperatures the use of the cubicles is deeply reduced and the animals prefer to stay in feeding area, thus benefiting from the cooling effect of water sprinkled by the showers and the air streams created by the fans. With air temperatures increasing from 21° to 33°C the cows reduce time spent in the cubicles, which went down from 52.0 to 29.2% ($r^2 = 0.8471$). With regards to the efficacy of zone cooling systems in the cubicles, the results are not particularly encouraging. The cows continue using the cubicles without changing the behaviour in relation to the presence of conditioned air flow.

PHYSICAL PROPERTIES OF CUMIN (CUMINUM CYMINUM) AND CARAWAY (CARUM CARVI) SEEDS

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CSBE100506 – Cumin and caraway seeds are two important agricultural commodities growing in western Asia and Iran, which are usually consumed as spices. Also, these products are widely used as herbaceous medicine. Physical properties of cumin and caraway seeds are vital parameters regarding the design of the planting and post harvest processing equipments such as metering devices, sieves, sorters and conveyers. In this study, physical properties of cumin and caraway seeds were measured at constant moisture content (7.5% d.b.) and compared statistically. The average of thousand weight of grains, mean length, mean width, mean thickness, equivalent diameter, geometric mean diameter, surface area, volume, sphericity, aspect ratio, true density, bulk density and porosity were 2.905 g, 4.553 mm, 1.185 mm, 0.817 mm, 1.654 mm, 1.634 mm, 7.964 mm², 2.487 mm³, 36.24%, 0.266, 1155.6 kg/m³, 622.0 kg/m³ and 46.18 %, respectively, for cumin-seed. In the case of caraway-seed, the corresponding values were 1.583 g, 3.941 mm, 1.016 mm, 0.618 mm, 1.377 mm, 1.348 mm, 5.469 mm², 1.400 mm³, 34.61%, 0.262, 1294.1 kg/m³, 736.5 kg/m³ and 43.08%. For green cumin, the average static coefficient of friction varied from 0.312 on aluminium to 0.569 on plywood, while for caraway seeds the corresponding value varied from 0.277 to 0.535 on the same surfaces. The angle of repose values for cumin and caraway seeds were 47.7° and 49.8°, respectively. Furthermore, there were significant differences in most physical properties of cumin and caraway seeds excepted for grain porosity.

CHARACTERIZATION OF ENERGY REQUIREMENTS IN PRESSURIZED IRRIGATION NETWORKS AND EVALUATION OF POTENTIAL ENERGY SAVING MEASURES IN SOUTHERN SPAIN

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CSBE100509 – With the aim of improving the water use efficiency, many irrigation districts in arid and semiarid regions like Southern Spain have carried out modernization processes where the traditional open channels were replaced by modern pressurised networks. This change has implied significant reductions in water demand but an inversely proportional increment in energy requirements and total water costs. In order to evaluate water and energy use together, a procedure based on performance indicators for evaluating water and energy efficiency in pressurised irrigation networks is developed. This methodology has been applied to ten representative Andalusian irrigation districts with on demand pressurised networks during the 2006-2007 irrigation season. The results confirm the high energy requirements needed for operating these irrigation schemes. To apply an average depth of 2589 m³/ha, the energy required was estimated to be 1000 kWh/ha. Average power requirements per unit of irrigated area were 1.56 kW/ha and the Pumping Energy Efficiency (PEE) was 58.1%. Also, the potential impacts of several energy saving measures proposed by the Spanish Institute for Diversification and Energy Savings (IDAE) are discussed. These energy saving measures include strategies such as sectoring the network, detection of critical points, optimization of pump stations and energy audits.

APPLICATION OF RESPONSE SURFACE METHODOLOGY FOR OPTIMISATION OF IN VITRO ENZYMATIC DIGESTION OF SOY PROTEIN ISOLATE USING HIGH HYDROSTATIC PRESSURE PROCESSING

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CSBE100513 – Enzymatic digestion of soy protein isolate (SPI) done with high hydrostatic pressure processing was studied using response surface methodology. The effect of pre-treatment pressure, pepsin-substrate and pancreatin-substrate ratios was studied and analyzed by a central composite experimental design (CCD). The goal of the CCD was to assess the effects of treatment variables and their interactions on the degree of hydrolysis of SPI. A predictive polynomial quadratic model was developed in SAS 8.0 software. Regression equations, response analysis, and mathematical models showed good combinations with the experimental data. The R² value indicated that 96.6% of the variability within the range of values studied could be explained by the model. A pre-treatment pressure of 590MPa, a pepsin-substrate ratio of 1.1 % and a pancreatin-substrate ratio of 3.2% were the optimal conditions achieving the highest degree of hydrolysis.

TILLAGE EFFECTS ON SOIL AND PRODUCTION MANAGEMENT FOR WINTER WHEAT IN SOUTHWEST TURKEY

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CSBE100514 – The main concept of tillage should be to create the most appropriate soil conditions by taking into consideration ecological balance for sustainable agriculture. The proper soil conditions improve seedling emergence, plant growth and thus yield. In this study, different tillage systems were examined for sustainable wheat production. The tillage systems consisted of minimum tillage, two rows of the ridge tillage, three rows of the ridge tillage and direct seeding techniques. The systems were analyzed in terms of the soil moisture content, porosity, bulk density, working efficiency, the percentage of emergence, yield, biological yield, harvest index and fuel and time consumption. As a result, the highest yield (8587.4 kg ha⁻¹) was obtained from minimum tillage system while the lowest yield (6419.8 kg ha⁻¹) was in the two rows of the ridge tillage. The maximum efficiency (1.34 a h⁻¹) on wheat production was obtained from the direct seeding technique. The minimum fuel consumption (7.9 l ha⁻¹) and the minimum time consumption (0.75 h ha⁻¹) were in direct seeding. The direct seeding system saved time on fuel consumption and working efficiency at the rate of 81-86 %.

MACHINERY MANAGEMENT DATA FOR WILLOW HARVEST WITH A BIO-BALER

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CSBE100515 – Willow harvested in 2-to-3-year rotations has been proposed as a reliable source of biomass. A novel harvester based on a round baler was developed in 2006. A third generation “bio-baler” was evaluated in two willow plantations in 2009 in Quebec. The first site (Godmanchester) was a three-year old regrowth with an estimated 52,000 stems/ha of large diameter (> 10 mm at waist height, i.e. 1.3 m above the ground) with average of 21 mm and maximum of 55 mm; small stems (diameter < 10 mm) were estimated at 51,000/ha. The bio-baler with a flail cutter harvested three plots totalling 4136 m². Total harvested biomass was 10.36 t DM in 42 bales (457 kg/bale at 46.0% moisture; 247 kg DM/bale; harvest of 26.72 t DM/ha). Harvest rate averaged 29 bale/h (12.86 t green crop/h; 6.94 t DM/h). Average bale size was 1.22 m wide by 1.30 m in diameter (152 kg DM/m³). Diesel fuel consumption averaged 0.81 L/bale or 3.23 L/t DM. Measured losses averaged 3.2 t DM/ha (11% of yield). The second site (Saint-Roch-de-l’Achigan) was a two-year old growth with an estimated 49,000 stems/ha of large stems (> 10 mm diameter) averaging 16 mm with a maximum of 28 mm; small stems were estimated at 84,000/ha. The bio-baler harvested seven plots totalling 15,740 m². Total harvest was 30.70 t DM in 148 bales (404 kg/bale at 48.6% moisture; 208 kg DM/bale; harvested yield of 19.51 t DM/ha). The first 14 bales were harvested with a saw blade header: 29.3 bales/h (14.5 t/h; 7.53 t DM/h). All other bales were harvested with the flail cutter at a faster rate: 45.5 bales/h (18.3 t/h; 9.3 t DM/h). Bale density averaged 129 kg DM/m³. Fuel consumption averaged 0.72 L/bale or 3.28 L/t DM. Losses averaged 6.17 t DM/ha with the saw blade header (20% of yield) and 4.52 t DM/ha [...].

HARVEST OF WOODY CROPS WITH A BIO-BALER IN EIGHT DIFFERENT ENVIRONMENTS IN MINNESOTA

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CSBE100516 – The bio-baler is an alternate approach to harvest woody crops as round bales, typically 1.2 m wide by 1.5 m diameter (4' x 5'). Originally developed for short-rotation willow in plantations, the bio-baler is now able to harvest a wide range of woody crops with a basal diameter up to 150 mm (6"). It can improve management of wild brush, forest understory vegetation, encroaching small trees on abandoned land, in addition to its original role of harvesting young planted trees. It allows easy handling, storage and transportation to sites where the biomass can be used for energy or other applications. In fall 2009, a third generation bio-baler was used on eight different sites across Minnesota (Waseca, Madelia, Faribault, Afton, Ogilvie, Hinckley, Aurora and Hibbing). A total of 160 bales were harvested at these sites. Average bale mass (green crop) was 466 kg (minimum of 403 kg; maximum of 528 kg). Bale density averaged 296 kg/m³ (min. 204 kg/m³; max. 388 kg/m³). Moisture content averaged 44.9% (min. 36.0%, max. 51.3%). Bale dry matter density averaged 163 kg DM/m³. Harvested biomass per unit area ranged from 2.49 t/ha on lightly covered land to 55.24 t/ha on densely covered land (average 14.72 t/ha). Biomass harvested (recovery) was 72.3% of original cottonwood in Madelia; 75.8% of original oak and maple shrubs in Afton; 73.5% of poplar regeneration in Hibbing. Actual harvest rate averaged 17.40 bales/h (min. 2.31 bales/h; max. 34.22 bales/h). Mass harvest rate averaged 7.78 t/h [...].

AUTOMATIC ON-LINE DEPTH CONTROL OF SEEDING UNITS USING A NON-CONTACTING ULTRASONIC SENSOR

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CSBE100519 Previous investigations on seed placement depth emphasize the importance of proper seeding depth for optimal crop stand and yield. On moist soils, care should be taken to plant as shallow as possible, but when surface soils are dry and sufficient moisture is not available at lower depths the planter should seed in a normal depth. To this effect, a non-contacting range sensing and control device for automatic control of seeding depth (DS) was developed. This system can measure the distance between the soil surface and the frame of a planter where the sensor is mounted. In this system time needed for an acoustic pulse to travel to and from a transducer (fixed to toolbar) to a reference surface (RS) (attached to planter furrow opener) is measured and it is a base for this technique. The reference surface plate (RS) is mounted on one side of the runner type furrow opener in such a way that as the runner increases its working depth the RS is pushed up to the soil surface. The sensor measures the vertical distance between the transducer and the RS. The measured difference (with no regard to size difference) is transformed into a proportionate signal which in turn results in an appropriate operation controllable linear actuator. The actuator then adjusts the tractor hydraulic arms. Indoor and outdoor experiments were conducted to evaluate the performance of the system under varying conditions. The results showed satisfactory performance of the rig on uneven soil surfaces and acceptable depth control for the row crop planter.

INTEGRATED WATER SUPPLY MANAGEMENT AT WATERSHED SCALE FOR AGRICULTURAL PURPOSES IN A PERSPECTIVE OF ADAPTATION TO CLIMATE CHANGE

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CSBE100520 – Among the hydrological effects that are expected from climate change impacts on the southern area of the Province of Quebec, the increase of summer temperatures, the consequent increase of the evapotranspiration, the disturbance of the rainfall regimes, as well as the decrease of summer low flows, are the ones which are the most susceptible to influence crop plants among which the productivity and the quality are significantly conditioned by a quantitatively and qualitatively appropriate water supply. This presentation exposes the results of two studies carried out by the Centre d'expertise hydrique du Québec (Quebec Water Expertise Center) (CEHQ) and applied on two crop plant productions concerned by this situation, namely the case of vegetable farming in the Norton brook watershed and that of cranberry farming in Bécancour River watershed, both watersheds in the southern part of Quebec. For these two types of crops, expected increase in irrigation needs and decrease of summer low flows, both due to climate change effects, are expected to amplify water stresses. Regarding good water management issues and sound approaches for its adaptation to expected climate change effects, these two studies show that a water supply management that would be integrated at watershed scale and based on criteria that characterize seasonally the minimum required streamflows would be a good way to optimize water supply for crop productions while being focused on environmental protection objectives.

ESTABLISHING MOISTURE SORPTION ISOTHERMS OF WILD MUSHROOM VARIETIES USING A DYNAMIC VAPOR SORPTION METHOD

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CSBE100522 – *Boletus edulis* (Porcini), *Cantharellus cibarius* (chanterelle), *Lentinula edodes* (Shiitake), *Morchella deliciosa* (Morel), and *Tuber melanosporum* (truffle) are mushrooms of considerable economic, commercial and gastronomic importance in international markets. The objective of this research was to investigate the moisture sorption behavior of various highly favored mushrooms at a temperature of 30 °C. Also, it was intended to produce equilibrium moisture content data of wild mushroom species, which has limited coverage in the literature. The samples were subjected to hot-air drying in an experimental laboratory dryer and were equilibrated in the range of 0.05-0.95 water activity using the dynamic vapor sorption method. The GAB equation was selected to fit the experimental data by non-linear regression analysis. The accuracy of fit was based on standard error, mean relative error, and coefficient of determination. The model predicted successfully the equilibrium moisture content of mushrooms. Sigmoid characteristic curves of sorption isotherms were obtained. This means that the equilibrium moisture content of mushrooms increases with an increase in water activity at constant temperature. Reliable equilibrium moisture content data on moisture sorption isotherms were provided which is essential for the optimization of different processes in food industry.

ENHANCING COMPACTION CHARACTERISTICS OF BARLEY STRAW BY MICROWAVE/CHEMICAL PRETREATMENT

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CSBE100523 – Biomass is an excellent renewable energy source for producing energy with low greenhouse gas and low acid gas emissions that can be intensively used as substitute for fossil fuels. Unfortunately, because of its low bulk density, the effective utilization of the biomass is not always practical. Densification process is often required to improve transportation and storage properties and improve the cost of low bulk density feedstocks. The goal of this study was to determine the ability of microwave and microwave/chemical pretreatments to enhance compaction characteristics and densification process of barley straw. In this study, ground barley straw samples were immersed in water, sodium hydroxide and calcium hydroxide solutions with different concentrations and then exposed to microwave at three irradiation powers. The compression characteristics of biomass samples were examined using a single pelleting apparatus with a compression force of 4000 N and relaxation test data were recorded. [...] The specific energy required to compress and extrude pellets from untreated and microwave or microwave/chemical pretreated barley straw was calculated. The tensile strength of the pellets was also evaluated via the diametral compression test. Chemical composition analysis showed that microwave/chemical pretreatment is significantly able to alter the lignocellulosic structure of biomass materials so that barley straw samples pretreated by microwave/alkali technique had lower cellulose, hemicellulose and lignin contents than samples pretreated by microwave alone or untreated samples. Data analysis also indicated that microwave/chemical pretreatment is significantly effective to enhance pellet density, tensile strength and compaction characteristics of biomass.

DYNAMIC ROLE OF REVERSE LOGISTIC CYCLE WITH IN LIFE CYCLE ANALYSIS FOR SUSTAINABILITY

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CSBE 100526 – In our Capitalistic System of Economy the main focus of every business activity is to monitor the profitability and enhance productivity through lean manufacturing system to produce low cost durable products for capturing new markets for the satisfaction of the quest of getting maximum benefit out of this whole process. In the context of Life Cycle Engineering, The flow of all inputs and out puts should be in such a systematic order that besides achieving the companys goals and targets all participating stakeholders requirement and needs must be met up to the ultimate limit available. With this respect Life Cycle Analysis and Reverse Logistic analysis are considered sine quo none for establishing a closed loop recycling System; As by means of this ideation a top down design approach will obviously result in producing a sustainable green product. A firm based upon this thinking supports the sustainable manufacturing system which makes possible to reuse the low cost resource while considering for re-manufacturing. This in turn increases the assets and also enables the manufacturer to produce high quality low cost products without using the virgin materials. Apart from that if the assets which are generated by the company due to life cycle thinking if follow the cradle to grave policy ; then the products will end up in the land fill or in incinerator by producing a negative impact on the environment, besides that more virgin resources will be utilized for the new product design. [...].

ENGINEERING DEVELOPMENTS FOR SMALL-SCALE HARVEST, STORAGE AND COMBUSTION OF WOODY CROPS IN CANADA

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CSBE100527 – Woody crops have been used for thousands of years by man as the primary source of energy for heating and cooking. They remain an important source of energy in less developed countries but have been largely replaced by fossil fuels, nuclear energy and hydroelectric power in developed countries. The role of woody crops for energy has been revitalized in developed countries with the need to diversify sources of energy. The current research program on woody crops at Agriculture and Agri-Food Canada includes the recent development of a woody crop harvester to collect small size trees (< 75 mm diameter) in plantations and in natural growth. The harvested package is a round bale, typically 1.2 m wide by 1.5 m in diameter; it allows natural drying from about 50% moisture at harvest down to 30% outside and 20% under shelter after four to six months of storage. The combustion value of woody crops averaged 19.4 GJ/t on a dry matter basis with little variation (standard deviation of 0.48 GJ/t DM). The woody crops can be pulverized into fine particles (< 3 mm), artificially dried to 10% moisture and processed into pellets for combustion. However, in a practical trial, more than 7.5 MJ/t DM were required to produce pellets (2.0 MJ/t DM for mechanical process and 5.0 MJ/t DM for drying) without providing more energy than coarse wood chips (< 50 mm). Several rural application (heating community and farm buildings, drying crops) can use locally grown woody crops (willow) or forest residues (branches, bark) in the form of chips to replace current fossil energy sources such as oil, propane or [...].

MANAGING RESIDUAL PHOSPHORUS AND NITROGEN FROM TREATED SWINE SLURRY USING A DISPOSAL FIELD: BEHAVIOUR OVER FOUR YEARS OF ON-SITE OPERATION

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CSBE100528 – Treated effluents can be discharged back into the natural environment by using a disposal field. The main concerns with regard to this technology involve the effectiveness of the phosphorus retention by the receiving soil and the behaviour of the residual nitrogen, in the ammoniacal or nitrate form, in the groundwater. The disposal field used as a test bench at the outlet of a large-scale BIOSORTM-Swine Slurry treatment system had an area of 750 m². Samples were taken on a monthly basis over a period of four years from the treated swine slurry and from some ten control piezometers. The average flow of swine slurry was 8 m³/d. The contents of the residual phosphorus at the treatment outlet ranged from 16 to 18 mg/l. At a distance of 6 metres after the disposal field, the concentrations measured were equivalent to those present at the start of the field (< 1.5 mg/l). The main mechanisms that come into play in phosphorus reduction are sequestration by physico-chemical adsorption in the receiving soil. For values of between 42 and 46 mg/l of ammoniacal nitrogen (N-NH₄) at the disposal field's inlet, the objective of 14 mg/l at the resurgence point was met. The presence of an aerobic zone on the disposal field's upper layer is necessary to promote nitrification. The nitrate (N-NO₃) concentration at the treatment system's outlet ranged from 400 to 550 mg/l and the objective of 100 mg/l at the resurgence point was met. The lack of any carbon element at the treatment system's outlet was compensated for by the presence of iron, playing the role of electron acceptor necessary for denitrification. [...].

PRELIMINARY STUDY ON THE PREPARATION OF A NEW FLOCCULANT AND THE APPLICATION ON TREATMENT OF POTATO STARCH WASTEWATER

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CSBE100534 – To avoid problems as complex as operation, high cost and easily caused secondary pollution by traditional flocculant in treatment of potato starch wastewater, a new green environment-friendly polymer starch flocculants, quaternary amine cationic modified starch with a high degree of substitution (DS) was prepared via the reaction of potato starch with 3-chloro-2-hydroxypropyl-trimethyl ammonium chloride (CHPTMA) using pre-drying dry process. Through the orthogonal test, the optimal conditions for preparing the cationic starch with high DS were: cationic etherifying agent dose 55% of starch (dry base), the mole ratio of NaOH to etherification substance is 1, reaction temperature is 85°, reaction time is 5 h, getting the flocculant of cationic starch with 0.3903 DS. The results showed that the flocculation effects of the flocculant of cationic starch were increased with the increasing of the DS. The average result of treatment of potato starch wastewater showed that the flocculation rate was about 10% higher than that with using traditional polyacrylamide flocculant with the same reaction time and the same dosage.

AUTOMATIC WEED CONTROL SYSTEM FOR PROCESSING TOMATOES

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CSBE100535 – This study describes a fully automatic system developed at UC Davis for intra-row mechanical weed control for processing tomatoes in California. We developed a novel weed control system using a real-time kinematics (RTK) global positioning system (GPS) to automatically control the path of a pair of weed knives based upon an automatically generated GPS plant map. The system was capable of precisely guiding mechanical weed knives within the seedline of the crop row and around the crop plants as the system was pulled along the row. In this study, processing tomato plants were transplanted using a GPS-enabled transplanter, which developed a precision plant map documenting the geo-spatial location of each tomato plant. At the time of first cultivation, a few weeks after planting, the GPS-controlled weed knives were operated in seven tomato rows. The weed knives were set to "open" 6 cm prior to reaching, and "close" 6 cm after passing each tomato plant, killing weeds between tomato plants when the knives were in the closed position. Results show that the average distance between knife opening and closing events was 12.4 cm with a standard deviation of 1.4 cm. The standard deviation of the opening and closing positions (relative to the crop plant) was 2.08 and 2.11 cm, respectively. These results demonstrate the feasibility of using RTK-GPS to automatically control a mechanical weed control system for sustainable production of row crops.

SOIL FAILURE MODE IN FRONT OF A MULTIPLE-TIP HORIZONTALLY-OPERATED PENETROMETER AFFECTED BY DEPTH/WIDTH RATIO OF ITS TIP AND SHANK

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CSBE100536 – Mechanical resistance of a soil to failure has been widely used to estimate the degree of soil compaction. Our previous study showed that the magnitude of force which was measured by the horizontally-operated penetrometer depends on the soil failure mode in front of the sensor. This research investigated whether the critical depth (d_c) where soil failure transitions from brittle to compressive was dictated by depth/width ratio (DWR) of the prismatic tip, or of the shank of the sensor. Two horizontally-operated soil penetrometers were developed. In the first sensor, the width of the shank was the same as the prismatic tip, which was 18 mm. In the second sensor, the width of the shank (36 mm) was twice as much as the tip. The sensors were tested in a field with a soil texture of silty clay loam and with gravimetric water content (WC) of 4 to 18% at forward speed of 0.5 m s^{-1} . The results showed that the d_c for 36 mm wide shank sensor was approximately 210 mm (a DWR of about 6), whereas for the 18 mm wide shank sensor, the d_c was at depth of 110 mm (a DWR of about 6). The d_c increased with an increase in the width of the shank and decreased with an increase in soil WC. There was no interaction between the adjacent 100 mm distance tips as long as they operated below the d_c . In both sensors, the d_c was dictated by DWR of the shank. Visual observations showed that [...]. This revealed that the prismatic tip was moving ahead of the soil rupture planes which radiated from the shank shin to the surface. It can be concluded that for the tip which is located just above the d_c , the length of its rod can be selected so it can operate in undisturbed soil (inducing compressive failure) ahead of soil disturbance (i.e. brittle failure) imposed by the shank.

REDUCING FOSSIL ENERGY CONSUMPTION OF A BELT DRYER BY USING BIOGAS WASTE HEAT

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CSBE100540 – Conventional multibelt dryers have a high energy consumption mainly supplied by fossil fuel energy resources. The goal was to harness the waste heat from a combined heat and power unit (CHP) of a biogas plant for drying curly parsley (*Petroselinum crispum*) on a belt dryer. After cutting the fresh material the stems and leaves were separated by air classifying. Both the stems and conventional substrates were used for the biogas fermentation. A standardised batch fermentation test (Hohenheimer biogas yield test) was carried out to measure the potential biogas yield of the parsley stems. The leaves were dried by hot air partially heated by the light fuel oil burners and waste heat from the CHP. The belt dryer consists of a single-belt predryer and a five-belt dryer including three temperature zones with a total drying area of 316 m^2 . High temperatures were applied for drying parsley with a temperature profile of $90/80/75^\circ\text{C}$ for the three zones. The energy consumption of light fuel oil and the energy from the biogas CHP was measured. The specific energy consumption for drying parsley was $7,158 \text{ kJ per kg of evaporated water}$, with a share of 47% thermal energy from the CHP. The throughput was 150 kg/h of dry material. The biogas test showed an output of 0.331 m^3 of methane/kg of organic dry matter. The waste heat of the CHP was capable of heating the drying air to 75°C , but 90°C is recommended [...].

UNCERTAINTY ANALYSIS OF USING CO₂ PRODUCTION MODELS BY COWS TO DETERMINE VENTILATION RATE IN NATURALLY VENTILATED BUILDINGS

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CSBE100542 – Accurate estimation of gas emission from livestock production facilities relies on the precision of the measurement of the ventilation flow and the gas concentration. However, it is difficult to make reliable direct measurements of the airflow exchange in naturally ventilated open type livestock buildings. Using tracer is one of the approaches to determine the ventilation flow rates. Application of an artificial tracer gas is complex, expensive, and may involve technical difficulties to make its distribution uniformly in the buildings. A feasible approach that has been applied by several published researches is using the CO₂ produced by livestock as tracer gas to estimate the ventilation airflow in open buildings. This paper reviewed the CO₂ production model and the field measurements of five dairy cattle buildings to estimate the feasibility of applying CO₂ production model to determine the ventilation airflow rates in naturally ventilated livestock buildings. The method using CO₂ production model was compared with the one using an artificial tracer gas. The feasibility of estimating the ventilation rates based on the differences of the carbon dioxide concentration in and out of the building, and carbon dioxide production of the animals were addressed. Uncertainty of determination of ventilation rates based on CO₂ production model was analyzed. [...] The conclusion is that for open buildings, the methods based on animal CO₂ production as tracer gas achieved the similar accuracy as other methods using tracer gas.

REDUCING EMISSIONS BY APPLYING A PIT EXHAUST IN NATURALLY VENTILATED LIVESTOCK PRODUCTION BUILDINGS – FEASIBILITY STUDIES BASED ON A WIND TUNNEL INVESTIGATION

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CSBE100543 – To reduce ammonia and greenhouse gas emissions from a naturally ventilated livestock production building, several approaches have been reported and are under investigations. One of the possible approaches to reduce the emissions from such a building might be using a pit exhaust in the system to remove most air pollutants and treating the air with an air purification unit. In order to study the feasibility of such an approach, a 1:2 scale model of a manure pit section of a cattle building was built. The model was built with slatted floor and a pit head space of 0.4 meter high. The top of the slatted floor was placed at the same level as the surface of the wind table in the wind tunnel. Investigations were performed under varied airflow velocities (speeds and directions) above the floor level, slatted floor opening ratios, and exhaust ventilation rates. The results showed that a proper design of a pit exhaust with about 10% of ventilation capacity may ensure that the air near to the slatted floor moving downward and the polluted air will exhaust via the pit ventilation channel and it will be treated by an air purification unit. The removing efficiency is increased by reducing the opening ratio of the slatted floor. Based on the experiences in a pig production room with pit ventilation it is estimated that a reduction of 70-80% ammonia by such a system is feasible.

GRID BASED RAINFALL-RUNOFF GIS MODELLING TO STUDY THE ANTHROPOGENIC EFFECT ON THE HYDROLOGY OF A SMALL WATERSHED

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CSBE100546 – In the Po basin urban development, land use change and variations in rain intensity have influenced watershed runoff and increased floods. In order to better study the anthropogenic effect on the basin hydrology the Olona river watershed proved to be an interesting small catchment to test. It went through a rapid change from agricultural land to urbanized and partly forest areas over the period 1954 – 1994. The Olona River is known for frequent flooding along its course and in some districts of Milan city. Using SCS-CN methodology, a rainfall-runoff model was calibrated with the observed outflow data in the Ponte Gurone station in the upper Olona basin ($\approx 110 \text{ km}^2$). The extreme rainfall data series of three meteorological stations near and inside the watershed are statistically elaborated to obtain the depth duration frequency curves, used as the model input data. Basin concentration time and SCS parameter I_a (Initial abstraction) values are chosen to fit the model results and the observed discharges in the two rainfall intensity classes tested. Within the upper Olona basin, waterproof surfaces increase, leading to less infiltration and a quicker runoff, and produce higher outflow peaks. Model results give an estimate of land use change effect on the basin rainfall-runoff process change.

ELECTRO-SEPARATION PROCESS FOR TREATING LIQUID ANIMAL MANURES

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CSBE100547 – Presently, the most economical way to dispose of hog manure is to spread it on land as a source of nutrients for crops. A high risk to contaminate the environment occurs when large amounts of liquid manure are applied on soils and that risk increases when higher levels are applied as result of excess number of animal units per farm. Phosphorus losses are the result of soil erosion or drainage of excessive water following important rain events mainly in the fall (over 70 mm). In addition, there is also an odour problem associated with transportation and spreading operation, which puts more pressure on hog producers. Sometimes, producers have no choice to invest in very expensive manure treatment units in order to reduce the environmental and social pressures as well as to insure their farms expansion. The objective of this R&D project is to offer hog producers, a method capable of reducing the environmental risks associated with hog manure application on land and to reduce odours while spreading. The electrochemical process, that has been developed, will separate the solid from the liquid phase. P and N will be concentrated mainly in the solid and the liquid phases respectively. This technology should be accessible to all sizes of hog farms: low cost, user friendly and economical to use. The study has resulted in an appropriate method capable of pre-treating the slurries and that insure a high level of efficiency and performance when removing suspended particles from the liquid in the electro-flotation cell unit. The data shows that the organic particles in suspension are removed at 99.9% (turbidity index). The phosphorus level in the liquid portion is reduced by more than 98%. Furthermore, the heavy metal contents in the treated liquid manure are under the suggested environmental levels. Moreover, the treated liquid portion still contains nitrogen that could be used on crops and vegetables. The liquid is sterilized (free of pathogens) and odours are limited. The slurry phosphorus is concentrated in the solid portion (flock). [...].

A SIMULATION MODEL TO PREDICT THE INTERNAL CLIMATIC CONDITIONS IN LIVESTOCK HOUSES AS A TOOL FOR IMPROVING THE BUILDING DESIGN AND MANAGEMENT

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CSBE100548 – A model simulating the transient environmental conditions inside livestock houses has been created for building design. The software can be applied to any type of building, animal or climatic situation and gives as outputs the heat exchange through all the building components and the internal air temperature and humidity values, per minute. From these values some useful parameters are calculated to evaluate the building thermal behaviour: temperature humidity index, duration of the exposure to heat stress, possibility of recovering by nocturnal refreshment, benefit from mechanical ventilation or evaporative cooling. Its application in three study cases (a pig house, a veal barn and a shelter for cows) is presented and the possibility of improving the building design and management is pointed out.

MATHEMATICAL MODELS FOR FLOOD MANAGEMENT: EFFICIENCY AND RELIABILITY

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CSBE100549 – Floods are among the most damaging of natural hazards, and are likely to become more predominant in the future due to the effects of the impacts of climate change. A good understanding of a flood event can only be achieved by means of 1D or 2D hydrodynamic models based on the De Saint Venant (SV) or Shallow Water (SW) equations. The topographic data resolution strongly affects the flood model efficiency. Sound Digital Elevation Models (DEMs) must provide an accurate description of the watershed micro-topography to create a computational mesh in which all the elements that affect flood dynamics and flood propagation are included. Comparisons between first-order (Lax-Friedrichs) and second-order (Lax-Wendroff, MacCormack) schemes show that only the last one provides a reliable picture of the flood wave characteristics, such as shape, length, celerity, peak levels and maximum discharge. The much faster first-order solvers can be used to analyze a great variety of scenarios, letting a deeper investigation of the most hazardous environments to the more accurate second-order algorithms, for the design of efficient defence structural and non-structural measures.

AMMONIA AND CARBON DIOXIDE EMISSIONS IN TUNNEL-VENTILATED BROILER HOUSES IN SAO PAULO STATE – BRAZIL

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CSBE100550 – Ammonia and carbon dioxide emissions were evaluated in broiler houses with different ventilation systems and litter conditions (new and built-up). Emission data were calculated on a weekly basis and averaged per flock. Annual emissions were then estimated for the 6 flocks produced per year in both house types. Two houses (1 and 2) were tunnel ventilated, negative pressure, and two houses (3 and 4) were tunnel ventilated, positive pressure. The NH₃ emission data in 1 with built-up litter had a higher average ammonia emission when compared to 2 with new litter. The results for the positive pressure 3 (new litter) and 4 (reused litter) had the lowest average ammonia emission since the number of birds in these houses was 13,000 and 1 and 2 28,000 both. Therefore, it was observed that both houses with reused litter showed higher average emissions by birds. This is in agreement with the literature, indicating that the ammonia emissions from reused litter can be six times higher than the ammonia emissions from new litter during the first weeks of the flock. Carbon dioxide emission showed differences in comparison with ammonia emission, since the highest values were found in positive pressure barns. It is related to the high temperature found in these barns compared to the negative pressure 1 and 2 houses showed and their average temperature was lower, demonstrating the efficiency of the system in the establishment of thermal comfort.

CONFINED AND SEMI-CONFINED COMPRESSION CURVES OF HIGHLY CALCAREOUS SOIL AMENDED WITH ORGANIC MANURES

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CSBE100552 – The soil compaction by mechanical and hydraulic stresses is a major factor responsible for physical degradation of cultivated soils with low structural stability in arid and semi-arid regions of the world. Incorporation of organic manures into soil can partially help to prevent soil degradation. Confined and plate sinkage compression tests (CCT and PST, respectively) are usually performed to characterize the compression properties of soil. Two main forms of compression curve have been observed: (i) the bi-linear curve having an elastic rebound curve at low stresses and a linear virgin compression curve at higher stresses and (ii) the S-shaped curve having deviation of the virgin compression curve at high stresses. [...] Large remould specimens were prepared by applying 100 kPa load at two gravimetric water contents (17.1 and 20.9%). [...] In the PST, because high soil volume was available in the large pre-compressed soil specimen, the elastic deformation of the soil structure and the reduction of the air-pore volume were dominated. For the CCT, the S-shaped form appeared because the flow of water from mesopores storing free water subjected to high capillary forces became significant at higher stresses. These different processes could explain the observed bi-linear and S-shaped curves under PST and CCT, respectively.

ENHANCING THE POLYPHENOLIC CONTENT OF ELDERBERRIES BY PULSED ULTRAVIOLET TREATMENTS

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CSBE100553 – Pulsed ultraviolet light is typically used to decontaminate food surfaces as it has an antimicrobial effect. The present study aimed to explore the effect of pulsed UV light on the antioxidant behavior of elderberry [...]. The changes in total polyphenolics in elderberry treated with various pulsed ultraviolet rays were investigated. A pulsed UV system [...] was used in the experiment. The system has the capacity of producing pulsed ultra violet light with maximum energy of 1.27 KJ/cm²/pulse. All energy levels were maintained at the pulse rate of 3 pulses/sec with a pulse width of 360µs. Four pulsed UV durations [...] at three energy dosages [...] were considered for the research. The total poly phenolic content was determined using Folin-Ciocalteu method. [...] Even though most of the treatments indicated an increase in total polyphenols, some treatment expressed a decrease in phenolics when compared to the control. Total soluble solids (TSS) of all treated elderberry samples were measured and compared with the polyphenolic content. No significant relationship was found between TSS and the total phenolic content. During the experiment there was no change in color of the ripened fruits, but immature fruits lost their color with the higher energy treatment of 1.1J/cm²/pulse. This research did not however identify the specific phenolics which were responsive and specifically increased by the pulsed UV light. There is a possibility that some phenols might decrease and some phenols might increase following the pulsed UV treatment. [...]

MICROWAVE EXTRACTION OF MYRTILLIN FROM BLUEBERRY

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CSBE100555 – One of the diseases that are spreading rapidly worldwide is diabetes. Diabetes, or diabetes mellitus, is a syndrome of disordered metabolism usually resulting from a combination of genetic and environmental factors that result in abnormally high blood sugar levels (hyperglycemia). Blood glucose levels are controlled by the hormone insulin, a product of the beta cells of the pancreas. Diabetes develops due to a diminished production of insulin or resistance to the effects of insulin. Both cases lead to hyperglycemia. Some compounds are available in nature which can add to the function of insulin to control blood sugar without any reported side effects. One of these is myrtillin (anthocyanoside) extracted from the European blueberry (*Vaccinium myrtillus*) which has been reported as a natural compound for regulating blood sugar levels. Studies have indicated that blueberries are useful for lowering blood glucose. Other components in the extract of the leaf include compounds closely related to myrtillin as well as other flavanoids such as quercetin and caffeic acid derivative. For the production of plant extracts, the most commonly used techniques are steam distillation and solvent extraction. There are drawbacks in these processes such as destruction of components, high energy and solvent consumption, low yield, and long processing time. Microwave assisted extraction offers an attractive alternative. The extracting selectivity and the ability of the medium to interact with microwaves can be exploited by using mixtures of solvents. So during this study the extraction of myrtillin from the blueberry by microwave assisted process was studied. The blueberries were freeze-dried and ground to obtain the sample. Ethyl alcohol slightly acidified with hydrochloric acid was used as the [...].

STRESS RELAXATION BEHAVIOUR OF A HIGHLY CALCAREOUS SOIL AMENDED WITH LONG-TERM APPLICATION OF THREE ORGANIC MANURES

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CSBE100556 – When soil strain occurs under external force the strain-stress relation is not linear and strains are composed of elastic and plastic or viscose components. Various combinations of rheological elements have been used to develop models for assessing the viscoelastic behaviour of soils. The viscoelastic properties of a soil can be determined by a uniaxial compression device using two kinds of transient test: creep and stress relaxation. In the present work, a uniaxial confined compression test was conducted on the remoulded samples collected from the topsoil of experiment plots in which organic manures [...] were added to a silty clay loam soil at three rates (25, 50 and 100 Mg ha⁻¹) for 7 years successively under annual wheat-corn rotation. Large remoulded specimens were prepared at two gravimetric water contents (17.1 and 20.9%) and axial load was applied. When the applied stress reached 100 kPa, the strain was kept constant and the decay of the stress with time was recorded for 30 min. The stress relaxation behaviour was represented by the generalized Maxwell model with 2 elements. The strain induced in the soils after having subjected them to 100-kPa stress decreased with increasing organic carbon, whereas the residual modulus of elasticity increased linearly indicating higher elasticity with higher organic matter. The residual stress increased linearly with increasing organic carbon. The stress relaxation rate of the soils was not influenced by the long-term incorporation of organic manures tested at two moisture contents.

BIOACTIVE GOUDA CHEESE POWDERS OBTAINED BY SPRAY AND FREEZE-DRYING

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CSBE100557 – The growth in the ready-to-eat meals sector in recent years had been reflected in the increase in the demand for cheese as a food ingredient. Today, cheese powders find widespread use in a variety of foods, including biscuits and other bakery products, sauces, snack coatings, soups, pasta, cheese dips, etc. On the other hand, consumers are nowadays not only looking into the traditional sensory and visual characteristics of cheese, but also to its nutritional value. Proteins, fats and minerals are common nutrients found in cheese. Among cheese nutrients, vitamins such as A, B, and D as well as conjugated linoleic acid (CLA) are presently of great interest due to their nutraceutical properties. Many of these nutritional attributes can, however, be lost or degraded by oxidation during transformations operated at severe operation conditions, such as is the case of spray drying process, which by economical reasons still remains the common industrial method for this application. The main goal of the present proposal is thus the study of drying methods to produce cheese powders with high bioactive activity. An emulsion will be made by first grinding Gouda cheese and then mixing it with hot distilled water in different proportions (TS 30-40%). Emulsifying salts will be added. The resulting slurry will be dried by spray drying and freeze-drying at different operating conditions. For spray drying, emulsions will be heated up to at least 50°C to low its viscosity in order to ease its flow through the spray dryer [...].

RADIO FREQUENCY ASSISTED EXTRACTION OF NUTRACEUTICAL COMPOUNDS

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CSBE100558 – Radio frequency (RF) technology has been used widely in many areas encompassing telecommunication, medicine, textile, wood and agri-food processing. Recently, its application has been extended to the extraction of nutraceutical compounds due to its promising advantages such as shorter extraction time, lower solvent utilization, uniform heating and mild thermal effect on extracts as compared to conventional extraction methods. In evaluating its potential as an extractor, a study on RF extraction of secoisolariciresinol diglucoside (SDG) was performed. SDG, a flaxseed lignans, has been selected as the targeted compound because of its anti-cancer characteristics and other health benefits. By incorporating extracted SDG into processed foods, it could enhance their nutritional and health promoting quality. The RF extraction study was performed by exposing a mixture of defatted flaxseed meal (DFM) with 10% ethanol and 0.1 M sodium hydroxide (NaOH) to an RF energy field for a short time and the extracted SDG amount was quantified by high performance liquid chromatography (HPLC). The efficiency of this process was compared with thermal conventional and non-thermal base hydrolysis methods. Initial results showed that the non-optimised horizontal parallel plates of RF extraction system were able to recover 81.45% of SDG within 25% shorter extraction time as compared to the thermal conventional method (22.37 mg SDG/g DFM for 1 hour) and 25 times more recovery than non-thermal base hydrolysis method (0.73 mg SDG/ g DFM for 1 hour). However, inconsistency in heating rate and moderately high energy loss was observed in the system due to incompatible applicator design. Thus, a new design of RF applicator is proposed in this paper. [...].

DETERMINATION OF THE OPTIMUM COMBINATION OF PROCESSES IN NANO-SIZING FLAX FIBRES FOR USE AS SUSTAINABLE REINFORCEMENT IN BIONANOCOMPOSITES

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CSBE100559 – Renewable materials have been getting a lot of attention lately especially in the light of replacing feedstock from fossil fuel-based products with environmentally friendly or “green” renewable materials without compromising engineering properties. These materials, like flax, hemp, jute, and a lot more, have been studied and proven to be effective in the reinforcement of composites at the millimeter or, at least, the micrometer scale. In the area of composite reinforcement, the advent of nanotechnology is necessitated by the fact that the smaller the dimensions (especially the diameter), the higher the aspect ratio and, therefore, the better the engineering properties. Moreover, at this size, quality inconsistency due to the intermittent presence of weak points such as nodes in millifibres and microfibres are eliminated. This study delves into the process of resizing flax fibres into nanometer scale using acid hydrolysis, homogenization, and beating in a PFI mill solely and in different combinations to find the optimized process or combination of processes based on the size, quality, and composition of the final product of nano-sizing. It is hoped that a novel flax nanofibre which is biodegradable, biorenewable, and biosustainable can be produced with consistent nano-size, consistent quality, and consistent composition to sustainably reinforce bionanocomposites with diverse applications.

INVESTIGATING THE POTENTIAL FOR RICE PRODUCTION WITH SPRINKLER IRRIGATION

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CSBE100561 – Almost all rice (*Oryza sativa* L.) produced in the US Mid-South is grown in a flooded culture that requires considerably more irrigation water than other crops grown in the region. One approach investigated for reducing the water requirements for rice involved producing rice with sprinkler irrigation rather than with continuous flood. Problems, including disease, were observed that precluded widespread adoption of the system; however, recently there has been renewed interest in both the US and internationally. The objectives of this research were to develop and test a procedure for scheduling irrigations on sprinkler irrigated rice and investigate the suitability of chemigation for disease control. Studies were conducted at the University of Missouri Delta Research Center Marsh Farm at Portageville on a field with highly variable soils. An experimental crop coefficient function was developed and included in a beta version of the Arkansas Irrigation Scheduler. A total of 410 mm of irrigation water was applied, this is less than published values for flooded rice in the region, but additional observations with varying climatic conditions will be required to determine whether the crop coefficient function is adequate. Strips of blast resistant and susceptible cultivars were produced with no fungicide and with fungicide chemigation. Observed yields with chemigation (6.0 - 8.3 Mg/ha) were comparable to five-year state-average-rice yields in Missouri (7.5 Mg/ha). However, susceptible cultivars were severely impacted by blast when no fungicide was applied. [...].

EFFECTS OF SUPER ABSORBENT POLYMERS APPLICATION METHODS ON CARROT GERMINATION AND GROWTH

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CSBE100562 – The super absorbents (SAP) have proven to increase germination rate and yield, but the effectiveness is depends on their application methods. Three methods were investigated, (i) seeds mixed with water absorbed polymer and soil (SMP), (ii) spreading dry SAP mixed with soil in furrow (PSF), and (iii) spreading dry SAP on soil surface then ploughing the soil in 20 cm depth (PSP). The results showed that three application methods increased germination rate by 37.6(SMP), 16.7(PSF) and 5.9%(PSP) and also improved carrot yield by 20, 14 and 5% respectively when compared with their controls in the first year. The SAPs applied in soil could absorb more water to improve soil moisture and also loosen soil surface structure due to swelling. The SMP method with better mixture of SAP and carrot seeds resulted in more SAP around seeds and more air into soil, and thus higher germination rate and yield. It seemed that the increase in amount of SAPs from 45 to 75 Kg hectare-1 had no further effects on improving carrot yield for SMP and PSP methods, but evidently reduced germination rate for PSF. The increased amount of SAPs for the method resulted in more pores around seeds and more evaporation and made seeds subject to drying during germination. [...].

DEVELOPMENT OF AN AUTOMATIC CONTROL MANAGEMENT SYSTEM FOR A GREENHOUSE

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CSBE100563 – This study focuses on rose disease detection. Pests and diseases represent a very important problem for the international trade in cut flowers and foliage and must be controlled. In Mexico, many varieties of flowers are being cultivated, with a total value that reached 387 million US\$ in 2006. Roses are currently the most economically important ornamental crop and are very susceptible to diseases which spread easily. It would be possible to conduct early protection and treatment if plant health could be diagnosed easily and if the causes of their infections were known. In this research a rose disease diagnosis system was developed with Open CV (Open Source Computer Vision). The disease diagnosed was powdery mildew (*Sphaerotheca pannosa*). Then a mask was created using the plant region and was combined with the source image. The combination of these two images permitted the removal of the background. Finally the accuracy of the diagnosis was evaluated. The developed disease diagnosis system is able to diagnose the powdery mildew disease through the HSV space color with Open CV. Better diagnoses were obtained when using close pictures (10cm) where the average coincidence rate was 77.6+14.1%. For distant pictures (50 cm) the coincidence rate obtained was 52.8+17.1%. The misconception rate caused mostly by halation when using distant pictures could be successfully avoided using active sensing which allows for disease diagnoses even when using distant pictures.

METHOD TO SUPPRESS OR REMOVE BLUE-GREEN ALGAE IN THE POND OF LARGE AREA BY MICRO BUBBLES

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CSBE100567 – Serious pollution caused by much propagated blue-green algae kills useful aqueous organisms and causes undesirable and intolerable bad smell and the other effects. Those negative effects further raise the environmental pollution in beautiful and safe nature resulting in inevitable loss of clean environments familiar to us. Until now, small scale evaluation tests for the restoration of clean environment from such kind of serious pollution have been done, however, large scale of the experiment and evaluation tests have not been done with low electric power consumption and without chemical applications. In our present study, we describe the machine (named “Nanomizer”) that generate the water flow containing ionized micro-nano bubbles and a successful example that show the restoration of clean water by applying the ionized water to the water polluted by the blooms of blue-green algae, that is, the removal of bad smell and the improvement of water quality by suppressing the growth of blue-green algae in early stage of their blooming in the ash disposal pond of 140 ha and 6 m deep on the site of South Korea – East Power Co. by using two 750 W Nanomizer.

ADVANCES OF RESEARCH ON STRUCTURAL CHARACTERIZATION OF AGRICULTURAL PRODUCTS USING ATOMIC FORCE MICROSCOPY

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CSBE100571 – Atomic force microscopy (AFM) is a relatively novel form of microscopy which has many unique features: high magnification with high resolution; minimal sample preparation; the ability to obtain different views of the sample from a single data collection; acquiring 2D and 3D images at the same time; observing ongoing processes directly and so on. AFM, as a nanotechnology tool, has been used to investigate the nanostructure information of materials in many fields. This review focuses solely on its application to characterize the macromolecular nanostructure and surface topography of agricultural products. First, the fundamentals of AFM are briefly explained. And then the macromolecular nanostructure information of agricultural products from AFM images is introduced, exploring the structure-function relation in three aspects: agricultural products processing, agricultural products storage, and genetic and environmental factors. The surface topography characterization of agricultural products using AFM is also discussed. The results reveal that AFM could be a new nanotechnology tool providing a deeper understanding of the mechanisms of structure and quality variations of agricultural products, which could be instructive in improving the agricultural products processing and storage technologies.

FOOD AND BIOMASS PRODUCTION IN SMALL OIL EXPRESSION FACILITIES

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CSBE100576 – In this study, first, rapeseeds were separated; high quality seed for food oil and low quality seed for biofuels. Next, a laboratory-scale oilseed screw press was used to investigate the effects of choke opening and seed preheating on the rapeseed pressing performance and the quality of food oil and biofuels oil. As maximum pressure increased, oil recovery increased, but chlorophyll content of rapeseed oil increased too. Acid value of the rapeseed oil extracted from low quality seeds had high value. For the rapeseed pressing performance, rapeseed heated by microwaves yielded more oil than that without heating. And the chlorophyll content of rapeseed oil extracted from the rapeseed treated by microwaves was higher than that without heating. The NEB ratio of microwave heating press with choke opening set at 8.0 mm is advantageous. And the oil extracted by this method was good and basically fulfilled the Codex Alimentarius requirements for edible oils.

DEVELOPMENT OF PEACH HARVESTING END-EFFECTOR WITH FUNCTION FOR ESTIMATION OF DEGREE OF RIPENESS

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CSBE100577 – For harvesting fruits using machines or robots, it is important to know the correct time at which they should be harvested and to harvest fruits without damaging them, particularly fresh fruits. The objective of this research is to develop a peach harvesting robot with a function for estimation of the degree of ripeness. Before the objective can be met, we have to develop a method for estimating the degree of ripeness. As the first step toward this aim, we attempted to investigate the relationship of the ripeness of peaches with their color, size, and odor by using cultivating peaches. We carried out this investigation starting one week before harvesting day. The results of this investigation are as follows. 1) The color of the fruit's skin changed from light green to light yellow ($a^* = -10$ to $+2$ in $L^*a^*b^*$ measured by the colorimeter). 2) The size of the peaches increased with each passing day. 3) The odor of the peaches increased gradually in the initial stage; however, it increased rapidly in the final stage (the odor was measured by an odor level indicator). Furthermore, we built a prototype of an end-effector by using a harvesting mechanism that is based on the principle of the iris diaphragm of a camera. This mechanism is expected to reduce the damage caused to peaches during their harvesting; however, this has not yet been confirmed. We will confirm the effectiveness of this mechanism during the peach harvesting season.

DESIGN, FABRICATION AND EVALUATION OF A MOISTURE-BASED FIG SORTER

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CSBE100579 Iran produced 88,000 tonnes of dried figs in 2006 which ranked 4th in the world. However, much of the production is downgraded due to traditional methods of harvesting and drying in which producers let the figs dry on trees until they fall down on the ground. This method of harvesting is laborious, time consuming, and somehow unhygienic. Using shakers would be a good option for mechanized fig harvesting, but with this method, harvested figs have different moisture contents. To dry the figs appropriately, a suitable sorter should be designed to sort the harvested figs based on their moisture content. The main objective of the study is to design and fabricate a moisture-based fig sorter. Based on some preliminary experiments on physical properties of fig which are affected by moisture content, the coefficient of friction and rolling resistance were introduced as the key characteristics in fig sorting. Considering the mentioned characteristics, a test rig was fabricated. The rig consists of an horizontal feeding belt and three sloped sorting belts driven by an electric motor. The angle of each sorting belt can be manually adjusted. A basket was placed at the bottom of each belt to collect the sorted figs. In order to evaluate the sorter, freshly harvested figs with different moisture contents were fed into the sorter. A factorial experiment with two factors including four levels of belt speed (7.2, 8.4, 9.4 and 10.6 m/min) and two levels of belt slope arrangement (8, 9, 10 and 10, 11, 12 degree) was conducted in a completely randomized design in three replications. A sorting index was introduced to show the performance of the sorter. Results have shown that the belt slope arrangement and belt speed both have very significant effect on sorting accuracy. The best sorting accuracy of around 80% was obtained at belt speed of 9.4 m/min and belt slope arrangement of 8, 9, 10 degrees.

A SIMPLE METHOD FOR MEASUREMENT OF POISSON'S RATIO FOR TISSUE OF AGRICULTURAL PRODUCTS

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CSBE100580 – Poisson's ratio, which characterizes mechanical properties of a material, was measured by means of image analysis from a digital photograph. A tissue of boiled Japanese radish or carrot, which is too fragile to measure their Poisson's ratio by traditional methods, was used as sample materials. Cylindrical samples were cut out of the tissue using a precise apparatus and their dimensions were set to 15 mm height and 30 mm diameter. The samples were then compressed. The stress of the samples against compression was measured using a creep meter apparatus. The compressed deformation of the samples was captured by a digital camera, which could obtain high resolution images and analyze its transformation accurately. The Poisson's ratio was calculated from such transformations. A Young's modulus was also measured by the creep meter. As a result, the Poisson's ratio of boiled Japanese radish was found to decrease with boiling elapsed time. The Poisson's ratio of carrot also decreased with boiling time, and its value was smaller than the Japanese radish's. On the other hand, the Young's modulus for each sample decreased sharply when boiling started but after 4 minutes of boiling it was stabilized at low values.

PREDICTION OF TOTAL SOLUBLE SOLIDS AND FIRMNESS OF CARROTS BASED ON CARROT WATER CONTENT

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CSBE100581 – There are many cases in which it is desirable to determine relationships among fruit quality characteristics. For instance, total soluble solids (TSS) and firmness (FIR) are often determined using laborious and/or time consuming laboratory tests, but it may be more suitable and economical to develop a method which uses an easily available characteristics. In this study, two linear regression models for predicting TSS and FIR of Nantes carrot based on carrot water content (WC) were suggested. The statistical results of the study indicated that in order to predict TSS and FIR of carrot based on WC the linear regression models $TSS = 34.9 - 0.30 WC$ with $R^2 = 0.86$ and $FIR = -1665 + 55.5 WC$ with $R^2 = 0.84$ can be strongly recommended.

REST-BASED WEB SERVICES FOR THE DISCOVERY AND DISTRIBUTION OF AGRICULTURAL PRODUCTION STANDARDS

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CSBE100584 – Modern agricultural production is governed by standards which direct and restrict farming practices. The number and complexity of these standards is continuously increasing with considerable manual labour involved in the verification of farms' compliance to these standards. It is the vision of the FutureFarm project that in the future, parts of this verification could be done automatically given that the agricultural standards are represented as formal rules allowing computerised management and reasoning. [...] Our research studies a solution consisting of two REST-based web services operating in unison. The first of these services provides a catalogue functionality for the discovery of standards while the second service manages the actual distribution. REST-based web services were found to provide an efficient mechanism for both aspects of the research problem. Despite their inherent simplicity, REST interfaces were able to provide all required functionalities for both services, which was confirmed with a prototype client implementation. Besides and prior to the eventual and at least partially automated verification of compliance to agricultural production standards, the proposed infrastructure could be used to conveniently distribute these standards in natural language for all stakeholders of modern agriculture.

A NOVEL COMPUTER VISION SYSTEM FOR SPECIFICALLY DETECTING ROTTEN CITRUS

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CSBE100601 – In order to guarantee the quality of a production process, automatic detection of blemishes in citrus packing houses is particularly important during postharvest. In the case of rotten fruit, early detection becomes critical since a single rotten fruit can disseminate the infection to others. Currently, the detection of fruit affected by fungal diseases and its removal of rotten fruit is performed manually by trained workers who inspect the fruit under ultraviolet illumination, since incipient rotten areas hardly contrast under standard white visible light at early stages. For this same reason, automated sorting machines based on colour image analysis, have certain limitations in detecting early rotten fruit, because the colour and texture of the damaged skin is very similar to healthy skin. In this work we used a hyperspectral imaging system to capture 57 monochromatic images of fruits affected by rot in different visible and infrared wavelengths. Then, eight data mining methods were applied to reduce redundant information. By combining the results of these eight methods, a wavelength ranking was established. The top three wavelengths were assumed to be the most discriminant ones and were used to build a three-band image analysis system that was compared against a conventional one based on RGB. The results showed that using the proposed systems, success rate of rot detection increased from 51% with a conventional system to 78%, while false detections were significantly reduced. In conclusion, the work demonstrates the possibility of building a non conventional three band computer image analysis system capable of detecting early rot without using dangerous ultraviolet illumination.

ANALYSIS OF THE MOVEMENT OF FRUITS DURING MECHANICAL HARVESTING WITH SHAKERS USING COMPUTER VISION AND A SLOW MOTION CAMERA

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CSBE100602 – Mechanization of citrus harvesting drastically reduces production costs. Shaking machines are commonly used for this operation in USA and are starting to be used in Spain, yielding around 70% of total fruit to be harvested. However, it is necessary to optimize such machines in order to increase their rates of fruit detachment, reduce the damage to the bark of the trees and preserve the quality of the fruit. Computer vision systems can help in this task by registering video sequences of the vibrating motion produced by the shakers on individual fruit in the canopy until they fall down. A slow motion camera is used in this work to register video sequences. All the images that compose each sequence are segmented and processed using high speed techniques. In each of the images, the contour of the main object (fruit) is deducted and the point of the insertion of the stem detected. The XY coordinates of the fruit centroid and the angle between the vertical and the stem-centroid axis is also calculated. These parameters are the basis of a study to understand how the fruit is really affected by the shaking produced by the machine.

COMPARISON OF MECHANICAL PROPERTIES OF TWO APPLE VARIETIES UNDER COMPRESSION LOADING

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CSBE100603 – In this study strength properties of two Iranian apple varieties (Golab Kohanz and Shafi Abadi), under compression loading, were considered and compared using standard methods. The properties such as rupture force and energy, failure stress and strain, Young's modulus, toughness and hardness were determined in 86% and 84% moisture content (w.b) for Golab Kohanz and Shafi Abadi, respectively. Mechanical properties of apples were evaluated using 20 cylindrical specimens of each variety, taken in horizontal and vertical direction by Universal Testing Machine. Average values of rupture force and energy, failure stress, failure strain, Young's modulus, toughness and hardness were determined, 57.82 N, 285.88 mJ, 0.37 MPa, 31.26%, 0.93 MPa, 0.07 J/cm³ and 9.14 N/mm for Shafi Abadi variety, respectively. The corresponding values for Golab Kohanz were obtained as 51.11 N, 157.51 mJ, 0.32 MPa, 23.36%, 0.81 MPa, 0.04 J/cm³ and 7.79 N/mm respectively. According to results, effect of the sampling orientation was not significant on the mechanical properties in any two varieties.

PROPERTIES OF COCONUT (*Cocos nucifera* L.) RELEVANT TO ITS DEHUSKING

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CSBE100609 – Coconut seed (*cocos nucifera* L.) is a tropical plant valuable for its oil and fat fractions for the production of soap and milk which are used for making soap, as diesel fuel, for lighting, for making candles. In developing, processing and handling the seeds, some engineering properties such as size, sphericity, roundness, volume, surface area, density, coefficient of friction against different materials and compression tests were studied. One hundred seeds were randomly selected for the physical properties tests, such as the shape, size, volume, density, surface area experiments. The three principal dimensions were measured using a Vernier Calliper with an accuracy of 0.02 mm. Major diameter varied from 17.36 cm to 19.70 cm; surface area varied from 4724 mm² to 5797 mm², seed volume varied from 600 cm³ to 800 cm³ with an average density of 1.065 g/cm³, which shows that it floats in water because the density is greater than that of water. The coefficient of friction is high for plywood and minimum for glass. The average modulus of elasticity is 153.625 N/mm with an average load at yield and deformation at yield at 5390.6 N and 35.22 mm respectively on the major axis.

AROMA PROPERTIES OF SELECTED LOCAL SPICES IN AKWA IBOM STATE OF NIGERIA

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CSBE100612 – Some popular local spices in Akwa Ibom State of Nigeria were selected for the determination of properties responsible for their aroma and flavours, which make them so widely accepted in many dishes. These spices include *Ocimum basilicum* or Tea bush, *Piper guineense* or Guinea black pepper, *xylopia aethiopica* or Ethiopian pepper, *Tetrapleura tetraptera* or Aidan tree and *Blighia Unijugata* or onion tree. Essential oils and oleoresins, which characterize the aroma pungency of the spices, were extracted and the esters responsible for aroma and flavours were identified with the use of UNICAM UV-VISIBLE SPECTROMETER v2.03. Maximum absorption at different wavelengths showed that *Piper Guineense* contains Quinoline, isoquinoline, Benzene and Nitrobenzene. Also, *Tetrapleura Tetraptera* contains Quinoline and Nitrobenzene. *Xylopia aethiopica* contains trans-stiibene, Diphenyl compound, pyridine or Nitrobenzene. Furthermore, other compounds such as tannin and total soluble oxalate were identified at lower levels in *Piper guineense* and *Tetrapleura tetreptera*. Lastly, these spices were found to be rich in macro elements such as sodium, magnesium, potassium, calcium, iron, copper, zinc, etc. Although rich in nutrients, the potential of these spices is not sufficiently used by local food industries to date.

SOIL BIN INVESTIGATIONS OF THE EFFECTS OF TILLAGE TOOL WIDTH ON DRAUGHT AND SOIL DISTURBANCE PARAMETERS IN SANDY CLAY LOAM SOIL

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CSBE100613 – Published data are scarce on soil bin investigations of tillage tools in the design of soil engaging implements in Nigeria. The major objective of this study was to investigate the effects of tool width on draught and soil disturbance of tillage tools (tines), with a view to generating relevant data in the design of soil engaging implements and soil/tool interaction. Experiments were conducted in an indoor soil bin filled with sandy clay loam soil at average moisture content of 11.5 % (dry basis). The implements used in these tests were tillage tines. Tests were carried out to study the effect of variation in tool width on soil disturbance and draught. In each of the two sets of tests, depth was held constant at 35 mm and then at 70 mm. Speed was varied at three levels, V_1 , V_2 and V_3 , corresponding to 1.0, 3.6 and 9.0 km/h respectively. The widths of the tines tested were 10, 20, 31, 40, 51, 88, 126, 163 and 200 mm. The penetration resistance (cone index) of the experimental soil varied from 400 to 600 kPa. Tools draught was measured with a load cell while soil disturbance was also observed and measured by means of a profile meter and meter rule. Draught increased at a decreasing rate with tine width Quadratic models best fit the data points with very high R^2 values. The increase in draught was also affected by the forward speed since higher draught values were obtained at higher speed. Soil disturbance was evaluated by the parameters: maximum width of cut (Wfs), maximum width of soil throw (TDW), rupture distance (f), ridge-to-ridge distance (RRD), height of ridge (hr), and after plough depth (df), and width of tool (w). The results show that the parameter of soil disturbance increased with increase in tine width, except height of ridge (hr), which did not show any specific trend. The specific draught was highest with tine T20 (10.63 N/cm), followed by tine T10, and then T5. [...].

MICROWAVE ASSISTED DRYING OF FLAX STRAW AND FIBRE AT CONTROLLED TEMPERATURES

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CSBE100614 – Flax fibre and stem were subjected to microwave drying at controlled temperatures. The rate of drying was then compared with conventional hot air drying. The product temperature was kept at 40, 60 and 80 °C for both microwave and hot air drying. The initial moisture content of flax fibre was about 60 % (wet basis); while for flax stem, it was about 70 % (wet basis). The microwave drying was conducted with a microwave apparatus which records the mass, product temperature, incident microwave power, reflected microwave power and inlet outlet air temperature. The final moisture content for both experiments was set to 9 % (dry basis). The microwave drying ensured about 60 % reduction of drying time for drying flax fibre and straw compared to hot air drying.

SUSTAINABLE BUILDING WITH CONCRETE: HOW LONG DO CONTAINERS LAST?

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CSBE100615 – In the developed world there is a lot of concern that agricultural production, mainly livestock farming, may cause environmental damage. Any kind of livestock farming produces animal excrements. In Europe most animals are kept in buildings, the construction of slurry (and/or dung) storage is required. Generally, these containers are made of concrete. The most important question is, whether these containers are leak proof. Tests on the tightness of storage reservoirs were run by the former Institute of Production Engineering and Building Research (new name: see above). In particular, pressure tests according to DARCY were run. Another important question addresses the durability of the concrete. To assess this, two different methods, both according to DIN EN 12504-1 (former DIN 1048) were used: the rebound-hammer method and the hydraulic pressure test of drilling core samples (diameter 151 mm). For comparison, samples one year old and 72 years old were tested. It generally could be seen that the samples of very different ages matched perfectly with regard to additives and structure. The newest samples showed strength in the range of 25.0 to 35.0 N/mm², the average of the old ones was 27.4 N/mm². Thus, today's legal constraints on the quality of concrete for agricultural containers are fully covered also by a 72 years old container. Therefore, the technical service life of the container by far exceeds the depreciation period.

IMPACT OF THE MANURE REMOVAL FROM SLATTED FLOOR IN A DAIRY BARN ON THE AMMONIA EMISSION

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CSBE100616 – Keeping dairy cattle in loose housing contributes to the total emission of ammonia up to 50% and has its main origin from soiled walking areas like slatted floors. The ammonia emissions from the barns have an impact on the environment, as does the soiled floor on the health of the claws. Aim of the investigations was to evaluate the impact of the manure removal from slatted floor on the ammonia emission in dairy barns. The cleaning system used is designed to combine the advantages of a wet and a mechanical cleaning-method. It features high-pressure water nozzles, mechanical star discharge rotors and a rubber-scraper. For the experiment, six exchangeable concrete slatted floor elements (55 cm x 62 cm x 20 cm) were cut out of the existing floor. This way the test elements could be separated from other sources of ammonia emission and moved into closed chambers (120 cm x 80 cm x 60 cm). Via membrane pumps the air carrying emitted ammonia from the slats was run through a solution of sulphuric acid (0,1n) and determined quantitatively in a lab using a photometer. Compared to untreated control slats, a reduction of the amount of manure weighted on the clean test elements up to 33.2% could be observed. However, no significant effect of the cleaning of the slats on the ammonia emission could be detected. Average ammonia concentrations measured directly after the cleaning (mean temperature in the barn: 21.1°C) were 13.2 mg NH₃ h⁻¹ m⁻² (clean) and 16.3 mg NH₃ h⁻¹ m⁻² (control), respectively.

MODELING AND STATISTICAL CHARACTERIZATION OF THE SIZE AND MASS DISTRIBUTION OF RAISIN BERRIES

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CSBE100618 – Processing of raisins involves various operations like washing, drying, cleaning, separating, and grading. Normally, for designing the grading and separating machines, it is not only important to know the mean values of these physical properties, but also the description of the berries properties distribution is needed. Therefore the prediction of size and mass frequency distributions of raisins by a suitable theoretical distribution model is important for designing the processing systems and the farm management. The size and mass of raisins were statistically analyzed by normal and three-parameter Weibull distributions to analyze the differences between mass and size distributions for damaged and whole berries. The goodness of fit of the models was evaluated by means of Kolmogorov-Smirnov statistical test. The results showed a high degree of randomness of whole berries in the range of 6.4-16.4 mm for length, 5.4-14.2 mm for width and 4.0-10.4 mm for thickness. Corresponding values for damaged berries were 3.9-9.9, 2.1-8.8, and 1.1-4.9 mm, respectively for length, width and thickness. The mass of whole and damaged berries also exhibited a high degree of variability in the range of 0.21-1.05 g and 0.02-0.42 g, respectively. The results showed that Weibull distribution was relevant for modeling the probability distribution of size parameters of whole and damaged raisins. The fitted distribution can then be used for calculating the berries properties based on percentiles of the data, in reliability-based design calculations, or in simulations of the performance of grading machines and separation of whole and damaged berries.

USING ARTIFICIAL NEURAL NETWORKS FOR DISCRIMINATION OF THE CORN PLANTS FROM THE WEEDS

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CSBE100620 – The main requisite for a weeding-thinning machine is the location of the main stem of the crop. In this study, crops and their positions were detected using image processing techniques with the aid of artificial neural networks. Morphological operations were performed to singulate different objects in the images. Several shape features were fed to artificial neural network to discriminate between the weeds and the main crop. In the final stage, position of the crop was determined which is necessary for the weeding machine to root up all of the other plants. 196 images of corn plants and four species of common weeds were collected from normal conditions of the field. Results showed that this technique was able to discriminate corn plants with an accuracy of 100%. It was concluded that high accuracy of this method is due to significant difference of corns and weeds in the critical period of weeding in the region.

ASSESSING DIFFERENT LEACHING MODELS IN SOUTH EAST IRAN

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CSBE100622 – Iran is located in a dry region with low nearly rainfalls and high evaporation, accumulating different salts in the soils surface. Therefore, it is necessary to accomplish an operational method in order to evaluate the required water needed to wash out salts from the soils. To study the possibility of the desalinization as well as desodification, three different experiments were conducted with 1) Karoon river water 2) a saline water, 3) 1 meter drainage water depth with 5 tone sulfuric acid in four (0.25 cm) intervals. Soil samples were analyzed in a laboratory. The desalinization and desodification leaching curves were then obtained. Different theoretical models were obtained from the desalinization and desodification curves. The results indicated that there is a relationship between the theoretical and experimental leaching curves for the studied area. Among the 11 analyzed models for desalinization and desodification, the logarithmic and exponential models with least standard errors and largest correlation factor were selected to be best for the studied area.

DEVELOPMENT AND TESTING OF TECHNICAL MEASURES FOR THE ABATEMENT OF PM10 EMISSIONS FROM POULTRY HOUSINGS

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CSBE100624 – Emissions of PM10 have to be reduced in the Netherlands to comply with EU ambient air quality standards. Poultry industry is one of the contributors to PM10 emissions and it has to implement mitigation measures before 2012. Given the lack of effective and cost affordable technical measures an extensive research and development program has started, 2008-2011, with the objective to provide abatement technology for broiler and layer houses as soon as possible. This paper gives an overview of the results from researches carried out in 2008 and 2009 by Wageningen UR Livestock Research. Both supplying industry and poultry farmers are participating in this program. Different methods and approaches have been researched: bedding material, light schedules, oil spraying systems, ionization systems, water scrubbers, combined scrubbers, electrostatic filters, and dry filters. Most methods were first tested and optimized in small units of the experimental poultry accommodation in Lelystad. A number of methods were validated in a next step on poultry farms, where the PM10 emission was measured to establish official emission factors. From mid 2009 and on both the oil spraying system and ionization system were tested in broiler houses and they are on the edge of implementation in practice. PM10 reductions with different methods vary from no effect to levels of 60%. The paper concludes with an outlook on adequate dust abatement measures for poultry housings in the near future.

SOIL BIOENGINEERING TECHNIQUES IN FLOOD RISK MITIGATION IN FRIULI VENEZIA GIULIA REGION (ITALY)

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CSBE100627 – In recent years severe floods have occurred in several parts of Europe and particularly in Italy, both as localised flash floods and basin-wide floods on major river systems. By their nature, floods are generated by the random coincidence of several meteorological factors but man's use of river catchment, also, has an impact upon the severity and consequences of the event: practically, when the runoff exceeds the capacity of the drainage channels – rivers, creeks (in rural environment) and storm water channel (in the urban environment). Floods frequently cause loss of life, property damage and destruction, disruption of communication, transportation, electric and community services. Their catastrophic effects are significantly increased with the rapid population growth which includes on hand a large urbanization and, on the other hand, the land misuses (e.g. deforestation and overgrazing). One of the output goals of flood damage reduction is to reduce environmental degradation caused by physical forces such as erosion. Erosion causes landslides, particularly in the upper part of the catchment river basin (e.g. rockfalls, landslides and avalanches, linear erosion channels, etc.) which occur, generally, in recent unconsolidated material with a shallow water table. In the last decades, the Friuli Venezia Giulia region has experienced many floods (1965-1966, 1979, 1983, 1990, 1995, 1996, 2000 and 2003) due to heavy rainfall (e.g. 50 - 60 mmph); most of these cases occur where the hill slope (with very poor geological and geotechnical characteristics) is very steep. At the base of the hill slopes, the landslides material often accumulates in the form of talus slopes which may pose an additional risk in presence, for example, of torrent bed. It is obvious that in cases of heavy rainfall or rainstorm, the sudden flash flood can trigger phenomena such as debris and mud flows (15.000 - 20.000 m³/sqkm). [...].

USAGE OF CONCRETE FOR FARM BUILDINGS AND MANURE STORAGES; SPECIFICATIONS, DURABILITY AND PRACTICAL CONSIDERATIONS

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CSBE100628 – The Canadian standard association has published a 2004 revision of the A23.1, A23.2, A23.3 and A23.4 standards for the selection and design of concrete structures. In this latest edition, the CSA A23.1 has defined four classes of usage for the selection of the concrete constituents. The latest standard for concrete requires higher compressive strength, lower water/cement ration and other specifications. Consequently, the basic cost for concrete is increased by 15 % to 25 % from the tradition cost of concrete used for farm buildings and manure storage in Quebec. Over 400 manure storage structures and barn floor inspection reports have been analysed in order to evaluate the present situation and the problems related to existing farm construction projects. The objectives are: 1) to identify the problems related with concrete deterioration, 2) present the design considerations for the expected life of a concrete structure and 3) present practical recommendations for farm buildings.

MICROWAVE-ASSISTED SEPARATION OF EGGSHELL AND MEMBRANE

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CSBE100630 – Eggshell and membranes which are largely disposed of as waste are a reserve of many bioactive compounds with high economic and monetary value which can be extracted by the efficient separation of eggshell and membrane. This study explores the possibility of separating the membrane from eggshell by the use of microwaves. Given that a material's response to electromagnetic radiation depends upon its dielectric properties, it was first necessary to determine these properties in eggshell and membrane over the range of 200 MHz to 20 GHz, at temperatures ranging from of 25 °C to 100 °C. The effectiveness of hot water and microwave treatments in reducing the total bond energy (mJ) to overcome in separating chicken egg membrane from its shell was then investigated. Microwave-treated eggs showed significantly lower ($p \leq 0.01$) bond energy than non-treated or hot-water-treated eggs. While increasing power density and soaking time both significantly ($p \leq 0.01$) reduced bond energy of microwave-treated eggs, neither treatment temperature nor the interaction between temperature and power density had a significant effect. A model for calculating the bond energy as a function of power density and soaking time is also presented.

DETERMINATION OF METALS IN ORGANIC PULP AND JUICES BY FLUORESCENCE X-RAY

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CSBE100631 – Fruit juices are an important source of minerals. Potassium and calcium are present in large quantities in citrus and apple juices. They also have significant amounts of magnesium and phosphorus in the case of citrus fruit. Juices can also be a source of minor elements such as iron, copper, zinc and manganese. In some cases, metals in juices are just due to contamination during the preparation of the product. Heavy metals are among substances that can cause problems of human poisoning by ingestion of contaminated food. Given the importance of minerals to human health, and the pace of industrial production of juices and fruit pulps, the need to develop rapid methods for the quantification of these nutrients in foods is highlighted. This paper presents the development of a methodology for determination of minerals in organic and non-organic juices and fruit pulps, by using fluorescence spectrometry X-ray energy dispersive. Two methods of sample preparation, as well as statistical tests on the results for each of these methods were evaluated. In order to study the nutritional quality, the results of the mineral composition of organic and non-organic foods were compared. The fluorescence spectrometer x-ray proved to be efficient to evaluate the mineral composition of juices and pulps. The equipment demonstrated greater sensitivity to potassium and calcium than for iron and magnesium.

A UNIFIED PEST SCOUTING FOR AREA-WIDE IPM

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CSBE100633 – The determination of pest populations is an essential part of area-wide integrated pest management to wisely respond to a variety of threats. Information regarding wide area population trends, previous control measures and other environmental parameters could improve decision making, reduce pesticide use and delay the acquired pest resistance to applications. As of now, dozens of scouts are employed by individuals or organizations to monitor pests in field crops plantations and controlled greenhouses. Pest control decisions are based on observations that are often translated into recommendations to the growers and then lost. A working data collection system was developed in collaboration with pest scouts, to create a common language among the solitary scouts. This system was implemented to enable the collection of data from field scouts in wide areas into a central database. The system employed cellular phones and the Internet to transmit data mainly from field scouts to a central data base, with a limited feedback. For reliable wide area IPM is required to establish quantification of pest population which takes into account the differences in estimation not only among scouts but also among crops. [...] A unified measure was developed to allow estimation of pest infestation across crops thus making it possible to evaluate the situation and its dynamics over a wide area. The calculation of the measure is done on the data server, and takes into account the crop stand, the pest and method of scouting. The measure of pest population is now being used to evaluate the method and its benefits.

DESIGN AND PERFORMANCE OF A LAB SCALE CONTROLLED ENVIRONMENT CHAMBER (CEC) USED FOR DETERMINATION OF HORTICULTURAL PRODUCE QUALITY DETERIORATION

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CSBE100636 – A project was initiated to develop models for predicting physiological and microbial changes, diseases and physiological disorders development of fresh horticultural produce, as a function of time (t), temperature (°T), relative humidity (RH), and quality parameters measured at harvest and at intermittent steps in the cold chain. Tomato was selected for this initial work due to its local availability year round. A lab scale storage device was developed to store fruits or vegetables at any combination of relative humidity and temperature possibly encountered in the cold chain at any time after harvest, while allowing sampling at various time intervals. The combinations of three RH (75, 85 and 95%) and three °T (1, 10 and 24°C) were used during the evaluation of the performance of the storage device. Produce sampling occurred on day 0, 3, 6, 10 and 13. The device consisted of three individual 222 L chambers assembled on a single support system that could be easily transferred to a refrigerated room maintained at a slightly lower °T than required inside the chambers. The RH of each chamber was controlled separately by a condensing unit inside each chamber that removed the excess moisture in the air by cooling down the ambient air below the set point. An electric resistance heating system was included in each chamber to generate sufficient heat to control the °T. An appropriate quantity of water was poured on the floor of each chamber to generate moisture as required. Fans and diffusers were used to [...].

DAIRY MANURE AMENDMENT EFFECTS ON ODOR AND GAS EMISSIONS

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CSBE100644 – Twenty-two amendments representing different modes of action were screened for odor and gas emission from dairy manure stored at room temperature (20°C) for short- (3 d) and medium-term (30 d). Seven of these amendments were selected for replicated (n=2-4) study at two temperatures (10 and 20°C) and three storage periods (3, 30 and 94 d). Amendment was added to 2-kg dairy slurry (1:1.7 urine:feces; 12% total solids) following the manufacturer rates. Untreated slurry was also evaluated as was a feed-through additive. Odor emissions were estimated by six qualified odor assessors following an olfactometry international standard. Odor quality characterizations included hedonic tone, supra-threshold odor intensity, and odor character. Gas emissions measured included hydrogen sulfide (H₂S), ammonia (NH₃), carbon dioxide (CO₂), methane (CH₄) and nitrous oxide. There were no consistent reductions of odor and gas emissions in the amendments and feed additive treatments for all storage periods at 20°C and 10°C. Average daily odor emission rates were 5 to 94 OU_E cm⁻² d⁻¹. Significant reductions (31%; P=0.032) were measured in the abandoned mine drainage (AMD) sediment treatment after 3 d at 20°C. Essential oils *Hyssopus* and peppermint reduced odor emission by 27-48% after 94 d at 20°C. But for 30 d at 10°C these oil treatments increased odor by 29-65%. Generally, mean gas emission rates were 1.4 to 2 times higher at 20°C than at 10°C (P=0.04-<0.0001). Only the AMD sediments consistently reduced NH₃ and CO₂ emissions after 30 d and 94 d (P=0.02-<0.0001). A microbial [...].

EFFECT OF TEMPERATURE AND PHYSICO-CHEMICAL CHARACTERISTICS ON THE EFFICIENCY OF COAGULATION FLOCCULATION PRETREATMENT OF WATER ON DAIRY FARMS

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CSBE100645 – The Canadian Quality Milk Program requires that the water used to wash milking equipment on dairy farms meet the provincial potability standards for bacteria. To comply with the program, some dairy farms will have to be equipped with onsite disinfection systems. However, the levels of turbidity and UV absorbance (UVA) are sometimes too high in water supplies, especially surface sources, for lower cost disinfection systems such as UV lamps. On some farms, the water will require the application of a pretreatment, such as coagulation flocculation (CF). The objective of this project was to examine the effect of water physico-chemical characteristics and temperature on the efficiency of coagulation flocculation of four surface sources supplying water to dairy farms in Eastern Ontario. Polyaluminum chloride (PACl) was used as the coagulant. For water sources with UVA remaining below 0.8 cm⁻¹, a single dose will be adequate throughout the year, but additional settling time should be provided in the winter when water temperature is below 8-10°C. For water with high variations in UVA, a simple online UVA sensor could be used to automatically control coagulant dose. The dosing system can also include a temperature sensor, but allowing additional settling time should be sufficient to adequately pretreat the water in cold temperature. There was no correlation between turbidity and coagulant dose, and UVA-based doses should apply to a relatively large range of turbidities (5 to 143 NTU).

USE OF FARM WASTE BIOMASS IN THE PROCESS OF GASIFICATION FOR ENERGY PRODUCTION

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CSBE100646 – The paper presents the process of gasification of waste biomass from farm production and the energy balance of the process. A novel technology of biomass gasification has been developed which meets all environmental requirements. Manure from poultry farms was used as the input material. The gas was purified in a membrane process in order to increase its calorific value and later used to feed an internal combustion engine powering a current generating system to produce electricity and heat in a cogeneration system (CHP).

APPLICATION OF INFRARED SPECTROMICROSCOPY TO CHARACTERIZE AND DETERMINE THE SPATIAL DISTRIBUTION OF LIGNOCELLULOSIC COMPONENTS IN AGRICULTURAL STRAW PELLETS

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CSBE100647 – Densification of low bulk density straw to high density pellets is critical for efficient and economic, handling, storage and transportation of lignocellulosic biomass. Traditionally, various physical parameters have been established to measure the quality (e.g. density and durability) of pellets produced. However, there is no information available on chemical structure and spatial distribution of lignocellulosic components in a biomass pellet. Therefore, a comprehensive study on quantitatively characterizing the lignocellulosic composition of agricultural straw pellets and their respective spatial distribution in the matrix using infrared spectromicroscopy was conducted. Infrared spectroscopy has the potential to produce qualitative and quantitative analytical data for samples with minimum or no sample preparation, and at high speed and throughput. This will enable one to identify the specific arrangement and distribution of lignocellulosic components in a high quality pellet (according to physical parameters) and possibly make changes to manufacturing processes that could provide the desired distribution of lignocellulosic components. In this study, the application of infrared spectromicroscopy on pellets produced from non-treated and steam exploded barley, canola, oat and wheat straw will be performed.

DESIGN OF A MECHANICAL RELEASE SYSTEM OF *PERILLUS BIOCULATUS* TO CONTROL THE COLORADO POTATO BEETLE, *LEPTINOTARSA DECEMLINEATA* (SAY)

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CSBE100650 – The Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say), is definitely a major insect pest of potato crops in North America, Europe, and Asia. Large amounts of chemical insecticides are used to control this pest. However, heavy reliance on these chemicals can often result on serious health and environmental problems. Also, the CPB has developed over the years a resistance to most of the registered chemical insecticides, including those that were very effective at one time. Consequently, most of the registered chemicals are not capable of effectively managing this insect pest on a long term basis. One of the most promising alternatives to chemical insecticides consists of taking advantage of the natural enemies of this insect pest. The use of the stink bug predator *Perillus bioculatus* to control the CPB has been successful on a pilot scale. However, this natural enemy is not abundant in nature and its hand release on large areas is not feasible. To remedy this problem, predators must be massively released in potato fields using a mechanical distributor. This represents a huge challenge because the predators are both very small and fragile. A mechanical distributor of predators has been designed and built at the Department of Soil Science and Agri-Food Engineering of Université Laval. In this distributor, masses of predators are placed in small containers and mixed with a carrier material. In the field, the containers are mechanically opened at different locations, based on a source-point mass [...].

HARVESTING FROM OUR FOOD WASTE - ECOLOGICAL TREATMENT SYSTEM FOR ANAEROBIC DIGESTED FOOD WASTE SLURRY

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CSBE100652 – About 25% of all food prepared in the US is wasted, most of which is currently disposed in landfills. As a more sustainable alternative, anaerobic digestion can extract energy contained in food waste in the form of biogas. Slurry from digestion contains high BOD, solids, ammonium and phosphorus that must be managed. An ecological treatment system (ETS) was constructed to remove some pollutants (BOD and SS), while conserving nutrients (N and P) as algal growth media, and producing harvestable value-added plants. The ETS consisted of two parallel vermifilters, a settling tank, and a vegetated aerobic reactor. Waste slurry for experiment came from a food waste anaerobic digester. To begin to develop empirical equations for ETS design, treatment efficiency was tested with 3 different hydraulic retention times (HRT): 100 days (d), 25d and 12.5d. Vermifilters, settling tank and vegetated aeration tank contributes to 20%, 8% and 72% of HRT, respectively. Under long HRTs (100d), BOD, SS and ammonium was removed at 99.5%, 99.0% and 99.8% rates. 25d HRT resulted in BOD, SS and ammonium was removal rates of 90.4%, 94.0%, and 92.0%. Short HRT (12.5d) test will be completed in December 2009. For purposes of post-treatment fertilizer use, 25.9% to 43.7% of removed ammonia was converted to nitrate in the ETS, and 4.9% to 12.8% of phosphate was maintained in the effluent. *Chlorella* algae were used to test effluent as algae growing medium; algal growth rates were high. [...].

