Program and Book of Abstracts for the 47th Annual:

Alberta Soil Science Workshop

Workshop Theme:

"Soils and the Alberta Land-Use Framework"

Including a Supplementary Meeting on:

"Greenhouse gas emissions from rangeland and perennial cropland"

February 16 to 18, 2010

The Coast Lethbridge Hotel & Conference Center
526 Mayor Magrath Drive South,
Lethbridge, Alberta

www.soilsworkshop.ab.ca

Organizing Committee for the 2010 Alberta Soil Science Workshop

Past Chair: Scott Chang
Dept. Renewable Resources, Univ. of Alberta, Edmonton

Chair: Benjamin Ellert
Agriculture and Agri-Food Canada Research Centre, Lethbridge

Treasurer: Sylvia Chan-Remillard
HydroQual Laboratories/Golder Associates Ltd., Calgary

Secretary: Miles Dyck
Dept. Renewable Resources, Univ. of Alberta, Edmonton

Chairpersons for Technical Groups:

Soil Fertility: Len Kryzanowski,
Alberta Agriculture and Rural Development, Edmonton.

Soil Conservation: Rob Dunn,
Alberta Agriculture and Rural Development, Lethbridge;
Jason Cathcart,
Alberta Agriculture and Rural Development, Edmonton;

Land Reclamation: Chi Chen,
Alberta Environment, Edmonton;
Claudia Gomez
Matrix Solutions, Inc., Calgary

Organizers of the Supplementary Meeting on Greenhouse Gases:

Brian McConkey[1], Alan Iwaasa[1], Vern Baron[2] and Benjamin Ellert[3];
Agriculture and Agri-Food Canada Research Branch,
[1]Swift Current SK, [2]Lacombe AB and [3]Lethbridge AB

Sheilah Nolan,
Alberta Agriculture and Rural Development, Edmonton

Karen Haugen-Kozyra
KHK Consulting, Edmonton

Sponsors of the 2010 Alberta Soil Science Workshop

We are grateful to the sponsors who have contributed to the 2010 Alberta Soil Science Workshop. Please consider sponsorship of future Workshops to support professional soil science in Alberta, and to enhance the visibility of your organization. For the 2010 Workshop we acknowledge the generosity of the following sponsors:

1) Agriculture and Agri-Food Canada - Lethbridge Research Centre
2) Agritrend
3) Agrium Inc.
4) Alberta Government: Environment; Agriculture and Rural Development
5) amec
6) Avensys Solutions
7) EBA Engineering Consultants
8) Encana
9) Genivar
10) HydroQual Laboratories/Golder Associates Inc.
11) Univ. of Alberta, Department of Renewable Resources
12) Univ. of Alberta, Faculty of Agriculture, Life and Environmental Science

About the Alberta Soil Science Workshop

Background
The Alberta Soil Science Workshop is held to facilitate regional interaction among professionals in soil science. Typically 100 to 150 participants gather for a 1½ to 2 day program comprised of 40 to 60 oral and poster presentations. These include: keynote papers focussed on the workshop theme, technical papers within four distinct fields, and volunteer papers. Currently the four technical groups are: Soil Conservation, Soil Fertility, Land Reclamation, and Forest and Wetland Soils.

Workshop participants include a diversity of professionals from private industry (e.g. consultants in agronomy, pedology, reclamation, remediation, and environmental services; chemists from commercial analytical laboratories), government (federal, provincial, municipal) and academia (universities and colleges). The Workshop is graduate student-friendly, providing an excellent opportunity to hone presentation skills in a supportive setting (travel bursaries are available for out-of-town students; awards are made for the best student presentations).

About the 2010 Workshop:
The Workshop coincides with the Alberta Government's recent initiative to better manage land to meet long-term goals (see www.landuse.alberta.ca). To this end, the Alberta Government is establishing a Land-Use Framework based on seven strategies to improve land-use decision making that is tailored to specific regions of the Province. In late 2009 the profile of South Saskatchewan Regional Plan was released to describe the key social, economic and environmental factors that need to be considered when planning land-use in that region. Thus, the theme of the 2010 Alberta Soil Science Workshop, "Soils and the Alberta Land-Use Framework", is highly relevant to developing forward-looking strategies to better manage soils and associated ecosystems.

In addition to the usual sessions, the program is supplemented by a meeting on GHG from rangeland and perennial cropland, emphasizing the mixed-grass prairie region. The Thursday afternoon session will involve considerable group discussion, and participation is optional for regular registrants. The technical session on Forest and Wetland soils will be reinstated at the next Workshop.

Note Abbreviations used in this program:

AAFC = Agriculture and Agri-Food Canada
AARD = Alberta Agriculture and Rural Development
UofA = University of Alberta, Edmonton
UofC = University of Calgary
GHG = greenhouse gases, viz. CO_2, N_2O & CH_4

Program for the 2010 Alberta Soil Science Workshop

Tuesday, February 16, 2010 – Evening: Registration

7:00 – 10:00 PM	Registration, Coast Hotel Lobby Technical Poster and Commercial Display Set-Up (no formal reception; feel free to gather in the Firestone Lounge)

Wednesday, February 17, 2010 – Morning:
Plenary Session, Grand Ballroom

7:00 AM – 5:30 PM	Registration: Coast Hotel Lobby
7:15 – 8:00 AM	Morning Coffee, Tea & Pastries

Plenary Session: "Soils and the Alberta Land-Use Framework"

8:00 – 8:10 AM	Welcome and Introduction
Chair:	Benjamin Ellert, Agriculture & Agri-Food Canada, Lethbridge
8:10 – 9:00 AM	**Overview of Alberta's Land-Use Framework** Morris Seiferling Stewardship Commissioner, Land Use Secretariat, Government of Alberta, Edmonton
9:00 – 9:45 AM	**Identifying the efficient use of soils under the Land-Use Framework** Dr. Jason Cathcart, Land-Use Policy, Alberta Agriculture and Rural Development, Edmonton
9:45 – 10:10 AM	Coffee and refreshments, generously sponsored by Genivar and amec
10:10 – 10:55 AM	**Cumulative ecosystem effects from multiple land uses in the Wood Buffalo region.** Justin Straker*, Brad Stelfox[†], and Shanti Berryman, Stantec, Sidney BC; [†]ALCES Group, Bragg Creek; *presenter
10:55 – 11:40 AM	**The ethics, risk and uncertainty of implementing a land-use framework in light of the evolution of systems-based ecological thought over the last half century** Dr. Ronald McCormick, Sokio Systems, Calgary
11:40 – 12:00 AM	Panel discussion All speakers

12:00 – 1:00 PM Lunch, Grand Ballroom

Wednesday, February 17, 2010 – Afternoon
Concurrent Volunteer Sessions

	Session 1, Grand Ballroom	**Session 2, Southern Ballroom**
1:00 – 1:05 PM	Introduction Chair: Dr. Sylvia Chan Remillard, HydroQual Laboratories and Golder Associates, Calgary	Introduction Chair: Dr. Miles Dyck, Dept. Renewable Resources, UofA, Edmonton
1:05 – 1:25 PM	Reclamation of Vertisolic soils. **Kathryn Bessie and R. Faye**, EBA Engineering Consultants, Calgary	A micrometeorological study to quantify ammonia volatilization losses from surface broadcast urea to cold soils. **Richard Engel & Rosie Wallander**, Montana State Univ., Bozeman MT
1:25 – 1:45 PM	The use of a bench scale biotreatability model as a tool in environmental remediation **Lyriam L.R. Marques,** **A. Crawford, A.L. Douglas, and** **J.S. Goudey;** HydroQual Labs and Golder Associates, Calgary	Nitrous oxide emissions from a Black Chernozem soil in response to polymer-coated urea application and herbicide management in a canola-barley cropping system. **Chunli Li, X. Hao, K.N. Harker, R.E. Blackshaw, G.W. Clayton and J.T. O'Donovan,** AAFC Research Branch, Lethbridge & Lacombe
1:45 – 2:05 PM	Total microbial profiling –A method used to study bioremediation **Pernilla Stenroos, A. L. Douglas, Lyriam L.R. Marques and** **J.S. Goudey;** HydroQual Labs and Golder Associates, Calgary	Nitrous oxide emissions from application of anaerobically digested cattle manure applied to soil. **Raj Mann, F. Zvomuya, X. Hao, R. Atkins and X. Li**; Univ. Manitoba, Winnipeg; AAFC Research Branch, Lethbridge; AARD Lethbridge; Highmark, Edmonton
2:05 – 2:25 PM	Nanomaterials from cradle to grave – terrestrial exposure and potential impacts on soil inhabitants. **Sylvia Chan Remillard and** **J. Stephen Goudey;** HydroQual Labs and Golder Associates Ltd., Calgary	Leaching of nitrate, chloride, and phosphorus from undisturbed soil cores amended with fresh or composted beef cattle manure **Jim Miller, B. Beasley, C.F. Drury, and B. Zebarth**, AAFC Research Branch, Lethbridge AB, Fredericton NB, and Harrow ON
2:25 – 2:50	Coffee & refreshments generously sponsored by EBA Engineering Consultants and Encana (served in the Grand Ballroom)	

	Session 1, Grand Ballroom	**Session 2, Southern Ballroom**
2:50 – 3:10 PM	Role of the Alberta Institute of Agrologists (AIA) Alberta Soils Network **Kathryn Bessie and Paul Martin, representing the executive of the AIA Soils Network,** Edmonton	Adventures in the evaluation of nutrient BMPs at the field scale in Alberta **Gerald R. Ontkean, J. Casson, J. Villeneuve and W. Buruma**, AARD, Lethbridge
3:10 – 3:30 PM	Cattle mortality disposal via composting in a cold climate: feasibility, GHG emissions, and land application of the end product **Xiying Hao, K. Stanford[†], Shanwei Xu, F.J. Larney and T.A. McAllister;** AAFC Research Branch and [†]AARD, Lethbridge	Life-cycle accounting of GHG emissions from beef production in western Canada **Xavier Vergé, R.L. Desjardins, J. Dyer and D Worth**, AAFC Research Branch, Ottawa ON
3:30 – 3:50 PM	Anaerobic digestion of specified risk materials with cattle manure for biogas production. **Brandon Gilroyed, T. Reuter, Angus Chu, X. Hao, W. Xu, and T.A. McAllister;** UofC and AAFC Research Branch, Lethbridge	Total greenhouse gas emission from perennial cropland under intensive management **Vern Baron,** AAFC Research Branch, Lacombe
3:50 – 4:00 PM	Outstanding questions for all presenters and group discussion	Outstanding questions for all presenters and group discussion

Wednesday, February 17, 2010 – Evening

5:00 – 7:00 PM Poster Session (authors present),
Commercial Displays (tradeshow), and
Reception (includes one free beverage),
Grand Ballroom

7:00 – 9:00 PM Banquet, Continental Ballroom

Entertainment by
Gabriel Kastelic - Violin and Tony Kastelic – Viola

Presentation of Student Awards

Wednesday & Thursday, February 17 & 18, 2010
Poster Presentations & Commercial Displays

Poster Session and Commercial Displays

Posters and displays may be set up from 7:00 – 10:00 PM on Tuesday February 16, 2010.

Authors present: 9:45 – 10:10 AM on Wednesday February 17, 2010
5:00 – 7:00 PM on Wednesday February 17, 2010

Posters and displays may be removed after 10:00 AM and must be removed by 1:00 PM on Thursday February 18, 2010

Poster No.

1. Long-term tillage, straw and N rate effects on quantity and quality of organic C and N in a Black Chernozem soil. S. S. Malhi, M. Nyborg, T. Goddard, D. Puurveen and D. Leach, AAFC Research Branch, Melfort SK

2. Long-term tillage, straw and N rate effects on quantity and quality of organic C and N in a Gary Luvisol soil. S. S. Malhi, M. Nyborg, T. Goddard, D. Puurveen and D. Leach, AAFC Research Branch Melfort SK

3. Microbial communities in the Athabasca oilsands. A. Hahn and S. Quideau, Dept. Renewable Resources, UofA

4. A remediation study of a soil system contaminated with produced water. R Saint-Fort and A. Carcamo, Mount Royal Univ., and Amber Environmental, Calgary

5. Water quality and land use in two agricultural watersheds in Alberta. Taren Cleland, Lynda Miedema, Clair Fitzpatrick and Colleen Phelan, AARD Lethbridge

6. Livestock manure improves acid soil productivity under cold northern Alberta climate. M. B. Benke, X. Hao, J. T. O'Donovan, G. W. Clayton, N. Lupwayi, P. Caffyn and M. Hall, AAFC Research Branch, Lethbridge & Lacombe

7. Ex-situ bioremediation of petroleum hydrocarbon (PHC F3 fraction) impacted sediments in upstream oil and gas. Alfredo Carcamo, and Macoura Kone Amber EnviroServices Inc. and Dept. Civil Engineering, UofA

8. Can Avail™ improve phosphorus efficiency in wheat? Rigas E. Karamanos, Viterra Inc.; Grant Jackson, Montana State University; Dick Puurveen, UofA; and John Miller, Montana State University.

