Canadian Weed Science Society

Société canadienne de malherbologie

Proceedings for the 2009 CWSS-SCM Annual Meeting

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Plenary Session "Climate Change and the Canadian Agricultural Environment"

Tuesday, November 24

[1] "Climate change impacts on agriculture" by Gary Lines, Climate Change Meteorologist, Environment Canada, Halifax, Nova Scotia

[2] "Some difficulties in predicting the biological impacts of climate change" by Dr. Jonathan Newman, Director of the School for Environmental Science, University of Guelph, Guelph, Ontario

[3] "A bio-climatic approach to assessing the potential impact of climate change on crop pests" by Dr. Owen Olfert, AAFC, Saskatoon, Saskatchewan

[4] "Climate change and the impact on the future of agriculture" by Dave Gustafson, Monsanto Company, St. Louis, Missouri

[1] Climate Change in Atlantic Canada: An Agricultural Perspective by Mr. Gary Lines (Climate Change Meteorologist)

Mr. Lines completed his Bachelor of Science (BSc) Degree at Dalhousie University in 1974 and BSc in Meteorology in 1975 in Toronto. His career with Environment Canada has taken him to Alberta and the Atlantic Provinces as a weather forecaster, lead meteorological instructor at the Transport Canada Training Institute in Cornwall, Ontario and Manager of the Meteorological and Oceanographic Centre (MetOc) at the Canadian Naval Dockyard in Halifax. His meteorological experience spans 30 years and, geographically, most areas of Canada and offshore.

Abstract: Agriculture is, by definition, adaptable. However there are projected climate change impacts on the agricultural industry that will force farmers to make choices that they have never before had to consider. If the nature and extent of these impacts on agriculture could be determined, the industry may be able to develop adaptive strategies to cope with projected changes.

Atlantic Canada is situated in a very diverse environmental area. The climate of the region is varied, encompassing both coastal and continental regimes and influenced by several major ocean currents and mountain ranges. Currently projections of climate change are available from sophisticated Global Climate Models; but are only applicable over large geographical areas that encompass several climate regimes. In order to best describe the expected climate change impacts for the region, climate change scenarios and climate variables must be developed on a regional, or even site-specific scale.

Application of regional scenarios for agriculture would allow the evaluation of climate change on a more site-specific scale; providing a range of temperature and precipitation values that can be used in agricultural research at a farm-scale. Recent research into agricultural impacts in Atlantic Canada has identified the benefit of having such scenarios.

This talk reviews historical climate change in Atlantic Canada and provides scenario information recently developed by the Climate Change Section of the Meteorological Service of Canada Atlantic Operations (MSC-Atl Ops).

[2] Some difficulties in predicting the biological impacts of climate change by Dr. Newman (Director and Professor of the School of Environmental Sciences, University of Guelph)

Professor Jonathan Newman received his PhD in ecology from the State University of New York in Albany, New York. He has previously held faculty positions at Southern Illinois University in the United States, and at Oxford University in the United Kingdom. He is currently the Director of the School of Environmental Sciences at the University of Guelph. His research focuses on the biological impacts of climate change. He is a member of the editorial board for the journal Global Change Biology *and the lead author for a forthcoming textbook on climate change biology, to be published by CABI press.*

[3] A bio-climatic approach to assessing the potential impact of climate change on crop pests by Dr. Owen Olfert – Saskatoon Research Centre, Saskatoon, SK Telephone (306) 956-7288; Fax (306) 956-7247; Email Owen.Olfert@agr.gc.ca

Dr. Owen Olfert is an insect ecologist with Agriculture & Agri-Food Canada - Saskatoon Research Centre, specializing in management of insect pests of field crops. Owen grew up on a farm in SW Saskatchewan, obtained his B.S.A in agricultural biology at the University of Saskatchewan and continued on to do a Ph.D. in pest management. He started his career with Agriculture Canada as a research scientist in 1979, joining the staff at Saskatoon in developing management tactics for control of grasshoppers.