DETECTION OF INTERNAL DEFECT IN PICKLING CUCUMBERS USING LASER SCATTERING IMAGE ANALYSIS

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CSBE100653 – Internal physical damage such as carpel separation or hollow centers in pickling cucumbers is difficult to detect by human inspectors, and the current inspection procedure would require cutting open the fruit, [...]. Our recent research has demonstrated that hyperspectral transmittance imaging technique can provide an effective means for internal defect detection in pickling cucumbers. However the technique is still expensive and cannot meet the speed requirement in commercial cucumber processing facilities. Therefore, an alternative technique using laser scattering imaging to inspect internal quality of cucumbers was investigated in this research. A diode laser with the center wavelength of 808 nm was used in the experiment. Fifty fresh pickling cucumber samples were subjected to mechanical load to simulate stress caused by mechanical harvesting and subsequent handling. Scattering images generated at 0, 30, 45, 60, and 80 degrees of laser incident angle [...] were acquired from the pickling cucumbers before and two hours after mechanical stress was applied. Image processing and analysis algorithms were developed and tested on the acquired images to distinguish defective from normal cucumbers. Detection accuracies decreased as the incident angle increased. The best detection accuracy of 96% was achieved with 0 degree incident angle. The laser scattering technique could provide a cost effective way for rapid detection of internal defect of pickling cucumbers.

PREDICTION OF THE MAX FLOW FOR THE MODEL SASIS: SENSIBILITY TO THE EMPIRICAL PARAMETERS OF THE FORM OF THE FURROW

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CSBE100654 – The model developed in this research presents effective mechanisms in the accomplishment of countless simulations, in a discharge strip understood between the minimum and the maximum allowable values, aiming to determine the relationship between discharge and water application efficiency, deep percolation and runoff rates, and consequently to optimize the performance of the furrow irrigation systems with continuous flow. The flow applied in each furrow must be adapted to its length, to the slope and to the nature of the ground. The authors studied the non erosive flow, in function of parameters obtained from the dimensions of the furrow being, ρ_1 and ρ_2 the coefficients, respectively, linearly and exponential, of potential functions that describe the relation between the area of the cross section of flow (or wet perimeter) and the height of the flow; this way, the multiplicative effect of ρ_1 in the area of the cross section of flow is linear, while of ρ_2 is exponential affecting, consequently having an impact on non erosive flow. A conjugated effect of ρ_1 and ρ_2 in the value of Q_{\max} was verified, in other words, the effect of a parameter depends on the effect of another parameter. The results of this inquiry demonstrate the importance of an estimate of the parameters of the geometry of the cross section of flow (ρ_1 and ρ_2) as precisely as possible, when it is known that the value of this section will produce impracticable values of Q_{\max} , based on acceptable literature belts, which varies from 1,2 to 4,0 L s⁻¹. This analysis of sensibility was also of great benefit and allowed the creation of an interface software SASIS, [...].

FLUX CHAMBER VALIDATION FOR AMMONIA MEASUREMENT VERSUS WHOLE ROOM EMISSION

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CSBE100656 – The design of a flux chamber affects accurate ammonia measurements from manure. The objective was to compare dairy manure ammonia emissions from a whole-room mass balance calculation (ventilation rate x gas concentration) versus emission measurements performed within that room using portable flux chambers. Assessment focused on two chamber measurement systems: a widely-accepted U.S. Environmental Protection Agency (EPA) steady-state flux chamber and a non-steady-state recirculation flux chamber designed specifically at Penn State for ammonia measurements from manure. To simulate naturally-ventilated animal building environment in the test room an air velocity of 0.3 m s^{-1} was established at 8 cm above the floor. During trials fresh dairy manure was uniformly spread over the room floor. Ammonia concentration (infrared photoacoustic analyzer) multiplied by room air flow rate (duct traverse of exhaust fan) calculation was compared with the ammonia emission rate calculated using accepted formulas appropriate for each flux chamber type. [...] The Penn State flux chamber offered more accurate emission estimates compared to the EPA device by measuring 90% to 119% of ammonia emissions of the whole room. [...] This work suggests that the EPA chamber method, although universally recognized in USA emission evaluations, is not as suitable for sources with high gas emissions (manure) versus its previous uses with lower emission sources (soil, industrial, etc.).

USING DATA MINING TO EVALUATE DIFFERENT MINIMUM VENTILATION SYSTEMS IN BROILER HOUSES

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CSBE100657 – This research analyzed a database of broiler houses climate data using data mining techniques such as attribute selection and data classification (decision tree) to model the impact of air quality and thermal comfort on broilers welfare. The objective was to evaluate four different minimum ventilation systems for broiler houses in relation to air quality and thermal comfort by studying ventilation systems. The study was carried out during the brooding phase with 1 to 14 days old broilers. The treatments were: T1: exhaust fans + curtains management on the end of the house (blue house), T2: exhaust fans + side curtains management (blue house), T3: exhaust fans + flag system (dark house) and T4: natural ventilation. The collected data were: [...] Four models were fit, one for each treatment. T1 model had a precision of 73.06%, a TP rate of 83.9% for Regular class having RH as root. T2 model had an 82.64% of accuracy a TP rate of 94.8% for Regular class having pHlitter as root. T3 model had 83.13% of accuracy a TP rate of 92.40% for Regular class having NH3 as root and T4 model had an accuracy of 84.27% a TP of 93.90% for Regular class having TempO as root. The results showed that T2 and T4 presented great percentage of predictive attributes classified as WELL in relation to BAD classification. Unexpected rules were generated by the data mining analyses.

OPTIMIZATION AND CONTROL OF A NOVEL UPFLOW ANAEROBIC SOLID-STATE (UASS) REACTOR

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CSBE100658 – The aim of this work was to investigate optimization and control strategies for a novel upflow anaerobic solid-state (UASS) reactor equipped with liquor recirculation. The UASS reactor converts solid biomass into biogas while the particulate organic matter (POM) ascends in the form of a solid-state bed (SSB) driven by the adherence of self-produced micro gas bubbles. Performance data and technical characteristics were obtained from a technical scale semi-automatic UASS reactor (400 L) operated for 117 days with maize silage under thermophilic conditions (55°C). In order to prevent an accumulation of volatile fatty acids, the process liquor was continuously recirculated through separate methanogenic reactors. During the experiment special emphasis was placed on the determination of gas and metabolite production. While the volatile solids (VS) loading rate was fixed at 5 g L⁻¹d⁻¹ the methane production rate of the UASS reactor stabilized between 1.5 and 2.0 L L⁻¹d⁻¹. The average VS methane yield of the maize silage was 380 L kg⁻¹. In respect to the control strategy, it was discovered that the liquor exchange plays a crucial role for the performance and stability of the digestion process. While low exchange rates can cause process failure by acidification, high exchange rates bear the risk of clogging inside the SSB. Based on the results, we conclude that the UASS reactor is a promising solution for the digestion of various organic materials.

BROILER GAS SPATIAL VARIABILITY ON DIFFERENT MINIMUM VENTILATION SYSTEMS

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CSBE100659 – The knowledge of the spatial variability of climatic attributes and the use of kriging maps can help livestock management of lodged animals. The objective of this research was to characterize the spatial variability of the ammonia concentration – NH₃ and carbon dioxide concentration – CO₂ in broiler houses during brooding phase (1 to 14 days old broilers) using geostatistics. Two different minimum ventilation systems were studied, such as treatment 1, exhaust fans + flags (Dark House) and treatment 2, natural ventilation. The studied attributes, NH₃ and CO₂ concentrations were sampled at 80 points, in regular spacing, as a grid at bird's height. According to the results, the geostatistical analysis showed that all studied variables were spatially dependent making it possible to find areas with different spatial distribution between both treatments and different studied ages. The maps illustrated that NH₃ and CO₂ concentrations in treatment 1 were greater near the exhaust fans (for 7 to 14 days old birds). On treatment 2, this greater concentration did not happen because of natural ventilation by the side wall curtains. As expected the CO₂ concentration increased with the age of the birds. The results showed inadequate levels (Globalgap, 2007) of CO₂ and NH₃ concentration in treatment 1 that had a greater thermal insulation and less openings when compared to treatment 2 where air changes occurred through the side curtains.

SEPARATION OF BENZOIC ACID FROM CRANBERRY JUICE BY USE OF NANOFILTRATION MEMBRANES

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CSBE100661 – Benzoic acid has been used widely in food industry and cosmetic industry as a preservative because of its antibacterial activity. Cranberry is rich in benzoic acid, about 100 ppm in the cranberry juice (10 °Brix). The concentration implies that if the excess benzoic acid in cranberry juice can be recovered at low cost, it will be a promising natural preservative. In this study, efficient conditions of nanofiltration for benzoic acid recovery from cranberry juice were investigated. Fifteen kinds of commercial nanofiltration membranes were tested with membrane test cell (C60F, Nittodenko, Japan) for checking benzoic acid separation ability from cranberry juice. Seven kinds of membrane (HC50, NFT50, G5, Desal-DK, DRA4510, UTC60 and NTR7250) showed relatively low rejection (less than 50 %) against benzoic acid while rejection against other components such as sugars, organic acids (citric acid, quinic acid and malic acid) and anthocyanins was high (more than 70 %). The effect of pH on the nanofiltration efficiency was also investigated. When pH increased from 2.5 to 4.5, the benzoic acid rejection decreased and negative rejection was observed with some membrane, while the rejection against other components was still high and increased with pH. Therefore, high separation efficiency was obtained at pH 4.5. The nanofiltration conditions for benzoic acid recovery from cranberry juice were clarified in this study.

INTENSIVE CULTURE OF AMUR STURGEON (*ACIPENSER SCHRENCKI*) FINGERLINGS IN A RECIRCULATING AQUACULTURE SYSTEM

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CSBE100662 – The present paper describes a recirculating system of Amur sturgeon fingerlings intensive culture. In the recirculating system of 120 m³ water and 19kg/m³ sturgeon culture density, we utilized a set of BAF-40 two-layer floating bead biofilter with 4kW power and 40 T/h flow, and some other components to treat the culture water for reuse. During culture period, pH, DO, turbidity, ammonia, nitrite and nitrate were recorded and the length and weight of culture sturgeon were measured. The results show that if water recycle is 3 hours and water exchange rate is 15% per day, the water quality is good and pH in 7~7.5, DO ≥ 5mg/l, turbidity ≤ 160 FTU, ammonia ≤ 1.16mg/l, nitrite ≤ 0.1~0.2mg/l, nitrate ≤ 21mg/l. After a 8 months of culture, fish survival rate was 80%, and they gained 5 times their weight. The recirculating culture system can be successfully used in Amur sturgeon fingerlings culture.

SHRINKAGE EFFECT ON MOISTURE DIFFUSIVITY CALCULATION DURING SUPERHEATED STEAM DRYING OF DISTILLER'S SPENT GRAIN

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CSBE100664 – The aim of this paper was to model the drying kinetics of distiller's spent grain (DSG) on an inert body in superheated steam (SS). The inert material was a Teflon sphere on which a thin layer of DSG was deposited. Drying curves were determined at SS temperatures between 110, 130 and 160°C and steam velocity of 1.0 m/s. The falling drying rate data were used to calculate the effective moisture diffusion coefficients from the Fick's equation for an infinite plate of the thickness of the DSG layer deposited on the surface of the inert body. The computer simulations were conducted at the diffusivity determined with no shrinkage and when the change in the layer thickness was due to shrinkage but with the diffusivity determined based on non-shrinkage conditions. Assuming no shrinkage took place, the values of effective moisture diffusivity ranged between 3.02×10^{-8} and 5.28×10^{-8} m²/s, while it was between 1.45×10^{-9} and 2.06×10^{-9} m²/s when a change in the layer thickness was due to shrinkage. Neglecting the shrinkage phenomenon during drying overestimated the diffusivity of DSG. The diffusivity coefficient determined for the best fit conditions for the experimental data ranged from 5.08×10^{-10} to 8.24×10^{-10} .

SHRINKAGE, DENSITY AND POROSITY CHANGES DURING SUPERHEATED STEAM DRYING OF DISTILLER'S SPENT GRAIN

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CSBE100665 – Computer modeling and simulation requires information on thermo-physical properties of the material being dried. These properties change during the course of drying affecting the validation results of computer simulations. Therefore, the objective of this paper was to investigate the effect of superheated steam (SS) on changes in physical properties of distiller's spent grain (DSG) during drying. The SS drying was conducted at temperature of 110, 130, 160°C and velocity ranging from 0.5 to 1.5 m/s. In particular, this paper examines the variability in the material's density, specific volume, porosity, volume shrinkage and surface area at various given moisture contents under the above drying regime. Image analysis was applied to measure the volume shrinkage and the surface area of DSG samples. Simple mathematical models were examined to correlate the above properties with the material moisture content. For comparison, the above properties were also measured during convective hot air drying at 110, 130, 160°C.

STUDYING DIFFERENT TYPES OF LEACHING MODELS IN TWO PILOTS LOCATED AT SOUTH EAST OF KHOOZESTAN PROVINCE

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CSBE100666 – In dry areas, such as Iran, where there are low precipitation and high evaporation, salt accumulation on soil surface is unavoidable. Therefore it is necessary to use an applicable method to estimate the water requirement for agricultural soil improvement. This study aims to draw desalinization and dealkalization curves and apply the best type of empirical leaching models for leaching salt and sodium of south east Khoozestan province. This study was conducted in two areas of Khoozestan state. For this propose, two experimental areas were selected and four treatments with three replications, were designed. The treatments included 25, 50, 75 and 100 cm water application. In addition of the above treatments, in the second area the above mentioned treatments were repeated with amendment matter (sulfuric acid). Eleven empirical models were compared using initial and final values of EC and Na. The results showed that the matter model was the best model with 83 and 85 percent coefficient correlation in pilot no.1. Meanwhile, in pilot no.2 the cubic model was the best model with 94 and 88 percent coefficient correlation. In this pilot when acid was used, the exponential growth, logistic, compound and inverse models with 88% coefficient correlation, showed maximum correlation.

REVITALIZING SMALLHOLDER IRRIGATION SCHEMES IN LIMPOPO PROVINCE OF SOUTH AFRICA

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CSBE100670 – Food production in Africa has to increase substantially to feed ourselves, and to provide for the expected future population growth. Most of the fields on communal owned farmland are not planted at all, while on many of those planted fields yields are poor in comparison to those achieved in commercial operations. In Limpopo province in South Africa 126 smallholder irrigation schemes were developed previously on communal land. The Limpopo provincial government supports the farmers by revitalising the schemes to encourage commercial production and establish sustainable agricultural farming units. Revitalisation of smallholder irrigation schemes is a social development with an input from engineering. The infrastructure requirements are informed by the production plan and the preferences of the farmers. Engineering is a service provider to revitalisation, but it does not own it because they spend the money. Three types of irrigation, namely overhead permanent sprinkler systems, centre pivot systems and drip irrigation systems were introduced on different schemes. Overhead sprinklers allow for covering of irregular field lay-out and production of high value cash crops such as potatoes, but automation is complicated and running costs are high. Drip irrigation systems are preferred for limited water and crop specific requirements, but are management and maintenance intensive. Centre pivot systems are easy to automate, allow for potatoes and have low maintenance and medium running costs, but are expensive when farmers insist to cover the historical footprint. A strategic cropping partner is involved to simplify the introduction of the business and production principles of commercial crop production.

THE EFFECT OF FAN FREQUENCY ON THE DROPLET SPRAYING SWATH OF AIR BLAST SPRAYER

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CSBE100673 – The range of droplet deposit is influenced by wind speed of air blast sprayer. Taking the D400 air blast sprayer as the experiment platform, the spraying experiment was carried out by using concentration of 1g/L solution being of mixed colorant Rhodamine-B with water instead of pesticide. Spray test sampling region was selected to be a sector in front of the cylinder, the centre angle and the radius were 38° and 18.5m respectively. 90 sampling points were set in the region. At each sampling point, a glass slide (7.5cm × 2.5cm) was placed to collected droplets. When spraying, the power supply frequency of fan was regulated from 50Hz, 49.5Hz down to 44.5Hz, in a step of -1Hz. Each spray testing period was 30s. The droplet depositing on sampling points was calculated using the fluorescence spectrophotometer. When spraying tests were conducted under variable frequencies of 49.5Hz to 44.5Hz, test results indicated: (1) When spraying directly, an average of 97.4% of the droplets deposited between two parallel lines shift away from the wind cylinder axes was ±2m. (2) When wind speed was less than 0.3m/s, the influence of the outside wind on the droplet deposition in front of the spout within 8m was quite small, but outside wind made the droplets in the area scatter away from the spout (>8m) drifting along the direction of the outside wind. (3) As the fan power supply frequency was reduce, the droplet transmission distance of air blast sprayer was shortened.

AERODYNAMIC MODELING OF WINDBREAKS IN SAEMANGEUM RECLAIMED LAND

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CSBE100677 – This paper discusses the quantitative effect of windbreaks on wind velocity in the reclaimed land at Saemangeum in South Korea. The effectiveness of windbreaks to reduce the velocity to prevent the generation and diffusion of dust are very critical. Using CFD simulations, the effects of porosity, height, and distance between the adjacent fences as well as the effect of tree windbreaks were investigated. A wind tunnel test was conducted and data gathered were used to develop and validate the CFD models. From the experiments and CFD simulations, the overall percentage difference of the measured velocities was 7.20% which is acceptable to validate the CFD models. In the case of tree windbreak simulation, the methodologies to model the real effect of tree windbreak were conducted and compared such as the application of tree porosity, inertial resistance and input velocity. Results have shown that a windbreak fence with porosity of 0.2 and a height of 0.6 m and constructed in array at 6 m distance between them is necessary. Initial simulation of tree windbreak also has shown that the effect of trees on flow fields using inertial resistance can be appropriate to model the real condition, although this should still be strongly validated in field studies or in wind tunnels. This study proved that CFD can be an effective tool to investigate wind flow affected by windbreaks.

RESEARCH ON WSN DESIGN AND FORMATION FOR DROUGHT MONITORING IN A TEA PLANTATION

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CSBE100679 – A wireless sensor network is a self-organizing network used to collect information from complicated geographical conditions. A wireless sensor network was designed and deployed in a tea plantation with the purpose of drought monitoring. The sensing nodes that were designed were composed of an ATmega128L micro-processor, a CC2420 transmit-receive module, an interface module and a solar cell based power supply. The TinyOS as well as the devices drivers were transplanted into the nodes. A WSNs gateway layout scheme based on ARM was demonstrated, which involves ARM920T micro controller S3C2410X as the kernel of the hardware platform, the storage system peripheral circuits, serial communication interface, Ethernet interface, serial-port extension unit and standard interface unit to be used for further linkage of other data transmission method. The networking experiments were conducted in a laboratory with Mesh Routing Protocol to determine the network performance under the scale of 5 nodes, 10 nodes, 15 nodes and 20 nodes. The performance of QOS (Quality of Service), including Packet Loss Rate (PLR), Retransfer ratio, and the Communication Link Quality, declined with network scale extensions. Simultaneously, the topology formation time, the topology stabilization time and the topology reconstruction time was prolonged. The entrance of a new node did little effects on routing performance of a steady-going WSN. Both random and deterministic deployments, diamond shaped deployment was chosen, of nodes were implemented in the tea plantation to be compared and analyzed. [...].

DEVELOPMENT OF A FAST MEASUREMENT METHOD FOR THE DETERMINATION OF AMMONIA EMISSION REDUCTION FROM FLOOR RELATED MEASURES

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CSBE100682 – New ammonia reduction measures based on new designs for floors or for the manure pit are in development for the cattle industry in the Netherlands. The effect of these systems could be investigated by measuring emission effects at floor level rather than from the whole barn, i.e. by comparing new floors and reference floors with flux chamber measurements. By doing this, the environmental potential can be determined faster and cheaper than by measuring whole barn emissions. In order to design an accurate comparison method, information is required on essential characteristics of the flux chamber measurement and spatial and temporal variation of floor emission. This paper describes experiments performed with a dynamic flux chamber in cattle houses to provide this information. Measurements were performed at three different (floor) places in the barn and at four air flow levels. Ammonia concentrations in the dynamic flux chamber reached equilibrium after approximately five minutes. The relation between ammonia emission and air flow was not linear: the emission rate slowed down for increasing air flow values. There was a significant difference in emission between measurements at different (floor) places in the barn (spatial variability). Measurements also showed a significant difference in ammonia emission between measurement days (variability in time), but not within a measurement day. [...].

MODELLING THE GROUNDWATER DYNAMICS AS INFLUENCED BY WATER MANAGEMENT IN HETAO IRRIGATION DISTRICT, UPPER YELLOW RIVER BASIN, AND PREDICTING IMPACTS OF FORESEEN WATER USE AND SAVINGS

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CSBE100684 – The upstream irrigation districts of the Yellow River basin are the highly productive agricultural area in North China. Due to the severe water scarcity, application of water-saving practices at both farm and district level is required for the sustainable agricultural development. An integrated methodology was developed on the basis of loose coupling the groundwater flow model (MODFLOW) and ArcInfo Geographic Information System to assess the impacts of irrigation water-saving practices and groundwater abstraction on the groundwater dynamics of the Jiefangzha Irrigation System in Hetao Irrigation District, upper Yellow River basin. The model was calibrated and validated with datasets of years 2004 and 2005, respectively. The model and corresponding methodology were then used to simulate the groundwater dynamics of the study area for various water-saving practices considering the groundwater abstraction foreseen for the year of 2020. Results showed that water-saving practices with 60% of canal lining and upgrading hydraulic structures, and upgraded irrigation technology in 50% of the area are feasible and it is a reasonable solution. Their implementation would reduce groundwater evaporation by 37 mm and the total diversions from the Yellow River by 208 mm.

ROUGH RICE STORAGE BELOW FREEZING POINT BY USING RENEWABLE ENERGY FROM FRESH CHILLY AIR IN WINTER

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CSBE100685 – A project was conducted to develop a new on-farm storage technique for rough rice at a temperature below freezing point by using renewable energy from fresh chilly air in winter. One thousand tons of rough rice was stored in two on-farm silos from the end of November and it was aerated through [rough rice] from bottom to top of the silos for 91 hours in January. The rough rice temperature in the silo fell below freezing point (minus 1.5°C on average). At the end of the storage period (end of July in the next year after harvesting) the temperature of rough rice in the center of the silo was still below freezing point (minus 0.5°C). The quality of the rice stored below freezing point was preserved at a level similar to that of freshly harvested rice. A combination of rice storage at a temperature below freezing point and utilization of renewable energy from fresh chilly air in winter enables the quality of rice to be preserved at a high level without the requirement of a cooling system or electricity. The new technique for storing rough rice below freezing point was named as super-low-temperature storage system. The use of this storage technique in cold regions of Japan has been increasing in recent years. In Hokkaido, the northernmost island of Japan, 28 rice grain elevators have been constructed for super-low-temperature storage since 1996. The storage capacity of rough rice in Hokkaido was 124,000 t at the end of 2007.

LIFE CYCLE ASSESSMENT OF AGRICULTURAL BIOGAS PRODUCTION SYSTEMS

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CSBE100688 – Climate change is one of the main challenges mankind has to face in the 21st century. Significant contributions to anthropogenic greenhouse gas emissions are caused by agricultural activities. One effective way to reduce agricultural emissions is the implementation of liquid manure to produce biogas. When applying this technique greenhouse gas emissions from manure storage are avoided and renewable energy in terms of heat and electricity is generated in combined heat and power plants. The objective of this study was to assess the environmental impacts of biogas production systems based on the methods of life cycle assessment. A comparison to the traditional use of agricultural manures and conventional energy production was included. A model was designed to evaluate the biogas production systems according their environmental impact using Gabi 4.3 software. Besides global warming potential other impact categories have been used for the evaluation of the effects of the systems in the field of eutrophication and acidification. The results show that environmental benefits can be obtained in regard to the emission of greenhouse gases when comparing electricity production from biogas with the typical German marginal electricity mix.

EFFECTS OF DIFFERENT CLUSTER TYPES ON TEAT CONDITION AND MILK RELEASE PARAMETERS

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CSBE100690 – In a joint project a standard cluster and a new innovative cluster were compared. The new cluster (AktivPuls, System Happel) is characterized by an innovative liner design. The vacuum shut off in the massage phase leads to a vacuum reduction at the teat under all milking conditions even with zero milk flow. In a 2 x 7 herringbone parlour the standard and the control group (137 animals in total) could be investigated for 127 days. Teat condition was assessed at five different occasions with the following parameters: teat skin condition, teat colour, ring formation, hardening and hyperkeratosis. The assessment of the teat condition was based on an international standard. For the calculation a total of 2181 teat assessments could be used. One-way and two-way analyses of variance were carried out with the actuating variable "day in milk" and "lactation". There was a significant improvement with respect to ring formation and hyperkeratosis. For the analysis of milk removal data two LactoCorder recordings were carried out. The investigations were carried out at the beginning and at the end of the project to gain information about total milk yield, rise, plateau and stripping-phase. Data from 75 animals could be used for one-way and two-way analysis. The first results show a highly significant effect of day in milk and lactation on some of the milk removal parameter. In addition two different models were used for optimized calculation of the data. The new cluster has a positive effect on the teat condition and [...].

USING PLANT MACROMOLECULES TO PRODUCE FLAVOR MICROCAPSULES BY SPRAY-DRYING MULTILAYERED OIL/WATER EMULSIONS

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CSBE100694 – Conventional oil-in-water emulsions could be considered as an important delivery system of lipophilic molecules because of their relative ease of preparation and low cost. However, these conventional emulsions generally suffer from physical instability when exposed to environmental stresses such as heating, chilling, freezing, drying, pH or ionic strength variation. Interfacial engineering was used in this work to produce spray-dried microencapsulated oil droplets containing flavor compounds. Pea proteins and pectin gave multilayered emulsions with a significantly higher stability to spray-drying process than emulsions stabilized by pea protein alone. To interpret these results, we propose that pectin, an anionic polysaccharide, formed a protective layer around the protein interfacial film surrounding the oil droplets that could improve their stability to spray-drying. In fact, the emulsions formed consist of oil droplets surrounded by multilayer interfacial coatings, which are comprised of an inner protein layer and an outer pectin layer. This second pectin layer was also effective to improve the protective efficiency of encapsulated food flavor compounds. On one other hand, results obtained in this study showed that the dextrose equivalent (DE) of the starch hydrolysates, used as drying matrices, had a marked influence on the microencapsulation efficiency. Therefore, glucose syrup (DE 28) could be recommended for the high flavor retention during spray-drying process as well as the ability to reconstitute emulsion with approximately similar droplet size. The plant macromolecules [...].

SIMULATION OF THE IRRIGATION FOR FURROW FOR THE MODEL SASIS: SENSIBILITY TO THE FACTORS OF SPACE CONSIDERATION AND STORM

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CSBE100695 – Surface irrigation systems are the most commonly used in Brazil and the in the world, mainly due to the low energy requirements and its operations easiness; however, these systems present low levels of performance, usually, as a consequence of inadequate design and management. Thus, the objective of this research was to develop a tool capable of optimization the continuous flow furrow irrigation performance, making successive simulations of the advance phase and respective prognostics of the performance parameters of the irrigation systems. The proposed model denominated SASIS, “Software Applied to Simulation of the Surface Irrigation”, and had its validation tested for different field conditions. Determined variables introduced in the model SASIS influence the results of the simulation of the irrigation for furrow with continuous flow was somewhat affected in an isolated form, the simulation, while in others the effect is conjugated as is the case of the factors of space consideration (ϕ) and time (θ), among the factors of space consideration (ϕ) used in the interval from 0.51 to 0.71 and time (ϕ) in the interval from 0.51 to 0.61 the software SASIS recommends values near of 0.60 for those two factors. The model presents effective mechanisms in the accomplishment of countless simulations, in a discharge strip understood between the minimum and the maximum allowable values, aiming to determine the relationship between discharge and water application efficiency, deep percolation and runoff rates, and consequently to optimize the performance of the furrow irrigation systems with continuous flow.

NUMERICAL SIMULATION OF A PIT EXHAUST SYSTEM FOR REDUCTION OF AMMONIA EMISSION FROM A NATURALLY VENTILATED CATTLE BUILDING

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CSBE100696 – Restrictions on ammonia emission from animal production are a growing challenge for farmers in many countries. Effective but still costly technologies for removal of ammonia from ventilation exhaust exits are limited to mechanical ventilation systems. Studies in mechanically ventilated pig units with slatted floor have shown that evacuation of a minor part of the exhaust air, beneath the slats, makes it possible to collect a relatively large share of the entire ammonia emission. And, in addition, cleaning of this minor part of the total air change is often sufficient to fulfill requirements for ammonia emission reduction. In this work CFD (Computational Fluid Dynamics) methods were used to investigate the potentials of transferring the experience from pig units to naturally ventilated cattle buildings. The analyses were based on a 2-dimensional cross section of a proposal for a 72 m wide well insulated milking cow barn. The developed CFD model included ammonia evaporation from slurry pits and from slatted floor, and it aimed to quantify the emission through the pit exhausts and through the openings in the building (in walls, roof and ridge) depending on outdoor temperature, wind speed and different adjustment of wall, roof and ridge openings. On a yearly basis under Danish weather conditions the results indicated that a pit exhaust system, treating 80 m³h⁻¹HPU⁻¹, has the potential to reduce ammonia emission about one third assuming fixed ventilation openings, and with controllable openings this figure will probably be above 50 percent.

WIRELESS SENSOR NETWORKS FOR ENVIRONMENTAL MONITORING IN PRECISION VITICULTURE

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CSBE1009698 – A Wireless Sensor Network (WSN) can be successfully used for environmental monitoring. WSNs represent nowadays one of the most exciting technologies. Data acquisition of environmental parameters by means of processing of satellite images to be used in Geographic Information Systems (GIS) and image analysis software is a time consuming process. The use of WSN currently promises to shorten time to acceptable margins. This paper shows the results of a research project developed in a vineyard of Castilla-La Mancha, Spain, where an experimental network was set up, consisting of 12 nodes with up to four different sensors measuring ambient temperature and humidity, soil moisture (water content and potential), soil temperature, photosynthetically active radiation. Data transmission follows the wireless ZigBee standard, due to its low power needs and simple networking configuration. The nodes can communicate with a gateway unit, which can transmit the information to other computers via LAN, WLAN or Internet. The results achieved in this project could help farmers use this new technology in modern grapevine growing. One key milestone was the development of a computer-based information system: a high-valued decision tool for the grapewine grower. The ultimate aim is to develop a full operational prototype for data acquisition and processing enabling the easy analysis of the data by the farmer. A better choice of grapes, leading to better wines, is the first step that wine-producers should consider, but an important constraint is the ease with which the systems can be deployed in an open field. [...].

CROP ROWS TRACKING BY DETECTING INDIVIDUAL PLANTS USING COMPUTER VISION TO GUIDE FARMING VEHICLES

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CSBE100699 – One of the uses of computer vision in precision agriculture is the assisted and automatic guidance of farming vehicles. Some experimental and commercial applications use satellite positioning (GPS), even beams of infrared light to detect the crop limit. The objective of this work was to develop a new computer vision system for detecting plant rows in crops without using Hough transform. This system could be applied to guide a farming tractor between rows while cleaning weeds with mechanical implements or spraying crops. A digital NIR (near infrared) camera with CMOS sensor and high resolution was used to acquire images in a continuous way. The camera was mounted on the front part of a tractor, looking forward with different inclination angles to obtain different perspectives. The system for acquiring and processing images was developed and automated with LabVIEW on a laptop. The tractor was driven through two different crops, sunflowers and peas. The individual plants in digital images were segmented from background soil using intensity information from NIR. Then a geometrical model was adjusted to the positions of the plants to detect seed rows. After correlating the rows found in different images of the same sequence, it was possible to predict the route of the vehicle in advance. Several tests were made with different perspective angles and it was shown that small angles (the camera [...]).

TRACTOR BASED SERVICES AND RELATED SUPPORT POLICIES IN DEVELOPING COUNTRIES

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CSBE100700 – Increasing agricultural production is of major concern to developing countries. It has been suggested that farm productivity is directly related to the farm power available which implies that significant increases in agricultural production can only be achieved through increasing power-based mechanization with two or four wheel tractors. To achieve such increases, the utilisation of existing agricultural machinery must be raised to economic levels by encouraging tractor owners to take a cross-sector approach and by providing tractor-based services to public/private sector enterprises in rural areas throughout the year. To realise this objective, it must first be ensured that a cross-sector market for tractor-based services exists and if so, to promote use of these services. This may be achieved through organising training workshops for tractor and machinery owners, creating service provider associations and establishing business linkage arrangements between tractor owners and rurally based enterprises. From the results of a market survey carried out in 1998 in three districts of Uganda, it was estimated that the annual demand for tractor services could be provided by about 97 tractors, so confirming the existence of a cross-sector market. Subsequently, a number of workshops for tractor owners were held which encouraged the start-up of a tractor-based service providers association. In addition, business linkage arrangements were identified in both the public and private sectors through the conduct of enterprise surveys. [...].

USE OF GAS CONCENTRATION DATA FOR ESTIMATION OF METHANE AND AMMONIA EMISSION FROM NATURALLY VENTILATED LIVESTOCK BUILDINGS

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CSBE100702 – Determination of emission of contaminant gases as ammonia and methane from natural ventilated livestock buildings with large opening is a challenge due to the large variety in gas concentration and air velocity in the openings. The close relation between calculated animal heat production and the carbon dioxide production from the animals have in several cases been utilized for estimation of the emission of ammonia and other gasses. Using this method the problem of the complicated air velocity and concentration distribution in the openings is avoided, but still there is considerable doubt about (1) the precision of the estimations (2) the requirement for the length of measuring periods, and (3) the required measuring point number and location. The purpose of this work was to investigate how estimated average gas emission and the precision of the estimation is influenced by different calculation procedures, different measuring period length, different measure point locations, different measure point numbers and different criteria for excluding measuring data. The analyses is based on existing data from a 6 days measuring period in a naturally ventilated, 150 milking cow building, and it shows that the methane emission can be determined with much higher precision than ammonia emission, and, for methane, relatively precise estimations can be based on measure periods as short as 3 hours. This result makes it feasible to investigate the influence of feed composition on methane emission in a relative [...].

WINERY DESIGN CRITERIAS FOR THE PRODUCTION OF VALUABLE WINE (DOC)

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CSBE100706 – Today the market requires wines with particular and constant organoleptic (flavor, acidity, etc.) and aesthetic characteristics (color, etc.). These wines depend not only on the quality of the grapes, but also by how they are collected, transported and processed in the wineries. We have performed a research in the province of Viterbo (Italy) where some wines have received the recognition of "value wines" (DOC). Examining the areas of grape production and some wineries, the research carried out has allowed the development of some general criteria for the design of wineries: the winery must be located in a central position with respect to areas of production so it takes less than 30 minutes to transport the grapes; if the grape farms are spread on the territory, it is necessary to establish stations for wine-pressing and to transport the product with refrigerated cars or to refrigerate the grapes before the transportation. The winery must be designed to allow: the cooling of the grapes when the temperature is above 20-25 ° C; the unloading as soon as possible; the immediate pressing of the grapes; every day full receipt of the must into a suitable number of wine fermenters; the protection of the wine apparatus from solar radiation. These are the first important rules elaborated for a correct winery design for valuable wine production.

RHEOLOGICAL CHARACTERISTICS OF ASSAI AND PASSION FRUIT SMOOTHIES FORTIFIED WITH UNRIPE BANANA PULP

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CSBE100710 – The determination of the food rheology is required in modeling and optimization of plant processes. In the food industry, juices are the most important liquids derived from fruits, so the characteristics of their flows have been a major topic of study in recent years. Ready-to-drink fruit beverages showed a growth of about 12% per year in Brazil, this increase was stimulated by the will to consume healthy drinks. Passion fruit juice has gained a special place in the juice market due to its intense exotic flavor, strong aroma (typically tropical), high acidity and efficient processed pulp. The assai, an exotic fruit from the Amazon, is rich in antioxidants and contains a variety of compounds associated to health benefits. Therefore, this project aims at determining the rheological characteristics of assai and passion fruit smoothies enriched with unripe banana pulp. Rheological properties and viscosity were determined by using a BROOKFIELD programmable rheometer, model DVIII. Results were evaluated using the software *STATISTICA version 8.0*. The evaluation of viscosity as a function of temperature corresponds to the Arrhenius model, which made it possible to determine the E_a (Activation Energy). The rheological behavior of smoothies followed the model of Herschel-Bulkley (HB).

INVESTIGATING CASE-BASED REASONING FOR ECOSYSTEM DESIGN

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CSBE100711 – Ecological engineering is applicable in many different situations, each with its own set of goals, obstacles, and conditions for which an ecosystem must be designed. [...] For such guidelines to be developed, the ability to qualitatively and quantitatively evaluate large datasets of information regarding ecological interactions and tools to aid in the design of ecosystems based off that information are both required. Thus, a project was undertaken to investigate the use of case-based reasoning (CBR) as a method of gathering and analyzing large sets of ecological data not only for prediction of the performance of design scenarios but for the purpose of design itself, a previously untested application. Simulation outputs from a number of randomly created virtual ecosystems and values for applied measures were compiled into a case base to test the capacity of a case-based reasoner to predict the results of several additional randomly created virtual ecosystems. The accuracy of the predictions made by the case-based reasoner varied, but they were more than 75% accurate 83.3% of the time. An initial attempt was made to apply this approach to “engineering” ecosystems for specified performance levels within the virtual ecosystem framework. While the targeted values of persistence were not obtained, the “engineered” virtual ecosystems were more persistent overall than the randomly created systems, with an average ratio of 0.40527 surviving species to initial species versus an average persistence of 0.20750 for the random systems. This is indicative of the potential of CBR for data analysis and ecosystem design for ecological engineering.

EXPLOITATION OF WIRELESS TELEMETRY FOR LIVESTOCK CONDITION MONITORING

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CSBE10712 – This paper investigates an adaptation of Wireless Sensor Networks (WSNs) to animal health monitoring. Multiple sensors are attached on each individual to monitor health condition or to study the animal's behaviour. However, the robustness of the sensor network cannot be guaranteed due to the limited transmission range on sensor nodes and the data sink as the animal mobility is considered. In this paper, two data collection approaches, router scheme and collector scheme, are proposed to enhance the network connectivity. Comparisons are also made between the proposed schemes and the traditional data gathering method with fixed base station (BS). The performance of the proposed design is evaluated through an 8-day trial field experiment.

DETERMINATION OF THE DAMPING COEFFICIENT OF COFFEE BRANCHES USING IMAGE PROCESSING TECHNIQUES

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CSBE100714 – The damping coefficient of coffee branches is a mechanical property used for simulating coffee fruit harvesting process. This property is an input in transient dynamic analysis when using finite element technique. The objective of this work was to develop a methodology to determine, in laboratory, the damping coefficient of coffee branches by using digital video and image processing of coffee branch vibration tests. The calculation of system damping ratio was performed by logarithmic decrement method. The oscillation decay process of the branches was recorded by using 1000 frames per second digital camera. Monitoring points were marked in each tested branch. Four control points, located in the image background and with actual known coordinates, were kept fixed in all tests. By using video and image processing tools, the coordinates, in pixel, of all control points were obtained for each frame. One interpolation function, based on the position of the control points, allowed the determination of the actual coordinates of the monitoring points. [...] The values of the damping coefficient were 0.03295 and 0.02041, and 0.02175 and 0.01942 N s m⁻¹, for Catuaí Vermelho and Mundo Novo variety, respectively. The proposed methodology worked well for determining the damping coefficient of coffee branches. The coffee branches of Catuaí Vermelho variety had greater values of damping coefficient, therefore dissipated more energy in vibration process than Mundo Novo variety.

IRRIGATION MANAGEMENT IN REAL TIME FOR ARUGULA CROP IN SERGIPE

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CSBE100715 – Irrigation management is a key to the success of vegetables crops. The present study was carried out to evaluate the productive responses of arugula (*Eruca sativa* Mill.) under four different irrigation levels: 50% of the reference evapotranspiration (ET_o), 75% ET_o, 100% ET_o and 125% ET_o, provided by an automatic weather station. The planting was done on December 16, 2008 through direct sowing in a nursery with a spacing of 0.1 m per 0.2 m, using a commercial cultivar called Folha Larga. After germination, management and thinning were carried out. The evaluations started from the 25th day after sowing with three subsequent evaluations on day 31, 37 and 43. The variables evaluated were: plant height (cm), number of leaves, fresh weight (g.m⁻²) and dry weight (g.m⁻²). The results showed significant differences for all variables at 5% of probability for the Scott Knott test. The conditions in which the experiment was carried out permit to infer that the irrigation exerted influence on these variables, and greater efficiency of water use was found for lamina on the basis between 75% and 100% of reference evapotranspiration.

DRYING CHARACTERISTICS AND NITROGEN LOSS OF BIOGAS DIGESTATE DURING DRYING PROCESS

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CSBE100724 – Digestate occurring during the fermentation of biomass in biogas plants contains high content of major plant nutrients like phosphorus, potassium and nitrogen. Due to the high water content of biogas digestate (90 – 97%) it is not economically justified to transport the digestate over longer distances. Reducing water content of biogas digestate by drying is an option to reduce volume and therefore alleviate transportation costs. However, during drying the digestate emits volatile compounds due to decomposition which are not yet sufficiently known in quality and quantity. Therefore, the objective of this study was to investigate the drying behavior and the change of digestate composition. Drying was performed in a hybrid solar/waste-heat dryer, which uses solar energy besides waste heat of a combined heat and power unit (CHP) and the exhaust air of a micro turbine. In this experiments 60 t of liquid digestate were applied. Climatic data were measured inside and outside the drying hall. Dry matter (DM) and organic dry matter (ODM) were measured on a daily basis. Furthermore, energy consumption of waste and solar heat were recorded and related to the quantity of dried feedstock. Chemical analysis of total nitrogen, ammonium, phosphate, potassium oxide, magnesium oxide and calcium oxide was undertaken before and after the drying process and losses of nitrogen were calculated. Specific energy consumption depended on the climatic conditions and most of the energy consumption was covered by the waste heat of the CHP. During the drying process a significant loss of nitrogen was observed.

THERMAL CONTROL OF HAZELNUT SUCKERS

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CSBE100726 – The emission of suckers in hazelnut (*Corylus avellana* L.) negatively affects crop management. Several applications are required to eliminate basal shoots every year with associated recurrent costs. Mechanical, thermal or chemical treatments can be used. A thermal control method was recently investigated. Its desuckering effectiveness was evaluated by applying an open flame in a hazelnut orchard. With this technique, a short blast of intense heat is carefully directed at the basal shoots keeping a short distance from the target. Flaming was carried out with two apparatus. The first equipment was a set of two handheld torches and the second was a tractor-operated orchard-vineyard type fitted with a set of 8 burners. The operative parameters for the handheld equipment were: LPG consumption of 1.8 kg/h per torch at a pressure of 0.1 MPa, 60 s or 30 s exposure time per plant. For the tractor mounted apparatus, the parameters were: LPG consumption of 20 kg/h at a working pressure of approximately 1.8 bar (0.18 MPa), treatment time was 10 s per plant. The effectiveness of the treatments was evaluated two weeks after their application. The single torch with a 30 s application resulted in high effectiveness. The 60 s application scorched vegetation excessively. The 8 burners 10 s application achieved good but not homogeneous results. Flaming is easy to use, requires low cost equipment and low fuel consumption. The handheld equipment allows the operator to intervene in a precise manner. The tractor mounted machine saves time but the orientation of the burners must be fine-tuned because heat must impact on suckers all over their length.

WATER VAPOR PERMEABILITY, CONTACT ANGLE AND WATER SOLUBILITY OF ZEIN BIOFILMS

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CSBE100733 – Zein is a corn protein with a degree of polymerization twice what is needed to produce linear polymers, thus, along with plasticizers, it has been considered to produce biomaterials. [...] Water contact angles are indicators of the surface hydrophobicity of the film and solubility is an important property because some applications require insolubility in water to maintain the integrity of the product. The objectives of this work were to produce zein-based biofilms with three types of edible oils (buriti, macadamia and olive oils) and determine the behaviour of the water interactions of the films and their compositions. As a control, pure oleic-acid zein biofilms were used and WVP, contact angle and water solubility were obtained. The WVP for films with buriti and macadamia oils have the highest values of 0.76 to 0.82 gmm/m²dKPa, respectively but with no statistical differences ($p < 0.05$) between them. Lipid particles dispersed on the surface of the films, observed by optical microscopy, could interfere on these results. The wettability characteristic could not be measured because of instantaneous absorption of the water droplets by those films. The initial value of contact angle for zein-oleic acid was $66.3 \pm 4.7^\circ$ and $33.9 \pm 2.1^\circ$ for zein-olive oil. The solubility of zein-olive oil film was also lower and accounted for $5.04 \pm 1.58\%$. Control films showed the lowest values for WVP, wettability and solubility, which implies that they were more hydrophobic than the others produced with edible oils.

MAPPING OF SOIL SALINITY AND CLAY CONTENT BASED ON ELECTROMAGNETIC INDUCTION MEASUREMENTS BY EM38

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CSBE100739 – The recent development in the field of electromagnetic induction (EMI) has made it easy to get rapid soil variability information, which can support precision agriculture. But the interpretation of the acquired ECa measurements is a complex process as ECa measurement depends on many influencing parameters. In this study the objective was to determine the main soil properties which influence the ECa measurement and to analyse the salinity levels after the 30 years of reclamation of salt affected areas in Wuqiao. Results show that for the irrigated sandy and non-saline fields, ECa maps correlate well with the cation exchange capacity (CEC) and the exchangeable cation such as Na⁺ (with R² of 0.89). The multiple linear regression (MLR) calibration model predicted ECe from EM38 readings with accuracy of R² ranging from 0.356 to 0.803.

POWER AND ENERGY REQUIREMENTS OF AGRICULTURAL MACHINERY DRIVEN BY TRACTOR USED IN GREENHOUSE VEGETABLE PRODUCTION IN TURKEY

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CSBE100740 – Power and energy requirement data is often used in machinery management. Farm system models often require power data to predict machine performance and fuel requirement. As seen in previous researches, many studies on the subject of power and energy requirements mostly concentrated on field crops production. However, the investigations related to energy use in greenhouse vegetable production are very limited. [...] This research was carried out in Antalya province which is in the centre of Turkey's greenhouse vegetable production. In greenhouse areas, mostly vegetables are cultivated in soil culture. In this research, power and energy requirements for agricultural machinery used for greenhouse vegetable production were determined and compared with the machinery used for field crop productions. In the production, some agricultural machinery is used in tillage and transportation operations like mouldboard plough, chisel, cultivator, rotary tiller and trailer driven by tractor. In greenhouse experiments, basic operational data are measured by a computer based data acquisition system. According to the results, the forward speeds of tillage machines, determined between 1.6 and 2.0 km/h, were lower than that of farm machinery used in field crops. Total power requirements of tillage machines were between 7.1-14.5 kW and that of trailer was 18.4 kW. Energy requirement of the rotary tiller (80.6 kW-h/ha) was greater than for the other tillage machines. The energy requirement values of moldboard plough, chisel and cultivator were 46.9, 38.2 and 30.9 kW-h/ha, respectively. Energy requirement per material mass during transportation operation was calculated as 0.53 kW-h/t.

UTILIZATION OF PLUG-IN AND CONTENT MANAGEMENT SYSTEM (CMS) AS TOOLS FOR DEVELOPING NATIONAL BIOSAFETY CLEARING HOUSE (BCH) APPLICATIONS: CASES IN ASIA AND LATIN AMERICAN COUNTRIES

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CSBE100741 – The Cartagena Protocol on Biosafety (CPB) under Article 20 requires that countries enter and manage their own data in a Web-based Biosafety Clearing House (BCH) Central portal (<http://bch.cbd.int>). The Secretariat to the Convention on Biological Diversity (SCBD) has developed two application tools called BCH AJAX Plug-in and HERMES Content Management System (CMS) to help meet the diverse needs of different countries in fulfillment of their Biosafety Clearing House (BCH) obligations by allowing them to select options that are useful and relevant to their needs and situations. The BCH Ajax Plug-in, a lightweight JavaScript application is a ready-to-use national BCH application while “Hermes” is an online CMS based on the Central Portal of the Biosafety Clearing House (BCH-CP) that includes a very simple and easy to use CMS that allows for the customization and localization of national BCH application. Relative to the two applications, the UNEP-GEF Biosafety Clearing House (BCH) project has packaged the training modules that aim to provide a practical “how-to” guide for countries to assist them in learning, understanding, using, and setting-up a national BCH using either Hermes CMS or BCH Ajax Plug-in. This paper discusses the development and utilization of AJAX and HERMES as tools in developing and maintaining National BCH applications in selected [...].

SOLVENT RECOVERY BY MEMBRANE FILTRATION FROM EXTRACT OF RASPBERRY MARC

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CSBE100742 – In the solvent extraction processes the usual way for the solvent regeneration is evaporation or distillation. These operations are energy consuming. Membrane separation processes are energetically more efficient, and since they are carried out at lower temperature the loss of valuable components can be decreased. The raspberry is one of the most cultivated fruits in Hungary. This fruit is rich in polyphenols, antioxidants, anthocyanins and linked to potential health protection against several human diseases. After the press valuable components which stayed in the fruit marc were extracted and then concentrated. In this study filtration and reverse osmosis (RO) were used for concentration and separation of solvent from solutions prepared by extraction of raspberry marc with ethanol (in different average). Extraction was performed by a conventional method for 2 h at permanent temperature. Extract solutions were collected. For clarifying a laboratory scale filtration equipment was used to remove suspended solids from the extraction solution. After filtration the clarified permeate was concentrated by RO, with a polyamide flat sheet membrane. The total soluble solid content and the density were measured, the total phenol and flavonoid compounds, the total anthocyanin and the total antioxidant capacity of samples were determined after the filtration by analytical methods and HPLC. The results of analytical methods showed that the separated solvent did not contain valuable components and the solid content therefore can be reused in the extraction process. A combination of (membrane) filtration processes was appropriate for the concentration of the valuable compounds from extracted solutions [...].

A META-ANALYSIS OF WEATHER EFFECTS ON CORN NITROGEN FERTILIZATION REQUIREMENTS

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CSBE100746 – Meta-analysis is an expression used to identify a set of statistical techniques developed to provide an objective comparison of research results from independent studies. A meta-analysis combines the results of several studies that address a set of related research hypotheses. In this study, a meta-analysis was performed on the relationship between the application rates of nitrogen fertilizer and the corn yield response in order to understand the effects of climate (air temperature, rain) and environmental conditions (latitude, soil surface textures). The database was constituted by publications from Africa, Europe and America published between 2000 and 2009, inclusively. The response ratios (RR) used to measure effect size indicated significant positive response of corn yield. The climate influenced nitrogen requirements. Corn grown on silt clay loams, and to a smaller extent on silt loams, was more responsive to added N. The latitudes from 39°N to 42°N were the most favourable to corn N response. During the first two months of corn growth, the effect of rain evenness on N response was larger than that of temperature or precipitation. For the mid-season period, the effect of precipitation was higher than the ones of temperature and rain evenness. For the last part of the growing season, all three factors were of equal importance for N response.

ODOUR CONTROL ON PIG FARMS BY BIOFILTRATION

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CSBE100747 – The growth of pig industry has caused a greater problem of undesirable odours, particularly in and around production buildings, storage areas and when the pig manure is spread. Even though there are over 150 volatile combinations in pig manure, the main components are methane, carbon dioxide, ammonia and hydrogen sulphide. According to their detection limit and their olfactory character, ammonia and hydrogen sulphide have been identified as being good indicators to monitor odours emanating from the treatment of pig manure. Increasingly stringent environmental standards, constantly growing public awareness of environmental problems and the conflicts associated with living with unpleasant odours, have led to enhanced research into various alternatives for treating pig manure in different countries. One alternative, the organic bed biofiltration, is a very promising technology for the deodorization of gaseous and liquid effluents in reducing the overall odour problem at the farm (building, storage, spreading). Given the potential of this technology, large scale research and development work has been conducted on a 150-sow farrow-to-finish operation on Île d'Orléans (Québec, Canada) using an industrial biofiltration system of 560 cubic meters total volume (primary biofilter: 400 cubic meters, polishing biofilter: 160 cubic meters). This work aimed to demonstrate the overall efficiency of biofilters to reduce odours in terms of foul air coming from the livestock buildings and manure produced. The results obtained during the long-term monitoring of the technology's purifying performance (6 years), show that the system installed on the farm offers a purifying efficiency of over 95% for NH₃. The measured elimination performances exceed 99% for H₂S. System efficiency is maintained at around 80% - 85% for odour intensity reduction. Moreover, foul air and raw manure [...]

CHARACTERIZATION OF LOW UVT LIQUID FOODS AND INGREDIENTS FOR ULTRAVIOLET PRESERVATION

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CSBE100748 – Ultraviolet (UV) processing holds promise as a low cost non-thermal alternative to heat pasteurization of liquid foods, drinks and ingredients. The application of UV technology for foods is still limited due to their low UV transmittance (UVT). In addition, low UVT foods have a diverse range of chemical (pH, Brix, Aw), physical and optical properties that are critical for optimal systems and process design. Food optics is the major impact on UV transmission and consequently microbial inactivation. Physical properties (viscosity, density) influence momentum transfer and flow pattern in the reactor. This paper aims to discuss properties of selected fresh juices, milk and protein ingredients that are critical for the design of a UV pasteurization process. Differences in regulatory pasteurization requirements will be presented. Three approaches including dilutions in standard cuvettes, micro-path cuvettes and integrated sphere (IS) were evaluated. The absorbance spectrums in UVC range of 200-400 nm, absorbance at 254 nm were measured and absorption coefficients (α_{10}) were determined. Tested juices (apple, carrot and orange), milk and liquid whey proteins represented different groups of UVT, pH, Brix and viscosities. For example, apple juices belong to the group of high acid semi-transparent UVT. The apparent α_{10} of four brands of apple juice varied from 39.1 cm⁻¹ to 7.1 cm⁻¹ and correlation with vitamin C was observed. Carrot juice and milk were close to opaque low acid liquids. The observed differences showed the importance of full characterization of low UVT foods to design model liquids, preservation process and as input data for modelling UV process using CFD.

PROBLEMS AND CRITERIA FOR RECUPERATING PERIPHERAL URBAN AREAS: THE CASE OF THE APPIA-PIGNATELLI AREA

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CSBE100750 – In the last decade a growing number of areas have formed on the outskirts of cities where farms, residential estates and industrial areas are combined and are often the source of environmental degradation and unauthorized house building. This research focuses on the problems and the difficulties farms face in carrying out their daily tasks concerning both production and how to safeguard the surrounding landscape and environment. These areas can only be salvaged socially and environmentally by using farming to advantage but farming activity will have to be restructured in order to make good use of the opportunities that the proximity with the urban areas offers. For this reason some guidelines were determined to aid the relaunching and utilization of farming in these areas aimed at the recovery of the landscape and environment. A suburban district of the city of Rome including the archaeological park of the ancient Appia Roman road was analyzed for this study and these guidelines were used for elaborating a retraining project based on the relaunching of agriculture. An economic analysis showed that there were good prospects for economic gain in outlining a policy for the safeguard and utilization of this territory based on these principles.

EVALUATION OF NOVEL HIGH INTENSITY PULSED UV SOURCES FOR PROCESSING FOOD BEVERAGES

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CSBE100751 – Ultraviolet (UV) technology has potential to become a novel non-thermal method for minimal processing of liquid foods. Presently a monochromatic low pressure mercury lamp (LPM) is mainly applied for UV treatments. The efficiency of novel high intensity pulsed (PUV) lamps is potentially greater than LPM due to high intensity and broader spectrum that may penetrate low transmittance UV liquids like foods. Performance of three PUV sources with various energy per pulse of 31 J (PUV-1), 344 J (PUV-2) and 644 J (PUV-3), was evaluated measuring effects on pre-selected markers in apple juice, milk and 30% fructose solution. Color, pH, soluble solid content, viscosity and absorption spectrums were measured. Vitamin C and enzyme activity of polyphenol oxidase in apple juice and alkaline phosphatase in milk were determined. LPM lamp was used as a baseline for comparison. The effects of pulsed lamps PUV-1 and PUV-3 on the beverage properties were comparable with the LPM lamp. For example pH of fructose decreased by 2.98% for LPM lamp and by 3.18% and 4.51% for PUV-1 and PUV-3 respectively. Vitamin C content was reduced by 2.41% in apple juice and 35% in milk for LPM, while reduction of 1.24% (PUV-1) and 2.01% (PUV-3) in apple juice, 26% (PUV-1) and 24% (PUV-3) in milk was observed for pulsed lamps. PUV-2 lamp caused higher loss of vitamin C in apple juice (10%) and milk (35%) and reduced pH of fructose by 6.02%. These results indicate that PUV lamps constitute promising alternative for non-thermal treatment of beverages that shorten processing time.

EFFECT OF HIGH HYDROSTATIC PRESSURES ON DRYING KINETICS OF BLUEBERRIES VARIETY O'NEIL

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CSBE100753 – The main aim of this research was to study the effect of high hydrostatic pressures before hot air drying during matter transfer of blueberries variety O'Neil in comparison to three pretreatments commonly used in drying kinetics. The samples were subjected to the following pretreatments: enzymatic (Pectinex 8% v/v at 50°C for 30 min), sodium hydroxide (1.5% w/v for 10 s), microwave (power 1500 W for 10 sec), high hydrostatic pressures (HHP) (350 MPa for 30 s) and with no pretreatment (only drying at 70°C). The drying experiments were carried out using a convective dryer at 70±0.2°C with an air flow rate of 2.0±0.1 m/s. All the experiences were carried out in triplicate. The equations of Modified Page, Wang & Singh, Modified Henderson-Pabis, Logarithmic, Two Terms and Fick's second law were applied in the study and in the modelling of the drying kinetics of this fruit. All pretreatments decreased considerably the drying time of 780 min (no-pretreatment) to 480 min, the HHP and Enzymatic pretreatments having the shortest processing time (420 min). Logarithmic and Wang & Singh models gave the best fits for each drying curve, based on the statistical test determination coefficient, sum square error and Chi-square. In consequence, both models are excellent tools for estimating the drying time of this product.

SIMULATION MODELS TO OPTIMIZE INPUT ENERGY IN MEDITERRANEAN GREENHOUSE PRODUCTION

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CSBE100754 – Simulation models can be useful for reducing the cultivation costs and the environmental impact of a greenhouse. This research was carried out to elaborate a mathematical model for simulating plant growth. This model predicts quite accurately the response of the plants to the most important climatic parameters (air temperature, solar radiation, etc.) and to energy inputs. The model was used for estimating plant production inside a greenhouse covered with plastic film (Mediterranean greenhouse) under different minimum values of inside air temperature and in several seasons. The results of the simulation clearly show the relationship between the minimum value of the air temperature and the energy input required and this relationship is very important for choosing the timing of the crop during the year. The further one gets from the optimal time of the cultivation the greater the number of energy inputs required. In particularly adverse conditions it may be necessary to add artificial lighting even in Mediterranean regions. This model enables us to establish quite accurately the best timing of the crops during the year and to define heating, ventilation and artificial lighting. Bearing in mind the energy costs and the market prices of the produce, it is possible to optimize the choice of crops to be grown and find their best time sequence without compromising the sustainability and the economic performance.

ELECTRONIC CANOPY CHARACTERIZATION AND REAL-TIME VARIABLE RATE DOSING FOR CROP PROTECTION IN PRECISION FRUITCULTURE: EFFICIENCY INCREASE AND DRIFT REDUCTION

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CSBE100755 – Adjustment of dosage of crop protection products has been an important issue in the past 20 years. Recent increase of robustness and decrease in costs in electronics allows the adoption of new technologies to solve old problems. Since 2002, a research group composed of research centers from Catalunya and València has been developing tools to better characterize canopies and to improve foliar application of plant protection products in the framework of PULVEXACT and OPTIDOSA projects. One of the objectives of these projects is to reduce excessive dose rates by means of increasing efficiency of applications and decreasing losses to the ground and drift. To this purpose, canopies are characterized by means of ultrasonic or lidar sensors both in post-process and real-time modes. Lidar sensors are much more accurate and information such as leaf area surface and leaf area density can be estimated from its data. The electronic canopy characterization system has been boarded in a sprayer prototype in order to adjust the dose rate in a continuous variable rate real-time mode. The canopy is scanned every 10 or 20 cm along the row and the spray flow rate varies accordingly. The eight variable rate treatments analyzed showed an increase in efficiency from 1.37% to 57.13% and a reduction in total losses (ground and drift) from 5.13% to 55.72%. Results show that it is possible to achieve more efficient applications by reducing overdosed zones in the canopy and drift in a clear example that engineering can contribute to a more sustainable agriculture.

AGRICULTURAL FLEET MANAGEMENT: A SYSTEM APPROACH

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CSBE100756 – The structural development and the imposed requirements within agriculture together with the introduction of sensors, actuators, software, on-board networking and auto-steering technology is gradually transforming conventional agricultural vehicles into supervised semi-autonomous machines which can traverse fields, turn at headlands and control implements automatically. Therefore, it is both imperative and technologically feasible to plan and coordinate the execution of field operations by fleets of modern agricultural machines optimally. In order to analyse the complex situation of how to develop an effective fleet management system, a conceptual model was developed. This involved using soft systems methodology (SSM) and a participatory approach involving users and stakeholders as providers of expected requirements for a proposed fleet management system (FMS) of tomorrow. The proposed system involves a management system on a farm/contractor level to support real-time management decision-making of mobile units, by means of automated acquiring and contextualising of operations data and external parameters to form a foundation for decision-making improvement of the quality of decision-making and reduce the time efforts. A holistic view and scope of the system is presented together with the system's constraints.

DEVELOPMENT AND VALIDATION OF A SIMPLIFIED METHOD TO QUANTIFY GASEOUS EMISSIONS FROM CATTLE BUILDINGS

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CSBE100758 – Obtaining representative gaseous emission factors from livestock production requires measurement methods adapted to a high number and a great diversity of livestock systems, including naturally ventilated buildings. The objective of this study is to propose such a method for cattle houses, based on livestock-related data (e.g., feeds, production, effluents) and intermittent measurements of gas concentrations (H₂O, CO₂, NH₃, CH₄, and N₂O), temperature, and relative humidity. These data were used to estimate gas-concentration gradients and mass-balance deficits of C, N, and H₂O). Emissions were calculated using the ratios of gas-concentration gradients. For quality control, the results were validated with water-budget observations and simulation model predictions of CH₄ and CO₂ emissions from cattle. During summer 2007, measurements were performed in seven types of barns commonly found in France. For buildings with slurry evacuated twice a day, good agreement was found between CO₂ and CH₄ emissions estimated with the simplified method and those predicted from models of cattle emission. For these buildings the observed emissions were homogeneous. For buildings with deep litter, observed emissions of CH₄ and CO₂ were higher than the predicted emissions. The difference indicates that a part of those gases was emitted by manure. Additional data and models should be used to improve this method for deep-litter systems. Data analysis continues to evaluate the method during winter [...].

FARMERS MITIGATION AND ADAPTATION OPTIONS TO SALINITY IN SICILY (ITALY)

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CSBE100759 – Groundwater salinisation is a growing issue in Italian coastal areas. Agriculture plays a crucial role by increasing water extraction and consumption especially in areas where intensive irrigated horticulture is widespread. In areas close to the coastline, aquifers over-exploitation can often cause salt water intrusion. Groundwater increased salinity affects productivity of irrigated crops and in the long term could contribute to secondary soil salinisation. Nevertheless, in some areas salinity has been conditioning agricultural productions from decades, but farmers are still able to cultivate by actively managing soil and water resources. An example is Licata plain, in Sicily, where farmers have been undertaken to adopt multiple strategies to mitigate salinity effects and adapt. Water salinisation in the plain is the result of complex interactions. Not only are cultivated areas close to the sea, but the plain is crossed by the Imera River whose water shows high levels of salinity. The river water chemical composition is determined by the solubilization process of gypsum rocks that are widespread along the river basin. Intensive agriculture is increasing pressure on soil and water resources and farmers have thus to deal with the damages they are causing. Farmers have been adapting for decades to high soil and water conductivity by adopting a mix of strategies that include crop and cultivar choice, rotation, irrigation methods, water storage, water mix, and desalinisation. A survey of farmers [...].

VISION-BASED WEED IDENTIFICATION WITH FARM ROBOTS

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CSBE100761 – Robots in agriculture offer new opportunities for real time weed identification and quick removal operations. Weed identification and control remains one of the most challenging task in agriculture, particularly in organic agriculture practices. Considering environmental impacts and food quality, the excess use of chemicals in agriculture for controlling weeds and diseases is decreasing. The cost of herbicides and their field applications must be optimized. As an alternative, a smart weed identification technique followed by the mechanical and thermal weed control can fulfill the organic farmers' expectations. The smart identification technique works on the concept of 'shape matching' and 'active shape modeling' of plant and weed leaves. The automated weed detection and control system consists of three major tools. Such as: i) eXcite multispectral camera, ii) LTI image processing library and iii) Hortibot robotic vehicle. The components are combined in Linux interface environment in the eXcite camera associate PC. The laboratory experiments for active shape matching have shown interesting results which will be further enhanced to develop the automated weed detection system. The Hortibot robot will be mounted with the camera unit in the front-end and the mechanical weed remover in the rear-end. The system will be upgraded for intense commercial applications in maize and other row crops.

MEASUREMENTS OF AIR VENTILATION RATES IN NATURALLY VENTILATED DAIRY CATTLE BUILDINGS

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CSBE100762 – Animal husbandry is a major source of methane as well as ammonia. The quantification of emissions from livestock buildings with natural ventilation is a particularly difficult task and it is associated with uncertainties which are largely unknown. The main issue is the determination of the ventilation rate. Therefore, air volume streams were determined simultaneously by two different methods and compared with each other. Five field studies each lasting approximately four weeks during three different seasons have been conducted to study the air volume streams from a naturally ventilated building for dairy cattle in Northern Germany. The air volume streams were determined on the basis of the carbon dioxide (CO₂) balance method and by the decay of the radioactive tracer Krypton-85. During each field campaign continuous measurements of gas concentrations within and around the building and two to six tracer gas experiments were carried out. Both methods delivered high ventilation rates about 1,000,000 m³ h⁻¹ as an overall average. These high air volume streams were driven by complete open sidewalls and openings at the gable walls of the investigated building. The CO₂ balance method is a quasi-continuously estimation of the ventilation rate whereas the Krypton-85 tracer gas measurements are discontinuous. However, both methods showed large scatter for the single measurement periods and should be further developed.

POTENTIAL SOIL CONTAMINATION UNDER FREE STALL DAIRY BARN USING EARTHEN BASE STALLS WITH SAND BEDDING

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CSBE100764 – Numerous dairy barns are currently built to use sand bedding. The stall platform can be built with concrete, packed stone, earth fill or other base materials. There is currently little knowledge on the risk of sub-base soil contamination by urine or faeces after usage. Considering the daily removal of sand and the deep bedding concept used for this stall design, the global objective of the project is to study the vertical migration of contaminants in various sand bedded stalls. Two 200 cows free stall dairy facilities have been instrumented to collect sand bedding and sub-soil samples over a five year period. Six stalls per barn with 4 locations have been selected. Total nitrogen, ammoniacal nitrogen and total phosphorus are the selected parameters.

SIMULATION OF HEMP FIBRE BUNDLE AND CORES USING DISCRETE ELEMENT METHOD

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CSBE100767 – Demands for high-grade hemp fibre are increasing for various industrial applications. To obtain high-grade fibre, it is important to understand the mechanical behaviour of hemp fibre and core. Modelling using discrete element method is a promising approach to simulate mechanical behaviour of any materials, including hemp fibre and core. In this study, a commercial discrete element software, Particle Flow Code – Three Dimension (PFC^{3D}) was used to simulate hemp fibre and core. Because the basic PFC^{3D} particles, named “balls”, are spherical. Individual virtual hemp fibres were defined as strings of balls held together by PFC^{3D} parallel bonds. The results showed that the resulting virtual fibre was flexible and could be bended and broken by forces, which appropriately reflect the characteristics of hemp fibre. Using the clump logic of PFC^{3D}, the virtual hemp core was defined as a rigid and unbreakable body, which reflect the characteristics of the core. The virtual fibre and core were defined with several microproperties, some of which were previously calibrated. The five PFC^{3D} bond properties including normal and shear stiffness, pb_kn and pb_ks ; normal and shear strength, σ_c and τ_c and bond disk radius, R of the virtual fibre were calibrated in this study. The calibration started with developing a PFC^{3D} model to simulate fibre tensile test. The microproperties of virtual fibre and core were calibrated through running the PFC^{3D} model. The simulations were compared with literature data from fibre tensile tests. [...].

DECORTICATION OF HEMP (*CANNABIS SATIVA*) FIBERS USING DROP WEIGHT IMPACT: FIBER YIELD AND PROPERTIES

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CSBE100768 – Hemp (*Cannabis Sativ L.*) is an important lignocellulosic raw material for the manufacturing of cost-effective environmentally friendly composite materials. However, traditional decortication processes using hammer mill, cutterhead or crushing rollers often generate low fiber purity, do not allow for an entire separation of fiber from cores. These machines also have high energy requirements. In this study, a decortication processing of hemp was conducted to mainly improve the fiber yield. A lab-scale drop weight impact test was used to separate hemp fibers from cores. The hemp stalks were from the hemp variety of USO 31 produced in Manitoba, Canada. There were two groups of hemp stalks: unretted and retted. Before decortication, the hemp stalks were cut into a length of 40 mm. The hemp stalks were decorticated using a hammer and a mold under without sieving and with sieving conditions at different impact energy levels: 254, 508, 763, 1017, 1271, and 1525 J. Fiber yield and effectiveness of impact tests were determined following decortication. Results showed that impact energy level and sieving conditions affected fiber yield and separation effectiveness. Higher impact energy and more sieving allowed for a greater separation of fiber and resulted in greater fiber yields. [...].

THEORETICAL ANALYSIS OF ENERGY REQUIREMENT FOR HEMP DECORTICATORS

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CSBE100769 – Hemp fibre is a renewable natural material which has been used in a wide range of areas. With the increasing need of high quality hemp fibres, various processing methods have been developed during the past decades. Decortication is a core procedure during fibre processing. Currently, the decorticators such as hammer mill and roll crusher are used both for laboratory research and commercial production. However, the selection of most machines and operational parameters for decorticators is based on experience and trials, and is mainly focusing on fibre quality and productivity improvement. Energy consumption is possibly high due to inefficient design. Little research has been conducted on decorticator's energy requirement. Lack of systematic theory in this aspect makes it difficult to efficiently develop better machines and optimal processing methods. This study constructed a theoretical analysis of energy requirement for hammer mills and roll crushers as the decorticators in hemp fibre processing. The estimation of energy requirement provided by the theory will help future improvement of decortication machine. The long term objective of this study is to extend the estimation of energy requirement for the decorticator to the whole processing line so that improvement of energy consumption for the entire fibre process is achieved.

INTERMITTENT MEASUREMENT TECHNIQUE TO ESTIMATE AMMONIA EMISSION FROM MANURE STORAGE

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CSBE100773 – More than 90% of ammonia emission originates from agricultural and about 97% of the emission from agriculture originates from livestock and related activities. About 50% of the livestock emissions originate from the livestock buildings and manure storage. The production of animals has to comply with several environmental requirements. The monitoring of ammonia emission out of agricultural buildings and storage systems is one of them. A condition for effective monitoring is the availability of a cheap measuring technique, which is not available for the moment for the storage systems. Nowadays, for mechanically ventilated barns, intermittent measurement technique is used. It is based on continuous monitoring of easily measureable variables such as ventilation rate, temperature, and animal's weight and number together with intermittent measurement of ammonia emission rate at six well selected days per year. The easily measureable variables allow to model ammonia emission rate continuously. The latter one is used to calibrate the model regularly. Unfortunately, for naturally ventilated agricultural buildings and manure stores, intermittent measurement technique has never been tried due to lack of reliable ventilation rate measurement system which provides accurate estimation of ammonia emission rate. The main objective of this paper is to represent a procedure to determine the ammonia emission from manure storage systems in the field, based on intermittent measurements technique. In this study, two experimental tanks were filled with fattening pig slurry; one of them was covered with a mechanically ventilated cover. [...].

EVALUATION OF AN EARTH HEAT STORAGE SYSTEM IN A SOLAR ENERGY GREENHOUSE

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CSBE100776 – A solar energy greenhouse stores solar energy in the north wall as well as in the floor (soil) during daytime and releases the stored energy back to the greenhouse at night. An earth heat storage system was constructed and tested in a solar energy greenhouse for enhancing energy storage. The system consisted of a network of perforated pipes berried in the soil at depths from 0.3 to 1 m. A fan drew the warm air near the greenhouse ceiling to the berried pipes. A network of thermocouples was installed to record soil and air temperatures at various locations. Energy balance analyses were conducted to evaluate the effectiveness of the earth heat storage system. The temperature profiles in the soil were analyzed to determine the recharging (summer) and energy depletion (winter) behaviour of the system.

DETECTION OF FUSARIUM DAMAGED KERNELS IN WHEAT USING HYPERSPECTRAL IMAGING

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CSBE100777 – Fusarium head blight is a disease of wheat, barley, oats and other small cereal grains. This disease reduces yield and grade and may also contaminate the grain with fungal toxins such as deoxynivalenol (DON). Fusarium damaged kernels (FDK) with a severe level of infection are typically characterized by thin or shrunken chalk-like appearance, which can be readily identified by human visual inspection. Kernels with mild infection, however, are extremely difficult to recognize by human inspectors. [...] Fast and accurate instrumental methods are required to meet the needs of grain industry. In this study, the use of hyperspectral imaging was investigated for detecting FDK in Canadian wheat samples. Samples of CWRS wheat grown in different regions were collected from which 600 individual kernels were picked representing three levels of FDK namely sound, moderately damaged and severely damaged. These kernels were imaged with a hyperspectral imaging system in the 400-1000 nm wavelength range. Average spectra from individual kernels were extracted to develop partial least squares discriminant analysis (PLS-DA) models for predicting the extent of Fusarium damage. A PLS-DA model classified the wheat kernels into three classes with an accuracy approaching 90%. Accuracy for 2-class (sound & FDK) segregation was better than 95%. Hardware implementation of the proposed method can provide a signal for automatic removal of FDK from wheat shipments thus improving overall grade and value of grain.

DETERMINATION OF PRESSURE DISTRIBUTION IN AN AERATED BED IN A CONTROLLED PILOT-SCALE COMPOST REACTOR

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CSBE100778 – Composting biological waste is one of the most effective methods of its utilisation. Many studies have been carried out around the world into the possibility of utilising such materials as biological fractions of municipal waste or farm production waste. Studies into the possibility of recovering excess thermal energy produced in the process of composting biological waste requires the determination of the parameters of mass and energy transport stream in the aerated compost bed. A 100 dm³ adiabatic, leak-tight reactor, equipped with a controlled aeration system, was made for the experiment. The system enabled determination of the temperature and pressure distribution in the bed under examination. Sensors allow for determination of the amount and humidity of emitted gases under variable external physical conditions. Owing to the fact that bed aeration is carried out through the perforated bottom of the reactor, the mass (humidity) and heat are transported upwards, forced by the air pumped in and by natural convection. It would be extremely useful to know the pressure distribution inside the composted and aerated bed. The results obtained in the experiment have demonstrated the existence of significant differences in pressure for the selected places of the bed of the composted biological material. An upwards pressure increase in the heap was observed throughout the experiment. Pressure differences in the same plane of the bed were also noticeable. The results of the experiment should enable researchers to develop a model of mass and energy transport in a bed of material which is being composted. A separate issue which requires special attention and which affects the pressure distribution is the [...].

CONTROLLING THE PROCESS OF COMPOSTING FARM BIOMASS WITH THE USE OF FUZZY LOGIC

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CSBE100779 – Composting is a well-known method for solid organic waste utilisation. The process produces organic fertiliser. The natural course of composting consists of three main phases: mesophilic and thermophilic stages and cooling down and maturing. The characteristic features of the thermophilic phase include a relatively high temperature (45-80°C) and carbon dioxide emission. Extending this phase of the composting process may result in a reduction of the entire process time and in the amount of methane produced. The current process control method consists in adjusting the amount of air supplied to the compost heap based on controlling the temperature in the bed or oxygen content in the air leaving the heap. During the experiments a problem regarding precise control appeared and would help optimise the composting process in terms of heat reception, duration of the process and the temperature inside the bed. The heat may be used in another place, e.g. to warm the substrate in a greenhouse. However, if the amount of collected heat is too great, this may result in compost temperature reduction and – in consequence – slowing down (or even stopping) the thermophilic phase of the composting process. On the other hand, overheating the heap of the biological material which is being composted dramatically reduces the population of thermophilic microorganisms and slows down the process. The literature survey focused on complex non-linear processes and has shown that systems based on fuzzy logic are effective in controlling the process. [...].

MICROWAVE-ASSISTED METHODOLOGY FOR QUANTITATIVE ANALYSIS OF LIGNANS IN FOODS

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CSBE100781 – Lignans with dibenzylbutanediol structure, such as the flaxseed lignan secoisolariciresinol, have been shown to benefit human health. They have antioxidant properties and the potential to lower the risk of developing chronic diseases such as diabetes and breast cancer. There has been increasing interest in the identification and quantification of lignans in foods. This has materialized in publications reporting lignan contents in various foods, and a free electronic database that compiles lignans data from peer-reviewed articles. However, the precise quantification of lignans remains challenging. The main limiting steps for a quantitative recovery of lignans are the choice of extraction methodologies and the extract purification procedures. Extraction with aqueous alcohols can take anywhere from 1 to 48 h without insuring a complete recovery of lignans from the food matrix. Due to the fact that plant lignans naturally occur conjugated to a variety of sugars, fatty acids, or are incorporated into complex polymeric structures, a hydrolysis step is required. Alkaline hydrolysis is robust, efficient and the method of choice for flaxseed lignan analysis. However, it is not sufficient for other grains where the lignans are conjugated to unknown sugars. Most food grains require acidic or enzymatic hydrolyses in order to free the lignans from their conjugated states. Acid hydrolysis leads to the formation of lignan artefacts thus complicating the subsequent chromatographic analysis. Enzymatic hydrolysis is less damaging than the acidic hydrolysis but conversion of lignan glucosides to aglycones [...].

UV-INDUCED FLUORESCENCE FOR DISCRIMINATING WEEDS FROM MAIZE

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CSBE100785 – In maize fields, weeds often appear in patches. Herbicide used can be reduced by up to 75% if their application is limited to weed infested areas (spot spraying). This can be performed if infested areas can be located. This paper reports on work to assess the potential of UV-induced fluorescence in discriminating between maize and weeds. The experimental program covered three years where plants were grown and measured under contrasting conditions. Plants were grown either in a growth chamber under artificial lighting or in a greenhouse under natural sunlight. Measurements were performed either in the greenhouse under natural sunlight or in a growth chamber under standardized lighting conditions. Several factors were considered: weed type (monocots or dicots), leaf side and position of measurement on the leaf. Plant fluorescence was induced at wavelengths around 328 nm and fluorescence measured between 400 and 760 nm. The discrimination between monocots and dicots based on the blue-green fluorescence yielded robust models with a classification error between 1.3 and 4.6%. From the partial least-square discriminant model, two large bands were chosen in the blue-green fluorescence: 400-425 nm and 425-490 nm. A linear discriminant analysis based on these two bands provided robust inter-year results with classification errors from 1.5% to 5.2%. Discriminating between maize (a monocot) and monocot weeds proved more difficult. Robust discrimination can be achieved based on properly normalized chlorophyll fluorescence signal and may require recalibration using a small sample of maize plants each year or each time a new field is being sprayed. [...].

MODELING OF ROUGH RICE DRYING KINETICS USING ARTIFICIAL NEURAL NETWORK

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CSBE100786 – The artificial neural network (ANN) approach is a generic technique to establish non-linear mappings between inputs and outputs without knowing the details of such mappings. The objective of this study was to predict Isfahan (central Iran) rough rice drying kinetics during hot air drying using ANN in deep bed mode. The inlet air temperature at seven levels (40, 50, 55, 60, 65, 70 and 80 °C), inlet air velocity at three levels (0.5, 0.8 and 1.1 m/s), and inlet air relative humidity at four levels (40, 50, 60 and 70 %) were the inputs of the neural network. To create training and test patterns, drying experiments were conducted by a laboratory fixed bed dryer. The multi layer perceptron (MLP) and generalized feed forward (GFF) neural networks with momentum and Levenberg-Marquardt (LM) algorithms were used to predict the drying kinetics. It was observed that the MLP network with LM learning algorithm produced the most accurate model. It was also revealed that the 4-15-1 topology and the hyperbolic tangent activation function provided better performance in comparison with other examined topologies. This topology predicted the drying kinetics with normalized mean square error (*NMSE*) less than 0.00079 and mean absolute error (*MAE*) 0.05215 and linear correlation coefficient 0.996.

LINKING TRADITIONAL AGROFORESTRY PRACTICES OF THE TSOTSIL MAYA IN SANTO DOMINGO LAS PALMAS, CHIAPAS, MEXICO TO ECOSYSTEM BIODIVERSITY, LAND MANAGEMENT SUSTAINABILITY, AND COMMUNITY WELL-BEING

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CSBE100788 – The Tsotsil Maya of Santo Domingo las Palmas, Chiapas, Mexico practice various forms of land management, including traditional agroforestry, corn (milpa) farming, and cattle ranching, while maintaining surrounding communal forest land. Tsotsil traditional ecological knowledge (TEK) originates in the highlands of Chiapas, Mexico, therefore its application to lowland forest ecosystems provides a working example of biocultural restoration and adaptation. Traditional ecological knowledge (TEK) may offer tools for ecological engineering to sustainably integrate human needs, ecological restoration, sustainability, and conservation. This study aims to understand how the land management techniques practiced by the Tsotsil Maya affect their subjective well-being, ecosystem biodiversity, and land management sustainability. The goal of the study is to better understand the link between humans' well-being, or happiness, and ecosystem health and to create a community-scale indicator framework for the assessment of this relationship within various production systems. TEK may offer insight to the western world in envisioning humans as part of their ecosystem, a fundamental principal of ecological engineering. Land management sustainability was assessed using Emergy analysis and was coupled with an assessment of subjective well-being using a modified psychological needs theory [...].

WEED COVER ON AND BETWEEN CORN ROWS IMPLICATIONS FOR REAL-TIME WEED DETECTION

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CSBE100789 – The spatial distribution of weeds in crop fields is heterogeneous. Therefore, limiting herbicides application to weed infested areas would lead to economical and environmental benefits. For real-time spot treatments, sensors detecting weed patches are needed. Vegetation sensors could be used in the inter-rows to trigger herbicide spraying on both rows and inter-rows if weed cover on and between the crop rows is uniform. To verify this hypothesis, weed cover on and between corn rows was evaluated using photographs acquired in corn fields at the 3 to 5 leaf stage. A one hectare plot was sampled in 2004, 2005 and 2007 at one location and nine one hectare plots were sampled in corn fields dispersed across the province of Quebec (Canada) in 2008. All fields were planted in corn under conventional tillage (75 cm row spacing). A segmentation algorithm was used to isolate vegetation pixels. Samples for the analysis consisted of 23 x 750 mm strips free of corn plants and covering three regions: undisturbed inter-row (UIR), corn row and inter-row compacted by tractor and/or seeders wheel during the seeding process (WIR). Repeated Anova measures indicated that weed cover on the undisturbed inter-row was generally lower than on the CR or WIR ($p < 0.001$). No significant difference in weed cover was observed between CR and WIR. A presence/absence contingency table showed that 13-15% of samples had no weed [...].

CLIMATE CHANGE IMPACT ASSESSMENT FOR A SMALL RIVER BASIN USING A PROCESS-BASED NUMERICAL MODEL OF COUPLED SURFACE WATER/GROUNDWATER FLOW

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CSBE100790 – We present an assessment of the sensitivity of hydrologic response (river discharge, aquifer recharge, and soil water storage) to future climate conditions using a fully coupled numerical model of surface and subsurface flow. The study area is the Des Anglais River basin located in southwestern Quebec, Canada. The future climate projection (2041-2070) is constructed by applying to an observed daily dataset (1961-1990) a monthly deviation factor extracted from projections generated by the Canadian Regional Climate Model (CRCM). Results comparing projections obtained with the land surface scheme that is coupled to the CRCM model to those obtained with the coupled surface/subsurface model are also presented for both past and future periods.

COMPARISON OF CLEANING PERFORMANCE FOR ROW CLEANERS ON A STRIP TILLAGE IMPLEMENT

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CSBE100791 – Strip tillage implements remove the residue from previous crops and form a seedbed ready for planting. An experiment was conducted to evaluate 5 row-cleaning devices. The proportion of residue removed by the implement was used as the performance indicator. Each of the 5 devices was evaluated at 2 speeds and orientations on the implement. The devices were tested in two blocks (fields) of corn residue (one high residue and one medium residue), and one field of wheat residue. An analysis was conducted, using a mixed effects model, to compare the performance of the cleaners operating in the different conditions. All cleaners performed well, with no statistical difference in mean performance. All row cleaners performed more consistently in wheat residue, compared with performance in corn residue. Numerically, the consistency of the different cleaners was different, with one configuration performing less consistently than the other four.