9. Effects of interception deposition and canopy exchange on H+ supply to soils in *Pinus banksiana* and *Populus tremuloides* ecosystems in the Athabasca oil sands region. Kangho Jung and Scott X. Chang, Dept. Renewable Resources, UofA

10. Influence of P- and N-based manure application on phosphorus fractions in runoff. Jim Miller, D. Chanasyk, T. Curtis, D. Lastuka, M. Lewis, B Olson, S. Petry, D. Rogness, C. Ross, K. Schmitt, E. Smith and W.D. Willms, AAFC Research Branch, Lethbridge

11. Vegetation response to spent drilling mud application to semiarid, mixed-grass prairie. Francis Zvomuya, Francis J. Larney, Walter D. Willms, Ryan K. Beck, and Andrew F. Olson; Dept. Soil Sci., University of Manitoba, Winnipeg and AAFC Research Branch, Lethbridge

12. Nitrogen indicators for forest productivity in the oil sands region of Alberta. En-Rong Yan, Francis Salifu, Xiao Tan, Chi Chen, Scott X Chang. Dept. Renewable Resources, Univ. Alberta; Suncor; Shell & AB Environment

Commercial
Display No.

1. HydroQual Laboratories and Golder Associates, Inc., J.S. Goudey

2. Avensys Solutions, Tyler Cooper

3. Agri-Trend Agrology, Rob Saik

4. University of Alberta, Dept. Renewable Resources, Miles Dyck

Thursday, February 18, 2010 – Morning
Concurrent Technical Sessions

7:30 – 10:00 AM Registration: Coast Hotel Lobby

	Soil Fertility **Grand Ballroom**	**Land Reclamation** **Southern Ballroom**
7:55 – 8:00 AM	Introduction Chair: Len Kryzanowski, Alberta Agriculture & Rural Development, Edmonton	Introduction Co-Chairs: Claudia Gomez, Matrix Solutions, Calgary; and Chi Chen, Alberta Environment, Edmonton
8:00 – 8:20 AM	Improved fertilizer application methods and enhanced efficiency fertilizers and the potential effect on fertilizer rates. **Tom Jensen**, IPNI, Saskatoon SK	Update on the Reclamation Criteria Advisory Group: Where we are at with the 2010 Reclamation Criteria? **Shane Patterson**, Alberta Environment, Edmonton
8:20 – 8:40 AM	Nitrogen release from pulse crop residues and green manure after 16-18 months of decomposition. **Newton Lupwayi and Y.K. Soon**, AAFC Research Branch, Lethbridge & Beaverlodge	Residual effects of topsoil replacement depths and organic amendments on reclaimed wellsites **Francis J. Larney, A.F. Olson and P.R. DeMaere,** AAFC Research Branch, Lethbridge
8:40 – 9:00 AM	Yield and quality of irrigated timothy to fertilizer application in southern Alberta **Ross H. McKenzie, Eric Bremer, Pat G. Pfiffner, Allan B. Middleton**; AARD & SymbioAg Consulting, Lethbridge	Implications for Reclamation and Soil Monitoring **Murray Riddell,** Matrix Solutions Inc., Calgary
9:00 – 9:20 AM	Phosphorus flows downhill – even in Alberta **Barry M. Olson**; AARD, Lethbridge	Pipeline installation in minimum- and no-till farming areas: Construction learning to assist in reclamation success **Simone Levy and Jim Burke**, Soil Scientists, Matrix Solutions Inc., Calgary
9:20 – 9:40 AM	Impact of controlled released nitrogen fertilizer versus urea on N_2O emission management in Alberta **A. Akbar, L. Kryzanowski, C. Sprout, G. Lohstraeter, L. Powers and T. Goddard**, AARD, Edmonton	Devon Canada Jackfish interconnecting pipeline case study **Don McCabe**, Alberta Environment, Calgary
9:40 – 10:05 AM	Coffee & refreshments generously sponsored by Agrium and Alberta Environment (served in the Grand Ballroom)	

Technical Sessions, Thursday February 18, 2010; Continued:

	GHG from Rangeland and Perennial Cropland **Grand Ballroom**	**Soil Conservation** **Southern Ballroom**
10:05 - 10:10 AM	Introduction Chair: Sheilah Nolan, Alberta Agriculture and Rural Development, Edmonton	Introduction Co-Chairs: Jason Cathcart and Rob Dunn, AARD, Lethbridge & Edmonton
10:10 – 10:30 AM	Semi-arid rangeland livestock GHG emissions **Alan Iwassa;** AAFC Research Branch, Swift Current SK	Effect of sustainable management practices on soil properties of an irrigated rotation study **Francis J. Larney D.C. Pearson, R.E. Blackshaw, N.Z. Lupwayi, and P.J. Regitnig;** AAFC Research Branch, Lethbridge & Lantic Inc., Taber
10:30 – 10:50 AM	Options to reduce greenhouse gas emissions from rangeland **Eric Bremer, B.W. Adams and B.H. Ellert**; SymbioAg Consulting, AARD and AAFC Research Branch; Lethbridge	Quantification of soil erosion: Evaluating wind erosion control BMPs for farm systems with low residue crops **Murray Lewis and M. Black**, AAFC Agri-Environment Services Branch, Lethbridge
10:50 – 11:10 AM	Canada's national greenhouse gas inventory and requirements for including effects of pasture management **Brian McConkey, Dominique Blain and Chang Liang;** AAFC Research Branch, Swift Current SK and Environment Canada, Gatineau QC	A riparian buffers design tool for the Canadian prairies **Alan Stewart, Sharon Reedyk & Bill Franz**, AAFC Agri-Environment Services Branch, Edmonton
11:10 – 11:30 AM	Managing rangeland and perennial cropland to mitigate GHG emissions and generate carbon offsets **Karen Haugen-Kozyra;** Carbon Offset Consultant, Edmonton	Soil C sequestration and other soil property changes under long-term cattle manure land application. **Chi Chang;** AAFC Research Branch, Lethbridge
11:30 – 11:50 AM	Considerations for developing offset protocols for semiarid pastures **Rob Janzen;** Climate Check, Coaldale	Long-term tillage and straw effects on the diversity and density of soil mesofauna in a Black Chernozemic and Gray Luvisolic soil **D. Puurveen, Jeff P. Battigelli* and L.A. Leskiw**, Dept. Renewable Resources, UofA and Paragon Soil & Environmental Consulting Inc., Edmonton *presenter
11:50 AM	Technical Sessions Close	

Thursday, February 18, 2010 – mid-day

11:50 AM – 1:00 PM Lunch, Grand Ballroom

12:30 – 1:00 PM ASSW Business Meeting (including Acknowledgements & Student Awards), Grand Ballroom

Thursday, February 18, 2010 – Afternoon

Supplementary Meeting on:
“Greenhouse gas emissions from rangeland and perennial cropland”

Chair:	Dr. Brian McConkey, Agriculture & Agri-Food Canada, Swift Current SK
1:00 – 1:15 PM	Welcome, Introduction and Objectives Dr. Brian McConkey, Agriculture & Agri-Food Canada, Swift Current, SK
1:15 – 1:30 PM	Terminology for Land Use, Land Cover, Land Management, Grazing Systems, Cropping Systems, Cattle Production Systems Dr. Vern Baron, Agriculture & Agri-Food Canada, Lacombe
1:30 – 2:20 PM	Discussion Paper: Greenhouse gas emission reductions and removals through improved grazing and forage management systems Dr. Emmanuel Mapfumo Instructor, Dept. Renewable Resources, Univ. of Alberta and EBA Engineering Consultants
2:20 – 2:45 PM	Facilitated Group Discussion
2:45 – 3:00 PM	Coffee and refreshments, generously provided by Climate Change Central?
3:00 – 3:50 PM	Grazing management contributions to net global warming potential from rangeland on the Northern Great Plains. Dr. Justin Derner and Dr. Mark A. Liebig, US Dept. Agriculture, Agriculture Research Service, Cheyenne WY and Mandan ND
3:50 – 5:00 PM	Panel discussion and facilitated group discussion All speakers and all participants
6:00 – 8:00 PM	Perennial GHG Group Dinner

Abstracts for the Plenary Session

A Land-Use Framework for Alberta

Morris Seiferling
Stewardship Commissioner,
Land Use Secretariat
Government of Alberta, Edmonton

Alberta's prosperity has created opportunities for our economy and people, but it also has created challenges for Alberta's landscapes. We have reached a tipping point, where sticking with the old rules will not produce the quality of life we have come to expect. To remedy this, the government has released the provincial Land-use Framework and will create seven new regions and develop a regional plan for each. These regional plans will integrate provincial policies at the regional level; set out regional land-use objectives/ thresholds and provide the context for land-use decision-making within the region. A cumulative effects management approach will be used in these regional plans to manage the combined impacts of existing and new activities within the region. New legislation, the *Alberta Land Stewardship Act* will help ensure better alignment of policy, planning and decision making at all levels in Alberta.

Notes:

Identifying the Efficient Use of Soils Under the Land-Use Framework

R. Jason Cathcart
Policy, Strategy and Intergovernmental Affairs, Alberta Agriculture and Rural Development, Edmonton
Email: Jason.Cathcart@gov.ab.ca

Under the Land-use Framework, a number of key strategies and policy gaps have been identified that not only deal with land-use issues, but are either directly or indirectly influenced by the provincial soil resource. This presentation will focus on two related initiatives that have the potential to be influenced by Alberta's soils – the provincial policy gap to reduce the fragmentation and conversion of agricultural land to non-agricultural uses and the Efficient Use of Land Strategy (Land-use Framework Strategy 5). Not since government restructuring in the mid 1990s, has Alberta had a strong direction on planning around agricultural lands. Prior to this period, the loss and conversion of agricultural land was tracked and reported regularly. Results indicating that although the total quantity of agricultural land was relatively stable, the quality of that land base was not, with ever increasing amounts of lower quality land coming into production at rates similar to the loss of high quality land. Moving forward under the Land-use Framework, it will be necessary to review where we are provincially with respect to both land fragmentation and conversion and the efficient use of soil and land resources. New and innovative ways to investigate and address this issue may be required.

Cumulative Soil and Ecosystem Effects from Multiple Land Uses in the Wood Buffalo Region

Justin Straker[1], Brad Stelfox[2], and Shanti Berryman[1]
[1]Stantec, Sidney, BC; [2]ALCES Group, Bragg Creek, AB;
Email: jstraker@jonesassoc.com

The Sustainable Ecosystems Working Group (SEWG) of the Cumulative Environmental Management Association (CEMA) is a multi-stakeholder group formed in 2000 to develop an approach to managing the cumulative effects of development and resource use on ecosystems and landscapes in the Athabasca Oil Sands region of northeast Alberta. In June 2008, SEWG/CEMA delivered its recommendation document, the Terrestrial Ecosystem Management Framework for the Regional Municipality of Wood Buffalo, to the Government of Alberta. The goal of the Framework is to reconcile competing land uses on a regional scale to achieve sustainable environmental, economic and social objectives. The Framework considered "trade-offs" between competing objectives and management actions, as SEWG explicitly recognized that the maintenance of ecological attributes is not simultaneously possible on all regional landscapes with current or projected rates of development. This paper presents:

- the primary technical concepts and methods used by SEWG to reach conclusions about regional cumulative effects;
- major management approaches evaluated by SEWG during Framework development; and
- key components of recommendations presented in the Framework.

The above information will also be discussed from a soils-based perspective, both in terms of environmental effects, and of activities (e.g., reclamation) designed to mitigate or off-set these effects. Finally, the paper attempts to provide information on how the SEWG Terrestrial Ecosystem Management Framework may inform the Lower Athabasca Regional Plan being developed as part of the Alberta Land-Use Framework.

The Ethics, Risk and Uncertainty of Implementing a Land-Use Framework in Light of the Evolution of Systems-Based Ecological Thought Over the Last Half Century

Dr Ronald McCormick
Sokio Systems, Calgary;
Email: mccormick36@gmail.com

The Province can be lauded for initiating such a long-term and broad-scale Land-use Framework. Given the risks and uncertainties inherent in the unfolding of such a complex process, how is it possible to make ethical management choices now in the hope that our land use ethic sustains our society long enough to review and reprise our current choices on using ecological goods and services? Ethical considerations are an exploration of situations in a world of grey. Within that grey cloud lies the idea of sustainability. Sustainability, as well as ethics, is a situational concept, changing in scope and definition with every change in scale and scenario. Changes in scale reveal new uncertainties, which cascade down to altered (increased or decreased) risks in decision making. Economic and societal processes have not progressed much over the past century with respect to addressing sustainability in complex systems. Ecological theory has, specifically in the areas of systems approaches, conceptual modeling, and integrated assessment. When dealing with decision arenas with high uncertainty and high decision stakes, a post-normal science approach insists that any consensus-based, stakeholder-driven decision-making process follows the essential tenets of holistic risk assessment. I shall explore these ideas more fully via the concepts of wicked problems and clumsy solutions.

Abstracts for Oral Presentations in the Volunteer Sessions

Reclamation of Vertisolic Soils

Kathryn Bessie and Robert (Bob) Faye
EBA Engineering Consultants Ltd., Calgary; E-mail: kbessie@eba.ca

The Vertisolic soil order is relatively new to Canada, being incorporated in the 3rd edition to the Canadian System of Soil Classification in 1998. These soils are characterized by high clay content (greater than 60%) and are self-churning. The properties of Vertisolic soils create some unique challenges for managing these soils for farming, as well as for disturbance and reclamation. EBA Engineering Consultants Ltd. (EBA) has conducted pre-disturbance assessments, monitoring, post-reclamation assessments and initiated remedial methods for sites with Vertisolic soils disturbed by upstream oil and gas well sites and borrow pits used to supply clay for transportation. These soils are highly susceptible to compaction if worked when wet. This paper presents data from a couple of sites disturbed by anthropogenic activities and provides comments from interviews with the landowners. One site will be used to demonstrate the effects of disturbance on plant growth and changes in soil chemistry. On another site, the dramatic change of structure over one freeze-thaw cycle is documented. Remedial actions undertaken on one site and their effectiveness will be reviewed.