Owen's current research mandate is focused on management tactics for control of insect pests in extensive agriculture systems. This includes the development of monitoring and forecasting tools, bio-climate modeling to assess risks, and the development of alternative control methods (e.g. host plant resistance, biological control). He is also a founding member of a long-term, multi-disciplinary alternative cropping systems study which is designed to explore how production systems function with respect to agronomy, soil, biotic factors (weeds, arthropods and diseases), climate, economics, energy and the environment. Specifically, he is interested in assessing the impact of farming systems on arthropod diversity (beneficial and pest species).

Abstract: A bio-climatic approach to assessing the potential impact of climate change on crop pests. The role of climate in determining the geographical distribution of plants, arthropods and pathogens is well documented. Given that the magnitude of predicted temperature and precipitation changes associated with climate change is beyond the historical experience of modern agriculture, it is unlikely that we can continue to use historical data as analogues to predict the impact of climate change. Predictive bio-climatic modelling approaches have been used to quantify species – environment interactions, in relation to changes in climate. Climate change may impact temperate agricultural pest populations (weeds, insect pests, plant pathogens) by extending the growing season and host plant availability, increasing growth and development rates, shorting generation times, reducing overwintering mortality, altering timing of emergence from overwintering sites, and changing their geographic distribution. Once bio-climatic models have been validated and vetted through peer-review, future climate scenarios can be applied either through: (i) incrementally adjusting climate variables (e.g. +1, +2, +3 oC) in order to study the sensitivity of a specific system's response to a range of potential climatic changes; or (ii) through application of comprehensive climate scenarios taken from Global Climate Models. These two related, complimentary approaches are useful in studying the behaviour or responsiveness of a species to projected climate changes, and on the impacts that this may have on common issues of interest (e.g. agriculture, biodiversity, forestry, etc.). Based on agro-ecological research data, case studies of insect pests, plant pathogens, and weeds are used to illustrate the utility of these approaches, and to draw out the general patterns of response.

[4] Climate change and the impact on the future of agriculture by Dave Gustafson,

(Monsanto Company, St. Louis, MO)

Dave Gustafson is a Senior Fellow at Monsanto Company, where he serves as the Regulatory lead for Water Quality and Ag Sustainability. His academic training was at Stanford University and the University of Washington in Seattle, where he received his B.S. and Ph.D. degrees, both in chemical engineering. His research on the environmental challenges surrounding agricultural has now spanned nearly 30 years. The initial focus of his work was the development of new computer models for predicting the environmental behavior of crop chemicals, especially their potential impacts on water quality. Among the models he developed for this purpose is the GUS-Index, which is now used by regulatory agencies worldwide to determine the potential of pesticides to contaminate ground water supplies. In subsequent years, Dave developed new modeling approaches to pollen-mediated gene flow and the population genetics of insect and weed resistance. In 2007, Dave served as an inaugural member and theme lead for the Monsanto Fellows Climate Change Panel, which reported back to the company on the degree of scientific certainty in global climate modeling, and how it is likely to impact agriculture around the world. He now serves on various Monsanto teams looking at the new imperatives and constraints placed on agriculture by man-made global warming and other environmental challenges.

Abstract: Although the exact magnitude of current and likely future human influences on climate is uncertain, several key facts about climate and the future of agriculture are known. Convincing data show that temperatures are increasing, and that changing precipitation patterns are already affecting agriculture. Impacts on crop production are likely to intensify, but not in a uniform manner, either spatially or temporally. Some regions, such as Africa, Australia, and certain portions of Europe, are projected to be quite negatively impacted, while other important agricultural production areas, such as Argentina and temperate portions of North America, may actually benefit from the expected changes, at least initially (over the next few decades). However, most models suggest that all regions are projected to suffer productivity declines by the end of the 21st century, unless successful mitigation measures are implemented soon. Exacerbating the climate change challenge, demographic and economic trends suggest that a doubling of overall crop productivity will be required by mid-century, in order to meet the food, feed, fuel, and fiber demands of an estimated world population of 9 billion by the year 2050. Clearly, new technologies are needed for agriculture to supply this escalating demand, while at the same time adapting to a changing climate and hopefully even contributing to climate mitigation, by reducing the greenhouse gas emissions associated with crop production. Fortunately, good progress is already being made. For most crops of global importance, there is considerable buffering and redundancy in breeding, seed manufacturing, and research sites, which should enable us to keep pace with the expected rate of changes. Crop chemical manufacturing is managing its "carbon footprint," and there are new biotechnology-based crop traits in the research pipeline, such as drought tolerance and nitrogen-use efficiency, that will help in both mitigating and adapting to climate change.