EMERGY SYNTHESIS FOR VALUING THE ECOSYSTEM SERVICES OF GREEN WALLS AND OTHER VEGETATED BUILDING ENVELOPE TECHNOLOGIES

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CSBE100792 – Increased environmental awareness and demand for green space are driving the need to find ecological solutions to environmental problems in urban areas. Covering the roofs and walls (i.e., envelope) of buildings with vegetation is a promising eco-solution that helps moderates temperature, creates habitat, attenuates noise and impedes stormwater runoff. Living building envelopes incorporate vines rooted in the soil to cover the vertical, horizontal and angled surfaces. The thermal and hydrological ecosystem services were valued using the energy-based environmental accounting methodology of emergy (with an ‘m’). Results suggest that buildings located in Maryland (US) can be cooled considerably during the summer by covering the southern wall, which reduces electricity consumption because of lowered demand for air conditioning. Emergy valuation determined that the embodied energy of the annual electricity savings was greater than the embodied energy of the capital investment amortized annually. The service of stormwater mitigation by green building envelopes was valued based on its ability to reduce peak storm flow. Valuation of the ecosystem services of green, living technologies by the emergy evaluation method provides useful sustainability information for urban building policy and engineering design.

DEVELOPMENT OF A MACHINE VISION SYSTEM FOR WEED MAPPING

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CSBE100794 – The objective of this work was to develop a machine vision for weed mapping in a field irrigated by a center pivot. The system was composed by two digital cameras and a DGPS. One camera acquired color images and another near-infrared (NIR) images from the same scene, and the DGPS saved the position of that scene. The DGPS position was assumed to be in the center of the image. Sample images of the field were acquired in a specific grid. The images were processed for estimation of weed infestation at each position. The green excess index and the ratio of near-infrared and red bands were used to enhancing the weeds and crops. The crop rows were detected by Hough Transform, and plants between rows were assumed to be weeds. An algorithm was developed with LabView software to do all the image processing and obtain the weed infestation results. Once the weed infestation georeferenced grid was built, it was possible to obtain maps using spatial statistics techniques. The system was tested in a 0.8 hectare center pivot irrigating black beans, half the area being in a tillage seeding system and the other half in a no-tillage. A total of 150 images of each tested spectral band were acquired to produce the maps. The developed algorithm was capable to produce weed spatial variability maps for both seeding systems using both cameras. The color images were more adequate to detect the weed infestation in both seeding areas than the NIR images.

CONCEPTUALIZATION DESIGN AND EVALUATION OF A HYPERBARIC RESPIROMETER

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CSBE100795 – For a long time, physical treatment has been used for different purposes in maintaining fruit and vegetable quality. Cooling, controlled atmosphere and heat treatment are examples of physical treatments used for that purpose. However, very little studies have demonstrated the physiological effects of these treatments, except for respiration rate (RR) decrease. More recently, UV and heat treatments were studied, but showed inherent heterogeneity problems resulting in relatively poor commercial applications. Physical treatment such as hyperbaric treatment is a technique that was explored to extend shelf life of fruits and vegetables. Hyperbaric treatment consists of exposing fruit or vegetable to compressed air in a range lower than 10 atmospheres. Unlike heat or UV processing, where temperature or radiation gradients are established, pressure treatment offers a very rapid establishment of homogeneous conditions as they act instantaneously and uniformly around each single produce or throughout an entire mass of food, independently of its size, shape or composition. A hyperbaric respirometer was designed, built and tested to explore the possibility of using hyperbaric treatment on postharvest commodity. It consisted of an air tight vessel that could be pressurized from 1 to 7 atm_{abs} and instrumented to automatically monitor gas concentration along time using computer controlled valves, flow meter and CO₂ gas analyzer. Calibration of the system and hyperbaric treatments were performed on tomato fruit to evaluate the performance of the respirometer. Results showed that RR was inversely proportional to pressure application.

DESIGN AND DEVELOPMENT OF A CUTTER AND FEEDER MECHANISM FOR A CHICK PEA HARVESTER

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CSBE100796 – Chickpea plants grown in Iran are short and mostly cultivated on rough dry lands. Although it is difficult to use a conventional grain combine to harvest it, chickpea production is limited due to harvesting problems, such as uneven ripening, lodging and shattering losses of hand harvesting. A special tiller mounted harvesting machine was designed and developed. The cutter and feeder mechanism simultaneously performs the tasks of (1) picking up the lodged plant material, (2) guiding the plant to the machine, (3) cutting the material stalk with changeable cutting height and (4) conveying and collecting shoots without threshing. The header consists of a V-shaped guide that uses three inclined sprockets and a chain on each side, two feeder belts, four identical pulleys and a new cutter bar that cuts the stalks without impact. Bending stress, modulus of elasticity and coefficient of friction of stalk for three varieties, Arman, Hashem and Flips were measured to determine the parameters of the machine design.

COMPARISON OF ENERGY REQUIREMENTS OF TRADITIONAL AND CONSERVATIVE SOIL TILLAGE FOR MAIZE CULTIVATION IN CENTRAL ITALY

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CSBE100799 – Traditional soil tillage for summer maize cultivation in Central Italy is based on medium depth ploughing followed by refinement of the surface for preparing the seedbed. Such a technique can involve excessive energy costs, loss of nutrients, decrease of natural soil fertility and, in some cases, increase of erosion phenomena caused by wind and water. These negative effects can be reduced by introducing conservative soil tillage techniques, such as tilling without inversion of layers and minimum tillage, which aim at maintaining a permanent soil cover and at reducing the number and the depth of the interventions. The CPMA of CRA-ING is specialized in testing of machines for soil tillage and sowing. During its activity, the tests of more than 50 machines of various types have been carried out on soil characterized by homogeneous clay-loam texture, widespread in Central Italy, providing a complete picture of their dynamic-energetic performances and of the work quality. Through the combination of data of the properly selected machines, according to the criteria of homogeneity, it has been possible to compose 5 tillage methods (2 traditional and 3 conservative) aimed at maize sowing, both in spring and summer in succession to wheat. Through the analysis of the parameters measured in the tests, for each method an estimate of the quality of work and the energy requirements has been provided. The results show increasing energy savings progressively moving from traditional to more conservative tillage methods, up to a maximum of 70%, without significant quality decrease of seedbed.

MOPAN AND QUE'CHI MAYA ECOLOGICAL ENGINEERING: DESIGN STRATEGIES FOR SUSTAINABLE ECOSYSTEM RESTORATION AND HUMAN SUBSISTENCE

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CSBE100800 – Many indigenous groups traditionally manage local ecosystems to provide for familial needs while protecting their surrounding environment, and such practices can aid in understanding efficient and sustainable ecosystem design strategies. The Mopan Maya of southern Belize practice an agroforestry system that conserves the surrounding rainforest while utilizing natural forces to drive change through nine distinct successional stages, including three herbaceous, two shrub, and four forest stages. This study presents Mopan traditional ecological knowledge (TEK), quantitatively describes the plant community and associated soil ecology of successional stages, and documents traditional knowledge regarding the immediate use of plant species and those useful for soil fertility enhancement. Woody plant diversity increases during successional stages, and surpasses that of primary forest. In all stages, traditional farmers use over 95% of available plant species for food, medicine, raw materials, and natural biocides. Over 90% of woody plant species present in fallow stages are traditionally thought to enhance soil fertility. Soil nutrients increase with succession and time since intentional burn, nutrient and soil macrobiotic activity in shrub and forest stages relate to the presence of managed plants, indicating engineered soil modification. Such effects on biodiversity and soil ecology, coupled with agricultural productivity, indicate Mopan TEK offers tools to provide for familial needs while concurrently promoting a biotically varied rainforest ecosystem. As Mopan techniques originate in [...].

POWER FROM TRITICALE STRAW

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CSBE100804 – With the increasing concerns over global warming, there is a lot of interest in renewable energy technologies. Among various renewable energy technologies, biomass energy sources have a high potential and are at various stages of development, demonstration and commercialization. The objective of this study is to look at the feasibility of using triticale straw for production of power in Canada. Triticale is a manmade hybrid of wheat and rye and it has a high potential of growth in Canada. The study involves estimation of cost of production power (\$/MWh) from triticale straw through development of a data intensive techno-economic model. This study also determines the optimum size of a biomass power plant (MW) which is a trade-off between capital cost of the plant and transportation cost of biomass. This analysis will develop cost curves to assess the impact of scale on power production costs. The techno-economic model is affected by the location of the power plant and the future expansion of triticale. The scope of the work includes all the processes starting from collection of straw to conversion to electricity through direct combustion at the power plant. Preliminary results of the study indicate that the cost of power is higher than the coal based electricity in Western Canada.

QUANTITATIVE ASSESSMENT OF MAPLE SYRUP PROPERTIES BY MEANS OF FLUORESCENCE SPECTROSCOPY

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CSBE100808 – Simple and portable tools that can speed up quality assessment and monitoring are of interest in the food industry. The progress made over the last decade in electro-optics makes fluorescence spectroscopy a potential tool as it is fast, requires minimal sample preparation, and it is now relatively low cost. Maple syrup is a high value commodity that is currently classified in terms of its color. It was recently found that maple syrup displays intrinsic fluorescence under excitation wavelength ranging from 250 nm to 500 nm and above. The objective of this study was to determine if the fluorescence signal could be used to assess routine physico-chemical parameters, determine its typicity, detect off-flavors or even distinguish flavor classes that can add further value to the product. It was possible to predict the harvesting period of maple sap within the season from its spectra ($R^2 = 0.88$ in 2003 and 0.81 in 2004). Color of syrup ($R^2 = 0.91$ and 0.88) and bacterial counts in sap ($R^2 = 0.75$ and 0.78) were also predicted from syrup spectra. Discriminant analysis revealed that between 71% and 100% of syrup samples were correctly classified according to the farm of origin in 2003 and 2004. Mixed data factorial analysis was used to explore the link between fluorescence, physico-chemistry parameters and flavor. This analysis found a well structured topology and a partial least square discriminant analysis showed a relationship between this topology and fluorescence. This was a strong indication that fluorescence of maple syrup can be used to assess its flavour.

ENVIRONMENTAL ASSESSMENT FOR DEFINING NEW MANAGEMENT STRATEGIES FOR THE CONSERVATION OF SOIL AND WATER RESOURCES

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CSBE100809 – The land use for agriculture and livestock activities in Brazil is marked by low technology and little knowledge about the environment support capacity. The results of this management way of the natural resources are the loss more than 90% of Atlantic Rainforest, erosion and loss of biodiversity. The site of research was in Capivara watershed, 22231 ha, that is inside of Botucatu city (Sao Paulo state – Brazil), inserted in Atlantic Forest biome and on the geologic formation called Basaltic Cuesta. The results of the research show that more than 40% of the basin is in conflict with land use according with the land use capacity and the Brazilian environmental legislation. Consequences of this inappropriate management are observed in the number of erosions, streams becoming wide and shallow, flood peaks shaking physical structure of the bridges, abandoned land by the farmers, and confinement of the wildlife in a few fragments of the native vegetation. Through the use of geographical information systems and remote sensing it was possible to define the current land use, a digital elevation model and spatial distribution of the different types of soils. This geographical information was the base to define the conservation areas of the watershed and the areas for agriculture and livestock through the investigation of the land use capacity. This method allowed a detailed evaluation of the conservation status of the watershed and the definition of the management zones according with the land use capacity and environmental legislation.

“APR SYSTEM”, A NEW DESIGN TO INCREASE WORKERS SAFETY IN GREENHOUSES MAINTENANCE OPERATIONS

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CSBE100815 – The present communication tries to show the important safety deficiencies of greenhouses roof maintenance operations, because these operations have to be carried out by workers at 4-5 meters height. A technical solution called APR System which eliminates or reduces those risks have been designed and tested. This investigation began with the study of the state-of-the-art maintenance operations for greenhouses roof, including scientific publications and patents, and simultaneously, an evaluation of the film cover renovation works in two multispan greenhouses was carried out. The collected data in these two greenhouses was used to make an evaluation of labor risks following the methodology proposed by the National Institute of Labor Safety and Health in Spain (INSHT), classifying the risk levels for each of the identified dangers. Finally, a technical solution was designed to guarantee the safety in these operations. The literature reviewed revealed at the moment that advances in this area of greenhouses construction are few, with no methods or designs that facilitate the accomplishment of these operations in a safe way. Nevertheless, the means and procedures used in the maintenance operations show great safety deficiencies, verifying that, in the majority of cases, the legal measures proposed to avoid or to reduce these risks are not applied. In this communication, design and operation of a new safety element named "APR System" has been described. This element has been tested and it is demonstrated that it improves the working conditions by avoiding risks of fall from height to which the worker are exposed.

OPTIMIZATION OF MICROWAVE ASSISTED EXTRACTION OF ANTIOXIDANTS FROM POTATO PEEL

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CSBE100819 – Microwave-assisted extraction (MAE) was applied to extract antioxidants from freeze-dried potato peel. The independent parameters of extraction time (min), solvent concentration (aqueous methanol, v/v) and microwave power (W) were analyzed using a central composite design to assess their effects and interactions on the extraction of phenolics. A response surface method (RSM) was used to optimize the extraction process. The resulting regression model indicated that a quadratic polynomial model was best suited for spectrophotometrically-determined total phenolics, whereas individual HPLC-measured phenolics were best described by a series of linear models. Solvent concentration and time had significant effects on total phenolics, microwave power was significant for ascorbic acid content, solvent concentration was significant for chlorogenic and caffeic acids, while both solvent concentration and time were significant for ferulic acid content. Optimal predicted contents were obtained for individual responses. Maximum total phenolics content (3.94 mg g⁻¹ dry weight(DW)) would be obtained with a solvent concentration of 67.40% (v/v), an extraction time of 14.76 min and a power level of 17.04% (122 W). Maximum ascorbic acid (3.25mg g⁻¹DW) and caffeic acid (3.12 mg g⁻¹ DW) contents would be obtained with a solvent concentration of 100% (v/v), extraction time of 15 min, and power level of 10% (63W). The maximum chlorogenic acid content (2.94mg/g DW) would be obtained at a solvent concentration of 100% (v/v), an extraction time of 5 min, and a power level of 10% [...].

COMPARISON OF DIFFERENT METHODS FOR SENSITIVITY ANALYSIS OF COMPOSTING MODELLING

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CSBE100823 – Sensitivity analysis was used to optimize a numerical model of the composting process. Sensitivity analysis of composting models usually considers perturbation as a fixed decrease or increase of several individual parameters. In this study, the most sensitive combination of perturbations was found. Since compost is a complex system, interactions involving microbial growth parameters were the primary focus, such as maximum microbial growth rate or compost heat capacity, rather than the isolated effects of each perturbation. Instead of examining two discrete, lower and higher, values for each parameter, a continuum of perturbations was assumed. The study focused on small perturbations, limiting the sum of the squares of the perturbations to a chosen value. The perturbations on parameters were chosen in proportion to their initial values. Several methods were reviewed to find the maximum error in the hypersphere of perturbation. Available time and resources limited the amount of simulation, so a comprehensive experimental grid design was not realistic. Several optimization algorithms were explored in order to limit the amount of simulation required. The chosen error function had specific characteristics that allowed the use of specialized methods in this context. The maximum error was approximated through the first order partial derivatives of the function. An evaluation of the amount of simulation required was done to compare it to some common algorithm methods, and those methods are summarized and compared.

A NUMERICAL INTEGRATED MODEL OF COMPOSTING PROCESSES USING FINITE ELEMENTS METHODS

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CSBE100824 – A dynamic finite element computer model of a composting system was created; it was temporally and spatially explicit. The modeled system was a cylindrical vessel, but it was conceptualized as a two-dimensional system on the assumption of radial symmetry. Air was blown in at the bottom through a distribution plenum and exited freely at the top. The evolution of the model was computed over time and space using multi-physics finite element modeling software (COMSOLTM version 3.5a). At each time step, the stationary solutions of the differential equations describing convection or diffusion were chosen, because those processes were assumed to occur much faster than any changes in the biomass. The compost was studied as a three-phase system. The water film around the solid particles hydrolyzed the nutrients that sustained the biomass and its chemical activities. Gases produced or consumed by the biomass – oxygen, carbon dioxide, ammonia – were exchanged with the gas phase through the water film. The gas concentrations and the temperature in the liquid or vapor phases were separately represented. Heat transfer was modeled as conductive through the liquid and solid phases, convective in the gas phase, and both convective and conductive therein. The population of micro-organisms was considered to be composed of mesophiles and thermophiles with different temperature-related growth coefficients. In order to model the heat and mass transfer between phases, a total of n growth characteristics were accounted for. Their development was computed through time and space. The modeling results and validation against physical experimental data are discussed.

INTELLIGENT CONTROL BASED ON EXPERT SYSTEM FOR GRAIN DRYING

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CSBE100826 – Drying is an integrative technique concerning diversified subjects such as heat and mass transfer, food properties, modelling, computer science, etc. In grain drying, the main objective is to achieve a desired moisture content with minimum consumption of energy in the shortest drying time. However, achieving this objective can be very difficult in grain drying process because of its multiple variables, long time delays and nonlinearity. In this paper, an intelligent control approach based on expert system (ES) is presented to achieve this objective. Expert systems provide powerful and flexible means for obtaining solutions to a large variety of engineering problems that cannot be solved by traditional methods. On the basis of this analysis, an on-line grain drying intelligent control and ES based on process parameter reasoning are designed for a cross-current drier. Finally, an on-line measurement and intelligent control software is developed by Lab VIEW. The practical control results show that the on-line measurement and intelligent control system of the dryer product has a satisfying control performance.

BIOCHAR PRODUCTION FOR CARBON SEQUESTRATION

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CSBE100827 – Greenhouse gas (GHG) emission is one of the important environmental issues facing the world today. Biomass usage, specifically capturing energy from biomass that would otherwise decay, is one of many options available to mitigate the impact of the GHG emissions buildup from fossil fuel utilization. This work will explore the utilization of agricultural biomass (e.g. straw) for biochar production and its landfill for carbon sequestration. This pathway can help increase the rate of carbon sequestration. Biochar is a solid fuel which can be produced from agricultural biomass such as wheat and barley straw. It is an organic solid and it can be produced by slow pyrolysis of straw. This work involves a conceptual techno-economic study to estimate the cost of production of biochar from straw in a centralized plant and its storage in a landfill to sequester carbon. This study draws on actual data to determine the cost of biochar production. The specific objectives of the work include: estimation of the overall delivered cost of straw to the charcoal production plant; estimation of the transportation costs of charcoal to the landfill site; estimation of the cost of landfill; and estimation of the overall cost of carbon sequestration through charcoal landfill. Preliminary result suggests that the cost of carbon sequestration through this pathway is higher than \$50 per tonne of CO₂.

AGAVE JUICE AS AN AGENT FOR PROBIOTIC ENCAPSULATION BY SPRAY DRYING

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CSBE100828 – Functional properties of natural food sources create alternatives to develop new products. Dietary fiber promotes several health benefits and the agave juice is a natural resource rich in it. Besides, probiotics are beneficial microorganisms which enrich the naturally present bacteria in human gut. The aim of this study is to evaluate the viability of encapsulated probiotic (*Lactobacillus casei*) when agave juice mixed with maltodextrin is used as an encapsulating agent by spray drying. The viability of *L. casei* was evaluated before and after the spray drying process as well as during storage for 20 days at room temperature. Two different air inlet temperatures, 140°C and 150°C and solution flow rates, 10 and 15 mL/min were evaluated for the spray drying process. Growth of *L. casei* in a model system with and without the encapsulation was also evaluated. Moisture content, a_w and bulk density were determined for the encapsulated probiotic powder. The outlet air temperature for the different spray drying trials was between 65 and 90°C. The final physical properties of the powders were moisture 0,79-3,21 %, bulk density 283-366 kg/m³ and a_w 0,27-0,33. The spray drying process conditions which produced the highest survival population of microorganisms (7×10^7 cfu/g) were 140°C and 10 mL/min. The microorganisms survival of this encapsulated probiotic after 20 days of storage was 9.71×10^5 cfu/g. The obtained encapsulated probiotic with agave juice-maltodextrin can be a suitable ingredient to develop new functional food products.

FAST ADULTERANT QUANTIFICATION IN CHINESE YAM POWDER USING VISIBLE, NEAR AND MID-INFRARED SPECTROSCOPY

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CSBE100836 – Authentication of food products is of primary importance for both consumers and industries in both economic and public health terms. Because of their similar appearance and lower prices to Chinese yam powder (CYP), sweet potato powder (SPP) and cassava powder (CP) are two main adulterants for CYP in China CYP market. This paper compared the feasibility of using visible and near infrared (Vis-NIR) spectra and mid-infrared (MIR) spectra for the adulterant quantification of CYP. Adulterant samples were prepared by adding 5%, 10% 15% and 20% weights of SSP and CP, respectively. Least-squares support vector machine (LS-SVM) was used for calibration. MIRS obtained the better results for both CP (The coefficients of determination for prediction (r_p^2)=0.989) and SPP (r_p^2 =0.986) adulterant quantification. But the results of Vis-NIR spectra were still acceptable (r_p^2 =0.963 for CP and r_p^2 =0.934 for SPP). In order to eliminate useless variables and reduce calculation time, successive projections algorithm (SPA) was used to select effective variables. Less than 1% of the full range spectral variables at either Vis-NIR or MIR range were respectively selected for CP and SSP adulterant quantification. The Effective variables based LS-SVM models obtained similar results of full range spectra for both CP and SPP analysis, which shows that SPA is a useful tool to select the Effective variables. [...].

QUANTITATIVE ANALYSIS SUPPORTED IN SNA OF THE PRODUCTION MILK CHAIN IN BRAZIL

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CSBE100837 – This article proposes a study to identify quantitatively the milk production organization in Brazil. The milk production chain in Brazil is of great relevance to society and to the economy as a job generator, accounting for a significant part of the Brazilian food and foreign exchange export earnings. The micro-economics of the production segments supply chain from small producers was analysed by identifying and modeling the relationships between contributors, located directly in production cooperatives, rural associations or unions. The attributes of the supply chain environmental considerations, allow the establishing of trust between the participants and formal contracts. The proposed methodology for the study provides a graph theory as a descriptive method based on the networks vision as a set of contributors connected by links. In this sense, the research is geared towards the development of a set of indicators obtained from the application of computational tools for gathering information, that add a final model with the main characteristics of the studied chain. Guided actions for improvement are inferred using these indicators. The main results achieved was a better understanding of the production chain from its structural features, launching indicators to generate bases for the proposed changes to the chain to promote general improvement of relationships and processes.

GASIFICATION OF WASTE FROM FURNITURE INDUSTRIES FOR GENERATION OF SUSTAINABLE ENERGY

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CSBE100839 – With the inevitable decline in availability of fossil fuel sources, there has been a worldwide increase of interest in renewable energy, aiming at sustainability in all aspects: technical, economical, social and environmental. The renewable energy has advantages over fossil fuels, such as generating employment opportunities in remote areas, contributing to poverty alleviation, diversifying the energy matrix, and diminishing impacts on the emission of pollutants into the atmosphere. The generation of waste in the forest-based industry is a natural consequence of the transformation of wood, so new techniques for the use of biomass for energy have been developed in order to meet the growing energy demand. The use of wood wastes as an energy source contributes positively to the environment by reducing environmental problems related to contamination of soil, air and water through improper disposal of waste. Thus, the process of biomass gasification becomes an interesting alternative, since among the techniques of energy conversion has been enacted, this process has many advantages due to the conversion of biomass into a combustible gas that can be used for heat generation, electricity and synthesis of chemicals. The syngas produced from gasification of eucalyptus residues showed large potential with an average High Heating Value of 6.60 MJ/m³, and regular composition during the process, with predominance of carbon monoxide (19,02% v/v), followed by hydrogen (11,58% v/v), carbon dioxide (10,18% v/v) and methane (8,20% v/v). There was no interference of climatic conditions in the results.

THERMAL ENVIRONMENT INSIDE BROILER HOUSING USING DISTINCT LATERAL MEMBRANE STRUCTURE

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CSBE100841 – Broiler performance decreases when the birds are exposed to heat stress. Minimal construction is used in Brazilian broiler production, and it relies mostly on lateral curtain (membrane structure) use. This research had the objective to evaluate the broilers' surface temperature reared inside two controlled environment houses using two distinct types of membrane structure (G1 and G2). Trial took place in São Paulo state in Northeastern Brazil and data were collected during four weeks. Membrane G1; external and internal color is blue, non-laminated polypropylene with an emissivity of 0.97. Membrane G2; external color is white and internal color is blue, with plastic-coated polypropylene, and an emissivity of 0.87. Surface temperatures were registered using a thermal camera and the images were processed extracting the punctual values of temperature in both birds and membranes. Statistical analysis was done using two ways ANOVA (house and birds age) and the averages were compared using Tukey test at a significance level of 95%. Membrane temperatures were significantly different ($p < 0.05$) and the higher averages were found in G2 house. The G1 house with the external white membrane showed the lowest temperatures inside, while the G2 house presented the ambient temperature closest to the outside environment. Both birds surface temperature and membrane temperatures varied significantly ($p < 0.05$) with the age of the broilers. The membrane using reflective color and plastic coated material provided more suitable ambient temperatures for rearing broilers under tropical conditions.

MOISTURE-DEPENDENT COLOR CHARACTERISTICS OF WALNUTS

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CSBE100843 – Characterizing the shell color of walnuts based on their moisture content (MC) at harvest can provide valuable information for performing walnut sorting before they are dried. The objective of this study was to investigate the relationship between the color characteristics of the shell of walnuts and their MC. Measurements were carried out for three walnut varieties, Tulare, Howard and Chandler. Samples of walnuts were collected from the harvester at the first and second harvest with and without ethephon treatment. The walnuts were sorted into two categories, namely with and without hulls. The CIE L*, a*, and b* color indices were measured to quantify the shell color of aforementioned categories, and total color difference, hue angle and chroma values were also calculated. The results indicated that there is a huge variability on MC among individual walnuts. The MC of walnuts with hulls at harvest was much higher than that of walnuts without hulls. On average, the walnuts with hull had MC of 32.99 % compared to 13.86% of walnuts without hulls. The presence of hulls was a major factor affecting the color of walnut shell. The L* and ΔE values highly correlated with MC for both walnuts with and without hulls. Regression models were developed based on the correlations between MC and L* and ΔE values. Although the a* and b* indices did not change much with MC for each categories, the a* values of walnuts with hulls were higher than those of walnuts without hulls. [...].

ALKANOLAMINE/IONIC LIQUID MICROEMULSIONS: ENHANCED CO₂ CAPTURE ABILITY WITH CURBED CORROSION BEHAVIOUR

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CSBE100850 – Carbon dioxide capture processes from large point sources especially involved in power generation are being extensively investigated at present. The major impediment in this regard is high energy consumption and solvent loss during regeneration steps particularly in the case of chemical solvent systems. One feasible practice may be the replacement of aqueous media with stable solvents. Room-temperature ionic liquids (RTILs), with high stability and practically no volatility even at elevated temperatures, are emerging as promising candidates. Scheming microemulsions with RTILs as continuous phase bearing dispersed alkanolamine droplets may provide a potential opportunity with less CO₂ capture cost and enhanced process stability. Negligible O₂ solubility in hydrophobic RTILs will not only alleviate the corrosion problems but will also suppress the oxidative degradation being faced in aqueous amines. In our laboratory, experiments verifying maximum gas loading attainment (0.5 moles of CO₂ per mole of diethanolamine) in the microemulsion facilitated by product (carbamate) precipitation have already demonstrated the viability of the process for further exploration. The insolubility of the capture product in the continuous phase is meant to ease the chemical capture to continue at higher rates by overcoming the equilibrium limitations and will thus provide the advantage of regenerating a small volume with less energy consumption. The hydrophobicity of the continuous phase (RTIL) will help to exclude the CO₂ drying step as well. Furthermore, emulsification phenomenon may [...].

EFFECT OF VARIOUS OPERATIONAL AND DESIGN PARAMETERS ON THE PERFORMANCE OF A ROTARY FEEDING AND CUTTING SYSTEM

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CSBE100851 – There has been extensive research completed in the area of biomass cutting, specifically, cutting plant material. However, there has been very little research completed with a focus on rotary feeding and cutting system (RFCS). A RFCS is a hybrid cutter which employs characteristics of both a sickle type cutter and a precision type cutter. With limited data available on the factors that affect the performance of a RFCS it has been assumed that the factors that affect the cutting performance of a sickle type cutter or a precision type cutter have the same influence on the performance of a RFCS. To validate these assumptions laboratory tests were conducted to investigate the effect of counter-knife sharpness, rotor speed, and throughput on the specific energy required to process barley straw. It was concluded that the only statistically significant factor (p 0.05) was counter-knife sharpness. The specific energy requirements to process barley straw at an average moisture content of 13 % wet basis was 0.39±0.16** for a sharp counter-knife and 0.74±0.08** for a dull counter-knife.

INFLUENCE OF POLYGLYCEROL ESTERS OF FATTY ACID ON IN VITRO DIGESTIBILITY OF SOYBEAN OIL-IN-WATER BY PANCREATIC LIPASE

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CSBE100852 – In humans, fat digestion in small intestine is mainly due to the hydrolysis of lipids by pancreatic lipase. The physicochemical properties of the interfacial layer surrounding fat droplets could play an important role in determining the extent of enzyme binding to the emulsion surface and therefore the extent of lipolysis. Our previous study confirmed that various polyglycerol esters of fatty acid (PGEs) surrounding emulsified lipids affected the stability of emulsions and the encapsulated lipophilic compounds during gastric digestion. The objective of this work was to investigate the influence of PGEs on in vitro digestion of emulsified oil by pancreatic lipase. Three polyglycerol esters of monooleate were used to prepare oil-in-water emulsions. Pancreatic lipase (1.6 mg/ml) and/or bile extract (5.0 mg/ml) were added to emulsion and particle charge, droplet aggregation, microstructure and free fatty acids released were measured. In the presence of bile extract, there were appreciable increases in amount of free fatty acids released (>19.8%) and negative charge in emulsions compared with the absence of bile extract. The stability of emulsions to droplet flocculation and coalescence during hydrolysis was strongly dependent on emulsifier type. Emulsion stabilized by decaglycerol monooleate was the most stable with a slight increase of particle size from 0.73mm to 0.97mm and a 69.6mmol/ml free fatty acid released. Our results suggest that emulsifiers could influence the susceptibility to lipid digestion of emulsions by pancreatic lipase and the susceptibility to droplet coalescence, which may have potential application for the design of foods to control the bioavailability of lipids. Acknowledgement: This work was also supported by a fund from National Natural Science Foundation of China (No. 20976187).

A NOVEL TECHNIQUE FOR PRODUCING ZANTHOXYLUM OIL PARTICLES BASED ON SUPERCRITICAL CO₂ EXTRACTION AND MICROENCAPSULATION METHODS

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CSBE100862 – Zanthoxylum Bungearnum Maxim (ZBM) oil is a popular ingredient in oriental foods. Normally, the production of the oil from ZBM is based on organic-solvent extraction or distillation, by which the product is relatively impure and is difficult to preserve due to its volatility. In the current study, a novel technique is developed to manufacture the ZMB oil. This technique is initially extract the oil from ZBM using supercritical CO₂ extraction process, and then the extracted oil is microencapsulated by spray drying. In this novel technique, the coating materials for the particles consists of Arabic gum and maltodextrin with a mass ratio of 1:1, and the supercritical CO₂ is used as extraction solvent for the core material Zanthoxylum oil, and as the atomizing fluid for the coating materials. Results showed that feasible technical conditions for the novel technique were best when extraction temperature was at 45°C, pressure at 25MPa, coating material solution flow rate of 1ml/min, CO₂ flow rate at 2L/min and concentration of coating material of 28.6%, the microencapsulation efficiency was 57.6% and the diameters of most microcapsules were less than 5 mm. In addition, the mechanism of extraction, atomization and the microparticle or microcapsule formation were also discussed in the current study. [...].

LOW-TEMPERATURE BROWN RICE STORAGE BY USING RENEWABLE ENERGY FROM SNOW

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CSBE100864 – A low-temperature storage system for brown rice in which grain temperature is maintained below 15°C during storage has been commercially used in Japan. However, the low-temperature storage system requires a cooling system and electricity to cool rice in summer. The objective of this study was to determine whether renewable energy generated from snow can be used to replace the cooling system and electricity for cooling a rice storehouse. At the beginning of March 2009, a snow pile was made next to a practical rice storehouse (capacity of 2500 t of brown rice). The shape of the snow pile was a trapezium, 17 x 23 m at the bottom and 4 x 10 m at the top and 5 m in height. The total amount of snow was 890 t. The snow pile was covered with wood chips of 200-300 mm in thickness acting as an insulation layer. About 27% of the energy for cooling the rice storehouse could be replaced by using the snow pile in summer. The quality of rice stored in the storehouse was preserved at a level almost similar to that of freshly harvested rice. The results of this study indicate that renewable energy generated from snow piles can be utilized for cooling a rice storehouse as a high-quality rice storage system without electric energy consumption.

CFD MODELING OF LIVESTOCK ODOR DISPERSION ON COMPLEX TOPOGRAPHY

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CSBE100870 – In most countries, odor annoyance from livestock production is an increasing problem in the community. In order to reduce the odor inconvenience and establish a good relation between livestock industries and the surrounding communities, many studies on the odor dispersion, such as diffusion simulations and field experiments have been investigated. Computational fluid dynamics (CFD), one of the well-known simulation techniques, has been effectively and widely used to study this kind of research since CFD considers both various wind conditions as well as topographical conditions to study aerodynamic phenomenon. Therefore, the ultimate objective of the study was to develop an aerodynamic model to predict qualitatively and quantitatively odor dispersion from livestock. Mesh models of mountainous study areas with a 1.8 km radius were built with a 5 m resolution. Modules for the atmospheric phenomena were also made by user defined functions and the scheme extension functions of FLUENT, and linked into a main computing module. The dispersion of odor was predicted by the 3D CFD model based on large eddy simulation and practically agreed to the field measured data. Based on several comparisons, the atmospheric stability was the most effective factor on the distance of the odor dispersion. The direction of dispersion was not depending mainly on wind direction, but also on the topography and the atmospheric stability. Later, this model will be used to predict the odor dispersion according to various meteorological and topographical conditions as well as to arrange the odor-related conflicts.

NUMERICAL INVESTIGATION OF A BUBBLE-COLUMN PHOTO-BIOREACTOR DESIGN FOR BIODIESEL PRODUCTION FROM MICROALGAE

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CSBE100880 – Renewable energy is interesting as a countermeasure for the fossil energy depletion and carbon dioxide reduction. Biodiesel using vegetable oils is one of the most desirable renewable energy because it can be an alternate diesel to petroleum. However, the biodiesel from soybean or corn, etc. can be confronted with food crisis. Microalgae have recently been researched as a new biodiesel source which not only contain high oil lipids with high growth rate but also offer value-added products such as cosmetics, health functional food or pharmacy from the residue. Because pond production system has limitations in unstable weather conditions and insufficient land availability especially in Korea, photo-bioreactors (PBRs) is essential for their cultivation. More so, controlling the suitable environments such as light, nutrients, carbon dioxide, temperature, etc. in the PBR is possible. Despite the availability of PBRs at present, only a few can be practically used for mass production due to some limitations. In this study, computational fluid dynamics (CFD) was used to design an optimum bubble-column PBR for mass production of microalgae. Multi-phase models including bubble movement, meshes and time step independent tests were considered to develop the three-dimensional CFD model. The model was enhanced and validated through Particle Image Velocimetry (PIV) tests. Various types of PBRs were simulated and compared quantitatively with consideration of the microalgae's growth model adaptable [...].

RESPONSE OF SPRING-MAIZE AND SOIL TO SALINE IRRIGATION IN NORTHWEST CHINA

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CSBE100883 – Field experiments were conducted during three successive years (2007-2009) to study the effect of saline irrigation on spring maize in northwest China. Irrigation was applied with four salinity levels: 0.7 gL⁻¹, 3 gL⁻¹, 6gL⁻¹ and 9 gL⁻¹. Seasonal water application was established referring to average evapotranspiration (ET_c) of 510 mm from 1956 to 2005. Water level of 0.94 ET_c and 0.56 ET_c were applied in 2007, 1.0 ET_c in 2008 and 0.56 ET_c in 2009. Higher water salinity of 6 gL⁻¹ and 9 gL⁻¹ led to significant decline in leaf water potential compared to irrigation with fresh water, and photosynthesis rate and transpiration rate were markedly reduced, resulting in lower plant height and leaf area index. Reduction of all parameters in 3 gL⁻¹ treatment was not more than 30%. Yield of 9 gL⁻¹, 6 gL⁻¹ and 3 gL⁻¹ treatment in 2009 was respectively 55%, 63% and 72% of fresh treatment (0.7 gL⁻¹). Water deficit at a certain extent under saline irrigation also increased water use efficiency (WUE) and irrigation water use efficiency (IWUE). The higher the salinity was, the lower the water use efficiency was. Soil water depletion decreased with increasing water quantity and salinity. Total salt content of average 0-100 cm at the end of experiment of 0.7 gL⁻¹, 3 gL⁻¹, 6 gL⁻¹ and 9 gL⁻¹ was 0.69 gkg⁻¹, 1.53 gkg⁻¹, 2.14 gkg⁻¹ and 2.64 gkg⁻¹, irrespective of the irrigation water quantity.

DEVELOPMENT OF A SOLAR THERMAL STORAGE SYSTEM SUITABLE FOR THE FARMHOUSE HEATING IN NORTHEAST CHINA

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CSBE100884 – A passive solar radiant floor heating system suitable for farmhouses in northeast China was designed and the heating performance of the system was analyzed. To design the passive solar radiant floor heating system, this study analyzed the weather data in this region (solar radiation, temperature, humidity, light levels, etc), the heating characteristics of the building materials (windows, doors, walls, roofs etc), and the indoor thermal environment of the existing farmhouse. Based on the analyzed weather data the heating load was calculated (9.86MJ/h) as well as the size of the thermal storage element (1.7m³ in volume) and the area of the collector element (11.23m²). The passive solar radiant floor heating system was designed to be used for heating during the winter and cooling in summer. To evaluate the heating performance of the system, the system was established in a standard energy saving-type farmhouse and the indoor thermal environment was analyzed. This study measured the indoor temperature and humidity in a room that used the system and was compared to measurements from a typical farmhouse room. The results of the passive solar radiant floor heating system design and its heating characteristics analysis performed in this study would be beneficial to improve farming villages environment and the use of renewable energy.

DEVELOPING WEB-BASED IRRIGATION MODELS AND SERVICES

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CSBE100887 – This paper describes a research project to develop web-based irrigation models and services based on models integration. Information and communication technologies (ICT) are now a priority in various areas of production and water use. Following this trend, ICT in the irrigation domain should favor efficient water use by farmers and web-based models may contribute for upgrading irrigation management at farm and system level. Adopting decision support systems (DSS) should help farmers to adopt water management practices balancing economic, environmental and water use criteria. To support the development of these approaches when developing web services related to irrigation management it is required to: upgrade the models and combine them using OpenMI technologies, adopt multicriteria analysis (MCA) - consider water use, environment and economic criteria - and provide these models for web multi-users. Tasks include: (1) upgrading design models for surface, sprinkler and micro-irrigation systems from the respective stand-alone versions; (2) integrating design and irrigation scheduling models; (3) creating the engine at the backend of the irrigation scheduling applications to be reached by the users; (4) testing the models with nearby and remote users. Several functionalities will be considered: (a) MCA to support decisions on normal planning of the season irrigation or to develop a deficit irrigation strategy; (b) capabilities to run the models in a GIS environment; (c) adopting spatial remote sensing data to provide for near real-time estimation of crop evapotranspiration. This web-based software will be analyzed to plan related web services.

AERODYNAMIC ANALYSIS OF AIR POLLUTANTS IN PIG FARMS USING CFD TECHNOLOGY

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CSBE100888 – In Korea, the number of large scale productions for livestock especially in the pig industry is continuously increasing. This requires proper understanding and adequate knowledge of the environmental condition inside and outside the production facilities to ensure comfort for the pigs as well as protection against diseases. In large production systems, air pollutants including viruses are one of the major modes of diseases spread. The spread depends greatly on the airflow characteristics which are highly affected by the topography. In Korea, approximately 65% of the country has a mountainous terrain. Investigating the spread of diseases as well as other air pollutants through field experiment is very challenging because of the unstable and unpredictable weather conditions. However, this can be done through computational fluid dynamics (CFD) for fluid flows where air flows inside and outside the pig production facilities can be investigated. The calculation of the flow was made by the FLUENT program which is the main module used in the study. The simulation model was developed using a T-grid and Gambit software with consideration of the available geographic information system (GIS) data. Furthermore, post processing of the simulation results allows visualization of the flow characteristics as well as the extent of the pollution. It is expected that proper ventilation system inside the production facilities as well as appropriate arrangement of the facilities were very critical in preventing and blocking the spread of livestock diseases and other pollutants.

MONITORING OF DUST EMISSION AND DEVELOPMENT OF A CFD MODEL TO PREDICT THE DISPERSION OF FUGITIVE DUST AT A RECLAIMED LAND

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CSBE100890 – A study on fugitive dust dispersion was conducted in a 40, 100 ha of reclaimed land located in the west coastal part of Korea. The dusts are composed mainly of minerals with high salinity that is very harmful to human health such causing skin and eye irritations and if frequently inhaled, respiratory diseases can occur. More so, the highly concentrated salty dusts can be very harmful to farms located nearby. A computational fluid dynamics (CFD) model was developed to predict the dispersion of fugitive dust from Saemangeum reclaimed land considering the topography of the area. Field experiments remain the ideal method to understand the aerodynamic phenomenon. Nevertheless, it is very difficult to find a correlation between weather condition and dust dispersion because of limited measuring points, labor and time. Moreover, the weather condition are very unstable and unpredictable as well and cannot be artificially controlled. To overcome these limitations, CFD simulation was used to quantitatively and qualitatively analyze the dust dispersion phenomenon according to various weather conditions. Great effort was needed to improve the CFD accuracy with topographical design, mesh structure, particle generation, and computational process by parallel processing technique. Results from this study in 2006, 2007 and 2008 showed that the changes in dust source are highly connected with the changes of dust concentration. The dust concentration showed a decreasing trend in 2008, [...].

REVIEW OF TECHNOLOGICAL ADVANCES AND TECHNOLOGICAL NEEDS IN ECOLOGICAL AGRICULTURE (ORGANIC FARMING)

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CSBE100891 – Technologies that facilitate organic farming, would allow to meet the demands of the organic produce market while meeting the standards of organic production. Local, organic food production uses recycled inputs, which makes it an appealing practice as fuel and transportation prices increase. Technological advances would allow for more efficient soil nutrient management and economical weed control in organic systems. In the case of organic therefore free-range animal production, they can help prevent nitrogen leaching, manage animals humanely, and monitor animal health. These technologies will need to meet constraints regarding capital and operating costs, use of renewable energy and high energy efficiency, minimum time and labor inputs, animal welfare and ecological sustainability. Such technologies as robotic weeders, software for soil nutrient management, concepts for vertical farms and animal feeders are being developed in various institutes. This review briefly defines organic plant and animal production and discusses the technologies relevant to these operations. Technologies addressing isolated problems have been developed, but none provide a systems approach to improving the sustainability and feasibility of organic farming. There is therefore potential in pooling existing tools in a management system for managing ecological agriculture (organic farming). Tools also exist that can be adapted to organic farming. Semi-autonomous robots could be developed as an alternative to the more complex autonomous ones. They would require an operator but their job would be of higher quality and comfort than that of current unskilled labor in agriculture.

CFD ANALYSIS AND COMPARISON OF FORCED-VENTILATION SYSTEMS OF POULTRY HOUSES IN KOREA

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CSBE100893 – In Korea, the demand for broiler consumption continues to increase while the agricultural population in animal and livestock production continues to decrease. This scenario prompts poultry producers to venture on large scale production systems. To ensure maximum production, the thermal suitability as well as the air uniformity inside the broiler house must be maintained. However, in large scale production facilities, the environmental conditions such as temperature and air quality are very difficult to control. The four distinguishable seasons of the country make it more complex. The internal environmental condition is greatly influenced by the design of the ventilation system which is very critical. Investigating the internal conditions affected by the ventilation design through field experiment is the ideal method, however restricted because of limited measuring points. Therefore, computational fluid dynamics (CFD) which is a powerful tool to study fluid movements was used in this study. The FLUENT program was employed using the three-dimensional large eddy simulation (LES) model for six broiler structures with a forced-ventilation system design. Data measured during the cold season and other environmental conditions in Korea was used in the simulation. The tracer gas decay method was used to investigate the CO₂ distribution as well as validate the model. The suitability, uniformity and stability of temperature and air quality were analyzed at the breeding section at a height of approximately 0.4 m.

DEVELOPMENT OF A WATER CATCHER FOR HIGH PRESSURE WATER JET CUTTING OF AGRICULTURAL GOODS

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CSBE100897 – Recently the cutting process of different agricultural goods by a high pressure water jet was examined and optimized at the Institute of Agricultural Machinery and Fluid Power. This technique is an alternative cutting method in agricultural engineering, which is especially suitable for cutting homogeneous goods like sugar beets. A cutting depth of more than 100 mm is easily attainable by pure water blasting. Due to the fact that the high pressure water jet is a permanently regenerating cutting tool a wearless, hygienic cutting process is afforded. Cutting forces can be reduced as well. To transfer this process to mobile working machines it is necessary to carry an amount of water on the machine which is sufficient for the cutting process. This requires space and increases the weight of the machine. In an ongoing project the feasibility of collecting and recycling cutting water is examined in order to reduce the amount of water which has to be carried. The presentation deals with the diffusion of the water jet after the cutting process and with the design of a catcher device. Test results show correlations between the spread angle of the water jet diffusion and the cutting pressure as well as the cutting speed. Further results show the water distribution in the diffusion area. The catcher has to be designed as a compact device, which allows the integration into the lifter unit of a self propelled sugar beet harvester. Simultaneously, the catcher device has to be sized sufficiently to catch most of the process water. A challenge is the material abrasion of the catcher device when hit by the water jet. This effect can be reduced by dissipating the water jet energy into kinetic energy of numerous small obstacles.

EQUIPMENT FOR DUST REDUCTION IN GRAIN HANDLING: EVALUATION OF DUST AND CHAFF EXTRACTOR AND ASPIRATOR

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CSBE100899 – Exposure to hazardous dust is a serious problem for farmer's working environment during handling of grain. The working environment in extreme dusty tasks should be improved through some effective technical approaches. The most common method for dust reduction is the use of equipment for cleaning grain with airflow that can be assembled in the grain flow from conveyors. This study aimed at investigating the level of dust reduction with such equipment. Two types of equipment for dust reduction, namely, dust and chaff extractor and aspirator, were evaluated, respectively. The evaluation was carried out at six occasions in drying plants of farms. The concentration of airborne particles in a size range of 0,1-10,0 µm was continuously collected and stored with a digital instrument. The results show that the average dust concentration varied among the measured occasions. Furthermore, a significant difference between the average dust concentrations with and without the evaluated equipment appeared. With the equipment, the dust concentrations were reduced by almost 50 % on average. The dust concentration without equipment for dust reduction exceeded substantially a health risk threshold value, 5 mg/m³, for half of the occasions studied. A lower grain flow had a more dominant impact on the dust reduction rather than the type of equipment used. In addition, the dust in grain plants could be reduced through restricting the distance between conveyor outlet and grain surface in the bin.

EFFECTS OF WOOD SHAVINGS ADDITION AND DIFFERENT CLIMATIC CONDITIONS ON AMMONIA AND ODOUR EMISSIONS FROM FRESH ANIMAL MANURE

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CSBE100900 – The addition of wood shavings and changing the climatic conditions as methods of mitigating ammonia and odour emissions were investigated using fresh pig and cow manure samples. The manure from each animal type was separated into two portions and wood shavings were mixed with one portion. Emissions from identical quantities of manure with and without wood shavings were measured in a flux chamber. The manure temperature was varied between 15 and 30 °C. Fresh air at temperatures between 15 and 25 °C was passed at a fixed rate over the manure in the chamber. Gas and odour concentrations were measured using a photoacoustic multi-gas analyser 1412 (Lumasense Technologies A/S) and an olfactometer respectively. The addition of wood shavings decreased the total-N and NH_4^+ -N but increased the ratio between carbon and nitrogen (C/N) as well as the pH. Ammonia emissions increased with manure temperature for both manure types. Odour emissions increased with the cow manure temperature. Odour emissions had a positive tendency with the pig manure temperature for samples without wood shavings. The water vapour pressure was positively correlated to the emissions from the cow manure but not from the pig manure. A clear relationship between ammonia and odour emissions could not be established. The addition of wood shavings lowered the ammonia emissions from the cow manure but not from the pig manure.

FOSTERING IRRIGATION PRACTICES IN THE HUMID TROPICS OF (SOUTHWESTERN) NIGERIA TO SUSTAIN LIFE AND DEVELOPMENT

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CSBE100901 – The rain fed agriculture which was about the only common means by which farmers in the humid tropics raised their crops had limited their earning capacity for quite some time. Also, the abundant land and water resources that had long remained untapped and unharnessed were not even noticed. Thus, there was the need to create awareness as well as embarking on a study whose findings could have an impact on the large farming populace in the southwestern part of Nigeria. The objectives of the study were to highlight the enormous land and water resources available for all year round farming as well as applying the modern methods to cultivated lands for massive crop production by irrigation practices. Five major sub-basins of the Osun river basin were considered and one of them, (Apoje sub-basin) was modeled for crop production using Hill's hydro-salinity crop yield model. 19 years of stream flow data for the Apoje sub-basin was obtained and subjected to statistical analysis using the Normal, Log-Normal and Log-Pearson Type II distributions. The experimental plots were planted with maize (DMR-LSR yellow) and irrigation water was delivered through an overhead line-source sprinkler irrigation system consisting of 4 single nozzle sprinklers, each with an effective wetting diameter of 24 m spaced 6.1 m apart along an irrigation pipe of 24 m long. Results obtained show that over 800,000 hectares of land was left unused while a minimum volume of water of about $60.24 \times 10^9 \text{ m}^3$ remained unharnessed. The values of maize grain yield ranged between 1 and 5 ton/ha when irrigated.

AGRICULTURAL FLEET MANAGEMENT: AN OPERATIONAL RESEARCH APPROACH

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CSBE100905 – Most agricultural field operations involve a number of highly interconnected tasks executed by co-operating heterogeneous agricultural machines. Agricultural machinery systems involved in “output material flow” operations, such as harvesting, as well as in “input material flow” operations, such as spraying and fertilising, include a number of primary units supported by a number of service (mainly transport) units. The characteristics of such operations require considerable efforts in terms of the managerial tasks of scheduling and planning. Here, an approach representing the planning and scheduling tasks for agricultural machines using basic well-known operational research problems is presented. A dedicated classification of field operations is given as the basis for the mapping of operational research problems.

METHODOLOGY OF ANALYZING VENTILATION EFFICIENCIES BASED ON “AGE OF AIR” THEORY USING CFD TECHNOLOGY

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CSBE100908 – In agricultural buildings, environmental conditions such as temperature, humidity, heat and contaminants are influenced by ventilation performance. Therefore quantitative analysis of ventilation system is very important for improving its effectiveness. Notable researchers have recently used a new concept of "Age of Air" to investigate ventilation efficiencies. The LMA and LMR values based on this theory were used to evaluate the fresh air distribution and the potential of eliminating contaminants. However the experimental methods for LMA and LMR have been restricted because of limitation of experimental studies where devices cannot simultaneously detect different tracers and the technology requires considerable investments, effort and time. In this study, "Age of Air" concepts were employed to mathematically and quantitatively analyze the ventilation efficiencies and CFD technology that was employed to overcome the limitations. As a basic step a 2D chamber was designed making the inlet steadily fixed and the outlet being varied according to the case. The methodology developed using C language as well as the simulation results was verified with the theory of Han et al.(1992) and it was found that the average difference of the comparison values was about 0.2%. The overall and local ventilation efficiency and its characteristic were analyzed and the results have shown that case 3-3 was favourable in terms of uniform fresh air distribution and elimination of contaminants. Comparison of the RMA values of case 2-1 and case 3-1 to case 1-1 showed that case 2-1 is superior in the range of 131% and case 3-1 is even higher at 201%.

EFFECT OF ALUMINIUM COOKWARE ON MICROBIAL INACTIVATION DURING PASTEURIZATION OF MILK

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CSBE100909 – The effect of aluminium cookware on inactivation of *Escherichia coli* and viable aerobic bacteria (viable aerobes) in milk during pasteurization was studied. Cells of *E. coli* were suspended in commercial milk (homogenized and pasteurized milk) in order to achieve a final concentration of colony-forming units of 107 per mL. Fresh raw milk (unhomogenized and non-pasteurized milk) was incubated at 20°C for 48 h to obtain 107 microbial cells per mL of viable aerobes. Samples of *E. coli* suspension milk in aluminium cups were immersed in a temperature controlled water bath at 65°C and 67°C for 3 and 2 min, respectively, and incubated milk samples with viable aerobes were treated at 60°C for 30 min. The results were compared with those obtained by using stainless steel cups. Cells that survived were counted after incubation at 37°C for 48 h. Results obtained under the temperature conditions of 65°C and 67°C clearly showed that cells of *E. coli* were eradicated more rapidly in aluminium cups than in stainless steel cups. Furthermore, decimal reduction times (D-values) in the aluminium cups were significantly shorter than those in stainless steel cups. For representative viable aerobes that survived in raw milk, there was generally no significant difference between samples in the aluminium and stainless steel cups at 60°C. This study indicates that an aluminium utensil has an inactivation effect on *E. coli* during pasteurization.

ANTIMICROBIAL ACTIVITY OF NOVEL PACKAGING MATERIAL MADE FROM BIOMASS PLASTICS AND SHELL (SCALLOP) POWDER

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CSBE100914 – Plastics derived from biomass have recently obtained much attention from the public because they are synthesized from renewable raw materials. About 400 000 tons of scallops are produced every year in Hokkaido Prefecture of Japan. About half of that weight is shell and it is dumped as waste. It has been known that the baked shell powder has an anti microbe function. The function results from calcium hydroxide (Ca(OH)₂) which is one of the components of baked shell powder. Ca(OH)₂ is highly ionized and indicates strong alkali in water. Most microorganisms can not survive under such strong alkaline condition. The objective of our study was to develop new functional packaging film from biomass plastics and from the shell in order to encourage the use of biomass plastics and to utilize the shell as a valuable resource. A halo test was adopted to evaluate the anti microbe function of the film. The film was placed on a solid agar containing indicator microbe and the effect in terms of size of “no micro organisms placed (halo)” around the film was observed. The result showed that the halo did not expand around the film and there were no colonies under the film. In addition, the film was put into water to assess if the results were caused by Ca(OH)₂. The result showed that the solution that was put in the film had a high pH value and indicated that Ca(OH)₂ had dissolved from the film. It was concluded that the film has an effect of antimicrobial activity, but the effect can appear only under aqueous condition.

AUTOMATED MONITORING OF VARIATIONS OF DRYING CONDITIONS IN A SEED DRYING FACILITY

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CSBE100916 – The primary research focus is the development and demonstration of a wireless sensor system for the process control in agricultural biomass during storage. The secondary research focus is potential energy savings using imbedded sensors for optimisation of the drying process and for active feedback control based on on-line measurements by sensors within the grain storage. The overall objective of this research is to reduce energy consumption for seed and grain drying and at the same time ensure a high product quality. The approach builds on novel applications of traceability and the usage of ICT in the primary agricultural production as methods and technologies for enhancing the grain and seed production system. The reliable performance of the network confirmed the correct choice of network characteristics (i.e., frequency range of 433 MHz, a handshaking communication protocol, and 10 mW transmission power). The results of this study indicate that the designed wireless sensor system could be used for effective process control and improving the storage and the processing facility.

INVESTIGATION ON FATTY ACID COMPOSITION OF JAPANESE BLACK WAGYU BEEF BY ATR-FTIR SPECTROSCOPY AND CHEMOMETRIC ANALYSIS

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CSBE100917 – Japanese black Wagyu beef is known worldwide for its excellent marbling, tenderness and juiciness, which is caused by the fatty acid composition of beef fat. The objective of this study is to develop a non-destructive and rapid method for the determination of the percentages of oleic acid (C18:1), palmitic acid (C16:0), monounsaturated fatty acids (MUFA), and saturated fatty acids (SFA) in beef fat by attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy. In this study, ATR-FTIR spectroscopy and gas chromatography (GC) were used for the solvent-extracted fat and non-processed fat tissue. The results of GC analysis showed that Wagyu beef could have higher percentages of oleic acid and MUFA and lower content of SFA. The principal components analysis (PCA) result of fatty acid composition allowed the subcutaneous fat to be discriminated from intra- and inter-muscular fats but inter- and intra-muscular fats were indistinguishable. Moreover, the optimum PLS validation models of C18:1, C16:0, MUFA and SFA contents in solvent-extracted fat were obtained with the combination of 1500-1000, 1800-1620 and 3050-2800 cm^{-1} and coefficients of determination (R^2) were 0.890, 0.905, 0.961 and 0.974, respectively. For non-processed fat, the best PLS models for C18:1, C16:0, MUFA and SFA were with R^2 0.470, 0.482, 0.611 and 0.647, by use of the combination of 1400-1000 and 3050-2800 cm^{-1} .

EFFECT OF A WATER-COOLED COVER ON THE THERMAL COMFORT OF PREGNANT SOWS IN HOT AND HUMID CLIMATE

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CSBE100921 – In China, the hot and humid climate during the summer season has a strong impact on the production and health of pregnant sows. This prompted a design of a water-cooled cover purposely for heat stress relief for sows. The field experiment was conducted to test the cooling effect on 24 pregnant sows which were divided into 4 groups. The results showed that the sow-occupied zone ambient black globe temperature (BGT) of water-cooled cover with and without sows were 4.8 and 5.4°C lower on average than that of control respectively, when the indoor air temperature was 34.3°C. The temperature reduction of the cooled occupied zone was proportional to the temperature drop between inlet and outlet water. Moreover, the cooling effect was enhanced by increasing water flow during the hot period according to the economic and energy efficiency. All the respiratory rate and surface temperatures of sows underneath the cooled-covered were significantly lower than those exposed to the high ambient temperature ($P<0.001$). The pigs in the treatment group remained almost 74% of the time lying in the water-cooled cover, and the thermoregulatory behavior lagged behind the peak temperature. The result of the present work implies that the water-cooled cover could ease the heat stress of pregnant sows in hot and humid climate.

A MODEL TO PREDICT CALVES' LYING TIME WITH WIRELESS 3-DIMENSIONAL ACCELEROMETER COLLAR

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CSBE100922 – Accelerometers have been developed for measuring lying time of cows, but they have not been applied to calves. The aim of this project was to develop a system of small wireless accelerometer to measure the lying time of calves. We developed a wireless 3 D accelerometer device, weighing 19 g. The device included an accelerometer, microcontroller and a 869 MHz transceiver. We programmed the devices to measure and transmit acceleration data with the range of ± 2 g at 25 Hz. The accelerometers were attached to collars of six calves under the age of six weeks. The calves were kept in a group pen. The behavior of the calves was filmed for 24 hours and the lying behavior was coded from the video continuously. We analysed the mean and variance to extract features from the acceleration data in 20 s epochs and used a Support Vector Machine Classifier for predicting the lying time. Leave-one-out cross-validation was used to develop and validate the model. The daily time spent lying was calculated from the observed and predicted behaviors. The model was able to distinguish (mean \pm SE) $90 \pm 4.7\%$ of the total lying time. We were able to measure the lying time of calves with a high accuracy without disturbing the animal. This is potentially useful data for automatically detecting health problems and studying different production systems.

CORPORATE HARVEST OF GRASS SILAGE - SQUARE BALES AS AN ALTERNATIVE TO FIELD CHOPPERS AND CROP LOADERS?

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CSBE100927 – Larger farms with growing dairy herds require increasing quantities of high-quality basic ration. The need for additional fodder acreage is fairly significant, especially when silage is fed year-round. As a rule this increase in acreage is associated with growing distances between field and farmyard, as well as higher transported quantities, greater transport distances, and higher transport costs. In this paper we investigate from a work-economics perspective whether this transport problem can be countered by the production of highly compressed harvested crops with higher dry matter content, in the form of square bales. By including calculation models supplemented by working time measurements of current efficient processes, we were able to calculate the working time requirement for different process chains in grass silage harvesting. Compared with the self-loading wagon and forage-harvester (chopper), the harvesting of grass silage in the form of square bales shows distinct advantages, particularly in the case of greater field-to-farm distances. Moreover, the process yields achieved are hardly lower than those of the chopper chain. With even larger distances, the ratio will shift yet further in favour of square bales.

WIRELESS SENSOR SYSTEM FOR PROCESS MONITORING OF TREE SEED STORAGE

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CSBE100929 – Monitoring both temperature and oxygen concentrations over time is necessary in order to provide critical information on whether the conditions that tree seeds experience are optimal for breaking dormancy and securing optimal seed quality. Manual control of conditions in hundreds of drums with seeds is very time consuming and the use of permanent sensors with wires is difficult in the case of rotating and movable drums. Therefore, a novel approach involving wireless monitoring systems was applied to measure property parameters in a tree seed storage or pre-treatment facility by placing wireless sensors network throughout the storage area, where the system will facilitate long-term data collection at scales and resolutions that are better than those obtained using traditional methods. The developed sensor nodes proved capable of precisely measuring the temperature and oxygen content inside two different tree seed treatment storage facilities, with a high communication reliability and a uniform distribution of the sensors in the material inside the drum both at steady conditions as well as when the seeds were being mixed.

DEVELOPMENT OF ON-SITE EMULSIFYING DEVICE FOR PRODUCTION OF COOKING-OIL-BASED PESTICIDES,

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CSBE100931 – World standards have become less tolerant regarding toxic pesticide residues, especially on fruits and vegetables. In the present study botanical cooking oils were selected as the basic constituents, since they are nontoxic to humans and not harmful to the environment. On-site pesticide-production devices were developed to facilitate technology that would be efficient and economical for manufacturing pest-control emulsions. Factors influencing the quality of the pesticide emulsion were tested to maximize its stability. A compact, inexpensive, energy-efficient mechanical homogenizer was developed to enable on-site emulsification and immediate application of the pesticides on greenhouse vegetables. Preliminary efficiency tests showed that cooking-oil-based pesticides in water emulsion can provide good control against aphids, mealy bugs, powdery mildew, and downy mildew on peppers and tomatoes. Homogenizer performances were ranked according to the average oil-droplet sizes in the water emulsion: smaller droplets have lower tendency for the cohesion that is a main cause of spoiled emulsions. The oil droplet sizes were estimated according to the average diameter and STD of the results in the water-based emulsion, at an oil-in-water concentration of 10%. The average diameter of cotton-oil droplets was reduced to 3 µm by increasing the speed of the homogenizer to 6000 RPM at a power consumption of 2 hp. Cooking-oil-based pesticides achieved the greatest control. For example, the infection levels of powdery mildew on leaves of pepper seedlings, [...].

USE OF CARBON DIOXIDE BALANCES TO DETERMINE VENTILATION RATES IN FATTENING RABBITS FARMS

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CSBE100932 – Determining accurately the ventilation rates in livestock houses is a crucial factor when measuring airborne emissions. Methods to determine these ventilation rates can be classified in two groups: direct and indirect methods. One of the most spread indirect methods to determine ventilation rates in livestock houses is the CO₂ balance. When using this method data on CO₂ concentrations in the inlet and outlet air of the farm as well as the carbon dioxide release rate for the animals and manure are needed to calculate the ventilation rate. This method has been successfully used before in poultry, cattle and pig farms, but not yet in rabbit farms. Thus, the aim of this work is to test the carbon dioxide balance as a method to determine the ventilation rate in fattening rabbit farms. Two fattening rabbit farms were evaluated during this work. CO₂ concentrations were simultaneously determined in the inlet and outlet air by using a photoacoustic monitor. Ventilation rates were also determined by calibration of the exhaust fans and monitoring their performance. Carbon dioxide emissions from the animals and also from their manure were determined using experimental values. Ventilation rates were determined by using the general equation of CO₂ balances and compared with direct measurements. Results obtained showed a deviation between measured and estimated ventilation rates. [...].

AUTOMATIC GRADING OF ANTHURIUM CUT FLOWERS USING 3D COMPUTER VISION

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CSBE100934 – Anthurium flowers, also known as “flamingo flowers”, exist in a wide range of colors, forms and sizes on the cut flower market. Nowadays each flower is graded manually which requires a high amount of manual labour and special expertise. Typically Anthurium flowers are classified according to the diameter of the spathe, the hood-like bract found along with the spadix. To be able to automate this sorting process the possibilities of computer vision were studied. Because of the cup shaped nature of the spathe it is impossible to determine the diameter accurately by means of a 2 dimensional camera image. Using stereo vision techniques three dimensional (3D) images of the flowers were recorded. Flowers passed the vision system with an arbitrary orientation and with some variation of the distance to the cameras. An algorithm was developed to determine the orientation of the flower in the image and the position where the diameter is measured. This algorithm needed to cope with the extreme high variability in color and shape of the different types of Anthurium. Shape based templates were used to analyze the 3D image and to measure the diameter of the spathe at the determined position. The results of these measurements showed good correlation with the manual measurements.

EVALUATION OF OPERATIVE ASPECTS OF A HEAT PUMP TO DRY CHESTNUTS

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CSBE100935 – The Italian chestnuts market, with a capacity of 50,000 tons per year, is in a leading position among European countries, and the fourth worldwide. The production of chestnut flour is a viable alternative to fresh consumption. The process includes a step of drying that can be done by different methods like the traditional one that uses coal, the dryer based on forced air by convection ovens and the innovative ones based on heat pumps. The last ones drying at low temperatures, allow to obtain qualitative properties of greater value. Drying is an energy intensive operation, heat pump drying allows the decrease of process costs. The research studied the efficiency of the dried plant based on a heat pump which provides a drying temperature of 30 °C and an air flow rate of about 5 m³/s. We monitored two cycles of drying of chestnuts to obtain the drying curves (from 45% to 10% humidity variation). The behavior of the process on the product (temperature and humidity levels) and the efficiency of the heat pump were analyzed. Thanks to an electric analyzer, in addition, it was possible to define the consumption of individual electric utilities and the techno-economics of the whole process. Some parameters were evaluated to characterize the final products resulting from the drying methods.

AN INSTRUMENT FOR MEASURING THE SKID RESISTANCE OF FLOORS IN LIVESTOCK HOUSING

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CSBE100936 – The improvement of the flooring materials performance on animal health and welfare requires the support of reliable testing techniques. This is particularly relevant with the synthetic soft coverings used for walking areas since the friction coefficient is not only depending on the surface characteristics, but also on the penetration of the animal hoof into the material. The paper presents the functioning of a new instrument capable of reproducing more closely the real interaction between the floor surface and the animal foot. The instrument is simple and portable and is suitable both for laboratory measurement and real housing conditions. The measure is made in two steps: first a probe shaped as a cow hoof and contacting the testing floor surface is loaded with a vertical force to obtain a pressure similar to that exerted by the animal; then a pushing force parallel to the floor is applied, at a constant speed, producing a displacement along the surface. The values of the vertical and horizontal strengths required for skidding and the angle of the instrument are continuously measured and by them various parameters can be calculated. The results of the tests carried out in laboratory and in real dairy houses are shown and the main floor properties obtained from the new instrument discussed.

IN-FIELD MEASUREMENT OF FRUIT RESPIRATION FOR DETERMINING CLIMACTERIC ACTIVITY AND HARVEST MATURITY OF MANGO

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CSBE100940 – Mango is a widely cultivated crop and is a climacteric fruit characterized by changes in respiration during development. Mangos are commercially harvested directly after the pre-climacteric minimum at a mature yet unripe state after which optimal post-harvest ripening occurs. Since methods for evaluating harvest maturity are typically subjective, destructive or expensive methods, much potential exists for rapid, accurate and economical technology. A sound approach for determining maturity stage of mango is the measurement of CO₂ production, as it is directly related to climacteric activity. Non-dispersive infrared (NDIR) is a simple spectroscopic technology used in gas detection, which is economical and highly accurate. NDIR sensors provide the possibility for developing tools for mango producers to measure fruit respiration, gauge mango development and optimally schedule harvest activities. The objective of this study was to investigate commercially available NDIR sensors for monitoring fruit respiration in mango orchards. An in-field system incorporating NDIR sensors for measurement of fruit respiration was developed. Experiments were carried out in Chiang Mai, Thailand and included two local varieties. A group of fruits was monitored on-tree during development and another was periodically sampled for analysis. Standard fruit respiration experiments were performed using a gas chromatograph for comparative studies with field measurements. Climacteric curves of fruits were [...].

GREENHOUSE GAS MITIGATION POTENTIAL OF SHORT-ROTATION-COPPICE BASED GENERATION OF ELECTRICITY IN GERMANY

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CSBE100941 – To sustain our resources for the future and avoid drastic climate change, society is now forced to increase energy efficiency as well as to explore and establish sustainable energy resources worldwide. Moreover, it is widely accepted that ideas have to be implemented on a regional scale. Wooden biomass, used for energy generation, is supposed to be helpful in securing local energy supplies as well as reducing the greenhouse effect by substituting fossil resources with bio-based ones. The latter can, in the case of short rotation coppice (SRC), be generated by extensive agricultural production systems. Consequently, they produce less CO₂-equivalent emissions than fossil resources. This work presents a model system for a regional supply chain producing second generation bioenergy generated from SRC in eastern Germany. It focuses upon the generation of electricity. For that reason, it is compared to a business-as-usual reference system, based on the latest German CO₂ mitigation factors for renewable energies in the German power-generation mix. Based on greenhouse gas inventories, according to the methodology of life cycle inventories, the assessment also takes into account further important aspects, for example possible options for nutrient cycling. The paper discusses major determinants for greenhouse gas mitigation with SRC with respect to indirect land-use effects, due to the possible increased demand for land.

DUST AND AMMONIA EMISSIONS FROM UK POULTRY HOUSES

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CSBE100942 – This project successfully characterised poultry dust, quantified emission levels, and assessed the potential of emission abatement techniques and the potential impact on human health. Measured in-house concentrations and emission factors of PM_{2.5} and PM₁₀ were within the range of previous measurements, but the average was significantly lower than the average of former studies, especially for broilers. Surprisingly high emission factors were found for housing emissions of free-range layers, for which literature data are sparse. Using the emission factors derived here, overall UK emissions of PM₁₀ from poultry were 1.865 t.yr⁻¹, reduced by fourfold compared with the NAEI. Ammonia emissions were also in the range of previous estimates, but average emission factors were 50% higher than those used to calculate the official UK emission estimates. Abatement using either two baffles and water bath outside the fans (U-bend principle) or a StuffNix filtration system, removed 22% and 67% of PM₁₀, respectively. Bioaerosol concentrations, quantified as bacteria, fungi and endotoxin, were also in line with previous results. In-house concentrations are of potential concern to poultry workers. However, due to dilution and dispersion effects, concentrations approach background values at a distance of about 100 m downwind. The bacterial and fungal composition was typical for agricultural areas and *E.coli* was only identified during one farm visit.

EFFECTS OF THE MACHINE WHEEL LOAD ON GRASS YIELD

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CSBE100944 – Heavy traffic has been shown to have a negative influence on the yield of grass and clover. A full scale grass-clover field trial was established to estimate the effect on clover-grass yields as a function of different wheel loads and tire pressures. The trial comprised 4 different traffic combinations (load and tire pressure) with 35 replicates and 1 traffic free treatment with 245 replicates. The yield in fresh grass was analysed in a linear model that included the effect of traffic intensities, a block effect describing the history of the field, the harvest date, the effect of the location, the effect of mean altitude, the effect of the mean of the EM38-measurements and the distance to wood, trees and hedge close to the north, south and east border of the field. No significant interactions were found between time of crop and soil damage and wheel load and tire pressure. However, there was a significant effect of the wheel load in terms of the yield being lower using a wheel load of 4745 kg than for a wheel load of 2865 kg and for all 3 times of load application.

CALCULATION AND PLANNING FARM MANAGEMENT TASKS IN PIG AND DAIRY FARMING

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CSBE100946 – Management tasks are assuming increasing importance in agriculture. Unlike the situation with production-related activities, there is a dearth of work-economics data on management tasks in pig and dairy farming, making it difficult to formulate reliable work-planning statements. Based on purposeful classification and a method of data collection and data modeling the present study serves to establish key work-economics figures for management in dairy farming, pig fattening and piglet production. Data on the corresponding work elements and influencing factors are recorded according to the systematic classification of farm management as a whole, using a new methodical approach. Separation is maintained between elements and influencing factors during the course of data collection. The work elements are collected in the form of work trials and stored in a database. The factors which affect the working-time requirement are collected empirically. Work elements and influencing factors can then be logically connected to one another in the mathematical model. The working-time requirement can thus be calculated for the individual working areas as well as for farm management as a whole. For dairy farming seventy-one dairy farms in the different regions of Switzerland as well as in southern Germany were chosen for the data recording. Depending on herd size, the working-time requirement for farm management is between 8.3 and 37.6 MPh per cow and year. The absolute values range between 263 and 1,281 MPh per herd and year. The percentage of the overall working-time requirement taken up by farm-management tasks fluctuates between 13 and 24%.

AN APPROACH FOR PESTICIDE LOSS ESTIMATION ADAPTED TO FIELD CROPS IN MEDITERRANEAN CONDITIONS

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CSBE100947 – During chemical crop spraying, important pesticide amounts are transferred to the environment, with negative impacts on the ecosystem, the health and the economy. Tunisian crops are sprayed in extreme conditions (high temperature and low humidity) and with low technology machines. The amounts of lost pesticides are unknown and a combined approach with laboratory experimentation and modeling has been chosen to evaluate these quantities. To evaluate drift and plant retention tests were set up i) in a wind tunnel and ii) under a mobile boom in laboratory conditions. A set of wind tunnel tests were used to develop a low complexity drift simulation model. The model is based on an advection-diffusion representation for diameter classes representing the spray. It includes evaporation simulation. Tests with the mobile boom were used to evaluate plant retention with different nozzle settings. Both wind tunnel and mobile boom tests were used in a combined approach to evaluate the amount of droplets lost in the air (volatilization). Predictions of these approaches were finally compared to field test results with two spraying setups (spraying Volume Median Diameter of 127 and 322 micrometers). These comparisons showed that the combined laboratory and modeling approach gave coherent results that could be used with few improvements to achieve a global balance of pesticide losses and provide farmers with a tool to decrease them.

POWER SPECTRAL ANALYSIS OF AGRICULTURAL FIELD SURFACES

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CSBE100948 – Agricultural vehicle operators are exposed to high levels of WBV related, specifically, to surface irregularities and forward speed, which are considered to be the most important sources. European Parliament Directive 2002/44/EEC sets the minimum requirements for protection of workers from risks to their health and safety arising from exposure to mechanical vibrations. Although most of the studies are directed to measure comfort, vibration dumping and developing models, one of the most important parameter, the surface profile, is not analyzed as expected both for the difficult of the measurement, and because it's deformable. This study aims to evaluate the possibility of defining the real and not the apparent profile acting vertically on the tractor. Three terrain test benches were prepared for the tests and one tractor was used driving at different forward speed. Acceleration at the hubs of the tractor was acquired and reproduced at a four plates test bench. The displacement of the plates defined the vertical input of the terrains and their spectrums were obtained. This first approach seems confirming the possibility of defining a common power spectral density for the solicitations on tractor on fields.

USING THE CUELA SYSTEM TO STUDY WORKLOAD IN AGRICULTURE

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CSBE100950 – Although work-related musculoskeletal disorders occur with above-average frequency in dairy farmers in particular, little is known about the effects of different milking systems or of the equipment of modern milking parlours on the physical loads experienced by the milker. The aim of the investigations is therefore the qualitative and quantitative recording of the loads arising in the milking parlour, in order to deduce from these optimisation strategies for the design of the milking parlour as well as for the milker's approach to work. These optimisation strategies in turn form the basis for preventing long-term damage to health. To determine load, we used the person-specific CUELA system, which records body movements and ground reaction forces by means of mechanical-electronic sensors. The feasibility study presented here served to examine the suitability of the CUELA system for agricultural measurements under practical conditions. Four male test persons were studied during two milking periods each in the auto-tandem and herringbone milking parlours. Based on these measurements, disturbing influences and resultant measuring errors were determined, quantified and further reduced by modifying the system. In total, 98 % of the data was used for further analyses. The validated data permits us to make initial statements on the effects of the milking method and of the individual approach of the various milkers on their posture, and hence on load. In addition, these data form the planning basis for further studies on workload during milking.

AQUACULTURE IN GREENHOUSE

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CSBE100955 – The main socio-economic sector of the province of Almería (Spain) is based on agriculture via the cultivation of fruit and vegetables in greenhouses, which represent 40% of its economic activity. The 27.000 hectares of greenhouses have generated a business cluster with added value through applied research and development. The auxiliary industrial sector around agriculture has a turnover of around € 2,000 million. The profitability of traditional farms and companies of the auxiliary industry for agriculture has been compromised in recent years due to the liberalization of markets, making it necessary to diversify production under plastic greenhouses. As an alternative to this market shift the development of intensive aquaculture systems of tilapia (*oreochromis niloticus*) under plastic covered greenhouses was established. Researchers have worked on the development of a greenhouse structure specifically designed for growing tilapia in the climatic conditions of the Mediterranean. To do so we have relied on the experience of the technological centre tecnova that has experience in designing greenhouses structures as well as major construction companies involved in building greenhouses in the province. The project has assessed the technical and economical feasibility of performing intensive aquaculture farming systems in a greenhouse. Also it proposes a model of sustainable aquaculture farming and discusses the feasibility of integrating tilapia aquaculture in obsolete greenhouse structures as a means of revitalising the economic sector.

ANALYSIS AND ASSESSMENT OF WORKLOAD IN DIFFERENT TYPES OF MILKING PARLOURS USING THE CUELA-SYSTEM

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CSBE100956 – Increasing mechanization and automation in milking technologies lead to a reduction in and simplification of work, but also result in one-sided, frequently repeated work sequences. For this reason, various aspects of milking in modern milking parlours have been investigated within the framework of numerous studies. To date, however, little has been known about the effect of milking-parlour type. We have therefore investigated workload in different types of milking parlours under practical conditions from both a qualitative and quantitative perspective. The findings we have obtained help in the formulation of optimisation strategies for an ergonomically favourable milking parlour design. The workload in the milking parlour was recorded by means of the ‘CUELA’ system (acronym formed from the German equivalent of ‘Computer-supported recording and long-term analysis of movements of the musculoskeletal system’). CUELA is a mechanical–electronic system for recording body movements and ground reaction forces. The studies were conducted in 15 milking parlours (three each of autotandem, herringbone 30°, herringbone 50°, side-by-side and rotary parlours) with two test subjects in each case. Premilking, stimulation, swinging in the teat-cup cluster and attaching it to the udder, and dipping were defined as work elements. In addition, the characteristics of the human milker, the milking parlours and the cows milked were recorded as accompanying parameters in order to analyse their relevance for the workload of the milker. Recommendations for the [...].

WORKLOAD IN MODERN DAIRY FARMS – ASSESSMENT FROM THE USER’S PERSPECTIVE

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CSBE100959 – Disorders of the musculoskeletal system are very widespread in dairy farmers, despite increased mechanization and automation. To date, however, little is known about the distribution of work-related musculoskeletal disorders among dairy farmers, or about the workload situation on modern family dairy farms. The workload situation on modern Swiss dairy farms was surveyed by means of questionnaires sent to 2000 farms where the livestock was kept in cubicle housing systems. Addresses were randomly selected from a basic population of approximately 15,000 farms. The response rate was 53 %. The core questions related to the respondents’ state of health, and to activities perceived as physically strenuous in dairy farming in general and in milking in particular. 68.7 % of the dairy farmers who responded to the survey stated that they regularly suffered from musculoskeletal disorders. Feed distribution (32 %), cubicle maintenance (20 %) and claw care (9 %) were perceived as especially physically strenuous in dairy farming in general. Milking was frequently rated as not very strenuous; 32 % of respondents did not state which task they found most of a strain. 18 % cited milking into separate churns or the manual transport of said churns as strenuous, 14 % applied this description to attaching the teat-cup clusters. Over 80 % of farmers enjoyed working in the milking parlour.

DEVELOPMENT OF A DISTRIBUTION SYSTEM FOR MEASURING NOZZLE INTEGRATIVE PARAMETER

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CSBE100961 – The experimental system used in this study was equipped with sensors and computer-controlled processing technology. This system was used in the measurement of major performance parameters such as pressure, flux, spray angle, spray distribution character of the nozzle and its integrative performance parameter. It could also achieve precise and synchronous measurements and process multi parameters. Measuring position of a single nozzle was also available for three-dimensional adjustment by nozzle transmission frame. The boom could achieve two-dimensional precision adjustment. Fluid power supply system could ensure the accurate measurement of nozzle flow between 50~15000ml/min. The control system consisted of a PC, a CCD image acquisition system, data acquisition cards, sensors, and single chip microcomputer. The spray angle was measured by image processing technique. Data fusion technology was used to improve the precise measurement of spray angle. Neural network technology was used to improve the precision and speed of the system. The results showed that it is promising for using this system for measuring nozzle integrative parameter.

CALCULATION OF TRANSPORTATION ENERGY FOR BIOMASS COLLECTION

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CSBE100962 – Assuming a bio-ethanol production facility using rice straw, characteristics of field-to-facility transportation were examined through simulation modeling and trial calculations. The conversion rate from straw to ethanol, the quantity of straw collected, and the ratio of the field area to that around the facility all affected the fuel consumption, the number of trucks needed, and other factors. Standard conditions were assumed based on reported data and actual observations: 15 ML/yr ethanol production, 0.3 kL output of ethanol from 1 t dry straw, 53.6 day/yr working days, 2.7 t truck load capacity, and 0.128 as the ratio of field to the area around the facility. The calculation results revealed that a quantity of 50 kt dry straw required the following: 2.78 L fuel consumption for transportation of 1 t of dry straw, 109.5 trucks, and a 19.1 km collection area radius. The fuel consumption for transportation was found to be proportional to the quantity of straw to the 0.5 power, but inversely proportional to the ratio of field to the 0.5 power. The study demonstrated that the rate of increase in the necessary number of trucks collecting straw increases with the decrease in the ratio of the field to area surface around the facility.

MILKING TECHNOLOGY ON MODERN DAIRY FARMS – ASSESSMENT FROM THE USER'S PERSPECTIVE

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CSBE100963 – Within the framework of a questionnaire survey of Swiss dairy farmers, the prevalence of different types of milking parlours and their technical equipment as well as the reasons for the purchase decision and satisfaction with the milking technology are analysed. The results, however, can be considered on a global level, assuming that the growth strategies of family farms are similar throughout the world. At 53 %, the response rate was above average, which significantly reinforces the validity of the results. In Switzerland, tandem and auto-tandem parlours are still the most common form of milking parlour, followed by herringbone parlours. Nevertheless, the survey shows that automatic milking systems and rotary parlours are becoming increasingly attractive for farms planning to invest in new milking technology. Milk volume measurement and automatic milking cluster removal play an especially important role in the installation of technical equipment in the milking parlour. Whereas a waiting area is a common feature, little use is made of mechanical aids for moving the cows into the parlour. Such aids will be used more frequently in future, however, owing to increasing herd sizes and the increasing rationalisation of labour. Generally speaking, the farmers surveyed were satisfied with their milking technology and in particular with the customer service, which plays the most important role in the purchase decision. Despite this, 20 % of the surveyed farmers have problems with milking, which they put down to the occurrence of leakage current.

QUALITY OF THE PULPED CHERRY COFFEE SUBJECTED TO CONTINUOUS AND INTERMITTENT DRYING

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CSBE100965 – This study was carried out to evaluate the quality of the pulped cherry coffee submitted to continuous and intermittent drying in a fixed-layer dryer. The appraised qualitative indicators were the sensorial analysis (cup test) and chemical (total titrable acidity, polyphenols, reducing and non-reducing and total sugars, potassium lixiviation and electric conductivity). The treatments were continuous drying (without rest period) and intermittent drying (drying for 12 hours and rest period for 12 hours), by revolving the grain mass every 3 hours. The treatment with intermittent drying had a 52.63% longer total drying time when compared to continuous drying. Concerning the effective drying period, the treatment with intermittent drying showed a reduction of 24.56 % in number of hours, comparative to continuous drying. Both sensorial and chemical analyses of the pulped cherry coffee dried in fixed layer, continuous or intermittently operated, showed no differences in the quality of the coffee. Thus, the coffee grower can choose the best option for coffee drying, as a function of labor availability and operational costs.

EVALUATION OF COFFEE DRYING COSTS: PRE-DRYING ON A CONCRETE TERRACE AND COMPLEMENTARY DRYING IN A CONCURRENT AND COUNTERCURRENT FLOW DRYER

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CSBE100966 – The study of drying costs is an important tool to be considered when deciding on an adequate drying system, which considers energy needed to heat the air, electrical energy needed to run the fans, energy to transport the product, labor costs, maintenance costs, depreciation, interest rates and breakdown costs. The objective of this study was to determine the total drying cost per sac of dry coffee beans, by means of the drying of processed coffee in the form of pulped cherries, with pre-drying on a cement terrace followed by complementary drying in a developed prototype dryer with concurrent and countercurrent flows. Two treatments were applied: a) Treatment 01: 12 hours of intermittent drying with intermittent rotation and 12 hours of rest, with drying air temperature of 45 °C and rotation of the grain mass at every 90 minutes of drying (for a period of 10 minutes each); b) Treatment 2: 12 hours of intermittent drying with continuous rotation and 12 hours of rest, with a drying air temperature of 70 °C. The utilized methodology was described by Young and Dickens. It was concluded that: 1. The fixed cost of the multiple flow dryer was the principal component in the total cost of drying, principally since it was treated as a prototype. 2. Increase in the drying capacity of the system with application of treatment 02 (with continuous rotation), in relation to treatment 01 (with intermittent rotation), drastically reduced total drying costs. 3. The results obtained for treatment 01 demonstrated that its not an economic feasible application, [...].