Notes:

The Use of a Bench Scale Biotreatability Model as a Tool in Environmental Remediation

Lyriam L. R. Marques,
A. Crawford, A. L. Douglas, and J. Stephen Goudey
HydroQual Laboratories Ltd., Calgary

The remediation of contaminants in soils occurs naturally by abiotic and biotic mechanisms. These mechanisms can be accelerated through the use of a number of technologies including, the addition of amendments, nutrients, bulking agents, sparging and venting. These technologies attempt to stimulate bacterial growth by increasing oxygen and nutrient availability or increasing the solubility and hence the bioavailability of contaminants as a nutrient source. Using a bench scale treatability-testing model the efficacy of these mechanisms can be optimized for site-specific degradation of contaminants of concern.

A key factor in designing a treatability test is how best to mimic site conditions and the effects that a treatment will have in the field. This is particularly important for sites with short growing cycles or extreme temperatures. Bench-scale tests can monitor for changes in chemical profiles of contaminants of concern and associated daughter products, bacterial respiration rates, and bacterial populations and speciation (e.g. hydrocarbon degraders, sulphate reducers etc), all key factors in the successful remediation of a contaminated site. Furthermore, bench scale tests that are performed parallel to full scale remediation projects can provide rapid data on the efficacy of remediation strategies prior to or manipulations during full scale implementation. Bench scale tests provide a powerful tool that mimics real environmental responses. The use of and key factors in the designing of this bench scale treatability testing model will be discussed.

Total Microbial Profiling: A Method Used to Study Bioremediation

Pernilla Stenroos, Annemarie L. Douglas, Lyriam L. R. Marques, and J. Stephen Goudey
HydroQual Laboratories Ltd., Calgary; Email: PStenroos@golder.com

Bioremediation of organically contaminated soils is regarded as one of the most successful technologies for cleanup of some contaminated sites. The key concept behind bioremediation is to optimize naturally occurring biological processes carried out by microorganisms present at the site. This process can eliminate and/or minimize the concentration of contaminants from soils and water by detoxification or mineralization of the contaminant. Bacteria, archaea, and fungi can be highly effective at degrading many contaminants into waste products that are generally safe. However, bioremediation has limitations. To promote the growth of functional microbial groups that degrade specific contaminants, environmental conditions must be manipulated to create the optimum conditions for sustained bioremediation. This is achieved by adding amendments that will enhance microbial growth and metabolism and/or the bioavailability of contaminants. In order to select the optimum bioremediation conditions that are likely to work in the field, it is critical to closely monitor the treatment effects on microbial communities and the reduction of the contaminants over time.

DNA profiling of microbial communities allows the monitoring of diversity (and relative abundance) of soil microbes in bench scale treatability/biotreatability studies as well as in full-scale remediation programs. It can also detect key organisms with specific functionality in the degradation of particular contaminants (organics, metals, etc). Typically, bioremediation studies focus mostly on bacteria and even then it may be limited to organisms that can be cultured through conventional microbiological techniques. In addition to bacteria, DNA profiling detects other microorganisms that are not typically evaluated for their bioremediation capacity, such as fungi and archaea. By profiling entire microbial communities, Total Microbial Profiling can be a used as a screening tool for monitoring changes in the microbial community structure over the course of a bioremediation program complementary to bioremediation studies. This approach has been applied to oil sands tailing pond laboratory microcosms. The impacts of physical or chemical treatments on microbial populations have been measured periodically. The results from this study indicate these microcosms provide an accurate bench scale representation of changes to microbial communities in tailings ponds upon exposure to different environmental conditions. These results and potential applications of this technology for the remediation of soil and water will be discussed.

Notes:

Nanomaterials from Cradle to Grave: Terrestrial Exposure and Potential Impacts on Soil Inhabitants

Sylvia Chan Remillard and
J. Stephen Goudey
HydroQual Laboratories Ltd., Calgary;
Email: sylvia_chanremillard@golder.com

Nanotechnology has become a major industry catch phrase being compared to the industrial and computer revolutions, with many new or improved applications to become the next technology platform. In fact many new and exciting advances have emerged from this science including stronger building materials, novel drug delivery systems and antibacterial clothing. However, in addition to harnessing this technology we must also consider the potential negative consequences of using materials with different physical-chemical properties and reactivity than their bulk counterparts. As these nanomaterials move through the ecological compartments, what happens to them (biotransformation/bioaccumulation/physical-chemical changes)? Do living organisms have adequate defenses against these new materials? What are the possible human health and ecological risks? Due to the paucity of environmental toxicity and exposure data available, the impact of nanomaterials on the environment is yet unknown.

To identify the potential exposure routes for nanomaterials entering the terrestrial compartment, we have analysed the product development life cycle from cradle to grave. We have also defined a framework for the identification of critical points and data gaps that manufacturers must be aware of regarding potential changes in physical/chemical properties of nanomaterials as they move through the product life cycle. We have applied this framework to representative nano-products through their development cycle and demonstrated the utility of this framework in identifying key risks and mitigation measures to ensure the safety of new nano-products emerging on the consumer marketplace to both humans and the environment.

Role of the Alberta Institute of Agrologists (AIA) Alberta Soils Network

Kathryn Bessie and Paul Martin,
representing the executive of the
AIA Soils Network;
website: www.albertaagrologists.ca
Email: lynette.esak@esakconsulting.com
or sluther@matrix-solutions.com
presenter: KBessie@eba.ca

As part of the Alberta Institute of Agrologists, the Alberta Soils Network (ASN) provides opportunities for agrologists in the field of soil science to network and develop professionally on a continued basis. The need for a network like this has gradually arisen because many new graduates no longer work at government agencies with the associated in-house training. Thus it is left more and more up to a consortium of government, industry, academic, professional organizations and consultants to work together on coordinating efforts for continuous education and linking resources. The network has identified a need to gain a current picture of soil science related training, education and information and so we are working to address this need. It is hoped that this exercise will provide members with a valuable online reference, allowing members to quickly identify and evaluate opportunities in continuing professional development available to them, including any timelines related to this availability. Findings to date of this exercise will be presented.

Notes:

Cattle Mortality Disposal via Composting in a Cold Climate: Feasibility, Greenhouse Gas Emissions, and Land Application of the End Product

Xiying Hao[1], K. Stanford[2], Shanwei Xu[1], F.J. Larney[1], and T.A. McAllister[1]

[1]Agriculture and Agri-Food Canada Research Branch, Lethbridge; [2]Alberta Agriculture and Rural Development, Lethbridge; Email: Xiying.Hao@agr.gc.ca

Increased disposal costs of specified risk materials (SRM) have reduced the competitiveness of the Canadian beef industry. The SRM materials are removed to reduce the risk of prions entering the food chain and include the skull, brain, trigeminal ganglia, eyes, palatine tonsils, spinal cord and dorsal root ganglia of animals over 30 months of age. This study investigated greenhouse gas (GHG) emissions during open windrow co-composting of manure with bovine SRM and mortalities (three experiments) as well as after land application of the compost (2005-2009). In the **first experiment**, windrows were constructed containing manure + straw (Control) or manure + straw + cattle mortalities (Mortality). The **second experiment** had similar set up except that the mortalities used were calves rather than mature cattle. In both experiments, GHG emissions and properties of the final compost were unaffected by compost turning method, but GHG emissions and final compost total C and total N contents (TC, TN) were higher in Mortality than Control compost, reflecting differences in materials used to construct the compost windrows. Additionally, the higher mineral N content (NO_3^{-} + NO_2^{-} + NH_4^{+}) of the Mortality compost increased its agronomic value as a fertilizer. In the **third experiment**, windrows were constructed containing manure + straw + SRM or manure + straw + cattle mortality. Coliform counts, moisture, pH and TC content of final compost were not significantly different between the SRM and mortality treatments, whereas TN and available N were lower for SRM than for mortality. The average surface CO_2 and N_2O flux from SRM windrows were not different from that of mortality windrows, but CH_4 emissions from SRM were lower. In the **fourth experiment**, GHG emissions and barley (*Hordeum vulgare* L.) production from fields receiving fresh manure, compost (with or without cattle mortality), or bio-digested cattle manure, commercial fertilizer or control (no amendments) were investigated from fall 2005 to 2009. The rates of CO_2 and N_2O emissions were similar for all treatments, reflecting low rate and one time application of the bio-amendments. Composting degraded all but a few large bones from cattle mortalities, and only trace amounts of DNA fragments originating from cattle were detected in land-applied manure and compost. Thus, composting may be a viable alternative to rendering for disposal of cattle mortalities and SRM, but further work to determine the fate of prions during composting is required before it can be fully recommended.

Notes:

Anaerobic Digestion of Specified Risk Materials with Cattle Manure for Biogas Production

Brandon H. Gilroyed[1,2], Tim Reuter[1], Angus Chu[2], Xiying Hao[1], Weiping Xu[1,3] and Tim A. McAllister[1]

[1]Agriculture and Agri-Food Canada Research Branch, Lethbridge;
[2]Dept. Civil Engineering, Schulich School of Engineering, University of Calgary;
[3]Dept. Bioscience and Biotechnology, Dalian Univ. of Technology, China;
Email: Xiying.Hao@agr.gc.ca

Biogas production from anaerobic digestion (AD) of specified-risk materials (SRM) co-digested with cattle manure was assessed in a 2 x 3 factorial design. SRM replaced manure at 0 (control), 10 or 25 % (w/w) as the substrate fed to six 2 L biodigesters maintained at 37 °C or 55 °C. Digesters were fed substrate (30 g L^{-1} total volatile solids) at 6 d intervals for 90 d, with a retention time of 30 d. Methane production was measured daily, and effluent was collected at feeding to monitor SRM degradation using real-time PCR analysis of bovine specific DNA fragments. Compared with control, methane production increased by 83 or 161 % (P<0.05) with 10 % or 25 % SRM at 37 °C, and by 45 and 87 %, respectively, at 55 °C ($P< 0.05$). Bovine DNA degradation over 6 d was higher ($P<0.05$) at 37 °C as compared to 55 °C. Inclusion of SRM increases the production of methane during the anaerobic digestion of manure and may offer a means of deriving economic value from the disposal of SRM.

Notes:

A Micrometeorological Study to Quantify Ammonia Volatilization Losses from Surface Broadcast Urea to Cold Soils

Richard Engel and Rosie Wallander

Dept. Land Resources and Environmental Sciences, Montana State University, Bozeman, MT;
Email: rengel@montana.edu

Winter wheat growers in Montana frequently broadcast urea to the soil surface during the fall to early spring period. Although, urea is known to be susceptible to ammonia losses, growers believe this problem is minimized if applications are deferred to cold weather months. This study was conducted to quantify ammonia emissions from surface urea and NBPT-coated urea applied during this cold weather period, and to validate or refute this belief. Ammonia emissions were measured over 8-wk gas sampling campaigns following fertilization using a micrometeorological integrated horizontal flux approach with a center mast and Leuning samplers. Ammonia-N losses from urea ranged from 3 to 40% of the application rate over the 8 campaigns conducted to date. Ammonia emissions were sometimes delayed (>2 wk) until precipitation occurred to dissolve urea prills. Significant emissions were then observed over 3 to 6-wks. Applying urea to cold soils did not guarantee emissions would be minimized. Surprisingly, some of the greatest emissions (up to 22 kg N/ha/wk) occurred when urea was applied to soils near 0 °C combined with high moisture. Coating urea with NBPT (4.2 ml/kg urea) provided ~2 wk volatilization protection following fertilizer dissolution, and reduced losses by ~60% over the 8-wk campaign.

Nitrous Oxide Emissions from a Black Chernozemic Soil in Response to Polymer-Coated Urea Application and Herbicide Management in a Canola-Barley Cropping System

Chunli Li[1], Xiying Hao[1], K.N. Harker[2], R.E. Blackshaw[1], G.W. Clayton[1], J.T. O'Donovan[2]
Agriculture and Agri-Food Canada Research Branch, [1]Lethbridge and [2]Lacombe;
Email: Xiying.Hao@agr.gc.ca

Environmentally Smart Nitrogen (ESN) fertilizer has potential to reduce N_2O emissions. Our study investigated the effect of ESN fertilizer application and weed management on N_2O emissions from a Black Chernozem soil located at Lacombe, Alberta, Canada. Two canola (*Brassica napus* L.) cultivars (InVigor 5020 and 2393LL) and two barley (*Hordeum vulgare* L.) cultivars (AC Lacombe and Vivar) were used in a 2-yr rotation from 2005 to 2008. Urea and polymer-coated urea (ESN) were applied at 1 and 1.5 times (x) the recommended rate. Crops were also treated with half (50%) or full (100%) rates of herbicide. Soil N_2O emissions were measured using vented static chambers at bi-weekly intervals during the growing season from 2006 to 2008. N_2O emissions over the 3-yr varied considerably (1.40 to 110.55 g N ha^{-1} d^{-1} or 0.20 to 17.69 kg N ha^{-1}) over the growing season. Emissions were affected ($P<0.05$) by crops in 2006 and 2008 but not by fertilizer and weed management. In 2006, the daily emission rates and the fraction of spring soil available N (mineral N in soil + fertilizer N applied) emitted as N_2O was higher ($P<0.05$) from barley (7.49 g N ha^{-1} $d^{-1}$and 0.74%) than from canola (3.33 g N ha^{-1} $d^{-1}$and 0.29%) while in 2008 the daily emission rate was lower ($P<0.05$) from barley (2.93 g N ha^{-1} d^{-1}) than from canola (4.11 g N ha^{-1} d^{-1}). N_2O emissions from half herbicide rates were similar to those from full herbicide rates. Similarly, N_2O emissions from both 1x ESN and 1.5x ESN were similar to those of urea at the 1x rate. Our results suggest that ESN fertilizer did not reduce N_2O emissions while higher ESN rates did not cause any increase in N_2O emission from the Black Chernozem soil.