TESTING OF A NIR SYSTEM FOR THE OPTIMIZATION OF STORED APPLES MANAGEMENT

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CSBE100967 – Non destructive and rapid tools in fruit production are required to monitor fruit quality during postharvest period for a better preservation during storage. An automatic desk Vis/NIR system (QS_200, Unitec spa®) was tested to predict fruit quality during postharvest phases in the wavelength range 600-1200 nm. The aim of the work was to select homogeneous lots of apples in a non destructive way to manage cold store at best. A total of 1152 apples (Golden Delicious and Stark Red Delicious) were analyzed with Vis/NIR device in order to classify apples in two different ripeness classes (ripe and not ripe). PLS regression models were built on the samples of the two apple varieties. Models based on spectral data of Vis/NIR device show, for both varieties, good prediction skills for soluble solids content and firmness. Seven monthly samplings were done during the whole period of apples conservation in cold store with controlled atmosphere in a storage centre in Valtellina (Lombardia, Italy). TSS and firmness predictions carried out with Vis/NIR device were compared with analytical data obtained by standard destructive analysis. The 72% of the analyzed samples of Golden Delicious and the 69% of Stark Red Delicious show a difference from reference value lower than 1° Brix. Encouraging results were obtained for firmness evaluation too. [...].

EFFECTS OF THE CROP ROOT ON THE SOIL PHYSIC PROPERTIES AND SOIL WATER TRANSPORT ENVIRONMENT

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CSBE100968 – The objectives of this study are to clarify the effects of the crop root on the soils physical properties and soils water transportation environment. The water retention and conductivity of soil samples which contain the crop roots are clarified by estimating the soil moisture characteristic curves by a one-step method. The water retention and conductivity of the soil can be quantified with crop root content. The experimental results indicate that the saturated water content increases with the crop root content because of the porosity generated by the crop root. The soil water transport is simulated considering the crop root effect on the soils physical properties. To verify the simulation models accuracy, field observations were conducted. The simulated matrix potential has good agreement with the measurement. Using this model, the soil moisture content distribution was simulated. The simulation results indicate that the soil moisture content in the plot with high crop root content is quite high. After irrigation, high water content in the plot around crop root is maintained. The simulation result indicates that the crop root is effective at retain the soil water around crop root zone.

FORMAL REPRESENTATION OF AGRICULTURAL PRODUCTION STANDARDS

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CSBE100970 – Production standards in the form of legal regulations or quality assurance labels are playing an increasingly important role in farming. Each farm must therefore gather information on all standards which apply, which may vary from field-to-field, and ensure that they are respected during operations. This information may be provided on paper or as electronic documents, by the standards publishers or by advisors. Together with the need to document compliance, the need to collect and process the requirements is becoming increasingly burdensome for farmers. In order to provide assistance, it is proposed that a machine-readable formal representation of standards be used. As an initial step, a general model of production standards was developed and applied to some common standards in European agriculture. Based on this model, separating standards into metadata and a list of individual rules (check points), a formal representation was developed. This uses elements from Dublin Core and OGC Geography Markup Language for representing the metadata, and W3C Rules Interchange Format and Web Ontology Language for representing the rules in a fully machine-readable form. Each rule is also additionally included in its original natural-language form, together with metadata indicating which field operations it regulates and what data is required for assessing compliance. In the first instance, this allows simple software to automatically generate a single checklist from all appropriate [...].

A NEW APPROACH FOR IN SITU POULTRY CARCASSES DISPOSAL: A CLOSED SEMI-CONTINUOUS COMPOSTER

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CSBE100972 – Composting experiences have been developed to evaluate the availability of a composter to decompose animal carcasses. These experiences were conducted over a four year period with poultry, under different operational parameters (aeration cycles, composting recipes and temperatures). The amount of carcasses and co-composting materials added was recorded during each loading of the composter. Additionally, pH, conductivity and redox potential were recorded during composting processes, on a weekly basis, and for the final product. Samples for physico-chemical analyses were also taken. Gases released from the decomposing material (CO₂, CH₄, NO₂ and NH₃) were measured on a weekly basis by an automatic analyser. Temperatures of the material mass inside the composter and outside the composter were recorded continuously with Pt-100 sensors and a data logger device. Agricultural evaluation of the final product was determined by the procedure described by Zucconi *et al.* (1985). Composting has been shown to be effective in destruction of pathogenic agents. In order to minimize the environmental impacts, composting of animal mortalities should begin within 24-48 hours of death. For a carcass compost pile, a C:N ratio of 30-35:1, moisture content of 40-60% (wet basis by mass) and proper [...].

TRACER GAS TECHNIQUE IN COMPARISON WITH OTHER TECHNIQUES FOR VENTILATION RATE MEASUREMENTS THROUGH NATURALLY VENTILATED BARNs

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CSBE100974 – Naturally ventilated barns have the advantages of providing energy saving and low noise environment for animals. Hence this type of building has gained wide acceptance worldwide. However, there is concern about the ammonia emissions and other airborne pollutants that cause direct damages to ecosystems. Therefore the researchers need to estimate the ventilation rate through out the barn at first to calculate the ammonia stream emitted from it. The calculations of the ventilation rate through such kind of stables are uncertain, because the inside climate in an open stable is directly influenced by atmospheric conditions. Tracer gas technique using radioactive gas (Krypton⁸⁵) was used to estimate the ventilation rates through two naturally ventilated dairy stables. A good relationship was found between the ventilation rate calculated from the tracer gas measurements and the one measured using velocity sensors at the inlet openings. The possibilities of this technique are described in this paper and the obtained results are compared with other methods. Finally some recommendations have been concluded to improve the experimental procedure and evaluation methodology.

REDUCING FRICTION BY ULTRASONIC VIBRATION EXEMPLIFIED BY TILLAGE

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CSBE100975 – Friction forces account for a significant share of the total power required in several agricultural processes, such as tillage. Therefore a reasonable possibility to lower the power requirement is to reduce these friction forces. The application of ultrasonic technology offers a very interesting opportunity to achieve this friction reduction. For this purpose the tool is activated by ultrasonic oscillation. Ultrasonic technology is already used in different industrial applications such as wire or tube drawing. Within a research project at the Institute of Agricultural Machinery and Fluid Power at the Technische Universität Braunschweig (Germany) in cooperation with the Institute of Dynamics and Vibration Research at the Leibniz Universität in Hannover (Germany) the possibilities to reduce friction in agricultural machinery by applying ultrasonic vibration are researched using the example of tilling. For this purpose in a first experimental setup a cultivator tine is activated with 20 kHz in vertical direction by an ultrasonic actuator. During the test procedure forces are measured in x-, y- and z-direction. Additionally the power requirement of the oscillation generator is measured. Finally the results of the experiments with ultrasonic oscillation are compared to those without oscillation.

IDENTIFICATION AND CLASSIFICATION OF OUT OF CONTROL MEASUREMENTS OF A NIR SPECTROMETER UNDER INDUSTRIAL USE FOR ONION QUALITY DETERMINATION

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CSBE100978 – The use of NIR spectrometry for determination of internal quality in fruits and vegetables is widely accepted even in real time applications. Still there exist a high number of variables that are not controlled that modify the spectral information and reduce the precision of the measurements. Some of these variables are: the inner temperature of the product and of the spectrometer, the thickness of the skin and the presence of caps or hollows that act as barrier inside the product. This study validates an unsupervised procedure for the identification of abnormal observations for an on-line NIR spectrometer under industrial use for onion quality determination. Pre-processing methods combined with process control statistics are used for a multivariate supervision of the onion bulb classification under a breeding strategy during five seasons (2004-2008). Since interactions are used in real time detection of abnormal spectra and this helps avoid classification errors that originate from poor contact between a bifurcated fibber and the bulbs, as well as by equipment glitches which eventually occur due to the aggressiveness of the environment. The LPF-TAG developed a model for soluble solid prediction in onion for dehydration based in the NIR spectrum (894 - 1650 nm), which was validated during 2002. The combination of the algorithms of the pre-processed spectra allows the elimination of a part of the interference variance, increasing the number of individuals inside the limits of control for the statistics used (Q and T2 of Hotelling). The evolution of these parameters of control along [...].

SUSTAINABLE PLANNING OF LAND USE CHANGES IN FARMING AREAS UNDER ECOLOGICAL PROTECTION

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CSBE100979 – Land use has been changing in the last decades because of agricultural intensification and land abandonment which implies deterioration in the optimum habitat structure and quality. Habitat degradation and loss, resulting from changes in land use remain significant drivers of biodiversity loss. These trends are widely recognised and have forced national and international agencies to identify protected sites for natural areas with high biodiversity value. Special Protection Areas (SPAs) are natural zones particularly relevant for nature conservation. Regional planning is bound to play an increasing role in nature conservation policies because much biodiversity is located in farming areas outside natural parks. Agriculture in the Mediterranean Basin has always been highly dependent on rainfed crops, cereal, vine and olive. Vine growing plays an important role not only from the economic point of view, but also environmentally as a permanent plant cover in terms of preventing erosion, managing land and water resources in a sustainable way, defending against desertification and settling population in rural areas. A Geographic Information System (GIS) was used to implement a decision tool system to analyse the feasibility of new proposals to upgrade traditional vineyards in Castilla-La Mancha, Spain. The study focuses on the sustainability of current farming practices in Special Protection Areas for Steppe Land Birds. This paper presents a model to quantify the resulting habitat [...].

ECONOMIC PRODUCTION AND PROCESSING OF AGRICULTURAL FIBRE PLANTS FOR HIGH QUALITY APPLICATIONS IN AUTOMOTIVE, BUILDING AND FURNITURE INDUSTRY

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CSBE100981 – There is an increasing demand for high-quality fibres and shives (hurds) from hemp and flax as alternative raw materials in industries such as automotive and building industry. Fibres are mainly used for composite reinforcement instead of synthetic fibres. Shives are used for animal bedding, but processing trials in wood industry for the production of low weight particle boards from shives are also very promising. Experience in cultivation and harvesting as well as modern processing technologies are needed for fibre producers to supply technical hemp and flax fibres as well as shives at competitive prices under the changing conditions of international raw material markets. For detailed investigations of all processing stages of fibre production a complete processing line has been developed, installed and tested at the Leibniz Institute for Agricultural Engineering (ATB). With the novel ATB line high quality fibres and shives can be produced from retted and unretted hemp, flax and oilseed flax straw without technical changes of the machine line. In the last two years the ATB pilot plant has been operated by a cooperation of farmers, a fibre processor and a machine producer at industrial scale. The experiences from industrial operation has been used to develop a modern fibre processing line with a throughput of up to 5 t h⁻¹ hemp straw in only one short line.

USING PRE-HEATED SUNFLOWER OIL AS FUEL IN A DIESEL CYCLE ENGINE

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CSBE100982 – In this work trials were carried out for 50 h on a single cylinder direct injection micro-tractor, using 100% sunflower oil as fuel to compare with petroleum diesel. In the first trial (E-1), we used the vegetable oil entering the system at air temperature in the injection system of the engine; in the second (E-2), the oil was heated at a temperature of about 90 °C; and in the third (E-3) only petrodiesel was used. In the first test after 50 h, a burning of the head gasket was found. To the trials E-1 and E-2 an increase in the compression pressure was found. The carbonized mass in the nozzle of the E-2 was 81.5% lower than E-1. The carbonized mass in the intake system of the E-2 was 51.7% lower than the E-1 and in the exhaust system of E-2 was 33.4% lower than the E-1. For the combustion chamber the carbonization of the E-1 was almost equal to the E-2. With respect to fuel consumption by hour, the E-1 and E-2 were respectively 2.3% and 0.7% higher than the petrodiesel (E-3). The lubricating oil was contaminated by vegetable oil fuel in the first two tests. Overall the E-2 was better than the E-1.

THE EFFECT OF PADDY MOISTURE CONTENT ON MILLING LOSSES AND POST-MILLING CRACK DEVELOPMENT IN RICE KERNEL, UNDER DIFFERENT STORAGE CONDITIONS

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CSBE100983 – In this study three major paddy varieties of Mazandran province, Iran (Tarom-Hashemi, Tarom-Shamsi and Fajr) were selected to determine the appropriate moisture content for reducing the milling losses and crake development after milling. The samples were taken from batches which were dried in oven for one day (24 hours), two days, three days, and one with no drying. The corresponding moisture contents were 10%, 8%, 6%, and 13% (all wb). The rubber-roll sheller and vertical abrasive cone whitener was used to mill the paddy. Recovered brown rice was passed through whitener, one and two times. Different parameters such as the weight of paddy, crack percentage before and after drying, and after milling, rice breakage, moisture contents of paddy before and after drying, white rice recovery, and their breaking hardness force were measured for taken samples. For measuring the crack development, samples were kept at two different conditions free at room condition (Jute bag) and plastic bag for two weeks. The factorial experiment with three replications was used for statistical analysis. The results revealed that the variety, whitening times and initial moisture content had significant effect on milling losses. It was also found that the storage type had significant effect on crack development after milling. According to the results, the appropriate moisture content was 8% and 10% for Tarom (Hashemi and Shamsi) and Fajr, respectively for maximum white rice recovery. The storage of rice in plastic bag for two weeks prevented the crack development in all rice varieties, especially for low moisture content treatments.

DEVELOPMENT OF A REMOTE CONTROL SYSTEM FOR AUTONOMOUS AGRICULTURAL VEHICLES

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CSBE100984 – This paper presents a method to develop a system, which will enable an autonomous agricultural vehicle to follow a leading vehicle with a given lateral and longitudinal offset. With the aid of the RTK GPS systems the position of the leading tractor was obtained every 500 ms with accuracy in the range of centimeters. To provide the target position for the guidance of the following agricultural vehicle, the position information of the leading vehicle was transmitted by wireless modems to the following vehicle continuously. With the method of curve fitting a desired path for the following vehicle could be dynamically created. Based on the target position and the generated path the desired speed and the desired steering angle of the following tractor are calculated. In order to ensure the precise navigation of the driverless following tractor, a course tracking controller and a speed controller were designed and implemented. Wireless communication was used to transmit process data and operation commands between the agricultural vehicles and a data protocol was developed to make the vehicles working collaboratively. In addition to the motion control algorithms which could keep the autonomous agricultural vehicle following the leading tractor, considerations about safety and robustness of the whole platooning control system will also be issued in this paper. The whole research work is supported by the Federal Ministry of Food, Agriculture and Consumer Protection of the German Government.

USE OF TWO DRIPPERS SPACING IN THE SAME LATERAL LINE AND THEIRS EFFECTS ON THE WETTED BULB FORMATION, YIELD AND QUALITY OF RADISH (RAPHANUS SATIVUS L.).

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CSBE100986 – The objective of the present study was to compare drip lateral lines with the same between emitter spacing and lateral lines consisting of two sections, each one with a different emitter spacing, which results in better emission uniformity but has not been evaluated under field conditions. This research evaluated the generated wetted bulb for both conditions and the physical, chemical and physicochemical parameters of the radish. Conventional drip lateral lines with 20 cm emitter spacing were compared to proposed drip lines, with 24 cm emitter spacing in the first section and 20 cm emitter spacing in the final section; conventional drip lateral lines with 30 cm emitter spacing were compared to proposed drip lines, with 36 emitter spacing in the first section and 30 cm emitter spacing in the final section. In the first section 100 kPa head pressure was used and 70 kPa in the final section of all the drip lateral lines, keeping the same unit discharge per meter of the lateral line in all the treatments. The experiment was carried out in a greenhouse located in Sao Manuel, SP, Brazil. A randomized complete block design with six treatments and four replications was used to simulate the first and final sections of all the drip lateral lines evaluated. Results showed no difference among treatments for most of the evaluated variables. Thus it was concluded that differences between emitter spacing can be used in the same lateral line to increase the line length without decreasing the crop yield and quality.

EXPERIENCES ON THE INTEGRATION OF THIN FILM PHOTOVOLTAIC MODULES IN A MEDITERRANEAN GREENHOUSE

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CSBE100987 – Photovoltaic thin film modules are a suitable option for the integration of solar based energy generation systems in greenhouses, specifically in countries where, as Spain, the existence of favourable feed-in tariff for renewable energy sources serves to increase the yearly income of such a agricultural exploitations. This work describes the experience performed at the University of Almería where a 1000 m² pilot installation has been built and monitored, allowing the analysis of key features of the system design (modules characteristics and structural integration), functionalities in terms of overall electricity injected into the grid as well as crop productivity in regard to a reference level. The installation consisted of dividing into two identical and contiguous greenhouse sections where one of the sections roof was equipped with a set of carefully designed thin film photovoltaic modules strips. Both sections were grown under similar conditions for a period of 6 months. Continuous monitoring of the power injected on the grid demonstrates the feasibility of such a systems when installed on a test greenhouse. In regard to greenhouse crop results, this work concludes the need for further research regarding the impact of optical properties changes to the roof related to the use of PV strips that reduce available photovoltaic active radiation (PAR light) for crops.

ENERGY USE IN LEGUME CULTIVATION IN TURKEY

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CSBE100991 – The aim of this study was to analyze the utilization of energy in the production of different legumes in eleven different regions of Turkey to improve the efficiency of its usage. Therefore, the data for the production of dry bean, chickpea and soybean under rainfed and irrigated conditions as well as lentil under rainfed conditions were collected and evaluated according to the energy use efficiency, energy productivity and specific energy for different regions of Turkey. The main energy sources are human, diesel, fertilizer, seed, machine, chemicals and water. The main agricultural operations are seedbed preparation, seeding, fertilization, hoeing, irrigation, spraying, harvesting, threshing and transporting. According to the results, total energy input ranged between 3361.5 and 25229.7 MJ/ha. Energy use efficiency varied between 0.96 and 4.32 based on product and their yields.

A NEW APPROACH OF RICE PROCESSING FOR CONTROL OF COMPOUND CONTENTS AND EATING QUALITY OF COOKED RICE

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CSBE100992 – Rice is one of the major commercial cereal grains. Unlike most cereals, rice is purchased as raw grain, and consumed as a steamed or boiled product. The ordinary process of rice cooking, which consists of adding water, boiling and post-heating, is very simple so that, generally, the quality of raw rice is important for its end products “cooked rice”. In this study, a new approach for rice quality control using changes in the grain tissue during processing was determined. During boiling, the formation and structure of grain tissue was changed or disrupted, this occurred by gelatinization of starch. Relation with such formation changes eluted compounds in the cooking water that were condensed by degrees, because the water was absorbed by the grain or evaporated during boiling. After boiling, the eluted compounds would coat surface of cooked grains. Because these complex changes occurred step by step, for example, the included enzyme related with eating quality was eluted in the early stage of boiling and the starch content was mainly eluted in the middle stage. To apply these changes, the compound content control and eating quality improvement for cooked rice products can be carried out by regulation of cooking water contents. The sensory test indicated that the controlled cooked grains had better eating quality.

APPROACH TO HEAT STRESS MANAGEMENT IN THE MEDITERRANEAN CONSTRUCTION INDUSTRY OF GREENHOUSES

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CSBE100994 – According to previous work, the risk of heat stress on workers who build and perform maintenance work in Mediterranean greenhouses was identified, therefore, this paper establishes the level of heat stress for workers between June and September. Those months correspond to the period of the year when greenhouses are usually built or converted and are also in direct relation to the most adverse climatic parameters in terms of heat stress. For this study, the heat stress index was determined and contrasted with the internationally WBGT index (wet bulb globe temperature heat stress index) for that period of months that were referred to in Almería (Spain). This region has the largest amount of greenhouses surface in the Mediterranean area, with total surface of approximately 30 000 hectares. It was concluded that the most damaging heat stress period of work during the day for those months is between 10:00 AM and 4:00 PM (GMT), and with regards to the months it was in decreasing order: July, August, June and September. However, in the greenhouse construction industry work schedules consider these occupational risks for their employees, and carry on with their work during these time periods, stopping only work one hour during the lunch period. It is necessary to propose a modification of the work schedule in this sector to help protect human health.

MODELLING BAFFLES IN WATER ACQUACULTURE PONDS

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CSBE100995 – The following article details the use of hydraulic characterization of waste water movement within phytotreatment ponds, collecting water coming from an intensive fish farm, located in the Orbetello area, before returning the water to the Orbetello lagoon (Grosseto, Italy) with the aim of increasing residence time and water quality. The problem analyzed through an experimental approach with trials on a physical model, to scale, of the pond. Visualization techniques, through the use of a tracer added at the entrance of the physical model, allowed the determination of the efficiency of the system, tested under different conditions. In particular, baffles have been used to improve the system efficiency, reducing recirculation areas which are not involved in the water movement within the pond. Results from trials conducted on baffles, by modifying their position and their length, were able to characterize the influence of the forced paths established by the baffles on the reduction of the recirculating areas and the lengthening of the residence time. Moreover, different tests on the influence of the water input and output position have been carried out to characterize the preferential paths in the water movement and the consequent effect on dead zones creation and extensions.

AN INNOVATIVE APPARATUS PROVIDED WITH A CUTTING AUGER FOR PRODUCING SHORT LOGS FOR BIOMASS ENERGY FROM FAST-GROWING TREE SPECIES

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CSBE100999 – Cutting fresh wood into small pieces, rather than into chips, may help avoid fermentations occurring in storage. A prototype was developed for reducing tree trunks into pieces through an innovative cutting mechanism that performs a gradual and oblique cut. The device consists of a large auger in which a knife, with a triangular section, is inserted on the outer edge of the helicoid, protruding 70 mm from the flight. The trunks, fed perpendicularly into the machine, are pushed along the axis and slices are cut off against a fixed counter blade having a sharp edge. The main frame of the machine is the cylinder enclosing the auger, it is closed at one end where a heavy flywheel is inserted to deliver the energy coming from the tractor's PTO. The pieces exit through the opposite end. The auger has a 700 mm diameter and a 300 mm pitch spacing. The logs are pushed into the machine by counter-rotating rollers placed in the feed funnel. Tests were carried out to establish operative performance and power requirements of the machine. The cutting method requires less power compared to wood chipping machines. Work capacity is greater when producing slices instead of chips and the system produces less noise and fewer vibrations in the machine. The auger reaches a constant velocity of 200 RPM, cutting fresh wood of different species easily, up to a maximum trunk diameter of 20 cm. The length of the slices of wood can range from 4 to 19 cm.

EVALUATION OF IRRIGATION SYSTEMS BY USING BENCHMARKING TECHNIQUES

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CSBE101003 – Water scarcity, which is typical of arid and semiarid regions such as Castilla- La Mancha (Spain), makes necessary the efficient use of water and energy resources. For this aim, there are several Decision Support System tools, where a benchmarking technique for one of them was established. This technique is based on comparison between management of different Water User Associations (WUAs). The aim of this work is comparison of two of the most extended irrigation systems (sprinkler and drip irrigation systems) in Castilla- La Mancha (Spain), by using performance indicators related to management of irrigated area. The Benchmarking technique was applied during three irrigation seasons (2006-2008) in seven WUAs of Castilla – La Mancha Region (Spain), in which groundwater resources are the most common source of water. The command area of those WUAs is comprised between 170 ha and 1700 ha. The proposed indicators utilized in the Benchmarking techniques are classified into two groups: descriptive and performance indicators. The information required to calculate the proposed indicators as obtained from managers and farmers of each WUA, complemented with data obtained by using specialized equipment. For each irrigation system analyzed (sprinkler and drip irrigation systems) a preliminary analysis by descriptive statistics was performed, with averages and dispersion measures for most of the indicators obtained. In order to establish the grouping and differences between WUAs with different irrigation systems, a Cluster Analysis was applied. The [...].

SIMULTANEOUS HARVESTING OF STRAW AND CHAFF FOR ENERGY PURPOSES - INFLUENCE ON BALE DENSITY, YIELD, FIELD DRYING PROCESS AND COMBUSTION CHARACTERISTICS

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CSBE101005 – In the harvesting of straw for energy purposes, only the long fraction is currently collected. Technological developments have now made it possible to also harvest chaff. By mixing in this fraction with the straw swath at combine harvesting should be possible to increase the amount of harvest residues collected and the bale density could be expected to increase. These considerations suggest that there is potential to increase the productivity of fuel straw harvest and transportation. The objective of the study was to investigate how simultaneous harvest of straw and chaff influenced yield, bale density, field-drying behaviour and combustion characteristics. Field experiments were carried out during 2009 for long- and short-stalked winter wheat crops. Combine harvesting was carried out with two different types of combine harvesters. Baling of the crop residues was accomplished with a high-density baler. It was observed that mixing in chaff in the straw swath by combine harvesting compared with straw only gave a lower initial moisture content in the swath behind the combine. With respect to baling, the density and the weight of each bale were not affected by the treatments. On the other hand the added chaff increased the total yield of crop residues by 14 %, showing that about half of the biologically available chaff was harvested. Mixing in chaff increased the ash content by 1 percentage unit. This did not cause any significant change in net calorific value or ash melting behavior.

COMPARISON OF TRACTOR-ROTARY TILLER COMBINATION AND POWER TILLER IN TERMS OF ENERGY EXPENDITURE OF OPERATORS

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CSBE101007 – Many different equipment and machinery have been used while performing agricultural operations. Some equipment and machines can be used to perform the same operation. When a user is purchasing equipment he often considers the power output, maintenance capability and ease of use before choosing a specific machine. In this study, we compared an operator's energy consumption for working a rotary tiller mounted tractor with a power tiller that has the same working width. Energy consumption of operators was measured by SensWear Armband when performing hoeing a field operation. Measurements were taken for the operation of four different machines at three different forward speeds. Three experienced operators participated in this research experience. Measurements of energy consumption values were statistically analyzed using Minitab 15.0 and MSTAT. Variance analysis showed that forward speed, operator, type of machine showed interactions that were statistically significant ($p < 0.01$). Based on the findings of these analysis; energy consumption of operators increased with the increasing of forward speed. Energy consumption value of each operator was different when working with power tiller. Energy consumption value of tilling operation with power tiller was higher than that of the rotary tiller mounted tractor.

DEVELOPMENT OF AN EXPERIMENTAL SYSTEM FOR AGRICULTURAL WORK PROCESS MEASUREMENT

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CSBE101008 – Agricultural work processes are human labour intensive and usually performed in hostile environments (e.g., humidity, temperature, radiation, low visibility due to occlusions). The processes consisted of complex, non-uniform manual operations which demand from the worker high mobility, accuracy and awareness and were not planned according to production engineering and ergonomics aspects. In addition, the physiological data of the workers such as fatigue or physical and mental workloads were not regarded. This paper presents an innovative experimental system developed for work processes measurements in agriculture. The experimental system consists of three measurement devices: work study device - an IPAQ 1930 PPC platform with dedicated software using C# developed by the authors; environmental and meteorological device – HOBO platform capable of measuring temperature, relative humidity; and, physiological measurement device intended to measure the overall work load by measuring heart rate during each task. All platforms were integrated to a single system and the measured data was synchronized using a PC. The experimental system developed can compare between the data collected with the three subsystems and evaluate the influence of one on another. Experiments were conducted on 8 different workers in a flower farm using the developed system. The results show that the actual system resolution is between 3 to 5 s. analyzing the work processes data collected by the system revealed that although the overall relative physical workload is not high during the day as reflected in the average heart rate there was a significant ($\alpha < 0.01$) negative linear correlation between [...].

EVALUATION OF DIFFERENT MINIMUM VENTILATION SYSTEMS IN THE PRODUCTION OF BROILER CHICKENS ON AIR QUALITY FOR PERIODS OF 1 TO 7 DAYS

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CSBE101010 – The objective of this work was to evaluate the efficiency of different minimal ventilation systems including positive pressure ventilation (SVMP), negative pressure ventilation (SVMN) and natural ventilation (SVMNat), associated with the thermal comfort environment, air quality and the influence of these factors on the productive performance of broiler chicken during the heating phase of hatchlings (1 to 7 days). Verification of different environmental variables such as air temperature, black globe temperature, relative humidity and air velocity at bird respiration level were evaluated. Ammonia, carbon monoxide and oxygen concentrations were verified at intervals of 3, 9 15 and 21 h. Minimal air renewal in the treatments with positive and negative pressures were controlled by means of timing devices, with differential air renewal for each week of life of the hatchlings. No statistical difference ($P < 0.05$) was observed for the environmental variables. Average ITGU values in the first week were below the birds comfort levels, exposing them to cold stress for the majority the three minimal ventilation systems, indicating probable deficiencies in the heating systems and/or the insulation system for hatchlings in their initial growth phase. Average pollutant gas measurements did not surpass tolerable levels for the three minimal ventilation systems evaluated. However, minimal ventilation systems were [...].

DESIGN OF AN AUTONOMOUS SPRAYING ROBOT FOR GREENHOUSE

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CSBE101012 – Chemical applications are intensively applied in agriculture to overcome insects and plant diseases which cause significant damage to pepper production. However, the extensive current use of pesticides in agriculture has several disadvantages: a) high cost, b) an increase in pest immunity, c) high poisoning in pesticide leaves a leftover toxicity in produce, as well as poisoning the food chain and environment. Another drawback is the manpower required for the application. The increase in human labour costs combined with the shortage of available workers and the will to develop safer and cheaper ways to apply the pesticides has lead to the development of autonomous spraying systems. The objective of this research is to design an autonomous robot for spraying in pepper greenhouses from a systems engineering aspect. A model which simulates the workspace and the requirements of the robot was developed. The performance of the autonomous sprayer is determined by a comparison to a conventional sprayer. The parameters analyzed include the nozzles position, the number of nozzles, limits of pesticide dose requirements for the spraying systems and influence of the environment. Two simulation models have been developed. One examines the system efficiency according to the amount of material needed in order to cover an infected area and the distribution pattern of the material on the plant. The other model examines the efficiency of the dynamic design of the autonomous robot. Both models incorporate an economic analysis model. [...].

AMMONIA EMISSIONS FROM BROILER HOUSING FACILITY: INFLUENCE OF LITTER PROPERTIES AND VENTILATION

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CSBE101015 – At present, the European Union regulations allow to keep broiler chickens on litter covered floors only. Properties of litter (litter temperature, litter age) with ventilation rate are therefore important parameters influencing ammonia (NH₃) concentrations and emissions in broiler houses. Litter temperature, litter age, and ventilation rate were measured in commercial grow-out facility with deep litter, designed for 25,000 broilers, during 6 consecutive flocks. Birds were housed from hatching to 40 days of age. Litter temperature and litter age positively correlated ($P<0.001$) with production of ammonia gas. The amount of ammonia emissions increased with increasing litter age ($P<0.001$), as a consequence of which both the ammonia concentration and ventilation rate ($P<0.001$) also increased. The lowest concentrations of NH₃ were observed during summer, although ammonia emissions tended to be higher in summer months due to higher ventilation rates. The elevated levels of ammonia in winter were attributed to the lower ventilation rates during cold weather. From the ammonia emission data, it can be concluded that during the grow-out period of broilers kept on renewed litter there is an average loss of 6.18 g ammonia per bird and/or 0.043 kg of ammonia per bird yearly. Increasing litter temperature during grow-out periods is a process, which could be controlled to prevent excessive ammonia volatilization from housing.

EFFECT OF THE TYPE OF SPRINKLER AND HEIGHT ABOVE THE SOIL ON ONION (ALLIUM CEPA L.) CROP

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CSBE101017 – In arid or semiarid regions such as Castilla-La Mancha (Spain), a sustainable use of water for agriculture should be carried out. Under these conditions it is necessary to use potentially efficient irrigation systems, such as drip and sprinkler irrigation systems. Centre pivots are a very interesting alternative among other sprinkler irrigation systems. In order to obtain the combination that best fits the field conditions (soil, wind, crops, etc.), it is important to determine the behaviour of the different sprinklers and their height above the ground level. The main goal of this work is to characterize the water application process in a centre pivot, above the crop and at soil level, by using two types of sprinklers and two heights above ground level, and studying its effect on onion (*Allium cepa* L.) yield. The case study has been analyzed during one irrigation season (2008) in a plot irrigated with a central pivot irrigation system, located in Albacete (Spain). In the irrigation system, two repetitions of the most common commercial types of sprinklers in the Region were installed in the centre pivot, Rotating Spray Plate (Rotator™) and Fixed Spray Plate (LENTM), and each one for two heights above the ground level (1 m and 2.5 m). During the irrigation season several evaluations of irrigation system were performed, obtaining parameters related to the distribution of water above the crop (Christiansen uniformity coefficient, distribution uniformity, etc.). In addition, for each combination of sprinkler and height, crop yield, biomass and harvest index were calculated. In order to monitor the soil moisture, Watermark™ sensors, which measure soil water potential, together with EnviroScan™ sensors, [...].

TECHNOLOGICAL AND ORGANIZATIONAL DEVELOPMENT POTENTIALITIES FOR GRAIN LOGISTIC IN GERMANY

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CSBE101018 – German agricultural grain logistic is in a process of transformation. The agricultural sector has to face up to several complex requirements in their entity. New technical and organizational structures in grain logistic are necessary to react on these changes like increase of farm sizes, power enhancement of combine harvesters, longer transport distances to the traders and increasing demand for high quality from the consumers. Based on multiple scientific analyses, possible adaptation strategies are demonstrated. For transport technology, an increase in the linkage of agricultural and industrial transport technologies can be observed. The results of these changes on working time, transport costs and management are shown for a farm with 400 hectares. Between the different transport chains cost differentials up to 9 €/t are possible. In the future, it will not be possible anymore to plan the transport organization only for a single farm but larger transport networks will become necessary. Simulations for systems with connection trailers and interim storage show that the bunching of available reserves lead to a reduction of work peaks with increasing farm sizes. Due to the development in transport organization an extension in transport data management is also necessary. Systems which are in use in the industrial logistics that are suitable for agricultural logistic that have reasonable costs have been examined.

BEDDING MATERIALS FOR CATTLE BARNS AND THEIR THERMO- TECHNICAL PROPERTIES IN DIFFERENT CLIMATIC CONDITIONS

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CSBE101021 – Thermo-technical properties of organic materials (straw, sawdust, separated slurry with thickness of 200 mm on concrete base) in comparison to rubber mats and rubber foam mattresses used for bedding of cubicles for dairy cows were evaluated. Thermal resistance and thermal effusivity were calculated according to official technical standards. Coefficient of thermal conductivity needed for these calculations were obtained in real conditions of experimental farms. Thermal resistance of straw varied from 0.966 to 2.914 m².K.W⁻¹, wooden sawdust from 0.688 to 1.781 m².K.W⁻¹, separated slurry from 0.908 to 1.274 m².K.W⁻¹, and rubber mattresses and mats from 0.76 to 1.47 m².K.W⁻¹. Thermal effusivity of straw ranged from 162.34 to 423.63 W.s.^{1/2}.m⁻²K⁻¹, wooden sawdust from 333.5 to 773.52 W.s.^{1/2}.m⁻²K⁻¹, separated slurry from 308.97 to 469.36 W.s.^{1/2}.m⁻²K⁻¹. Data were collected in summer as well as in winter conditions and both with dry and wet organic materials.

EVALUATION OF CHIPS QUALITY BY THE ANALYSIS OF TWO DIFFERENT HARVESTING METHODOLOGIES

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CSBE101024 – An innovative SRF harvesting system based on two steps operation, was developed by CRA-ING 1) the tree felling and inter-row windrowing performed by a feller-windrower equipment; 2) subsequent chipping performed by a harvester equipped with pick-up device. At the harvesting time, the windrowed trees showed a low moisture content affecting their physical qualities and mechanical strength throughout the chipping operation. This work aims to analyze the moisture losses of windrowed trees, in relation to the windrow location, on field storage and weather condition, as well as to characterize chips quality changes during on field storage by the two different harvesting systems comparing the innovative two steps with the traditional one step harvesting systems.

A NEW DESIGN FOR HIGHLY EFFICIENT PARTIAL PIT VENTILATION

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CSBE101025 – The study was conducted at an experimental farm with three sections with 32 growing finishing pigs, fully slatted flooring, diffuse air inlet and a maximum ventilation capacity of 100 m³/hour/pig. The control section was equipped with room exhaust, and the two experimental sections with both room and pit exhaust. In both experimental sections, the openings of the slats in the fully slatted flooring were reduced by 40 per cent in order to improve the efficiency of the pit ventilation. Two suction points were studied, either underneath the dunging area or the resting area of the pen. During the summer 2009, measurements were made for two batches of pigs weighing 32-107 kg. Every week, the pit exhaust was switched between two fixed rates of either 10 or 20 m³/hour/pig. Altogether, 120 odour and hydrogen sulphide measurements were made. Ammonia was measured continuously. Results showed that at a pit ventilation of 10 m³/hour/pig, the concentration of hydrogen sulphide was reduced from 246 ppb in the control section to 87 ppb and 22 ppb in the experimental sections with suction point underneath dunging and resting areas, respectively (P<0.001). Comparing the control with the experimental section with suction point underneath the resting area, the room concentration of ammonia was reduced from 9.3 to 2.2 ppm and odour concentration from 480 to 200 OU_E/m³ (P<0.001). Year-round, a partial pit ventilation rate of 10 m³/hour/pig can be expected to collect more than 70 per cent of the ammonia emissions, more than 50 per cent of the odour emissions and more than 90 per cent of the hydrogen sulphide emissions.

QUALITY OF WOODEN CHIPS PRODUCED BY CLAAS JAGUAR FITTED WITH EXPERIMENTAL CRA-ING ROTOR

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CSBE101026 – The Agriculture Engineering Research Unit of the Agricultural Research Council (Rome) has designed a new innovative chipper device for mounting on Class Jaguar chipper harvesters for short rotation forestry harvesting. The new rotor differs from standard rotors as it has a lower number of blades and blade-holders, from 24 to only 10 and it has a different cutting angle and drum insertion. This study evaluates the particle-size distribution of chip produced by standard rotors compared to those with the experimental rotor. The scope of this study is to distinguish the particle size distribution of chips produced using the two types of chippers, thereby evaluating a possible influence of wooden species in the chip formation process. The tests were conducted using 860 and 890 Claas Jaguar chipper harvesters, both equipped with standard and CRA-ING rotors. Furthermore, the experiment was conducted on poplar cultivations on biennial shift and on arboreal cultivations, the latter being cut down previously. As opposed to using traditional rotors, CRA-ING rotors provide a significant product increase within particle sizes ranging from 12.5 to 25 mm, and an equivalent product reduction within the finest particle size classes. However, it is evident that the new rotor tends to concentrate dimensional increments along the longitudinal section of the chip, regardless of the species used. Therefore, following the results, a second rotor was devised to engrave a cleaner cut on the biomass introduced by the feeding rollers, thereby obtaining a superior quality of chip in terms of particle size and increasing the size of the chip [...].

EFFECTS OF HABITUATING HEIFERS TO THE MILKING PARLOUR ROUTINE PRIOR TO CALVING AND EFFECTS OF THE REARING METHOD ON HEART RATES OF HEIFERS DURING MILKING

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CSBE101028 – One of the aims of this study was to investigate changes in heart rates in the first days of lactation during the milking procedure as a result of habituating heifers to the milking parlour environment prior to calving. The other was to evaluate the influence of the rearing method. A group of five heifers (group TF) was exposed to the full milking parlour routine once daily (afternoon milking) on three subsequent days about one week prior to calving. Ten heifers routinely entered the milking parlour the first time for the afternoon milking after calving. Five of these heifers (group F) were reared with an automatic teat feeder, five (group FKK) were reared naturally by suckler- or foster cows. The control group consisted of two cows (group K), entering the milking parlour routinely the first time for the afternoon milking after calving. Heart rate was evaluated with a POLAR heart rate monitor on day one and nine of lactation during the milking procedure. The respective heart rates could be assigned to the events in the milking parlour via videoanalysis. On the first day of lactation group F and group FKK displayed nearly the same heart rates. TF had lower heart rates compared with the two other heifer groups. On day one of lactation the lowest heart rates were recorded for group K. During the first nine days of lactation the differences between the heifer groups diminished. Only group K showed lower heart rates on [...].

THIN LAYER DRYING OF SLICED SQUASH BY FORCED CONVECTION

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CSBE101029 – In this study, a laboratory dryer was used for thin layer drying of sliced squash at different drying conditions. The effect of slice thickness, drying air temperature and velocity were investigated. The head and the end parts were removed and then the squash was sliced. The moisture ratio changes during the drying time were calculated with initial moisture content and weight changes during the process. The moisture ratio values were applied to the 12 different thin layer drying models, namely Newton, Page, Henderson and Pabis, logarithmic, two-term, two-term exponential, Wang and Singh, Thompson, diffusion approximation, Verma et al., modified Henderson and Pabis and Midilli et al. These moisture ratio models were evaluated according to the statistical criteria of root mean square error, reduced chi-square and modeling efficiency. According to the results, sliced pumpkin was dried in about 1.5 hours at slice thickness of 6.4 mm and 5.5 hours at slice thickness of 25.4 mm for constant drying air temperature of 80°C and velocity of 2.0 m/s. The drying time was 1.5 hours at drying air temperature of 80°C and more then 8.0 hours at temperature of 40°C at slice thickness of 6.4 mm and drying air velocity of 2.0 m/s. While the drying time was about 4.0 hours at drying air velocity of 1.0 m/s, it was decreased to 1.5 hours at the velocity of 2.0 m/s at constant slice thickness of 6.4 mm and drying air temperature of 80°C. The Page model was chosen to explain thin layer drying behaviour of sliced squash satisfactorily.

STUDY ON THE PARAMETERS OF HIGH PULSED ELECTRICAL FIELD ON FRUIT AND VEGETABLE AS PRE-PROCESSING FOR THE VACUUM FREEZE-DRYING

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CSBE101030 – The effect of high pulsed electrical field as pre-processing on fruit and vegetable was studied, and it was aimed to break down the tissue cells reversibly and increase the dehydration rate efficiency. More importantly, the research was conducted to solve processing problems in the vacuum freeze drying, such as energy consumption, processing cost and low drying rate etc. The drying experiments of apples on high pulsed electrical field were carried out, and the results showed that high pulsed electrical field pre-treatment could increase the drying rate significantly. Based on the range analysis, the optimum parameters were obtained as follows: pulse strength was 1000V·cm⁻¹, pulse duration was 120μs, and pulse number was 30. In condition of optimized drying process, energy consumption per unit of water was reduced by 17.74%, freeze drying time was shortened by 22.50%, and productivity of per unit area was increased by 28.50% than that of the untreated group. Moreover, the pulse duration, pulse strength and pulse number were in order of importance among the obtained parameters.

QUALITATIVE AND QUANTITATIVE ASPECTS ON FIELD DRYING OF SORGHUM AND EVALUATING THE MOWER CONDITIONER PROTOTYPE DEvised BY CRA-ING – CRESSONI

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CSBE101031 – Fiber sorghum is an important crop with a large potential as an energy target related not only to energy but also to anaerobic digestion (biogas), as well as second generation bioethanol production. Structural aspects of this crop in size, strength, reduced water release in post-mowing, have often represented a limit to the harvesting mechanization as adried product. In Italy the harvesting of dried fiber sorghum has frequently been a serious problem in regards to mechanical limits of the commercial harvester in conditioning fiber sorghum that do not permit the spread of the cultivation except for silage use only. The result established that the crop was only established in areas able to use the fresh product, for which standard equipment is readily available on the market. To overcome the above mentioned limits, CRA-ING after harvesting, analyzed the structural aspects of the crop after the evaluation of the modified solutions available on the market. The design and development of a prototype mower conditioner was completed in 2007 and then modified in the winter of 2008. The experimental tests were conducted northern and central Italy. In 2009, other experimental tests with the equipment were carried out in others regions of the country, in order to define the prototype performance. In addition, investigations on the qualitative aspects of the drying by evaluating the degradation of cellulose from the early stages of harvest, were carried out. The experimental activity was conducted in collaboration with major corporations [...].

RADIO FREQUENCY INTERACTIONS WITH AIR CARGO CONTAINER MATERIALS FOR REAL TIME COLD CHAIN MONITORING

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CSBE101034 – Transportation is an important part of the supply chain as goods are being transported over thousands of kilometres from their production sites to consumers thanks to increasing globalization. Many perishable items, most of which are temperature sensitive, need to be transported by air due to their short shelf life. Today's regulations do not allow RFID to be utilized inside aircrafts during flight, but the need for real time cold chain management is pushing the air cargo industry to investigate the capabilities of this technology. Since, environmental conditions highly influence the RFID system's outcome, it is mandatory to understand the RF behaviour around air cargo materials. For this study, three frequencies (433MHz, 915MHz and 2.45GHz) and five aircraft container (ULD) materials (Aluminum, Duralite, Herculite, Kevlar® and Lexan®) were evaluated inside an anechoic chamber. Two tests were performed to detect the signal strength at various points in the measurement space under different configurations to observe the effects of aircraft container materials on RF wave propagation. The results of this study showed that the signal transmission through Aluminum was poor due to the fact that most of the energy was reflected from the surface which caused variations in signal strength in front of the sample. On the contrary, RF waves propagated easily through all four of the other materials, allowing most of the energy to be available behind the samples while a very small amount [...].

DESIGN AND EVALUATION OF A JAB PLANTER

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CSBE101037 – Final year Bioresources Engineering students at the University of KwaZulu-Natal, South Africa, have designed, constructed and evaluated a manually operated jab planter to operate under no-till conditions. The planter consists of a frame and handle, seed hopper, a precision seed metering mechanism, a seed delivery tube and a ground opening device. The planter was evaluated by comparing the performance when planting using a conventional hoe or using the no-till jab planter. This paper contains a summary of the design requirements and performance of the jab planter.

FIRST APPROACH TO CORRELATE THE TIRE CONTACT AREA TO TRACTION FORCE IN THE FIELD

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CSBE101038 – Tractor working capacity could be restricted by the losses along all the power train including the effect of tires. Since increasing the pulling performance is the key for operational and cost effective practices, tire selection and arrangement have been investigated. The pulling properties of an agriculture tire depend on several factors characterizing the interaction with soil. In order to estimate the possible correlations between geometrical measures of the tires and the force exchanged with soil, the CRA-ING Research Laboratory of Treviglio investigated footprints obtained on paper sheets by inked treads. From these footprints were studied both the total area and only the area from treads, and were correlated with the drawbar force. Two tractors fitted with different tires and in different test conditions were tested. During the 2009 field test season, the performance of several different tires made by different companies in two test campaigns were compared on three different fields, two ballast weight setups, two tire pressure setups (100,160 kPa) and different wheel slippage percentage with two and four wheel drive. Data processing showed a high correlation between the values of the contact area and the drawbar force at certain values of the wheel slippage.

SHORT ROTATION WOODY BIOMASS PRODUCTION AS OPTION FOR THE RESTORATION OF POST-MINING AREAS IN LOWER LUSATIA, GERMANY

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CSBE101040 – Site conditions on reclaimed mine sites in the Lusatian lignite-mining district, located in the German Federal State of Brandenburg are characterized by low annual precipitation sums and marginal soils. Due to these unfavorable conditions, crop yield is generally low, and hence, conventional land use systems often fail in terms of reliable and efficient crop production. In this context, the production of woody biomass for bioenergy may be a promising alternative for both to improve soil fertility and to enhance the economical value of these post-mining areas. Previous investigations have resulted in black locust (*Robinia pseudoacacia* L.) being seen as a suitable tree species for this purpose. In this paper the attempt is made to evaluate the production of woody biomass in short rotation coppices (SRC) and alley cropping systems (ACS) with black locust concerning possible ecological and economic benefits. The results show that, due to both high establishment and harvesting costs and comparatively low prices for energy wood, land use systems such as SRC or ACS are currently hardly profitable compared to conventional agriculture. However, due to an improved microclimate the crop yield in ACS is higher than at conventional agriculture. Furthermore, the cultivation of black locust resulted in a higher humus accumulation and in a lower harvest-related nutrient export than the cultivation of alfalfa (*Medicago sativa* L.) as a typical recultivation crop in this region. Therefore, it can be concluded that for an improvement of soil fertility in the degraded post-mining areas of Lower Lusatia, SRC with black locust are more beneficial than conventional agriculture.

BIODRYING OF ANIMAL SLAUGHTERHOUSE RESIDUES AND HEAT PRODUCTION

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CSBE101041 – For several years, the cost of disposing of slaughterhouse residues has been rising sharply in Québec. Composting of animal carcasses is usually done on farms, but the composting process is not optimized and requires large amounts of carbonaceous inputs. This type of composting takes place over a prolonged period of time (6 to 9 months) in a static pile that is non-aerated and use a large volume of carbonaceous residues that is the equivalent of 3 to 5 times the volume of the original carcasses. To optimize the treatment of slaughterhouse residues, CRIQ developed an organic biodrying process (BIOSECO) adapted to large-scale operations. Biodrying is a form of composting, in which the thermophilic phase is optimized, making it possible to evaporate large amounts of water. Biodrying is done inside a building and reduces the amount of carbonaceous residues significantly (1.75 volume of slaughterhouse residues for 1 volume of carbonaceous residues). The sequence in which the slaughterhouse residues are added, the choice of input and the aeration flow make it possible to optimize the process. Slaughterhouse residues can be treated non-stop throughout the year, summer and winter. Biodrying can be done near the slaughterhouse, since the odours are almost completely limited to the building. During the pilot phase of the project, CRIQ staff observed that a large amount of heat was produced by the process and realized that it offered an interesting potential for use. In brief, the BIOSECO biodrying process makes it possible to treat slaughterhouse residues in an effective and economic manner, to produce heat that could be put to profit for various purposes [...].

DESIGN AND EVALUATION OF AN AUTOMATED SHORT FURROW IRRIGATION SYSTEM

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CSBE101042 – Automated short furrow irrigation (ASFI) is a prototype irrigation system that has the potential to be robust and relatively low cost, with highly effective and efficient water use. ASFI also has low energy requirements compared to other irrigation systems. The aim of this project was to develop, implement and evaluate a suitable ASFI system and to compare the system to a reference sub-surface drip irrigation (SSDI) system with sugarcane as the test crop. This process resulted in the development of a “boot and piston valve”, which was used to automatically control the flow between specific plots. The valve was then used in a trial of the ASFI system at the University of KwaZulu-Natal’s Ukulinga research farm. The testing and evaluation included irrigation uniformity tests and the crop yields. The results indicate that the ASFI performance in terms of distribution uniformity and yield data for the Ukulinga trial could be described as “similar to” SSDI and that the ASFI was considerably more cost effective than the SSDI system in terms of operating and fixed costs per hectare. It is therefore believed that the ASFI system meets the required objectives of the project in that it is robust, low cost (both operating and fixed) and able to supply water efficiently and effectively.

DETERMINATION OF WORK QUALITY AT DIFFERENT TYPES OF SUGAR BEET HARVEST MACHINES

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CSBE101043 – Turkey is an important sugar beet producer in the world. Turkey has produced 15 488 332 tones of sugar beet from 3 219, 806 ha of production area and has also produced 2 061 000 tones of sugar in 2008. Sugar beet harvesting by machine is common practice in Turkey. During mechanical harvesting several mechanical loaders have caused skin and tissue damages to sugar beets. The damages to the skin and tissue of the sugar beets results in quantitative and qualitative losses. After harvesting, comparisons of sugar beets quality are important in terms of sugar losses during transformation process. Three widely used types of harvesters have been operated in this study. One of these machines is fully hydraulic sugar beet harvest machine with adjustable depth and row, the second one is semi-hydraulic sugar beet harvest machine and the last one is a mechanical sugar beet harvest machine. Harvesters were tried in the same field conditions during the months of September and October 2009. Performance values were obtained from three different evaluation methods. These methods are topping quality determination, the determination of sugar beet injury rate and the soil removal rate of the sugar beet. The determinations of these factors are important to obtain the optimum harvest performance. Image process and analysis methods have been used for evaluations. Based on this data the harvest quality difference for harvesters was analyzed statistically.

THERMAL INACTIVATION OF *BYSSOCHLAMYS NIVEA* IN PINEAPPLE NECTAR COMBINED WITH PRELIMINARY HIGH PRESSURE TREATMENTS

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CSBE101045 – *Byssochlamys nivea* is a thermal resistant filamentous fungi and potential micotoxin producer. Recent studies have verified the presence of ascospores of such microorganism in samples of pineapple nectars. Although the majority of filamentous fungi have limited heat resistance and are easily destroyed by heat, *Byssochlamys nivea* ascospores have shown high thermal resistance. The aim of this work was to evaluate the application of linear and Weibull models on thermal inactivation (70, 80 and 90°C) of *Byssochlamys nivea* ascospores in pineapple nectar after pretreatment with high pressure (550MPa or 650MPa during 15min). Following the treatments, survival curves were built up for each processing temperature and adjusted for both models. It was observed that survival curves at 90°C after high pressure pretreatment at 550 MPa/15 min did not fit well to linear and Weibull models. For all the other treatments, the Weibull model presented a better fit. At 90°C without pressure treatment, the Weibull model also showed a better adjustment, having a larger R^2 and a smaller RMSE. Regarding the process effectiveness, a 5-log reduction (t_5), as recommended for pasteurization, was only achieved for *Byssochlamys nivea* ascospores presented in pineapple nectar at 90°C/10.7 min with previous high pressure treatment of 650 MPa for 15 min. Considering the high intensity and energy demanding process with possibly product damage, other preventive and alternative treatments are being investigated.

OPTIMAL HYDRAULIC AND ENERGY DESIGN OF PIVOTS DIRECTLY FED WITH GROUNDWATER

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CSBE101047 – Nowadays, under a context of climatic change and ascending trend of the energy costs, it is necessary to develop methodologies, tools, and actuations with the aim of optimizing the energy resources use, which imply environmental and economic benefits. In Spain, as in the rest of Europe, several measures to improve the energy efficiency in irrigation systems are being implemented. Thus, important energy and economic savings have been obtained by the development of energy analysis in Irrigation Societies, which are also being implemented in private farms. This makes it necessary to determine optimal design of the irrigation systems in plots together with the pumping systems. In this work, a new methodology to determine the minimum total cost (investment+operation costs) in pivot systems fed directly from wells by optimizing the characteristics and efficiency curve of the pump together with the pumping pipe diameter and the pivot diameter, considering soil, hydraulic, and energy conditions. This methodology is based upon the theoretical relations between the characteristic and efficiency curves of the pumps, and considers different aspects such as: hydrological variables (water table and its temporal variation), hydraulic variables (head losses in pipes, demanded flow), and economic variables (energy cost, pump and pipes costs), soil variables (surface sealing and Kostiakov infiltration parameters). [...].

PREDICTION OF LACTIC-BACTERIA GROWTH IN TURKEY HAM PROCESSED BY HIGH HYDROSTATIC PRESSURE

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CSBE101048 – High hydrostatic pressure (HHP) is an innovative technology for food processing with lower environmental impact and product quality damage. Instead of heating, commonly used for food preservation, it uses high pressure (100 MPa to 900MPa) to ensure microbiological safety and maintain sensory and nutritional characteristics. More recently it has been investigated and industrially applied to extend shelf life of meat-based products. Traditional ham stored under refrigeration and microaerophilic conditions may sometimes present high population level of deteriorating lactic acid bacteria, which limits shelf life due to development of unpleasant odour and greenish and sticky appearance. This study aimed to evaluate the shelf life of turkey ham pressurized at 400MPa/15 minutes and stored at fridge temperatures 4, 8 and 12° C, in comparison to the non pressurized product. The population of lactic acid bacteria was considered the limiting shelf life parameter up to 107 CFU/g of product. It was found that by using the storage temperature of 4 ° C, the commercial viability of the control sample resulted in 45 days while the pressurized sample achieved 75 days, showing that the high pressure process greatly increased the product shelf life. Predictive modified using Gompertz and Baranyi & Roberts models fitted well both for the pressurized and control samples, allowing further prediction of product shelf life according to the storage conditions. These results indicated that the high hydrostatic pressure treatment may double the commercial viability of turkey ham, by slowing down the growth of microorganisms in the product.

DEVELOPMENT OF REFERENCE EVAPOTRANSPIRATION MODELS WITH LIMITED DATA BY USING ARTIFICIAL NEURAL NETWORKS STRUCTURES

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CSBE101050 – The analysis of evapotranspiration (ET) measured at ground level has been mainly considered for agricultural activities, with the aim of determining the water requirements and the supply of water in an appropriate manner. Irrigation activity uses 70% of freshwater in the world, which denotes the importance of this use. ET₀ calculation is a key factor for water balance and crop production, water resource management, irrigation scheduling, and environmental assessment. ET₀ can be obtained with indirect measurements, with high-cost micrometeorological techniques, or can also be estimated with mathematical models. The Food and Agriculture Organization of the United Nations (FAO) has proposed the use of the Penman-Monteith equation as the standard for estimating ET₀ and for evaluating other equations. However, some of the weather variables that are required by this model are often not available in irrigation. In such cases, a simple empirical Hargreaves equation is mainly used. The main objective of this paper is the generation of a model that estimates monthly ET₀ values in Castilla-La Mancha region (Spain) from available termopluiometric weather stations with monthly data that can be applied to historical time series. The procedures to estimate the ET₀ values in this study are in one hand, the use of Hargreaves equation, which requires the maximum and the minimum monthly temperature differences, [...].

FARM-SCALE ANAEROBIC DIGESTION OF BEEF AND DAIRY CATTLE MANURE FOR ENERGY COGENERATION AT TWO FARMS IN CANADA

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CSBE101052 – Anaerobic digestion of beef and dairy cattle manure for biogas production, and its combustion for electrical and thermal energy cogeneration was studied since 2003-2005 at beef and dairy cattle farms in Canada. Manure from about 7500 beef cattle at a feedlot was digested at thermophilic temperature (55 deg. C) in two 1800 m³ above-ground digesters with a hydraulic retention time (HRT) of 14 days. The biogas with average 58 % methane content was combusted in a General Electric Jenbacher 999 kW cogeneration system. At the second farm, manure from about 165 lactating cows, 110 heifers and 40 calves was digested at mesophilic temperature (40 deg. C) in a 500 m³ below-ground digester with a HRT of 28 days. A unique feature of this digester is that it was retrofitted in a pre-existing larger slurry storage tank. Biogas with average 65 % methane content was combusted in a 75 kW (100 Horse-power) Perkins diesel engine, capable of running on either diesel or biogas, connected to a 65 kW Schnell generator. Addition of fats, oils and grease (FOG) restaurant waste residue to manure fed to the digester in 2007 increased biogas production by about 300% and electrical energy generation by 180 %. Both systems have operated year-round from December to February at average ambient temperatures that ranged from -9 to -12 degrees Celsius. The paper will present results on biogas as well as electrical and thermal energy production. This information will be useful for development of long-term sustainability options for animal farm operations.

AN INNOVATIVE COLORIMETRIC CALIBRATION METHOD USED TO QUANTIFY DIFFERENCES AMONG WILD AND REARED GILTHEAD SEABREAM (SPARUS AURATA, LINNAEUS 1758)

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CSBE101054 – The appearance of a product is a primary criterion in the purchasing decisions of consumers, being at the base of the selection judgement of the product's individual quality. Appearance characters are defined by size, shape, form, colour and absence of visual defects. Appearance is utilized as a selection criterion throughout the market production chain, storage, marketing, and finally the utilization. Fish experts are able to visually discriminate among wild and reared fish of the same species by the fish colours. For the European fish market gilthead seabream (*Sparus aurata*) is, together with seabass (*Dicentrarchus labrax*), the most important marine cultured species. A novel colour calibration method based on the association between a standard colour chart and a Partial Least Squares (PLS) model developed in Matlab environment was developed. RGB declared values of the ColorChecker (24 patches) were used as y-block. The x-block was represented by the mean RGB values of the same 24 patches. Once colorimetrically calibrated, the images of 20 wild and reared seabreams were shape adjusted with landmark based geometric morphometric tools. Superimposed fishes were then compared with a PLS Discriminant Analysis. The results quantified differences between wild and reared fish. [...].

A FARM SYSTEM APPROACH TO ANALYZE GREENHOUSE GAS (GHG) MITIGATION STRATEGIES FOR RUMINANT PRODUCTION SYSTEMS

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CSBE101055 – Agriculture is a significant emitter of GHGs. Especially ruminant production systems that contribute substantially to global warming due to the enteric fermentation. Ruminant production systems are often integrated in mixed farm systems, including arable production, grassland systems and possibly energy production, which may provide opportunities for mitigation of GHGs when considered as a whole system. The paper analyzes systematically the GHG mitigation potentials of a mixed farm system, which represents a typical farm in northeastern Germany by modeling interactions and substance flows between different subsystems within a model farm. The following mitigation strategies are compared: 1) increased milk production per dairy cow, 2) integration of a biogas plant. The results show that the integration of the biogas plant has the greatest mitigation effect, followed by increased performance of the dairy system. Each mitigation practice has specific uncertainties which determine the overall results substantially. Uncertainties in the biogas mitigation option are due to emissions from the digestate spread to the fields. In option 2 the mitigation of methane production due to increased milk production per animal is partly compensated by increased methane emissions per animal and increased emissions due to feed production. The integration of the biogas system requires additional land to be cultivated, which may lead to induced emissions and thus lower the positive GHG effect.

SUSTAINABLE ENVIRONMENTAL MANAGEMENT FOR TROPICAL FLOATING NET CAGE MARICULTURE, A MODELLING APPROACH

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CSBE101056 – This paper presents a modeling approach for the development and management of floating net cage mariculture under sustainable operation. Suitable sites for marine fish cages are defined with respect to physical and water quality properties as well as coastal uses. Ranges of sustainable production are estimated with respect to environmental carrying capacity. The procedures involved are embedded into a decision support system (DSS) aiming to facilitate the planning process of sustainable marine finfish cage farming. Its application to a coastal site in Bali, Indonesia is demonstrated.

EVALUATING THE PERFORMANCE OF VEGETATIVE TREATMENT SYSTEMS ON OPEN BEEF FEEDLOTS IN THE MIDWESTERN UNITED STATES

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CSBE101057 – United States Environmental Protection Agency (US EPA) regulations require concentrated animal feeding operations (CAFOs) to control open feedlot runoff resulting from storms up to and including a 25 year-24 hour storm event. Runoff collection systems commonly used in the United States for open beef feedlots consists of a basin designed to intercept runoff and provide storage until field conditions exist for land application. An alternative system being evaluated by a three-state research team is a vegetated treatment system (VTS) designed to infiltrate all of the feedlot runoff. This paper reports the runoff volumes and the mass of five physical parameters released from nine CAFO's utilizing VTS's located in the U.S. Great Plains region (six sites in Iowa, two in Nebraska, one in Minnesota). Comparisons between sites were made based on the volume and mass of these parameters retained within the system. The performances of the nine VTS varied depending on site specific rainfall, stocking densities, feedlot to VTA ratio, and system design. Five of the nine VTAs monitored in 2009 did not report an actual release from their system. The percent runoff controlled varied by site ranging from a high of 100 percent to a low of -6 percent. The overall average percent of mass reduced from five tested parameters varied from 100 to 72 percent.

GAS EMISSION RATE FROM DIFFERENT JAPANESE OPEN TYPE PIG HOUSES WITH NATURAL VENTILATION

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CSBE101059 – NH₃, C₂, N₂O, CH₄ emissions were measured in five different naturally ventilated pig houses during summer and winter in Ibaraki prefecture, Japan as to collect inventories. The houses were a nursing hoop type house with saw dust litter on flat floor (*A-1* house), a conventional fattening house with retaining waste under floor (*A-2* house), a conventional nursing house (*B-1* house), a nursing house with retaining waste under fully slatted floor (*B-2* house) and a conventional fattening house with manure scrapers (*C* house). Results demonstrated that summer NH₃ emissions for *A-1* house, *B-1* house, *B-2* house and *A-2* house were 1.97, 2.30, 8.78 and 0.241 g d⁻¹ head⁻¹ respectively. The winter NH₃ emissions for *A-1* house, *A-2* house and *C* house were 1.05, 49.2, and 15.2 g d⁻¹ head⁻¹ respectively. The gas emissions were somewhat higher when the waste was retained for prolonged periods of time inside the houses.

A DEVICE FOR EXTRACTING 3D INFORMATION OF FERTILIZER TRAJECTORIES

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CSBE101060 – Centrifugal fertilizer spreaders are the most commonly used type in Europe. Their possible inaccuracy results in extra fertilizer being spread, which contributes strongly to environmental imbalance. This imbalance can only be corrected if the correct amount of fertilizer lands in the right place. Accuracy depends on understanding the spreading process from the vane to the soil. This knowledge enables the development of a feedback system that adjusts the spreader settings to the measured spread pattern. The spatial distribution of fertilizer granules on the soil can be predicted by a ballistic flight model based on the measurement of the velocities, directions, pellet size and angular distribution of the pellets. Several models have been proposed to meet this challenge. In an earlier study we proposed a standard camera and a strobe combined with a cross-correlation image- processing algorithm to determine the motion parameters of the pellets at ejection. This system is highly accurate for predicting spread patterns, but only for flat discs, as it only measures the 2D information of the ballistic flight of the pellets. Information on the third dimension will make this model more applicable in practice, as most centrifugal spreaders have concave discs. We developed a 3D image acquisition system based on stereoscopy to characterize the spreading process. Several tests were performed on simulated grain trajectories. Distances and vertical angles were measured with an error of less than 2%.

MEASUREMENT METHOD OF VENTILATION RATE WITH TRACER GAS METHOD IN OPEN TYPE LIVESTOCK HOUSES

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CSBE101061 – The relationship between locations of tracer gas measuring points and those of the emitted point in the constant emission method was examined to investigate a measurement method of ventilation rate in Japanese open type dairy houses. Wind tunnel model experiments were performed. The constant emission method which is applied easier on site was compared to the concentration decay method. An air exchange rate obtained from the constant emission method was 5 times as large as that from the concentration decay method when the tracer gas measuring points were distributed in the house. The air exchange rate was estimated 40 % as small as that from concentration decay method when the measuring point was located near the tracer gas emitted point.

ENHANCEMENT OF EXTRACTION EFFICIENCY OF CITRUS JUICE AND SACS BY TWIN OBLIQUE AIR JET MOVES IN 3D SPACE

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CSBE101062 – This study evaluates the development of a new air jet impinging method related to a machine for extracting citrus juice and juice sacs. The method is based on a twin nozzle that moves in a spiral direction towards the depth of halved citrus fruits. In this study the effect of reservoir air pressure, nozzle velocity direction (depth of fruit), rotational speed of the nozzle, twin nozzle configuration (nozzle inclination and distance between nozzle outlets), and fruit size were studied on extraction efficiency. Maximum removed juice and juice sacs were observed at air pressure of 500 kPa, nozzle velocity of 10 mm/s, and rotational speed of 20 rpm. Nozzle configuration was found to be a dominant parameter in extraction of juice sacs. Oblique adjacent twin nozzle showed higher extraction efficiency (96.92%) than normal detached twin nozzle (91%). Fruit size had no significant effect (5%) on extraction efficiency.

A PREDICTIVE MODEL FOR THE VIBRATION RISK EVALUATION IN AGRICULTURAL MACHINERY USE

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CSBE101064 – Several well known national and international Standards provide different limits relevant to workers' vibration exposure. The agricultural activity is characterized by seasonal work peaks, in which operators widely exceed the traditional 8-hours work day, alternated to other long time periods of relatively light activity. On the other hand, agricultural machinery management involves many different tasks, in terms of procedures to be completed, considering the variety of operating conditions. As a consequence, the evaluation of the operator's vibration risk exposure is very difficult, and the results obtained are normally very poor, because they take into account the inputs from the vibration levels published on the machinery instruction manuals. On the basis of a suitable campaign of field trials, the present paper proposes the building of a predictive model for the vibration exposure, starting from the worldwide most popular agricultural machine, the tractor and one of the most frequently carried out operation, ploughing. This job represents a very effective example, as for its high frequency of execution, because ploughing is normally (both in-furrow and out-of-furrow) a very hazardous operation when considering vibrations point.

AERODYNAMIC PROPERTIES OF HEMP FIBRE AND CORE

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CSBE101065 – Decorticated hemp material is a mixture of fibre and core. Separation of the core from the fibre is an important process to obtain clean fibre. Several machines, including vibratory separators and straw walkers, have been used for the separation process of decorticated hemp material. However, results in the literature showed that using these machines, one could not obtain clean fibre. This study explored the potential of using an air flotation system for removing core from fibre. The specific objective was to study the aerodynamic properties of fibre and core which are the prerequisite for the development of an air flotation system. A testing apparatus is currently being designed to measure the terminal velocity of fibre and core. The apparatus consists of an air blower, a flow straightener, a vertical transparent column, and a stationary screen. In a test, hemp material (fiber or core) is placed on the screen in the column. Through the flow straightener, air is forced by the blower into the column. When the terminal velocity of the material is reached, the material begins to float, and the velocity is recorded with an air velocity measuring sensor. The test will be run for treatments: various hemp fibers and cores for retted and non retted conditions. Each treatment will be replicated 10 times. Before the terminal velocity test, fibre and core material will be characterized in their length, width, and thickness and mass. Based on these measurements, drag coefficients of hemp fibre and core will be determined for each test. The experiment is undergoing and the results will be presented in the conference presentation and paper.

ORANGE FRUIT RHEOMETRICAL CHARACTERIZATION USING STRESS-RELAXATION TESTS

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CSBE101069 – In this work the rheometrical behaviour of Tarocco-variety orange fruit was assessed under stress-relaxation testing. By analyzing the stress-relaxation data collected, at times 10 times greater than the loading period, the time course of the experimental dimensionless relaxation modulus (G^*) was typical of a viscoelastic solid and was reconstructed by considering two Maxwell elements in parallel to an elastic spring element. As the engineering deformation (ϵ_E) or cross-head speed (V_t) was increased from 5 to 12% or from 5 to 15 mm s⁻¹, respectively, the dimensionless viscoelastic constants (A_i) were found to be approximately constant. Moreover, the elastic component responsible for the equilibrium residual stress represented about 60% of the initial relaxation modulus, this confirming that any orange fruit under study behaved as a linear viscoelastic solid, characterised by a unique relaxation time spectrum, for the time-scale and deformation range examined.

PROCESS OPTIMIZATION OF WATER JET EXTRACTION OF POMEGRANATE ARILS USING RESPONSE SURFACE METHODOLOGY

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CSBE101072 – Jet impinging method was employed for extracting arils from pomegranate fruit. The method is based on extracting the arils with the help of water jets while broken open pomegranate is in motion during jet impinging. Response surface methodology was used to determine the optimum processing conditions that yield maximum extracted arils and minimum mechanical damage to them. The independent variables were water pressure, nozzle diameter, reciprocating speed of nozzle, number of nozzles, and speed of pomegranate conveyor. The coefficient of determination, R^2 values for extraction efficiency and percentage of damaged arils were greater than 0.900. The complex interaction of these variables was investigated and two quadratic mathematical models were derived for the prediction of extraction efficiency and damage amount. The analysis of variance showed that nozzle diameter was the most significant factor affecting extraction efficiency and integrity of arils. An increase in water pressure, number of nozzles and/or decrease in nozzle diameter, conveyor speed, resulted in an increase in extraction efficiency and also increase of damaged arils. Based on surface and contour plots, optimum conditions for water jet extraction of pomegranate aril were: water pressure 327 kPa, nozzle diameter 4.3 mm, reciprocating speed of nozzle 36 cm/s, conveyor speed 1.1 cm/s and three nozzles. This study showed that RSM could effectively be applied for the modeling of extraction process and to find an operating optimum condition to achieve maximum extraction efficiency and minimum damage of arils.

ENERGY AND CO₂eq ANALYSIS OF THE AGRICULTURAL PHASE IN THE SUNFLOWER BIODIESEL CHAIN

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CSBE101073 – The European Directive on renewable energies indicates the reference values on CO₂eq emissions for every phase of the biofuels chain. The paper reports the results of an LCA analysis focused on sunflower agricultural phase. In the studied cases, CO₂eq emissions due to the cultivation phase exceed the reference value indicated by the EU. The relevance of the allocation methods to spread out energy consumption and CO₂eq emissions among sunflower biodiesel and oilcake are highlighted. Allocation was made according to the principles of mass content, energy content and economic value of co-products. The CO₂eq reductions obtainable with the three methods are about 60%, 50% and 25%, respectively when compared to the “No allocation” case. These methods do not distinguish the different functionality of co-products in relation to their real use, although this issue is strongly recommended by the LCA methodology. For this reason the method of system expansion and allocation by substitution is also taken into account. The considered equivalent functions of oilcake are: animal feed (soybean meal), fuel (coal) and fertiliser. The results show that while the substitution with coal gives rise to an emission credit, the others allow only minor improvements. A sensitivity analysis stresses the importance of fossil fuels and fertilisers on energy depletion and CO₂eq emission. As a conclusion we can state that, within the constraints for CO₂eq emissions indicated by the EU, in Central Italy only a major revision of farm practices, aimed primarily at reducing the use of N-fertilizer, can allow the sunflower to be suitable for biodiesel.

MODELLING THE STRESS RESPONSES OF LIVESTOCK TO THE THERMAL LOADS EXPERIENCED ON TRANSCONTINENTAL, EXPORT JOURNEYS

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CSBE101074 – The thermal environment to which livestock are exposed during transportation is the source of significant stress, increased losses and reduced welfare. A novel, comprehensive, holistic approach has been developed which allows the concurrent assessment of well-defined. Pertinent, physiological and behavioural indices of stress in pigs subjected to long distance, transcontinental road transportation on export journeys. These journeys (n = 7) of approximately 3000km length and lasting around 72 hours were undertaken in high summer in Europe in order to assess the effects of elevated thermal loads upon the welfare of the pigs (90 pigs per journey). The physiological and behavioural measures obtained have been correlated with a full and continuous characterisation of the transport thermal micro-environment. Statistically significant responses (p<0.05) in parameters such as body temperature and drinking and resting behaviours accurately reflected the consequences of imposed thermal loads. These data then have been employed as the basis of predictive models that allow definition of the acceptable ranges and limits for thermal loads in transit under commercial conditions. This is the first study to employ such comprehensive assessment of both physiological parameters and behavioural responses in practical and commercial transportation practices and on commercial vehicles. The findings have been compared with thermal limits prescribed in current European legislation and recommendations are made for the development of more appropriate regulations and codes of practice.

UTILIZING A VAST AND COMPLEX WIRELESS COMMUNICATION NETWORK IN A SUSTAINABLE “BIOSYSTEM” FOR THE PRODUCTION OF FIBER FOR USE IN BIOENERGY, PAPER AND SOLID WOOD PRODUCTION

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CSBE101075 – The GreenWood Resources Boardman Tree Farm (GWR BTF), located in Eastern Oregon US, covers 104 km² within which a wireless network of 134 radio modems communicate to irrigate and chemigate 10,360 hectares planted with more than 10,000,000 very-fast growing Pacific Albus trees. Additionally this wireless network supports irrigation and chemigation on 1,930 hectares of very high-value agriculture crops, including organic crops. This huge network consists of two totally independent licensed wireless networks using a combination of Standard and High-Power industrial strength radio modems. One of the most advanced and sophisticated Irrigation Supervisory Control and Data Acquisition (I-SCADA) systems in the world utilizes this dual wireless network to operate the worlds largest contiguous drip irrigated farm and also the largest Tree Farm in US. This I-SCADA system, via the wireless network, uses more than 2,800 sensors to remotely monitor a massive irrigation system of 19 individual pump stations with 100 pumps, 46 center pivots, 369 individual blocks of fields (16 to 28 hectares each), 850 kilometers of buried pipe and 31,000 kilometres of drip line. The I-SCADA system with its reliable wireless network has enabled BTF to sustain its position for the past decade, as the world's leader in large scale drip irrigation efficiency. It has also allowed BTF to maintain a high level of efficiency in its endeavors to sustainably produce the most efficient and cost-competitive, high-quality [...].

THERMAL DISINFECTION OF POULTRY GROW-OUT FACILITIES IN CENTRAL-NORTHERN ITALY

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CSBE101077 – Chemical treatments are commonly adopted for poultry houses sanitation. In fact, ordinary floor disinfection is needed to achieve the depletion of pathogenic population (i.e. some species of bacteria and fungi) and reduce the risk of meat contamination. Recently, the increased attention of consumers and operators health, as well as the quality of food, brought farmers to consider environmental friendly alternative methods. A specific two-year experimental research (2005-2007) was carried out in a Central-Northern part of Italy in order to set up new machines and strategies for floor disinfection of poultry houses by means of an open flame. The trials were run in the machine shop of the University of Pisa (indoor, under controlled conditions) and in two different private farms (a broiler house and an outdoor pheasant farm). The first experiment consisted in a series of bench test trials, carried out in order to evaluate the efficiency and the adjustment of LPG fed open flame burners on pre-inoculated steel plates. During the second experiment, the ordinary chemical disinfection strategy was compared, in a broiler house, to the innovative technique, carried out by means of an adapted 1.5 m wide mounted flaming machine. The last experiment consisted in the evaluation of the efficiency and operative performances of a 2 m wide flaming machine prototype built for open air pheasant farms. The results obtained are very promising as, thermal disinfection strategy seems to be very effective on floor pathogens and cheaper than the ordinary chemical one.

STUDY OF THE EFFECT OF TWO DIFFERENT EDIBLE COATINGS ON WALNUT KERNEL SHELF LIFE

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CSBE101078 – Edible coatings are protective layers capable of reducing oxidation in food containing lipids. In this study the effects of two different major edible coatings namely; 3% pectin-based edible coating and 2% CMC-based coating as well as other additives like sorbitol, PG, Lecithin and also antioxidants like vitamin E and BHT on the shelf life of walnut kernels were investigated. Kernels were dried in open air then stored in polyethylene zipped bags and were kept at 25°C and 23% relative humidity for 4 months. Every two months, kernels were observed based on their color, weight loss, and rancidity. Finally, the taste trial survey was performed on coated kernels. The results proved that CMC-based coatings preserved rancidity of kernels much better than that of pectin-based ones. Particularly, CMC based coatings added with vitamin E or BHT had more acceptable performance comparing to pectin based coatings. The most promising results came from samples coated with CMC combined with vitamin E.

EFFECTS OF AIR EXCHANGE, TEMPERATURE AND SLURRY MANAGEMENT ON ODORANT EMISSIONS FROM PIG PRODUCTION UNITS AND SLURRY TANKS STUDIED BY PROTON-TRANSFER-REACTION MASS SPECTROMETRY (PTR-MS)

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CSBE101079 – Little knowledge exists on factors influencing the variability of odorant emissions from intensive pig production facilities. This is mainly due to the lack of time-resolved quantitative methods for measuring the full range of known odorants. Recently, proton-transfer-reaction mass spectrometry (PTR-MS) has been employed for monitoring emissions of odorants and has been demonstrated to be very suitable for this purpose. Quantitative and time-resolved results for protonated ions representing H₂S, volatile organic sulphur compounds, organic amines, volatile carboxylic acids, carbonyls, phenols and indoles can be obtained. In this work, results from PTR-MS measurements of odorant emissions from finisher pig houses and finisher manure storage tanks are presented and discussed. The measurements were performed at an experimental full-scale pig section with mechanical ventilation and at an experimental manure storage facility with controlled air exchange. The data sets include field measurements during variable air exchange rates and temperatures, during finisher growth, and during emptying of the slurry pit. The results demonstrate a pronounced diurnal variation in emissions of odorants from the pig section with peaks in daytime coinciding with the highest ventilation rates and highest room temperatures. Highest emission rates were observed for H₂S and carboxylic acids. Based on odour threshold values, methanethiol and 4-methylphenol are also estimated to contribute significantly to the odour nuisance. Discharging of the slurry pit led to reduced H₂S emissions, but peaks of H₂S were seen during manure handling. Emissions of other odorants were not affected by emptying the [...].

SPATIO-TEMPORAL VARIABILITY OF SOIL MOISTURE AT THE FIELD SCALE USING REMOTE AND PROXIMAL SENSING

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CSBE101080 – The spatio-temporal variability of soil moisture is an important factor to consider in agriculture. It helps understand the conditions of water and air availability, two elements essential to plant growth and environmental risk assessment. Previous studies have shown that soil electrical conductivity (EC) and remote sensing techniques are helpful as ancillary variables in digital soil mapping at various scales. This study objective is the soil drainage mapping at the field scale using remotely sensed images (RADARSAT-1 and IKONOS) and proximal sensing technologies (VERIS 3100 soil EC meter and handheld CS-620 HydroSense soil moisture sensor). The study has been conducted on three adjacent fields (15.6 ha) in an experimental microwatershed (3 km²) of the Bras d'Henri catchment (167 km²), located on south shore of the St. Lawrence River, nearby St. Narcisse municipality. This highly intensive agricultural area has been mapped by the Pedology and Precision Agriculture Laboratories, Agriculture and Agri-Food Canada, in 2004 and 2005 for updating and upgrading soil survey information at different scales (1 :40 000, 1 :20 000 and 1 :10 000). Five out of the seven soil drainage classes defined in the Canadian system of soil classification have been observed in the watershed [...].

MAXIMIZING THE HYDROLOGICAL IMPACT OF STREET TREES THROUGH SIDEWALK DESIGN

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CSBE101082 – Urbanization increases the total area of impervious ground cover leading to post-development rain runoff quantities that can damage and flood the natural downstream catchment. The Low Impact Development aim is to ensure that a resulting runoff from a given area is equivalent to pre-development levels. Trees, both in a natural and urban environment, play a vital role in the surrounding hydrology through interception, transpiration, evaporation, and infiltration. This increase of rain runoff created by a greater percentage of impervious surfaces can be in-part accommodated and improved by sidewalk design engineered to support healthy urban trees. Engineered soils can be used to meet the required bearing capacity of traditional compacted sidewalk subgrade soils while increasing volume available for root growth and water retention. Different engineered soils will be tested for their compatibility with pervious pavement materials to determine the most effective draining system that still meets the required load carrying capacity demanded by municipal sidewalk regulations. In combination with the structural soils further changes to the traditional sidewalk design are proposed to create beneficial growing conditions and maximize tree health. An assessment of the initial investment and cost of maintenance for this street tree catchment design will be explored to determine if the relief afforded to the stormwater management of a developed area justifies the expense. This paper will focus on the tools and methods used to pursue the analysis of the hydrological effect of sidewalk design centered on urban trees, with a specific concentration on application in Montreal, Canada.

INNOVATIVE STRATEGIES AND MACHINES FOR PHYSICAL WEED CONTROL IN VEGETABLE CROPS IN CENTRAL AND SOUTHERN ITALY

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CSBE101083 – Weed control is one of the most serious problems in vegetable crops limiting yields. Therefore, the aim of this work was to set up and improve innovative strategies and machines for physical weed control in organic or “integrated” vegetable crops cultivated in five important areas of Central and Southern Italy. Experimental on-farm trials were carried out on fresh marketable spinach, processing and fresh market tomato, cauliflower, savoy cabbage, potato, greenhouse cultivated leaf beet, garlic, chicory, fennel and carrot. The traditional farm weed management system was always compared to an innovative system. The innovative strategy was the combination among preventive methods (false or stale seed-bed technique), cultural methods (crop spatial arrangement adjusted in order to improve machinery effectiveness) and direct control methods (flaming, hoeing, etc.). Different kinds of flex tine and rolling harrows (patented by the University of Pisa) and flamers were used for false or stale seed-bed technique. Precision hoes and hoe-conformed rolling harrows, equipped with elastic tines for selective in-row weed control, were used for post emergence interventions. The innovative weed management systems always resulted in significant weed abundance reductions (from 70 to 100%), relevant yield increases (from 10 to 100%) and high contractions of manpower requirement (from 20 to 80%) compared to the standard systems. The results of these on-farm experimental trials emphasise that physical weed control can be effectively performed using the innovative machines built at the University of Pisa. [...].

EFFECTS OF MECHANICAL AERATION ON THE COMPACTION AND PERMEABILITY OF A GRASSY SWARD

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CSBE101085 – In a golf course located at El Kantaoui, Sousse, Tunisia, many trials were carried out over a sandy soil grassy sward to investigate the effects of mechanical aeration on its compaction and permeability. For this purpose, many soil cores were extracted using a 1.6 m effective width Verti-Drain aerator equipped with hollow spades spaced 65 mm apart. Aeration was performed at a rate of 350 holes /m². Soil resistance to penetration and permeability were determined at the initial state before aeration as well as 10, 20, and 30 days after aeration. Compared to the initial state, the results showed that mechanical aeration positively affects the grassy sward ground by reducing its resistance to penetration as 35 and 43% decrease in penetration resistance were noticed at 5 cm depth 10 and 20 days after aeration, respectively. Also, resistance to penetration decreased by 41 and 48% at 15 cm depth during the same two periods of time. However, soil resistance to penetration at 5 and 15 cm depths only decreased by 21 and 26%, respectively. Regarding the soil permeability measured after aeration, a significant improvement was observed compared to that at the initial state (4.9 cm/h). Indeed, the permeability was 12.5, 13, and 14.1 cm/h 10, 20, and 30 days after aeration, respectively.

RADIO FREQUENCY IDENTIFICATION TECHNOLOGIES FOR TRACEABILITY OF POTTED FLOWERING PLANTS

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CSBE101086 – Systems to guarantee the traceability, the quality and the origin of the plant are needed in the potted flower industry as well as to empower worldwide logistic allowing to meet the requirements of a strongly vertically integrated fast changing global market. RFID systems are now becoming more and more diffused in important markets to track batches of products. RFID item level identification could be applied to potted plants allowing constant updating of information related to the single plant for business management, reducing errors and increasing automation and efficiency. Moreover it can contribute to oppose the counterfeit phenomenon and promote the originality of the trademark. This paper addresses the problem of the coupling of RFID tags to potted crops, evaluating the performances, in term of tag persistence and readability, of different technical solutions at three operating frequencies. The potential benefits derived from the application of an automated system for the traceability based on RFID have been evaluated in greenhouses.

BIODIVERSITY OF MANAGED FORESTS SURROUNDING THE CALAKMUL BIOSPHERE RESERVE IN MEXICO

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CSBE101087 – Forest management for both ecosystem health and human provisions should be an important part of ecological engineering practice, the interface between conservation and natural resource utilization. Agroforestry for production and ecosystem health is a centuries-old form of ecological engineering utilized in many indigenous villages in Mesoamerica. Agroforestry systems relying on traditional ecological knowledge (TEK) can result in improved soil quality and forest biodiversity, as well as a critical abundance of numerous agricultural products. This study evaluates management differences in agroforestry systems of Southern Mexico and investigates if differences in forest management have an impact on forest biodiversity in areas bordering the Calakmul Biosphere Reserve. Agroforestry systems were studied in three village communities surrounding the Calakmul Reserve in Campeche Mexico. Each village had similar community structure, population, ecotype, and utilized agroforestry as their primary means of forest management. Tree and bird diversity were analyzed in each stage of the rotation, 5-10, 10-20, and >20 years using twenty meter grids for a total of forty samples in each stage. Results were computed using the Simpson's diversity index and ANOVA analysis. These sampling techniques will be applied in mature, unmanaged forest within each community, to act as a reference ecosystem. Interviews regarding species use, management, plantings, and origin of management knowledge were conducted at each sample site. Findings suggest that species richness and diversity were higher in communities utilizing a greater diversity of forest products, and [...].

INNOVATIVE STRATEGIES FOR PHYSICAL WEED CONTROL ON HARD SURFACES IN URBAN AREA IN CENTRAL ITALY: DEVELOPMENT OF NEW FLAMING OPERATIVE MACHINES

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CSBE101088 – In Italy, weed control in urban areas is mainly performed by means of mowing cutting and herbicide application. While trimmers are not effective in reducing weed density and they are also have the potential to cause injuries to hard surfaces and the safety of citizens and operators, chemical control induces resistance to active compounds in spontaneous plants and it is surely a source of environmental pollution and a risk factor for the health of human beings and animals. For this reason the use of herbicides in urban areas is strictly regulated by laws. As an alternative to ordinary weed control devices, thermal equipments can be used successfully for weed control on hard surfaces. Flaming machines are the most efficient among thermal devices and they are suitable for treatments in many urban contexts. Several equipments for thermal weed control were designed, realized and optimized by University of Pisa in order to efficiently perform treatments in urban areas. An experimental trial was also carried out in two cities of Tuscany (Central Italy) aiming to verify machine reliability and to evaluate both the effects of flaming treatments on weed density reduction and LPG consumption and costs (as showed in another specific work submitted to this congress).

MECHANICAL CONTROL OF QUACKGRASS IN GRASSLAND

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CSBE101089 – It is well known that quackgrass is both very aggressive and persistent. It is considered as one of the most troublesome perennial grassy weeds as it rapidly spreads by creeping rhizomes. In agriculture, many attempts have been made to control this weed without success. Within the context of a sustainable agriculture, mechanical control of quackgrass represents an interesting alternative to chemical means. In this research study, the effectiveness of using a rotary cross-harrow, a C shaped mounted tine cultivator, and an S shaped tine cultivator alone or in combination to control quackgrass in grassland was investigated. Trials were carried out on grassland using a Latin square experimental design. Three treatments were considered: (1) four passages using a C shaped mounted tine cultivator, (2) use of the rotary cross-harrow followed by three passages of a C shaped mounted tine cultivator, (3) use of the rotary cross-harrow followed by three passages of an S shaped trailed tine cultivator. Each treatment was replicated three times. The percentage rate of quackgrass present in each experimental plot was determined before and after the four passages of the equipments using a one square meter quadrant randomly placed in the plot and replicated ten times. Also, the time required for each passage as well as the fuel consumption were computed for every treatment. Analysis of the data revealed that the use of the rotary cross-harrow in combination with the C shaped tine cultivator resulted in a better control of quackgrass compared to the use of the S shaped tine cultivator in combination with the rotary cross-harrow. The use of the rotary cross-harrow requires however more energy to [...].

FOURIER FILTERING FOR WHEAT DETECTION IN A CONTEXT OF YIELD PREDICTION

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CSBE101090 – Prediction of wheat yield appears as a fundamental objective in agriculture for economical and environmental reasons. The use of image processing can be one of the solutions not only with remote sensing tools, but also with “proxy-detection” systems. Nevertheless, to obtain a wheat yield, three components have to be measured and first of all the number of wheat ears per m². The evaluation of this parameter is a two-steps experiment: detection and counting. A colour and texture image analysis method based on the representation of the images in a hybrid space was first developed for a feasibility study to count (semi-)automatically *Triticum aestivum* wheat ears to simplify manual counting. This new representation was constructed with a priori knowledge about the images (especially the number of classes and training points), providing a better recognition than in the standard RGB space (Red/Green/Blue). Results on a few images gave errors on classification accuracy ranging from 6% to 10%. To improve the image processing, robust and rapid solution has to be found. This paper presents the development and implementation of a high-pass filtering on the Fourier image of the scene coupled to mathematical morphology tools like skeletonization. This method requires low calculation time, is easily to implement and is invariant, in most cases, to illumination constraints. It provides better wheat ear detections than those obtained with hybrid spaces. First experiments on wheat ear counting give errors of 4% between calculated and manual counting which corresponds to classical errors [...].

INNOVATIVE STRATEGIES FOR PHYSICAL WEED CONTROL ON HARD SURFACES IN CENTRAL ITALY: RESULTS ACHIEVED IN TWO DIFFERENT CITIES

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CSBE101091 – Concern about environment and water pollution has lead researchers to find and set up alternatives to urban herbicide application all over Europe. Moreover, the ordinary non chemical weed management in the Italian cities is mostly carried out by means of mowers, that are neither effective nor safe for citizens and operators. As an alternative to ordinary devices, thermal equipments can be used successfully for weed control on hard surfaces. Flaming machines are the most efficient and versatile among thermal devices and are suitable for treatments in many urban contexts. A research was carried out in 2006-2008 in two important towns of Tuscany (central Italy), Pisa and Livorno, in order to evaluate the effects of different weed managements (flaming, mowing, herbicide application, and integrated use of flaming and herbicide application) on both weed dynamics and total working times and costs in order to define the best strategies to be used on hard surfaces in a typical Mediterranean environment. Each site was characterized by different plant population, density, and hard surface typology. Flame weeding at low and high frequency was compared to mowing (4 treatments year⁻¹) in Pisa, and to chemical (2 treatments year⁻¹) and integrated (1 herbicide + 3 flame weeding treatments year⁻¹) management in Livorno. The results showed that flaming reduced weed density more effectively than the other methods. Moreover, in the second year, according to the reduction of the number of treatments needed to maintain an acceptable level of weed coverage, the costs of flaming decreased reaching values lower than those of mowing and similar to those of herbicide distribution.

BROWNING KINETICS EVALUATION USING IMAGE PROCESSING TECHNIQUES

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CSBE101092 – Colour changes in peach 'Extra' jam owing to thermal treatment at different temperatures (80°C, 85°C, 90°C and 95°C) were investigated. Browning kinetics were assessed on jam samples brought just after concentration phase in order to determine the effect of the thermal treatments, subsequent to this step, that take place during the production process (hot bottling, final pasteurization). Colour measurements were performed applying image processing techniques on images acquired through a flatbed scanner as well as by traditional measurements with colorimeter. CIELAB colour space was considered using lightness (L^*), colour difference (ΔE) and a^* parameters to describe browning evolution with time at the considered temperatures. A first order kinetic model was applied to L^* changes. A kinetic model based on a two-stage mechanism was employed to describe a^* evolution. Colour difference was modeled with both kinetics even if the two-stage model better describe the evolution of this parameter. Experimental data strongly fit with the adopted models except for the treatment at 80°C in which colour changes resulted almost negligible.

ANAEROBIC DIGESTION AND RELATED BEST MANAGEMENT PRACTICES: UTILIZING LIFE CYCLE ASSESSMENT

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CSBE101095 – Anaerobic digestion of dairy manure with energy recovery through biogas combustion is generally viewed as a positive environmental approach to increase the use of renewable energy. However, there are potential negative impacts associated with emissions of methane and nitrogen species during digestion and after spreading of digester effluent that have the potential to counteract the environmental benefits of anaerobic digestion. To promote best management practices, assessment of environmental impacts and investigation of their causes should be conducted using a broad perspective. A life cycle assessment (LCA) comparing environmental impacts of business-as-usual manure management with those of a manure management operation incorporating anaerobic digestion with combined heat and power generation was conducted. The case study, based on a medium sized dairy farm in northern New York State, USA, showed benefits across multiple categories due to the displacement of fossil fuels, and reduction of related emissions. Knowledge gained from the LCA was used to assess the benefits associated with various management practices. For example, design and construction of biogas systems must minimize the potential for fugitive emissions of biogas that can easily outweigh the climate change related benefits associated with fossil fuel displacement. This paper defines and explains the environmental trade offs associated with various manure management and energy recovery systems.

ONLINE MODEL PREDICTIVE MONITORING FOR CONTROLLING AND OPTIMIZING THE PERFORMANCE OF AGRICULTURAL PRODUCTION PROCESSES

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CSBE101097 – The biological uniqueness of the members of an agricultural production unit results in a large variability between production units of the same production process and of the same production unit in time. As a result, monitoring and controlling such processes using general standards is not very effective. It would be of interest to have Production Unit Specific Standards (PUSS). In this paper, a procedure is presented to develop such a PUSS for production data of a flock of laying hens. As these standards should only be based on in-control data, the technique of statistical control charts is used to detect out-of-control observations in order to exclude them from the PUSS estimations. This procedure debuts with a parametric trend model that is estimated to describe the time dependent trend present in the production data. The autocorrelation structure of the data series of prediction errors from the trend model, in its turn modeled by an autoregressive moving average (ARMA) model. The stationary and independent data series of prediction errors of the ARMA model are then analyzed by a control chart and out-of-control points are excluded from further model estimations. This sequence is repeated for each new observation. The final PUSS is formed by the time series of predictions of the parametric model. [...].

THIN-LAYER DRYING BEHAVIOUR OF COFFEE BERRIES

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CSBE101103 – Mathematical modeling of thin layer drying is important to optimize operating parameters and performance improvements of drying systems. The ease of use is the main advantage of empirical or semi-empirical models in drying simulations. Many mathematical models have been used to describe the drying process, and thin-layer drying models have been widely used. Thus, the objective of this work was to study and compare the thin-layer drying characteristics of coffee berries (*Coffea arabica* L.) and to include the experimental data obtained to semi-theoretical models widely used to describe thin-layer drying behavior of agricultural products. The effect of drying air temperature was evaluated. Drying kinetics of coffee berries in a thin-layer dryer was investigated within a temperature range of 40–60 °C. The time required to dry coffee from an initial moisture content of around 1.10 dry basis to the final moisture content of around 0.13 dry basis was 97.67, 40.92 and 17.98 at 40, 50, and 60 °C of drying air temperature respectively. Six mathematical thin layer equations (Page, Diffusion approach, Midilli, Modified Henderson and Pabis, Thompson and Two-term) were used to fit the drying data. Precision of these models was based on the coefficient of determination (R^2), standard error of the estimate (SEE) and mean relative error (MRE). The Page equation was the most adequate in describing thin layer drying tests. Temperature dependence of the model parameter k was well documented by Arrhenius-type relationship. The activation energy for k parameter during drying was found to be 43.2589 kJ mol⁻¹.

ASSESSMENT OF REAL TIME VARIABLE APPLICATION OF NITROGEN USING REMOTE SENSING SENSORS: PERSPECTIVES IN SLOVAKIA

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CSBE101105 – The management of nitrogen fertilising is a common problem to many agronomists. It is an essential issue for winter wheat husbandry. Ground-based, machine-mounted sensors offer practical advantages because they are under the control of the operator. The Aim of this investigation was to evaluate variable application in Nitrogen using the Yara N sensor and justification of the use of these sensors in Slovakian conditions. Evaluation comprises almost all variable application of Nitrogen conducted in Slovakia in 2007 and 2008 at 1227.06 ha of winter wheat crop. Application at growth stage 31/32 and growth stage 39 was assessed in three regions of Slovakia: A – west – south part of Slovakia, B – west middle part of Slovakia, C – west -north part of Slovakia. Based on obtained data, it can be concluded that the application of ground based remote sensing sensors for variable application of Nitrogen brought benefits to Slovakian farmers. The amount of saved Nitrogen ranged from 7.85 to 19. 83 kg of Nitrogen per hectare at growth stage 31/32. Late application, at growth stage 39, did not bring saving on applied Nitrogen in the north part of Slovakia. However, there was significant spatial redistribution of the dose. Further research is needed combining the sensor data with historical information about the field.

CONTROLLED TRAFFIC FARMING AND MINIMUM TILLAGE: RESULTS OF INITIAL EXPERIMENTS AND A LAYOUT OF A LONG TERM EXPERIMENT

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CSBE101106 – Controlled traffic farming is technology that minimizes the compacted area of the field. Hence, applications are mainly combined with no-till technology. There is no existing evidence about the effects of CTF in combination with conventional or minimum tillage. This paper presents: A) the layout of along term experiment aimed at assessing the CTF combined with tillage practices used in Slovakia. B) The results of initial measurements conducted on a 16 ha field (using controlled traffic) and a 17 ha control field (using random traffic), both growing spring barley. The CTF system designed uses a 6 m basic module providing minimum tillage practices. CTF system was introduced during drilling operation. The first operation was conducted in a different direction when compared to traditional practice that was stubble tillage; this had an impact on the quality of the operation. Field surface unevenness together with distribution of crop residue (using image analyses) was assessed. Based on the obtained results it can be concluded that there was no significant difference between the quality of stubble tillage operation conducted under control and random traffic systems. However, these are the results obtained after one growing season of the CTF adoption and further investigation is needed.

NEAR INFRARED HYPERSPECTRAL IMAGING FOR CLASSIFICATION OF BEEF MUSCLES

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CSBE101107 – Hyperspectral imaging has gained widespread importance in many applications in food safety as well as quality control and monitoring of various food products. Rich spatial and spectral information offered by hyperspectral images provides detailed material composition which requires challenging pattern recognition routines to deal with this complex nature. Therefore, by using various image processing techniques objects can be categorized and correctly classified. The objective of this study is to develop and test a near infrared (NIR) hyperspectral imaging system to classify different beef muscles. A pushbroom hyperspectral imaging system in the near infrared region (900–1700 nm) was developed and calibrated. Hyperspectral images of beef steaks originated from *Longissimus dorsi*, *Psoas major* and *Semitendinosus* muscles at 2-day post-mortem were acquired. All images were corrected and calibrated for reflectance and dark current of the camera. An image processing routine to deal with spectral image at different wavelength was developed for segmenting image to isolate the lean area of the sample as the main region of interest (ROI). The segmented lean area (ROI) was then used as a mask to extract spectral information from each muscle. Spectral data was then analysed by multivariate principal component analysis (PCA) to reduce the dimension along the spectral axis. The first three principal components explained over 97% of the variance of all spectral bands in the image. The results indicated that hyperspectral imaging has a considerable potential for classifying beef muscles.

MICROENCAPSULATION OF FISH OIL INTO CROSS-LINKED WHEY PROTEIN MATRIX

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CSBE101108 – The aim of this study was to investigate the effect of phenolic compounds (gallic and tannic acids) on the release and oxidative stability of whey protein encapsulated fish oil during long term storage. The oxidation products of tannic and gallic acids were used to induce covalent bindings amongst whey protein molecules adsorbed at the oil-water interface. The results showed that the reaction was greatly influenced by the type and concentration of phenols in the aqueous phase. The mean diameter of oil droplets and the flow behaviour of emulsions changed with increasing the proportion of phenolic compounds. The particle size and water solubility of spray dried powders were also found to be affected. Microcapsules with cross-linked membranes were shown to have lower release rate constants and more stability against oxidation and environmental conditions. The results of this study suggest cross-linked microcapsules as appropriate vehicles for protection of labile functional foods in the gastric system and their controlled release in the intestinal track.

ANALYSIS OF THERMODYNAMIC PROPERTIES OF COFFEE BERRIES DURING DRYING

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CSBE101109 – Drying process is an important post harvest procedure, which grants the possibility to prevent or minimize the quantity and quality losses of agricultural products. This process decreases the water activity of the product, which is the main factor that affects the respiration rate of the product, fermentation processes and plague attack. Drying procedure is affected by several parameters, in which thermodynamic parameters have been recently investigated. The correct knowledge of the thermodynamic properties of the drying process of agricultural products is an important attribute in order to design drying equipments, calculate the energy required to do so, to study the properties of adsorbed water, evaluate the microstructure of foodstuff and to study the physical phenomenon that occurs on the food surface. Thus, the aim of the present work was to evaluate and obtain thermodynamic parameters of the drying process of coffee grain (*Coffea arabica* L.), cv. Catuaí Amarelo. The dynamic method was employed to obtain the equilibrium moisture content. Entropy, enthalpy and Gibbs free energy were investigated in the present research. Three conditions of temperature and relative humidity were used (35 °C and 32.1 %; 45 °C and 15.7 % and; 55 °C and 10.2 %). Coffee berries were manually harvested with initial moisture content of 1.25 dry basis (d.b.), being submitted to the drying process until an average moisture content of 0.13 (d.b.). Enthalpy and entropy increased with the decrease of the drying air temperature. Gibbs free energy had an increment behavior with the increase of temperature.

PREDICTION OF PROCESS AND PRODUCT PARAMETERS IN DEEP BED DRYING OF ROUGH RICE USING ARTIFICIAL NEURAL NETWORK

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CSBE101110 – The objective of this study was to predict the performance indices in deep bed drying of Isfahan rough rice (Sazandegi variety) using artificial neural networks (ANNs). In our experiments, the effects of air temperature, air velocity, and air relative humidity on product output rate (*POR*) as an indicator of work capacity dryer, evaporation rate (*ER*) as a quality index of drying kinetics, and kernel cracking (*KC*) percentage as a criterion of dried product quality were investigated. To create training and test patterns, drying experiments were conducted using a laboratory dryer in deep bed mode. The desired parameters for various input variables were calculated using physical and thermodynamics relations. To predict the dependent parameters, three well-known networks namely multi layer perceptron (MLP), generalized feed forward (GFF), and modular neural network (MNN) were examined. Four learning algorithms consisted of step, momentum, conjugate gradient, and Levenberg-Marquardt (LM) were also used for the training purpose of the networks. The GFF network provided superior results than those achieved by MLP and MNN networks. Among several examined topologies and activation functions for the GFF network, the 3-8-7-3 topology and the hyperbolic tangent function revealed the best results. A remarkably high degree of prediction accuracy was achieved by the resulting GFF neural network, with a normalized mean square error (*NMSE*) of only 0.00865, mean absolute error (*MAE*) of 0.97514 and Spearman correlation coefficients (*r*) of 0.9912. It was concluded that the ANN could be an effective method to model Isfahan rough rice drying process.

MONITORING OF COAGULATION PROCESS OF SOYMILK BY AN INTEGRATED ELECTRICAL SENSING AND CONTROL SYSTEM

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CSBE101111 – Coagulation of soymilk is the most important process in tofu processing. The aim of this study is to develop a monitoring method which can detect the coagulation of soymilk by electrical impedance spectroscopy (EIS) to control the temperature of soymilk in a vessel accurately and uniformly by Ohmic heating. Monitoring and heating were completed with the same electrodes in at different time intervals. Soymilk coagulation process was investigated by electrical impedance spectroscopy and rheological analysis of tofu break stress, break strain and Young modulus. The impedance amplitude of soymilk decreased at frequencies of 42 to 200 Hz and increased over 200 Hz with the progress of the coagulation of the soy milk, splitting method indicated that the electrode capacitance might increase and that electrical conductivity of medium (soymilk) might decrease during coagulation. Volume resistivity of soymilk at 10 kHz showed a positive linear correlation with the rheological properties. Therefore, EIS can provide a simple, safe and rapid approach for predicting both tofu physical quality and the coagulation degree of soymilk. The developed method is capable of controlling the coagulation degree during a soymilk coagulation process and estimating the tofu textural properties.

IMPACT OF HARVESTING TIME ON ULTIMATE METHANE YIELD OF SWITCHGRASS GROWN IN EASTERN CANADA

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CSBE101113 – Green energy production from crops has been under investigation for the last two decades. In Europe, this led to the development of energy crops-fed full scale bioreactors. Switchgrass was recognized as one of the most promising crops for energy production among several perennial grass species grown under moderate to hot climates. However, few studies were initiated under colder climate conditions. The aim of this study was to determine the mesophilic methane yield of switchgrass grown under the cooler growing conditions of the north-eastern area of North America. Switchgrass was harvested at three different times (late July, late August, and late September) in 2007 and conserved as silage. The regrowth of plots harvested in late July was also harvested in late September as a two-cut strategy. The switchgrass silage samples were anaerobically digested using small-scale (30 L) laboratory digesters. Specific methane yield decreased significantly with advancing plant development (from 0.289 to 0.207 L_N CH₄ g⁻¹ VS), but was similar between the first harvest in late July and the regrowth in late September. Approximately 25% more methane could be produced by hectare for the two-cut strategy compared to harvesting once in late August. Further studies are required to determine the effect of cutting times and strategies on the long term yield of switchgrass in order to adequately establish the production cost of this green energy.

RADIANT HEAT DISTRIBUTION IN BROILER HOUSING USING INFRARED THERMOMETRY

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CSBE101114 – The use of infrared thermography makes it possible to identify hot spots of distinct values of radiant temperature and it has been used to identify physiological events in humans and animals. Surface temperature measurements can be made without disturbance and with greater precision, especially on animal coats that have low heat capacities. This research aimed to analyze the ambient dry bulb temperature variation as function of the surface temperature of litter during the first four weeks of growth. The research was carried out in two commercial flocks reared in South eastern Brazil and registered the variation of ambient climatic data. Environmental variables (dry bulb-DTB, and relative humidity-RH) were recorded using the thermal stress monitor Questemp[®] 34. Surface temperatures of litter were registered using infrared thermography. Air velocity and light intensity were also registered. Data was analyzed using one-way ANOVA and statistical significance was adopted at a level of 95%. Difference in both surface temperature of litter and dry bulb temperature between weeks was significant. Results showed also significant difference between the second and third weeks of growth, and between the second and fourth week of growth in flock 1 and 2, between the first week and the following weeks of growth. Calculating Pearson correlation between ambient dry bulb temperature and the surface temperature of litter it was found a high correlation (0.86) in flock 1, and moderate correlation in flock 2 (0.53). [...].

TEXTURE EVALUATION AFFECTED BY PHYSICAL CHARACTERISTICS OF CARROTS DURING STORAGE

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CSBE101115 – Texture is one of the most important factors that determine consumer choices among different products. Texture is a sensorial parameter, measured indirectly by imitative tests that are the combination of different tests that provide mechanical properties of a product. These properties can provide information essential to optimize postharvest procedures, such as handling, transport and storage of agricultural products that suffer alterations during the shelf-life, due to temperature and relative humidity conditions during storage and physical aspects of the product. Thus, the objective of this work was to evaluate the influence of physical characteristics on the texture of carrots (*Daucus carota* L.) cv. Brasília during storage. Carrots with conic shape type were classified by means of surface-volume ratio values, in three different classes: short, average and long (0.1214, 0.0847 and 0.0710 mm² mm⁻³, respectively). The roots were stored in climatic chambers at temperatures of 10, 20 and 30 °C, and air relative humidity of 45, 65 and 95 %, during 120 h. Texture was analyzed through penetration test during 10 s using a probe of 1.0 cm of diameter with a force of 4 N and a loading rate of 10 mm s⁻¹. Surface-volume ratios were calculated by means of the dimension characteristics of the roots, with the aid of a digital caliper. It presented significant influence on the texture. Short carrots obtained the lowest resistance to penetration force during storage. All classes studied at temperature of 10 °C and relative humidity of 95 % maintained texture at a good commercialization value.

INVESTIGATING DESIGN CRITERIA TO BUILD A PERFORMING MICROBIAL FUEL CELL RUNNING ON SWINE LIQUID MANURE

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CSBE101116 – Microbial fuel cell (MFC) is a promising technology for swine liquid manure treatment with a good energy recovery potential. A MFC converts energy available in a bio-convertible substrate directly into electricity while decreasing its chemical oxygen demand (COD). This project is devoted to understand bacterial and electro-chemical phenomena occurring in a microbial fuel cell running on swine liquid manure (MFC_{lm}) as fuel. Many steps have been achieved to obtain these results. Construction of a first single chamber MFC_{lm} generation based on literature has been done. Various support media filling the anodic chamber have been tried to optimize surface area on which bacteria may develop according to the hypothesis that large bacteria concentration will enhance energy production and decrease treatment time. Bacterial communities extracted from selected support media were analyzed using molecular technologies such as DNA extraction, PCR amplification, denaturing gradient gel electrophoresis (DGGE) and cloning and sequencing. These analyses revealed that only a few bacteria species coming from raw liquid manure are responsible for electrical activities. [...].

COMPARISON OF AMMONIA EMISSIONS FROM A NATURALLY VENTILATED DAIRY LOOSE HOUSING WITH SOLID FLOOR SURFACES OVER TWO SEASONS

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CSBE101117 – To date, ammonia (NH₃) emissions have not been determined for loose housing systems with outdoor exercise areas, which are common in Switzerland. The measurements presented below were carried out in a naturally ventilated loose housing with cubicles (46 cows), solid floor surfaces and a combined cubicle access area/outdoor exercise area alongside the cowshed. The feeding aisle and the combined cubicle access area/outdoor exercise area were mucked out four times daily with stationary scrapers. To account for seasonal effects, measurements were performed over a three day period in both summer and winter. A tracer ratio method with two tracer gases was developed to quantify emissions from two sources with different emission levels. In order to characterise the measuring situation the following parameters were also recorded: descriptive farm data, climate, use of the different areas by the animals, aisle/exercise area soiling, as well as nitrogen input, output and utilisation. In both seasons, animal uses as well as soiling levels were higher in the feeding aisle than in the combined cubicle access area/outdoor exercise area. The proportion of dry soiling was considerably greater in summer than in winter. Temperatures were between 7 and 37 °C during summer, and between -8 and 12 °C in winter. The average daily values for NH₃ emissions ranged from 46.2 to 67.4 g/LU·d in summer and from 12.4 to 12.9 g/LU·d in winter. Diurnal patterns were only recognisable during the warm season. Events such as mucking out operations are partly reflected in the NH₃ emissions.

SEARCHING FOR IMPROVED IRRIGATION SCHEDULING ALTERNATIVES FOR HORTICULTURAL CROPS IN THE HUMID TROPICS

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CSBE101118 – Excess water is often applied to horticultural crops irrigation, which contributes to inefficient water use and lower yields in horticultural production. However, these problems may be controlled when improved irrigation scheduling is adopted. The water balance and irrigation scheduling simulation model ISAREG was selected for searching improved irrigation schedules for selected horticultural crops in Cuba. The calibration and validation of the model was first performed using two independent data sets for each studied crop. The calibration refers to the crop coefficients (Kc) and the soil water depletion fraction for no stress (p). Results show a good agreement between observed and model predicted available soil water, with the root mean square error ranging 0.97 – 2.82 mm, and a index of agreement ranging 0.93 - 0.99. After this calibration and validation process the simulation model ISAREG was used to analyze the current irrigation schedules and develop appropriate alternatives that control percolation and may support improved yields and water use as well as productivity. Improved schedules may lead to nearly 30% increase in water productivity or 50% if deficit irrigation is adopted.

PATHOGEN REMOVAL FROM PIG MANURE BY FULL-SCALE PSYCHROPHILIC ANAEROBIC DIGESTION IN SEQUENCING BATCH REACTORS

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CSBE101119 – Pathogens in pig manure used as fertilizer constitute a challenge regarding environmental issues. This study assessed the efficiency of commercial scale psychrophilic anaerobic digestion in sequencing batch reactors (PADSBRs) for pathogen removal from pig manure. The impact of treatment cycle length (one and two weeks) and of hydraulic flow regimes on pathogen removal efficiency was investigated. Two reactors (BR1 and BR2) were operated as conventional SBRs while two others (BR3 and BR4) were fed from the bottom of the reactors simultaneously with draw step. The latter operational conditions allowed for avoiding operational constraints. Reactors were monitored over a two year period for pathogens and indicator removal. Total and fecal coliforms, and *Escherichia coli* concentrations decreased by more than 2.5 log₁₀ units in BR1 and BR2, while BR3 and BR4 removed 0.9 to 1.2 log₁₀ unit of these organisms. *Yersinia enterocolitica* removal averaged 2.1 log₁₀ units for BR1 and BR2, and ranged from 1.1 to 1.3 log₁₀ unit for the other reactors. *Salmonella* and *Campylobacter* sp. removal by BR1 and BR2 ranged from 1.2 to 1.5 log₁₀ unit, while their concentration decreased by 0.9 to 1.1 log₁₀ unit in BR3 and BR4. *Clostridium perfringens* and *Enterococcus* spp. concentration remained high in the digesters. The PADSBRs maintained the same level of pathogen removal when the treatment cycle length was reduced from two to one week. Mass balances on volatile fatty acids (VFAs) revealed short-circuits averaging 6.3% and 6.4% of inlet flow in BR3 and BR4 effluents respectively, significantly reducing the overall performance of the reactors regarding pathogens removal. [...].

INFLUENCE OF CONJUGATED LINOLEIC ACID (CLA) SUPPLEMENTATION ON PROBIOTIC BACTERIA VIABILITY AND SENSORY PROPERTIES OF STIRRED YOGURT

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CSBE101120 – Conjugated linoleic acid (CLA) has attracted much attention because of its numerous health promoting effects, such as anticarcinogenesis, anti obesity, anti diabetes, and cholesterol lowering. Dairy products contain relatively large amounts of CLA (2-37 mg/g fat), but this quantity is not enough to satisfy the minimal requirements for promoting beneficial health effects. Consequently, there are many efforts to increase the CLA concentration of dairy products, but no significant results have been achieved to date. In order to enhance the CLA concentrations and to provide dairy products richer in CLA, we evaluated the sensory and stability properties of stirred yogurt supplemented with CLA (mainly *cis*-9,*trans*-11,octadecadienoic acid and *trans*-10,*cis*-12, octadecadienoid acid), as well as the influence of this supplementation on the number of viable probiotic bacteria (*L. acidophilus*, *L. rhamnosus* and *B. lactis*). The CLA concentration of yogurts was evaluated and quantified by gas chromatography. Sensory evaluation was carried out with trained panelists in order to estimate possible changes in the sensory properties of yogurts by the addition of CLA. The results showed that it is possible to enhance the concentration of CLA in yogurts without affecting the viability of probiotic bacteria or the sensory properties.

EFFECTS OF SOME CUTTING BLADES AND PLANT FACTORS ON SPECIFIC CUTTING ENERGY OF SUGARCANE STALK

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CSBE101122 – Design and development of equipments to cut plant material requires some basic data to avoid waste of energy on a wide area. In this research, the effect of some plant and blade factors on specific cutting energy (SCE) requirements to cut sugarcane stalk was investigated using pendulum method. A pendulum-like apparatus was designed and calibrated. SCE in this research means energy requirement per area per dry matter (d. m) density of section of cut (J/g.cm^{-1}). Blade factors included knife velocity and knife angle; while plant factors included moisture content, cane cutting position from node or internodes and maturity degree by one month of time difference. A 3-replicate factorial experiment with completely randomized design (CRD) layout was used. Results showed that minimum SCE of 0.21 J/g.cm^{-1} of dry matter was obtained with a minimum knife velocity of 1.34 m/s ($P < 0.05$), minimum moisture content of 48% ($P < 0.01$) and also with lower degree of maturity ($P < 0.01$). Knife angle and cutting position (node or internodes) had no significant effect on SCE. Then the relationship between SCE and moisture content was extracted.

EFFECT OF DRYING AND TEMPERING CONDITIONS ON MILLING QUALITY IN MULTI-PASS DRYING OF ROUGH RICE

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CSBE101123 – Drying and tempering conditions in multi-pass drying of rough rice directly affects head rice yield (*HRY*), drying kinetics, and energy utilization. The objective of this study was to determine the optimum multi-pass drying condition for two different rice varieties namely, Shafagh (long-grain variety) and Sazandegi (medium-grain variety). The rough rice cultivars were dried at high (air temperature and relative humidity of 60°C and 17%) and low (air temperature and relative humidity of 40°C and 12%) drying conditions at four drying durations (1.5, 3, 4.5 and 6 percentage point moisture content removal). Then each drying batch was split into seven sub-samples, which were tempered for 0 to 240 min in increments of 40 min. Finally all samples were dried to 12.5% (w.b.) moisture content. After hulling and whitening, the *HRY* index was measured and statistically compared for each sample. Results showed that drying air condition, drying time and tempering duration had a significant effect on *HRY*. For both varieties and two drying conditions, the *HRY* value decreased as drying duration increased. Also the high temperature drying condition resulted to more loss in *HRY* as compared to the low drying condition. Results for both varieties revealed that applying high temperature drying condition resulting to remove 6 percentage points moisture content along with 2-4 hours tempering duration achieved high *HRY* value as approximately equal as corresponding values for low temperature drying condition. Therefore, for both varieties, it is concluded that high air temperature to remove 6% moisture content at first drying pass could be applied to rapid drying operation without damaging the rice kernel, as long as sufficient tempering is allowed.

FACTORS INFLUENCING FORMATION AND STABILITY OF ORANGE-FLAVOURED BEVERAGE EMULSION

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CSBE101125 – The influence of concentration of Arabic and xanthan gums as well as sucrose on the characteristics of orange flavoured beverage emulsions subjected to heat and freeze-thaw treatments were investigated over a long storage period. The results showed that surface and interfacial tensions were both greatly affected by the composition of the aqueous phase. The flow behaviour of emulsions and also the average size of oil droplets and their stability against coalescence were found to change by increasing the proportion of hydrocolloids and sucrose. Heat and freeze-thaw treatments were shown to affect the stability of emulsions in both concentrated and diluted forms during prolonged storage periods, with the speed depending on the formulation of aqueous phase. In this paper, the mechanisms governing the stability of beverage emulsions and the models predicting coalescence and phase separation of oil droplets will be discussed in detail.

IRRIGATION SYSTEM MANAGEMENT ASSISTED BY THERMAL IMAGERY AND SPATIAL STATISTICS

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CSBE101126 – Thermal imaging has the potential to assist with many aspects of irrigation management including scheduling water application, detecting leaky irrigation canals, and gauging the overall effectiveness of water distribution networks used in furrow irrigation. Many challenges exist for the use of thermal imagery to accurately determine the timing of irrigation based on crop water status. These challenges include proper accounting for variations in solar radiation and wind on a spatiotemporal basis, delineating canopy-air temperature difference (CATD) under periods of low vapour- pressure deficit, and accounting for altitude effects on canopy temperature represented at the camera. At the Crop Production Systems Research Unit of the USDA-ARS in Stoneville, MS (USA), information from thermal imagery obtained with agricultural aircraft are being used along with ground-based readings of soil moisture status and canopy temperature in an attempt to develop consistent criteria for scheduling irrigation. A review of some issues with thermal imaging is presented, along with a proposed approach using spatial statistics that can enhance the value of thermal imagery for detecting water-stressed field areas. Thermal imagery has been used to identify plant canopy temperature differences related to crop water/heat stress. In addition, we have applied spatial statistics to help to delineate areas of the field with high potential for crop water stress. Thirdly, we illustrate the utility of thermal imagery for detecting leakage from irrigation canals and poly-pipe furrow irrigation systems. Lastly, operational characteristics of a new variable-rate center pivot irrigation system that can utilize spatial irrigation scheduling criteria are described.

CUT CHRYSANTHEMUM (CHRYSANTHEMUM MORIFOLIUM RAMAT.) IRRIGATION SCHUEDELING UNDER GREENHOUSE CONDITIONS

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CSBE101127 – Soil water tension has been used with success as a criterion of irrigation scheduling. It avoids the excessive application that frequently results in lost of quality. Looking for the best representation of the obtained data, this research was developed at a farmer located in Paranapanema-SP, Brazil, in cultivations developed by the producer. The aim of this research was to identify the soil water tension which results in the best quality of cut chrysanthemum (Dark Orange Reagan cultivar). Experimental design was totally randomized with 3 repetitions, subdivided in 30 parcels, each one controlled by a register, with drip tape lines. Treatments were defined for 10 soil water tension levels: 5, 10, 15, 20, 25, 30, 35, 40, 45 e 50 kPa. Leaves area evaluations, dried weight, diameter, and plant high were measured every 14 days, using 3 plants per parcel. Results showed that there is no significant difference among treatments for most of the evaluated variables. Plants irrigated with soil water tensions of 20 and 50 kPa showed increases in dried weight and in the highest number of A1 packs (highest possible quality).

DRYING EFFECT ON SOME PHYSICOCHEMICAL PROPERTIES OF IRANIAN DATE

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CSBE101129 – The main objective of this study was to produce pure date powder. Two varieties of Iranian low moisture dates called Zahedi and Abbas-abad were selected as studying samples. Drying experiments, included oven drying at different temperatures (65, 75 and 85 °C) and at a constant time (72 hr) were carried out. Moisture content and some main physicochemical properties of the selected dates and dried samples such as sugars, protein, fat and color were analyzed. Furthermore the influence of drying temperature (65, 75 and 85 °C) on the date palm fruits was investigated. The results show that drying process decreases the lipid and protein contents. Sucrose contents of two selected dates are very limited whereas fructose and glucose are dominant. The results show that fructose and glucose amounts in each date have been decreased after drying whereas sucrose amounts of two dates increased. For Abbas-abad date, L, a, b and yellowness values are increased by drying with significant differences. For Zahedi date, color assessment results are different from Abbas-abad date for a and yellowness parameters; values of a and yellowness are decreased by drying.

MEASURING CONCEPT FOR DETERMINING AMMONIA EMISSIONS FROM NATURALLY VENTILATED DAIRY HOUSING WITH AN OUTDOOR EXERCISE AREA

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CSBE101131 – There is a pressing need for up-to-date data on NH₃ emissions from naturally ventilated dairy farming, from both an agricultural and an environmental policy point of view. However, existing data are very limited because they mostly rely on individual farms and/or do not cover seasonal variations sufficiently. The aim of this study is to determine NH₃ emissions for the most common future dairying situation in Switzerland and to derive an emission factor as a contribution to emission inventories. A novel tracer ratio method with two tracer gases (SF₆, SF₅CF₃) was employed to determine the emissions. The diluted tracer gases were continuously dosed to the NH₃ emitting surfaces. An air collection system facilitated representative sampling in the spacious housings. A recently developed GC-ECD method was used to simultaneously quantify SF₆ and SF₅CF₃ with a detection limit below 1 ppt, while NH₃ was measured using a photoacoustic trace gas analyzer. A set of relevant accompanying parameters such as climate data, N-level related parameters and other descriptive farm data (outdoor climate, climate in housing and outdoor exercise area, use of the different areas by the animals, aisle/exercise-area soiling, and nitrogen input, output and utilisation) were used to characterise each measuring situation. Measurements were taken over twelve measurement periods on six farms with loose housing cubicle systems with solid floor surfaces and an outdoor exercise area. Measurements in two out of three seasons on each farm covered the variation in climate over the course of the year. Statements relating to various climatic situations are made possible beyond the individual farm level [...].

ANAEROBIC DIGESTION AS A SLURRY MANAGEMENT STRATEGY: A CONSEQUENTIAL LIFE CYCLE ASSESSMENT

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CSBE101132 – In high animal density countries, anaerobic digestion of slurry represents an environmental opportunity for both slurry management and renewable energy production. This study assesses the environmental consequences of four biogas production alternatives where slurry is the only input in the process (i.e. without supplementary addition of easily degradable carbon). This is achieved by concentrating the slurry through the use of different separation technologies. The biomass mixture input for biogas production thus includes solid fraction from slurry separation as well as raw slurry, proportioned in order to achieve economical methane yield. The separation processes considered are: mechanical separation (pig slurry), mechanical separation combined with the addition of flocculants (“mechanical-chemical” separation: for both pig and cow slurry) and mechanical separation combined with a thermal treatment (pelletisation: pig slurry). These four biogas alternatives were compared to a reference slurry management scenario, i.e. using the slurry as a fertiliser without prior treatment. The modelling is based on Danish conditions and uses the consequential life cycle assessment methodology. The produced biogas is used for production of heat and power and the degassed slurry is used as an organic fertiliser. [...].

ELECTRICAL ENERGY USE IN DIFFERENT HEATING SYSTEMS FOR EARLY WEANED PIGLETS

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CSBE101133 Many technologies can be used to promote the welfare in pig production. In order to make them viable, it is necessary to develop research works to lower their costs and increase their practicality, enabling the sustainability of the process. Heating systems for piglets in nursery and farrowing may be improved to save energy, without affecting the animals welfare. There is little information in current literature and specific information about electricity in Brazilian swine farms. The objective of this research work was to compare the electrical energy use and thermal comfort conditions promoted by three heating technologies for piglets in nursery. The evaluation was performed in a commercial farm, located in Brazil, in a subtropical climate area. Each treatment allocated 150 weaned piglets at 21 days-old. The systems were designed to keep the piglets at 28 a 30°C, during fourteen days. The heating technologies studied were: TR - suspended electrical resistors, TP - heated floor and TA – convection heating. Electrical energy consumption (kWh), maximum power demand requirements (kW), specific consumption (kWh/kg of live produced body mass), efficiency of heating system (°C/m³ air) and dry-bulb temperature (°C) were evaluated. The heated floor system was better under the aspect of electrical energy use. The electrical resistance heating system was the best regarding to the animals thermal comfort needs.

APPLICATION OF HYPERSPECTRAL IMAGING TECHNIQUE FOR DETERMINATION OF PORK QUALITY ATTRIBUTES

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CSBE101134 – Meat grading has always been a research subject because of its economical importance and the large variations among meat product qualities. In this study, a hyperspectral imaging system in the near-infrared (NIR) range (900-1700 nm) was developed for quality assessment of pork meat. Pork samples were classified in three quality grades, as reddish-pink, firm and non-exudative (RFN), pale, soft and exudative (PSE), and dark, firm and dry (DFD) based on colour, texture and exudation of the meat. Spectral information obtained has shown that there are differences among pork meat quality classes that allows for classification of samples based on spectral features. Some significant wavelengths linked to drip loss, pH and colour attributes were identified by using first derivative of the spectra. Principal component analysis (PCA) has shown that spectral information can distinguish pork meat according to quality characteristics. Results are encouraging and show the promising potential of hyperspectral technique applications for fast and non-destructive assessment of pork quality.

ASSESSING ODOUR PLUMES SURROUNDING SWINE OPERATIONS

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CSBE101135 – Instantaneous downwind odour plumes were measured on two 3000-sow swine farrowing farms located in a flat area of southern Manitoba, one with open earthen manure storage (EMS) and other with negative air pressure (NAP) covered EMS. The downwind odour plumes were quantified by 15 trained human odour sniffers using an 8-point n-butanol scale. Downwind odour intensity peak-to-mean ratios were computed from field odour intensity measurement and analysed against downwind distances, atmosphere stability class and averaging time. The peak-to-mean ratio increases with downwind distance and averaging time; higher peak-to-mean ratios occurred under unstable atmosphere conditions.

MANAGEMENT ZONE DEFINITION FOR COFFEE PRODUCTION SYSTEM BY USING SOIL APPARENT ELECTRICAL CONDUCTIVITY

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CSBE101136 – Researchers have demonstrated the application of soil electrical properties to explain the spatial variability of yield and of physical-chemical soil properties. The objective of this work was to evaluate the process of management zones definition based on soil apparent electrical conductivity. A portable meter model ERM-02, made by Landviser, was used to determine the bulk electrical conductivity of soil. This equipment uses the resistivity method, in which four electrodes are inserted into the soil. Soil apparent electrical conductivity was measured at 0.20 m deep. Krigging map interpolation method was used. The management zones were defined using the Fuzzy K-Means algorithm. The results were evaluated using the kappa coefficient to analyze the accuracy in the classification of soil properties using the management zones defined. The best kappa coefficients were obtained to identify the availability of soil potassium and remaining phosphorus. The kappa coefficients calculated in the classification of potassium were 62%, 38%, 24% and 32% for two, three, four and five management zones, respectively. For the remaining phosphorus, the kappa coefficients were 61%, 15%, 31% and 27%, respectively, for two, three, four and five management zones.

ENVIRONMENTAL COMFORT OF EARLY WEANED PIGLETS IN DIFFERENT HEATING SYSTEMS

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CSBE101137 – There are many stressors in pig nurseries. Thereby, research works that aim to minimize these stressors may be helpful. The thermal environment is a proven stressor that can compromise the animal welfare. There is a complex interaction of climatic factors that determine the heat exchange process between the animal and the environment. The effect that temperature has on the animals may be affected by relative humidity, wind, precipitation, radiation and thermal contact surfaces. The thermal environment can also change other environmental parameters such as air quality. The objective of this research work was to compare the environmental conditions promoted by three heating technologies for piglets in nursery. The systems were designed to heat piglets by different mechanisms of heat transfer (conduction, convection and radiation). Climatic variables (dry-bulb temperature, relative humidity and air velocity), Thermal Humidity Index (THI) and air quality variables (ammonia, hydrogen sulphide, and carbon dioxide) were evaluated. The evaluation was performed in a commercial farm, located in Brazil, in a subtropical climate area. Each treatment allocated 150 weaned piglets at 21 days-old. The systems were designed to keep the piglets at 28 to 30°C, during fourteen days. The heating technologies studied were: TR - suspended electrical resistors, TP - heated floor and TA – convection heating. We conclude that the heating system with electrical resistance (TR) was the best to promote thermal comfort for piglets and heated floor was the worst one. The convection system (TA) showed intermediate performance when considering the thermal comfort, but had lower levels of ammonia.

EFFECT OF CONSTRUCTION AND ENVIRONMENTAL FACTORS ON THE PERFORMANCE OF HEATING AND COOLING SYSTEMS FOR POULTRY PRODUCTION

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CSBE101139 – In agribusiness, the poultry production stood out in recent decades by a trend of technological advances that have transformed the venture into a genuine economic activity. The knowledge of the thermal environment of the facilities allow the evaluation of response to changing weather ahead and offer technical alternatives to ensure adequate performance based on locality. The objective of this study was to evaluate the indoor breeding of broiler chickens under the standpoint of constructive and thermal systems and their correlation. Poultry houses in the city of Videira, Santa Catarina, southern Brazil, during the winter were evaluated. We evaluated the internal heat of the birds, between 07:00 a.m. and 19:00 p.m. and estimated through the psychometrics properties of the air, the internal temperatures of the air associated with a relative humidity of 80% in order to determine how much these temperatures can be reduced by humidifying the environment and subsequently analyzing the relative efficiency of these sheds. In winter conditions, the poultry houses were considered optimal and relative efficiency was isolated based on the low external temperatures. However, the internal thermal conditions were uncomfortable for the birds during the hot days. Moreover, the external temperatures were relatively close to the comfort zone for most of the time. [...].

DETERMINATION OF FORWARD SPEED EFFECT ON PLANTING UNIFORMITY IN A SUGARCANE BILLET PLANTER

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CSBE001142 –Today's agriculture industry has become highly dependent on new technologies which result in better performances in terms of quality and quantity. In other words, new technologies contribute to higher productivity in agriculture sector of developing economies. Sugarcane as an industrial crop plays an important role in many countries. Precision planting in sugarcane plantations worldwide is a main concern mainly because saving in billets planted could decrease production costs and increase the profit in the form of an increase in sugar production from the billets being saved. This research was conducted to determine the effect of forward speed on planting uniformity in a sugarcane billet planter. The machine was designed and developed for precision planting and was able to pick single billets from a secondary hopper and place them on the furrow with a desired overlap of around 15 centimeters. Ground-driven power train was used to run the metering units, hence providing a constant billet overlap planting pattern according to the changes of forward speed. The planter was evaluated in the field based on the percent filling of the cupboards, over-overlapping and under-overlapping planting patterns as affected by planting speed, cane variety and angle of the chain conveyor structure from vertical line. The aim of this field evaluation was to determine the best operation speed and level of billet consumption rate. A split-split plot experiment with a completely randomized design was used to determine effect of speed of planting and angle of the chain conveyor on percent filling of cupboards, over-overlapping and under-overlapping indexes. Data obtained from experiments were analyzed [...].

DEVELOPMENT OF BELOW-FLOOR LEVEL SOIL BIN SYSTEM FOR SOIL TILLAGE DYNAMICS RESEARCH AT THE FEDERAL UNIVERSITY OF TECHNOLOGY AKURE, NIGERIA

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CSBE101143 – The Federal University of Technology, Akure, Ondo State, Nigeria was established in 1981. In line with the motto of the University, “Technology for self reliance” the University had developed indigenous machines and equipment. The University also has a mandate to accelerate agricultural production and to have impact in the immediate community and the country at large. A below floor level outdoor soil bin facility for the evaluation of full-scale tillage and other soil engaging machines is being developed for soil tillage research at the University. It consist of the soil bin itself, the soil processing unit and the instrumentation system for the measurement of soil forces and soil disturbance, soil and machine test equipment and a control unit. The facility will also enhance studies in the areas of precision farming, design and manufacturing of machines, waste engineering and compaction studies. The University will also extend knowledge to other establishments via training, workshops and extension services. The paper therefore presents the construction details of a below floor level soil bin for the evaluation of full scale tillage implements at the University. The facility will enhance the generation of data for the design of indigenous soil engaging implements for local soil conditions.

CHARACTERIZING AMBIENT AND SPRAY MIXTURE EFFECTS ON DROPLET SIZE REPRESENTED BY WATER SENSITIVE PAPER (WSP)

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CSBE101144 – Water sensitive paper (WSP) cards are frequently used to provide visual representation of droplet size and density for spray drift and deposition studies. Droplets collected on WSP spread out on the surface of the paper, and standard “spread factor” equations are used to compensate for spread to characterize actual droplet size. To date, no data have been presented to consider the effects of ambient conditions and formulation on droplet size represented by WSP. These data would be useful for creation of more accurate spread factor equations, and significant effects on droplet size could be modeled into new equations to account for these variables. A preliminary study was conducted using a newly constructed enclosed chamber that allows independent control of temperature (T) and relative humidity (RH) to determine the effects of T, RH, formulation, and droplet volume on droplet diameter as represented by WSP. Droplets of a known diameter were placed on several WSP cards using five mixtures of Domark[®] fungicide, Syl-Tac[®] surfactant, and water while RH, T, and droplet volume were varied at three levels each. The WSP were optically scanned to obtain droplet size. Statistical procedures were used to determine the effect of T, RH, droplet volume, and spray mixture on stain area, and a model was developed over the droplet size range applied. A useful relationship of the influence of ambient conditions was derived, which indicated a linear relationship between RH and droplet stain area.

DEVELOPMENT OF A NEW SYSTEM FOR MEASURING THE COEFFICIENT OF DYNAMIC FRICTION OF AGRICULTURAL CROPS

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CSBE101147 – In this research a simple and low-cost method for measuring the coefficient of dynamic friction of agricultural crops was developed and a system based on it was designed and calibrated. The system made it possible to obtain the coefficient of dynamic friction with a wide range of sliding velocity values. Calculation of the accelerated motion of a body on an inclined surface was the base of the system design. Then, the coefficient of dynamic friction of sugarcane billets sliding on a common steel surface was determined in two states of 1) wet surface and 2) dry surface and with two types of tests, i.e. a) by single billets, and b) by set of billets. A linear equation of the coefficient of dynamic friction against sliding velocity was obtained that indicated the decrement of the coefficient relative to the sliding velocity. In addition, results showed that coefficient of dynamic friction obtained by single billets were influenced by surface wetness more than by set of billets.

USE OF HYPERSPECTRAL IMAGING FOR THE QUALITY CLASSIFICATION OF COOKED TURKEY HAMS

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CSBE101148 – This study was carried out to develop a hyperspectral imaging system in the near infrared (NIR) region (900-1700 nm) to evaluate the quality of cooked turkey hams. Different qualities of turkey hams were studied based on their chemical ingredients and processing parameters used during processing. Hyperspectral images were acquired for ham slices originated from each quality class and then their spectral data was extracted. Spectral data was analyzed using Principal component analysis (PCA) to reduce the high dimensionality of the data and for selecting some important wavelengths. It is seen that from 241 wavelengths, only five wavelengths (980, 1061, 1141, 1215 and 1326 nm) was considered to be the optimum wavelengths for the classification and characterization of turkey hams. The data analysis showed that it is possible to separate different quality turkey hams with few numbers of wavelengths on the basis of their chemical composition. Linear Discriminant Analysis (LDA) showed that the best classification accuracy was 88.57%. The result revealed the potential of NIR hyperspectral imaging as an objective, rapid and non-destructive method for the authentication and classification of cooked turkey ham slices.

FLUID-DYNAMIC PROPERTIES AND PRESSURE LOSS OF BLACK BEANS IN A PACKED BED

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CSBE101149 – Fluid-dynamic behaviour based on physical properties of agricultural products is important in wide applications to handle and process those products. In this research work, the effect of several lengths (L): diameter (D) ratios of black beans bed and of air velocity on fluid-dynamic behaviour were studied. The equipment used was a fluidized bed chamber, which consists in a 150mm cylindrical column by approximately 1000mm of height and a flat perforated base. A frequency inverter controlled an electric centrifugal fan and air velocity. Black beans porosity was calculated by relation between solid and bulk densities. Bulk density was determined by filling a graduated beaker with a weighted portion of black beans. The void volume was full filled with distilled water. Solid density is the ratio between immersed mass and free void sample volumes. The experimental runs for fluid-dynamics behaviour consisted of determining the pressure loss of increasing and decreasing the air flow and the expansion of black beans bed for different L:D ratios. The minimum fluidization velocity U_{mf} was determined in each experimental run by characteristic curves of pressure loss, which were obtained by variation of air velocity through the black beans bed. U_{mf} values were about $2,0 \text{ m.s}^{-1}$.

COEFFICIENT OF RESTITUTION OF SUGARCANE BILLETS MEASUREMENT USING AN INSTRUMENTED PENDULUM SYSTEM

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CSBE101150 – This research was conducted to measure the coefficient of restitution (e) of sugarcane billets for use in a discrete element model. A pendulum system was developed and calibrated so that a completely controllable horizontal impact between two bodies was obtained and measurements of the coefficient of restitution and the corresponding impact velocity could be performed. Coefficient of restitution (e) of billet–billet and billet-steel impacts were measured in two states of 1) wet and 2) dry surface with various impact velocities. Results showed that surface wetness decreased the values of the coefficient of restitution. In addition, because of the difference in the shape of the impact surfaces, the coefficient of restitution values of billet-steel impacts were less than that of billet–billet impacts.

IMPROVING THE PERFORMANCE OF LANDSCAPE SPRINKLER IRRIGATION THROUGH FIELD EVALUATIONS AND MODELLING

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CSBE101153 – Field evaluations of sprinkler irrigation in a garden landscape were performed in Ponte de Lima, North Portugal, show a low average system uniformity ($CU = 74\%$ and $UD = 67\%$). Field evaluations of sprinkler irrigation systems in a golf course at Oeiras have shown a variable distribution uniformity, from very low $DU = 33\%$ to high $DU = 80\%$. Results are highly impacted by wind speed and by quality of sprinkler system design. Aimed at improving the performance of sprinkler systems using field evaluation data the model ProAsper was used. The model allows identifying appropriate improvement measures and provides information that supports design. It is a user friendly decision support tool that is able to simulate various design alternatives for sprinkler set systems and to manage data from field evaluations. The model supports searching solutions that satisfy target performance indicators and allows the user to analyze and select the alternatives that better satisfy his(her) objectives. In this paper, the model is presented with some detail, showing its databases, pipe sizing computations and the module for performance analysis. Results of its application to these landscapes are presented, including the search of alternative design solutions. Results show that ProAsper is a tool easy to operate and that effectively supports decision-making for design of sprinkler set systems. Further developments are being performed.

RU-SLIMS DEVELOPMENT OF RUTGERS UNIVERSITY'S WEB-BASED SOILS LABORATORY INFORMATION MANAGEMENT SYSTEM

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CSBE101154 – We present a web-based application for sample tracking and automated generation of fertilizer and lime recommendations produced for the Soils Testing Laboratory at Rutgers University. During development, soil amendment recommendations were reviewed and a new simplified approach was taken. Recommendations are drawn from a look-up table based on crop, management level, and measured values of phosphorous and potassium. Management levels for turfgrass, the most requested crop, are more detailed than other crops. The program utilizes the popular Apache/PHP/PostgreSQL software packages. Extensions to PHP allow the creation of PDF formatted reports and the emailing of those reports. The modular nature of the programming and database structure allow the system to be easily adapted for other laboratories and modified to include additional analytical test results.

RICE PLANT DETECTION IN HEADING TERM FOR AUTONOMOUS ROBOT NAVIGATION

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CSBE101157 – Our objective in this research is to develop a method to detect rice plant in image of paddy field during heading term. It is essential for autonomous robot navigation on levee in paddy field to distinguish between rice plant and weed because the robot must be able to judge whether a domain in the field is travelable or not. Nevertheless, distinction between rice plant and weed is a challenging problem because colors of them are very similar. We address paddy field in heading term and focused on pattern that is formed by rice ears in the image. Our proposing method uses rice ears as a clue to the rice plant detection. The sequence is as follows. Firstly, rice ears in the image are extracted by using simple threshold method. The rice ears form a discriminative pattern in the rice plant domain of the image. Meanwhile, in the weed or levee domain, some pixels are also extracted but they form different pattern. Secondly, we detect the ears' pattern by calculating moment. The moment is calculated by using window which is moved in the image. Finally, rice plant domains are detected by evaluating moment values. We used a number of images taken from paddy fields by digital camera and assessed the effectiveness of our method. Our method worked well on certain condition, but there were some failure cases. We discuss about further improvements.

REFRIGERATED FRUIT STORAGE MONITORING USING RFID AND WSN

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CSBE101159 – Every day, millions of tons of temperature sensitive goods are produced, transported, stored or distributed worldwide. For all these products the control of temperature is essential. The quality of these products might change rapidly, when inadequate temperature and relative humidity conditions happened. It is estimated that 300 million tons of produce are wasted annually through deficient refrigeration worldwide. Quality control and monitoring of goods during the cold chain is an increasing concern for producers, suppliers, logistic decision makers and consumers. In this framework, Radio Frequency Identification (RFID) and Wireless Sensor Networks (WSN) are entering in a new phase. RFID was developed for identification; however, recent developments in RFID hardware outfitted with sensors extend its range of application. Wireless sensor nodes, known as motes, enable environment sensing together with data processing. In this paper we present the results of a set of studies performed in 3 commercial wholesale chambers of 1848 m³, with different set points and products. Up to 90 semi-passive RFID temperature loggers were installed simultaneously together with 7 motes, during one week in each chamber. The motes host a variety of sensors: temperature, relative humidity, light intensity, barometric pressure and two-axis accelerometer. 3D temperature mapping charts were obtained and also the psychrometric data model from ASABE was implemented for the calculation of enthalpy changes and the absolute water content of air. Thus it was possible to estimate energy consumption, water loss from the products and detect condensation over the commodities.

QUANTITATIVE ANALYSES ASPECT OF VIBRATIONAL SPECTROSCOPY AND ITS APPLICATIONS IN AGRICULTURE

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CSBE101162 – The three main branches of vibrational spectroscopy, i.e., mid-infrared, near-infrared, and Raman spectroscopy, are widely accepted techniques for qualitative analyses in the agriculture and food sectors. Mid-infrared and Raman spectroscopy probe the same ‘fingerprinting’ area for most organic as well inorganic matter. Such advantages make them ideal classification tools, with little need for sample preparation in routine analysis. Utilization of these vibrational spectroscopy techniques for quantitative analysis is more complicated and requires data handling to render meaningful interpretation of the spectra. A brief introduction to the theoretical background of infrared absorption and Raman inelastic scattering processes is presented. This article presents a detailed discussion of the fundamental principles behind quantitative analysis using absorption and emission spectroscopy techniques. Different measurement modes and their relationship to the acquisition and transformation of spectral data are explained with practical applications related to the quantitative theory. This paper also talks about the rationale for pre-treating the data. A review of the available procedures to pre-process different kinds of spectra and to build calibration concludes the paper. Linear calibration methods, e.g., classic linear regression, principal component regression, partial least squares regression, support vector machines, and nonlinear methods such as artificial neural network, are briefly reviewed.

AMMONIA REDUCTION AND MAINTENANCE COSTS FOR OLD AIR CLEANING SYSTEMS AND SLURRY ACIDIFICATION SYSTEMS

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CSBE1163 – The objective of the present study was to demonstrate environmental performance and the cost of maintaining, servicing and repairing air cleaners and slurry acidification systems after several years of operation. Previous studies and tests have primarily been carried out on relatively new systems. Since 2002, air cleaning systems have been installed in Denmark on 100 pig farms, and acidification systems have been installed on 80 farms. During the summer of 2009, 17 finisher units with air cleaning or slurry acidification systems were inspected. The units were randomly chosen from among addresses where environmental technologies had been installed. It was necessary to contact 27 owners by telephone in order to arrange the 17 farm visits. Of the 27 owners, 7 responded that their systems were not running. All the systems inspected in this trial were running on the two days of inspections. Ammonia reductions were documented in 9 out of 10 units with air cleaning systems. At maximum ventilation rate, the ammonia concentration was 4.6 ppm in front of the filters, and the average reduction was 65 per cent ($p=0.0018$). In the units with slurry acidification systems, the set point for pH regulation was 5.5. During the inspections the ammonia concentration was 2.6 ppm in units with pH 5.3-5.8 and 5.5 ppm in units with pH 5.8-6.3. However, the difference was not statistical significant. The farm owners received a number of service visits without charge. Pointing forward the service and maintenance costs is estimated to be about EUR 0.60/finisher for a farm with 500 Danish animal units, corresponding to 17.500 produced finisher per year .

THE DUAL CROP COEFFICIENT APPROACH: APPLICATION OF THE SIMDUALKC MODEL TO WINTER WHEAT IN NORTH CHINA PLAIN

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CSBE101164 – The SIMDualKc model is a soil water balance and irrigation scheduling model that uses the dual crop coefficient approach for estimating crop evapotranspiration (ET_c). This approach separately considers soil evaporation and plant transpiration. The model uses a daily time-step and adjusts the crop coefficients to climate, crop density and height, and to soil water conditions. Three years of field experimental data relative to winter wheat were used for model calibration and validation. Data includes ET_c measured with lysimeters and soil water content observed with TDR in a silty loam soil. The calibration procedure consisted on adjusting the soil evaporation parameters, the basal crop coefficients (K_{cb}) and the soil water depletion fraction for no stress (p) for the soil water content simulated to match the observed values. Results show a good agreement between model predictions and field observations. For the calibration a regression coefficient $b = 0.99$ and an error $RMSE = 0.01 \text{ m}^3 \text{ m}^{-3}$ were obtained; for the validation b ranging 0.99-1.03 and $RMSE$ ranging 0.013-0.016 $\text{m}^3 \text{ m}^{-3}$ were computed. The simulated ET_c shows $RMSE = 0.75 \text{ mm d}^{-1}$ for calibration and $RMSE$ ranging 0.51-0.79 mm d^{-1} for validation. Soil evaporation and crop transpiration average respectively 40.3 and 7.5 mm during the initial crop stage, 10 and 30 mm during the frozen soil period, 8.5 and 52.0 mm for the vegetative growth period, 7.0 and 190.8 mm for the mid season, and 16.5 and 75.0 mm for the end season. Soil evaporation represents 19% of ET_c .

THE DEVELOPMENT OF TOOLS FOR MANAGING, MONITORING AND ASSESSING WATER STRESSED CONDITIONS IN JAMAICA

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CSBE101166 – Agricultural production is an important contributor to the Jamaican economy. However, drought is a serious issue in Jamaica, with the potential to cause millions of dollars in crop losses. In fact, there were crop losses amounting to 6 million USD in the 2000/2001 drought. Therefore, drought index information is essential to the better planning for drought impacts and will allow for the introduction of mitigation measures by the agricultural sector. The first objective of this paper is therefore to describe the suitability of both the Normalized Difference Vegetative Index (NDVI) as well as the Standardized Precipitation Index (SPI) in reflecting water stressed conditions for three agricultural areas in Jamaica. The SPI was developed for different time scales, and then correlated to monthly soil water. Depending on location, either the 1 or 3 month SPI was found to be more representative of soil water conditions. The NDVI however, does not provide a suitable representation of soil water for any of the areas studied. The second objective is to disseminate monthly rainfall values of 80% and 90% probability of occurrence for the three locations, in order to facilitate irrigation planning and management by farmers and water managers. To this end, net irrigation demands for vegetables and sugarcane are provided.

METHODS FOR THE ASSESSMENT OF CANDY GUM ELASTICITY

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CSBE101167 – The objective of the work reported here was to determine appropriate test method and evaluation procedure to describe mechanical and rheological characteristics of candy gums of the same composition but of different shapes. Furthermore, the task was to find appropriate parameters to compare mechanical and rheological behavior of candy gums of different heights and volumes. Texture Profile Analysis and creep- recovery compression/decompression tests were performed with candy gums of five different shapes. The results show that both the ratio of the maximum second compression force to that of the first compression force ($F_{\max 2}/F_{\max 1}$), and the ratio of the second compression work to that of the first compression work (W_2/W_1) do not change as the function of the height of the candy gums according to Texture Profile Analysis. Therefore, the values of the mentioned ratios do not show definite changes as the function of the product height, therefore these ratios are independent on the product height. The ratio of elastic to total deformation and the ratio of plastic to total deformation as the function of product height determined as a result of the recovery test during the decompression process are promising parameters to describe the mechanical and rheological characteristics for candy gums of different shapes. The mentioned ratios show a definite tendency as the function of the product height. Consequently, these ratios are suitable to evaluate the rheological parameters of candy gums depending on the product height.

ADVANCED TECHNOLOGIES APPLIED TO HOSE REEL RAIN-GUN MACHINES: NEW PERSPECTIVES TOWARDS SUSTAINABLE SPRINKLER IRRIGATION

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CSBE101170 – The paper describes some outstanding technological innovations and improvements of hose reel rain-gun machines related to working characteristics, application efficiency, distribution uniformity, energetic performance and economic profitability. During time, electronics and control units evolved, and the improved quality of polyethylene enables the industrial production of bigger and longer pipes. Increased efficiency of pumps, hydraulic turbines and transmission systems, results in substantial reduction of energy requirement per unit of irrigated land and supplied water. New rain-gun sprinklers allow high water distribution uniformity and minimal effects of drops on crop and soil. Operating capacity of modern medium-high machines allows irrigating of 50 ha and more of horticultural and industrial crops during peak period under sub-humid climate. Comfort and safety of labour take advantage of the remote control of several operations. Machine handiness is facilitated by hydraulic control systems, resulting in time and labour saving. Fertigation can be practised, allowing significant crop yield increases. Interfacing transmission control of pipe rewinding, field mapping, Global Positioning System (GPS) technology, sprinkler rotation speed and wetting angle, gives the possibility of precision agriculture, also increasing irrigation efficiency. The latest rain-gun machines can practice precision farming, having the chance to irrigate irregular field shapes. Precision irrigation has high potential, due to new technologies, for the future.

RECONDITIONING BY FILTRATION WITH EARTH DIATOMACEOUS AND REUSING THE SUCROSE SYRUP FOR OSMOTIC DEHYDRATION OF PEACHES

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CSBE101172 – A method for reconditioning the sucrose syrup used in the osmotic pre-drying (OPD) of peaches was evaluated consisting of sieving (1mm mesh), filtration with earth diatomaceous, vacuum concentration and syrup replacement. The osmotic dehydration trial was carried out in 15 cycles (50°C, 65°Brix, syrup/fruit ratio of 4:1 and process time of 4h), using reconditioned syrup in each cycle. Complementary drying was carried out in a forced air dryer at 65°C for approximately 5h. Physical (color and turbidity), chemical (soluble solids content, pH, titratable acidity, reducing sugar content, electrical conductivity) and microbiological (yeasts and molds) analyses were carried out on the syrup. The osmotic pre-drying parameters water loss and solids incorporation were also determined. A sensory evaluation was carried out with dried peach using the Difference from Control Method, evaluating the following attributes: flavor, texture, color and appearance. The reconditioning process showed no influence on the osmotic pre-drying parameters, and the microbiological loads of the syrup remained low. The following alterations occurred in the syrup during the OPD cycles with reconditioning and reuse: increase in titratable acidity, lowering of the pH, increase in electrical conductivity and an increase in the reducing sugar content. The turbidity remained constant. Reuse did not influence the flavor or texture and favored maintenance of the yellow color of the dried peach.

ADJUSTED METHODOLOGY FOR DETERMINING RESIDENCE TIME BY IMAGE ANALYSIS ON A VIBRO-FLUIDIZED DRYER

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CSBE101173 – Fluidized bed dryers are used extensively for the drying of wet particulate and granular materials that can be fluidized with or without mechanical assistance. Furthermore, agitation contributes to achieving the fluid like behaviour of solids where rapid, easy transport and intimate fluid contacting are often the most important fluidization properties for industrial operations. Therefore, dryers that permit solid movement are frequently used. In this research work, we pretended to evaluate a new treatment procedure on image analysis methodology for determining residence time distribution on a continuous vibro-fluidized dryer. Knowing what is happening within the dryer, i.e., a complete velocity distribution map for the solid; makes it possible to predict the behaviour of this solid inside the dryer. In many cases, it is not necessary to have substantial knowledge about the flow, simply how long the individual particles stay in the dryer. The intention of this work was to determine the residence time of granular material using image analysis without any manual procedure. The material used was black beans, whereas tracers were black beans painted with white spray ink. The digital images were fitted in a specific computational program. The residence time values obtained by evaluated methodology were compared with ideal threshold image analysis and manual separation procedure values. The residence time distribution curves were determined for different vibration amplitudes. Residence time values obtained by adjusted method present lower mean relative deviation modulus than simple image analysis.

USE OF HYPERSPECTRAL IMAGING TO IMPROVE THE SAFETY OF FOOD

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CSBE101174 – Concerns regarding food safety are growing worldwide, and the recent increase in the prevalence of outbreaks of food borne illness and the pathogenicity of microorganisms responsible for these outbreaks has only heightened these concerns. In this regard, our laboratory has developed a number of imaging devices that can be used to inspect food and food processing surfaces. The underlying technology used to develop these devices is reflectance and fluorescence VIS/NIR hyperspectral imaging. Generally, acquired 3-D hyperspectral image cubes are used to identify multispectral wavebands that can be used to detect attributes of concern in a commercial environment. Examples of devices (all patent-pending) near the end of their development cycle include a hand-held fluorescence imaging device to detect contaminants such as feces in processing plants, a system to detect wholesome poultry carcasses, and a system that allows simultaneous acquisition of fluorescence (400-720 nm) and reflectance (800-950 nm) images using a single camera. This last device has been used to simultaneously detect fecal contamination and quality problems of apples at commercial processing speeds. Devices under development include a hand-held hyperspectral imaging system for surveying production facilities and a portable time-resolved laser-induced fluorescence line-scan hyperspectral imaging system for detection of feces in produce fields. One application of the hand-held system might be to identify biofilms on processing surfaces. The presentation will outline the practicalities of hyperspectral imaging, and will discuss the benefits and limitations of imaging-based food safety detection systems.

INFLUENCE OF HUMMOCKS AND EMERGENT VEGETATION ON HYDRAULIC PERFORMANCE IN A SURFACE-FLOW WASTEWATER-TREATMENT WETLAND

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CSBE101176 – Proper design and operation of constructed treatment wetlands is critical to the success and sustainability of the systems. Hummocks (shallow planting beds) are a design feature that promotes sustainability by providing a means to manage long term vegetation patterns more than other treatment wetland designs. Through the use of biannual tracer tests, we investigated the hydraulic characteristics of a wetland containing hummocks and emergent vegetation. Our goal was to determine whether vegetated hummocks increased hydraulic mixing and solute retention to ultimately improve sustainable treatment performance. Following reconfiguration of a wetland from alternating shallow emergent marsh areas with deep open water zones to one which included open water and hummocks, vegetative coverage was relatively low (maximum of 37% of total shallow marsh area). However, these changes in vegetation spatial distribution did influence wetland hydraulics. Hummocks are intended to promote flow distribution through multiple tortuous flow paths that effectively increase the length to width ratio of the wetland and reduce short-circuiting. In this study, the density and spatial pattern of emergent vegetation influenced hydraulics and led to desirable non-uniform flow velocities (deviation from plug flow). The hummocks also enhanced volumetric efficiencies as well as recirculation zones. The tracer response curves had multiple secondary peaks suggesting the formation of both short and long pathways. Based on data collected at this site, as the wetland matures, development of healthy, upright emergent vegetation that spatially cover the hummocks [...].

DEVELOPING A FRAMEWORK BASED DATABASE (OR AS A CENTRAL TOOL FOR) MAPPING AND ANALYSING RESEARCH AND DEVELOPMENT ON ICT AND ROBOTICS IN AGRICULTURE AND ENVIRONMENTAL RELATED BUSINESSES

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CSBE101182 – New ICT and Robotics technologies are rapidly emerging and can revolutionize future farming through their major impacts on productivity and profitability. Extensive research on ICT and Robotics in Agriculture and environmental related issues is conducted. Unfortunately human and financial resources are fragmented. The objective is to provide a structured framework capable of mapping all relevant research and development within the described research area. First a three dimensional task-technology oriented framework was designed. This structure combines technology (e.g. robotics), with tasks (e.g. milking) and subtasks (e.g. milk quality measurement) within four different scopes: fundamental, applied, innovation and standardisation. This framework was tested and evaluated by 3 working groups of 20 experts. The results indicated that the three axes: task, technology and scope seemed not sufficient to describe the whole research area. Therefore an improved framework was developed. Based on the theory of De Leeuw (2000) the farm was approached as a managing system controlling a process or production system and receiving input from an information system. By extending the task-technology oriented framework with the process-control-information system a useful framework was designed. It will be tested on large scale by implementing it as a free accessible web based database. [...].

SHELF-LIFE DETERMINATION OF “QUESO DOBLE CREMA” BY MEANS OF ELECTRONIC NOSE

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CSBE101183 –The determination of food shelf life is a critical parameter in the food industry, because it gives important information to consumer about acceptable sanitary, nutritional and sensorial qualities of foods. Nowadays, techniques making possible the rapid control of food damage are developed. The main purpose of this work was to study the viability of the electronic nose to determine the shelf-life of “queso doble crema”, a traditional cheese from Colombia, during storage at two different temperatures (4 and 10°C), and to correlate the obtained results with the standard physicochemical, microbiological and sensory analysis normally used for the shelf-life determination. Multivariate analysis (PCA) of electronic nose data showed that this instrument is able to identify differences between cheeses stored at different temperatures, as well as within different storage times at the same temperature. Electronic nose data were well correlated with the microbiological and sensory analysis, indicating that it can be used as a new technology for measuring the shelf life of “queso doble crema” in real-time.

FORECASTING HYDROLOGICAL TIME SERIES IN THE FACE OF CLIMATE CHANGE

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CSBE101184 – The importance of highly accurate flow forecasts, especially in flood-prone areas, has increased significantly in Canada over the last few years as extreme events have become more frequent, severe, and costly due to climate change and other factors. A problem with presently available data-based forecasting methods is that they have limitations handling non-stationary data due to, among other things, climate change. Wavelets are, for intrinsic reasons, well suited for dealing with non-stationary time series since they automatically filter the non-stationary component of the signal instead of trying to de-trend or suppress quasi-periodic smooth components as, for example, in the classical non-stationary autoregressive integrated moving average approach. In this study, a method based on coupling discrete wavelet transforms and artificial neural networks for flood forecasting applications is proposed. The discrete wavelet transform is used to decompose stream flow time series data into wavelet coefficients. The wavelet coefficients are then used as inputs into artificial neural network models to streamflow. The relative performance of the coupled wavelet-neural network models were compared to regular artificial neural network models for flood forecasting with a lead time of one month. The coupled wavelet-neural network models were found to provide more accurate streamflow forecasts than the artificial neural network models. The results indicate that coupled wavelet-neural network models are a promising new method of flood forecasting.

EFFICIENCY OF THE HEAT PUMP COOPERATING WITH VARIOUS HEAT SOURCES IN MONOVALENT AND BIVALENT SYSTEMS

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CSBE101186 – This paper presents the findings of tests carried out on the efficiency of compressor heat pumps cooperating with various types of lower heat sources. Lower heat sources are as follows: horizontal ground heat exchangers, vertical exchangers and sources operating in the bivalent system. The system for receiving energy comprised a traditional heating system and liquid-air exchangers. A strong relationship between the heating efficiency of the analysed systems and temperature inside the structure was noted. Furthermore, it was indicated that for heat requirements of approximately 1 MJ·m⁻² the applied bivalent system was fully capable of meeting this heat requirement.

EVALUATION OF INJECTION SITES OF THERMAL SENSING TRANSPONDERS IN CATTLE FOR AUTOMATIC BODY CORE TEMPERATURE RECORDING

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CSBE1001187 – The measurement of body core temperature is a helpful tool for the early recognition of diseases in cattle. Up to now, temperature measurement is done manually by measuring rectal temperature. Nevertheless, there is an increasing demand on automatic and continuously measuring devices considering the growing herd size of dairy farms. Thus the objective of our study was the evaluation of injected transponders with temperature sensing option in cattle with respect to the development of an automatic body core data logger. In the study injected transponders with temperature sensor were tested in twelve male Holstein calves at three different application points: Under the scutulum of the left ear, at the base of the right ear and at the left part of the neck in the middle between poll and withers. The temperatures of the transponders were recorded using a hand held reader. The rectal temperature was measured simultaneously. 11.380 transponder measures of body core temperature were recorded and compared to 3.948 manually and parallel measured rectal temperature values within four different climatic periods. 90.8 % of the subcutaneous transponder measures were lower than parallel measured rectal temperatures. Referred to the three different injection sites 97 % of neck values and 96 % of measures at the right ear base were lower than the corresponding rectal measures whereas only 79.3 % of the scutulum values were lower than the rectal temperatures. In fact the differences between the scutulum temperatures and rectal temperatures were lower (0.34 to 0.68 °C) when compared to the two other injection sites (0.69 to 2.77 °C). The results reflect the impact of [...].

THE DEVELOPMENT OF A STANDARD TEST METHOD FOR MEASURING THE EVENNESS OF FLOW OFF METER ROLLERS

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CSBE101188 – Currently, air carts come equipped with a product metering device that consists of a fluted/studded roller or rotary valve of various sizes, depending on seed size and profiles. The rollers are required for metering seed into the distribution system for precise placement into the ground by a tillage tool. The flow of material pulsates as each flute of the roller gradually lets the next batch of seed empty into the distribution system. This discontinuity of flow off the meter roller will lead to uneven seed placement in the ground that is sub-optimal for plant growth. Flow is affected by certain factors such as the seed properties and physical parameters of the roller. Currently, there is no standard for testing the discontinuity in the output of rotary valve metering systems. To evaluate the problem of uneven flow, an experimental procedure and apparatus were developed to look directly at the flow coming off the roller on a discrete mass-per-degree basis and on a continuous roller rotation basis. As measured by the coefficient of variation, a discontinuity of flow has been observed in canola, wheat, and field pea of up to 18, 32.4, and 35.7%, respectively, of the theoretical even continuous flow using the discrete method, and up to 22.9, 19.8, and 18.6%, respectively, in the continuous method of meter roller testing. These procedures were effective for visualizing and quantifying the discontinuity of product flow in the metering devices.

MASS MODELING OF POMEGRANATE FRUITS: ARTIFICIAL NEURAL NETWORKS METHOD

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CSBE101190 – Pomegranate fruit (*Punica granatum* L.) is one of the major fruit produced in Iran. Sorting of pomegranate fruit is an essential routine operation in fruit marketing. Accurate weighting of fruits in different sorts at fast speed is a key problem in many industrial processes. It may be easier and faster to develop a grading system working on the basis of size. The size of fruits can be correlated to fruit mass and may be used for the measurement of the mass of fruits. Determining the mass-size relationship using mathematical (regression) models has been the main focus of the published researches. This paper discusses the development of an artificial neural networks (ANN) model for the automated prediction of pomegranate fruit mass based on 7 dimensional characteristics (minor diameter, major diameter, intermediate diameter, volume, and three projected areas), which acted as the input data to the ANNs. The ANN models had just one output neuron, mass. In this paper, image processing technique was used for automated measurement of fruits dimensions. The ANN models were designed to have 1, 2, 3, ..., or 7 input neurons.. It was concluded that the ANN model consisting of fruit volume as input parameter was the best model ($R^2 = 0.992$, RMSE = 0.0011) for prediction of pomegranate fruit mass. The ANN model with all 7 dimensional parameters as input was also acceptable ($R^2 = 0.989$, RMSE = 0.0016). Although the later model performed well, it is not useful in real applications. The prediction performance of ANN models was better than mathematical models obtained in this study as well as obtained before by other researchers for mass-size modeling of pomegranate fruits.

MACHINE LEARNING MODELS FOR PREDICTION OF ADDED WATER IN MILK AS A FUNCTION OF MILK TEMPERATURE AND SOME OTHER PHYSICAL CHARACTERISTICS

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CSBE101191 – Several methods have been reported to detect the water content in milk. However, most of these methods are expensive and time consuming. It has therefore become necessary to develop and improved a method for the rapid and reliable detection of this kind of fraud. The added water in milk has an important influence on milk electrical conductivity, density, fat, total solids, total solids-not-fat, pH, etc. Some of these parameters, including electrical conductivity are strongly dependent on temperature. It expected with knowing all of these parameters and using machine learning methods, the amount of added water in milk is calculated. Milk samples were prepared by adding ultra pure water to untreated cow's milk (raw milk) to achieve the required volume percent water (0, 0.5, 1, 1.5, 2, 2.5, 3, 5, 10, 15, 20, 25, 30, and 35%). For each milk sample and at different temperatures (4, 7, 7.6, 10, 12, 13, 17, 18, 20, 22, 23, and 25 °C) the electrical conductivity, milk density, fat, total solid, total solid not fat, and pH were measured. Various back-propagation artificial neural networks (ANN) with 7 neurons in the input layer and 1 neuron in output layer (percent added water) were investigated. The results showed that added water in milk had a linear decreased effect on all measured milk properties. It was found that temperature had an increasing effect on electrical conductivity of milk. The best ANN model produced a correlation coefficient of 0.963 between the actual amounts of added water and [...].

CREATING RENEWABLE ENERGY USING ECOLOGICAL ENGINEERING PRINCIPLES

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CSBE101192 – Ecological engineering designs utilize natural energy sources as the predominant input to manipulate environmental systems and integrate society with its natural environment for the benefit of both. While there are many conservation methods that reduce our consumption of fossil fuels while incorporating ecological concepts into their design, there are very few ecological engineering designs that actually produce energy. In fact, many current renewable energy production methods can be harmful to the natural environment: hydroelectric dams, ethanol production using fertilizer-intensive corn, and deforestation for planting of biodiesel crops. Given the ecologically problematic nature of energy production, this presentation addresses the critical question of whether ecological engineering principles can be incorporated into renewable energy design. I will examine two renewable energy production designs: anaerobic digestion and algal turf scrubbers, and identify how these designs can incorporate ecological engineering principles by quantifying environmental inputs and ecological consequences. Anaerobic digestion utilizes microorganisms to breakdown organic material and produce methane-enriched biogas. The microbial process decreases water pollution from the waste materials, such as manure, reduces greenhouse gas emissions and odors, and enhances the fertilizer potential of the liquid effluent. Current applications in the US have focused on large-scale applications, but small-scale systems that incorporate more natural inputs have the ability to revolutionize renewable energy production potential in sustainable agriculture. [...].

APPLICATION OF MATHEMATIC MODELS OF WATER IN IRRIGATED BEAN CROP UNDER NO-TILLAGE SYSTEM

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CSBE101193 – Irrigation quality is estimated through mathematical models that describe the water depths distribution along its irrigated area, indicating the irrigation efficiency parameters (application efficiency, storage efficiency, depth water percolation and deficit area) on hydraulic evaluation of field systems. The objective of this research work is to determine these efficiency parameters from two mathematical models of water distribution on soil surface (linear and normal) for each bean crop stage irrigated by sprinkler irrigation, in no-tillage system with 4, 6, 8 and 12 t ha⁻¹ of mulching originated from summer crop (millet) and verifying its relation with grain production. The irrigation management was carried through irrigation schedule, keeping the water content of the soil around 28% (critical moisture for the crop) and 31% (field capacity). Mathematical models analyzed indicated similar behaviour between evaluated parameters for all treatments; some exceptions were noticed regarding depth water percolation. The normal mathematical model indicated higher values in relation to the linear mathematical model. Irrigation quality evaluation parameters obtained through the evaluated mathematical models demonstrated similar field conditions for this experiment based on water depths, either when in deficit or in excess of water on crop productivity. Treatments 4 and 12 t ha⁻¹ indicated lower values of application efficiency, excess water and higher productivity.