Nitrous Oxide Emissions from Anaerobically Digested Cattle Manure Applied to Soil

Raj Mann[1,2], F. Zvomuya[2],Xiying Hao[1], R. Atkins[3], and X. Li[4]
[1]Agriculture & Agri-Food Canada Research Branch, Lethbridge; [2]Dept. Soil Science, Univ. Manitoba, Winnipeg; [3]Alberta Agriculture and Rural Development, Lethbridge; [4]Highmark Renewables Research, Edmonton;
Email: Xiying.Hao@agr.gc.ca

There is growing interest in the anaerobic digestion of beef cattle (*Bos taurus*) feedlot manure to generate biogas. Land application of anaerobically digested manure (ADM) may increase nitrous oxide (N_2O) emissions from amended soils as ADM is a nitrogen source. We tested this hypothesis in a field experiment initiated in spring 2008 at Lethbridge, Alberta, in which the effects of manure vs. different forms of ADM [digestate, separated solids (SS), separated solids + urea (SSU)] on N_2O emissions from a soil cropped to forage barley were examined. All amendments were applied annually at rates equivalent to 100 and 200 kg N ha^{-1}, with a non-amended control treatment included for comparison. N_2O flux measurements were taken at weekly intervals during the first 6 wk and at biweekly intervals thereafter. Results from 2008 showed that N_2O fluxes were higher with digestate and SSU applications (mean 11.2 g day^{-1} ha^{-1}) compared with all the other amendments (3.4 g day^{-1} ha^{-1}). However, amendment differences were only significant on day 41 when digestate gave the highest flux and on day 55 when the flux was highest with digestate and SSU application. Amendment rate had no significant effect on N_2O flux. These results suggest that N_2O emissions may be higher in soils amended with ADM, but the effect depends on the ADM form.

Leaching of Nitrate, Chloride, and Phosphorus from Undisturbed Soil Cores Amended with Fresh or Composted Beef Cattle Manure

Jim Miller[1], Bruce Beasley[1], Craig Drury[2], and Bernie Zebarth[3]

Agriculture & Agri-Food Canada Research Branch, [1]Lethbridge AB; [2]Harrow ON and [3]Fredericton NB; Email: millerjj@agr.gc.ca

Although fresh beef cattle (*Bos Taurus*) manure has traditionally been applied to cropland in southern Alberta, Canada, in application of composted manure has recently increased in this region. The implications of fresh manure (FM) versus composted (CM) beef cattle manure on N and P leaching has not been investigated. Our objective was to compare N and P leaching potential under FM and CM annually applied at 77 Mg ha^{-1} dry wt. for nine years to a clay loam soil compared with a non-amended control (CON). Intact soil cores were taken from a field experiment in the spring of 2007. Deionized water was applied to the soil cores in the laboratory under steady-state (4.9 cm d^{-1}) and near-saturated conditions. Concentrations of NO_3-N, Cl, and dissolved reactive P (DRP) were measured in the leachate and breakthrough curves, flow-weighted mean concentrations (FWMC), and cumulative mass loss curves obtained. Peak concentrations of NO_3-N, Cl, and DRP were greater for CM than FM. For example, the peak concentration of NO_3-N was 27% to 3 fold greater for CM (400 mg L^{-1}) than FM (315 mg L^{-1}) and the CON (142 mg L^{-1}). The FWMC and total mass loss of these four chemicals were similar for FM and CM, but values were significantly ($P \leq 0.05$) greater for the amended than unamended cores. Recovery of N and P in leachate as a percentage of total N or P in the soil prior to leaching was negligible (≤ 1%) for FM and CM. Macropore flow, as evident by early peak concentrations before one pore volume, was evident for NO_3-N and Cl under CM than FM, but was not evident for DRP. Application of CM for nine years may increase leaching potential risk compared to FM with respect to peak concentrations of NO_3-N, Cl, and DRP, but not for FWMC, mass loss, or recovery in leachate.

Adventures in the Evaluation of Nutrient BMPs at the Field Scale in Alberta

Gerald R. Ontkean, Janna Casson, Janelle Villeneuve and Wiebe Buruma

Water Resources Branch, Alberta Agriculture and Rural Development, Lethbridge;

Email gerald.ontkean@gov.ab.ca

Numerous beneficial management practices (BMPs) have been developed for Alberta producers to manage manure nutrients. Due to minimal data showing the effectiveness of these BMPs at a field scale, a 6-yr project was undertaken to evaluate a selection of BMPs in three areas of Alberta. Preliminary water and soil data indicated that while high levels of nutrients were often detected in edge-of-field runoff at the majority of the BMP sites in the Indianfarm Creek and Whelp Creek watersheds, soil nutrient levels in adjoining fields were often not considered excessive. This was in contrast to two heavily manured fields near Lethbridge, Alberta that exhibited high water and soil nutrient concentrations. These discrepancies resulted in evaluating a wider range of BMPs than originally anticipated with the focus of the BMPs shifting from manure rate management to the modification of manure application methods and timing of manure application as well as the modification of livestock grazing patterns.

Notes:

Life-Cycle Accounting of GHG Emissions from Beef Production in Western Canada

Xavier Vergé, R.L. Desjardins, J. Dyer and D Worth
Agriculture & Agri-Food Canada Research Branch, Ottawa ON;
Email: Xavier.Verge@agr.gc.ca

An assessment of the greenhouse gas (GHG) emissions from beef production in Canada was recently completed. All sources of on-farm emissions for the three main agricultural GHGs, CH4, N2O and CO2 from fossil fuel, were accounted for. This assessment included the associated complex of crops that support beef production. This presentation will give a general overview of the life cycle approach used in the model to estimate the GHG emissions (total emissions and emissions per kg of meat produced) from the beef sector in western Canada and to present the associated on-farm GHG efficiency (amount of GHG emitted per kg of meat produced). The specific case of grazing animals will be then be presented and discussed.

Total greenhouse gas emission from perennial cropland under intensive management

Vern Baron[1] and John Basarb[2]
[1]Agriculture & Agri-Food Canada Research Branch and [2]Alberta Agriculture and Rural Development, Lacombe;
Email: Vern.Baron@agr.gc.ca

Can intensity of land use impact potential land use alternatives for carbon sequestration in grassland-livestock systems? Estimating the net global warming potential (GWP) of grassland –livestock systems on a land area as well as an animal basis is essential in the understanding the role of land management in reducing greenhouse gas emission. The presentation will compare beef stocker systems with varying grazing management intensity based on research at Lacombe Research Centre and on industry survey data for GWP per unit land area used and intensity per unit beef produced. Scenarios were taken from results of research pastures that were rotationally grazed, using managed intensive grazing with fertilizer application (High Input) or continuously grazed without fertilizer application (Low Input) with heifers, initially 340 kg hd^{-1} for an average of 91 d from 1999 until 2005. Pastures were stocked so that on a seasonal basis they had the same average daily dry matter allocation. Consequently average daily live wt. gain was almost identical. Average daily gains were 1.0 and 0.9 kg d^{-1}, for Low Input and High Input systems respectively. A third scenario was developed from an industry survey of stocker cattle operations, which had mean rates of gain of 0.86 kg d^{-1} over 119 pasture days. Mean stocking rates for High Input, Low Input and Industry examples were 4.4, 1.78 and 1.98 hd ha^{-1}, respectively. The fact that daily gain was similar meant that daily gross energy intakes of forage per animal could be estimated and was assumed similar among scenarios; forage nutritive value data was available fro the Lacombe pastures. A combination of empirical soil based data scaled to farm level and IPPC (2006) Tier 2 equations based on estimated excreted-N per animal was used to determine N_2O emission. Methane emission per animal d^{-1} was estimated from daily gross energy intake hd^{-1} using IPPC (2006) Tier 2 equations. Ecosystem and soil organic-C sequestration rates were uncertain across management systems, so whole-system sequestration levels were estimated at high and low or equilibrium levels. Other inputs such as fertilizer-N were accounted for. Total emissions were determined on an animal basis and then converted to a land area basis, if necessary, using a modest carbon sequestration rate of equilibrium for Industry and Low Input systems and -206 CO2 equiv. for the High Input system. Absolute emissions for Industry and Low input systems were 47% and 36% of the High Input system, respectively. However, on a GWP intensity basis per kg beef produced, the Industry and High Input systems were identical. On a land area basis the High Input system required 139 ha less than industry to manage 500 hd or 140 ha less than Industry to produce 50,000 kg beef. In this case the Industry and Low Input systems had lower absolute emissions on an area basis but required double the land to produce similar amounts of live beef. The advantage of the High Input system is that the extra land could be used to produce alternative carbon sequestering crops such as forest or biofuel crops to offset emission of beef production on the whole-farm basis.

Abstracts for Poster Presentations

Long-term Tillage, Straw and N Rate Effects on Quantity and Quality of Organic C and N in a Black Chernozem Soil

S. S. Malhi[1], M. Nyborg[2], T. Goddard[3], D. Puurveen[2] and D. Leach[1]

[1] Agriculture and Agri-Food Canada, P.O. Box 1240, Melfort, SK S0E 1A0
E-mail: sukhdev.malhi@agr.gc.ca
[2] Department of Renewable Resources, University of Alberta, Edmonton
[3] Alberta Agriculture, Food and Rural Development, Edmonton

A field experiment (barley-wheat-canola rotation) was conducted to determine the effect of 19 or 27 years of tillage (zero [ZT] and conventional [CT] tillage), straw (straw removed [S_{Rem}] and straw retained [S_{Ret}]) and N rate (0, 50 or 100 kg N ha^{-1}) on total organic C (TOC) and N (TON), light fraction organic C (LFOC) and N (LFON), mineralizable C and N, microbial biomass C (MB-C), macro organic matter C (MOM-C) and N (MOM-N), pH, extractable P, ammonium-N and nitrate-N in a Black Chernozem soil at Ellerslie, Alberta. TOC and TON was higher with S_{Ret} than S_{Rem}, and tended to increase with ZT and N fertilization. LFOC and LFON increased with S_{Ret} and N fertilization, but were higher under CT than ZT. S_{Ret} and N fertilizer had higher C_{min}, N_{min}, MOM-C and MOM-N than corresponding S_{Rem} and zero-N treatments. Linear regressions between crop residue input and soil organic C or N were mostly significant. Soil pH decreased with N application. Extractable P was higher under ZT than CT, or with S_{Ret} than S_{Rem}. Extractable P decreased and nitrate-N increased with N fertilization. In conclusion, elimination of tillage, straw retention and N fertilizer application usually improved soil organic C and N.

Long-term Tillage, Straw and N Rate Effects on Quantity and Quality of Organic C and N in a Gray Luvisol Soil

S. S. Malhi[1], M. Nyborg[2], T. Goddard[3], D. Puurveen[2] and D. Leach[1]

[1] Agriculture and Agri-Food Canada, P.O. Box 1240, Melfort, SK S0E 1A0
E-mail: sukhdev.malhi@agr.gc.ca
[2] Department of Renewable Resources, University of Alberta, Edmonton
[3] Alberta Agriculture, Food and Rural Development, Edmonton

A field experiment (barley-wheat-canola rotation) was conducted to determine the effect of 19 or 27 years of tillage (zero [ZT] and conventional [CT] tillage), straw (straw removed [S_{Rem}] and straw retained [S_{Ret}]) and N rate (0, 50 or 100 kg N ha^{-1}) on total organic C (TOC) and N (TON), light fraction organic C (LFOC) and N (LFON), mineralizable C and N, microbial biomass C (MB-C), macro organic matter C (MOM-C)

and N (MOM-N), pH, extractable P, ammonium-N and nitrate-N in a Gray Luvisol soil at Breton, Alberta. Zero tillage, straw retained and N fertilizer treatments had higher soil TOC, TON, LFOC, LFON, MOM-N, and mineralizable C and N compared to the corresponding CT, straw removed and zero-N control treatments. Soil pH was reduced slightly with N application. Soil extractable P was higher with straw retained than straw removed, and also higher under ZT than CT, but decreased with N application. Soil nitrate-N increased with N addition. In conclusion, elimination of tillage, straw retention and N application all improved organic C and N in soil, and generally differences were more pronounced between $CTS_{Rem}0$ and $ZTS_{Ret}100$ treatments. This will be better for long-term sustainability of soil quality, fertility, and subsequently productivity..