RIPARIAN CONSTRUCTED WETLANDS FOR IMPROVING WATER QUALITY IN A POLLUTED RIVER IN SOUTHEASTERN MEXICO

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CSBE101195 – Sordo River is a heavily polluted stream because it receives untreated urban sewage. Riparian Constructed wetlands CW are an adequate alternative to improve water quality in polluted rivers in developing countries. The objective of this study was to compare the efficiency of surface flow water CW (SSFCW) and subsurface flow CW (SFCW) to improve water quality in the Sordo River. The CW cells measured 1.5 m length, 0.25 m wide and 0.6 m depth, four cells were set up for SFCW (upland soils, 0.4 m deep, free water flow column of 10 cm) and four for SSFCW (volcanic gravel 0.04 m diameter, 0.4 m depth, water flow 10 cm below surface). Two cells of each type were planted with *Typha* sp and two cells were left without plants as controls, hydraulic retention time was 5 days. From June to November 2009, concentration of ammonia nitrogen (N-NH₄) in the river water ranged from 2-18 mg L⁻¹, Chemical Oxygen Demand (COD) ranged from 2-450 mg l⁻¹, Phosphates (P-PO₄) ranged from 0.5-5 mg L⁻¹ and nitrates (N-NO₃) ranged from 0.5 to 7 mg L⁻¹. Both, SSFCW and SFCW were efficient in P-PO₄ removal (63-93%) but the SSFCW without plants was significantly less efficient (20-83%). COD removal efficiency was similar in SSFCW and SFCW (27-51% and 28-73% respectively) and only the SFCW without plants showed significantly lower efficiencies (21-45%). For N-NH₄, SSFCW showed significantly higher removal efficiencies (48-95%) than SFCW (9-70%). It was concluded that SSFCW are an ecological alternative to improve water quality in this river.

TOWARDS A FRAMEWORK FOR PLANNING AND DESIGNING OF RURAL KNOWLEDGE CENTRES

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CSBE101196 – Exponential growth in Information and Communication Technologies (ICTs) and establishment of Rural Knowledge Centres (RKC) have been fast spreading across the globe. In the continuous process, there are tens of thousands of RKC that are being established by various agencies, to provide shared public access to ICTs for meeting educational, social, personal, economic, and entertainment needs of the rural community. As most of these initiatives are relatively new, there are mixed opinions on the social and economic impacts of RKC. There is also lack of good understanding on the conceptual and theoretical framework for planning and designing of RKC. This study seeks to fill this information gap by assessing selected ICT for development (ICT4D) project sites in rural India. Through the systemic analysis of the data and continuous interpretation of the observations, the study proposes a framework for planning and designing of RKC.

POSTURAL ANALYSIS AND BIOMECHANICS OF WORKERS IN POULTRY SLAUGHTERHOUSE

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CSBE101197 – The production and consumption of chickens has been steadily increasing in recent decades. Along with this, the slaughter and processing of poultry has increased and changed rapidly as population of major urban centers increases. Parallel to this development, the processing industry of poultry began to pay attention to how the activity is performed, and how the machinery, equipment and environment influences the occurrence of bodily injury. Working in a poultry slaughterhouse comprises high health risk, this study aimed to evaluate postural and biomechanical analysis of workers in this environment. The posture and the biomechanics were analyzed from photographic records of the individuals when at work. The postural analysis was interpreted in accordance with the method OWAS (Ovako Working Posture Analyzing System) and biomechanical evaluation was performed using a two-dimensional biomechanical model prediction of postures computer program (Michigan). The data collected revealed that the unloading of boxes from the delivery vehicles, scalding and plucking (cleaning sector), and the lifting and pushing of boxes from various sectors to the freezing and shredded areas were worth improving in the short term. With respect to biomechanics, it was observed that the loading of boxes with pieces of chicken, stemming both from the cutting room and sector of frayed, exposed workers to injury to the elbow, shoulder and back. Thus, one can conclude that the loading weight and inappropriate or incorrect postures are responsible for physical injuries of workers in a poultry slaughterhouse.

ASSESSING BIOMASS CHAINS FEASIBILITY AT LOCAL LEVEL

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CSBE101199 – “Valle dei Latini” is one of the first examples of agro-energy district in Italy for the development of different bio-energy chains. A feasibility study, with the identification of all bio-energy resources available in the area has been carried out. A multidisciplinary approach, through which the analysis of the rural districts socioeconomic characteristics is integrated with information on the agroindustry sector, networks and land morphology has been developed. The collected and estimated data on biomass production, potential and energy consumption have been processed together and integrated via spatial analysis. A specially designed GIS has been used as a support tool for a feasibility analysis for different biomass chains. This paper describes the main results of the land suitability study for sunflower, an oil crop largely cultivated in Italy for the production of biooil and biodiesel. The designed methodology includes different analysis steps: data collection, geodatabase creation (by data integration about geomorphology, climate, land use, soil), sunflower suitability factors and constraints definition and GIS processing. The core processing is based on set up and resolution of a multi-criteria analysis of multi-attribute form. The methodology has been optimized to obtaining the maximum spatial resolution and analysis completeness related to the available data. The analysis result is a sunflower land suitability map characterized by the subdivision of the area in distinct land suitability classes. The spatial heterogeneity and the resolution of available data have been implied in the subdivision of the final result in two distinct maps with different levels of detail.

REUSING CONTENT WITH REUSABLE LEARNING OBJECTS (RLOS): AN APPROACH FOR ADDRESSING CONTENT ISSUES OF AGRICULTURAL EDUCATION AND EXTENSION

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CSBE101200 – In the recent days, content designers and developers of electronic learning introduced new technology mediated approaches for generating electronic learning content. However, most of these approaches are context and technology specific, which sometimes demands content designers and developer to rework on the existing content again, to make little modifications, considering the users need and technical preferences. This has been viewed as an expensive and time consuming process. The development of new content enables technology to be packaged as Re-Usable Learning Objects (RLOs) and is carving a new path for research on reusing, and repurposing content. In this paper, the authors present a new approach for content generation and localization with “Reusable Learning Objects”, which follow the features of reusability, interoperability, durability and accessibility. The authors also discusses in detail about the need and use of this approach for designing and developing cost effective educational material for mass agricultural education and extension in an open and distance learning approach.

EFFECT OF ADDITION OF DIFFERENT TYPES OF MODIFIED CLAYS IN THE PROPERTIES OF OPACITY AND SOLUBILITY OF ZEIN BIOFILM

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CSBE101201 – Zein is an alcohol-soluble protein contained in the endosperm tissue of *zea mays*. The degree of polymerization of zein allows producing “useful high molecular weight” polyamide or polyester linear polymers. It can be used to produce films and coatings. The zein biofilms, even with the addition of plasticizers still show brittleness of the films caused by high intermolecular force between the protein chains of these materials. Thus, compared with polymers derived from oil, this polymer has different characteristics and properties. In order to improve some of these characteristics, two types of modified clays (hydrophilic and hydrophobic) were added at 1, 2 and 4% (w/w) in the films produced by “casting” methodology. Biofilms (zein-Cloisite® 15A and zein-Cloisite® 30B) were analyzed by water solubility and opacity and results were compared with zein-oleic acid film. Related to opacity, clay’s and control’s biofilms are more yellow than polyethylene, because of carotenoids pigments, but, the presence of Cloisite® 15A (1 and 2%) and Cloisite® 30B (4%) did not differ statistically among them. However, the higher opacity was obtained for Cloisite® 15A (4%) due to particles of clay dispersed in the film. The results of solubility showed that the sample with Cloisite® 15A (2%) showed lower solubility, thus, it supposes that there was great interaction between the clay and filmogenic matrix; the others samples, control and Cloisite® 30B (1, 2 and 4%) and 15A (1%), did not differ statistically. The films with 4% of Cloisite® 15A had the higher solubility among them suggesting that there was the intercalation of the clay into the matrix.

FERMENTERS WITH MAGNETIC FIELDS FOR AGRICULTURE. TECHNOLOGICAL AND PRACTICAL ISSUES

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CSBE101205 – Magnetic fields have a potential effect on increasing the efficiency of process involving fermentation of microorganisms. Previous experiences with magnetic fields of intensities on the 60 – 100 mT range applied to several fungi employed for agricultural pest control were conducted. Exposure times were between 15 and 30 minutes in all cases. Experimental evidence showed an increment of up to 50 % in the growth of *Trichoderma harzianum*, a broadly employed biocontrol fungi under the influence of magnetic fields. On the growth of *Beauveria bassiana*, coinadiation was improved up to 20 % after the exposition at magnetic fields lower than 0.1 T for 20 minutes. Results for *Verticillium lecanii* at 80 mT and 30 minutes exposure time showed that fermenting time was decreased to 12 hours. Since magnetic fields of low intensity have no toxicological or mutagenic effect the scale-up of this technology is envisioned. Technical and practical issues are discussed in order to integrate the magnetic devices to the fermenting systems. Main technological considerations were done in order to guarantee a homogenous field distribution on the fermenting equipment. Other aspects that were taken in to account were the portability which can ensure the possibility of using this technique at different production capacities. [...].

DEVELOPMENT AND COMMERCIALIZATION OF EMERGING INFRARED RADIATION FOOD PROCESSING TECHNOLOGIES

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CSBE101206 – In order to demonstrate a newly developed simultaneous infrared dry-blanching and dehydration (SIRDBD) technology on an industrial scale, a mobile and continuous IR heating system was built and tested to examine its performance for SIRDBD of sliced and diced potatoes. The mobile IR heating equipment had an effective total heating area of 5×15 feet. The IR heating from both top and bottom was provided by catalytic IR emitters using natural gas as energy source. During processing, the products were conveyed using a belt and the total residence time in the IR equipment varied from 224 to 544 s. The result showed that inactivation of polyphenol oxidase (PPO) was achieved when the belt speed was 3.175 ft/min with corresponding residence time of 283 s for 2.89 mm thick potato slices. To achieve full blanching of thicker slices of 6.42 and 9.03 mm, the belt speeds were 2.43 ft/min and 2.739 ft/min, respectively, corresponding to 370 and 328 s residence time. The fully blanched product can also be achieved by using high heat in the early stage with reduced heating time. Using high heat in the very first stages to heat the slices to inactivation temperatures was essential for obtaining high quality blanched product and for less energy consumption. Moisture loss during blanching could be replenished to a certain extent by dipping blanched products in water. The results showed that SIDBD could be an effective and efficient method for processing fruits and vegetables.

CONFOCAL LASER SCANNING MICROSCOPY IMAGING OF DEEP-FAT FRIED BATTER COATING

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CSBE101207 – Porosity and pore size distribution are very important microstructural properties of fried foods needed in process optimization and product development. Confocal laser scanning microscopy provides a means of imaging food samples to qualify and quantify specific components identified by staining, and also produces images of higher resolution compared to the conventional light microscopy. The objectives of this study were to characterize pore properties and quantify fat distribution of deep-fat fried chicken nuggets batter coating using confocal laser scanning microscopy imaging. Chicken nuggets were fried at three temperatures namely 170, 180 and 190°C. Detached batter coatings were stained non-covalently with drops of 0.005% solution of Nile Blue A, cryosectioned to 60 µm and 2-D images were obtained at fluorescence and reflection modes of the microscope. The images were quantitatively analyzed for fat and pore characteristics. Fat distribution was significantly affected by frying temperature and time and it decreased within the depth of the coating's thickness. The correlation coefficients between fat distribution obtained from the image analysis and fat content obtained by the conventional method ranged between 0.60 – 0.79 and the relationship was only significant (P<0.05) at two temperatures, 180 and 190°C. Porosity ranged from 4.97 to 32.7% and was significantly influenced by frying temperature. Pore size varied between 1.2 and 523 µm. There was formation of small and big pores with frying time. The results show that fat distribution and pore properties of fried chicken nuggets batter coatings are influenced by the frying conditions, [...].

USE OF A NOVEL IN-PACKAGE OZONATION PROCESS FOR REDUCING SALMONELLA ENTERITIDIS ON CHICKEN MEAT

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CSBE101209 – There exists a need to ensure food safety in regards to raw chicken meat. The goal of this research was to evaluate an in-package ozonation process on raw chicken meat to reduce pathogenic contamination of *Salmonella enteritidis*. A novel, patent-pending technology has been developed at Purdue University that generates ozone inside a sealed package. Ozone treatment is an approved method by the FDA (“GRAS”- Generally Recognized as Safe); and research has shown that ozone treatment has the ability to reduce pathogens and extend shelf-life. Research has shown ozone’s ability to reduce pathogens; results indicate significant reductions (3-5 log₁₀) of *E. coli* O157:H7 on lettuce and spinach and *Salmonella enteritidis* on shell eggs, tomatoes, and raw chicken. Characteristics of this technology include: no heating, low power requirement (≤ 50 Watts), short treatment time (seconds to minutes), and adaptability into existing processes. The treatment process involves exposing the packaged chicken to a high voltage field (kilovolts) for seconds to minutes. During treatment, the gas inside the package (air, modified atmosphere, nitrogen) is converted into reactive ions (ozone, nitric oxide, etc.). This ionization process has been demonstrated using common packaging materials including: low-density polyethylene, high-density polyethylene, and polypropylene. For chicken packaged in air, approximately 1,000 – 2,000 ppm ozone can be generated in five minutes of treatment. After treatment, the ozone and other reactive ions slowly convert back to their elemental forms within 24 hours. Results [...].

MEASURING EMISSIONS FROM A NATURALLY VENTILATED TURKEY GROW- OUT BUILDING

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CSBE101211 – Animal production buildings emit a variety of airborne compounds through the exhaust fans in mechanically ventilated (MV) barns and through ridge vents and sidewalls of naturally ventilated (NV) buildings. Some of these gas, odour, or particulate emissions can result in animal and/or human health issues and/or create environmental air quality concerns. The objective of this paper is to demonstrate how airflow or ventilation rates for naturally ventilated barns can be determined for use in emission calculations by using emission measurements from a similar type of animal building with MV. Initially the continuous “net” carbon dioxide (CO₂) concentrations (exhaust – inlet) need to be measured in the MV barn along with the building’s airflow rate, typically found by measuring the onsite performance of its exhaust fans. The continuous net CO₂ concentrations are then measured in a similar animal building that is NV. The NV room’s ventilation rate (on a per animal basis) is determined by multiplying the CO₂ concentrations ratios MV/NV from the earlier measurements and the MV room’s ventilation rate. This technique is demonstrated in the paper using data from a turkey barn study, where ammonia (NH₃) concentrations were measured in both a MV and NV room and NH₃ emissions are calculated for both rooms. Thus, by using this modified CO₂ balance approach, one can calculate any airborne contaminate emissions rate from a NV barn as long as the CO₂ concentration ratios are known [...].

ENERGY ANALYSIS OF BIOCHEMICAL CONVERSION PROCESSES OF BIOMASS TO BIOETHANOL

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CSBE101214 – Bioethanol is one of the most promising biofuels that can replace or compliment fossil fuels. It is a renewable resource that can be produced from different biomass including agricultural products, waste and byproducts. In this paper, energy analysis for conversion of different groups of biomass including lignocelluloses, starchy and sugar biomass to bioethanol were studied. Depending on the structure of a biomass, biochemical conversion typically involves the breakdown of the biomass to simple sugars using different pretreatment methods. Energy requirement for the various conversion steps were calculated and summed to obtain mass and energy efficiencies for the conversions. Mass conversion ratios of corn, molasses and rice straw were calculated as 0.3396, 0.2300 and 0.2296 kg of bioethanol per kg of biomass, respectively. The energy efficiency of biochemical conversion of corn, molasses and rice straw were calculated as 28.57, 28.21 and 31.33%, respectively. The results show that conversion of lignocelluloses with specific microorganisms such as *Mucor indicus*, *Rhizopus oryzae* and using the Simultaneous Saccharification and Fermentation (SSF) methods or similar technologies is very attractive for many reasons.

ULTRAVIOLET DEPURATION OF ESCHERICHIA COLI FROM THE JUVENILE CLAM, CYCLINA SINENSIS IN CHINA

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CSBE101215 – This paper deals with ultraviolet light assisted depuration of Escherichia Coli (E.Coli) in Juvenile Clam, Cyclina Sinensis in China. An orthogonal test was designed to determine the influence of various environmental parameters on the ability of the juvenile clam to eliminate E.Coli itself. Juvenile Clams were artificially accumulated with Escherichia Coli and placed in a pilot-scale depuration tank using ultraviolet light assisted circulating water system. High levels of E.Coli were found in the shellfish meats after 9 hours. After 48 hours treatment in the depuration system, the numbers of E. Coli in the shellfish meats reduced about 3-5 log units. Optimal depuration was obtained within the following environmental limits: temperature, 15°C; water changing rate, 4 times/hr; water weight to clam weight, 2 :1.

SUSTAINABILITY OF RICE PROCESSING IN RURAL SUB-SAHARAN AFRICA

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CSBE101216 – Energy and environmental sustainability are important considerations for increased rice production. This study examines the energy utilization and sustainability of rice processing in sub-Saharan Africa. The community of Gadan Loko village in the Song local government of Adamawa State, Nigeria was selected as the focus of study. In this community, rice paddy is typically parboiled in small quantities of about 13.2 kg using traditional tripod support stove. Parboiling was the most energy intensive process. Sun dried parboiled rice is milled in local cottage milling stalls operating with single cylinder diesel engines. There were large variations in the quality of milled rice due to lack of consistency in processing parameters. Accumulation of rice husk in the community created important environmental issues. The areas looked at includes: utilizing waste heat from the diesel engines for improved drying and efficient pre-soaking; the utilization of solar energy for pre-soaking; the utilization of rice husks as alternative fuel to firewood; and the optimization and redesign of the stoves and parboiling vessels to minimize heat loss to the environment. The results shows that, the utilization of rice husk as alternative fuel and the redesign of the stoves and parboiling vessels will increase the sustainability of rice processing and can be easily adopted by the community. While solar energy pre-soaking is not economical and the utilization of waste heat from the diesel engines for drying and pre-soaking will be difficult to implement at the rural scale, because most of the parboiling is done far away from the milling stalls. This study shows that research, development of appropriate technology, and education (RATE) of the rural community is an important way of increasing sustainability

DELISATION OF PULSED ELECTRIC FIELDS FOR TROPICAL LIQUID FOOD INDUSTRIAL PROCESSING

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CSBE101217 – In order to process food destined to human consumption, most of the methods which have been used industrially till today are various forms of thermal processing, which unfortunately trigger unwanted reactions in foods, altering their qualities by causing extensive loss of flavour, colour, nutrients and vitamins. These qualities are naturally very important to consumers whose demand for fresh-like food products is still increasing. This is why there is a growing interest in non-thermal processes for food quality preservation. Non-thermal processing technologies have are being developed to eliminate, or at least minimise, the resulting degradation of food due to classic methods. Pulsed electric field (PEF) is one of those non-thermal processing technologies. It is still not well known. Many empirical experimental results have already been obtained: PEF should be applied to non-treated liquid food in the form of short-duration high voltages pulses in order to generate inactivation of micro-organisms. Some authors confirm that exposing some microbial cells to pulsed electric fields may result in a dielectric breakdown of cell membrane, and have noticed that the said breakdown can be reversible or not depending on the intensity and the duration of the applied electric field [1, 2]. [...].

EFFECT OF THERMAL PRETREATMENT AND BATTER COMPOSITION ON FAT ABSORPTION IN DEEP-FAT FRIED BATTER

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CSBE101218 – The effects of batter composition, thermal pretreatment and frying time on mass transfer during deep-fat frying were studied using response surface methodology. Prior to frying, dough composed of wheat and rice flour mixtures (wheat/rice ratio between 0 and 100%) mixed with water at ratio 1:1.3 (mixture:water) were put in closed aluminum cells and preheated in a water bath at temperatures ranging from 60 to 90°C. Then, the samples were fried for 1, 2, 3 and 4 min. A central composite rotatable design was built to study the effects on fat uptake and moisture content of samples. Pre-gelatinization and batter formulation had impact on the degree of fat uptake in deep-fat fried batter coating. The results showed that flour ratios had more impact on fat uptake than pretreatment temperature. Moreover, the interaction between these 2 factors was more significant than their main effects. Batter composed of 75% wheat flour and pre-treated at a temperature of 82.5°C had the minimum optimal points for fat uptake with a value of 3.3% after 4 minutes of frying. The degree of gelatinization and the moisture content under these conditions were 80.55% and 30 % db, respectively.

IMPACT OF THE AGE OF LAYING CHICKEN ON MECHANICAL STRENGTH OF EGGS

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CSBE101219 – External and internal qualities of eggs are affected by a number of factors including the age of laying chicken. Understanding changes in quality is critical in industrial handling and processing of eggs. The aim of this study was to analyze mechanical strength of eggs laid by hens at 52 to 55 weeks of laying cycle. About 12000 white-shelled leghorn eggs from 6 flocks over 3 months period were used. Mechanical strength of eggs was measured in terms of the rupture force and energy using Universal Instron testing machine. Mean values of eggshells strength decreased from 34 to 31 N between 52 and 55 weeks, respectively. Eggshell thickness was in the range of 0.33 to 0.31 mm. The results showed that age of laying chicken significantly ($p<0.05$) influenced eggshell strength and eggshell thickness. Older hens laid weaker and thinner eggs. Thus, the age of laying chicken should be considered as a critical factor affecting egg handling and processing quality.

EFFECT OF NONIONIC SURFACTANT BRIJ 35 ON THE FATE OF METRIBUZIN IN A SANDY SOIL

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CSBE101220 – Given the water scarcity endemic to a large portion of the globe, arid region irrigation has increasingly had to resort to the use of treated, partially treated, or even untreated wastewaters. These contain a number of pollutants, including surfactants. Applied to agricultural lands such surfactants could affect the fate and transport of other chemicals in the soil, particularly pesticides. A field lysimeter study was undertaken to investigate the effect of the nonionic surfactant, Brij 35, on the in-soil fate and transport of the commonly used herbicide, Metribuzin [4-Amino-6-*tert*-butyl-3-(methylthio)-1,2,4-triazin-5(4*H*)-one]. Nine PVC lysimeters, 1.0 m long × 0.45 m diameter, were packed with a sandy soil to a bulk density of 1.35 Mg m⁻³. Antibiotic-free cattle manure was applied (10 Mg ha⁻¹) at the surface of the lysimeters. Metribuzin was then applied to the soil surface of all lysimeters at a rate of 1.00 kg a.i. ha⁻¹. Each of three aqueous Brij 35 solutions, 0, 500, 5000 mg L⁻¹ (i.e., ‘good,’ ‘poor’ and ‘very poor’ quality irrigation water) were applied to three lysimeters. Analysis for metribuzin residues in samples of both soil and leachate, collected over a 90-day period, showed the surfactant Brij 35 to have increased the mobility of Metribuzin in soil, indicating that continued use of poor quality water could influence the pesticide transport in agricultural soils, and heighten the risk of groundwater contamination.

DEVELOPMENT OF BIOENGINEERING PROCESSES TO TRANSFORM GREENHOUSE WASTE INTO ENERGY, FERTILIZER AND TOMATO

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CSBE101221 – The greenhouse industry needs to develop sustainable production systems to reduce its ecological footprint and maintain its competitiveness. Anaerobic digestion (AD) and nitrification processes are bringing solutions to issues in greenhouse production regarding waste, nutrient management and energy consumption. Among these issues, organic soluble fertilizers are costly (30-35\$ /m²), and high-quality products are difficult to obtain on the market. It is therefore a strong limitation for converting conventional greenhouses to organic practices. Our previous works have shown that AD is a promising solution for disposal of tomato leaves pruned during greenhouse operations. AD generates also end-products (supernatant, sludge) with high agronomic potential. Previous studies have shown agronomic benefits of land application of AD end-products for forage and cereal crops. However, little has been done for horticultural crops. Contrary to field crops, nitrification of digester effluents is a key step for using AD effluents as fertilizers for vegetable greenhouse plants. Greenhouse vegetables require nitrogen mainly under the nitrate form (NO₃⁻) for an adequate growth, the other forms (NO₂⁻ and NH₄⁺) being detrimental to plant and fruit quality. However, nitrification of AD supernatant can be challenging because of its high ammonia content (>1000 mg NH₄-N/L) and its inhibition potential of nitrifying micro-organisms. Only few nitrification processes have the potential to operate under these conditions. [...].

DEVELOPMENT OF A SCADA SYSTEM FOR ACCESS, PROCESSING AND SUPERVISION OF DATA COMING FROM A WIRELESS SENSORS NETWORK IN AGRO-ENVIRONMENTAL APPLICATIONS

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CSBE101222 – Wireless sensors networks appeared in the 1970's for military and industrial use. They have since undergone a major evolution, particularly since the 90's, thanks to the improvements in wireless communications. These changes have allowed them to participate in a wide variety of applications in different sectors such as agriculture and environment. This paper shows the development of a SCADA application programmed with LabVIEW[®] 8.6 (National Instruments), which allows management of data received by wireless sensors networks through a friendly interface for users. For the application shown in this paper we have worked with a MEP 510 sensors network (Crossbow). The functionalities implemented are the following: Network configuration; Data storage into database; Statistical processing of historical data with polynomial adjustment and spline interpolation; Visualization by data graphics in real time and historical data; Visualization of 2D intensity diagrams from the spatial distribution of sensors; and Creation of a users registry system that allows, depending on the category assigned, receiving or not [...].

DIAGDATA: A TOOL FOR GENERATION OF FUZZY INFERENCE SYSTEM

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CSBE101224 – In this paper is described the architecture of a tool called DiagData. This tool aims to use a large amount of data and information in the field of plant disease diagnostic to generate a disease predictive system. In this approach, techniques of data mining are used to extract knowledge from existing data. The data is extracted in the form of rules that are used in the development of a predictive intelligent system. Currently, the specification of these rules is built by an expert or data mining. When data mining on a large database is used, the number of generated rules is very complex. The main goal of this work is minimize the rule generation time. The proposed tool, called DiagData, extracts knowledge automatically or semi-automatically from a database and uses it to build an intelligent system for disease prediction. In this work, the decision tree learning algorithm was used to generate the rules. A toolbox called Fuzzygen was used to generate a prediction system from rules generated by decision tree algorithm. The language used to implement this software was Java. The validation process involved measurements and comparisons of the time spent to enter the rules by an expert with the time used to insert the same rules with the proposed tool. Thus, the tool was successfully validated, providing a reduction of time.

DESIGN CHALLENGES TO THE INTEGRATION OF ECOSYSTEM SERVICES INTO AGRICULTURAL LANDSCAPES IN ARID ECOSYSTEMS

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CSBE101225 – The San Joaquin Valley of California has an arid to semi-arid climate characterized by very dry summers. The landscape of the San Joaquin Valley has been transformed on a regional scale from seasonal wetlands and grasslands to intensively managed agriculture. There is significant interest in restoring ecosystem services to the San Joaquin Valley and using natural systems to mitigate widespread negative impacts from agricultural activities, including eutrophication of surface waters. In this paper we discuss the nature of diffuse pollution in the San Joaquin Valley and evaluate the design challenges that are faced for the engineering of ecosystem services into the agricultural landscape. The regional climate is characterized by annual rainfalls between 25 and 30 cm with average summertime (July-August) rainfalls of less than 0.1 cm per month. Stream flows, however, are highest in the summer and lowest in winter months, due to the influence of agricultural activities on flow. Flow and water quality were measured in multiple watersheds over several years. Flow, specific conductance, and temperature were measured continuously at key tributaries along the San Joaquin River. Continuous data was supplemented with intermittent measurement of water quality parameters, including organic constituents and nutrients. Geographical information systems were used to relate landscape activities to flow and water quality outcomes. Analysis of continuous flow data demonstrated that flow from agriculturally dominated drainages was not normally distributed and could fluctuate widely on a daily and seasonal basis. Water quality was not flow dependent, was typically not normally distributed, and could be related to landscape activities in individual watersheds. [...].

EFFECTS OF PHOTOSELECTIVE SHADE NETS ON THE METEOROLOGICAL ELEMENTS, GROWTH AND RADIATION USE EFFICIENCY OF CUCUMBER

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CSBE101226 – Crop growth is influenced by meteorological conditions. Thus, crops growing inside protected environments versus field conditions, are submitted to different meteorological conditions. This research was conducted under photoselective shade nets and field conditions in order to quantify the influence of radiation net (Rn) on growth rate, productivity, global radiation (SR), photosynthetically active radiation (PAR) and PAR use efficiency of local variety cucumber crop. The experiment was carried out in the spring of 2009 in a experimental area (Lat. 16°40'S, Long. 49°15'W and alt. 730 m) that consisted of three treatments, named: T1- field conditions; T2 - 30% red filter net in the visible and 30% transmission in the far red spectrum; T3 - 30% red filter net in the visible and 40% transmission in the far red spectrum. The best results in terms of growth rate, productivity, energy efficiency were obtained under T3 condition. Under these conditions, the reduction of global solar radiation was not limited for the cucumber growth below the nets, being that a crop growth rate of 0.431 g day⁻¹ was observed with an average global solar radiation incident of 4.4 MJ m⁻² day⁻¹ and PAR use efficiency of 0.079 kg MJ dia⁻¹. Both red filter nets increased dry matter and chlorophyll content.

GENERATING USABLE AND SAFE CO₂ FOR ENRICHMENT OF GREENHOUSES FROM THE EXHAUST GAS OF A BIOMASS HEATING SYSTEM

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CSBE101227 – CO₂ enrichment of greenhouses has been well proven to improve crop production whether it occurs from liquid CO₂ or combustion of fossil fuels. The main objective of this research is to demonstrate the use of a renewable fuel, biomass, to enrich a greenhouse with CO₂. Biomass, in the form of wood chips or pellets, has received considerable interest as a sustainable and economically feasible alternative to heat greenhouses. Therefore, there is an opportunity to convert exhaust gases from a greenhouse wood heating system into a useful resource. Carbon dioxide can be extracted from flue gas via membrane separation which could prove to be an economical alternative to electrostatic precipitators. This technique has shown a lot of potential for large industries trying to reduce and isolate CO₂ emissions for sequestration and could be applicable to the greenhouse industry for enrichment. Additionally, some research has been done with wet scrubber using particular catalysts to obtain useful plant fertilizer. Sulphur (SO₂) and Nitrogen (NO) emissions can be stripped out of flue gas to form ammonium sulphate as a by-product valuable to fertilizer markets. The potential of these techniques will be reviewed while experiments conducted at the Macdonald Campus of McGill University will begin in summer 2010.

TECHNICAL, ECONOMIC AND LEGAL ASPECTS OF MANAGEMENT OF TRANSBOUNDARY WATER RESOURCES – A CASE STUDY OF INDUS WATERS TREATY 1960

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CSBE101228 – Sustainable management of some 263 transboundary rivers and lakes and hundreds of aquifers, basins of which contain more than half of the population of the world presents a major challenge and holds a strategic importance in the immediate and long-term future. There are nine transboundary river basins in Africa alone, counting towards 80% of the continent's surface water resources. Management of this essential shared resource is crucial for poverty reduction strategies and for related international memoranda of understanding. Agreements among water sharing nations/states are required to protect the respective water rights and to properly manage the limited water resources while attempting to balance the recurring floods and droughts. Such agreements would be effective as well in so many other ways as in reducing the risk of pollution, protecting the environments, establishing the fair and sustainable allocation of water between states, encouraging the regional cooperation and exchange of information for the benefits of all regarding river sharing and to prevent possible conflicts over water. The paper under reference hints on the technical, technological, economic and legal aspects of such a development/management and the use of water resources of transboundary (interstate) rivers while discussing the guidelines to this effect. Indus Waters Treaty signed between India and Pakistan in 1960 has been taken as a case study for this paper.

EFFECTS OF MICROWAVE DRYING AND COOKING ON THE HARDNESS AND STICKINESS OF RED LENTILS

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CSBE101231 – Microwave drying, compared to conventional convection drying of lentils, is energy efficient and rapidly heats dielectric materials. Because of its rapid drying time, microwave drying technology is being explored as an alternative method for drying red lentils. The volumetric heating during microwave drying may affect the hardness, toughness, and stickiness of red lentils differently compared to convection (air) drying. In this investigation, the effect of microwave drying and cooking on the hardness, toughness, and stickiness of red lentil varieties, ‘Impact’ and ‘Robin’, were studied. The red lentil varieties were dried using a microwave dryer at the power levels of P10 (713 W), P7 (606 W), and P4 (330 W). The dried samples were cooked in boiling water at a temperature of 98.6oC for 5, 10, 15, and 20 min. Undried original and convectional air-dried (70oC) lentils were also cooked for comparison. The samples were not presoaked before cooking. The cooked samples were drained, cooled and 6 kernels were compressed using a 35 mm cylindrical probe. After draining, the gain in weight of the samples were measured and used to estimate water absorption during cooking. Moisture content of the cooked samples was determined at 130oC for 20 h. Water uptake by the undried original ‘Impact’ lentils was lower compared to the microwave and convectional air-dried samples. On the other hand, the undried ‘Robin’ lentils water uptake was higher compared to ‘Impact’ samples. Cooking and drying method has significant effect on the moisture content of the cooked red lentils. Cooking time, drying method, and their interaction had significant influence on the hardness, toughness and the stickiness of the cooked red lentils.

EFFECTS OF ROASTING TEMPERATURES AND STORAGE ON THE QUALITY OF RED LENTIL

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CSBE101232 – Legumes including red lentils have soluble and insoluble fibers, resistant starch, folate and proteins. The functional properties of these nutrients may reduce the risk of cardiovascular diseases and promote the well-being of pulse consumers. Roasting of red lentils can be used to produce flour, high protein and starch fractions. Dehulling of red lentils may be improved by roasting. Roasting may improve the flavor and palatability of red lentils, and may reduce anti-nutritional factors associated with legume consumption. Little is known regarding the effects of roasting temperatures and storage on the quality characteristics such as breakage susceptibility, color and hardness of roasted red lentils. ‘Robin’ red lentils at initial moisture content of 15 to 16% were roasted at temperatures of 160, 180, and 200°C for 15, 30, and 45 minutes. The roasted lentils were cooled immediately. The lentils were placed in Ziploc bags and stored at temperatures of 5°C and 25°C. The breakage susceptibility, color and hardness of the stored lentils were measured periodically. The color of the samples was determined using Hunterlab spectrophotometer. The Stein breakage test was used to determine the breakage susceptibility of the lentils. The hardness of the roasted and stored lentils was measured using a texture analyzer. The results of the quality characteristics of the roasted and stored red lentils will be presented.

STORAGE AND QUALITY FEATURES OF CARROTS AND CORN GROWN UNDER ORGANIC AND CONVENTIONAL AGRICULTURAL PRACTICES

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CSBE101233 – Conscious of their health, the demand for organic vegetables is sought by consumers in many parts of the world including Canada. Saskatchewan has the potential of producing high-quality organic vegetables cost-effectively and in a sustainable manner. Preliminary vegetable production research is being undertaken at the Canada-Saskatchewan Irrigation Development Centre (CSIDC), Outlook, to develop efficient agronomic practices and storage management for producing high-quality vegetables under irrigation. This paper presents the interactive effects of field production and storage practices for corn and carrots. Carrots and corn were grown under organic and conventional agricultural practices. Controlled atmosphere (CA) and refrigerated storage of the harvested produce were compared. The carrots and corn were stored at a temperature of 4°C and relative humidity of 80.4% to 92.5% for CA storage and 83.9% to 93.6% for refrigerated storage. Some of the carrot samples were blanched using a microwave oven before storage. For the CA storage, the set-points for CO₂ and O₂ were 5% and 3%, respectively. The moisture content, storage losses, total soluble solids, hardness, toughness, and color of the stored carrots and corn were measured periodically. The conventional corn stored under refrigerated conditions had the highest mass loss. At the end of each storage period, the total soluble solids for the CA stored samples were higher compared to the refrigerated samples. At the end of the first storage period, the hardness values for organic samples were higher compared to the conventional stored corn samples. [...].

MODELLING CORN STOVER HARVEST OPERATIONS

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CSBE101239 – Corn stover is one of the most abundant agricultural residue, typically yielding 8 to 10 t of dry matter (DM)/ha. Leaving stover on the ground is beneficial for erosion control and soil organic matter renewal. However, several studies suggest that 50% of stover could be removed sustainably under appropriate conditions (negligible slope, no-till system, adequate rotation). Two major factors limit corn stover removal: cost of harvesting including transport, and final end use. This paper addresses the first factor by considering several harvest options, mainly related to spring harvest. The objective is to develop a corn stover harvest, transport and storage simulation model by a systems approach. The model takes into account field machinery, field area, yield, distance and timeliness of operations. The weather data are used to take into account delay in stover collection. Empirical data collected during in-field operations, transport and handling are used as input for the dynamic simulation model. Other input data include DM loss and stover moisture content. The model is implemented using Extendsim® (www.extendsim.com). The main operations modeled are: corn stover windrowing, baling, making stockpiles of bales in the field, loading trucks in the field, loading trucks from the stockpiles, transport of bales, and unloading bales at the point of use. The model considers sharing available equipment and tractors among different operations modeled to carry out the whole corn stover harvest. The model can operate with either a low level or a high level of input data. [...].

THE ROLE OF THE WEB IN THE EFFECTIVE DETECTION OF SERIOUS AND FATAL TRACTOR OVERTURNING ACCIDENTS

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CSBE101243 – The official statistics report published in Italy details that a range of 25-40 fatal agricultural tractor accidents are due to overturning. These figures, published by the government bodies providing the work safety (very often with a remarkable delay due to the time necessary to conclude the investigation on each event included), appear significantly underestimated. This delay can most likely not be eliminated; consequently, the statistical data appears to be non useful to carry out an effective surveillance of overturning accident trends in order to eventually accomplish actions to increase the safety. On the other hand, nowadays internet plays a fundamental role regarding the publications of real time worldwide information, in all fields of the knowledge, including news events. Moreover, many portals have been created on the web for the reporting of live news events in a given area, both internationally and nationally. Furthermore, portals have been created based to weekly or daily newspapers at a local level, obviously reporting important localised events that have occurred. A fatal tractor overturning accident is most likely to be considered breaking news and will certainly be reported on the web portal relevant to the specific area in which this event has happened. So, an accurate survey was carried out on the web, obtaining a realistic situation on tractor overturning accidents in Italy, with the remarkable advantage to learn in real time the progress of the statistics, related to several characteristics regarding events, such as gender and age of the injured, time and location of the accident, make, type, power and age of the tractor, etc.

PRELIMINARY STUDY OF AMMONIA EMISSIONS FROM NATURALLY VENTILATED FATTENING PIG HOUSES IN THE SOUTH-EAST CHINA

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CSBE101254 – In this study, the monitoring technology of ammonia emissions, and estimating method of ventilation airflow rate from naturally ventilated fattening pig houses were investigated by using experimental simulation. The experimental simulation study was conducted in the two pig houses with identical construction, dimensions, pig numbers and management. The natural ventilation is used in the experimental pig house and the reference pig house is equipped with mechanical ventilation. Controlled artificially, to maintain identical air temperature and relative humidity in both houses, the ventilation airflow rate of the experimental pig house was estimated by calculating the ventilation airflow rate in the reference pig house. In addition, the ventilation airflow rate of the experimental pig house was also estimated based on heat pressure theory. The results showed that the room air temperature and relative humidity were related to inlet air temperature and relative humidity for both ventilation systems. The average air temperature in room 104 (19 days) was 4.1(±1.1) °C higher than inlet air temperature, but the relative humidity was lower by 7.1(±2.8) %. In room 103 with naturally ventilation, the average air temperature (19 days) was 3.9(±1.2) °C higher than inlet air temperature, but the relative humidity was lower by 4.3(±2.8) %. [...].

BIOFILTER COMBINED WITH A BIOTRICKLING FILTER AND A CHEMICAL AIR SCRUBBER

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CSBE101260 – The aim of this study was to investigate if a biofilter with crushed tree roots as a filter material combined with a commercial biotrickling filter and a chemical air scrubber could increase the odour reduction of these air scrubbers. Two experimental setups were made with a biotrickling filter from SKOV A/S. In the first setup, a biotrickling filter with two filters of cellulose was followed by a biofilter. In the second setup, a cellulose filter with an increased surface area of 40 % compared to traditionally used cellulose filters was installed followed by a biofilter. An experimental setup was also made with a chemical air scrubber from ScanAirclean A/S / INNO+. This setup consisted of a plastic filter, which was moistened with sulphuric acid liquid at a pH of 2.2, followed by a biofilter. On each experimental setup, a measuring campaign of 6-10 days was performed during the summer months. Results from the biotrickling filters showed that the biofilter did not contribute any further to the odour reduction. However, the cellulose filters did reduce the odour concentration by 45-48 %. Results from the setup with the chemical air scrubber showed an odour reduction of 57 % during the first four days of the measurement period. However, no significant odour reduction was seen during the last six days of measuring. The reason for this could be an unintended load of at least 15 kg sulphuric acid into the recirculation liquid of the plastic filter. This increased load of acid presumably affected the microbial conditions on the biofilter. Investigations of the biofilter showed colonization of fungi. A theory could be that a sudden growth of fungi may have settled as a layer on top of the active biofilm and thereby eliminated aerobic odour transferable processes.

HIGH VOLTAGE ELECTRIC FIELD EFFECTS ON STRUCTURE AND BIOLOGICAL CHARACTERISTICS OF BARLEY SEEDS

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CSBE101261 – Electric seed treatment (electric bio-stimulation) is one of the physical pre-sowing treatments. Electric field treatment of seeds increases germination of non standard seeds and leads to acceleration of plant growth and root development. In this paper the effects of AC electric field and exposure time on structure and some biological characteristics of barley seeds were carried out experimentally to investigate the potential of acceleration of seed germination and plant growth by the electric field strength and exposure time. The barley seeds of *Makooei* cultivar were used in this study. The effect of electric field strength (at 2, 4, 9, and 14 kV/m) and exposure time (at 15, 45, 80, and 150 min) were studied on seed germination (%), height of seedling, length of root, height of stem, length of leaves, earliness, dry weight and wet weight of seedling. Before the germination experiments, the treated seeds were stored for a month in a refrigerator at 5 °C. The initial germination percent of the seed sample was 81%. The results showed that treatment of barley seeds in an AC electric field had a positive effect on all investigated parameters. The germination percent of the treated seed sample was increased to 94.5%. The seeds exposed for long periods of (45 to 150 min) showed better germination than the seeds exposed to lower exposure times. Dry and wet weights of seedling were increased 143.4% and 45.7%, respectively. [...].

REDUCING ODOUR AND AMMONIA EMISSION BY COOLING INLET AIR IN A FARROWING FACILITY

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CSBE101262 – The aim of this study was to investigate the reduction of odour and ammonia emissions for 90 sows in three units of a farrowing facility by tempering the inlet air during the year with a geothermal heating and cooling system (GHCS). By cooling the inlet air during summer, the maximum ventilation rate could be limited to 200 m³/hour/sow, and an optimal temperature could still be maintained inside the farrowing facility. The results were compared to three control units which were traditionally ventilated with a maximum ventilation capacity of 430 m³/hour/sow. Results showed that the temperature of the inlet air during the year could be kept between +4.3 °C and +19.6 °C by using the GHCS, while the outdoor temperature varied between -4 and 32 °C. During the summer, a tendency of 23 % lower odour emission on average was measured in the experimental units compared to the control units (P=0.06). Moreover, on warm days with a high airflow rate in the control units, the odour emission in the experimental units was 39 % lower when compared to the control units (P<0.01). In the summer, there was a tendency of 11 % lower ammonia emission from the experimental units compared to the control units (P=0.10). However, during the entire year there was no significant difference in ammonia emissions between the experimental and control units. For ventilation, 45 kWh less per farrowing pen was used in the experimental units compared to the control units, corresponding to savings of 4.57 € per farrowing pen. In contrast, the GHCS required 47 kWh per farrowing pen, corresponding to 4.70 € per farrowing pen. Operating costs amounted to 0.13 € per farrowing pen since the GHCS did not affect the consumption of floor heating.

THREE-TIER WIRELESS SENSOR NETWORK FOR ENVIRONMENTAL MONITORING

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CSBE101270 – Three-tier wireless sensor networks were designed and deployed in several experimental sites to remotely monitor sediment concentration and movement in real time. Sensor nodes, gateways, repeater stations, and central stations were strategically deployed to insure reliable signal transmissions. Radio signal strength was tested to analyze effects of distance, vegetation, and topographical barriers. Omni- and directional antennae with different gains were tested to achieve robust, long-range connection in a wireless-hostile environment. Sampling times of sensor nodes within a local sensor network were synchronized at the gateway station. Error detection algorithms were developed to detect errors caused by interference and other impairments of the transmission channel. Both GSM and CDMA modems were used at different locations based on cellular coverage. Procedures for selection of solar power components were developed and tested. Data were analyzed to verify the design principles.

EFFECT OF PACKAGING AND PRESERVATION METHODS ON THE QUALITATIVE AND SENSORY CHARACTERISTICS OF DEHYDRATED JUJUBA FRUIT

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CSBE101272 – Jujuba (*Zizyphus jujube*) fruits resemble the crab-apple in flavor and appearance and the pulp is mealy and sweet; they are more palatable and less acid than the wild varieties. When ripe and dried, it is a mild laxative and expectorant. Khorasan province in Iran is one of the main producers of Jujuba and in southern parts of this province this fruit is one of the main sources of income for local farmers. In this research, Jujuba fruits were harvested at 120 days after full bloom, dried industrially (cabinet dryer), packed and stored for one year. The experimental design was completely randomized design with 3 replicates. Factor A was packaging methods (crate, low density polyethylene and cellophane), factor B was storage temperatures (25, 10, 4 degrees centigrade) and factor C was storage times (0, 6 and 12 months). The attributes consisting of weight changes, contamination by insects, moisture content, panel tests (texture, color, odor, taste, overall acceptance) were measured every 6 months. The results showed that the best packaging method was low density polyethylene and preservation in 4 degrees centigrade for 1 year.

ENERGY SAVING DURING BULB STORAGE APPLYING MODELING WITH COMPUTATIONAL FLUID DYNAMICS (CFD)

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CSBE101275 – Tulip bulbs to plant the next season are stored in containers which are ventilated to a level of 500 or 300 m³ per m³ bulbs per hour to avoid high ethylene concentration between the bulbs. In this study a commercial CFD code was used to investigate the distribution of air flow between the containers and the potential energy saving by applying simple solutions concerning the design of the air inlet area and the adjustment of the ventilation rate. By doing so we calculated a variation of container ventilation between 60 and 180%, where 100% is the average flow through the containers. Various measures for improvement were investigated. By smoothing the sharp corners of the entrance channels of the ventilation wall about 7% energy can be saved. The most effective and simple way for improvement, was by covering the open top containers. In this case the variation is between 80 and 120%. By adjusting the overall ventilation to the container with the minimal air flow acceptable in the current situation (67%), energy saving is about 38%.

INFLUENCE OF INSECT NETS AND THERMAL SCREENS ON CLIMATE CONDITIONS OF COMMERCIAL SCALE GREENHOUSES: A CFD APPROACH

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CSBE101277 – The influence of different type of insect nets and both NIR and shading screens to climatic conditions of a commercial scale greenhouse of 1 ha was analyzed using Computational Fluid dynamics (CFD). The calculations were carried out for a typical 1ha Venlo type greenhouse focusing on summer weather conditions of Western Turkey. The crop (tomato) was simulated using the equivalent porous medium approach by the addition of a momentum and energy source term. Wind characteristics, temperature and humidity of outside air and application of different type of insect nets and NIR screen specified to set up the 3D CFD model. The numerical analysis was based on the Reynolds-averaged Navier-Stokes equations in conjunction with the Realizable k- ϵ turbulence model. The ventilation rate in terms of air changes per hour for all the models was calculated by simulating the decay tracer gas method. By using insect nets the decrease of ventilation rate was ranged between 15-30%. NIR screen and shading screens influence not only the radiative heat exchange but also the air temperature distribution. Numerical techniques are proved to be a useful tool to customize the design of commercial scale greenhouses to local conditions and analyze what if scenarios for future investments.

TEST AND EVALUATION OF TWO PROCESS CONTROL STRATEGIES FOR ADAPTING DIRECT INJECTION PESTICIDE APPLICATION TO SMALL SCALE FARMS

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CSBE101278 – Small scales farmers, in developing and in some developed countries, are faced with actual difficulties regarding the application of pesticides accurately and safely on vegetable crops, mainly due to the use of the hand operated sprayers. To help resolve this issue, a small direct injection system based on a parallel boom layout was designed to improve chemical application. The boom layout was optimised to obtain the same minimal lag time response for the ten nozzles. Two control strategies were implemented using PI feedback control loops for monitoring tracer injection (fluorescing) proportionally to simulated forward speed (from 0.6 to 1.2 m/s) and for controlling pressure to maintain carrier flow constant (constant carrier flow strategy) or for controlling a variable operating pressure proportionally to the injected chemical amount (variable total flow strategy). The dynamics of the system was approached as first order model with delay and optimised on the basis of reaction curve method. Three forward speed magnitudes (0.6 to 0.9, 0.9 to 1.2 and 0.6 to 1.2 m/s) were induced using different solicitations (up and down steps, ramps, sweeps and sine waves) and by simulating different accelerations (1.2, 3 and 4.8 m/s²) and frequencies (0.2, 0.3 and 0.4 Hz). The system stability was tested for its ability to maintain the expected application rate. The results show that the lag time remains less than 3 s (dead time < 2s, rise time < 1s) and the system remains stable for the maximal speed variation and acceleration tested (?V=200%, a= 0.48 m/s²) which induce less than 10% variation of application rate.

DIVERSITY OF FRUIT ORIGIN BY USING 26S rDNA FINGERPRINTING OF YEAST COMMUNITIES BY PCR-DGGE: AN APPLICATION TO SHEA TREE FRUITS

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CSBE101279 – The economic importance of Shea tree fruits has been rising and achieving a great success in African, American, European markets. In Europe, Shea butter is used mainly (95%) by the chocolate industry. The quantities exported to Japan, the United States or Switzerland would be mainly used for cosmetic or pharmacological uses. The traceability of fruits is unreliable. In case of doubt or fraud, no standardized analysis makes it possible to trace back the origin of the fruit. The aim of this study is to use a new tool for tracing the products (PCR-DGGE) as a molecular technique to analyse in a unique step all the yeasts present on the fruit to create a linkage between yeast communities and the geographical origin. A method of yeast ecology, the PCR-DGGE, was used to characterize the yeast flora of Shea tree fruit (*Vitellaria paradoxa*) from four countries (Ghana, Senegal, Mali, and Cameroon). DGGE fingerprints analysed by multivariate analysis permitted to distinct different fruit origins by their microbial communities. The fingerprints of Shea tree fruit yeasts were specific for each country and could be used as a unique biological bar code to identify the country of origin of fruits. The Creation of a new traceability analytical tool by using 26S rDNA fingerprinting of yeasts that provides the fruits in general and Shea tree fruits in particular with a unique bar code for each country is highly significant.

REDUCING THE DISPERSION OF SEED COATING PARTICLES CONTAINING NEONICOTINOIDS IN MAIZE SEEDING

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CSBE101280 – In recent years, especially in Italy, France and Germany, the dust detached during the vacuum seeding from the maize seeds coating (and that of some other crop) based on neonicotinoids caused a wide bee devastation, due to their very high neurotoxicity. The dust had a fallout on vegetation along the field borders; bees fly on to grass and flowers to gather nectar, pollen and morning dew and become poisoned, going basically mad and become lost. Among the different solutions proposed, one of them was to re-direct the air flow coming out of the seeder fan towards the soil surface, in order to limit the dust dispersion. A further improvement was to divide the flow into two parts, by creating a “dual-pipe deflector”, in order to decrease the air velocity, and so to reduce its turbulence. Unfortunately, this solution was found to have a poor result and leading to the adoption of filters. Paper filters seem to be an effective solution, but the right type in terms of density must be accurately selected; moreover, once worn-out, the filters have to be suitably disposed. Based on these findings, water filters seems to be an adequate solution, because they do not require disposal and the effluent material, adequately diluted, could be used in the soil as a pesticide, avoiding any dispersion into the air. Collaboration with the vacuum seeders manufacturers have enabled the elaboration of suitable solutions and are presently being researched under study.

CULTIVATION AND UTILIZATION OF SPECIFIC WOOD BIOMASS FOR SYNTHESIS OF CELLULOSE BASED BIOETHANOL

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CSBE101283 – The determination of energetic characteristics of six types of poplar clones was achieved, four developed by Alasia New Clones - Italy, (AF-2, AF-6, AF-8, Monviso) and two by ICAS - Romania (Turcoaia, Sacrau-79); they were cultivated for different pedoclimatic conditions in Romania. The plant survival rate and biomass production rate were analyzed in five experimental cultures. The main results obtained after two years of studies were as follows: Very good adaptability of Italian clones to the pedoclimatic conditions in Romania in comparison with local clones (better growth speeds and biomass production capabilities); the Italian clones Monviso and AF-6 registered the most substantial growths and the highest resistance to disease. The synthesis of bioethanol was achieved by acidic hydrolysis of the cellulose following two methods. In the first approach the lingo-cellulosic raw material was hydrolyzed with diluted sulfuric acid (4.5%) at 50°C for 24h. After filtration, the solid residue was treated with 30% H₂SO₄ at 100° for 6h. Following again filtration, the obtained solutions were neutralized with Ca(OH)₂ and the resulted solution (pH 6.5) was subjected to fermentation with *Saccharomices Cerevisiae*. In the second approach the lingo-cellulosic raw material was subjected to hydrolysis with 10% H₂SO₄ at 100° for 4h. After filtration, the solid residue was hydrolyzed with 30% H₂SO₄ at 100° for 6h. The resulted solution were neutralized with Ca(OH)₂ and then subjected to alcoholic fermentation with *Saccharomices Cerevisiae*. The fermentation took place at 25°C for 72h. The results show no significant difference between the two methods.

HARVESTING CANBUS DATA TO IMPROVE SOIL COMPACTION MANAGEMENT

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CSBE101284 – Modern tractors are equipped with electronic monitoring systems (CANbus) that can provide a wealth of information on a wide variety of operational parameters. However there is currently no simple way to access and use CANbus data by farmers. One area of interest is the monitoring and mapping of soil compaction zones using data acquired on a standard tractor. The goal of this project was to assess the accuracy of standard tractor sensors to measure soil compaction, using a cone penetrometer and a single-shank subsoiler. The CANbus data was compared to impact penetrometer compaction readings to determine which mechanized compaction measurement method is the most accurate.

APPLICATION OF NEAR INFRARED SPECTROSCOPY AND LEAST SQUARES-SUPPORT VECTOR MACHINE TO DETERMINE SOLUBLE PROTEIN IN OILSEED RAPE LEAVES

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CSBE101287 – Soluble protein was an important parameter to indicate and monitor the growing status of oilseed rape. Near infrared (NIR) spectroscopy combined with least squares-support vector machine (LS-SVM) was investigated to determine soluble protein in oilseed rape leaves under herbicide stress. Different preprocessing methods were compared, including Savitzky-Golay smoothing (SG), standard normal variate (SNV), multiplicative scatter correction (MSC), first-derivative (1-Der), second-derivative (2-Der) and de-trending. The optimal performance was determined by the PLS model with correlation coefficients (r) and root mean squares error of prediction (RMSEP). Successive projections algorithm was applied to select effective wavelengths (EWs), which were used as inputs of LS-SVM. The optimal prediction results was achieved by SPA-LS-SVM model (De-trending spectra) with $r=0.9879$ and RMSEP=61.8231. The results indicated that NIR spectroscopy combined with SPA-LS-SVM was successfully applied for the determination of soluble protein in oilseed rape leaves under herbicide stress.

OVERCOMING FOOD SHORTAGE THROUGH IMPROVED IRRIGATION STRATEGY

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CSBE101288 – Studies have been conducted during the years 2004-2007 in big lysimeters as well as in the field to tailor strategy for most productive use of available surface and sub-surface water resources. Wheat and maize crops were selected for this trial. The following three irrigation treatments were compared: Irrigation as per Farmer's Practice, Tensiometer based irrigation, No irrigation during entire crop season except heavy pre-irrigation to bring upper 2m soil column at field capacity. Agronomic and cultural practices were followed as per general practice of the area. Tensiometers were installed up to 210cm depth with an interval of 30cm to monitor soil water status at different depths during crop growth period under each treatment. Moisture depletion pattern developed from tensiometer data indicated that the moisture depletion zone for wheat and maize was about 1 meter for treatments (i) and (ii); whereas it extended to more than 2 meters for treatment (iii). Yield data analysis revealed that the crop grain yield and water use efficiency were generally higher in case of treatment (iii) when compared with treatments (i) and (ii). It was further noticed that strew yield had opposite trend. Similar studies were also conducted under field condition at Research and Demonstration Centre of PCRWR situated at Sial More and at four different locations at farmer's fields. The results of these field trials were found inline with findings of lysimetric studies. Taken together these results it can be concluded that: Present water management practices being followed in Pakistan can further be improved to enhance water use efficiency. The criteria for irrigation applications should be based on water availability in the soil and not on rotational basis at pre-fixed intervals. Rain water, flood water and residual moisture of rice fields if stored in top 2m soil depth can be utilized for successful crop production.

EFFECT OF MICROWAVE RADIATION ON STARCH DIGESTIBILITY AND PHYSICO-CHEMICAL PROPERTIES OF THREE BARLEY TYPES

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CSBE101290 – Samples of normal barley (NB), high-amylose barley (HAB) and waxy barley (WB) were tempered to 42-45% moisture and treated with microwave radiation (2450 MHz) at three power levels. Samples were microwaved immediately after tempering or after 14 days of storage at 4°C. The effect of microwave power level on *in vitro* starch digestibility was not significant. Levels of resistant starch (RS) in microwaved samples were lower than those in corresponding unprocessed samples. The highest and lowest RS contents in microwaved samples were observed in NB (15.7%) and WB (0.0%), respectively. Unprocessed samples of NB, HAB and WB contained 17, 24 and 9% RS, respectively. The enthalpies of gelatinization (ΔH) of unprocessed barleys, as determined by differential scanning calorimetry, were in the order of WB>NB>HAB. Microwaved HAB did not exhibit a phase transition. Microwave treatment increased the pasting temperature of NB and the peak viscosity of WB, as determined by rapid viscoanalysis.

DESIGN OF A 60MW CFB GASIFICATION SYSTEM (CGAS) FOR UGANDA- UTILISING RICE HUSKS AS IN PUT FUEL

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CSBE101302 – Biomass resources are potentially the World's largest and most sustainable renewable energy resource. In Uganda Biomass comprises over 95% of the total energy supply. Agricultural residues are a major source of energy and can be effectively harnessed by converting them into producer gas in suitably designed biomass gasifiers. Over 90% of the Ugandan population has no access to electricity due to limited and unreliable electricity produced in the country and this has resulted in high poverty levels. To generate a system for effective utilization of agricultural wastes for energy production, a circulating fluidized bed (CFB) gasification system was designed with fuel input as rice husks for a power output of 60MW. The gasification system was designed using ERGUN CFB software with the available theoretical and experimental data. The design was divided into four parts: reactor subsystem, air distribution plate, cyclone, air inlet and fuel feeding systems. The designed gasifier has an overall reactor height of 10m, fuel flow rate of 8.1kg/s, inlet air flow rate of 11m³/s, fluidization velocity of 0.9m/s, pressure drop in the bed of 1.5kPa, 25.2m/s cyclone inlet gas velocity, about 99% cyclone efficiency, less than 1kPa pressure drop in cyclone, gas flow rate of 41.2kg/s and effective cold gas efficiency of 50%. Under the mentioned design conditions, the gasifier can be used for effective power generation of 60MW from locally available and environmentally friendly energy resources.

APPLICATIONS OF MEMBRANE TECHNOLOGIES FOR TODAY AND TOMORROW

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CSBE101303 – Traditionally, in the food industry, microfiltration (MF) and ultrafiltration (UF) were mainly used for concentration, purification and/or recovery of product from aqueous solutions while electrodialysis (ED) was used for demineralization. There is now a new key driver for the development of new membrane technologies applications: consumers want foods that provide beneficial effects for their health. As a result, several researches in the field focus on: (1) the removal of antinutritional factors from food ingredients or the isolation of bioactives compounds, in order to make them available in the form of new “health” ingredients, or (2) the stabilization/protection of bioactive compounds. In this presentation, a few recent applications of membrane technologies will be discussed including: (1) the removal of phytic acid from plant protein isolates by combining electrodialysis with bipolar membranes (EDBM) and UF. Briefly, phytic acid/protein ratio in the protein isolate is decreased by as much as 50%, when compared to the ratio observed in the isolate produced by acidic precipitation, and in addition the solubility is improved by as high as 25 % for the pH range 2-4.5; (2) the stabilization of polyphenols present in opalescent apple juice by combining EDBM for acidification of the juice to pH 2.0 with a mild heat treatment at 45°C. The PPO enzyme (responsible for enzymatic browning reaction) is inactivated in only 5 minutes, and the treatment did not induce cooked apple aftertaste. The result is a clear and stable juice with a high content of polyphenols.

CONTINUOUS AND PULSED ULTRASOUND-ASSISTED EXTRACTIONS OF ANTIOXIDANTS FROM POMEGRANATE PEEL

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CSBE101304 – There is a great demand for developing efficient extraction methods in order to reduce extraction time and increase the yield and activity of functional antioxidants. The yields, activities, and extraction kinetics of antioxidants from dry peel of pomegranate marc were studied using ultrasound-assisted extraction in continuous and pulsed modes and the results were compared with conventional extraction (CE) at a temperature of 25 ± 2 °C and water/peel ratio of 50/1, w/w. The studied factors were intensity level and treatment time for continuous ultrasound-assisted extraction (CUAE), and intensity level, number of pulse repetition, and pulse duration and interval for pulsed ultrasound-assisted extraction (PUAE). The results showed that all factors significantly affected the antioxidant yield, but only treatment time had a significant effect on the antioxidant activity. Compared to CE, PUAE at intensity level of 59.2 W/cm², and the 5 and 5 s of pulse duration and interval increased the antioxidant yield by 22% and reduced the extraction time by 87%. Similarly, CUAE at the same intensity level increased the antioxidant yield by 24% and reduced the extraction time by 90%. PUAE resulted in the antioxidant yield of 14.5%, DPPH scavenging activity of 5.8 g/g, and energy saving of 50% compared to CUAE. A second [...].

ADSORPTIVE REMOVAL OF PHOSPHATE ANIONS FROM AQUEOUS SOLUTIONS USING FUNCTIONALIZED SBA-15: EFFECTS OF THE ORGANIC FUNCTIONAL GROUP

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CSBE101305 – Water pollution stemming from agricultural activities is a multidimensional serious environmental worldwide problem encompassing several types of pollutants such as phosphates, nitrates and pesticides. Phosphates are particularly deleterious as they are implicated in aquatic eutrophication. The present work is devoted to the study of the adsorption process for phosphate (H_2PO_4^-) from aqueous solutions over mesoporous silica SBA-15 materials modified with mono and di-ammonium organic functional groups. The objectives pursued are: i) synthesis and characterization of the adsorbents; ii) experimental investigation of the effects of the number of amino groups in the organic chain in functionalized silica material as well as the loading of amino-functional groups in the silica framework on the adsorption performances. The adsorbents were prepared via a post-synthesis grafting method. They were then characterized using nitrogen adsorption, powder X-ray diffraction, CHN-elemental analysis and solid state ^{13}C and ^{29}Si NMR. The adsorption tests were performed batchwise at room temperature. The loading of amino moieties on the SBA-15 surface was varied from 5 to 40 % as organoalkoxysilane/silica (OF/Si) molar ratio. Results showed that adsorption capacity increased with increasing the concentration of functional groups on the SBA-15 adsorbent. In the case of monoammonium functional groups, the adsorption capacity increased from 0.64 to 1.07 mmol $\text{H}_2\text{PO}_4^-/\text{g}$ when the OF/Si ratio was varied from 5 to 40 %, respectively. Similar tendency was observed in the case of diammonium [...].

HOW TO INTEGRATE MULTI-SENSOR DATA FOR PRECISION AGRICULTURE

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CSBE101306 – Geo-electrical sensors are often used as auxiliary variables with sparse direct measurements to estimate soil properties. Using a single sensor often proved problematic, but use of complementary sensors can compensate such weaknesses. The objective of this work was to integrate field data from EMI (EM38, EM31), γ -ray and DGPS sensors for delineating areas of homogeneous soil. The geophysical survey was carried out on an 80-ha cropping field in Corrigin, Western Australia. The EM38 and EM31 data were strongly correlated between them as were γ -radiometric counts from thorium (Th), uranium (U) and all elements (Tc). The multi-sensor data were split into 4 subgroups, based on their similarities: 1) EMI data; 2) γ -radiometric counts from potassium (K); 3) γ -radiometric counts from Th, U and Tc and 4) DGPS height. Each group of data was separately analysed using geostatistical techniques. The EMI data showed anisotropy and an anisotropic Linear Model of Coregionalisation was used before cokriging. The EM31 and EM38 maps looked similar. The maps of γ -U, Th and Tc were also similar, suggesting that they reflected the same soil properties, but were somewhat different from the γ -K maps. High values of EMI coincided with both low γ -radiometric values at the valley bottom, due to moist sandy salinity-prone soil of varying depth to texture contrast, and high γ -radiometric values at elevated areas of the field due to emission from finer textured soil. High γ -radiometric values coincided with low values of EMI over gravely sands. [...].

BIOREACTORS

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CSBE101311 – Considering the present push towards greener industrial and residential activities, composting is once again a hot topic amongst Ecological Engineers. Keeping in mind that uniform composting is necessary to insure decomposition and to keep the whole system at the same composting stage, it is essential to maintain a homogeneous temperature throughout the media. Therefore, in the quest to accomplish the latter, a design consisting of a heater core made of copper tubing was designed and tested. Through two four-inch holes made at the top and bottom of the barrel to enable air to flow through the system, allowing aerobic composting. Once composting gets underway and temperature rises, water flow through the copper piping would occur, distributing the core heat throughout the medium and permitting uniformity. The results obtained by inserting three thermocouples at different heights on a 200 litre plastic barrel fitted with the aforementioned apparatus and compared to a barrel ran at the same time without the device demonstrated that our system accomplishes its objectives. In conclusion, temperature variations were significantly lower when ran with the heat redistribution system, permitting uniform composting, accelerating the process and reducing the risks of pathogenic or other contaminants remaining active in the barrels.

APPLICATION OF RESPONSE SURFACE METHODOLOGY TO THE OPTIMISATION OF *IN VITRO* ENZYMATIC DIGESTION OF SOY PROTEIN ISOLATE OF HIGH HYDROSTATIC PRESSURE PROCESSING

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CSBE101313 – Enzymatic digestion of soy protein isolate (SPI) using high hydrostatic pressure processing was studied by response surface methodology. A central composite design (CCD) with three independent variables: pre-treatment pressure (337, 400, 500, 600 and 663MPa), pepsin-substrate ratio (0.16, 0.5, 1.0, 1.5 and 1.8%) and pancreatin-substrate ratio (1.3, 2.0, 3.0, 4.0 and 4.7%) were used to study the response variable (degree of hydrolysis, DH). A predictive polynomial quadratic equations model was developed in SAS 6.0 software. Regress equations, response analysis, and the mathematical model showed good fit with the experimental data. The R² value indicated that 96.6% of the variability within the range of values studied could be explained by the model. A pre-treatment pressure of 590MPa, a pepsin-substrate ratio of 1.1 % and a pancreatin-substrate ratio of 3.2% were the optimal conditions achieving the highest DH.

MODELLING AND SIMULATION OF PROCESSES BY SMART SENSING: A SOLAR DRYER FOR PLANT MATERIAL

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CSBE101316 – Operation and decision making in most processing plants is guided by highly empirical recipes and rules which are too rigid to adapt the process to changes in the external or internal conditions. Such empirical rules often lead plants to operate far from optimal conditions, both in terms of operation cost and product quality. Considerable efforts have been made to develop several types of solar dryers around the globe, which properly designed may prove to be energy saving devices for drying processes. In this study, a small wood dryer has been used for modelling. The drying rate expressed as $-dX/dt=f/X$ (where X is DB wood moisture content), allows to identify two different kinetics; 1) for high X values (X 65% to 30%) or fibre saturation point (FSP); and 2) for X values under FSP, in which diffusion is the mechanism that governs a decreasing drying rate at this stage. A complex drying rate model developed in this work allows the determination of the wood and convective mass transfer at wood-air interface. Validation and application to fruit and plant drying cycles is being carried out. The implementation of three different proposed models is used as the software for a "smart" sensor system, which is based on *Sensirion* sensors (for temperature and relative humidity in the air) and thermocouples for timber temperature.

EFFECT OF DRYING TEMPERATURE ON STRUCTURE OF PASTA ENRICHED WITH PEA PROTEIN ISOLATE

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CSBE101317 – Pasta enriched with plant proteins is becoming very popular since consumers are more and more aware about their health and wellbeing. However, little is known about the effect of enrichment as well as drying process on pasta structure. Consequently, the objective of this work was to characterize the effect of those parameters on some key engineering properties of pasta, namely dimension, porosity, shrinkage and density. Pasta enriched with 0, 5, 10 and 15% commercial pea protein isolate was processed using a pasta extruder equipped with a 2.5 mm Teflon die. Then, they it was dried inside an environmental chamber under a controlled atmosphere at 40°C or 80°C (65% relative humidity) for 20 hours. An air pycnometer (100 psig) was used for porosity measurement. Moreover, scanning electron microscopy (SEM) was performed to characterize the external structure of pasta. Results indicated that protein content level had little effect on measured properties compared to drying temperature. High drying temperature led to production of pasta with higher density and lower porosity compared to low drying temperature, which might be the result of a more important radial and volumetric shrinkage. SEM observations showed that pasta structure was affected by processing conditions.

ANTIOXIDANT ENRICHMENT OF CRANBERRY JUICE BY ELECTRODIALYSIS WITH FILTRATION MEMBRANE: IMPACT OF PROCESS ON JUICE COMPOSITION

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CSBE101320 – Cranberry is recognized for its high antioxidant potential and its nutraceutical properties. So, the enrichment of a cranberry juice with functional phytochemicals, such as anthocyanins and proanthocyanidins, would be particularly interesting for the nutrition-health market. Indeed, in the past years the nutrition-health market has known and still knows an incredible continuous increasing development. Hence, the food industry is looking for innovative technologies for the production of new products in order to answer consumer demands for healthy products. Recently, it was demonstrated that it is possible to enrich a cranberry juice in antioxidants from another cranberry juice by an electrodialysis with filtration membrane (EDFM) process (Figure 1). The objectives of this work were to study, during consecutive EDFM treatments, the evolution of raw and enriched cranberry juices composition as well as the ED parameters. The anthocyanin concentration and the antioxidant capacity of the enriched juice increased respectively of 19.41% and 23.74%, while the anthocyanin concentration and antioxidant capacity of the feed juice remained constant throughout treatments. Proanthocyanidin concentration of both juices also remained constant which suggests that the duration of treatments was too short to allow the migration of these molecules. However, enriched juice concentration with decreased citric and malic acids resulted in a significant decrease of its astringency.

EFFECT OF PROCESS UNIT OPERATION AND LONG TERM STORAGE ON EGCG-ENRICHED TEA DRINK CATECHIN STABILITY

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CSBE101321 – Due to the increasing market of functional foods having health benefits and recent demonstration of (-)-epigallocatechin gallate (EGCG) chemopreventive action, manufacturers try to produce and package ready-to-drink green tea infusions enriched or not in EGCG. However, the stability of green tea catechins in drinks is always controversial and very few studies on the subject are reported. In this context, the objectives of this study were 1) to evaluate the impact of the different process unit operations on the stability of catechins during EGCG-enriched tea drink production, 2) to assess the catechin stability in an EGCG-enriched tea drink produced at a semi-pilot scale during a 6-month storage, and 3) to compare the EGCG-enriched tea drink catechin contents with commercially available tea drinks. It appeared that the stability of catechins during long-term storage was optimum at low temperature (4°C) and pH (pH 4.0) (Figure 1). During the processing of the EGCG-enriched green tea drink, all the process unit operations, except heat-treatment, had no impact on catechin concentrations. The EGCG-enriched green tea drink presented high values in catechins in comparison with commercially available tea drink available commercially as well as anti-cancer properties (Figure 2).

MEASUREMENT OF AMMONIA EMISSIONS FROM THREE AMMONIA EMISSION REDUCTION SYSTEMS FOR DAIRY CATTLE USING A DYNAMIC FLUX CHAMBER

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CSBE101322 – There is increasing interest among dairy farmers in The Netherlands for animal friendly housing systems that at the same moment reduce the ammonia emission compared to currently available systems. Therefore, there is a need for a relatively cheap and easy measuring method to investigate the potential effect of new emission reduction systems. In 2008 and 2009 Wageningen UR Livestock Research performed emission measurements on 3 different ammonia emission reduction systems using a dynamic flux chamber. All systems were meant for use in a free stall housing system for dairy cows. Two of the emission reduction systems were concrete floors and one was an emission reduction system covering the slurry in the pits. The experiments were conducted at three different practical dairy farms in the Netherlands, one for each system. Emission of the reduction system was related to emission of a reference floor. In all cases a concrete slatted floor with slurry pits was used as a reference. Emission levels ranged from 39% to 71% of the emission of the reference system. The two systems based on reduction of floor emissions seemed to have more perspective than the system based on reduction of pit emissions. A complete closing of the pits is however an important condition. Because of the case-control character of the flux chamber measurements the results can not be translated directly to full scale emission factors for dairy housing neither can they be used for between farms comparison.

EFFECT OF LOW ANODE/CATHODE VOLTAGE DIFFERENCE APPLICATION ON REDOX POTENTIAL MODULATION DURING MILK ELECTROREDUCTION AND STORAGE

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CSBE101323 – Milk degradation during processing and storage is mainly due to oxidation-reduction reactions. Recently, electroreduction was applied to modulate the redox potential of milk but on a very large range of anode/cathode voltage (2, 4, 6, 8 and 10 V). The suggested value based on process effectiveness was 4 V. Our objectives in the present work were to 1) investigate the effect of low anode/cathode voltage differences on milk redox potential modulation during electroreduction, 2) optimize the process and 3) compare storage of a low-voltage electroreduced milk with a non electroreduced milk. It appeared from these results that electroreduction at anode/cathode voltage difference of 3 V was sufficient to ensure a significant decrease in ORP and DO. The application of a 3V treatment instead of the 4 V value would allow an energy saving of 79%. It appeared also that oxygen is an important parameter to consider during storage of electroreduced milk.

LARGE SCALE BIOSEPARATION OF AN ANTIHYPERTENSIVE PEPTIDE FROM ALFALFA WHITE PROTEIN HYDROLYSATE BY ELECTRODIALYSIS WITH ULTRAFILTRATION MEMBRANE

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CSBE101324 – In recent years, a new field of research dealing with bioactive peptides was developed. It has been reported in several studies that various peptides isolated from enzymatic hydrolysis of proteins exerted a number of biological activities. However, to be valuable for exploitation in functional foods and as new medication, these bioactive compounds have to be separated or purified. Consequently, growing interest has been focused on developing efficient operations for their separation, purification and concentration. In a previous study, the selective recovery of bioactive peptides, more specifically antihypertensive peptide, identified as VW was evaluated from an alfalfa white protein hydrolysis using EDUF but with a maximum transmission rate of 1.67%. The authors proposed that such low migration rates were due to the pH condition in the recovery compartments. The purpose of this present study was to produce VW enriched fractions by controlling the pH of the recovery compartment and by scaling-up the EDUF technology in two different configurations (Anion- (AEM, Figure 1a)) and cation-exchange membrane (CEM, Figure 1b)) configurations) with a semi-industrial pilot plant. The average transport rates of peptides obtained for the AEM and CEM configurations were 8.7 and 5.3 g/m².h respectively. The maximum transmission rate recorded for the VW peptide was up to 32% in the CEM configuration (Figure 2). Furthermore, the streaming potential measurements carried-out before and after electrodialysis, [...].

SHORT ROTATION COPPICE WITH ROBINIA PSEUDOACACIA L. – A LAND USE OPTION FOR CARBON SEQUESTRATION ON RECLAIMED MINE SITES

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CSBE101326 – In North-East Germany a promising land use option to improve farmer's income on marginal soils may be the establishment of short rotation coppices (SRC) of Robinia pseudoacacia L. The purpose of these wood plantations is the fast production of woody biomass for energy utilisation. Within the plants carbon is not only accumulated in the harvestable biomass, but also in the stump and the roots. These plant compartments survive a harvest, stay vital at the site and grow steadily with increasing plant age. In result, these compartments form a long-time carbon storage pool in the agricultural landscape. Besides the living biomass, additional carbon is sequestered under SRC as soil organic carbon due to decomposition of organic litter material. Several field studies conducted on reclaimed mine sites in the post-mining landscape of Lower Lusatia (NE-Germany) resulted in an average above ground dry matter productivity of R. pseudoacacia of 3 to 10 Mg ha⁻¹ yr⁻¹ depending on the plantation age and rotation period. Estimates of the carbon storage within the soil account to a carbon sequestration of up to 6 Mg ha⁻¹ yr⁻¹ for a soil depth of 60 cm. This paper aims to provide an overview of the results of selected field studies covering carbon sequestration in SRC of R. pseudoacacia on mining sites within the Lusatian region. The outcomes are complemented with findings of current field studies. [...].

EXPERIMENTAL STUDY OF BANANA DRYING ENERGY COSTS IN A PROTOTYPE ELECTRIC DRIER

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CSBE101329 – This work is devoted to the experimental study of banana drying energy cost. A prototype drier with a capacity of 120 kg of fresh produce, meeting the need of a producer, was designed and built. The system was then used to undertake an experimental study on energy costs of banana drying, taking into account the influence of aerodynamic settings within the drying enclosure. The results showed that the final sought water content, approximately 20% in dry base, is obtained in 35 hours when drying is performed at 60°C without air recirculation; the power consumption was 83 kWh. The power consumption was lower (only 30 kWh) when drying at lower temperatures combined with air recirculation during the process. The combination of the aerodynamic settings would therefore make it possible to divide the energy drying cost by three but would consequently increase operation time. These results offer an interesting indicator on energy constraints related to this type of processing for banana conservation, a strongly perishable product of great economic importance for the Sub-Saharan African countries in particular.

IMPACT ASSESSMENT OF CLIMATE CHANGE ON IRRIGATION BY A DISTRIBUTED WATER CIRCULATION MODEL

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CSBE101332 – The paper summarizes the impact assessment of climate change on irrigation carried out by using a distributed hydrological model for the Mekong (7,950,000km²) and Sekikawa (1,140km²) River basins, which are representative examples for large international and irrigation dominated river basins, respectively. At first, we proposed a distributed water circulation model incorporating variations in agricultural water use, so that the model provides useful information on paddy cropping area, actual water intakes for irrigation, actual evapotranspiration, soil moisture and runoff at arbitrary times and points in the basin. It was initially applied to the Mekong River Basin, in which we compared discharges and actual evapotranspiration estimated by the model with the observed data. The comparisons revealed a high degree of reliability and usefulness of the model. The model was then strengthened with snowing/melting and dam operation models developed and combined with the model mentioned above for the Sekikawa river basin in Japan. Eventually, the model proved to be a useful tool for evaluating the effects of human activity on agricultural water and for predicting these effects of climate change on agricultural water use in the future. Secondly, the estimation of future climate condition by MRI-CGCM2.3.2 and MIROC3_2_HIRES was inputted into the above model and the results obtained are as follows: 1) Bias corrections are necessary to assimilate probability distributions between the observed and recreated (GCM/RCM) meteorological data series. 2) Snowmelt runoff decreases in early spring, minimum flows decrease from May through September, and maximum flows increase after June, due to global warming. 3) Actual agricultural intake at the “Itakura” head works decreases especially during puddling periods due to the above decrease in snowmelt runoff, 3) Although cropping areas of rain-fed paddies increase due to the increase of rainfall, these areas will experience drought decreases in the future (2046-2065, 2081-2100) compared to the present period (1981-2000).

THE EFFECT OF FAN FREQUENCY ON THE DROPLET SPRAYING SWATH OF AIR-AIDED SPRAYER

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CSBE101336 – The range of droplet deposit is influenced by the wind speed of the air-aided sprayer. The spraying experiment was carried out by using concentration of 1g/L solution being mixed colorant Rhodamine-B with water instead of pesticide. Spray test sampling region was a sector area in ground, anterior of the wind cylinder spout. At each sampling point, a glass slide (7.5cm × 2.5cm) was placed in order to collect droplets. The droplet depositing on sampling points was calculated using the fluorescence spectrophotometer. When spraying, the power supply frequency of fan was regulated from 50Hz, 49.5Hz down to 44.5Hz, in increments of -1Hz. Each spray testing period was 30s. The test results indicated: (1) About 97.4% of the droplet deposition fell between the range of two parallel line shifts away from the wind cylinder axes ±2m. (2) When wind speed is less than 0.3m/s, the influence of outside wind on the droplet deposition is quite small in front of the spout (within 8m), but with increased outside wind the droplet drifting directionally to wind in the area is far from the spout (>8m). (3) As the fan power supply frequency is reduced, the droplet transmission distance of air-aided sprayer is shortened.

HYPERSPECTRAL CHARACTER ANALYSIS OF RICE LEAVES INFESTED BY BROWN PLANT-HOPPER (NILAPARVATA LUGENS)

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CSBE101337 – Rice Brown Plant-hopper (BPH) (*Nilaparvata lugens*) is one of the most serious infestations in rice production of China. To implement timely targeted pesticide applications, reducing input costs and benefiting the environment, an accurate early detection and quantification of damage caused by BPH infestation in rice plants is required. Currently, traditional methods, such as plant-flapping method, are the most common but subject to bias and can be inaccurate. Based on these imprecise and inaccurate detection systems and lack of damage evaluation data may cause costly errors to variable-rate spraying in Rice Precision Agriculture. A study was conducted to investigate: 1) the feasibility of using an ASD Fieldspec 3 radiometer to identify and discern differences of rice leaves with and without BPH infestation; and 2) the sensitive bands and the useful and optimum eigenvalues that extract from the spectral curves of the rice leaves. Reflectance data and derived vegetation indices from the radiometer were analyzed using statistical analysis procedure. Results show that it is possible to detect the stress caused by the BPH and to discriminate the rice leaves that were infested (I2PP, at a density of two BPHs per plant) and non-infested (NINP) by BPHs using remote sensing. The data provided evidence that 986nm may be most sensitive to BPHs infestation. The sensitive bands 550nm, 972-1000nm, 1250-1300nm, 666-673nm, 1919-1931nm, 758-790nm, which selected from hyperspectral spectrometry, have the potential to detect the infestation caused by BPHs in rice. The eigenvalues, such as the Trough Amplitude at 986nm, Difference of the Crest to the Trough (at 758~1063nm, 666~673nm; 758~1063nm, 972~1000nm; 758~1063nm, 1187~1300nm; 758~1063nm, 1919~1931nm; 1250~1314nm, 1919~1931nm), [...].

A TRIPLE-SENSOR HORIZONTAL PENETROMETER FOR ON-THE-GO MEASURING SOIL MOISTURE CONTENT, ELECTRICAL CONDUCTIVITY AND MECHANICAL RESISTANCE

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CSBE101339 – Following the development of a dual-sensor horizontal penetrometer for the simultaneous measurements of soil moisture content (MC) and mechanical resistance (MR), an electrical conductivity (EC) sensor with a 4-ring-Wenner-array was incorporated into the cone of the horizontal penetrometer. Both laboratory calibration and field test were conducted, and the experimental results showed that the triple-sensor horizontal penetrometer could provide more soil physical information on a field-scale.

NUTRITIONAL QUALITY AND LIPID OXIDATION OF PLANTAIN CHIPS FROM SMALL SCALE PRODUCERS IN CAMEROON: CORRELATION WITH FRYING PROCEDURES

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CSBE101343 – Plantain chips are increasingly produced and sold by small size enterprises with highly diversified frying methods and practices which could affect quality of the fried products. The objective of this study was to evaluate some nutritional and sanitary qualities of the plantain chips available on the Yaoundé/Cameroon local market and to establish the correlation with the frying practices of small scale producers. During a survey, frying oils and chips samples were collected from ten producers and analyzed for fat and water contents of the chips, fatty acid composition, tocopherols and tocotrienols, *trans* fatty acid, lipid oxidation of the oils. The Rho test of Spearman was used for correlations between parameters. The study revealed that the frying processes and practices varied from one producer to another, resulting in a great influence on the quality of the chips. The water content (2.7 to 19.3 g/100g) and the fat content (15.9 to 42.5 g/100g) of the chips varied widely. The oils collected were characterized by a wide range of saturated (27 to 45%), monounsaturated (33 to 47%) and polyunsaturated (7 to 39%) fatty acids. No *trans* fatty acid was identified in these frying oils, which contained various amounts of tocopherols and tocotrienols, from 163 to 465 mg/kg. The stability of these oils towards oxidation was significantly different, with conjugated dienes from 11.3 to 17 mmol/kg and p-Anisidine index from 7.3 to 62.2. The frying conditions - state of maturity of plantain, time of frying, depth of fryer, ratio of mass of plantain/oil ...- correlated significantly with vitamin E, polyunsaturated fatty [...].

MANGO (MANGIFERA INDICA) AND AMBARELLA (SPONDIAS CYTHEREA) PEEL EXTRACTED PECTINS IMPROVE VISCOELASTIC PROPERTIES OF DERIVED JAMS

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CSBE101344 – In order to assess their feasibility to be used in jam processing, ambarella and mango (Mango variety) peel pectins were extracted using HCl, water and oxalic acid/ammonium oxalate (OAAO). Phase diagrams of purified pectins established as sucrose concentration versus reduced pectin concentration were studied (pH 3). Using a controlled stress rheometer, the mechanical spectra of pectin gels formed were recorded and compared to those of commercial citrus pectins. Mango and ambarella jams were prepared with and without peel pectin (0.4%) and characterized for their gelatine kinetics and mechanical spectra. On the dry weight basis, pectin extraction yields were very low with water (12-16%) and high with OAAO (22-32%). At pH 3, gelatine of OAAO extracted pectin was possible at low polymer (0.2%) and standard sucrose concentration (60%). OAAO extracted pectin exhibited the highest gelling ability. With a higher storage modulus, based on their gelatine kinetics, ambarella pulp was more suitable than mango pulp for jam preparation. Mango and ambarella jams exhibited very strong gel ($G' = 5000$ Pa) behaviour with OAAO extracted pectins. Thus, OAAO is a good extracting agent allowing the recovery of high yields of mango and ambarella peel pectins with excellent gelling ability which improves the visco-elastic properties of jams prepared from these fruits.

INTERFACING FEEDSTOCK LOGISTICS WITH BIOENERGY CONVERSION

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CSBE101347 – The objective of this research was to develop tools to investigate the interface between biomass production and biomass conversion platforms: Assemble functional relationships in a modeling platform that would simulate the flow of biomass feedstock from farm and forest to a densification plant. The model also maintains an account of key properties of biomass for downstream pre-processing and conversion. These properties would include composition (moisture content, cellulose, hemicelluloses, lignin, ash), particle size, specific and bulk densities. The model would simulate logistical operations such as grinding to convert biomass to pellets. The pellets are supplied to bio-refinery for conversion to heat, power, or biofuels. We have already developed equations that describe the physical aspects of each unit operation. We will demonstrate the effect that each of the process variables would have on the efficiency of the conversion processes. In the first instance we used properties that are important for producing durable solid biofuels.

MODELING OF SOIL FLOW FOR TILLAGE TOOLS, SEEDERS AND PLANTERS

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CSBE101349 – Few virtual soil bins were developed at CNH to model the soil flow around the tools for tillage, planters and seeders. These soil bins were created using the Discrete-Element Method (DEM) that can also be linked with computational fluid dynamic (CFD) if necessary to include air flow. Soil properties (sand, loam, clay and mixed soil e.g. clay-loam), stubble conditions (roughness, stubble thickness, roots, stones, clusters,...) and tool geometries were imported in the software to recreate realistic desired conditions. Models are validated with field and lab tests. Different soil bins were developed, in particular for wear test, draft test, deep tillage, stone impact on tool, soil fracture, seed and fertiliser placement.

APPLICATION OF DISCRETE ELEMENT METHOD (DEM) SIMULATIONS AS A TOOL FOR PREDICTING TILLAGE TOOL WEAR

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CSBE101350 – The number of instances the discrete element method (DEM) is being employed in research is steadily growing. The ability to apply this type of simulation to wear studies would be extremely beneficial as a time and cost-saving tool. Not only would typical studies be easier to perform, but the complexities of a tillage tool wear scenario could be more easily controlled and results of a variety of tests could be more easily obtained. The objective of this study was to investigate the possibility of using a DEM simulation to recreate the results of a physical wear test conducted within a rotary soil bin. The benefit of a DEM model is its ability to model granular particles such as the soil medium. By analyzing forces and particle speeds, an approximation of actual wear conditions can be achieved. Cylindrical bars of aluminum, operating in a soil bin environment, were simulated using 3D DEM software. Data collected from the model was compared to results from soil bin experiments which employed identical materials and conditions with the intent of creating a relationship such that further soil bin testing could be replaced by DEM simulations. Predicted values of compressive force followed the anticipated trends as higher forces on the bottom of the tool correlated to higher wear rates. The application of the simulation results showed promising levels of correlation to experimental wear data.

EFFECT OF SILVER NANOPARTICLES ON SEED PROTECTION IN DIFFERENT SOILS

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CSBE101351 – To investigate the possibility of using silver nanoparticles for protection of a living organism, wheat seeds were coated with these particles and planted. If germination of seeds is not affected by this new nano-treatment, the method can be used on a wide range of common treatment for seed protection. The effect of treatment on seeds with this particle protection against fungi was compared with seeds treated with a conventional preplanting fungicide (Carboxitiram). Being that soil is the most common medium for plant growth in agriculture, this can play a major role in plants life and their relationships with other factors in the field. This study looks at the effects of different soil conditions on pre-treatment. The effect on soils with different levels of nutrient, pH and humidity were investigated. Results showed that soil conditions have little affect on seed protection with silver nanoparticles against fungi, and protection is completely independent of soil conditions. Results showed that silver nanoparticles do not reduce seed germination. In other words, seed viability is not significantly affected. Moreover, seed protection cost with Silver nanoparticles and Carboxitiram was not significantly different. This effect is completely independent of soil conditions regardless of levels of nutrients, pH and humidity.

MODELING OF CROP FLOW IN COMBINE CHOPPER AND SPREADER

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CSBE101355 – Understanding the flow of straw in a combine chopper and spreader is an old challenge. Manufacturers typically perform field tests to measure the power requirement to chop and spread the material versus the quality of chopping (length-of-cut) and homogeneous distribution of chopped residues across the cut width. Analytical and empirical crop flow models were developed over the years to visualize the effect of chopper knife geometry (dimensions, angle of attack, knife density, thickness, speed, diameter, bevel angle, etc.) and spreader geometry (number of drums, paddles, angles, speed, exit angle, cover, etc.). Different types of models (analytical, empirical, stochastic and Discrete-Element Method) are used to model the cutting of particles by the chopper, discharging a mat of material, acceleration/ redirection and spreading of the particles on the field. The overall objective is to model various types of choppers and spreaders and create virtual benchmarks validated with physical assemblies. Special tests are made in the laboratory and in the field with high-speed cameras and field apparatus to validate the models.

A FULLY INTEGRATED MARINE ENVIRONMENTAL AQUACULTURE RECIRCULATION SYSTEM (MEARS™) IN CONJUNCTION WITH THE ENVIRONMENTAL RECIRCULATION OF WASTE

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CSBE101356 – In a Marine Environmental Aquaculture Recirculation System (MEARS™), for a landbase total recirculation abalone farm, there are two distinct periods of seawater parameters that need to be managed. The day rate when abalones are mainly inactive requiring less seawater maintenance than the night rate when abalone are most active requiring far more seawater maintenance. It's uneconomical for a business to operate staff on a 24 hour 7 day shift and we need to rely on today's technology in order to maintain live stock. In order to maximize the company's profit, better equipment, that works in ways that have not been normally used, in the aquaculture industry is necessary. This means, testing water parameters, controlling equipment, monitoring, recording data and the use of fuzzy logic in the event of changing parameters. All this must be on a real time basis and accessible from anywhere in the world. In the 21st century, better environmental aquaculture practices along with increased demand for seafood requires the rethinking of waste production matched with recirculation of seawater. This process, along with the normal process of providing the right parameters for production becomes a total integrated system. A new combined system that covers all aspects of the operations (seawater parameters, feed requirements, environmental issues, reduce operating cost and improved data management) provides the ability to enhance aquaculture farming operations to maximize both production outputs and profitability. This paper will identify process improvements in the fields of; designing; controlling; maintaining; recording data; automation IT; environmental operations and the economical cost benefits for the aquaculture farming industry.

STABILITY OF NANO-EMULSIFIED LYCOPENE UNDER THERMAL PROCESSING

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CSBE101357 – The stabilization of lycopene in food preparation and processing is a challenge for the development of functional foods and ingredients in the food industry. Soy-protein was used as emulsion carrier, and a non-emulsified lycopene sample was used as control sample in the present study. The stability of lycopene by nano-emulsion technology was evaluated under different thermal conditions. The first order kinetic model was used to monitor and reveal the changes of stability and antioxidant properties of nano-emulsified lycopene during thermal processing. The samples were heated for 5, 10, 15, 20, 25 and 30 min at temperatures of 60, 70, 80, 90, 100, and 120°C, respectively. The experimental data showed best fitting on the first order kinetic model with coefficient constant value (R^2) greatly than 0.91. The degradation of both contents and antioxidant properties of lycopene were observed during thermal process at high temperatures and long process times. In comparison of non-emulsified samples, the nano-emulsified samples were significantly more stable in both their content and antioxidant properties during thermal processing. Moreover, no significant changes were observed to their stability in regards to nano-emulsified samples under treatment at temperature of 60 to 80°C for 5 to 30 min. The results showed that the stabilization of lycopene by nano-emulsion showed a great potential for functional food applications.

DESIGN, FABRICATION AND EVALUATION OF A MOBILE ROBOT FOR GREENHOUSE SPRAYING

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CSBE101358 –Chemical application of nutrients and pesticides is one of the most important and dangerous processes in agricultural production. By using robots, it is possible to reduce human exposure to pesticide application risk. The aim of this research was the automatic spraying of plants in greenhouses. Therefore, a three-wheel differential steering mobile robot was designed and built to act as a greenhouse sprayer. Power was transmitted from two DC motors to two driver wheels through a gearbox and shaft system. Six ultrasonic sensors were used to produce guidance signals for the robot. A proportional controller was developed and installed for controlling the left and right motors, which navigate the robot through the aisle ways using range information provided by ultrasonic sensors. After design and fabrication, performance of the robot was evaluated using the developed controller inside a real greenhouse with 98 cm aisle widths and concrete floors along a U-shaped path at three speeds. Also the spraying, central station, safety and obstacle detection units of the robot were evaluated. Tests results showed that the average of RMSE of the robot position were 4.93, 5.34 and 6.51 cm at speeds of 15, 25 and 35 cm/sec respectively. By increasing the speed, RMSE of the robot position increased. Also turning radius and turning space of the robot at the end of aisles increased by increasing the speed. The performance of central station, safety and obstacle detection units of the robot were acceptable. The accuracy of spraying unit in “spraying” was 99.47 % and in “not-spaying” was 99.92 % that are acceptable for greenhouse applications.

COMPARISON OF FUZZY LOGIC AND CLASSIC CONTROLLERS' PERFORMANCE IN GUIDING OF A GREENHOUSE APPLICATIONS ROBOT

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CSBE101359 – In recent years many studies have been carried out to develop robots for agricultural applications. The aim of this research was to build a mobile robot for greenhouse applications. Many of the studies used from fuzzy logic control (flc) to navigate the robots. But it is possible to use a form of classical control functions for agricultural robots guidance. The question is which type of control has better performance? The objectives of this research were: 1) To find the best controller type for the robot 2) To find the best position for installing the driver wheels. A fuzzy logic-based and a proportional type controller were developed and tested for guiding a prototype mobile robot inside a real greenhouse through a straight aisle with 115 cm width using three speeds (15, 25 and 35 cm/sec) on a concrete surface. At first the robot performance was evaluated based on the driver wheels at front (dwf) mode with two types of controllers and the best controller was determined. After that the robot performance was evaluated in driver wheels at rear (dwr) mode with the best controller, and the best position for the driver wheels was determined. Experiments results showed that the proportional controller performed better than the fuzzy logic-based controller at all speeds. [...].

A NOVEL SINGLE-STEP ROUTE BASED ON SOLVOTHERMAL TECHNIQUE TO SHAPE-CONTROLLED TITANIUM NANOCRYSTALS

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CSBE101360 – A novel single-step route based on a solvothermal technique has been developed for the preparation of highly crystalline TiO₂ nano-crystals exhibiting different shapes such as rhombic, truncated rhombic, spherical, dog-bone, truncated and elongated rhombic. Using water vapour as the hydrolysis agent to accelerate the reaction and both oleic acid and oleylamine, which act as two distinct capping surfactants to control the growth of the TiO₂ nanoparticles, are essential features to permit the generation of uniform TiO₂ nanocrystals. Furthermore, we also show that the presence of an appropriate amount of water vapour along with the desired oleic acid/oleylamine molar ratio plays a crucial role in controlling size and shape of TiO₂ nanocrystals. These nanocrystals have potential applications as photocatalysts and photovoltaic cells.

MECHANICALLY-AIDED HARVESTING OF ARTICHOKE WITH AN ELECTRICALLY PROPELLED PROTOTYPE

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CSBE101362 – Harvesting operations account for as much as 40% of the total production costs in Globe Artichoke. The edible heads are harvested exclusively by hand, machine harvesting being hindered by an extended harvest maturity. Many passes through the fields are required over the season to complete the job. The pickers move through the rows cutting the mature heads and placing them in sacks carried along the field. Work efficiency can be increased employing machinery to move the produce in the rows and out of the field. A variety of over the row high ground clearance equipment can be employed to aid artichoke harvest (tractor, self-propelled machinery, conveyor belt). To improve labour efficiency an electrically propelled over-the-row harvesting prototype was developed at the CRA-ING “Agricultural Engineering Research Unit”. The machine is operated by the use of foot controls, so that the operator can pick artichokes while driving over the row and accumulates produce on a wide loading platform. In field tests, hand and machine-aided harvesting were compared. After adequate training the driver learns to pick at the same rate of ground harvesters, thus improving the ratio of pickers on total field workers and consequently reducing work time (h/ha) up to 40%. Time loss due to field stops and to walking non-working distance for unloading the sacks is avoided. The hourly productivity (n° heads/h) of the crew in mechanically aided harvest is 73% higher than in hand harvesting. On the whole, harvesting yield is improved by a 65%.

WOLFFISHES, IDEAL SPECIES FOR INTENSIVE AQUACULTURE: REARING DENSITY AND WELFARE ASSESSMENT

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CSBE101364 – Size-dependent stocking density is considered a priority topic in aquaculture research due to its incidence on the welfare of farmed fish and the need for future recommendations governing stocking density of novel fish productions. It is also mandatory for the evaluation of production costs aimed at profitable farm operations, especially when land-based recirculation technology is the favoured rearing strategy. Spotted wolffish is a promising marine fish species and a candidate species in Quebec, Canada. Wolffishes displays strong domestication traits including a “low-stressed” behaviour. Reports on the physiological responses to stressors of spotted wolffish are scarce and stocking density recommendations for small size fish (range of 50-200g) are not yet available. A first trial evaluated the growth response of 50-100g juvenile wolffish to increasing densities (10, 20 and 40 Kg·m² in duplicates) in order to identify the preferred range of density to evaluate more closely. A second trial was conducted in triplicates at fixed densities (20, 30 and 40 Kg·m²) on 100-170g fish. Growth was only slightly impaired in the increasing densities trial where final densities reached >50 Kg·m². Acute stress challenge tests were conducted at the end of the growth trials. Cortisol, ionic composition, HSI, hematocrit, plasma protein and water content (liver and muscle), lysozyme activity were measured. Sedentary [...].

AIR POLLUTION AND LIVESTOCK PRODUCTION

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CSBE101366 – The air in a livestock farming environment contains high concentrations of dust particles and gaseous pollutants. The total inhalable dust can enter the nose and mouth during normal breathing and the thoracic dust can reach into the lungs. However, it is the respirable dust particles that can penetrate further into the gas-exchange region, making it the most hazardous dust component. Prolonged exposure to high concentrations of dust particles can lead to respiratory health issues for both livestock and farming staff. Ammonia, an example of a gaseous pollutant, is derived from the decomposition of nitrous compounds. Increased exposure to ammonia may also have an effect on the health of humans and livestock. There are a number of technologies available to ensure exposure to these pollutants is minimised. Through proactive means, (the optimal design and management of livestock buildings) air quality can be improved to reduce the likelihood of risks associated with sub-optimal air quality. Once air problems have taken hold, other reduction methods need to be applied utilising a more reactive approach. A key requirement for the control of concentration and exposure of airborne pollutants to an acceptable level is to be able to conduct real-time measurements of these pollutants. This paper provides a review of airborne pollution including methods to both measure and control the concentration of pollutants in livestock buildings.

EMPTY DRAIN AND THE WATER LEVEL AT MIDWAY BETWEEN THE DRAINS. ASPECTS REGARDING MANAGEMENT

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CSBE101372 – Standing water above drains as a result of a submerged drain outlet, promotes flow conditions so that there is a smaller rise in the water table height at midway between the drains. This case has been studied through theoretical analyses by van Deemter (1950); Childs (1958), Kirkham(1958); Santos-Júnior (1971); Wessseling (1979) and Gammal *et al* (1995). In this paper the numerical results from DRENAFEM software package simulator are compared with the theoretical analysis of Santos-Júnior (1971). The software uses a finite element analysis to solve the Richard's equation. Several simulations were performed with a small drain radius, and with a back pressure in the drain outlet to achieve a high entrance resistance and promote the rise of the water table at midway between the drains. With the standing water above the drains, the theoretical and numerical results show a rise in the water table height which is smaller than the drain outlet pressure. This paper demonstrates how the software can be used to simulate the behavior of a water table under controlled drainage to determine the water table's position in situations with no analytical solutions, such as hydraulic conductivity anisotropy or in non-homogeneous soils with several layers.

ANAEROBIC CO-FERMENTATION PROCESS USING THE SWINE MANURE WITH ORGANIC BYPRODUCT

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CSBE101373 – The present study aims to develop a co-fermentation process using animal manure and organic by-products. The fermentation materials used were: swine manure only as a control, swine manure mixed with corn silage, and swine manure mixed with kitchen wastes. Two concentrations of total solid materials of 5 and 10% were used. The digested materials were analyzed before and after the experiments and the biogas generation was evaluated in terms of CH₄. The system is evaluated under continuous feeding with mesophilic temperature. Results indicated that increasing the total solid matter from 5% to 10% leads to increase the biogas generation from 0.389 to 0.556 L/L-d for swine manure only. Using the higher TS of 10% produced biogas of about 1.43 times more than that of low TS (5%). Mixing with the corn silage, the test has shown a gas production of 1.11 L/L-d for the level of TS 10%. It was two times more than that of the control. The test with kitchen waste has a biogas production of 1.01 L/L-d, which is close to the result of corn silage. Based on the organic dry matter (odm), a biogas production was 203, 362 and 216 L/kg odm-d for control, manure mixed with corn silage, and manure mixed with kitchen waste, respectively. Because the kitchen waste has shown relatively high odm contents, the gas production based on the odm was low compared to manure mixed with corn silage. The experimental results indicated that, utilization of organic by-products have enhanced the biogas production from anaerobic fermentation of animal manure up to 2 times.

VACUUM PYROLYSIS OF SWINE MANURE: BIOCHAR PRODUCTION AND CHARACTERISTICS

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CSBE101374 – Quebec caters to about 25% of swine production of Canada and tackles the swine manure generation via land spreading and conversion into fertilizer. However, the present regulations restrict the use of swine manure as fertilizer on a majority of farmlands due to phosphorus and nitrogen surplus problems. There are several existing treatment technologies to separate phosphorus and nitrogen from the organic-rich dry matter in swine manure, however, about 40% of the waste matter thus treated, still requires environmentally friendly disposal schemes. The present study investigated the technical feasibility of pre-treatment and value-addition of the swine manure solids into biofuels on a farm-scale basis using vacuum pyrolysis process. For this, a custom built stainless steel pressure vessel was used to carry out pyrolysis reaction of swine manure biomass in batch over a temperature range between 200 to 600 °C under vacuum. The vacuum was maintained between 200 to 400 mm-Hg. The pyrolytic vapour was condensed in two glass condensers in series and the biochar was collected directly from the pyrolysis vessel after the completion of the pyrolysis batch. The non condensable vapour and gases were considered as losses. The pyrolysis process provided four products, biochar, biooil, aqueous phase and gas mixture. Prior to the pyrolysis tests, the thermogravimetric analysis of the swine manure samples was conducted at three different heating rates, 4.2, 5.4 and 7.5 °C/min, which resulted into final temperatures of 238, 403 and 586 °C, respectively. The optimal pyrolysis temperature with respect to biochar was 238 °C, which resulted in a mass yield of 73, 9.6, [...].

DEM ANALYSIS OF THE SOIL-TOOL (SWEEP) INTERACTION

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CSBE101375 – The main function of the field cultivator is to prepare a proper seedbed for the crop to be planted into, to bury crop residue in the soil, to control weeds, and to mix and incorporate the soil to ensure the growing crop has enough water and nutrients to grow well during the growing season. To achieve these goals, it is important to have a basic understanding of interaction between soil and tillage implements. The discrete element method (DEM) seems to be a promising approach for constructing a highfidelity model to describe the soil–implement interaction. Discrete Element Models were built in correspondence with the field tests. In the DEM, the interaction of the particles is treated as a dynamic process with states of equilibrium developing whenever the internal forces balance. In this paper we will introduce the methods of DEM approach used in developing a model for the prediction of draught force on cultivator sweeps and the final porosity of the soil. A verified DEM is a cheap and useful tool in the development procedure of cultivators and can be used to research and analyse the performance of resulting prototype. There are some factors that we can determine such as the soil and the cultivator tools. The influences of cultivator sweep geometry was researched by the DEM and compared to results of soil bin tests to validate the sweep shares. With the results of the methodology it is possible to validate the optimal β angle of the sweep in a 2D model.

MIGRATION OF PERFLUORINATED COMPOUNDS FROM ANTISTICK COATING TO FOOD PRODUCTS DURING COOKING PROCESSES

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CSBE101376 – This presentation proposes an overview related to the use of perfluorinated anti sticking coating in the case of food preparation, and to the potential residue levels of these contaminants in selected food products. These anti sticking coatings are widely used in the industry. A limited amount of literature exists on the real risk factors related to transfer of fluorinated compounds to food. This presentation will be introduced by a literature review on this topic. Recent results obtained with commercial pans purchased in local supermarket will be presented. Successive cooking of water and of pancakes (used as model foods) has been done. Highly sensitive measurement methods based on LC-MS/MS and/or LC-HRMS have been developed for determination of 13 perfluorinated compounds (including PFOS and PFOA) in the tested samples. Note: This research project has been co funded by the Région Pays De Loire within the AISQAL project (2007-2010). This presentation is done within the frame of the AGRIFOODRESULTS European project (FP7- Grant Agreement 226927) aiming at communicating the results of European projects toward the industry. It does not necessarily reflect the views of the European commission and in no way anticipates the Commission's future policy in this area.

IMPACT OF BREAD MAKING PROCESS ON QUALITY PARAMETERS, NUTRITION, PARAMETERS AND ENERGY DEMAND; KEY RESULTS FROM THE EU-FRESHBAKE PROJECT

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CSBE101377 – This presentation proposes an overview of bread making technologies applied to industrial bread production. A focus is proposed on the use of refrigeration to extend the shelf life of bread products; this concerns the BAKE-OFF-TECHNOLOGY which allows the production and marketing of freshly baked breads and specialities made from industrial frozen (and non frozen) bakery preparations. Selected results from the European funded project “EU-FRESHABKE” (Sept 2006 – Nov 2009 – 12 partners) will be presented: impact of post baking chilling conditions on product quality, impact of freezing on the thermomechanical behaviour of bread crumb and the impact of freezing on bread aroma, impact of baking process on the glycaemia index. A focus will be done on the impact of the processing conditions on the energy demand. Some innovations have been developed during this project among which several solutions to save energy during baking and refrigeration. These solutions will be briefly introduced. They highlight the importance of having knowledge on both products and processes and the interaction that might occur between product and process.

AFFECT OF DROUGHT ON POLLUTION OF LENJ STATION OF ZAYANDEHROOD RIVER BY ARTIFICIAL NEURAL NETWORK (ANN)

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CSBE101378 –ABSTRACT Iran is one of the most arid countries in the world. In recent years due to planetary climate changes, precipitation reduction has been observed. Rivers provide one the most important domestic water resources as well as agricultural consumptions and are affected by the reduction in rainfall. The amounts of salts in the rivers are increasing and threaten living organism. Therefore prediction of salt quantities in the river based on rainfall reductions is necessary. Three years information of Lenj station was used at Zayandehrood River in this research. The monthly precipitation considered as the input and the river pollutants as output. Modeling with ANN was done and the result showed that discharge, EC & TDS with Root Mean Square Error 9.56 m³/s, 0.11 dS/m and 84.5 mg/lit respectively depend on rainfall in the case stationed directly.

OHMIC HEATING BEHAVIOR AND ELECTRICAL CONDUCTIVITY OF SOLID FOODS USING LOW AND HIGH FREQUENCY POWER SUPPLY

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CSBE1013682 – Ohmic heating is considered as a potential alternative to conventional heating processes. The heating occurs when an electric current passes through food, resulting in fast heating and short process times. In this study, experiments were conducted using an ohmic heating unit under different conditions: food materials, power frequency, high temperature and pressure. The experimental system consisted of a Teflon cylindrical cell (190mm length, 70 mm diameter, and 33 mm wall thickness) with two titanium electrodes, a power control unit with high frequency power source, and a data logger with several thermocouples. Fresh foods were cut (10-20 mm cubic particles), blanched (100°C for 3 min), blended in small particles (<5 mm), and then were put into the heating cell for tests (about 750 g). Under regular power (60 Hz), the EC of the ranked foods was as: radish > chicken breast > pork muscle > potato > carrot > beef. A higher frequency resulted in a larger EC, e.g., potato EC at 20 kHz was about 1.5 times of that at 60 Hz. There was a temperature peak at 100°C because of pressure build-up inside the cell, but this phenomenon didn't appear when temperature was raised to 130°C under pre-pressurized condition (2 kg/cm²).

SPATIAL AND TEMPORAL VARIATION IN THE BIODEGRADATION OF ORGANOPHOSPHATE PESTICIDES IN AGRICULTURAL DRAINS AND RIPARIAN WETLANDS

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CSBE101384 – The biodegradation of the organophosphate pesticide chlorpyrifos (O,O-diethyl O-3,5,6-trichloro-2-pyridylphosphorothioate) in sediments from agricultural drains and riparian wetlands in San Joaquin Valley, California was investigated. Five agricultural watersheds were selected for inclusion in this study. The sites were chosen based on their diverse levels of riparian function and their inclusion in pesticide monitoring plans and other water quality studies. Stream sediments were collected, transported to the laboratory, and rates of chlorpyrifos loss were measured using a standardized aerobic biodegradation assay. Phosphoesterase enzyme activities were measured and related to observed biodegradation kinetics. First-order biodegradation rates varied between 0.38 and 0.02 day⁻¹. Sites showed temporal and spatial variation in observed biodegradation rates. Temporal variation included a seasonal trend that may correspond to stream primary productivity. The watersheds included in this study have similar cropping practices. Other factors, such as pesticide exposure histories, degree of riparian vegetation, and levels of in-stream primary productivity are being investigated as possible factors for predicting difference in biodegradation potential between watersheds. Phosphoesterase enzymes are known to be involved in biodegradation of organophosphate pesticides; however, relative phosphomonoesterase and phosphodiesterase activities were not reliable surrogate measures of relative chlorpyrifos biodegradation rates. [...].

COMBINATION OF NEAR INFRARED SPECTROSCOPY AND MULTIVARIATE ANALYSIS TO DETECT VALINE (C₅H₁₁NO₂) IN OILSEED RAPE LEAVES

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CSBE101385 – Valine (C₅H₁₁NO₂) is one of the most important amino acids in oilseed rape and has a close relationship with the influence of herbicide stress during growing stage. The traditional methods for amino acid detection were to use high performance liquid chromatography (HPLC) or amino acid analyzer. These methods were time consuming for preparation and detection, costly, laborious and not convenient for fast determination during each growing status of oilseed rape. Therefore, near infrared (NIR) spectroscopy (1100-2500 nm) combined with multivariate calibrations was investigated to determine valine in oilseed rape leaves under herbicide stress. The calibration set consisted of 186 leave samples, and the validation set consisted of 62 samples. Different preprocessing methods were compared, including multiplicative scatter correction (MSC), first-derivative (1-Der), second-derivative (2-Der), de-trending and direct orthogonal signal correction (DOSC). The optimal performance was determined by the PLS model with correlation coefficients (*r*) and root mean squares error of prediction (RMSEP). The optimal PLS model was achieved by DOSC spectra with *r*=0.9822 and RMSEP=0.0379. Successive projections algorithm (SPA) was recommended for variable selection procedure. After computation, the number of selected variables was 15, 17 and 1 for 1-Der, de-trending and DOSC spectra, respectively. [...].

MICROBIAL COMMUNITY ANALYSIS OF AMBIENT TEMPERATURE ANAEROBIC DIGESTERS

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CSBE101387 – To produce smaller and affordable digesters we modified designs for Chinese and Indian fixed-dome anaerobic digesters. While these types of systems are widespread in tropical regions of developing countries, they have not been implemented in colder climates in part due to the reduction in biogas yield during the winter months. While there is evidence that sufficient biogas production can be maintained in colder temperatures through design and operational changes, there is a lack of knowledge about the seasonal changes in the composition of the microbial communities in ambient temperature digesters. Increased knowledge in this area is necessary to design and operate systems for maximum biogas yield in temperate climates. The goal of this research will be to cultivate a microbial community that maximizes biogas production at psychrophilic temperatures. Microbial community response to ambient temperature changes was investigated using culture-independent methods on weekly samples collected from a 300 gallon experimental anaerobic digester on the campus of Ohio State University. Microbial community profiles were established using universal bacterial and archaeal primers that targeted the 16S rRNA gene. In addition to the methanogenic archaea, our analysis also targeted some of the other numerically and functionally important microbial taxa in anaerobic digesters including hydrolytic, fermentative, acetogenic and sulfate reducing bacteria. Preliminary results suggest a shift in microbial community composition with seasonal temperature variation with a decrease [...].

TEST BENCH FOR MECHANICAL DISTRIBUTION OF PREDATORS TO CONTROL INSECT PESTS

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CSBE101390 – In agriculture, chemical insecticides are widely used to protect crops from insect pests. Over the years, some insects like the Colorado potato beetle, *Leptinotarsa decemlineata* (Say), succeed in developing resistance to most of the registered chemical insecticides. In these cases, heavy applications of chemical insecticides to control this insect pest become ineffective on a long-term basis and can lead to serious health and environmental problems. The use of natural enemies to control the Colorado potato beetle represents an interesting alternative to chemical means. However, hand release of predators is not feasible at a large scale in the field. It is time consuming and even not conceivable. The main objective of this research study was to design and build a test bench to investigate the technical feasibility of mechanically releasing predators. The test bench consisted in a vertical chain conveyor mounted on two vertical shafts driven by an electric motor. Since the predators are very small and fragile, they were placed into a specially designed container to preserve their physical integrity. At one end of the container, a trap held closed with a hinge spring was installed. The container is then mounted on the chains using a sliding support. When crossing a plastic rail, the trap opens to allow predators dropping on the ground. Trials using this test bench showed that a carrier material is required since most of the predators cling firmly to the walls of the container and hence remain inside. When mixed with a carrier material, all the predators are successfully released. The success of this mass release [...].

IMPACT OF TEMPERATURE CONTROL STRATEGIES ON ANIMAL PERFORMANCE, GAS EMISSIONS AND ENERGY REQUIREMENTS FOR GROWER-FINISHER PIGS

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CSBE101391 – When grower-finisher pigs are housed within their thermoneutral zone, the feed energy required to maintain animal thermal comfort is at a minimum and their retained energy is at a maximum. Beyond the lower and upper limits of the thermoneutral zone, pig performance will decrease. A warmer building air temperature may increase ammonia emissions and building energy requirements for heating during cold weather conditions. The objectives of this study were to compare the impact of three control strategies of the temperature setpoint for grower-finisher pigs on the animal performance, ammonia emissions, and heating and ventilation energy requirements under Quebec conditions. The three control strategies were defined from the literature information and industry practices: 1) warm strategy (22.2 to 20.0°C); 2) intermediate strategy (21.7 to 17.2°C) and 3) cool strategy (21.1 to 14.4°C). Two 11-wk trials occurred in 12 environmentally controlled chambers each housing three grower-finisher pigs from 30 to 115 kg. Each temperature control strategy was replicated eight times over both trials. Pig weight and feed/water disappearance were measured once a week and the room air temperature, relative humidity, ventilation rate and gas emissions were continuously monitored by electronic sensors and gas analysers. On average, combining both trials, for the warm, intermediate and cool temperature strategies, the [...].

REDUCTION OF GAS AND ODOUR EMISSIONS FROM A SWINE BUILDING USING A BIOTRICKLING FILTER

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CSBE101392 – Animal housing can emit substantial amounts of aerial contaminants such as odorous compounds and gases. Since total ammonia and odour removal is not possible within the confined animal space, the remaining option is to remove these contaminants from the exhaust air. The air treatment at the exhaust of the building could thus play an important role in the reduction of atmospheric pollution due to swine production. Three laboratory-scale air treatment units (ATU) were developed and used to treat the air from three bench-scale pig chambers over two 4-wk trials. Methane, carbon dioxide and nitrous oxide emissions were evaluated using a gas-chromatograph while non-dispersive infrared spectroscopy and UV fluorescence techniques were used to measure ammonia and hydrogen sulphide emissions. Dynamic olfactometry was also used to predict odour emissions and the hedonic tone before and after air treatment. Gases were monitored on a continuous basis while odour emissions and hedonic tone were determined once a week. NH₃ emissions were reduced by 62 to 91% and H₂S emissions were decreased by 24 to 66% whereas CO₂ and CH₄ emissions were practically unchanged by the ATU treatment. N₂O emissions were increased by 100 to 700% after the air treatment. As for odour emissions, after 4 wks of operation, a 54 to 92% reduction was observed. The N₂O production as well as water consumption of the equipment are two of the elements which will be optimised during the next development stages of the system.

NITROGEN ESTIMATION OF OILSEED RAPE USING SPAD AND VIS/NIR SPECTROSCOPY

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CSBE101397 – The estimation of nitrogen status, non-destructively, in oilseed rape was performed using spectral reflectance with visible and near infrared reflectance spectroscopy (Vis/NIRS), and SPAD values of the oilseed rape leaves of 30 plots were measured by a SPAD 502 chlorophyll meter, and the research was carried out at experiment field in the Zhejiang University during growing season from 2007 to 2008. The SPAD 502 chlorophyll meter was applied to investigate the distribution rule of chlorophyll concentration in the oilseed rape. Regression model between the spectral reflectance and chlorophyll concentration (SPAD value) was built by partial least squares (PLS), the correlation coefficient (r), root mean square error of prediction (RMSEP) and bias in prediction set were 0.9368, 3.4992 and 1.834e-07. Correlation between the first derivative of spectral reflectance of oilseed rape leaves and chlorophyll concentration (SPAD value) were analyzed, and the results showed that good correlation coefficient was obtained in the range from 510 to 640 nm and 685 to 720 nm, and the maximum value for correlation coefficient was at the wavelength 707 nm. The linearity equation between the red edge index and chlorophyll concentration (SPAD value) was also analyzed, with the correlation coefficient of 0.986. It is concluded that Vis/NIRS combined SPAD 502 chlorophyll meter was a promising technique to monitor nitrogen status in oilseed rape.

DEVELOPMENT AND USE OF A WEB-GIS-BASED INFORMATION SYSTEM FOR THE MANAGEMENT AND SUPPLY OF HICKORY ENVIRONMENT CONDITION DATA

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CSBE101398 – Hickory is a kind of deciduous tree, belong to Juglandaceae Carya, China is hickory's origin. Its fruit has been the favourite of consumers for high nutritional value and the unique taste. Hickory needs suitable environmental conditions and must be planted at an altitude of 300 meters to 700 meters on hills. In this paper, we import Web-GIS to manage hickory environmental conditions based on the date. The system can analyze the date and offer direct-viewing, it can also give advises to the farmers on where it is best for hickory growing. The data included longitude; latitude; altitude; PH value; hydrolysable nitrogen; Olsen P and available K which was measured by every 5 kilometres in Lin'an (a city in Zhe-Jiang province in China) were used. This data was converted into map file format--shp by ArcView. And then geo-spatial interpolation techniques --- Kriging were applied to infer the value of unknown points in Lin'an's map. While the Web-GIS-Based Information System was developed by Mapserver (one of the open source WebGIS) and C# in Visual Studio 2008. In which farmers can click the points on the map to find the environmental conditions and if the place is suitable for hickory's growing.

IMPROVEMENT OF NUTRITIONAL BENEFITS IN FOODS BY INCORPORATION OF STARCH-ANTIOXIDANT ASSEMBLIES

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CSBE101402 – This project was Financed in part by the regional program AISQAL. AISQAL (Integrated approach of food quality and safety) is a research program supported by the 2006 call for proposals of the *Région des Pays de la Loire*. Coordinated by Patricia Le Bail (inra-Nantes), this program proposes an effective integration of concerted research in the entire food chain to ensure the quality and the safety of foods. Phenolic acids have numerous health benefits; they represent a major stake for the research and the industry. Indeed, their use can constitute an attractive alternative to synthetic antioxidants that are less acceptable to the consumer. The main objective of this work is to preserve the phenolic acids nutritional interest in food emulsions. An innovative strategy has been developed to incorporate the phenolic acids in the emulsion with the aim of protecting their nutritional properties in the aqueous phase. A protective assembly made of hydrocolloids (using starch in particular) is in charge of embedding the antioxidant. This molecular encapsulation has been studied by X rays diffraction and differential scanning calorimetry to better understand the interaction and the location of the antioxidant in the assembly. Ageing tests have been carried out to assess the stability of the system. This work demonstrates the importance of the timely incorporation of protective compounds and of health benefit substances during the production of a food.

EFFECT OF LONG TERM CROP ROTATION AND FERTILIZATION ON MOLDBOARD PLOW DRAFT IN A CLAY-LOAM SOIL

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CSBE101409 - A long term crop rotation and fertilization experiment was established on a clay-loam soil in 1959. Treatments included fertilized and non-fertilized continuous corn, and a fertilized and non-fertilized four year corn-oat-alfalfa-alfalfa crop rotation with all phases of the rotation present in each year. Moldboard plow draft measurements were made with an instrumented research tractor in conjunction with fall plowing over a six year period from 2004 to 2009. The continuous corn with no fertilizer plot consistently had the highest plow draft, and in one year, it was more than twice that of any other plot with a corn crop. Moldboard plow draft for non-fertilized rotation corn was higher than that for fertilized rotation corn. Draft for fertilized continuous corn was higher than for fertilized rotation corn. Fertilized alfalfa had higher draft than non-fertilized alfalfa. The above trends were consistent over the six year period, although the differences were not always statistically significant. The differences in moldboard plow draft were attributed to differences in soil structure which developed under the different management practices. The data clearly demonstrate the importance of good soil and crop management on maintaining a healthy soil.

TILLAGE AND PLANTING ENERGIES FOR CORN PRODUCTION UNDER THREE TILLAGE SYSTEMS ON A CLAY-LOAM SOIL

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CSBE101414 – Diesel fuel for field operations represents a major portion of total energy input for crop production. Of these, fuel for tillage is generally the largest. Energy measurements for tillage and planting were made on the corn phase of an existing field experiment with a corn-soybean-winter wheat rotation on a clay-loam soil. Three tillage treatments were used, conventional till, zone till and no till. Conventional till consisted of fall moldboard plow followed by two cultivations in the spring. For zone till, 200 mm wide strips spaced on 760 mm centers were tilled in the fall and the 560 mm wide strips between the tilled zones were left untilled. In the following spring, corn was planted directly into the tilled strips without additional tillage. For no till, corn was planted directly into the previous year's winter wheat stubble. Drawbar energy data for tillage and planting operations were acquired with an instrumented research tractor over a three year period. Total drawbar energy consumption over the three year period ranged from 185 to 266 MJ/ha for conventional till, 54 to 83 MJ/ha for zone till, and 12 to 16 MJ/ha for no till. Tillage and planting energy represents only part of the total energy input for corn production, but nevertheless, the data reveal opportunities for substantial energy savings by selecting energy efficient tillage systems. Other energy intensive inputs (e.g. fertilizer and grain drying), and the resultant yields need to be included to determine the total energy cost per ton of corn produced.

NEW BUILDING CONCEPTS FOR SUSTAINABLE SWINE PRODUCTION IN QUEBEC: A SYSTEMATIC REVIEW

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CSBE101415 – The Québec swine industry generates major economic spinoffs for the province (\$3.1 billion in 2008, FPPQ 2009). However, it has gone through some slow periods in the past few years, particularly due to its social and environmental impacts. This project's objective was to establish, through a critical literature review, the best practices and technologies available for the design of a green swine building adapted to the Québec livestock farming context and in agreement with the general principles of sustainable development (economic, environmental and social aspects). Thus, a research strategy inspired by the approach developed by the National Institute for Health and Clinical Excellence of the United Kingdom (NICE 2007) was developed for six niches: animal nutrition and welfare, materials, control of atmospheric emissions, waste treatment, energy efficiency and architecture. This approach allowed the authors to identify several hundred titles, abstracts and articles for each niche, with the assistance of specialized databases (Dialog, Cab Abstract, Biosis, Google Scholar, etc.). The documents were evaluated according to criteria of inclusion and relevance by a jury composed of several experts to identify and retain the most relevant structures. The authors thus will present, for each niche, the techniques and technologies that stand out for the design of future swine buildings. Based on the collected information, in the future, large group configurations (500 pigs and more) will become more popular [...].

REDUCTION OF ODOUR EMISSIONS FROM SWINE BUILDINGS: COMPARISON OF THREE REDUCTION TECHNIQUES

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CSBE101416 – Although several technologies have been developed to reduce odour emissions from swine housing, there is actually no official inventory that can be used to compare the reductions obtained with these technologies. The objectives of the present study were 1) to select from the literature the most promising technologies allowing odour emissions reduction; 2) to evaluate the selected technologies in an experimental barn and 3) to compare the emission reductions. A literature review listing all developed technologies was carried out. A list of criteria classified within six different categories (agronomic, economic, technical, environmental, use of resources and social & health) was used to assess the global potential performance of all those technologies. An experimental laboratory farm was then used to compare the selected technologies. The experiment involved five treatments: diet alterations, under slats separation system, a combination of diet alterations and under slats separation, biological air treatment and a control. Identical and independent chambers housing four growing-finishing pigs were monitored during seven weeks (3 weeks of accommodation and 4 weeks of testing). Odour concentration was evaluated weekly by olfactometry. Preliminary results showed that an appropriate diet can [...].

REMOTE SENSOR NETWORKS FOR PROTECTED CHRYSANTHEMUM PRODUCTION

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CSBE101419 – Chrysanthemum is a popular flower in Korea and Japan especially at funerals. Most chrysanthemums are cultivated in indoor facilities. The micro climate such as temperature, humidity, light, water, and nutrient are critical for yield and quality of chrysanthemum. Hence farmers must be present on the chrysanthemum facility to monitor and control growing conditions. To solve these problems and relieve the labour, remote sensor network for monitoring these environmental and operational factors would be a preferable option. In this research, a remote sensor network for protected chrysanthemum production was designed so that farmers could monitor the environmental factors at a distance. Important environmental and operational factors were selected and monitored through wireless sensor network (ZigBee & CDMA). Those factors were provided as control settings for the control of remote systems.

CHARACTERISTICS OF PADDY OPERATIONS WITH BIODIESEL FUELLED TRACTOR

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CSBE101421 – 20% biodiesel (BD20) and 100% biodiesel (BD100), alternative fuels for tractors, were tested for its power and competitiveness in the various paddy operations including plowing and rotary tilling in the paddy fields. Troubles such as no ignition or abrupt stopping were not monitored during operations of plowing, rotary tilling and travelling on the road. According to the tractor PTO test in accordance with OECD tractor PTO test codes, no significant PTO power difference was found between the three fuels. However, fuel consumption rates were quite different between the biodiesels and diesel fuel in the paddy works, when biodiesel content went up; fuel consumption rate went up too. About 35~40% more fuel was needed for rotary tilling operation than plowing operation. Within the operations, maximum difference occurred at rotary tilling of wet paddy and this difference was as high as 20%, between BD100 and diesel fuel, 5.45 versus 6.53 l/hr. Regarding exhaust gases, more CO₂ was discharged from diesel fuel than biodiesels, but more NO_x was discharged with biodiesels. It was difficult to differentiate CO quantities between the three different fuels.

REMOVAL OF PHOSPHATE AND NITRATE ANIONS FROM AQUEOUS SOLUTIONS USING AMMONIUM-FUNCTIONALIZED MCM-48: BREAKTHROUGH CURVES

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CSBE101423 – Adsorption using surface-modified mesoporous silica materials is a promising technique for the treatment of water and wastewaters. Indeed, the use of such mesostructured adsorbents offers a number of advantages over conventional adsorbents. These include their high surface areas, their open pore structures and the possibility of conferring them appropriate surface fictionalization leading to desired adsorption properties such as high capacity and selectivity. The present work is intended to study the adsorption process for phosphate (H₂PO₄⁻) and nitrate (NO₃⁻) aqueous solutions over mesoporous silica MCM-48 material modified with organic ammonium functional groups. The objectives are: i) synthesis and characterization the adsorbent, and ii) experimental optimization of the adsorption operating conditions in the continuous mode of operation. The adsorbent was prepared via a post-synthesis grafting method, using aminopropyltriethoxysilane, followed by acidification in HCl solution to convert the attached surface amino groups to ammonium moieties. It was then characterized using nitrogen adsorption and the BET analysis and powder X-ray diffraction. The breakthrough curves were measured in a packed bed column. The effects of experimental conditions such as flow rates, inlet anion concentrations and bed depth on breakthrough curves were examined. Results showed that breakthrough times and breakpoints decreased with increasing flow rates and inlet anion concentration. Moreover, increasing the bed depth increased the breakpoint and breakthrough times. Relative low pressure drop obtained allowed best equilibration of the fluid with the adsorbent and maintained the stability of the bed. Regeneration tests performed for phosphate anions showed that the column recovered its complete performances with no significant change in the breakpoint and exhaustion points even after three adsorption-elution-regeneration cycles.

VELOCITY OF CONVEYED SEEDS IN AN INCLINED TRANSITION TUBE

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CSBE101428 – An air-seeding cart is an important piece of farming equipment which is employed in the seeding process. It is used to carry fertilizer and seeds through the field and deliver them to an air hoe drill. Dilute-phase pneumatic conveying is used to transport those materials. An inclined transition tube is used to change the elevation of the conveying tube between the point of seed entry and delivery tubes. The flow of materials is disturbed by bends, altering the material velocity and acceleration profiles. Therefore, the seed flow behaviours through this transition tube needs to be understood. Vertical and 45° transition tubes were chosen for testing. Seed velocity, acceleration, and slip velocity in these transitions will be measured using imaging techniques and compared to model predictions and previous research.

NEW SOFTWARE FOR THE OPTIMAL DESIGN OF DRAINAGE NETWORK IN STEADYSTATE SUB-IRRIGATION CASE STUDY: GREONI-TICVANU MARE DRAINAGE ARRANGEMENT

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CSBE101429 – This paper presents the results of research conducted in Romania, at “Politehnica” University of Timisoara, Faculty of Hydrotechnical Engineering, Hydrotechnical Construction and Land Improvement Department, in drainage area after the VIII Drainage Congress from Sacramento, California, where we presented in a synthesized way the methodology and the results of drainage studies performed in Romania, on the main soils with humidity excess from the west side of this country (Timis, Arad, Bihor, Maramures and Satu Mare County). For an optimum and efficient technical-economic design of agricultural drainage (horizontal) networks, the calculations, that were presented in Sacramento, California, were laborious, this led to the realization of a software that allows the calculation of the distance between drains in steady-state regime and the verification of this operation in sub-irrigation. DrenVSubIR application is developed in Borland Delphi Pascal v7.0 programming system and was created for calculating sizes specific to drainage systems such as: determination of the distance between drains with the verification of operations in sub-irrigation. This paper presents block diagrams of three modules: “Drainage - Ernst Equation - David” module (for the calculus of resistance coefficient at water entry in drain tube, with and without filter); “Verifying Sub-Irrigation – David Equation” module (for the drainage verifying operation calculus in sub-irrigation) and “Drainage: Technical-Economic Calculation” module (for the specific investment calculus and for establishing the optimum technical-economic solution of drainage). As a case study, we are presenting the results Caras Severin County taking in consideration three types of soils with humidity excess situated in Caras Drainage Arrangement Area, left bank, Greoni Ticvanu Mare zone. (Ticvanu Mare, Fishery, Meadow).

THE SUCCESSIVE PROJECTIONS ALGORITHM FOR VARIABLE SELECTION ALIEN INVASIVE WEEDS CLASSIFICATION BASED ON VIC/WSNIR TECHNIQUES

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CSBE101446 – In this paper, the feasibility of visible and short-wave near-infrared spectroscopy (VIS/WNIR) techniques as means for the non-destructive and fast detection of alien invasive plants was applied. Selected sensitive bands were validated by successive projections algorithm (SPA) and soft independent models of class analogy (SIMCA) separately. The SPA- discrimination model measured and predicted Correlation coefficient is 0.926. And the SPA- SIMCA discrimination model measured and predicted Correlation coefficient is 0.931. The SPA- PLS-SVM discrimination model measured and predicted Correlation coefficient is 0.981. It was showed above indicated that the selected wavelengths validated by SPA can delegate the main characteristics of three weeds, including Veronica Persica, Veronica potita, Veronica arvensis Linn based on Vis/WNIR spectroscopy.

FAST DETECTION OF CRUDE PROTEIN CONTENT IN FISH FEEDS BASED ON INFRARED TRANSMISSION SPECTROSCOPY AND CHEMOMETRICS

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CSBE101447 – Infrared spectroscopy and chemometric methods were investigated to determine crude protein content in fish feeds fast and non-destructively. 15 different brands were prepared for infrared transmission spectroscopy measurement using a FT/IR-4100 Fourier Transform Infrared Spectrometer (350-7800 cm⁻¹). A total of 150 samples were randomly selected to create the calibration model, and the remaining 75, with similar distribution of crude protein content, were used to verify the model. Multivariate analysis techniques including partial least squares (PLS) and least square-support vector machine (LS-SVM) were developed to construct the crude protein component calibration models simultaneously. Grid research and leave one out cross validation procedures were employed for optimization of LS-SVM parameters. Compared with PLS, an eximious prediction precision was achieved based on LS-SVM with correlation coefficient (R) = 0.9955 and root mean square error for prediction (RMSEP) = 0.8918 based on mid infrared spectral data. Furthermore, the comparison of prediction results showed the performance of models with mid infrared (MIR; 400-3999 cm⁻¹) spectral data was better than that with near infrared (NIR; 4000-6666 cm⁻¹) spectral data. Based on this study, near/mid infrared transmission spectroscopy combined with LS-SVM could be promising to be applied as a simple and alternative way for the fast quantitative assessment of crude protein content in fish feeds.

A VARIABLE RATE GRAIN DRILL FOR PLANTING SEEDS TREATED WITH SILVER NANOPARTICLES

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CSBE101456 – Precision farming can be an effective tool to maximize output while minimizing input (i.e. fertilizer, pesticides, herbicides, etc) through monitoring environmental variables and applying targeted action. A new frontier for precision farming is plant protection with regards to seed protection. Silver nanoparticles can protect wheat seeds against fungi when used as a preplanting fungicide. Variable planting of regular & nano treated seeds based on static variability of pathogens in the field requires the use of a variable rate grain drill. Since variable grain drills are not commonly used, we set out to convert a regular grain drill into a precision grain drill in a simple, inexpensive & reliable way. For this purpose additional parts were designed & added to a conventional grain drill. The accuracy of planting with this planter was tested at variable speeds equal to 2, 4 and 6 rotations of the planter's drive wheel. According to the results, the reliability for this planter can reach 90% using appropriate rotation times.

STRUCTURAL PLANT MODELLING BASED ON REAL 3D STRUCTURAL PARAMETERS, RESULTING SIMULATION SYSTEM AND RULE-BASED LANGUAGE XL

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CSBE101457 – This paper presents a new method for producing a structural plant static model that simulates the details of the structure of individual plants, yet does not require detailed knowledge of underlying physiology. The example presented with this method in this study is the modelling of the tomato plant. This new structural modelling approach is based on linking a resulting simulation system representation of the static structure of the plant with real structural parameters and rule-based language XL (extended L-system language). The static model is built by applying the structural parameters of a tomato plant which is gained by using a 3D scanner, yet iteration is not under consideration in this modelling approach. The main advantage of the approach is that the 3D reflects the real structure of plant. This approach, combining real structural parameters, resulting simulation system and rule-based language XL, fills the important role of providing an intermediate level of representation between the two extremes of 3D dynamic modelling and purely 2D empirical modelling.

HERITAGE INTERPRETATION AND LANDSCAPE CHARACTER IN THE FORESTRY DISTRICT OF SERRA SAN BRUNO (CALABRIA, ITALY)

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CSBE101459 – The research presented in this paper was aimed at the characterization, interpretation and valorisation of the forestry landscape in a representative mountainous region of Southern Italy, located in the centre of Calabria (Italy). The integrated valorisation of the forestry resources and landscape was proposed for the development of youth tourism experiences based on environmental education. The traditional charcoal-production sites, where many vertical mound charcoal-kilns are still present and active, were chosen as the main interpretive key of the local landscape; they were linked - logically and physically - to the other territorial signs documenting the old monastic civilization, and to the main elements of the water-wood system and industrial archaeology (watermills, old iron factories and hydroelectric power stations, etc.). On the basis of a dedicated GIS implemented for landscape resource analysis and management, a network of Heritage Trails was defined so as to emphasise and actualize the multifunctional use of the forestry land in the area. The Heritage-Trail System proposed is the starting point for the design and creation of a thematic Wood and Water Ecomuseum in the study area, thus increasing awareness and participation in landscape valorisation on the part of the local community.

THE "VIRTUAL-CAGE CULTURE": CONTROLLING AND HARVESTING FISH USING BEHAVIOURAL CONDITIONING

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CSBE101460 – World-wide stock enhancement and marine ranching of invertebrates and fishes includes more than 100 species in over twenty countries. While stock enhancement represents the effort to improve annual recruitment of depleted stocks, ranching represents in addition, an effort to increase the annual yield of a species. Present sea ranching technology mainly involves raising juveniles in hatcheries and releasing them into the water to rely entirely on natural food. With fish stocking the control over the released fish is terminated. The released fish are captured with the same fishing technology applied to wild stock. A “Virtual-Cage Culture” technology for sea ranching and harvesting stocked fish is suggested. Juvenile fish are trained to associate acoustic signals with food. Trained fish are released to the sea or lake to grow on natural food and finally “called” back to a collection spot, trapped and harvested when they reach a market size. Control over the fish location and behaviour is maintained by periodic signalling the associated signals from anchored floating platforms or moving fishing boats and rewarding the fish which gather close to the sound source with a very little amount of food, thus maintaining their response. This technology could possibly increase the capture rate and the overall profitability of sea ranching. It offers new possibilities for aquaculture, using the open sea for high quality food production. The technology may be beneficial for the environment, fisherman and consumers. There are many issues to be dealt with for this technology to become economically and ecologically viable. Of these issues, the behaviour of the species of interest and the fish capture technology are of major importance. Using tilapia (*Sarotherodon galilaeus*) as a model species, we have studied the ability of this fish to be trained to associate acoustic signals with food [...].

THE DEVELOPMENT OF PROCESS MECHANIZATION PRODUCTION AND TECHNICAL SPECIFICATION OF THE ENTIRE PROCESS MECHANIZATION OF RAPE IN EASTERN CHINA

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CSBE101464 – Rape is the most important winter crop in China, however, the traditional production mode by manual labor has seriously hindered the production of Rape. This paper exposes the situation of rape production in East China regarding Mechanized Rape, scale of mechanization, main agricultural machinery and relative agronomy. Some restricted factors were compared and countermeasures were proposed to develop the entire mechanization process for production of rape. By analyzing the current situation of rape production, this paper puts forward the technical specification of the entire mechanization of rape production. It also details key technologies, the standards and the requirements, as well as the available farm machines such as direct seeding, management, harvesting and drying, which is useful for promoting the entire process of automation production of rape in China.

PRODUCTION OF MICROSCOPIC ALGAE FOR ITS CONSEQUENT USE AS AVIATION FUEL

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CSBE101467 – We aimed to produce algal oil from algal cultures and use it as aviation fuel, more precisely as jet fuel, on an industrial scale. Aviation fuel has a huge market in the aviation industry in Japan, and the annual demand for aviation fuel is 12 million KL. In the near future, algal oil as a biomass fuel must represent 3%, 5% and 10% of total annual demand, by 2011, 2013, and 2020, respectively for ensuring compliance with the cap-and-trade environmental policy of the European Union. In this study, we used a microscopic algae *Euglena gracilis* with a lipid concentration of approximately 20%. The extraction residue contains a high-density protein that can be effectively used in animal fodder or food. The summarized results of our study are shown as follows: 1) The electric power supply of light required for the cultivation of *E. gracilis* ranged from 180 mw to 900 mw for 4 L of bioreactor medium. 2) The maximum quantity of photons required in the cultivation liquid was 2 microeinstein·s⁻¹·m⁻². 3) During the start-up period, the light intensity required for the cultivation of *E. gracilis* was less than 1 microeinstein·s⁻¹·m⁻². 4) Continuous harvesting in high yields of *E. gracilis* kept the density of the dry matter of *E. gracilis* between 0.5 g/l to 1.5 g/l. 5). The cultivation liquid used for the cultivation of *E. gracilis* should be effectively sterilized by maintaining a low pH level by blowing CO₂ into the liquid.

PHOSPHORUS REMOVAL AND RECOVERY FROM HIGH CALCIUM HOG LAGOON SUPERNATANT USING A GRAVITY SETTLED STRUVITE REACTOR

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CSBE101468 – In Canada, the majority of swine waste is stored in open lagoons and land applied according to crop nitrogen requirements. This practice over-applies phosphorus (P) two to five fold, leading to runoff and a loss of P to the environment. Removing P from liquid hog wastes is an important step in correcting the N:P ratio of manure applied to cropland. Reclaiming this P as struvite (MgNH_4PO_4) would ease environmental concerns of eutrophication, provide a saleable fertilizer, and help address the limited global supply of phosphate. Most struvite reactors are capital and operationally intensive, making the process too expensive to be implemented by the average farmer. In addition, high calcium levels found in some supernatants compete with Mg and struvite formation is impaired. We have used a low energy, low capital approach to P removal by employing two 400 litre gravity settled batch reactors. Lagoon supernatant with total phosphate (TP) concentration of 190 mg/l and pH of 6.7 was adjusted to pH 8.5 and allowed to settle with no addition of magnesium chloride. Results show TP was reduced by 70%, total suspended solids by half, and soluble P was reduced by 90% (94.5 to 10.3 mg/L). Particulate mineral forms of P were removed from the liquid (reduction from 83 to 26 mg/L), perhaps by flocculation. The dried precipitate had a TP concentration of 5.6%, total nitrogen of 6.3%, and potassium of 3.8%. Struvite content in the dried sludge was estimated at 30% and calcium phosphates comprised the remainder of the mineral P compounds. Half of the precipitate was estimated to be organic solids. These results indicate nutrient rich supernatants with high SS are good targets for P recovery but product purity is a challenge.

TREATMENT OF DAIRY SOILED WATER USING A WOODCHIP FILTER

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CSBE101469 – Agricultural activities are main sources of nutrient inputs to European waters and, as a result, land spreading of dairy soiled water (DSW) is highly regulated by the EU Nitrates Directive (91/676/EEC) and the Water Framework Directive (2000/60/EC). Therefore smart, economical, low maintenance and green technologies for treating DSW merit investigation. This study on treating DSW investigated the performances of woodchip filters at three filter depths (0.5 m, 1.0 m and 1.5 m) - each with three replicates – and at two substrate loading rates. The filters comprised de-barked Sitka Spruce (*Picea sitchensis*) woodchips in 300 mm diameter columns. Dried DSW was reconstituted to 1 % (S1) and 3 % solids (S3) suspended solids (SS) concentrations and each DSW was applied to one set of 9 woodchip filters. The filters were loaded 3 times daily with 0.67 l of reconstituted DSW at a top surface hydraulic loading rate of 28 l/m²/d for 277 days (S1) and 197 days (S3). Average DSW influent concentrations were 12,167 mg chemical oxygen demand (COD)/l, 10,000mg SS/l and 235 mg total nitrogen (TN)/l for S1 and 34,418 mg COD/l, 30,000 mg SS/l and 542 mg TN/l for S3. Average SS, COD and TN removals of 99%, 95 % and 88 %, respectively, were achieved by the filters at both DSW loading rates, indicating that a filter depth of 0.5 m-1.0 m might be adequate for the high DSW loading rate. Pilot scale filters using on-site DSW are currently being investigated with early results proving positive.

CONCEPTUAL MODELING FOR THE DESIGN OF A COMPUTER-BASED TRACEABILITY SYSTEM

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CSBE101471 – The European Standard UNI EN ISO 22005:2007, which defines the principles and objectives of traceability, mandates each organization belonging to a food-and-feed supply chain to choose appropriate tools for the implementation of a traceability system. Literature points out that the most suitable tool for the implementation of a traceability system is a computer-based information system (IS). In the context of the life cycle of a IS, the phase known as ‘conceptual modeling’ makes it possible to define models describing information content and functions of the IS, without taking into account the particulars of coding it. In this paper, the Unified Modeling Language (UML) was used in the phase of ‘conceptual modeling’ to model the information content of traceability IS. This modeling language was proposed as an alternative to the entity-relation model (E-R) since it provides the conceptual modeling phase with the same language for both the information content modeling and the function modeling. An application of UML was carried out to a case study concerning nursery-chain traceability of certified citrus plants. The importance of ‘tracking’ and ‘tracing’ citrus-plant production arises from the need to limit the diffusion of plant diseases, e.g. the *Closterovirus Citrus Tristeza Virus* which causes one of the most damaging diseases in citrus orchards and is the most important pathogen associated with this crop and has detrimental financial effects.

A METHODOLOGY TO MANAGE ENVIRONMENTAL EFFECTS OF CROP-SHELTER COVERAGE

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CSBE101472 – There is a growing concern about sustainable use of territorial resources at both national and local levels. Enhancement of agricultural production, from one hand, and actions aiming at the prevention of environmental degradation, on the other hand, have to be monitored by using suitable land-use and environmental indicators within causal-chain framework models (e.g. Pressure-State-Response or PSR; Driving force-State-Response or DSR; and Driving force-Pressure-State-Impact-Response or DPSIR). Description and quantification of these indicators provide local authorities with suitable tools to carry out decisions apt to contain the impact on the environment within adequate thresholds by means of standards and regulations. Among intensive agricultural production, crop shelters contribute to the modification of the environment by acting on different factors. In this study some land-use and environmental indicators were defined within a causal chain framework suitable to the environmental management of crop shelters. A methodology based on the characterization of these indicators made it possible to define an index which describes the level of soil occupation over time due to crop shelters and could be used to manage the localization of protected cultivations. The methodology was applied in a highly representative protected cultivation area located in south-eastern Sicily (Italy). The results produce thematic maps of the indicators and index values in the different zones of the study area. Taking into account both the level of crop shelter coverage and its time modification, the index constitutes a basic knowledge for local authorities to deal with problems related to the reduction of the environmental impact.

PREDICTION OF MELON FRUIT FIRMNESS USING VIS/NIR DIFFUSE REFLECTANCE SPECTROSCOPY

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CSBE101473 – Visible/near-infrared reflectance spectroscopy has shown usefulness for measurement of fruit internal quality, which is related to the chemical components of the fruit, because it measures spectral diffuse reflectance of the fruit. However, VIS/NIR spectroscopy cannot provide satisfactory measurement of fruit firmness, which is associated with the physical properties of the fruit. Thus, the goal of this study was to explore the possibility to measure melon firmness using VIS/NIR diffuse reflectance spectroscopy that is the modification of NIR spectroscopy. Melon samples were taken at different development stages and different growing seasons. Calibration models were built using partial least squares regression (PLSR) with nine pre-processed spectral data and raw spectral data. The highest R^2 value of calibration was 0.759. It was believed that NIR diffuse reflectance spectroscopy was potentially possible to measure firmness of melon. Finally, performance of prediction models developed with the mixed data of melon samples produced in different season was demonstrated and discussed to show their scope.

MELON SOLUBLE SOLIDS CONTENT MEASUREMENT USING VIS/NIR DIFFUSE REFLECTANCE SPECTROSCOPY

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CSBE101474 – Visible/near-infrared diffuse reflectance spectroscopy for assessment of fruit quality is in intermediate level between simple reflection and transmittance spectroscopy in term of travel length of light. This study was aimed to assess the soluble solids content of muskmelon fruits using VIS/NIR reflectance spectroscopy. Muskmelon samples of the same cultivar were taken at the same growing area but in different seasons. Calibration models were built using partial least square regressions with nine pre-processed spectral data and raw spectral data. The calibration models from the spectral data collected using the diffuse reflectance spectroscopic technique showed good performance for assessment of melon SSC ($R^2_{\text{cv}} > 0.969$). But the models were unstable depending on the experiments that were conducted with the melon samples of different seasons. This can be a critical problem for practical application of the technique. New models were built with the mixed spectral data sets. In general, the performance of the models from the mixed data was improved. The coefficients of determination of prediction (R_p^2) of the model was in a range of 0.666~0.916 with the standard error of prediction as 0.58~0.80°Brix. The result shows that the model of mixed data has a possibility of multi-season use, if the model was developed using spectral data of melon of various seasons.

COLOR TEXTURE FEATURE ANALYSIS FOR ESTIMATION OF MELON INTERNAL QUALITY

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CSBE101475 – The net rind pattern and color of melon surface are important for a high market value of melon fruits. The development of the net and color are closely related to the changes in shape, size, and maturing. Therefore, the net and color characteristics can be indicators for assessment of melon quality as melon fruits develop. The goal of this study was to explore the possibility of estimating melon soluble solids content (SSC) and firmness by analyzing the net and color characteristics of fruit surface. The true color images of melon surface obtained in the equatorial region were analyzed with 18 color features and 9 texture features. Partial least squares (PLS) method was used to estimate melon internal quality using the color and texture features. In the prediction of melon SSC, the coefficients of determination of validation (R_v^2) of the models using the color and texture features were 0.84 (root mean square error of validation, RMSEV: 1.92 °Brix) and 0.96 (RMSEV: 0.60 °Brix), respectively. The R_v^2 values of the models for predicting melon firmness using the color and texture features were 0.64 (RMSEV: 4.62 N) and 0.79 (RMSEV: 2.99 N), respectively. In general, the texture features were more useful for estimating melon internal quality than the color features. However, to strengthen the usefulness of the color and texture features of melon surface for estimation of melon quality, additional experiments with more fruit samples of different varieties need to be conducted.

INSHORE RECIRCULATING SYSTEM FOR THE PRODUCTION OF MARINE FINFISH

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CSBE101477 – The Sustainable Marine Aquaculture System Facility was established by the USDA Agricultural Research Service in collaboration with Harbor Branch Oceanographic Institute / Florida Atlantic University to improve the efficiency and sustainability of recirculating aquaculture systems for the production of inland warmwater marine fish. The systems have been utilized for the research production of Florida pompano and red drum marine finfish. The water treatment and recirculating aquaculture systems used for juvenile and production studies of the project include: (1) the incoming saltwater and freshwater primary treatment system and 10 m³ storage capacity; (2) the 10 tank (1 m³ volume each) low-head fingerling production system design that utilizes a 0.7 m³ polygyser and low-space moving bed bioreactor for solids removal and nitrification; (3) the 9-tank (1 m³ volume each) hybrid low-head fingerling production unit that utilizes air injection foam fractionation, paired tank moving bed torrus filters (0.11 m³ each), and microscreen rotary drum filtration (40 µ); (4) a 43 m³ low-head production system with four replicated systems each with 4 tanks (7.8 m³ each), a microscreen rotary drum filter (40 µ) for primary solids removal, static filters for additional solids and biofiltration, and a long-flow pathway moving bed biofilter and; (5) a 45 m³ system with four replicated systems of 4 tanks each (7.8 m³ each), microscreen rotary drum filtration (40 µ), two propeller-wash floating bead filters (0.7 m³ each), oxygen cone for oxygen supplementation, degassing towers, UV sterilization. [...].

EVALUATION OF THE EFFECTIVENESS OF AN ANTIMICROBIAL AIR FILTER TO AVOID PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME VIRUS (PRRSV) AEROSOL TRANSMISSION, AFTER 16 MONTHS OF EXPOSURE TO A COMMERCIAL SWINE ENVIRONMENTAL CONDITIONS

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CSBE101478 – The objective of this study was to assess the effectiveness of Noveko's antimicrobial filter after 16 months of exposure to commercial swine production environmental conditions. An adaptation of the experimental design and scale model of a commercial swine finisher was used for this experiment. The facilities consisted of 2 chambers (1.3 m x 1.3 m x 1.8 m) connected by a duct (0.65 m x 0.65 m x 1.3 m) containing the filters. A 5 kg PRRSV naïve pig was placed in reception chamber for a period of 6 hours after the aerosolization of PRRSV. Blood samples from pigs and swabs collected in the reception chamber before and after aerosolization were tested for the presence of PRRSV RNA and only blood samples were tested for PRRSV antibodies by IDEXX 2XR ELISA. The results of this study showed that there were no infected pigs (0 positive of 9 tested pigs) and no positive swabs. Therefore, the results of this study indicate that the technology used to integrate the antimicrobial agent into the filter fibers allows the filter combination to endure the actions of extreme weather and commercial swine production for at least 16 months and maintains its effectiveness to avoid airborne transmission of PRRSV.

HOW TO MANAGE LEGUME-RHIZOBIA N₂-FIXING SYMBIOSES AS ECOLOGICAL ENGINEERS?

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CSBE101480 – Legumes have the capacity to fix large amounts of atmospheric N₂ into the biosphere through their capacity to establish a symbiosis with soil rhizobia. However this legume contribution to the N biogeochemical cycle varies with the physico-chemical and biological conditions of the nodulated-root rhizosphere. In order to assess the abiotic and biotic constraints that might limit this symbiosis in an agro-ecosystem, a nodular diagnosis was performed in field-sites chosen with farmers of legume areas of production of the Mediterranean basin, with common bean as a model grain-legume, and a major source of plant proteins for world human nutrition. With this methodology a large partial and temporal variation in the legume nodulation was found in cereal-cropping systems. In various reference areas of bean production, the nodular diagnosis showed that low P availability of soils is a major limiting factor of the rhizobial symbiosis. The relation with engineering the legume symbiosis was further addressed by participatory assessment of bean recombinant inbred lines contrasting for their efficiency in use of phosphorous for symbiotic nitrogen fixation. In situ RT-PCR of candidate gene on nodule sections has been developed in order to relate the field measurements with functional genomics of the symbiosis. It is concluded that various tools and indicators are available for developing the engineering of the rhizobial symbiosis for its beneficial contribution to the biogeochemical cycle of N, and also C and P in various Mediterranean and temperate climates.

GRADE CLASSIFICATION AND PROTEIN CONTENT DETERMINATION IN MATCHA BASED ON VIS/NIR

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CSBE101481 – In order to analyze matcha green tea powder grade classification and predict the protein content of matcha with near infrared spectra quickly, 240 samples of 3 matcha brands were collected for Vis/NIR spectroscopy on 325-1075 nm using a field spectroradiometer. The spectral data was processed by chemometrics which was integrated with partial least squares (PLS), principal component analysis (PCA) and back propagation neural network (BPNN) models. 180 samples (60 with each brand) were selected to build training model, the remaining 60 samples (20 with each brand) were applied as the prediction set. Firstly, PLS models were developed with comparison of different spectral pre-processing by smoothing, standard normal variant (SNV), multiplicative scatter correction (MSC), first and second derivative. The best PLS models were obtained by SNV both for the grade classification and protein measurement. Secondly, the selected principal components (PCs) from pre-processed spectra by SNV or original spectra were used as the inputs of back propagation neural networks (BPNN) models. The prediction results showed that PCA-BPNN models with original spectra were better than PLS models. The recognition ratio of 100% was achieved in validation set for matcha samples of three different brands. Moreover, an excellent precision was obtained in validation set for predicting the protein content, resulting in correlation coefficient (R), RMSEP and bias of 0.954, 1.114 and -0.123, respectively. The overall results indicated that Vis/NIR combined with PCA-BPNN was successfully applied for the grade classification and protein content determination in matcha.

DEFINITION OF UNAMBIGUOUS CRITERIA TO EVALUATE TRACTOR ROPS EQUIVALENCE

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CSBE101482 – The Roll Over Protective Structure (ROPS) is still now the most diffused means to reduce the operator's risk in case of an agricultural and forestry tractor overturning. On the other hand, many tractor models are available on the market today, satisfying various needs of farmers; consequently, a ROPS has to be provided for each tractor model and this worldwide, manufacturers are frequently compelled to install and then submit for testing and approval a high number of ROPS with similarities, in order to comply with the relevant regulations. On the other hand, the most popular dedicated standards (OECD, EC, ISO, etc.) often do not provide clear and unambiguous criteria for evaluating the capacity of ROPS thus revealing only slight differences among old and new versions that are frequently modified for a higher manufacturing uniformity. Based on these findings, it becomes useful to establish one (or more) maximum tolerance value(s), within a structural modification that could be considered admissible without carrying out a new validation test. For this study, the common ROPS standard, issued by the OECD (Organisation for Economic and Cooperation Development), Code 4, provided for standard agricultural and forestry tractors, was taken into account. Under section 3.9.2.1 "*Extension of the structural test results to other models of tractors*", is written that "...The required energy shall not exceed the energy calculated for the original test by more than 5 %..."[...].

IMPACT OF SHALLOW WATER TABLE DEPTHS ON SURFACE IRRIGATION REQUIREMENTS AND CROP PERFORMANCE

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CSBE101484 – The impact of shallow water table depths on surface irrigation requirements of major crops was studied through a series of experiments conducted in 18 lysimeters situated in Lahore during 1975 to 2004. These lysimeters are of the size 3.05m x 3.05m at the surface and 6.1m deep filled with representative soil profile of the Punjab. Each lysimeter was equipped with tensiometers, soil water extractors and automatic arrangements for the quantitative measurement of up flux of water from water table into root zone or deep percolation losses occurring due to surface irrigation or heavy rainfall. Water table depths in these lysimeters were maintained from 0.9m to 4.5m with an interval of 0.9m in phase I; whereas in phase-II water table depths were maintained from 0.3 m to 3.0 m with an interval of 0.3 m. The crops experimented were wheat, maize, sugarcane, sunflower, berseem and sorghum. In each experiment each treatment was replicated twice and repeated for three years. The results indicate that movement of water from the water table into root zone is negligible if the water table is located at 3 m depth or more. Groundwater contribution to crop water requirements increases as water table depth decreases. It was observed that crops can meet all their water requirements from water table if situated at a depth shallower than 1.2 m. This condition is generally detrimental to crop performance due to harmful semi-saturation conditions and accumulation of salts in the top layers due to upward movement of salts with the upflux of water. Periodic flushing of such salts is necessary to minimize toxic effect of salts for sustained crop production. Summarizing the results it was concluded that: 1) In the areas where water table is located at a depth shallower than 3 m, a considerable amount of surface irrigation water can be saved by making use of contribution of shallow water table. [...].

PRODUCTION PROCESS EVALUATION OF WASTEWATER-IRRIGATED PLANT BIOMASS THROUGH LIFE CYCLE ASSESSMENT

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CSBE101485 – In this study the Life Cycle Assessment (LCA) of *Arundo donax* production process for energy purpose is proposed. The cultivation of this type of herbaceous biomass, irrigated with urban wastewater, was carried out in an experimental field, located in eastern Sicily (Italy). The analysis by LCA makes it possible, among other things, to evaluate the potential environmental impacts related to each phase of the process. In this study sensitivity analysis of the LCA results were carried out by varying the process stages. Furthermore the incidence of each process stage on the damage categories by varying the cultivation-cycle length was evaluated. The stages constituting the *Arundo donax* production process, considered in this assessment, regard seedling production, agronomic practices, irrigation, and transport to boiler. The functional unit used in the analyses was 1 ton of biomass and crop productivity values were derived from literature. The analyses allowed the identification of the most significant stages of the *Arundo donax* production process related to the experimental field. In detail, this study highlights that seedling production and irrigation stages contributed most of all to the overall environmental burden, whereas agronomic practices stage showed a minor influence on the process.

REMOTE SENSING AND GIS FOR RURAL/URBAN GRADIENT DETECTION

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CSBE101486 – Identifying and mapping land cover/land use (LC/LU) and its change is one of the most important topics in remote sensing since this is the source of a wide range of environmental information about landscape changes, which is essential for an effective sustainable land planning and management. In this framework, a case study has been conducted in the area of Avellino (Southern Italy) by means of remote sensing techniques in combination with GIS and landscape metrics. A multi-temporal set of remote-sensed data has been used: aerial photos (surveys: 1954, 1974, 1980, 1990), Landsat images (MSS 1975, TM 1993, ETM+ 2000 and 2004) and digital aerial orthophotos (1994, 2000 and 2006). In order to highlight the temporal dynamics of changes, the study has integrated temporal trend analysis and landscape metrics and focussed on the urban-rural gradient. First, aerial photos have been interpreted and satellite images have been classified: the result has been a map of LC/LU changes during the last fifty years. This has allowed the characterization of landscape patterns through significant indices, in order to understand the changes therein, especially along the urban-rural fringes. This study has shown that LC/LU pattern and its change are linked to both natural and social processes whose driving role has been clearly demonstrated in the case study: after the disastrous Irpinia earthquake (1980), the local specific zoning laws and urban plans have significantly addressed landscape changes.

FROM THE CONSTRUCTION OF AN ECOLOGICAL NETWORK TO THE DEFINITION OF AN ENVIRONMENTALLY SUSTAINABLE PLANNING MODEL FOR PERIURBAN SPACE

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CSBE101488 – Any action of anthropization of the natural environment implies the destructuring of the ecomosaic with varied modes and intensity. If this destructuring stretches in time and space, it will result in phenomena of landscape fragmentation leading to environmental unsustainability due to the change in functionality and in the biological processes. Over the last ten years, field studies have highlighted that the classical methodologies for nature protection are not adequate and have identified ecological networks as the most suitable tool to assure the functional perpetuity of ecosystems (the EU has even formalized their adoption in environmental protection strategies). To tackle such issues, the authors have started a research program leading to the construction of a GIS model for the definition of ecological networks. It is based on biological and orographic principles and on the anthropic structure of the territory, thus surpassing classical monodisciplinary approaches. A set of indicators has been defined, structured and associated to this tool to monitor its effects on the territories functionality. This paper shows the results of the integration of the ecological network with the indicators in a sub-model defined to envisage the possible policies of the new urbanization and to support regional and sub-regional land-use planning tools. The implemented model generates policies of expansion of the urban tissue which do not alter the biological functionality of the ecological network system. [...].

DISCRIMINATION OF LAMB MUSCLES BY NIR HYPERSPECTRAL IMAGING

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CSBE101492 – Hyperspectral imaging has been emerged to combine imaging and spectroscopy techniques in a single system to acquire both spatial and spectral information simultaneously. It is considered one of the most efficient techniques and advanced non-destructive technologies for the estimation of quality attributes of different food products. In this study a near-infrared (NIR) hyperspectral imaging system (900-1800 nm) was developed for discriminating lamb muscles of Charollais breed. Muscles from *Semitendinosus* (ST), *Semimembranosus* (SM), *M. Longissimus dorsi* (LD) and *Psoas Major* (PM) at 2-day post-mortem were tested in this study. Principal components analysis (PCA) was used for dimensionality reduction, wavelength selection and to aid in visualizing the hyperspectral data. The results showed that hyperspectral imaging has a great capability for discrimination between lamb muscles.

PREDICTING DYNAMIC EQUILIBRIUM IN STREAMS IN THE OLENTANGY RIVER WATERSHED, OHIO, USA

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CSBE101493 – In the United States, the status of water resources is assessed regularly as required by the Clean Water Act. This important directive calls for the protection, restoration, and enhancement of “...the chemical, physical, and biological integrity of the Nation’s waters.” Historically, regulatory agencies responsible for assessing water resources have focused efforts on the chemical and biological aspects of water resource integrity while the physical components have received disproportionately less attention. This is perhaps due to inadequate and inconsistent definitions of what constitutes physical integrity. Recently, definitions of water resource physical integrity have been proposed that focus on evaluating fluvial processes and determining whether a stream system is in dynamic equilibrium with the surrounding watershed. Streams in dynamic equilibrium provide a wealth of ecosystem services that benefit human society - water filtration, nutrient assimilation, flood peak attenuation, baseflow augmentation, temperature moderation, maintenance of functional habitats, etc. A study was conducted at 36 sites in the Olentangy River Watershed in central Ohio, USA to assess the physical integrity (i.e. dynamic equilibrium status) of stream reaches within the drainage network. A multi-factor, weight-of-evidence approach utilizing knowledge of hydrology, hydraulics, stream geomorphology, and sediment transport was used to evaluate dynamic equilibrium in each stream reach. Each site was classified as “in dynamic equilibrium” or “not in dynamic equilibrium” based on expert interpretation of 9 quantitative indicator variables. Logistic regression was used to identify significant variables which [...].

CLAW AND FOOT HEALTH: EARLY DIAGNOSTICS AND PREVENTION OF FOOT LESIONS IN DAIRY CATTLE

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CSBE101495 – Lameness is a painful and costly disease. It is estimated to be one of the major animal welfare issues in dairy production. Lameness decreases milk production, increases involuntary culling and affects reproductive performance. Due to these costs it is the third important health trait after mastitis and fertility disorders. We present here a new research program aiming to predict existing lameness cases with technological methods and preventing new cases via breeding. Lameness or claw disorders have found to have genetic variation, which enables the selection for better claw and foot health. Many conformation traits have also been found to be genetically correlated to lameness and claw disorders; hence they can be used as information to increase the accuracy of genetic evaluation of lameness or utilized through correlated response. Due to its high cost and welfare problems lameness has to be included in the breeding goal in dairy cattle. The aim of this three years project is to develop automatic lameness detection in a milking robot and develop a model to predict the lameness from the early observations with automatic device. Another aim is to estimate the genetic parameters of claw disorders and the genetic correlations of claw disorders with conformation traits, calculate the economic value of lameness or foot lesions and construct an overall index to be used in selection for better claw and foot health. The project aims to improve the welfare of dairy cows and the economical efficiency of milk production through earlier observation of claw problems and through better claw and foot health.

SKIM MILK CRYOCONCENTRATION AND ASSESSMENT OF ITS PHYSICO-CHEMICAL, THERMAL AND FUNCTIONAL PROPERTIES

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CSBE101498 – Cryoconcentration is a phenomenon which occurs during the thawing of frozen aqueous solution. More concentrated phase is then separated from the initial solution. This phenomenon can be exploited in the bio-food industry to obtain products of high nutritive, biological and organoleptic values. Cryoconcentration was successfully used to concentrate skim milk. In the present research two objectives were studied. The first was aimed to optimize the cryoconcentration process by minimizing the amount of dry matter entrapped in the ice fraction. This was possible by recycling the ice fraction. According to the used experimental conditions, it was possible to concentrate skim milk up to $35.68 \pm 0.03\%$ (w/w) total dry matter using three cryoconcentration cycles. At the same time, one recycling ice cycle was used to minimize loss of dry matter and enhance the process efficiency. Denaturation effect of the freeze/thaw procedure was evaluated by DSC and FTIR analysis. The second objective of the present study was to evaluate physico-chemical and functional properties of the concentrated fractions. Two functional properties were studied: emulsifying and foaming properties. The obtained results showed that both the emulsion stability index (ESI) and the emulsion activity index (EAI) were cryoconcentration cycle dependent. Foaming ability was expressed as nitrogen volume needed to obtain foam volume three times higher than the initial volume. The obtained results also showed a dependency of the foaming ability from the cryoconcentration cycle. The obtained results from this study are promising in the cheese making industry.

RED APPLE JUICE – DEVELOPMENT OF A NEW, INNOVATIVE PRODUCT

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CSBE101499 – Because of low prices and saturated demand on the apple-juice market, there is need for the German fruit drink industry to insure its commercial effectiveness by creating a new, innovative product. That product has to combine new attractiveness for the consumer with higher effectiveness in production. A new option would be to introduce a natural breed of an apple “McIntosh” from Canada which gives its consumer attractiveness by its red juice with high nutritional value. Its potential to increase the effectiveness in production is given by its shape, called “Wijcik” and shows the so called columnar growth, meaning the trunk has only a few side branches, so that the resulting fruits will grow close to the trunk. The plant has only 50 cm in diameter at a final height of 3 – 4 meters. The advantage of this kind of tree is that tree-cut is mostly unnecessary, agent reducing tunnel-spraying equipment can be used and harvesting maybe fully mechanised. To prove the suitability of that new cultivar system, different types of harvester and tunnel-spraying equipment, adapted for these special apple trees, has been and will be tested. Furthermore, the mechanization of all work procedures in the fruit juice production combined with GPS- and RFID transponder supporting systems opens the possibility to establish a chain oriented quality management system which fulfils the standards of legal regulations and trade partners. This and the possibility to get the Carbon-footprint of the product is an additional part of that future oriented production system.

A MODEL FOR THE EVALUATION OF BUILDING SUSTAINABILITY IN AGRI-FOOD INDUSTRY

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CSBE101502 – This study aims at defining a method for sustainability building evaluation in the specific context of agri-food industry. As a matter of fact, from an environmental point of view, this is one of the most critical industrial sectors and, consequently, sustainability evaluation is needed for the whole production chain, including all the aspects related to the design, use, remodelling, dismantling or reuse of the building facilities. A global building sustainable index was defined so as to appropriately and synthetically consider both the interaction of the many concurring factors and the specific aspects related to the agri-food production cycles.