Microbial Communities in the Athabasca Oilsands

A. Hahn and S. Quideau
Dept. Renewable Resources, 344 Earth Sciences Building, UofA, Edmonton;
Email: ahahn@ualberta.ca

Resource extraction in the Athabasca oil sand region (AOSR) disturbs ecosystems at the landscape scale, after which land reclamation is required to re-establish ecosystem function. Reclaimed sites on a trajectory towards sustainable ecosystem function should become more similar to natural sites over time. Establishment of biogeochemical recycling between soils, microbes, and plants is one of the most critical factors required to insure long-term sustainability in reclaimed landscapes. Currently, the two main types of surface soil substrate used in land reclamation in the AOSR consist of a peat mineral mix (PM) and/or a forest floor mineral mix (LFH) overlying subsurface materials. Evidence from recent research indicates that salvaged LFH applied to reclaimed areas exhibits native revegetation response superior to typical PM reclamation practices and may better stimulate microbial activity. This study aims to build on previous results to determine where the soil microbial community (SMC) of sites reclaimed with LFH, PM, or a combination of the two, may be positioned on the recovery trajectory towards natural ecosystem function. This study used lipid biomarkers from microbial cell membranes on sites treated with LFH, PM or a combination of the two, to quantify the microbial composition of the SMC. Data was collected from 2004-2006 on reclaimed sites and in 2004 on a natural control site. Community composition, total biomass, functional groups and community diversity of the SMC on reclaimed sites were compared to those of the natural site. Results show that while the reclaimed sites differ from the natural site, they are similar to one another. Microbial biomass has increased each year under all reclaimed treatments; however, the biomass found on the natural site is close to an order of magnitude larger. Climatic factors may be confounding the results, as community composition trends by year do not appear to be chronological.

Notes:

A Remediation Study of a Soil System Contaminated with Produced Water

R. Saint-Fort[1] and A. Carcamo[2]
[1] Department of Environmental Science, Mount Royal University, 4825 Mount Royal Gate S.W., Calgary T3E 6K6;
Email: RSaintFort@mtroyal.ca
[2] Amber Environmental Services Inc., Suite 106, #5 8720 Macleod Trail SE, Calgary, T2H 0M4;
Email: alfredo@amberenviro.com

Produced water streams will typically have salts and hydrocarbons associated with their matrices. Their accidental spills can lead to environmental degradation and significant adverse on soil physical and chemical properties. In Alberta, returning produced water impacted soil systems to their equivalent land capability through remediation activity has proven to be a difficult challenge, both technically and economically. This study evaluates the feasibility of treating a salts/hydrocarbon contaminated fine-grained soil using soil washing. Several factors were assessed as to the impact of hydrocarbon concentration on NaCl solubility, kinetics of divalent/monovalent cations exchange, optimum ratio soil/wash, and various amendments concentrations. Maximum rate of Na exchange with Ca at 25 and 8 °C under intermittent mechanical mixing occurred within the first minute yielding a concentration ratio of 1702 mg/L Na:1040 mg/L Ca. Solubility of NaCl was partially affected in a hydrocarbon:water matrix at the ratio of 12mL:50mL. The use of a polymeric agent was also tested as an amendment and resulted to a 75% of Na recovery from the soil matrix. A bench scale study was subsequently implemented based on the results of the evaluated factors which resulted in significant reduction of SAR and EC levels in the treated soil matrix. Remediating produced water spills requires a good understanding of the soil matrix system particularly in the case of a fine-grained soil since the formation of several pools of Na may be formed due to the presence of hydrophobic contaminant.

Water Quality and Land Use in Two Agricultural Watersheds in Alberta

Taren Cleland, Lynda Miedema, Clair Fitzpatrick and Colleen Phelan
Water Resources Branch, Alberta Agriculture and Rural Development, Lethbridge;
Email: Taren.Cleland@gov.ab.ca; Lynda.Miedema@gov.ab.ca

The purpose of this poster is to highlight land use practices and water quality in two agricultural watersheds in Alberta. These two watersheds were chosen for a 6-year project to evaluate the effectiveness of Beneficial Management Practices (BMP's) to improve water quality. Indianfarm Creek (IFC) Watershed (14,500 ha), near Pincher Creek, and Whelp Creek (WHC) Subwatershed (4,685 ha), near Lacombe, were selected for the project. The IFC Watershed consists of annual crops, cow-calf operations, and confined feeding operations. The WHC Watershed is predominantly annual crops and dairy production. Water samples were collected at various sites on a watershed-wide basis, specifically at the outlet of both watersheds. The water quality values at the outlet in IFC Watershed were 1.65 mg L^{-1} total nitrogen, 0.20 mg L^{-1} total phosphorus, 150 mg L^{-1} total suspended solids, and 540 mpn 100 mL^{-1} *E. coli*. The water quality values at the outlet in WHC Subwatershed were 2.77 mg L^{-1} total nitrogen, 0.44 mg L^{-1} total phosphorus, 9 mg L^{-1} total suspended solids, and 147 mpn 100 mL^{-1} *E. coli*. These values are typical of watersheds with moderate to high agricultural intensity found elsewhere in the province.

Notes:

Livestock Manure Improves Acid Soil Productivity under Cold Northern Alberta Climate

M. B. Benke, X. Hao, J. T. O'Donovan, G. W. Clayton, N. Lupwayi, P. Caffyn and M. Hall
Agriculture & Agri-Food Canada Research Branch, Lethbridge;
Email: Monica.Benke@agr.gc.ca

Cattle manure ameliorating acidity and improving crop production properties were evaluated under canola/barley rotation in soils from the Peace River Region, Alberta from 2004 to 2007. Treatments included Check, NPS, Lime+NPS and manure at 80 and 160 Mg ha^{-1} (treatments M80 and M160). Manure and lime were applied only once (fall 2003) while NPS was applied annually. Manure treatments increased ($P < 0.05$) soil pH and the increase persisted over the 4-yr. Soil 0.01 M $CaCl_2$ extractable Al and Mn contents were lower ($P < 0.05$) in M160 than Check. Barley and canola straw Mn content in manure treatments was also lower ($P < 0.05$) than Check. Soil available P and K contents were higher ($P < 0.05$) in M80 and M160 than Check, whereas values from NPS and Lime+NPS were not different ($P > 0.05$) from Check. Treatment M160 also increased ($P < 0.05$) barley straw P and K contents compared to the Check. Grain yields were almost twice as high ($P < 0.05$) in M160 as in Check. Results indicated that manure incorporation at 160 Mg ha^{-1} every 4-yr to Peace River acid soils had the same effectiveness as Lime+NPS in increasing soil pH, improving soil fertility and enhancing crop yield at field scale..

Notes:

Ex-situ bioremediation of petroleum hydrocarbon (PHC F3 fraction) impacted sediments in upstream oil and gas

Alfredo Carcamo[1] and Macoura Kone[2]
[1] Amber Environmental Services Inc., Suite 106, #5 8720 Macleod Trail SE, Calgary; Email: alfredo@amberenviro.com
[2] Dept. Civil & Environ. Engineering, UofA, Edmonton; Email: mkonedanumah@shaw.ca

Hydrocarbon impacted sediments are widespread in western Canada due to historical activities associated with oil and gas industry. In the past, ex-situ systems have been successful at treating spills associated with light end hydrocarbon including gasoline, condensates, and BTEX. Despite the widespread use of bioremediation technologies, they haven't been used to treat heavier end hydrocarbons. Conventional ex-situ remediation systems may be slow to degrade the recalcitrant hydrocarbon fractions, or may not achieve the stringent regulatory criteria. Bioremediation which uses microorganisms to eliminate contaminants from the natural environment appears to be a suitable and cost effective remediation approach, but is often limited by nutrient or oxygen availability. Addition of nutrients and incorporation of oxygen sources can enhance bioremediation.

In this study, we investigated the feasibility of microbial dynamics in bench and pilot field trials of bioremediation process in degrading hydrocarbon impacted sediments in north central Alberta. The bioremediation feasibility studies were conducted during the summer/ fall 2007. The main pollutants of concern were hydrocarbons type Fractions F2 and F3 associated with underground storage tanks at one site and flare pit at another site. In the bench-scale test, soils were amended with nutrients and organic amendments to determine the bioremediation potential of impacted

sediments. Tests were conducted for nine weeks.

Results clearly showed a decrease in hydrocarbon concentrations throughout all treatments conducted. PHC F2 and F3 concentrations were reduced to 70% and 45% respectively, after nine weeks of bioremediation. Based on this trend, a pilot study was conducted using conventional turning equipment as well as passive aeration to maintain aerobic conditions and promote biodegradation. it is believed that continued monitoring and site management for a three to five year program may decrease PHC F2 and F3 concentrations below applicable criteria.

Can Avail® Improve Phosphorus Efficiency in Wheat?

Rigas E. Karamanos[1],
Grant Jackson[2], Dick Puurveen[3],
and John Miller[2]
[1] Viterra Inc., P.O. Box 2500, Calgary T2P 2N1;
Email: rigas.karamanos@viterra.ca
[2] Montana State University, Western Triangle Agricultural Research Center, Conrad, MT
[3] Dept. Renewable Resources, UofA, Edmonton; Email: Dick.Puurveen@afhe.ualberta.ca

Two projects were established, one in 2007 at the Breton and Ellerslie University of Alberta experimental farms and one in 2008 on a field north of Conrad and at the Western Triangle Agricultural Research Center in Montana to test the effectiveness of Avail® technology, a polymer chain product of high CEC that is hypothesized to increase P availability by attracting soil solution cations in the vicinity of a phosphate granule, thus preventing P from precipitating out. The Alberta experiments included seven treatments consisting of an unfertilized control and three rates of seed-placed P (6.5, 13 and 19.5 kg P ha^{-1}, corresponding to 13, 26 and 39 lb P_2O_5/acre) applied as mono ammonium phosphate (MAP, 11-52-0) and were arranged in a randomized complete block design with six replications. Nitrogen was applied at 100 kg N ha^{-1}. Annual treatments were repeated on the same plots, which were seeded to wheat (AC Barrie) all three years. The Montana Experiments, also arranged in a randomized complete block design, included three rates of N (0, 40 and 80 kg ha^{-1} with and without NSN) and three rates of P (0, 15 and 30 lb P_2O_5/acre) with and without treatment with Avail® and were replicated three or four times. There were no responses to P at Breton in 2007 and the Western Triangle Agricultural Research Center in 2008; however, wheat responded to P application in all other cases. Neither a significant effect of treating MAP with Avail® nor a significant interaction between Avail® treatment and rate of P were observed. Phosphorus uptake patterns in the Alberta experiments mirrored those of grain yield; however, N uptake was influenced by P fertilization, but not treatment with Avail® only at the Breton site.

Effects of Interception, Deposition and Canopy Exchange on H^+ Supply to Soils in *Pinus banksiana* and *Populus tremuloides* Ecosystems in the Athabasca Oil Sands Region

Kangho Jung and Scott X. Chang
Dept. Renewable Resources, University of Alberta, Edmonton, T6G 2E3
Email: :kangho@ualberta.ca

Soil acidification in forest ecosystems is of concern in the Athabasca oil sands region which is the largest area for open-pit oil sands mining in Alberta. To assess the effects of canopy interaction on H+ deposition, bulk precipitation, throughfall, and stem flow were studied in jack pine (*Pinus banksiana*) and trembling aspen (aspen, *Populus tremuloides*) stands in two watersheds (NE7 and SM8) for three years. The pH values were lower in jack pine than in aspen stands (p=0.002) in the forest floor but were not different in the mineral soil. Base cation:Al ratio in the whole soil profile were greater in aspen than in jack pine stands (*P*<0.01). Concentrations of Ca, Mg, and K in leaves, branches, wood, and bark of trees were greater in aspen trees while Al concentrations were greater in jack pine trees (*P* <0.05). Bulk deposition of SO_4^{2-} and NO_3^- was as much as 8.05 kg S ha^{-1} yr^{-1} and 3.94 kg N ha^{-1} yr^{-1}, respectively, in NE7, and 3.94 kg S ha^{-1} yr^{-1} and 2.81 kg N ha^{-1} yr^{-1}, respectively, in SM8. Interception deposition of SO_4^{2-} was greater in NE7 than in SM8 (*P* = 0.005) but no difference was observed for the other ions between the watersheds. The jack pine canopy intercepted more SO_4^{2-}, Ca^{2+} and Al^{3+} than the aspen canopy (*P* <0.05). More Ca^{2+}, Mg^{2+}, and K^+ were leached from aspen than from jack pine trees (*P* <0.05); no differences were found between the watersheds. The pH of throughfall and stemflow in jack pine stands were lower than that of bulk precipitation while the reverse was true in aspen stands. Regardless of stand type, more H^+ was intercepted in NE7 than in SM8 (p=0.049 for aspen and 0.003 for jack pine); no difference was found between stand types. Trembling aspen removed more H^+ through canopy exchange than jack pine did (*P*<0.001). Analysis of H^+ in throughfall showed that H^+ removal by canopy uptake and release of organic acids may be major reasons making a difference of throughfall acidity between jack pine and trembling aspen. Greater H^+ input by throughfall may accelerate soil acidification in jack pine stands than trembling aspen stands.