AUTOMATIC AND FREQUENCY-PROGRAMMABLE SYSTEMS FOR FEEDING TMR: STATE OF THE ART AND AVAILABLE TECHNOLOGIES

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CSBE101506 – Feeding Total Mixed Rations (TMR) or Partial Mixed Ration (PMR) has become a common practice for dairy cows as a result of the benefits for the animals and the labour savings for farmers. Characteristic for this feeding system are the – trailed or self propelled – man-operated mechanical mixers. Besides the advantages of the TMR technique, it has the same drawback as most traditional ad libitum feeding systems that the discharge of feed is limited to once, maximum twice a day. During the last 3-5 years, technologies for automatically feeding cows with TMR or PMR have grown in popularity. More than 15 manufacturers are working worldwide on different designs for automatic TMR/PMR feeding systems (AFS) while an estimated 300-400 farms have adopted this technology, mostly located in Northern Europe, Canada and Japan. The different manufacturers offer a wide range of technical solutions. Some of the most important aspects that characterize these systems include the possibility of a variable frequency drive to modulate the ration, to control the feeding times, to stimulate the cow activity and to manage the composition of the total daily ration with the objective to control the feed intake. Management possibilities and work quality seem to be strongly affected by available technical solutions. This paper provides a proposal for the classification of different AFS's and suggestions for future research on feeding strategies; it also focuses on daily feeding frequency and the time intervals between distributions.

THE NATURAL MATERIAL IN BIOCONSTRUCTION BETWEEN TRADITION AND INNOVATION: THE USE OF GIANT REED ARUNDO DONAX L. IN THE RURAL CONSTRUCTIONS

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CSBE101507 – Buildings are accountable for over 40% of energy use in OECD countries. Most energy is used for indoor environment control and artificial lighting; the rest is used for the production of materials used in buildings construction and demolition. The correct utilization of natural materials could lead to energy saving during the use of the buildings and during the demolition phase because less material would be subjected to transformations energy expenses. Moreover, the study of material properties, in order to choose the most suitable products, allows energy saving during the building lifespan. Moreover, the utilization of local materials in rural buildings minimizes the energy cost for transport as well as its environmental impacts, because, when the building is demolished, the material can be reintroduced into the environmental system. In this work the principal physical and mechanical properties of the giant reed (*Arundo donax* L.) are studied and analysed. It is a natural material available everywhere around the world and is an abundant natural resource particularly in temperate climates and subtropical areas. The giant reed has been a conventional construction material since ancient times. It has been used to make baskets, building walls, fences, roofs, floors, music instruments, paper, bio-fuel. Owing to its lower thermal conductivity coefficient, in some places, it is also used in rural traditional constructions. [...].

EFFECTIVENESS OF AGRICULTURAL TRACTORS CABS FOR PROTECTION AGAINST HAZARDOUS SUBSTANCES IN ACCORDANCE WITH EN 15695 PART 1

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CSBE1510 – Tractors and self-propelled machine operators can be exposed to hazardous substances such as plant protection products, fertilizers and other toxic materials generated during soil tillage and harvesting. Cabs fitted on these machines can provide protection against these substances and can be used to reduce operator exposure to air contaminants. Recently available Standard EN 15695-1:2009 provides 2 test procedures to assess the protection cabs are able to assure protection to operators with regards to hazardous substances. The first method consists in measuring the cab tightness using an artificial generated aerosol. A number of studies have been conducted to develop this method, references supporting these results are available. The second method, called “blind filter test” in the Standard, consists in blocking the active filter area and measuring the air leakage through the filter seat. Little information is available about this second method. Thus a blind filter test has been performed on a cab fitted on an agricultural tractor to assess the effectiveness of the method in measuring the air tightness of the enclosure. The test has been performed on a 75 kW, four wheel drive orchard tractor fitted with a cab equipped with carbon filter filtration system. Different combinations adjustment of the engine and fan speeds, and air recycling and aperture for remote operations have been examined. During the investigation improper assembly of the filter housing was detected. Therefore the investigation confirms that small cracks due to faults in filter assembly are the major source of penetration of hazardous materials into the cab enclosure. In accordance with the obtained result of the study the blind [...].

POSITIONING ANAEROBIC DIGESTION SYSTEMS IN THE SWINE SECTOR IN QUEBEC: A TECHNICAL AND ECONOMIC STUDY

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CSBE101515 – The goal of this study was to position on-farm anaerobic digesters using technical and economic analyses based on scenarios adapted to the regulatory and economic context of the swine sector in the province of Quebec where little experience with this type of process is available. For the present study, three scenarios were selected in order to represent, as closely as possible, operating conditions in the swine sector to perform this global technical and economic analysis. An economic analysis was carried out to determine the profitability of each scenario. Preliminary results indicate that this type of project under prevailing conditions in Quebec generates little profit. If thermal use of biogas is considered, the challenge becomes producing biogas at a lower cost than that of natural gas (\$0.46/m³ of methane at 0°C and 1 atm) whereas the best-case scenario (1) in the present study shows a production cost of \$0.65/m³ of methane giving a 5-year payback. If biogas is used to generate electricity, the issue at stake is to produce electricity at a cost lower than \$0.0746/kWh (Hydro-Québec, 2010) when it is used directly at the farm, or to obtain a price of \$0.112/kWh in cases where it can be resold on the electrical grid [...].

PREDICTING VENTILATION RATES IN HYBRID VENTILATED PIG HOUSING FACILITIES

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CSBE101516 – The potential impact of livestock production on ambient air quality continues to raise concerns in agricultural areas. Therefore, a precise evaluation of gas and odour emissions from the barn is becoming important. In this context, the prediction of ventilation rate (VR) is an important parameter in the evaluation of these emissions. This paper presents and discusses the methodologies used to measure VR from a hybrid swine building (mechanically and naturally ventilated). The production site consisted of two hybrid swine buildings housing 1,400 grower-finisher pigs each. A room housing 700 pigs was monitored during approximately nine weeks both for summers 2007 and 2008. Ventilation rates from the barn were calculated using two different methods: 1) the wind and thermal buoyancy method and 2) the CO₂ balance method. Carbon dioxide concentrations were measured at various locations for the CO₂ balance method. Wind speed and direction along with curtain opening data were also considered in the calculations. Under average climatic conditions (cooler temperatures and average wind speed) the VR due to wind and the VR obtained by the CO₂ balance method were generally in the same range. However, when the wind speed was low, it was difficult to predict the ventilation rate with the CO₂ balance method. Based on this study, more research is needed to define the opening effectiveness of full-scale [...].

ENVIRONMENTAL IMPACTS OF MANURE MANAGEMENT STRATEGIES IN PIG PRODUCTION

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CSBE101517 – A life cycle approach was used to evaluate the environmental impacts of manure management strategies (land application, anaerobic digestion, in-barn solid/liquid separation with land application of the solid fraction or pyrolysis of the solid fraction) in pig production. A simplified life cycle model was developed using local data and local production models. The life cycle boundaries considered in this study included cradle-to-farm gate activities. The considered impact categories were global warming, acidification, eutrophication, energy use and land use. Results were expressed using two functional units: per kg of pig produced and per hectare of land used. Results obtained with the land application scenario (conventional manure management) showed that more than half of the environmental impacts were associated with crop production and land management. The impact of the functional unit chosen to express the emissions and to compare scenarios had an influence on how the results were interpreted. The solid fraction from the in-barn solid/liquid separation scenarios was used on potatoes crop. The remaining liquid fraction was then spread on a smaller surface lowering emissions per kg of pig produced while increasing emissions per hectare of land used.

GREEN MANURE PRODUCTION AS A VALUE-ADDED COMPONENT OF TREATMENT WETLANDS FOR LIVESTOCK WASTEWATER

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CSBE101518 – Producing plant-based fertilizers – green manures – in treatment wetlands for livestock wastewater could provide economic benefits similar to land application of manures without the environmental hazard. Land application provides low-cost nutrients for agricultural production and is, for many high density animal agriculture operations, the only economical method of waste handling. However, direct land application can harm local ecosystems, public health, and long-term soil fertility. Treatment processes for liquid manure, including treatment wetlands, improve water quality but do not effectively utilize manure nutrients. Using small, fast-growing wetland plants like duckweed and the nitrogen-fixing fern *Azolla* for nutrient capture and green manure production in treatment wetlands allows the treatment system to provide the same benefits as land application – water reuse and agricultural fertilizer – at a higher quality for both. The current study explores optimization of water purification and green manure production in a wetland system treating liquid dairy manure, consisting of a duckweed growth pond (with multiple, wild-collected *Lemnaceae* species), a horizontal subsurface-flow wetland, and an *Azolla* growth pond (with *A. caroliniana*). Hydraulic retention time and plant harvest rate will be manipulated to determine conditions for maximum water purification (by reduction of COD, TP, TN, NO₃, and NH₃) and plant production. Data will be modeled using both dimensional analysis and a nutrient-based dynamic growth model. The best resulting model will be developed to suggest design criteria for treatment wetlands producing maximum yields of green manure while meeting site-specific water quality needs.

AQUATIC MACROINVERTEBRATE DIVERSITY IN CONSTRUCTED STORMWATER WETLANDS

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CSBE101519 – Aquatic macroinvertebrates were collected from a total of 25 constructed stormwater wetlands across North Carolina, USA using the sweep net method. Metrics of biotic integrity (macroinvertebrate community richness and evenness, percent tolerant taxa, and functional feeding group composition) were then determined for each wetland and related to wetland design features, including temporary storage depth and wetland to watershed area ratio, and watershed characteristics. Macroinvertebrate surveys were similarly conducted in naturally occurring reference wetlands and statistical analyses were conducted to compare the macroinvertebrate communities observed in stormwater and reference wetlands. Although impacted by stormwater runoff, some stormwater wetlands supported a diverse macroinvertebrate community similar to that observed in reference wetlands. Measures of macroinvertebrate richness and evenness in stormwater wetlands varied widely but were loosely correlated to wetland storage depth and the ratio of the wetland to watershed area, two factors that dictate stormwater wetland hydrology and which may play a role in the establishment of aquatic macroinvertebrate communities. Macroinvertebrate diversity is presented as one of the suites of ecosystem services provided by constructed stormwater wetlands [...].

IDENTIFICATION OF KEY ODOUR COMPONENTS FROM PIG BUILDINGS FOR MODELLING PURPOSES

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CSBE101523 – Three biotrickling filters are installed in bench-scale pig chambers to study potential ways of optimizing the performance of these kinds of reactors in reducing odour emissions from swine production facilities. Though mathematical models are known to be useful tools in describing and simulating performance of reactors, it would be impossible to simulate the removal of hundreds of components in the exhaust air from pig buildings. However, modelling the removal of key components, those that are mainly responsible for the unpleasant odour might be sufficient to describe the overall odour reduction. Thus, air samples at the inlet and exhaust of the biotrickling filters were collected to identify the main odorants that are removed by the system as well as those that remained after the treatment. Samples were collected by means of carbotrap tubes and analyzed by GC-MS coupled with an olfactory port (GC-MS/O). This system identifies the different odour components as well as the odour intensity of each component. A total of 176 volatile organic compounds (VOCs) were identified at both the inlet and exhaust of the bioreactors. The key odour components in swine gas were identified using the odour index of each component. The odour index was estimated as the geometric mean of intensity and hedonic tone of the individual component. The compounds having the highest odour indices in the samples taken at the inlet of the bioreactors are 2,3-butanedione, 2-methylbutanoic acid, 2-methylpropionic acid, 3-methylbutanoic acid, acetic acid, butanoic acid, dimethylsulfide, and p-cresol while those measured at the exhaust are p-cresol and dimethylsulfide.

CONSTRUCTION DESIGN SYSTEMS FOR SUSTAINABLE FARM BUILDINGS. A CASE STUDY IN CALABRIA, ITALY

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CSBE101525 – Recently in Italy the construction design systems applied to farm buildings have been required to improve their eco-compatibility, adaptability to the local environmental conditions, and functional/operational performance when answering the needs of the specific activities housed. This paper presents the results of a study carried out in Calabria (South Italy) and aimed at defining sustainable building systems for farm buildings. On the basis of previous studies conducted by the Authors in the same region and with regards to building types and layouts for animal housing based on local breeding systems, this paper is focussed on the construction design aspects to be applied to those buildings in regards of sustainable design. They are characterized by: local availability of raw materials, low cost, low energy demands, use of renewable resources, reduction of carbon dioxide emissions, ability of materials and components to be reused or recycled, aesthetic and visual integration with the regional landscape, valorisation of on site labour. In particular, three different construction design systems have been defined and applied: straw bales coupled with timber structural frame; timber frame and autoclaved aerated concrete-blocks; reinforced adobe.

FLUME ANALYSIS OF IN-CHANNEL RESTORATION STRUCTURES AND IMPACTS TO SECONDARY CIRCULATION FLOWS

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CSBE101526 – River restoration with natural channel design utilizes in-channel restoration structures to redirect cut bank flows toward the channel center and reduce scour erosion. Prior research has utilized primary circulations or streamwise flows along the channel to site in-channel structures, trying to move the higher velocity water away from the cut bank. This research used a series of flume experiments to characterize the impact of in-channel structures on the cross-channel flows, also known as secondary circulations. Our flume experiment represented the geometry of pool-riffle systems and used width to depth ratios between 3 and 8, and flows from 2 to 10 Litres per second. The in-channel structure was a j-hook, which consists of a vane tied in at the bank with a bankfull elevation, extending at an angle of 30 degrees off of upstream, and sloping toward the channel bed. A mesh frame was inserted in the channel to fix sampling locations, and dye injection used to determine local vector components of the secondary circulation. The in-channel structure disrupts the secondary circulation, breaking a single circulation cell into 2 circulation cells. The larger cell is located on the opposite bank to the structure, while the smaller cell is contained within the wake zone of the structure. This disruption of secondary circulation has potential impacts on sediment transport along alluvial channels, and may lead some adjustments in point bar and cut-bank geometry. River restoration engineers should consider both secondary and primary circulation patterns when setting in-channel structures. Computational fluid dynamic simulations were used to further refine the characterization of these secondary flow impacts on river hydraulics and sediment transport.

MEANDER BEND REGULATION OF SURFACE-GROUND WATER EXCHANGE AND IMPACTS FOR RESTORATION DESIGN

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CSBE101528 – Meander bends in alluvial pool-riffle rivers experience cut-bank erosion and point bar deposition dynamics, and a river may contain various stages of meander cutoff, quantified by their relative curvature. Large values of curvature indicate morphologically young meanders with gentle bends, and small values of curvature indicate older meanders pinched and nearing cutoff. Modeling studies have shown as curvature adjusts toward meander cutoff, rates of surface-ground water exchange increase through the point bar. These hyporheic exchanges in the point bar set in place ecologically important nutrient flows and should be a functional target for stream restoration designs. Our field and laboratory work provide new data to support these otherwise mathematical predictions of steepened hydraulic gradients and increased hyporheic exchange through point bars of nearing cutoff, and suggest river restoration utilize a range of meander curvatures. Additional computational and river table analysis of meanders with in-channel structures, such as j-hooks common to natural channel design, showed structures can further influence hyporheic exchange across the point bar. Restoration structures create local steepening of the water surface, either in pools or riffles, and increase the gradients driving hyporheic exchange through the point bar. The results document a strong mixing of groundwater and surface water by downwelling and upwelling fluxes in both sides of the meanders near cutoff.

SAD-RH: A GENERIC DECISION SUPPORT SYSTEM FOR WATER RESOURCE MANAGEMENT

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CSBE101529 – The new Brazilian water resource policy brought an innovation in the management, organizing and planning of water use in river basins, especially the instruments provided for its implementation, as the water right. During the decision process, the water manager may select the best alternative for a use or effluent discharge, so he must access information related to water resources and environmental issues, which are usually scattered among the environmental public services. Gathering such knowledge becomes a complex task that often does not allow the access to complete data. Thus, it is important to design a computational tool that can aggregate all necessary information to the water manager during the decision process, such as the issue of authorization. This paper presents a generic decision support system for water resource management called SAD-RH, developed in Delphi programming language. The system has layers containing relevant factors, such as: hydrographs, vegetation, conservation units, geology, slope, hydrological stations, surface water and groundwater monitoring points and water withdrawal points. The basin selected for implementation of the system is the Guapi-Macacu and Caceribu-Macacu region, located in the eastern portion of Guanabara Bay in Rio de Janeiro state, Brazil. The selection of this region was motivated by the fact that the Petrochemical Complex of Rio de Janeiro - Comperj, greater individual enterprise in the history of Petrobras, will be installed there.

CHARACTERIZING SURFACE-GROUND WATER EXCHANGE RATES AND HYDRAULIC TRANSPORT PROCESSES IN A CASCADING STREAM

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CSBE101532 – Cascading streams in mountain areas are the source for drinking water in many Honduran villages, and source water capture may dewater the stream and diminish ecologically important surface-ground water exchange. Our study quantified the rates and hydraulic transport processes of surface-ground water exchange for several flow rates, from 1 to 15 Litres per second, in Prieta Creek, a cascading stream in northern Honduras. Surface-ground water exchange was monitored within a 40 m reach with chloride tracer tests and piezometer pressure measurements, and analyzed using models for transient storage, hydro-static and hydro-dynamic flux. Transient storage analysis of the tracer data indicated a reach wide decrease in exchange with decreasing flow rate, but did not provide spatial information on the key locations or transport processes affected by dewatering. Piezometer data and the hydro-static MODFLOW model simulation showed decreasing downwelling strength with decreasing flows, but the model accuracy was compromised in steeper sloped sections of the channel. The MODFLOW model failed to represent dynamic velocity head and turbulent based momentum transfer identified as active in the channel based on effective diffusion analysis. We addressed this limitation by applying the Reynolds averaged Navier Stokes based computational fluid dynamic (CFD) Flow3D model with the k-e renormalization grouping turbulence algorithm. The CFD model allowed for spatially detailed analysis of transport processes involved in surface-ground water exchange. These CFD simulations demonstrated for the steeper cascades a strong spatial correlation [...]

SENSORY EVALUATION OF STANDARD HARD CHEESE MINAS ADDED WITH BRAZIL NUT – A HIGH ANTIOXIDANT DELICACY

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CSBE101536 – Increasing consumer interest to enhance their quality of life has encouraged the development of new food products containing high nutritional values. In response, the dairy industry has adapted itself to an increasingly competitive market and has made great efforts to offer consumers alternative food products that possess functional properties but do not affect any of the typical characteristics of the original product in terms of appearance, taste and texture. Standard hard cheese Minas is also known as Minas Curado (“cured Minas”), Minas Prensado (“pressed Minas”) or Minas Padronizado (“Standardized Minas”). Standard hard cheese Minas is probably the oldest and the most original cheese variety in Brazil, which began to be manufactured in the 19th century, particularly in the State of Minas Gerais. The Brazil nut kernel has excellent nutritional and functional properties, particularly due to the quality and amounts of proteins, lipids, dietary fibers, minerals such as selenium, and vitamins (B and E families). The objective of this study was to evaluate the sensory characteristics of appearance, color, taste and texture of Standard hard cheese Minas, manufactured with the addition of Brazil nut. The cheese was manufactured with the addition of a soluble 1:7 dilution of Brazil nut extract and Brazil nut paste (2%) and using the traditional manufacturing process of Traditional standard hard cheese Minas. The [...].

PREDICTION OF REPAIR AND MAINTENANCE COSTS OF TWO-WHEEL DRIVE TRACTORS IN IRAN

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CSBE101542 – Predicting of repair and maintenance (R&M) costs of tractors in any mechanized farm is necessary for owners and managers to obtain information on overall maintenance costs in order to control production cost. In this context a study was conducted to predict accumulated R&M costs (Y) of two-wheel drive (2WD) tractors based on total usage hours (X) in Misagh-e-Sabz Agribusiness Company in Iran. Recorded data from the company was used to determine regression models for predicting total R&M costs (as percentage of initial purchase price) based on total usage hours. The statistical results of the study indicated that in order to predict total R&M costs of 2WD tractors with based on usage hours of 2260 h or less the power regression model $Y = 0.013 (X/100)^{1.677}$ with $R^2 = 0.976$, and to predict total R&M costs of 2WD tractors with based on usage hours of 2260 hours or more the polynomial regression model $Y = 0.004 (X/100)^2 - 0.181 (X/100) + 4.373$ with $R^2 = 0.998$ is strongly suggested. Results of the study also indicated that total R&M costs predicted in this study were lower than those predicted in the previous studies. Cumulative life of 12000 hours, for instance, indicated an total R&M costs equivalent to 40.3% of initial purchase price. The most likely reasons that explain these differences between the predicted results in this study and those predicted in the previous studies probably can be attributed to new tractor technology for production during the last two decades and lower labor wages in Iran.

ANTIBACTERIAL ACTIVITIES OF NANO-CRYSTALLINE CAO, MGO AND ZNO ON LACTIC BACTERIA

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CSBE101543 –The antibacterial activities of nano-crystalline metallic oxides (CaO, MgO and ZnO), prepared by sonication-thermal decomposition method, and micrometric metal oxides were evaluated on three strains of lactic bacteria, *Lactobacillus plantarum*, *Lactobacillus helveticus* and *Leuconostoc mesenteroides*, and on spores of *Alicyclobacillus acidoterresris* involved in fruit juice spoilage. The effects of particle size, pH, concentration and exposure time on the viability were examined in physiological solution as well as culture broth. The tests were performed by adding the bacterial or spore suspensions in flasks containing metal oxides. The results showed that CaO nanoparticle was the most effective in killing all the three strains of lactic bacteria exposed for 24 h at 100 ppm, but its antibacterial activity is attributable in part to its pH effect. MgO was lethal against *L. helveticus*, but exhibited little effect against either *L. mesenteroides* or *L. plantarum*. The nanoparticulate ZnO clearly showed a bactericidal effect on all lactic bacteria tested, but less so against *L. helveticus*, and it was also more effective in inhibiting their growth compared with alkaline metal oxides. No antibacterial effect of the metal oxides was observed against the spores of *A. acidoterresris*. This investigation showed that, in general, higher concentration, longer exposure and smaller particles size of metal oxides tend to increase their antibacterial effect. However, the aggregation of nanoparticles at high concentrations of metal oxides in the slurry tends to lower the antimicrobial action. It was also evident that the antibacterial activity of metal oxides depends on the type of metal oxide (alkaline or amphoteric) and on the morphological and physiological characteristics of the bacteria.

ANTIFUNGAL ACTIVITIES OF NANO-CRYSTALLINE AND MICROMETRIC CAO, MGO AND ZNO

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CSBE101544 – Nano-crystalline metal oxides (CaO, MgO and ZnO) and micrometric metal oxides were evaluated for their lethal effect on yeasts (*S. cerevisiae* and *C. tropicalis*) and fungal spores (*A. niger*, *P. variotii* and *Byssoschlamys* sp.) and growth inhibitory effect on yeasts and fungi, which are involved in the spoilage of fruit juices and drinks. The effect of exposure time, pH, concentration and particle size of metal oxides were examined. The lethal effect was determined by exposing yeast cells or fungal spores to specific concentrations of metal oxides in isotonic water for 48h or 96h. Growth inhibition was carried out in PDB. The viable cells were counted on culture media. Fungal growth was assessed by dry weight of the mycelium. The results showed that CaO, MgO and ZnO have the ability to kill and inhibit the growth of yeasts to various degrees. Although they did not exhibit any significant lethal effect on fungal spores or ascospores of *Byssoschlamys* sp., they inhibited fungal growth. While CaO was effective against yeasts, due in part to its high alkalinity, but it was also less effective in inhibiting the growth of fungi, particularly *A. niger*. ZnO was effective in inhibiting completely the growth of fungi even at 100 ppm. Overall, there was only a small effect of concentration or particle size of metal oxides on their antifungal effect, but exposure time had an impact. This suggests that the contact of the oxide particles with the microbial cell appears to be a key factor on their antifungal efficacy.

SENSORS FOR EFFECTIVE IRRIGATION SCHEDULING AND IMPROVED WATER USE EFFICIENCY OF COTTON CULTIVARS

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CSBE101545 – Competition for water with the environment has and will continue to demand more water or severely limit other uses. Many existing sources of water are being stressed by increasing irrigation needs that currently account for about 65% of the national water withdrawals. The overall objective of this study was to determine the feasibility and improve the utility of sensor-based soil water monitoring techniques in south-eastern Coastal Plain soils to more effectively manage irrigation and conserve water resources. Field experiments were conducted to determine the accuracy of two multi-sensor capacitance moisture probes (EnviroSCAN and AquaSpy) using two installation techniques (Slurry and Direct). The results showed that, if installed and calibrated properly, these probes can accurately measure volumetric soil water contents for real-time site-specific irrigation scheduling. The “Slurry” installation method over estimated volumetric soil water contents in a sandy Coastal Plain soil. Multi-sensor probes were also used to determine the water use efficiency of four cotton cultivars under multiple irrigation regimes. There were strong correlations between the depths of seasonal irrigation and seed cotton yields. Maximum yield for all cotton cultivars was obtained around 520 mm total water applied (irrigation plus rain). Yields decreased when more water was applied. There were significant differences in water use efficiency among the cotton varieties, with the highest values of 0.77 kg of lint cotton per m³ of total [...].

USE OF ELECTRONIC DEVICES IN COMBINE HARVESTERS: A CASE STUDY FOR ANTALYA REGION IN TURKEY

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CSBE101549 – Electronic devices in combine harvester have become a key factor for the efficient use of these machines. The complex process technology inside harvesters has to be managed by operators to maximize the performance of machines (ha/h, t/h) by taking into account the requirements of plant production (minimal grain loss, grain damage). The objective of the study is to analyse the use of electronic devices in combined harvesters in Antalya Region, Turkey. Electronic devices, which are used in combine harvester in Antalya are described in the paper. For this purpose, a questionnaire study was carried out with 43 combine harvester users. Users were questioned on the following sensor: grain loss sensor, hectare meter, and failure sensors. 26% of total 43 units combine harvesters belongs to the +30 age group. 25 (58%) unit combine harvester have been used only wheat and barley harvesting. 0-5 years old group combines located in the 23% of combine harvester park. 18 units combine harvester have been used the wheat-barley and corn harvesting. Annual average usage of a combine in harvesting of wheat, barley and corn fields were 411, 311 and 211 ha, respectively. The rate of the grain sensor+failure sensor was determined as 40% (17 units). 16 % (7 units) of combine harvester has got only a time indicator. There is no warning system in 28% of (12 units) combine harvester. It was determined that 31 units combine harvester (72 %) of the operator to follow the developments, 12 combine operators (28 %) to deal with the technological developments.

MODELING CITY TREE GROWTH WITH ARTIFICIAL INTELLIGENCE AND MULTIVARIATE STATISTICS FOR SUSTAINABLE URBAN ECOSYSTEMS

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CSBE101550 – Trees form the main natural element of the urban landscape. However, the urban environment induces severe ecological conditions that impair tree growth and survival. To adequately preserve arboreal heritage and warrant a sustainable ecosystem, an analytical model that express street tree growth and define efficient urban tree inventory procedures needed to be developed. To fulfill these objectives, an ecological engineering research project was designed. Using multiple abiotic and biotic variables, data were collected on 1532 trees in five different urban ecological zones of Montréal (Québec, Canada). Seven species representing 75% of the street tree population were sampled. To define the analytical model, artificial intelligence algorithms and multivariate statistics were used synergistically. It was discovered that a combination of eleven dendrometric parameters gave an adequate portrayal of tree physiological stages. Second, the analysis unveiled links between environmental factors and tree growth. Third, artificial neural networks (ANNs) trained under supervised learning recognized tree growth patterns. For most species, growth-cluster prediction on unseen test files ranged from 80% to almost 100%. Finally, for input data typical of aerial lidar laser measurements, multilayer perceptron networks were used to predict the value of essential tree morphological parameters with surrogate variables, and performed well. Overall, the average Pearson r coefficient value for all simulations was 91%. Despite different age-class distribution of trees, dissimilar morphological characteristics, and uneven species partition within urban ecological zones, [...].

IN VIVO FLATFISH SIZE AND WEIGHT MONITORING BY IMAGE ANALYSIS

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CSBE101551 – In Recirculating Aquaculture Systems (RAS) the knowledge of fish size is important for an adequate management: Feed-size and feed quantity should be based on the mean fish size (and number). Sorting is complex and if fish have not reached their full grown slaughtering weight harvest is not possible. In this project a camera system in combination with image analysis is used to estimate parameters like shape, size and weight of turbot (*Psetta maxima*). Different camera setups (above surface, glass bottom box and submerged) were tested for optimising the hardware. For the software, different algorithms (threshold, edge, motion detection) were tested and enhanced. The camera system worked stand-alone 24 hours a day with a mean frame rate of five per second. Images for analysing were automatically selected by motion detection. So, only motion-less flatfish lying on the ground were measured. A pixel-to-centimetres calibration was used to save the measured values and to do the statistical analysis (mean fish length and weight estimation). The comparison of the different camera setups was done in a test tank. Best performance results were achieved with a submerged monochrome camera in a sloped view with an error less than 3 % in length estimation. A trial in a commercial plant leads to consistent values of manual weighting with a deviation of 5 % to the mean fish weight.

MOISTURE ADSORPTION ISOTHERMS OF CASTOR BEANS

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CSBE101553 – The knowledge of equilibrium moisture content of agricultural products is of fundamental importance in the determination of water loss or gain at a given condition of temperature and relative humidity, relating directly with drying and storage processes. The relationship among moisture content and relative humidity of a certain product at a specific temperature can be expressed by mathematical equations, denominated sorption isotherms. They are important to define dehydration limits of the products, as well as to estimate alterations of moisture content due to variations of environment conditions. Also, they provide information that can be used to define adequate moisture content range during storage in order to prevent processes that deteriorate the products quality. That being stated, the aim of the present work was to obtain the adsorption isotherms of castor beans at several temperature and relative humidity conditions of air. The dynamic method was employed to obtain the equilibrium moisture content of castor beans. The air conditions were provided by a temperature controlled chamber, in which removable perforated trays were placed inside the equipment to allow air to pass through the samples. Mathematical models to represent the hygroscopic properties of agricultural products were fitted to the experimental data. It was concluded that the equilibrium moisture content of castor beans, obtained through adsorption, decreases with temperature increase at a certain relative humidity, as observed by most agricultural products. Based on statistical parameters, the Modified [...].

IMPROVEMENT OF A PASSIVE FLUX SAMPLER FOR THE MEASUREMENT OF NITROUS OXIDE (N₂O) EMISSIONS

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CSBE101555 – This paper presents the research projects performed on the development of a passive flux sampler used to measure nitrous oxide (N₂O) from agricultural sources. The main objective was to improve sampler efficiencies and analysis methods. Many aspects of the developed sampler were improved: 1) the sampler was modified to insure air tightness and to facilitate maintenance; 2) the gas adsorption capacity was increased by enlarging the thickness of the adsorbent layer; 3) a new desorption process was evaluated; 4) a more accurate K factor (relation between inside and outside air velocity of the sampler) was calculated for every absorbent thickness tested. The adsorbent thickness was increased from 2 mm (original thickness) to 4, 6 and 8 mm, gaining adsorption capacity of 96, 187 and 275%, respectively while having a similar adsorption efficiency of 98%. The new desorption process improved desorption efficiencies for every absorbent thickness: from 68% to 83% in 2 mm layer, from 57% to 75% in 4 mm layer, from 45% to 82% in 6mm layer and from 30% to 74% in 8 mm layer. The accuracy of the sampler was also improved to reach 77% ± 14%. The calculated K factors were between 7.9 x10⁻⁴ and 8.8 x10⁻⁴. The results confirmed that the modifications done to the sampler and analysis methods contributed to improve its performances and development.

CONTINUOUS FERMENTATIVE HYDROGEN PRODUCTION IN DIFFERENT PROCESS CONDITIONS

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CSBE101564 – Hydrogen is a clean energy carrier which has a great potential as an alternative fuel. To produce hydrogen by fermentation of biomass, a continuous process using a non-sterile substrate with a readily available mixed microflora is desirable. This work investigates a continuous procedure at pH 5.2 and 37°C, using heat treated digested sewage sludge of a wastewater treatment plant, and continuous hydrogen production from waste sugar in different stirring speeds and Hydraulic retention times (HRT). For continuous biohydrogen production the experimental setup of three 5.5-L-working volume continuously stirred tank reactors (CSTR) in different stirring speed (240, 135, 80 rpm) were constructed. At the optimum operation condition seven HRTs and different organic loading rates (OLR) of 3-11 kg DOC/m³.d (Dissolved Organic Carbon) was examined. The results indicated that the stirring speed of 135 rpm had a beneficial effect on H₂ fermentation. The best performance was obtained in 135 rpm and 8 h of HRT. The gas amount varied with different OLRs, but could be stabilized on a high level as well as the hydrogen concentration in the gas with 62-64%. No methane was detected in the HRTs less than 16 h. The most stable result achieved with reactor at 135 rpm. In addition the highest specific rate of hydrogen production was reached at with 2.13 LH₂/Lmedia.d.

THE CONTRIBUTION OF AGROFORESTRY SYSTEMS TO ECOSYSTEM SERVICES

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CSBE101565 – Agroforestry systems are traditional land management systems that have recently been under development in temperate zone. These systems are defined as sustainable ways using land which integrate both agricultural and forestry practices on the same land and at the same time. They are of particular significance to marginal regions and degraded lands where the land use system represents an alternative to land abandonment and afforestation, leads to diversification of land use and offers new socio-economic benefits. Agroforestry systems improve the efficiency of utilisation of natural resources, improve microclimatic conditions within the system, can help mitigate severe soil erosion problems and nutrient losses, enhance landscape biodiversity, lead to an overall high biomass production for material or energy conversion (fuel wood), and thus matching the increasing demand for a self-supplied bioenergy in rural decentralized areas. For this reason, temperate zone agroforestry systems attract more and more public attention as they offer a promising and comprising way for adapting agricultural production to Climate Change and providing comprehensive ecosystem services. A comprehensive assessment of the ecosystem services in agroforestry systems in temperate regions should consider the potential to produce biomass and food, the evaluation of the carbon and nutrient budgets, [...].

AN INTERDISCIPLINARY ECOLOGICAL ENGINEERING APPROACH TO THE ASSESSMENT AND ENHANCEMENT OF LAGOONS IN CALIFORNIA'S CENTRAL COAST

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CSBE101569 – Along the Central California Coast, the term “lagoon” is most commonly applied to backbarrier wetlands and areas of open water that form where coastal stream mouths are naturally dammed by accretion of beaches during low flows, when the stream discharges by seepage through the beach. High winter flows breach the beach berm, and the systems are temporarily able to experience marine influence from storms and spring tides. The variable but predominantly fresh-brackish salinity regimes in these lagoons differentiate them from their analogues in other areas. Recent studies suggest that these highly productive ecosystems may play a disproportionally important role in the life cycles of federally-listed steelhead and coho salmon, as well as providing critical habitat for a broad range of other species such as tidewater goby, California red-legged frog, and many birds. For these and other reasons, lagoon systems have increasingly become a resource of management interest for many federal, state, and local agencies. However, due to their unique combination of coastal and fluvial hydrology, morphodynamics, and ecological communities, the relationships between governing physical processes and ecological responses in lagoons are poorly understood. This has made it difficult for resource agencies to assess and, if necessary, enhance these habitats for the benefit of target species and overall ecosystem health. The authors present an interdisciplinary, ecological engineering approach to assessing and enhancing these ecosystems that has been successfully applied to two very different lagoon systems: Laguna Creek Lagoon in Santa Cruz County and Pilarcitos Lagoon in San Mateo County.

IN-LAKE ALGAL BLOOM REMOVAL AND ECOLOGICAL RESTORATION USING MODIFIED LOCAL SOIL TECHNOLOGY

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CSBE101575 – A “modified local soil induced ecological restoration” (MLS-IER) technology was developed for the restoration of degraded shallow lakes. This technology makes it possible to remove harmful algal blooms (HAB), to improve water quality, and to restore submerged macrophytes in shallow lakes simultaneously, safely, efficiently, and cost-effectively by using modified local soils, which can be carried out mechanically and automatically to very large areas. In 2006, MLS-IER was used in the whole bay (0.1 km²) in Taihu Lake (Wuxi, China, where a HAB caused disaster (the bay was fully covered by several centimeters’ HAB; fish and aquatic plants died; huge malodor) was successfully removed within one day using MLS-IER. Chlorophyll-a, total-P, and total-N within the bay were reduced by more than 86 % one day after the treatment and remained decreased over the following months. Algae toxins of microcystins RR and LR were reduced by more than 50% and 40% respectively compared to that outside the bay 4 months later. Macrophytes were successfully restored 4 months after the treatment, while the biomass of submerged macrophytes outside the bay was still nil during the same period. Four months after the treatment, the biodiversity index of zoobenthos and that of phytoplankton inside the bay became higher than that outside the Bay, [...].

TRANSFORMING ANAEROBIC DIGESTION WITH THE 'MODEL T' OF DIGESTERS

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CSBE10578 – Currently, the large scale and high cost of anaerobic digesters prohibits more than 90% of U.S. livestock farmers from realizing the benefits of this technology. This limitation results reduces renewable energy production and declines environmental quality of farmlands. To expand anaerobic digestion methods and address this need, affordable and smaller-scale digesters should be developed that produce renewable energy, and improve environmental quality. Such new technology will enable the majority of livestock farmers to convert manure to methane and realize the benefits of anaerobic digestion while improving their economic efficiency and environmental sustainability. To better explain the need and potential for this technology, an analogy will be made to the development of the Model T. To address this need we installed a modified fixed-dome digester on the OSU dairy in Columbus, OH. The digester is unheated, buried, had a volume of 1m³ and received diluted dairy manure as feedstock. Initial results include the production of biogas at digester temperatures as low 10°C during colder ambient temperatures, and water quality improvements. Results from the first year of operation will be analyzed to improve future performance and enable future development of this technology.

QUANTIFYING AND UTILIZING UNCERTAINTY IN STREAM RESTORATION DESIGN

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CSBE101585 – Public agencies are spending significant funds on stream restoration projects to improve the quality of impaired stream reaches. However, the parameters used for stream restoration design are based on field measurements and calculations that can exhibit a large degree of error and variability. These errors, as well as other uncertainties, such as natural stochasticity and model-structure uncertainty, propagate through to the final design. For this study uncertainty analysis was performed on a stream restoration that took place on 1.5 km of Stroubles Creek in Blacksburg, VA. Monte Carlo simulations were used to calculate a range of design solutions including bench width, bench height, and roughness from measurements such as bankfull flow, slope, shear stress, and grain size. Results of this research indicate the final stream restoration design outcomes can vary over an order of magnitude, reinforcing the high uncertainty and risk associated with stream restoration.

REDUCING ENVIRONMENTAL VULNERABILITY AND ENHANCING COMMUNITY RESILIENCY ALONG THE LOUISIANA COAST THROUGH THE COASTAL SUSTAINABILITY STUDIO

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CSBE101589 – The Coastal Sustainability Studio (CSS) uses a multi-disciplinary and systems-oriented approach to develop pragmatic, trans-disciplinary techniques for reducing environmental vulnerability and enhancing community resiliency along the Louisiana coasts. The CSS approaches issues differently than traditional planning efforts in deltaic coasts, placing more emphasis on achieving both environmental and economic sustainability. The CSS deliberately links challenges of storm disturbances, land-use transformations, and climate change to develop adaptations in coupled natural and human systems. The goals of the CSS are to design sustainable systems that reduce vulnerability associated with diverse scenarios of coastal hazards, habitat degradation, and global environmental change and to find innovative and sustainable solutions to critical problems associated with coastal protection and restoration. The CSS is currently working on a plan to restore environmental, community, and economic sustainability in an area affected by Hurricane Katrina.

CLIMATE CHANGE, ENERGY SCARCITY, AND MISSISSIPPI DELTA RESTORATION

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CSBE101590 – The Mississippi delta is the largest contiguous coastal ecosystem in the U.S. During the 20th century, there was a high rate of coastal wetland loss (up to 100 km²/yr) that was mainly attributable to levee construction along the Mississippi River, resulting in elimination of riverine input to most coastal wetlands, and pervasive hydrologic alterations within the delta due to navigation, drainage, canal construction for energy development-related infrastructure, and impoundments. These hydrologic changes resulted in saltwater intrusion, reduction of sheet flow hydrology, increased flooding of wetlands, and reduction of sediment input to marshes. Historically, the river and delta were managed mainly for navigation and flood control under a complicated array of federal, state, local government regulations. This often resulted in disorganized, contradictory, and ineffective management. Recognition of the severity of the wetland loss problem led to a growing effort to restore the delta. Initially, restoration efforts were focused on small scale, and often unrelated projects. More recently, there has been a realization that restoration must be a comprehensive, integrated effort based on natural functioning of the coast that fundamentally alters the way that people live and work along the coast. Hurricanes Katrina and Rita caused widespread damage to natural ecosystems and human infrastructure and led to the conclusion that effective storm protection is not possible without a restored coast. The Mississippi delta and other deltas worldwide began forming after sea level rise stabilized after the last glacial period. Sea level stabilization led to a massive increase in coastal margin productivity. The first development of civilizations worldwide occurred in the coastal margin, generally near large deltas like the Mississippi, within a millennia after sea level stabilization and seems to be related to high coastal margin productivity. During the 21st century, it is likely that climate will become more extreme and that energy will become scarce and expensive. Before the [...].

WATER USE AND SUSTAINABILITY IN GLOBAL CORN PRODUCTION

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CSBE101591 – Increasing stress is being placed on the water resources of the world as the human population continues to grow and more water is demanded for different applications. Corn in particular is a crop of interest due to its widespread cultivation as both a food source and a bioenergy material. In this study we used high resolution (0.5 degree), publicly available data for determining the water demand for corn production at a global scale. The corn growth model DSSAT CERES-Maize was used along with precipitation, temperature and soil data for the year 2000 to predict yield and water demand over the growing season. The results were used to compare both green water use (precipitation) and blue water use (irrigation) at multiple scales: ecoregion, basin, country and continent. This study is part of a life cycle assessment (LCA) for the production of commodity corn globally to create a framework for prioritizing policy, technology and management choices that will optimize global production relative to water use through 2050. The overall purpose of the study is to support a public dialogue about the policy, technology and management choices for water use in agriculture.

QUÉBEC DRIVEN PILOT-SCALE CULTIVATION OF SPOTTED WOLFFISH (ANARHICHAS MINOR)

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CSBE101592 – A pilot-scale growth trial featuring the spotted wolffish (*Anarhichas minor*) is currently being run at the facilities of the Maurice Lamontagne Institute (Fisheries and Oceans, Mont-Joli, Qc, Canada) in collaboration with UQAR, SODIM, MAPAQ, MDEIE and the Biodôme de Montréal. Spotted wolffish is a cold-adapted bottom-dwelling marine fish species found in the northern part of the Atlantic ocean (including the Gulf and Estuary of the St-Lawrence). Optimal growth temperatures vary between 6 (broodstock) and 10 °C (early stages). The wolffishes have been identified as group of promising candidates for aquaculture diversification in cold environments (e.g. Quebec, Newfoundland, Norway, Iceland) due to their flesh qualities, robustness, high growth rate at low temperature, density requirement and ‘farming friendly’ life-cycle. Research efforts on these species have been conducted in Québec, Canada since 1999 and focused on reproduction, early-life stages and market outlooks of the spotted wolffish. The next crucial step is to demonstrate that it is an economically interesting species and worthy of further development. This project is aimed at applying “state of the art” rearing practices in order to reach optimal growth of the spotted wolffish until commercial size (1.0-1.5 Kg) is reached, while taking into consideration “fish welfare”. Our large-scale trial will also be examining family effects and the impact of grading fish on growth and hierarchy. Our current estimations indicate that our captive population display similar performance than Icelandic and Norwegian growth data.

GREYWATER IRRIGATION: ANTIBACTERIAL AGENTS AS BARRIERS TO GREYWATER REUSE

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CSBE101593 – The development and use of marginal water for non-potable uses (e.g. irrigation) is critical in light of global water shortages. Greywater (GW), household wastewater containing all used water except sewage, accounts for between 50 and 80% of the wastewater produced in households. The use of GW for irrigation could therefore result in substantial savings in potable water in arid regions. Because greywater reuse results in direct discharge to the environment, concerns have been raised about possible environmental and public health impacts. For example, the presence of antibacterial compounds in greywater raises concerns regarding the potential selection for and spread of antibiotic resistant microorganisms in the environment. Our findings show that, microbial populations resistant to tetracycline increased in soil irrigated with GW containing triclosan. Furthermore, the structure of the soil microbial community changed showing two very distinct patterns of substrate utilization. The microbial community in the soil irrigated with GW plus triclosan was significantly less diverse than that irrigated with GW only. This difference could influence microbial soil processes such as nutrient cycling and ultimately impact plant growth and ecosystem health. Therefore, our results indicate that greywater should be treated to remove antibacterial agents before its use in lawn irrigation. Alternatively, the use of antibacterial containing products should be significantly reduced.

DESIGN AND IMPLEMENTATION OF A FOREBAY-POND-WETLAND SYSTEM FOR URBAN STORMWATER TREATMENT IN SOUTH TEXAS

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CSBE101595 – Urban stormwater runoff water quality is increasingly becoming a major contributor to nonpoint source water pollution for 21st century development. It can not only become a cause of flooding if not properly managed during storm events, but also is a cause of water pollution through runoff containing sediment and materials. Natural and semi-natural water and wastewater treatment technologies can provide effective water quality improvement and quantity control. Over the past several years, best management practices, including detention basins, biofilters and constructed wetlands, have been very successful in removing total suspended solids and pollutants from wastewater. A sequential treatment system including a forebay, pond, and wetland has been proposed to incorporate the merits of these approaches and improve runoff water quality. Hydraulic detention time, attached growth media and vegetation were three important parameters identified in the designs to help optimize system performance.

GAS PRODUCTION ANALYSIS OF A FIXED-DOME DIGESTER OPERATED UNDER TEMPERATE CLIMATES IN CENTRAL OHIO

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CSBE101597 –The applicability of anaerobic digestion in small farms in the United States is ignored due to the high costs and large size of existing digesters. This creates a need to develop more affordable digesters to realize environmental and energetic benefits on smaller farms in temperate climates. Field and lab experiments were completed to determine the effects of seasonal temperature variation on gas production. After determining a baseline for gas production and digester function, methods can be identified to increase gas production in these conditions. At the OSU dairy farm, a modified fixed-dome digester of 1 m³ was buried 0.5 m below the soil surface and fed with 1 kg/m³ day of diluted cow manure (5% VS). Lab experiments were performed to determine the kinetics associated with six specific anaerobic trophic groups at 5°C and 15°C. For three months in 2009 (10/1/09-12/31/09), the average ambient temperature was 7.2°C, while the average digester temperature was 8.6°C. The average specific gas production during this period was 0.01746 l/Kg VS. Preliminary results show an average reduction of 44% in VS and VFAs concentration of 8441 mg/l inside the digester from which 61%, 26%, 1%, 7% and 5% were acetic, propionic, isobutyric, isovaleric and valeric acids respectively. These preliminary results suggest that the decreasing gas production is related to some kind of kinetic constraints for a specific trophic group.

THE LANDSCAPE DYNAMICS IN PIRAÍ DA SERRA, BRAZIL

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CSBE101600 – The region of the *Piraí da Serra*, located in the *Paraná* State, Brazil, presents the last significant remnants of the *Campos Gerais* ecoregion, which is characterized by a mosaic composed for grasslands and fragments of *Araucaria angustifolia* forest. This area encompasses approximately 51,000 hectares and it was placed among the country's top conservation priority areas. The objective of this work is to analyze the regions' landscape dynamics and to design a new land use system, able to complement economic and nature conservation demands. We set a GIS (Geographic Information System) data-base and mapped land uses systems through visual analysis of patterns on SPOT-5 images (2005), followed by field survey to check the mapping and the land arrangement. It was found that the region has about 59% of native landscapes. These have been threatened by global demand for farming commodities, mainly soybeans and corn, and intensive forestry. The continuous subdivision of the land has also contributed to land use intensification. The land use system is characterized by three main types: intensive farming, intensive forestry and rangeland management; which has distinct liaison and cultural roots to the region. The rangelands systems are considered more compatible with grasslands ecosystems conservation, once it adds direct economic value and presents a lower environmental impact, when compared to other human activities. It also has deeper regional cultural ties. In conclusion, land use planning is essential to the definition of sustainable activities. Thus, participatory strategies are considered fundamental to the success of conservation plans.

ROLE OF TAO (BELOTIA MEXICANA) IN THE TRADITIONAL LACANDON MAYA SHIFTING CULTIVATION ECOSYSTEM

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CSBE101602 – For centuries, the Lacandon Maya of Chiapas, Mexico have farmed the forest while also preserving its regeneration. The Lacandon manage their fallow by planting certain tree species, and voluntarily removing trees that are not optimal for soil fertility. This study focused on tao (Belotia mexicana), one of the Lacandon tree fallow species, and its impact on the soil as it matures in the secondary forest. The effect of tao on soil fertility was evaluated using phosphorus, carbon, nitrogen, earthworm density, pH, and soil moisture. Results were compared using a split-plot analysis. Soil C:N ratios decreased with age of tao, indicating an improvement of litter quality over time. Soil extractable phosphorus decreased with age of tao and increased with distance from tao, which suggests that tao is depleting phosphorus. These results provide a framework for further analysis into how managed trees affect soil fertility in the traditional agroforestry systems. It also shows how traditional ecological knowledge has the potential to contribute to our agro-ecological engineering designs and soil restoration in Mesoamerica.

LOAD ESTIMATIONS USING LOADEST WITHIN AGRICULTURALLY DOMINATED WATERSHEDS ACROSS THE CONTINENTAL UNITED STATES

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CSBE101603 – Row crop agriculture can lead to pollution of streams and rivers through multiple pathways. These effects can be severe, often resulting in eutrophication, increased turbidity, and degradation of benthic habitats. Changes in agricultural management practices have occurred over the years in an attempt to mitigate some of these effects. In order to evaluate the impacts cropping and tillage practices can have on pollutant loading rates, annual mean loads and concentrations were estimated at over 90 sites within agriculturally dominated watersheds (<5% urban land use) across the continental US. Each site was classified according to four major cropping practices including corn, soybeans, cotton, and wheat as well as five major management practices including ridge tillage, mulch tillage, reduced tillage, conventional tillage, and no tillage. To assess pollutant loading at each of the sites, LOADEST, a FORTRAN program developed by the United States Geological Survey (USGS) was used to produce nutrient, sediment, and pesticide load and concentration estimations. Calibration and streamflow data for the program was obtained from the USGS North American Water Quality Assessment (NAWQA) between the years 1992 and 2006. A time series analysis was performed to establish any loading or concentration trends for each of the four cropping practices and five management practices.

PATTERNS IN GROUNDWATER HYDROLOGY OF A SMALL CONSTRUCTED FLOODPLAIN WETLAND

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CSBE101604 – In constructed wetland design, the groundwater component of the hydrologic budget is often oversimplified or unaccounted for completely in practice. The objectives of this study were to 1) characterize the hydroperiod of a constructed floodplain wetland 2) identify trends in groundwater flow and extent of potential confining layers in the soil profile, and 3) estimate annual groundwater contributions to the hydrologic budget. Nested piezometers were installed throughout a small constructed floodplain wetland in the Ridge and Valley of Virginia. Water level data from the central nest in the wetland show a fully connected system with little evidence of confining layers and that the ACOE wetland hydrology criteria is met; the water table was within the top foot of the soil profile for a duration of the growing season for each of the two years of the study. Hydraulic gradients created elevation change from the hillslope to the stream channel drive the direction and magnitude of groundwater flow during most of the annual hydroperiod; however, flow direction changes when the floodplain water table is lowest in the months of July-Nov. Precipitation events cause the stream stage to rise and losing stream contributions to the floodplain reverse flow direction for a period of time. Spatially differentiated flow gradients will be used to quantify wetland through flow and the groundwater component of the hydrologic budget and evaluate seasonal groundwater flow response to precipitation events.

RAIN GARDEN NETWORKS: IMPACTS ON WATER QUALITY

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CSBE101608 – Rain gardens are promoted as a best management practice to reduce overland runoff in communities where impervious surfaces are widespread. Benefits of stormwater mitigation include fewer combined-sewer overflow events, reduction of watershed discharge volume and partial reduction of pollutant loads via biofiltration. There is extensive literature detailing hydraulic and chemical behaviors of individual bioretention cells and a growing number of network models, but currently no peer-reviewed studies on implemented networks of rain gardens. Starting in February 2009, two adjacent neighborhoods of comparable size and residential density (0.05 sq.mi., ~33 homes) in Westerville, Ohio were monitored for storm water discharge before and after the construction of residential rain gardens (14 downspout, 6 street-side) in one neighbourhood. The other neighbourhood was monitored as a control site to provide a reference for each storm event during the three year experiment. Flow data was collected at the outfalls of storm sewers for each neighbourhood. A weather station and rain gage were installed to calibrate flow data to specific storm events. The rain gardens will be installed during a 28-day period starting June 2010, allowing for four months of baseline discharge data collection. Models show rain gardens decreased total runoff in the experimental neighbourhood by 50% or greater (confirmed by data collected in spring of 2010). Water samples were collected from the outfalls and channels during storm events and analyzed for TN, TP and DOC to understand the impact of overland runoff from residential yards and roads on water quality in the drainage channel.

PHOSPHORUS REMOVAL FROM AGRICULTURAL SUB-SURFACE DRAINAGE WASTEWATERS IN A CONSTRUCTED WETLAND

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CSBE101609 – Constructed wetlands (CW) are an efficient and cost-effective way of removing pollutants from wastewaters. Agricultural sub-surface drains can expel significant amounts of pollutants, such as excessive nutrients, BOD and COD, suspended solids and endocrine disrupters. Excessive Phosphorus is one of the major causes of accelerated eutrophication of freshwater ecosystems, characterized by cyanobacterial blooms. The Sub-Surface Horizontal Flow (SSHF) CW is one of the simplest and most promising CW technologies. It can easily be implemented as a third line of defence Best Management Practice for the alleviation of pollution coming from agricultural sub-surface drains. Water is circulated through a soil media, over which vegetation is grown. The objective of this study is to observe the P-removal efficiency of a SSHF Constructed Wetland. The experiment has been ongoing since 2006 at McGill University's CW pilot-scale experimental site, located in Ste-Anne de Bellevue, Québec. The soil media is coarse grain sand and the CW is planted with Cattails (*Typha latifolia* L.) and Reed Canary Grass (*Phalaris arundica* L.). The actual retention time is 2.2 days, with the theoretical retention time (plug flow assumption) being 1.0 day; the active volume ranges from 56 to 74%. From July 1st to October 1st 2009, the system was continuously fed with 1 L*min⁻¹ of a simulated agricultural sub-surface drainage wastewater, containing 0.3 mg*L⁻¹ PO₄-P. The experimental site includes 3 replicates and the P-removal efficiency is monitored on a weekly basis. We will present the results and discuss the evolution of P-removal efficiency throughout the 2009 season.

EVALUATION OF TOXICITY METRICS AND THE TOXICITY OF DIFFERENT PRODUCTION METHODS IN THE US

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CSBE101610 – The objective of this study was to evaluate different index methods used for assessing toxicity and to assess the toxicity of different US cotton production practices, using these toxicity methods. These methods include CML 2001, TRACI, Impact2002+, ReCiPe and EIQ. We have found that none of the methods have values for every pesticide in the study, although Impact2002+, EIQ and ReCiPe have most of the pesticides. Each method provides index values for both ecological toxicity and human toxicity; however each method breaks these down into more refined categories that differ across each study. Impact2002+, EIQ and ReCiPe also provide a weighting system that combines the human and ecological toxicity values into a single score value. Each toxicity index uses different calculation and weighting methodology which causes the methods to produce fairly different results for both pesticide ranking and production method ranking. Due to these differences in results, one must have a clear understanding of how the different methods work in order to determine when it may be more appropriate to use one method over another. In particular, when making claims comparing one product or production method, there must be clear justification for using one method over another. These index methods appear to generally provide good first approximation rankings for pesticides and production methods, but because toxicity really depends upon the exposure to the substance, [...].

USING USGS NAWQA AND EPA WSA DATA TO ASSESS THE IMPACT OF AGRICULTURAL PRACTICES ON AQUATIC BIODIVERSITY, IN-STREAM WATER QUALITY, AND HABITAT PARAMETERS AFFECTING BENTHIC MACROINVERTEBRATES IN THE UNITED STATES.

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CSBE101612 – Data from the United States Geologic Survey (USGS) North American Water Quality Assessment (NAWQA) and the United States Environmental Protection Agency (EPA) Wadeable Streams Assessment (WSA) were used in an attempt to identify any correlations between agricultural cropping and tillage practices and aquatic biodiversity. Also analyzed for correlations to agricultural practices were in-stream water quality and habitat parameters which can affect benthic macroinvertebrates. Sites from the USGS NAWQA program had data from 1992 to 2008 at many sites. Data from the EPA WSA were mostly from a single year (2004). Loads of nutrients, sediment, and pesticides were calculated for the NAWQA assessment sites using the USGS computer modeling program LOADEST. Watershed values for landuse, cropping practices, and tillage practices were calculated from county level resolution data. Data were analyzed for relationships among the different measures as well as temporal variation. This presentation will mostly cover the methods used and challenges encountered with using such expansive data sets, as well as any significant correlations found.

ENGINEERING AUTONOMY IN AN ALGAL TURF SCRUBBER TECHNO-ECOSYSTEM

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CSBE101613 – One of the frontiers of ecological engineering is the design of autonomous technoecosystems—engineered self-organizing hybrids of ecological and technological components. Results from the engineering of an algal turf scrubber (ATS) technoecosystem that employs feedback control to optimize limiting factors are presented. To inform the design of the feedback control algorithm, the subsidy-stress relationship of flow turbulence on ATS ecosystem metabolism (measured via diurnal pH monitoring) and algal biomass production was determined for low- and high-light conditions at a moderate nitrogen loading rate. Results showed that, for low-light conditions, both net productivity (P) and respiration (R) were significantly reduced at the extremes of flow turbulence compared to a moderate turbulence level. This effect was reduced at higher light conditions and higher nutrient conditions, displaying the interaction of limiting factors in the determination of overall ecosystem metabolism. This information was used to develop a feedback control system that executes changes to volumetric flow rate to optimize the turbulence level for maximum algal productivity. Testing of the algorithm both virtually and physically resulted in convergence on the expected flow rate for maximum productivity, although the rate of convergence was sensitive to time-scale parameters of the algorithm and to variance in the metabolism parameter. Results from the testing of the feedback control system suggest implications for the design of more autonomous techno-ecological hybrids.

EFFECTS OF OZONE AND WATER EXCHANGE RATES ON WATER QUALITY AND RAINBOW TROUT, *ONCORHYNCHUS MYKISS*, PERFORMANCE IN REPLICATED WATER REUSE AQUACULTURE SYSTEMS

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CSBE101615 – Rainbow trout performance and water quality criteria were evaluated and compared within replicated 9.5 m³ water reuse aquaculture systems (WRAS) operated with: 1) low water exchange with and without ozone; 2) low water exchange with ozone versus high water exchange without ozone; and 3) near-zero water exchange with and without ozone. Ozone caused a significant increase in ultraviolet transmittance of the culture water and significantly reduced total suspended solids, color, and biochemical oxygen demand, as well as dissolved copper, zinc, and iron. Reduction of the aforementioned dissolved metals was important since each can be toxic to fish at elevated concentrations. The origin of dissolved copper, zinc, and iron in the WRAS was likely feed related since these metals are added in trace quantities within the vitamin pack, but copper was also found to leach from copper piping which supplied water to the systems. Ozone did not inhibit nitrate nitrogen concentration. Nitrate nitrogen accumulated to approximately 100 mg/L in WRAS operated at low exchange and >400 mg/L in WRAS operated at near-zero water exchange. Rainbow trout mortality was greater in WRAS with mean nitrate nitrogen of 400+ mg/L and fish exhibited erratic behaviour. Thus, nitrate nitrogen accumulation could represent a barrier to operating WRAS as closed or near-zero exchange, without the addition of unit processes capable of denitrification. Rainbow trout growth rates, feed conversion, and condition factor were generally greater within WRAS operated with ozone due to the improvements in water quality described in this paper.

EVALUATION OF ATTACHED PERIPHYTIC ALGAL COMMUNITIES FOR BIOFUEL FEEDSTOCK GENERATION

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CSBE101617 – Algal biomass is a promising feedstock for biofuel production. With a high lipid content and high rate of production, algae can produce more oil on less land than traditional bioenergy crops. Algal communities can also be used to remove nutrients from wastewater. A variety of algal growth systems have been introduced, including enclosed photobioreactors and open pond systems. These systems can be highly productive, but also difficult to maintain. The purpose of this study was to demonstrate the ability of an algal turf scrubber (ATS)TM to facilitate the growth of attached periphytic algal communities for the production of biomass feedstock and the removal of nutrients from a local stream. A pilot scale ATS was implemented in Springdale, AR, and operated over the course of a nine month sampling period. System productivity over the nine month operating time averaged 26 g per m² per d. Total phosphorus and total nitrogen removal averaged 48% and 13%, respectively.

DECISION SUPPORT SYSTEMS FOR ENVIRONMENTAL MANAGEMENT AND CONSERVATION: A GIS-BASED MODEL

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CSBE101618 – Geographic Information System (GIS) applications for environmental data analysis and planning are gaining interest in different disciplines concerning Environmental Management. Some of these GIS-based applications are already playing an important role in decision making at various levels, both in government and private organization such as ecology labs, planning departments, parks, agencies, and non-profit organizations to promote sustainable growth. In this research, we devise a conceptual framework for designing a GIS-based decision support system that encompasses and synthesizes a broad spectrum of data into four basic components, namely: the water component, the land component, the wildlife component, and the vegetation component. The proposed system leads environmental managers to support managerial decision making in some important issues concerning environmental hazards, environmental health, and some human and ecological impacts. In order to analyze the applicability of the proposed system in Puerto Rico, we are considering two environmental problems in a case study: the impact of reducing vegetation in urban areas in Puerto Rico, and the action plan for conserving the fragile ecosystem in the San Juan Bay Estuary.

DEFINING SUSTAINABLE DEVELOPMENT TARGETS FOR COASTAL HYDROLOGY, WATER QUALITY, AND ECOLOGY IN SOUTH CAROLINA, USA

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CSBE101620 – Headwater streams in lower Coastal Plain forests of the Southeastern U.S. function as natural storage and conveyance mechanisms for surface and groundwater flows. Water table elevations influenced by evapotranspiration, both seasonally and diurnally, often control stream flows where soil saturation typically drives surface runoff. The dynamics of coastal forested watersheds are complex, and water budgets of these headwater streams are difficult to quantify. Assessing baseline hydrology and vegetative ecology, as well as their interaction, provides a benchmark for sustainable development goals over the course of land use change, and understanding short- and long-term hydrologic response to this change. Bannockburn Plantation, located in coastal South Carolina, USA provides a unique opportunity for the spatial and temporal investigation of coastal hydrology, ecology, and land use change. The site is currently dominated by forested wetlands and upland pine stands and is slated for future development. The site is also part of a remote data acquisition network project - the Intelligent River™. Toward the goal of quantifying the water budget in a pre-development forested watershed, stream flows, groundwater levels, and rainfall are being measured in an approximately 400-acre coastal watershed, Upper Debidue Creek, at Bannockburn Plantation. Evapotranspiration rates are also being estimated where temperature, relative humidity, and photosynthetically active radiation (PAR) are being measured on site. Sap flow is being measured in both upland pine stands and in stands of mixed hardwoods in the floodplain.[...].

THE EARSING SILLS OXBOW WETLAND RESTORATION EFFORT: A CASE STUDY IN INTERDISCIPLINARY COLLABORATIVE EDUCATION IN ECOSYSTEM RESTORATION

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CSBE101624 – The Ecosystem Restoration through Interdisciplinary Exchange (ERIE) Program at the University at Buffalo (UB) is an interdisciplinary doctoral program that advances ecosystem restoration science and engineering while contributing to the ecological recovery of the Great Lakes and western New York State. Collaborative partnerships span seven UB academic departments and external entities to provide a novel environment for training researchers in the technical, cultural, and ethical issues of restoration practice. Training activities include interdisciplinary courses on restoration philosophy, theory, and practice; team dynamics workshops; and professional exchanges with U.S. and Canadian partners. A test of the interdisciplinary learning environment occurred in Fall 2009 with the inaugural “Ecosystem Restoration Practicum” course in which trainees collaborated across disciplines in a culminating restoration project. Six trainees from five separate disciplines (American Studies, Biology, Environmental Engineering, Geography, and Philosophy) coalesced as a consultant team to study restoration alternatives for the Earsing Sills Oxbow Wetland (West Seneca, NY), a regionally-rare riparian environment of legacy value to the heavily industrialized Buffalo River watershed. Trans-disciplinary intra-group communication was facilitated by the shared experience of the ERIE educational environment. Self-organization of the project goals and objectives yielded a unique set of deliverables, including a sub-watershed restoration and stewardship plan that contributes to [...].

UNDERSTANDING THE REMOVAL MECHANISMS OF PHARMACEUTICAL COMPOUNDS IN A CONSTRUCTED WETLAND SETUP

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CSBE101626 – Veterinary antibiotics are a major player in the usage and ecological occurrence equation of pharmaceutical compounds. Ionophoric antibiotics are widely administered to farm animals. Of the total, only a small portion is used for actual disease specific therapy, rest of the usage is for metaphylaxis, prophylaxis and subtherapeutical purposes. Their presence in various environmental matrices has been confirmed by numerous studies. On account of limited removal by traditional methods, there is a need to evaluate non-conventional approaches like wetlands. The study primarily is an attempt to obtain an insight in the removal mechanisms of Ionophoric antibiotics that potentially occur within a constructed wetland setup. In this context, sorption potential for the selected compounds shall be determined for the wetland soil matrices; role of photodegradation will be evaluated, contribution of wetland bio-factor in the overall reduction shall also be discussed

INVESTIGATION OF SHELLLED CORN DRYING IN A MICROWAVE ASSISTED FLUIDIZED BED DRYER USING ARTIFICIAL NEURAL NETWORK

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CSBE101628 – Drying characteristics of shelled corn (*Zea mays*.L) with an initial moisture content of 26% dry basis (db) was studied in a fluidized bed dryer assisted by microwave heating at four air temperatures (30, 40, 50 and 60°C) and six microwave powers (zero, 180, 360, 540, 720 and 900W). Several experiments were conducted to obtain data for sample moisture content versus drying time. The results showed that increasing the drying air temperature resulted in a decrease of at most 5% in drying time while in the microwave-assisted fluidized bed system, the drying time decreased dramatically up to 50% at a given and corresponding drying air temperature at each microwave energy level. As a result, addition of microwave energy to the fluidized bed drying is recommended to enhance the drying rate of shelled corn. Furthermore, in the present study, the application of Artificial Neural Network (ANN) for predicting the drying time (output parameter for ANN modeling) was investigated. Microwave power; drying air temperature and grain moisture content were considered as input parameters for the model. An ANN model with 170 neurons was selected for studying the influence of transfer functions and training algorithms. The results revealed that a network with the Tansig (hyperbolic tangent sigmoid) transfer function and trainrp (Resilient back propagation) back propagation algorithm made the most accurate predictions for the shelled corn drying system. The effects of uncertainties in output experimental data and [...].

TECHNO-ECONOMIC ASSESSMENT OF ANAEROBIC DIGESTION SYSTEMS FOR AGRI-FOOD WASTES

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CSBE101633 – It is estimated that activities in the Fraser Valley region of BC generate 3 million tonnes of agriculture and food wastes annually, 85% of which are estimated to be readily available for anaerobic digestion; and the overall potential for energy generation from biogas through anaerobic digestion is estimated to be 30 MW. The most probable scenario, at least in the near future, for the development of anaerobic digestion in BC is on-farm manure-based systems, which may also accept off-farm food processing wastes as an alternative option to large centralized industrial complexes. The environmental benefits of adapting anaerobic digestion include: odor control, pathogen reduction, improved water quality, reduced greenhouse gas emissions and reduced landfill usage. The economical benefits of using anaerobic digestion include: power and heat generation, biogas upgrading, and further processing of the residues to produce compost or animal bedding. An Anaerobic Digestion (AD) Calculator has been developed to assist users in their decision making process of investing in AD facilities. One objective is to classify the many currently available and feasible technology options into several major types of AD systems. Another objective is to construct kinetic and economic models for these systems. The calculator was developed, keeping in mind that it should be relatively simple yet providing fair estimation on biogas yield, digester volume, capital cost and annual income. Factors such as the degradability of wastes with different compositions and different operating parameters are taken into consideration. Economic assessment of alternative AD systems and biogas utilization options is [...].

CENTRIFUGAL POTENTIAL ENERGY: AN ASTOUNDING RENEWABLE ENERGY CONCEPT

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CSBE101636 – It has now been discovered that an entirely new energy concept, known as the “Centrifugal Potential Energy” can now be used as an alternative or replacement to the conventional work and heat transfers in Engineering Systems. This new energy concept is capable of increasing the pressure, temperature and enthalpy of a fluid, without having to apply a work or heat transfer to the fluid. The operation is due to a change in the centrifugal potential energy of the flowing fluid in a Rotating Frame of Reference (Centrifugal Force Field), work is done internally by the centrifugal weight of the fluid on the fluid, thus increasing fluid pressure, temperature and enthalpy. Hence, this energy concept has led to the derivation of novel energy equations, as the Rotational Frame Bernoulli’s Equation for liquids and the Rotational Frame Steady-Flow Energy Equation for gases. Some important applications of these equations are incorporated in the design of the centrifugal field pumps and compressors respectively. These devices are capable of compressing a fluid without a physical load transfer, but via the effect of centrifugal force applied to the object. When this high pressure compressed working fluid is made to expand in an expansion engine (i.e. turbines, nozzles etc), a large amount of energy is produced. Analyses conducted show that when water is used as the working fluid, it could reach renewable energy densities in the range of 25-100 kJ/kg-H₂O; and when atmospheric air is used, it could reach energy densities in the range of 500-1,500 kJ/kg-Air. Centrifugal power systems utilizing such energy density [...].

SEVERAL GROUNDWATER LEVELS AFFECTING SORGHUM PLANTS IN PROTECTED ENVIRONMENT

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CSBE101637 – This study aimed to evaluate the development of sorghum plants (*Sorghum bicolor* L. Moench) submitted to different water table treatments. The experiment was carried out in a glasshouse on trays with water reservoirs that allowed sub irrigation and pots made of PVC tubes (15 cm diameter) with different heights simulating different levels of a water table with six depths (0.17m; 0.31m; 0.45m; 0.59m; 0.73m and 0.87m) in a completely randomized design. The statistical analysis of the data was done by comparing means using Tukey’s test at 5%. Treatment T6 was not considered in the analysis because of the lack of sufficient plants. Under the prevailing conditions in this experiment, it was not recommended to have water table level depths below 73 cm; water table level depths between 45 and 59 cm had significantly higher values for both fresh and dry matter of plants. These variables for the panicles, as well as the length, were thought to be higher for the water table level from 59 to 73 cm; but the plants tended to be higher at depths of 45 cm (130.55 cm) and 59 cm (133.80 cm). Regarding the stem diameter, there was no statistical significance among the treatments at 45, 59 and 73 cm. However, they were significantly differences between the plants cultivated at water table levels closer to the surface; the roots with water level at 17 cm presented the lowest statistical values when compared to the other ones; the plant evapotranspiration rates had similar values, except for treatments at 17 and 73 cm that presented the lowest values. The values of Kc (ETc/ETo) had averages around 0.50 in the first stage and 1.30 in the following one.

A MULTI-LINGUAL TRANSLATION ENGINE FOR TRANSLATING RATION FORMULATION PROGRAMS FROM ENGLISH TO SPANISH, PORTUGUESE, ITALIAN, GERMAN, AND FRENCH LANGUAGES

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CSBE101638 – A multi-lingual translation engine was developed to translate the existing ration formulation programs from English to Spanish, Portuguese, Italian, German, and French languages. The Engine consists of two modules: The first module is a scanning module that scans the source code of the target program written in C++ language and extracts all the English phrases and saves them in a dictionary in Excel spreadsheet format. The dictionary has a column for the scanned English phrase and another blank column for the translation of that phrase. The dictionary also tracks the file name and the line number of each phrase. This dictionary is then forwarded to an expert translator to translate all English phrases into the target language. The second module is a translation module, which uses the translated dictionary and scans the source code written in C++ programming language and replaces all the English phrases with translated phrases. The final step is to re-compile the translated source code and to create a new program in the target language. Currently we are using this approach to translate our dairy cattle ration program, PCDAIRY, from English to Spanish.

WASTEWATER RECLAMATION AND REUSE PRACTICES FOR AGRICULTURE IN KOREA

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CSBE101639 – This paper describes the field experiment with reclaimed wastewater, and reuse practices in Republic of Korea (ROK). The objectives of this study were: 1) to assess the agro-environmental effects of wastewater reuse for agriculture; 2) to develop safe and economically feasible wastewater reclamation systems for districts where the agricultural reuse technologies are applied. Wastewater reuse systems can be greatly beneficial for irrigating crops and improving river water quality by the natural purification effects of rice paddies. The effects of various wastewater treatment levels on water quality, soil, crop growth, yields, and environment were investigated in the study field. The agricultural reuse technologies were applied to in several regions in ROK, such as Suwon, Jeju, Gangjin and so on.

A SEQUENTIAL WET SCRUBBER USING RE-CIRCULATED AND BIOLOGICAL PROCESSED WATER FOR PURIFICATION OF DISCHARGE AIR FROM PIG HOUSES

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CSBE101640 – A prototype of a new wet scrubber has been developed to clean discharge air from a pig barn. It showed the ability to remove more than 90 % of ammonia and up to 90 % of odour (measured in OUE m-3) from the exhaust air of the pig barn. The system applies a two-step process: 1) Removal of pollutants from the air by absorbing them into spray water of two pH-levels. 2) The spent water containing pollutants is purified by a sequential biological water treatment process, which returns water with two different pH levels to the absorption column. It consists of an absorption column (airflow capacity of 500 to 1000 m³ h⁻¹), a water purification unit (total volume of 2 m³) and an ozone generator (10 g ozone h⁻¹). The absorption column is non-biofilm 3-stage spray tower including two different types of nozzles. Their spray rates differ largely from each other (0.35 respectively 0.011 kg s⁻¹). The water purification unit includes a rapid-purification bio reactor (RPBR) and a thorough-purification bio reactor (TPBR). The retention time of RPBR is about 1 min, while TPBR requires a retention time of more than 8 hours. Both bioreactors function in water with high concentrations, e.g. 500 mg l⁻¹ of ammonium, nitrite and nitrate. The system has been established at a pig farm and its performance has been explored.

RHEOLOGICAL PROPERTIES OF PROCESSED LIQUID EGG WHITE PRODUCTS

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CSBE101642 – Recently the food industry increasingly uses ready-to-process egg products as basic materials instead of shell eggs. Subsequent to breaking shell eggs and completing pasteurization they are put on the market as liquid egg products or in powdered form as dried eggs. Consumers prefer a liquid egg that preserves the advantageous properties of natural eggs but its viscosity can be too high due to denaturized egg protein. The aim of present study was to investigate flow properties of liquid egg white produced by recently accepted industrial technologies (pasteurized; long term heated at 53°C; powdered and rehydrated) in comparison with carefully heat treated products (at 53, 57, 63°C temperature for 5, 10, 15 minutes) using raw liquid egg white as control. Rheological measurements were performed using MCR 51 (Anton-Paar, GmbH, Germany) rheometer, controlled by Rheoplus software. A concentric cylinder measurement system (CC 27, 27 mm in diameter, 18 ml measuring cell) was used. Rotational measurements were carried out in controlled shear rate mode at 4°C, increasing the shear rate logarithmic from 500 to 1000 1/s, using five replicates per sample. The Herschel-Bulkley model was fitted to the flow curve of egg white products. Main parameters of the model: yield stress, consistency and power law index, and also the correlation coefficient (R) were determined. Results indicate that structural viscosity of raw liquid egg white was destroyed by all of the industrial pretreatments used. In the case of carefully heat treated products above 53°C and for longer duration times of 5 minutes or higher viscosity compared with control was observed, indicating that due to heat stress egg proteins are denaturized, aggregated producing high viscosity. Based on rotational measurements the optimal heat treatment for liquid egg white products could be predicted, providing objective method for qualifying egg products for industrial purposes.

CHALLENGES IN ECOLOGICAL NICHE MODELLING

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CSBE101644 – Ecological niche modelling combines species occurrence points with environmental raster layers, in georeferenced coordinates, so as to obtain models that describe the probabilistic distribution of a biological species in a pre-defined area. This problem involves many challenges in different areas of knowledge, such as systems interoperability and architecture, distributed database integration, algorithm research, modelling strategies, statistics and parallel computing solutions. This paper presents the main challenges related to the ecological niche modelling problem and discusses the relevance of solving these problems in a broader context. In addition, this work also presents suggestions in order to apply the obtained solutions to solve other related problems.

ANDERSON INTRODUCES A NEW BIOMASS BALER

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CSBE101656 – Anderson Group Co., a Canadian-based company, introduces an innovative round baler able to harvest a large variety of woody biomass. First developed in collaboration with the University Laval and Agriculture & Agri-Food Canada in 2005, the third generation biobaler is now built, engineered and commercialized by Anderson. The machine called, the BIOBALERTM, can produce up to 40 bales/hr in short rotations woody crops as willow and hybrid poplar. The unit can harvest brushes up to 125 mm in diameter. Powered and pulled by a standard tractor, the BIOBALERTM can collect small diameter brushes and understory vegetation in fallow or abandoned land, under power transmission lines, and between planted trees. The patented BIOBALERTM includes a mulcher head attachment, a choice of long or short swivel tongue, a fixed chamber and an undercarriage frame. For more details, visit our website at www.grpanderson.com

MONITORING AND MODELING PHOSPHORUS CONTRIBUTIONS IN A FRESHWATER LAKE WITH CAGE-AQUACULTURE

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CSBE101657 – This project will address current challenges in water quality risk assessment and risk management of cage-aquaculture in Ontario. A mass-balance modeling approach has been applied to gain an improved understanding of the relative contributions of phosphorus loading from various sources into a freshwater lake with cage-aquaculture in Ontario. Lake Wolsey is located on Manitoulin Island in Lake Huron, Ontario. The lake is connected to the North Channel by a small canal where water exchanges periodically. The farm was established 1986 and has annual production of approximately 400 metric tonnes of rainbow trout. We have estimated total phosphorus loadings from 8 sources of inputs and 3 sources of outputs from the lake. We then applied a sensitivity analysis to establish parameters that require empirical measurement and field validation. Preliminary results show tributaries to be the most sensitive parameter in terms of phosphorus loading followed by the exchange via the canal and then followed by contributions by the farm itself. Information from this project will; 1. provide improved understanding of the relative phosphorus contributions of a fish farm to a freshwater lake in Ontario and, 2. will provide water quality managers with scientific information to aid in the decision-making processes related to determining policy and regulatory approaches to sustainable aquaculture management in Ontario.

DRYING OF DATES IN OMAN USING A SOLAR TUNNEL DRYER

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CSBE101658 – A 12 meter long by 2 meter wide solar tunnel batch dryer was designed and constructed to dry 180-200 kg of freshly harvested dates. Half of the partially air-tight tunnel base was used as the flat plate air heating solar collector and the remaining half as a dryer. The drying air was forced from the collector region (south side) to the drying region (north side) of the half circular tunnel where the product was to be dried. The drying temperature could easily be raised from 5-300°C above ambient temperatures inside the tunnel at an air velocity of approximately 0.5 m/sec. The moisture content of 190.2 kg of freshly harvested dates was reduced by 32.8% (wet-basis) to a final average moisture content of 18.6% (wet-basis) within two days (20 hours). The results indicated that the drying was faster in solar tunnel dryer than under natural open air sun drying. It was possible to reach the moisture content level for safe storage within less than two days (20 hrs) with a solar tunnel dryer and 5-7 days in open air natural sun drying. The improvement in the quality of dates in terms of color, brightness, flavor, and taste and food value was distinctly recognizable.

INTEGRATION OF PV MODULES IN EXISTING ROMANIAN BUILDINGS FROM RURAL AREAS

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CSBE101661 – The paper is based on an on-going national research project focused on the promotion of new architectural concepts i.e. BIPV systems, which includes active solar systems (PV generators) and solar tunnels. The advantages of using the distributed solar architecture are more remarkable in the case of large network-connected PV systems, such as the PV systems in the rural area, installed on building's façades or roofs. Thus, in contrast to other EU states, in Romania there is no photovoltaic building construction branch, the limited number of isolated cases being insufficient to identify a starting point regarding the photovoltaic market in the building industry. The major purpose of the project is to demonstrate the efficiency of integrating various PV elements in buildings from rural areas, to test them and to make them known so that they can be used on a large scale. To do this, the new products will be installed on three pilot buildings (two in Bucharest and one in Timisoara) and the PV modules will be integrated in consonance with their architecture. One of them will be a historical building and the other two will be new buildings; they will have different typologies and they will be located in different areas, inclusive in rural areas. The installed power for each building will be of approximately 1.000 Wp, including some technologies with PV modules integrated in the architecture of the buildings.

COUNTERMEASURE OF ENERGY CONSERVATION OF FARM BUILDINGS IN RURAL AREAS OF COLD REGION IN CHINA

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CSBE101662 – In order to evaluate the situation of energy conservation of farm buildings in rural areas of cold regions of China, this paper investigated and analyzed farm buildings in the Dashigou Village of the Heilongjiang Province. In this investigation, several instruments were used. The instruments used were a SCQ-01a Temperature Gathering Recorder, BES-A Overall Heat Transfer Coefficient of Building Envelope Detector and TVS—100 Portable Thermal Infrared Imager. The instruments were used to measure the indoor temperatures and the thermal irregularities in building envelopes were identified. Then the energy consumption was analysed. The result show that when the indoor temperature is low, it is not possible to guarantee comfort and the farm buildings consumed high amounts of energy. The study summarized these problems of energy conservation of the farm buildings in rural areas of this cold region. Additionally some countermeasures were provided based on the study. The first is integrated architectural design including the optimal shape coefficient for buildings and the fewer windows on the north side. The second is the improvement of heat insulating properties of walls by adding insulation material. And the last is improvement of heat insulating properties of doors and windows by reducing heat loss by infiltration. These countermeasures will improve human comfort in rural areas of cold region in China, and reduce energy consumption and greenhouse gas emissions.

BIOSYSTEMS ENGINEERING CURRICULA IN EUROPE

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CSBE101663 – The harmonization process of the European degree study programs in Agricultural/Biosystems Engineering was started in 1989 and is still in progress. At present this process benefits from the results of two European thematic networks: USAEE-TN, whose best achievements are the core curricula to be used as benchmarks for degree study programs in Agricultural/Biosystems Engineering; ERABEE-TN, still working towards developing the results of USAEE-TN itself. Another important contribution towards the harmonization of the European curricula in Agricultural/Biosystems Engineering was achieved through the cooperation between the EU and the US, during the project of POMSEBES consortium. This paper describes the harmonization process of degree study programs in Agricultural/Biosystems Engineering in Europe.

MACHINES FOR WRAPPING DRAINAGE PIPES WITH A DEFINED VOLUMINOUS SYNTHETIC FIBER FILTER

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CSBE101667 – The use of wrapped drainage pipes with voluminous synthetic fiber filters has been very common for the past 30 years in Europe due to their ease of use that eliminate the need for transporting and laying gravel filters that are invariably more expensive. The corrugated flexible drainpipe pipe is completely wrapped with a voluminous fiber filter and the advantages in comparison to gravel filters are: 1) The filter can be produced according to required specifications. Permeability of the filter can be precisely defined by blending different fibres 2) The Filter offers a higher efficiency against silting up as the correct filter can be used for different types of soil. 3) Higher water absorption of the pipe compared with a non-wrapped pipe as the penetration resistance is reduced along the pipe by using a voluminous fiber filter. 4) Highly uniform filter along the whole pipe 5) Filters are easy and cost effective to produce 6) Easy and trouble free installation. A.H. Meyer Maschinenfabrik manufactures very effective machines for wrapping voluminous filters from loose fibers around drainage pipes. The defined permeability of the filter is achieved by precisely blending new and recycled polypropylene (PP) fibers in defined proportions. For example PP450 (permeability is 450 microns). This is done in accordance to the worldwide accepted KOMO Standard for voluminous fiber filters. The machines can also wrap prefabricated filter blankets. A.H. Meyer is the pioneer and worldwide leading company for pipe wrapping machines and has delivered over 100 machines worldwide. The sister company RBM Twistringer Drainfilter is the worldwide biggest pipe wrapping company. www.roess-nature-group.com

DRAINAGE CONTROL SYSTEMS (DCS)

VINCENT MACHABEE

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CSBE101668 – Water management in the field is a very important issue, particularly in vegetable production where shortage in water may significantly reduce crop yield and quality. Drainage control system (DCS) is a system that has been developed by Innotag to use more efficiently rainfall and drainage water. The basic principle of the system is to control the level of the water table by capillarity. It permits to maintain the water in the soil for a longer period of time and reduces the leaching of agrochemical residues. By prolonging the presence of the water table in the soil, the plant water supply occurs during a longer period of time thereby increasing the yield of the crops. In eastern Canada, more than 5000 units have been installed and yields increased from 10 to 40% in a variety of crops such as corn, soya, potatoes and market gardening. The DCS helps to maintain a suitable environment for plant growth in periods of surplus water as well as periods of drought. This permits to obtain stable yields in spite of the whims of Mother Nature. In periods of high rainfall, the drainage needs are met by the system, in order to insure a good yield. DCS also reduces the leaching of agrochemical residues and lower the quantity of discharged water.

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