Notes:

Influence of P- and N-based manure application on phosphorus fractions in runoff

Jim Miller[1], David Chanasyk[2], Tony Curtis[1], Dennis Lastuka[1], Murray Lewis[1], Barry Olson[3], Shane Petry[4], Dwayne Rogness[5], Carlyle Ross[1], Kim Schmitt[6], Elwin Smith[1], and Walter Willms[1]

[1]Agriculture and Agri-Food Canada, Research Branch, 5403-1st Ave. S., Lethbridge, T1J 4B1
Email: millerjj@agr.gc.ca
[2]University of Alberta, [3]Alberta Agriculture and Rural Development, [4]Fisheries and Oceans, [5]County of Lethbridge, [6]Ducks Unlimited

Five beneficial management practices (BMPs) are being evaluated within the Lower Little Bow (LLBow) River watershed of southern Alberta to determine their influence on surface water quality. One of the BMPs evaluated is comparing the effect of N- versus P-based manure application on P in surface runoff. The experimental treatments were the current industry standard of beef cattle manure applied annually based on nitrogen (N) to satisfy crop growth requirements for one year (N1), BMP of manure applied annually based on phosphorus (P) to satisfy crop growth requirements for one year (P1), and BMP of manure applied once the first year based on P to satisfy crop growth requirements for three years (P3). There was also an unamended control (CON) or check plot. A portable rainfall simulator was used to generate artificial runoff. Our findings indicate that one to three years of P-based manure application does not reduce total P and total particulate P in runoff but does reduce total dissolved P and dissolved reactive P, and soil test P was lower after the third year of manure application. An economic analysis indicated that the N1 treatment was the least costly, the P3 treatment was intermediate in cost, and the P1 treatment was the most costly.

Vegetation Response to Spent Drilling Mud Application to Semiarid, Mixed-grass Prairie

Francis Zvomuya[1], Francis J. Larney[2*], Walter D. Willms[2], Ryan K. Beck[2], and Andrew F. Olson[2]
[1] Dept. of Soil Science, University of Manitoba, Winnipeg, MB
[2] Agriculture and Agri-Food Canada, Research Branch, 5403-1st Ave. S., Lethbridge, T1J 4B1
Email: Francis.Larney@agr.gc.ca
*presenter

Landspraying while drilling (LWD) is an approved disposal method for water-based drilling mud (WBM) systems used by the oil and gas industry in western Canada. The mud is applied either on cultivated land where it is incorporated by tillage, or on vegetated land where it is not incorporated. This study examined the effects of summer WBM application (0, 15, 20, 40, and 80 m^3 ha^{-1}) on native vegetation properties at CFB Suffield, Alberta. Our results indicated significant LWD effects on percent bare soil, which increased, and lichen cover, which decreased at the 80 m^3 ha^{-1} rate relative to the untreated control. Nitrogen (N), sulfur (S), and magnesium (Mg) concentrations in aboveground plant tissue increased with increasing LWD rate in samples taken 45 d after WBM application, but these differences had disappeared one year after treatment. Increase in tissue concentration of phosphorus (P) with LWD rate, however, was only detected 3 yr after LWD. Nonetheless, these changes in tissue chemistry were not associated with significant changes in biomass yield or species composition. Overall, our results suggest that single WBM applications at rates (≤20 m^3 ha^{-1}) commonly used in western Canada, if properly managed, are unlikely to adversely affect native prairie vegetation.

Nitrogen Indicators for Forest Productivity in the Oil Sands Region of Alberta

En-Rong Yan[1], Francis Salifu[2], Xiao Tan[3], Chi Cheng[4], Scott X Chang[1]
[1] Department of Renewable Resources, University of Alberta, Edmonton T6G 2E3;
Email: enrong@ualberta.ca
[2] Suncor Energy Inc., Drop 901, P.O. Box 4001, Fort McMurray T9H 3E3
[3]: Shell Canada Energy, P.O. Box 5670, Hwy 63 North, Fort McMurray T9H 4W1
[4] Air and Land Policy Branch, Alberta Environment, Edmonton T5K 2J6

Linking soil nitrogen (N) transformation process and availabilities with tree growth performance is important for understanding how forest productivity is affected by soil N supply. However, quantitative relationships between soil N available indicators and forest growth are lacking in the oil sands region of Alberta. In this study, soil N available indicators, including in-situ soil N mineralization rates, aerobic and anaerobic soil N mineralization rates and soil N supply rates (measured with Plant Root Simulators – PRS probes) in the forest floor and 0-20 cm surface soils, and tree growth (based on increment cores) and unit leaf weight were quantified among three forests types (i.e., trembling aspen, jack pine and white spruce) in the oil sands region of northern Alberta. Most soil and forest floor N indicators were significantly correlated with forest productivity indices in jack pine stands, but few significant correlations were found in aspen and spruce stands, suggesting that responses of forest productivity to soil N availability are forest-type specific and forest productivity is more N-limited in jack pine stands.

Notes:

Abstracts for Oral Presentations in the Technical Sessions

Soil Fertility

Improved Fertilizer Application Methods and Enhanced Efficiency Fertilizers, and the Potential Effect on Fertilizer Rates

Tom Jensen
International Plant Nutrition Institute (IPNI), Saskatoon, SK; Tel. 306-652-3467
E-mail: tjensen@ipni.net

There is much discussion about increasing the efficiency of fertilizers. It is useful to understand what is meant by efficiency. The main meaning is that fertilizer use by the target crop is improved and results in greater crop yields, or improved crop quality. Another just as important meaning is that lower amounts of nutrients are lost from the plant-soil system. Loss means that nutrients from applied fertilizers are released into water, air or soil out of reach by crop plants. Rates of nutrients applied using improved methods of application or increased efficiency fertilizer products should normally not be reduced unless there are actual reduced losses of nutrients to the surrounding environment. Of the macro fertilizer nutrients N, P, and K, N is most subject to potential losses, P losses are comparatively lower than N losses but are still of a concern environmentally, and K losses are minimal and tend to be of little concern environmentally.

Notes:

Nitrogen Release from Pulse Crop Residues and Green Manure after 16-18 Months of Decomposition

Newton Z. Lupwayi[1] and Y. K. Soon[2]
Agriculture & Agri-Food Canada Research Branch, [1]Lethbridge and [2]Beaverlodge
Email: lupwayin@agr.gc.ca

The rotational benefits of pulse crops include N contribution to nonlegume crops grown after them in rotation. However, it is believed that little N is released to the first subsequent crop because pulse crop residues (a) contain little N (after most of it is removed with seed at harvest), and (b) have a wide C/N ratio. It is not clear how much N is released to the second and third crops in rotation. Using a litterbag method, we quantified N released from residues of two pea varieties (Camry, a semi-leafless variety, and 4010, a taller, normal-leafed forage pea variety), faba bean grown for seed, faba bean green manure (GM) and chickling vetch GM. The N contained in these residues at harvest was in the order: faba bean (154 kg N ha^{-1}) ≥ 4010 pea and chickling vetch GM (129 and 125 kg N ha^{-1}, respectively) ≥ faba bean GM (107 kg N ha^{-1}) > Camry pea (65 kg N ha^{-1}). The percentage of residue N released in the first 71-78 weeks (16-18 months) of residue decomposition (before the second subsequent crop was seeded) was in the order: GMs (approx. 90%) > faba bean grown for seed and peas (55-60%). These percentages were inversely related to residue C/N ratios, which were 10 and 11 for the GMs, 17 for faba bean grown for seed, and 26 and 28 for peas. However, the order of amount of N released (%N released x residue N) was in the order: faba bean grown for seed and chickling vetch GM (95-120 kg N ha^{-1}) > faba bean GM and 4010 pea (70-80 kg N ha^{-1}) > Camry pea (35 kg N

ha^{-1}). Faba bean grown for seed and chickling vetch GM released the most N because (a) faba bean grown for seed accumulated the most N and retained most of it in residues (only 37% of its N was exported to the seed due to low seed yield), and (b) chickling vetch GM had a low C/N ratio. Camry pea residues released the least N due to a combination of low N content (66% of its N was exported to the seed) and high C/N ratio. Considering that the order of N release in the first 14-22 weeks (3-5 months) of decomposition was: faba bean grown for seed and GMs (approx. 60-80 kg N ha^{-1}) > peas (approx. 10-20 kg N ha^{-1}), proportionately more N was released from pea residues subsequently than from GMs or faba bean grown for seed. Therefore, although pulse crop residues do not release as much N as GM residues immediately after addition to soil, they seem to release more N than GM residues later in the decomposition process. Nitrogen release from pulse crop residues may be better synchronized with N requirements of nonlegume crops grown after them than N release from GM crops.

Notes:

Yield and quality of irrigated timothy to fertilizer application in southern Alberta

Ross H. McKenzie[1], Eric Bremer[2], Pat G. Pfiffner[1], Allan B. Middleton[1],
[1]Alberta Agriculture and Rural Development, Lethbridge; [2]Symbio Ag Consulting, Lethbridge; Email: ross.mckenzie@gov.ab.ca

Timothy hay production for export markets has expanded considerably in western Canada during the past decade. Fertilization practices for optimum yield and quality of irrigated timothy were investigated for four years at two locations in southern Alberta. The efficacy of spring-broadcast urea and ammonium nitrate (AN) were similar and greater than that of controlled-release urea. The optimum N rate for dry matter yield was approximately 130 kg N ha^{-1} for the first cut and 110 kg N ha^{-1} for the second cut, depending on crop and fertilizer prices. Both green colour and brown leaf ratings increased with N rate, with optimum colour for the first cut obtained with 100 to 150 kg N ha^{-1}. Digestibility was unaffected by N rate except when crops were very deficient in N. At the location where timothy was responsive to P fertilization, yields were similar with annual broadcast applications of 13 kg P ha^{-1} or one pre-seeding application of 86 kg P ha^{-1}. Timothy yield and quality were not responsive to K fertilization. High yields of timothy hay (average 11 Mg ha^{-1} y^{-1}) were consistently obtained with adequate N and P fertilization.

Notes:

Phosphorus Flows Downhill – Even in Alberta

Barry M. Olson
Water Quality Section, Alberta Agriculture and Rural Development, Lethbridge;
Email: barry.olson@gov.ab.ca

Not only is phosphorus (P) an essential major nutrient in intensive agricultural production, it is also a nutrient of environmental concern, particularly for water quality. Much of this concern is focused on livestock production and manure management. Long-term monitoring through the Alberta Environmentally Sustainable Agriculture Water Quality Program showed that as agriculture intensity increases the amount of P also increases in watershed streams. Small-plot studies have shown that over application of manure results in rapid increases in soil phosphorus, which may increase the risk of loss through surface runoff. A linear relationship was observed between soil P and P in edge-of-field runoff based on a 3-yr study in eight Alberta watersheds. A 6-yr field study was carried out to compare P-based and N-based application of fresh and composted cattle manure on crop growth and soil nutrients. This agronomic-based study showed that at least five times the land base may be required to switch from N-based to P-based manure nutrient management. Current work is being carried to evaluate beneficial management practices of nutrient management in selected watersheds in Alberta. These and other Alberta research work will be highlighted in this presentation.

Impact of a Controlled Released Nitrogen Fertlizer versus Urea on N_2O Emission Management in Alberta

Adil Akbar, L. Kryzanowski, C. Sprout, G. Lohstraeter, L. Powers and T. Goddard
Alberta Agriculture and Rural Development, Edmonton; Email adil.akbar@gov.ab.ca

Nitrous oxide (N_2O) emissions from a controlled released nitrogen fertilizer (Environmentally Smart Nitrogen – ESN) were compared with urea at three field sites located in different agroclimatic areas in Alberta. Sites included Lethbridge on an irrigated Dark Brown soil, Lacombe on a dryland Black soil, and Barrhead on a dryland Gray Wooded soil. The study was a part of a four year multi-site, multi-crop project initiated in 2008 to evaluate and compare urea vs ESN for agronomic, economic and environmental performance based on the 4R fertilizer management system ("Right Source @ Right Rate, Right Time, Right Place™"). Five treatments were applied at each site, i.e., control with no fertilizer (Control), and urea and ESN side banded at rates of 60 and 120 kg N ha^{-1} (U60, U120, E60 and E120). Data were collected for two data-years, fall year (October 2007 - October 2008) and spring year (May 2008 - May2009). While data analyses continue for all three sites, preliminary analysis for Barrhead showed that N_2O emissions during both years increased in the order of Control < ESN 60 < Urea 60 < ESN 120 < Urea 120, indicating that the increase in N_2O emissions was directly proportional to the increase in the fertilizer application rates and that on the average N_2O emissions from ESN were smaller than urea for both fall and spring years. The results also showed that N_2O emissions from fall applications of both ESN and urea were greater than spring applications. Based on these results it was concluded that under similar conditions N efficiency of ESN could be higher than urea. And, if economically viable, producers could use ENS as a potential alternative to urea for improving crop production as well as reducing N_2O emissions, particularly, for fall applications. However, since numerous field and climatic conditions can control N_2O-N losses to the environment, further evaluation of the data gathered on these conditions at all three locations is required to verify these results.

Land Reclamation

Update on the Reclamation Criteria Advisory Group 'Where we are at with the 2010 Reclamation Criteria'

Shane Patterson, Ph.D., P.Ag.
Alberta Environment, Edmonton;
Email: shane.patterson@gov.ab.ca

The Reclamation Criteria Advisory Group (RCAG), established in 2005, is a multi-stakeholder group chaired by Alberta Environment. RCAG's mandate is to review and provide recommendations for upgrading the 1995 Update of the Reclamation Criteria for Wellsites and Associated Facilities. This review of reclamation criteria is intended to include improvements in reclamation practices, scientific developments and recommendations for improving the former criteria. In 2008, practitioners assessed 115 reclaimed cultivated, grassland, and forested sites using the methodology outlined in the draft criteria. Data and feedback from practitioners was used in the creation of the *2010 Reclamation Criteria* documents for Cultivated Lands, Native Grasslands, and Forested Lands.

Compared to the *1995 Criteria*, the *2010 Reclamation Criteria* now places greater emphasis on the establishment of natural forest vegetation in the Forested Criteria, community structure and composition in the Native Grassland Criteria, and vegetation parameters in the Cultivated Criteria. The intent of the *2010 Reclamation Criteria* is to measure appropriate parameters and evaluate whether land function and operability is comparable to the surrounding area or an appropriate reference.

Residual Effects of Topsoil Replacement Depths and Organic Amendments on Reclaimed Wellsites

Francis J. Larney, Andrew F. Olson and Paul R. DeMaere
Agriculture & Agri-Food Canada Research Branch, Lethbridge;
Email: Francis.Larney@agr.gc.ca

Soil samples were taken from three wellsites (Strathmore, Hesketh, and Rosedale) in south-central Alberta in 2007, ~10 yr after the sites had been reclaimed with combinations of four different topsoil replacement depths (0%, 50%, 100%, 150%) and five amendments (compost, manure, straw, alfalfa, check). The 2007 samples were analyzed in the laboratory for soil organic carbon, total nitrogen, nitrate-nitrogen, available phosphorus and inorganic carbon alongside archived samples from the same wellsites from 1997 (baseline), 1998 and 2000. The study showed that residual effects of organic amendments in restoring soil quality and productivity (as measured by soil organic carbon concentration and other soil properties) were still present 10 yr after reclamation. However, even though residual effects of compost and manure were still measured, their magnitude has declined over time.

Notes:

Recycling Industrial Process Water for Food Production in Alberta: Implications for Soil Monitoring and Reclamation

Murray Riddell
Matrix Solutions Inc., Calgary; Email: mriddell@matrix-solutions.com

Recycling industrial process water for food production in Alberta depends on irrigation water quality guidelines, irrigation land classification, salinity and nutrient management planning and soil/groundwater monitoring. Water quality guidelines screen based on chemistry. Irrigation land classification selects landscapes suitable for recycling. Salinity and nutrient management plans determine when and how much water can be recycled. Soil and groundwater monitoring evaluates the success of the planning and provides feedback to the water manager. The amount and quality of food and fiber produced evaluates the success of the soil monitoring plan.

The soil monitoring program must be designed to suit the landscape and cropping patterns for each project. Groundwater monitoring is essential and the location of the wells and piezometers should complement benchmark soil sampling locations. Annual soil sampling in the fall, after frost has set, provides the least disruption to farming operations and captures the impact of all process water irrigation events within a calendar year.

Several observations can be made after a decade of monitoring on two process water recycling projects in Alberta. Soil salinity and sodicity levels can be maintained at or near baseline levels. Fall rains have been shown to be helpful in managing salinity levels. Soil phosphorus levels are generally stable. Soil nitrogen levels are subject to wide fluctuations and need to be managed carefully. Resting land or fall leaching with irrigation district water is essential for salt management in areas with high evapotranspiration driven by temperature and wind speed. The sizing of process water storage lagoons and land requirements for irrigation should consider the capability to rest up to 25% of the lands on an annual basis.

Pipeline Installation in Minimum- and No-Till Farming Areas: Construction Learning to Assist in Reclamation Success

Simone Levy and Jim Burke
Matrix Solutions Inc., Calgary
Email: slevy@matrix-solutions.com; jburke@matrix-solutions.com

Installation of pipelines in zones of no-till and minimum-till farming present unique reclamation challenges. Under conventional tillage, deficiencies such as cavitation, compaction and uneven topsoil distribution are corrected through farming operations. However, when a farmer follows a no- or minimum-till approach, compaction is not alleviated, topsoil is not redistributed, and cavitation can cause equipment damage where the ground surface is uneven. In areas of minimum- and no-till farming practices, it is important to minimize reclamation deficiencies within pipeline right-of-ways to maintain good relationships between pipeline operators and land owners. This presentation provides some practical applications of soil science to improve construction practices and conserve soil resources.

Reclamation deficiencies including compaction, cavitation, uneven topsoil distribution, admixing, rocks at surface and salinity redistribution throughout the profile have been identified along pipeline installations in no-till farming zones of southern Alberta. Matrix has been assisting pipeline operators in the identification and reclamation of these deficiencies as well as providing advice on construction practices to minimize deficiencies. Construction practices that will be discussed in this presentation include soil handling considerations to maintain soil quality, controlling the yearly cycle of pipeline installation, compaction avoidance, construction supervision, and postconstruction reclamation techniques. In addition, "trouble spots" such as hot line crossings, side bends, tie-ins and road crossings will be discussed along with construction practices to alleviate difficulties in these areas

Devon Canada Jackfish Interconnecting Pipeline Case Study

Don McCabe,
Alberta Environment, Calgary;
Email: Don.McCabe@gov.ab.ca

Innovative Pipeline Strategies (IPS), a multi-disciplinary approach to pipeline development, was utilized during the construction of the Devon Canada Jackfish Pipeline Project near Conklin, AB, in the winter of 2009. IPS involves the combined effort/commitment/skills of contractors, companies, landowners and regulators to plan and implement pipeline projects so that all desired enviro-economic outcomes are achieved. IPS evolved from some recurring issues with pipeline development across Alberta, and the recognition that there were opportunities to achieve greater enviro-economic outcomes. Admixing during frozen topsoil salvage, trench subsidence, and the roaching and feathering of trench spoil can create long-term socio-enviro-economic impacts for the company (costs to remediate, costs of strained relations), the landowner (costs to land management, loss of soil quality/quantity, costs of strained relations) and the regulator (costs to respond and enforce). Applying the principles of IPS - working together to develop innovative solutions and best practices - Devon completed the Jackfish Pipeline Project on schedule and within budget, while minimizing disturbance and addressing these long-term impacts. AENV and ASRD see the principles of IPS as the application of cumulative effects management in pipeline development that aligns with the vision of the Alberta Land Use Framework.

Soil Conservation

Effect of Sustainable Management Practices on Soil Properties of an Irrigated Rotation Study

Francis J. Larney[1], Drusilla C. Pearson[1], Robert E. Blackshaw[1], Newton Z. Lupwayi[1], and Peter J. Regitnig[2]
[1]Agriculture & Agri-Food Canada Research Branch, Lethbridge; [2]Lantic Inc., Taber, AB;
Email: Francis.Larney@agr.gc.ca

Common irrigated crops in southern Alberta, Canada, such as potatoes (*Solanum tuberosum* L.), sugar beets (*Beta vulgaris* L.) and dry beans (*Phaseolus vulgaris* L.) produce little crop residue for return to the soil. Growing these crops in tight rotations may have long-term detrimental effects on soil quality. An irrigated rotation study was initiated in 2000 to examine the impact of conventional and sustainable rotations on crop and soil response. The sustainable rotations (3 to 6 yr in length) were built around four specific soil management practices: (1) reduced tillage; (2) cover crops; (3) feedlot manure compost application and (4) where beans occurred in the rotation, solid-seeded narrow-row beans vs. conventional wide row beans. Most soil parameters pointed to beneficial effects of sustainable soil management (e.g. increased soil organic carbon (SOC), microbial activity, and available water). Sustainable management increased soil organic carbon on the 3- and 4-yr rotations by an average of 11% (0-15 cm depth) after 9 yr. In contrast, conventional management led to a 10% decline in SOC after 9 yr. The 3- and 4-yr sustainable rotations averaged 26% higher than their conventional counterparts for microbial biomass C in bulk soil.

Quantification of Soil Erosion: Evaluating Wind Erosion Control BMPs for Farm Systems with Low Residue Crops

Murray Lewis and M. Black
Agriculture & Agri-Food Canada, Agri-Environment Services Branch, Lethbridge;
Email: Murray.Lewis@agr.gc.ca

Soils under low residue crop rotations (ie. potato & bean) in Southern Alberta are often at risk to wind erosion due to climatic factors, lack of vegetative cover at critical times, required soil disturbance and late crop harvest. Innovative producers have developed and continue to refine erosion management programs for their specific farm system and conditions. A multi-year wind erosion project was initiated in 2007 to better understand the benefits and potential applications of current wind erosion control beneficial management practices (BMPs). Measurements of soil surface characteristics (texture, organic matter content, dry aggregate size distribution and surface residue), daily wind conditions and soil movement were made. Soil movement (10-100cm above the soil surface) was determined over winter using Big Spring Number Eight (BSNE) dust collector arrays located along the eastern field edge. As expected, soil erodibility tended to be most heavily linked with soil texture. Sandy fields (>75-80% sand) generally eroded the most while fields with higher clay content (10-15% clay) generally eroded the least. Management practices also seemed to play a significant role in reducing wind erosion however the appropriate BMP or combination of BMP's was dependant on soil texture and time of year. There was little erosion from rough field surfaces on heavier soils (loams) but the same management practice on sandy soils resulted in erosion at or above tolerable limits. Cover crops seemed to offer additional protection although their effectiveness was limited if planted late and on sandy soils. Winter wheat and fall rye were generally better suited to fall growing conditions than annual cereals and could provide additional spring protection. Manure application also seemed to reduce soil erodibility in the fields monitored. Implementing multiple BMP's such as surface roughness + manure or surface roughness + cover crop seemed to provide better erosion protection than a single BMP, especially on highly erodible soils. Additional monitoring is required, but early results look promising for the development of more effective erosion control practices in low residue crop systems.

A Buffer Design Tool for the Canadian Prairies

Alan Stewart, Sharon Reedyk and Bill Franz
Integrated Natural Resources,
Agri-Environment Services Branch,
Agriculture & Agri-Food Canada,
Edmonton

Vegetated buffers are a recognized Beneficial Management Practice (BMP) and buffer establishment was included the recent Canada-Alberta Farm Stewardship Program. Buffers are permanently vegetated strips placed between cropland and streams designed to protect the streams from the impacts of cropping. There has been a great deal of research on buffers, largely addressing design in terms of buffer width and assessing functional variables such as landscape slope, buffer vegetation, soil permeability, soil texture etc. However, field staff had difficulty designing buffers because the width criteria required fitting uniform buffers onto complex landforms with irregular stream morphology. As well, there was low confidence in recommendations because of the wide variations in the literature. This project is developing a tool to assist staff in designing buffers in the Canadian prairie region. The tool, initially developed by examining a variety of buffer/landscape settings, was refined by feedback from workshops in Alberta, Saskatchewan and Manitoba. We are now preparing a field handbook and are also seeking partners to apply the tool and to validate the approach developed. We are also seeking opportunities to have the test the tool rigorously tested in a scientific basis.

Soil C sequestration and other soil property changes under long-term cattle manure land application.

Chi Chang,

Lethbridge Research Centre, Agriculture and Agri-Food Canada, Lethbridge

Cattle manure is a major by-product of feedlot cattle operations. A large quantity has been produced in Southern Alberta annul. It is often costly for the producers to remove and “dispose” properly. Even though animal is an excellent soil amendment with some values as a crop nutrient source, “over” manuring could have negative impacts on soil and cause other environmental issues. Animal manure can be used for generating biogas and bio-fertilizers. However, “land disposal” is till the most common method to manage. Alberta government has developed guidelines how to utilize animal manure properly. This report will summarize the effects of a 30-year annual feedlot cattle manure application study in southern Alberta on C sequestration and other soil properties to highlight both beneficial and potential detrimental outcomes of “over” manuring.

Notes:

Long-term Tillage and Straw Effects on the Diversity and Density of Soil Mesofauna in a Black Chernozemic and Gray Luvisolic Soil.

D. Puurveen[1], J.P. Battigelli[2]* and L.A. Leskiw[2]

[1]Dept. Renewable Resources, University of Alberta 751 General Services Building, Edmonton T6G 2H1

[2]Paragon Soil & Environmental Consulting Inc., 14805 - 119 Ave., Edmonton AB T5L 2N9; *presenter

Email: jbattigelli@paragonsoil.com

A field experiment was conducted on a Black Chernozem (Ellerslie Research Station, Edmonton, Alberta) and a Gray Luvisol (Breton Plots, Breton, Alberta) to examine the influence of 28 years of tillage practices and straw management on the soil mesofauna community. After harvest in the fall of 2007, samples were collected from four treatment plots at each site: Zero Tillage (ZT)/Straw Removed (Srem); Conventional tillage (CT)/Srem; ZT/Straw Retained (Sret); and CT/Sret. Twelve soil cores were collected (0-10 cm in depth) from each treatment plot. Cores were split into 5 cm sections and placed into a modified Merchant-Crossley Extractor. Extracted specimens were sorted and counted under a dissecting microscope. Acari were identified to Suborder, Collembola to Family and the remaining fauna to Class, Order or Family depending on the specimen. Collembola, oribatid mites and mesostigmatid mites were further sorted to morphotaxa. Density and relative abundance of each faunal group were analyzed. Morphotaxa analysis utilized three diversity indices. Results demonstrated a negative impact of tillage and a positive influence of straw retention on soil mesofauna communities. Density of total soil mesofauna was significantly greater on ZT/Sret treatments. Morphotaxa diversity was significantly higher on Sret plots than Srem plots.

Technical Papers on GHG Emissions from Rangeland and Perennial Cropland

Semi-arid Rangeland Livestock GHG Emissions

Alan Iwaasa[1], Ph.D., Brian McConkey[1], Ph.D. and Reynald Lemke[2], Ph.D.,
AAFC Research Branch, [1]Swift Current and [2]Saskatoon SK
Email: Alan.Iwaasa@agr.gc.ca

It is estimated that the arid and semiarid brown soil zone of western Canada accounts for about 5.6 million hectares of land. This important ecoregion supports a number of intensive and extensive agricultural production systems. In particular, this land base is extremely important for the Canadian cattle industry in the area of supporting the cow/calf industry by providing forage and grazing resources. It is recognized that the way we use the land and management practices have the greatest potential to either store or emit the three main GHG's most commonly associated with agriculture [i.e., carbon dioxide (CO_2), methane (CH_4), or nitrous oxide (N_2O)]. The presentation will focus on the ongoing grazing and forage (native and tame) research being conducted at the Semiarid Prairie Research Centre on each of the main agricultural GHG's under various livestock pasture systems. Research efforts are focusing on developing grazing systems that are environmentally and economically sustainable. Many management practices that reduce GHG emissions also can increase environmental sustainability and/or production efficiency.

Notes:

Options to Reduce GHG Emissions from Rangeland

Eric Bremer[1], Ph.D.,
B.W. Adams[2], and B.H. Ellert[3]
[1]SymbioAg Consulting, [2]Alberta Sustainable Resource Development; [3]AAFC Research Branch, Lethbridge
Email: ericbremer@shaw.ca

Rangelands provide a wide range of societal benefits. Can they also be managed to reduce GHG emissions? Rangelands contain large reservoirs of organic carbon and may be sequestering additional atmospheric CO_2 through their response to elevated CO_2 levels. Improving range health through the effective application of rangeland management principles may increase carbon storage on rangelands that are currently rated as unhealthy. Unfortunately, this benefit is difficult to quantify due to the large, highly variable background of carbon stocks on rangeland. Improved rangeland health or grazing practices also impact methane emissions from grazing animals. Conversion of annual cropland to rangeland can increase carbon sequestration substantially, as can inclusion of legumes in seeding mixes and application of compost when degraded lands are converted to rangeland. Overall, maintaining rangelands in good condition is the most certain and effective means to preserve carbon stocks in rangeland

Notes:

Canada's national greenhouse gas inventory and requirements for including effects of pasture management

Brian McConkey[1], Ph.D., Dominique Blain[2], Ph.D. and Chang Liang[2], Ph.D.
[1]AAFC Research Branch, Swift Current SK; [2]Pollution Data Branch, Greenhouse Gas Division, Environment Canada, Gatineau, QC; Email: Brian.McConkey@agr.gc.ca

Under the United Framework Convention of Climate Change, Canada is required to produce an annual National Inventory Report that summarizes emissions and removals of greenhouse gases (GHG) due to anthropogenic cause that occur within Canada. This report includes emissions and removals for agricultural activities including the management of soil and the rearing of livestock. The rearing of livestock represents 5% of Canada's total GHG emissions expressed in CO2 equivalents (excluding N2O emission from livestock manure applied as N source to cropland). The calculation of these emission account regional differences in diet, housing, and manure management for livestock in confined situations but only has single emission factors for emissions of livestock when on pasture or range. The reason for single factors is that there is perceived to be insufficient information to refine emissions estimates between regions and/or grazing management systems.

For purposes of calculating carbon stock changes for the NIR, Canada divides its land into six (6) broad land-use categories of Forest, Cropland, Grassland, Settlement (including built-up areas, sites of mineral extraction, and transportation and utility corridors), Wetland, and Other (bare rock, sand, ice). To reduce the amount of land-use change between grassland and cropland or forest for which to account, Canada chose to define managed grassland as unimproved pasture or rangeland that is grazed by domestic livestock located in areas that would not grow into forest if left unmanaged excepting fire suppression. This area is then further specified as unimproved pasture on Brown and Dark Brown Chernozemic soils in Alberta, Saskatchewan and the interior of British Columbia. Because of perceived lack of knowledge of carbon changes on this defined managed grassland, Canada has not estimated its carbon stock changes. Following a formal review of its GHG inventory in 2007, Canada has been requested to include estimates of carbon stock changes on managed grassland. Hence, the Government of Canada desires to improve estimates of GHG emissions and removals for livestock-grassland system and is seeking expert input to guide and inform these inventory improvements. To include improvements in the national inventory, the data needs are:

1) the livestock-grassland system divisions need to be comprehensive and include all livestock-grassland systems in Canada
2) the extent and its uncertainty of livestock-grassland systems must be estimatable from 1990 to present (and expected to be estimatable in the future), and
3) the GHG emissions/removals and their uncertainties for all the divisions of livestock grazing systems must be estimatable.

Divisions of livestock-grassland systems within the GHG inventory that have the same or very similar estimates of GHG emissions and/or removals are perfectly acceptable for inventory purposes whereas any division of livestock-grassland system within the inventory that has unestimatable GHG emissions/removals is unacceptable.

Notes:

Managing Rangeland and Perennial Cropland to Mitigate GHG Emissions and Generate Carbon Offsets

Karen Haugen-Kozyra, MSc.,
P.Ag., Carbon Offset Consultant,
Principal, KHK Consulting, Edmonton
Email: karenhk62@gmail.com

Karen will provide the audience with a general understanding of Carbon Offsets - what they are, how they are created, the policy criteria and standards that must be met in both voluntary and emerging regulatory carbon markets. The discussion will include the state of Canadian, Provincial and regional North American systems currently at play. Agricultural projects are an important component of all of these systems as the regulatory context gets closer to finalization. Karen will focus on how agriculture has been involved to date by focusing on the practical aspects of standards development - called Greenhouse Gas (GHG) Quantification Protocols - and the unique challenges that the diffuse, non-point GHG emission sources and sinks that characterize agricultural and landscape-based systems, give rise to. Karen will also highlight the efforts in Canada and the provinces with regards to agricultural Carbon Offset projects, focusing primarily on the experiences of the Alberta Offset System, in operation since July 1, 2007, and producing over 2.2 Million tonnes of compliance-based Carbon Offsets from agriculture (to date).

Notes:

Considerations for Developing Offset Protocols for Semiarid Pastures

Robert Janzen Ph.D. P.Ag.,
VP ClimateCHECK,
Email: rj@climate-check.com;
Web: www.climate-check.com
Tel: 403-332-0115;
Head Office: 325 Dalhousie St., Suite 204, Ottawa, ON, K1N 7G2

The conservation and restoration of rangeland and perennial cropland is identified by a number of programs in North America as a strategy to mitigate greenhouse gas (GHG) emissions and to generate carbon offsets. Practices to mitigate GHG emissions include conversion of cropland to grassland, innovative management of existing grassland, and avoided conversion of grassland to cropland. Quantification methods, policy decisions, and program criteria needed to generate compliance-quality offsets are in development. Carbon offsets are currently traded in the voluntary market, using protocols approved by the Chicago Climate Exchange and by the Climate, Community & Biodiversity Alliance. These voluntary protocols will be used to illustrate considerations for developing compliance-quality offset protocols for semi-arid pastures.

Notes:

Abstracts for the Keynote Presentations on Greenhouse Gas Emissions from Rangeland and Perennial Cropland

Terminology for Land Use, Land Cover, Land Management, Grazing Systems, Cropping Systems, and Cattle Production Systems

Dr. Vern Baron,
AAFC Research Branch, Lacombe AB
Email: Vern.Baron@agr.gc.ca

The National Inventory Report and similar activities are examples of Canada's documentation required under the policy known as the United Nations Framework Convention on Climate Change. The reporting system requires the classification of emission attributes that fit into a scale of spatial hierarchy that may include scientific plot, field, farm, landscape, agro-ecoregion, region and country levels. The levels may conflict on the continuum from difference to similarity. From the country and region levels there is a drive to typify or consolidate information into units that are alike to make them manageable for reporting. The farm level may be unique for management and business values within a similar landscape; the science thrives on detail. Each level has differing management styles, academic backgrounds, traditions, priorities and objectives, creating a confusing language and awkward decision-making process. However, the hierarchical levels are interdependent in developing the typology necessary in describing emissions for the GHG inventory as well as in the development of carbon credit systems. This is because the science must substantiate and verify best management practices executed at the farm level within the guidelines of a national policy. Land use change must effect distinctive impacts of management practice within agro-climatic or vegetation zones. In the national context the cumulative effect of a science-based farming practice must have net impacts at the country level although may be represented regionally. Thus to create or bulk divisions based on livestock grassland management on the prairies it may be best to work within the major agro-climatic regions, beginning with the brown and dark brown soil zone, because of similarities in climate, climax vegetation and management style. The presentation will use examples of grassland-management terminology that may assist in developing a typology, which will describe significant management practice-emission relationships useful at most levels of the spatial hierarchy as it relates to greenhouse gas emission and climate change.

Discussion Paper: Greenhouse Gas Emission Reductions and Removals through Improved Grazing and Forage Management Systems

Dr. Emmanuel Mapfumo,
Dept. Renewable Resources, UofA and EBA Engineering Consultants, Edmonton
Email: mapfumo@ualberta.ca

This project focuses on beef-cattle production and includes the development of typologies for grassland, pasture and forage systems, the classes within the typologies, and the effects of change between classes within typologies on greenhouse gas emissions and terrestrial carbon balance.

The specific objectives of the project are to develop appropriate typologies for beef-cattle production in Alberta and the division of these typologies into classes, and to quantify the effect of shifting between classes within each typology on the terrestrial carbon balance, nitrous oxide (N_2O) emission, methane (CH_4) emission and changes in direct and indirect emissions from fossil fuel use.

Data collected under Section III of the Farm Environmental Management Survey (FEMS 2006) livestock module was used in the development of typologies. The data included the types of livestock on the farm (calves, steers, heifers, cows and bulls), the area of land under natural versus tame pasture, days of grazing native and tame pastures, residual forage height, frequency of reseeding for the tame pastures, practices used to extend the grazing season, movement/bedding practices used when feeding livestock in an open area, proximity of paddocks to surface water bodies, and type of access to the paddocks (unlimited, limited etc.). Cluster analyses was conducted using SPSS Windows version 14 and the results were used to aid in the development of beef-pasture typologies for Brown and Dark Brown soil zones in Alberta. The various vegetation species (native and introduced) and their associated productivities were used to develop classes within typologies.

The changes in terrestrial carbon balance between classes within typologies was assumed to be largely dependent on the changes in residues left following grazing or hay removal, and the amount of excreta deposited by grazing livestock. The results from long-term research conducted in western Canada were used to estimate the amount of residues associated with each typology class, and the amount of carbon sequestered.

The changes in N_2O and CH_4 emissions between classes within typologies were estimated from the modified version of IPCC Tier 2 methodology that uses total above-ground net primary productivity, forage utilized by beef-cattle and residues left on the surface.

The presentation will focus on an example of the approach taken in developing typologies and the assumptions used in quantification of greenhouse gas emissions and reductions between classes within typologies.

Grazing Management Contributions to Net Global Warming Potential from Rangeland on the Northern Great Plains

Dr. Justin Derner[1] and Dr. Mark A. Liebig[2]
US Dept. Agriculture, Agriculture Research Service, [1]Cheyenne WY and [2]Mandan ND
Email: Justin.Derner@ARS.USDA.GOV

Soil organic carbon (SOC) sequestration rates in Northern Great Plains rangelands [0.07 to 0.30 Mg C ha^{-1} yr^{-1}] play an important role in the global C cycle and net global warming potential due to a number of factors, including 1) large land area that translates into a globally significant change in SOC storage despite relatively low rates of sequestration compared to croplands, 2) large reservoir of sequestered C that could be released back into the atmosphere with improper management, especially in more fragile environments, and 3) potentially high rates of SOC accumulation in newly established pastures and degraded rangelands. Soil organic C sequestration in these rangelands is influenced by grazing management, N inputs and environmental conditions (principally drought). Carbon uptake on these rangelands is typically characterized by short periods of high uptake (2-3 months) and long periods of C balance or small losses, suggesting that proper grazing management is critical during the short periods of high uptake. Three main drivers that will control the fate of C sequestration and net global warming potential in these rangelands are 1) long-term changes in production and quality of above- and below-ground biomass resulting from vegetation community changes associated with grazing management; 2) long-term changes in the global environment such as rising temperatures, altered precipitation patterns and rising CO_2 concentrations that affect plant community composition and forage quality, and 3) effects of short-term weather conditions (e.g. droughts) on net C exchange. Here, we will use two case studies with long-term (25 and 70+ years) grazing treatments to showcase grazing management contributions to net global warming potential from rangelands of the Northern Great Plains. In addition, we will address tradeoffs associated with C storage, biomass production, livestock gains, soil communities, plant diversity and vegetation change in these case studies.

Notes:

SPONSORS FOR THE 2010 ALBERTA SOIL SCIENCE WORKSHOP:

Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada
Lethbridge Research Centre / Centre de recherches de Lethbridge

Alberta
Freedom To Create. Spirit To Achieve.
Government of Alberta
Agriculture and Rural Development

HydroQual Laboratories Ltd.

Golder Associates

amec

GENIVAR

Avensys Solutions

Agrium

Alberta
Freedom To Create. Spirit To Achieve.
Government of Alberta
Environment

eba

EnCana™
energy for people

AGRI-TREND AGROLOGY LTD

FACULTY OF AGRICULTURAL, LIFE & ENVIRONMENTAL SCIENCES
UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

RENEWABLE RESOURCES