Continuing Education Workshops

Tuesday Afternoon, November 24, 2009

Scientific Evaluation and Decision-Making Process for Pest Control Products in Canada – PMRA

[5] "Value Assessment" – **Michael Downs**, Section Head, Value and Sustainability Assessment Directorate, PMRA

[6] "Health Assessment" – **Denise MacGillivray**, Acting/Section Head, Health Evaluation Directorate, PMRA

[7] "Environmental Risk Assessment" – **Michelle Kivi**, Senior Evaluation Officer, Environmental Assessment Directorate

NSERC Partnering with Industry Workshop

[8] "Partnering with Industry: An Overview of NSERC Research Partnership Funding Opportunities" **Lynda Wood**, Portfolio Manager – Bio-industries, NSERC, and **Catherine Vardy**, Development Officer – NSERC Atlantic

[9] "Preparing a Winning Collaborative Research & Development Grant Application" **Lynda Wood**, Portfolio Manager – Bio-industries, NSERC, and **Catherine Vardy**, Development Officer – NSERC Atlantic

Mental Models Project

[10] "What farmers think and why it is important" **Dr. Doug Doohan,** Ohio State University, Wooster, Ohio

Scientific Evaluation and Decision-Making Process for Pest Control Products in Canada – Pest Management Regulatory Agency (PMRA)

[5] *Michael Downs - Michael began his career in the federal public service with Agriculture and Agri-Food Canada in 1999 at the Harrow Research Centre as a member of the weed science and weed ecology research programs. With the creation of AAFC's Pest Management Centre in 2003, Michael transferred to Ottawa to join AAFC's Minor Use Program as the herbicide Project Coordinator. In 2006 Michael joined the Pest Management Regulatory Agency in his current position as Section Head of the Herbicides and Plant Growth Regulators Section in the Value and Sustainability Assessment Directorate where he works with a team of weed scientists conducting value assessments on herbicides*.

[6] *Denise MacGillivray - Denise has been a Federal Government scientist with Health Canada since 2004. She is currently acting Section Head for Exposure (Fungicides & Herbicides) within the Health Evaluation Directorate of Health Canada's Pest Management Regulatory Agency (PMRA). After obtaining her B. Sc. from the University of Guelph in Ontario, Denise received a post-graduate degree in Pharmacology & Therapeutics from the University of British Columbia. Prior to joining the PMRA, Denise was a research biologist and project manager for a biopharmaceutical company located in Vancouver, BC.*

[7] *Michelle Kivi - Michelle has been a Federal Government scientist with Health Canada since 1998. She is currently the Acting Senior Science Advisor in the Environmental Assessment Directorate of Health Canada's Pest Management Regulatory Agency (PMRA). The Environmental Assessment Directorate is responsible for conducting environmental risk assessments on pesticides. Ms. Kivi obtained her B.Sc. in Environmental Toxicology from the University of Guelph.*

Scientific evaluation and decision-making process for pest control products in Canada.
Downs, M., Kivi, M., and MacGillivray, D. Pest Management Regulatory Agency, Health Canada, Ottawa, ON

Health Canada's Pest Management Regulatory Agency (PMRA) is responsible for pesticide regulation in Canada under the authority of the *Pest Control Products Act (PCPA)*, and is committed to providing an open, transparent and participatory process for pesticide regulation. The PMRA registers pesticides only if a stringent, science-based evaluation shows they will pose no unacceptable risks to human health or the environment and have value. Scientific evaluations focus on three main areas: value, environmental effects and health effects.

Value assessments are conducted within the Value and Sustainability Assessment Directorate. During the value assessment, scientists review information related to how effectively the pesticide controls the target pests, any adverse effects on the host crop or site to which it is applied, its contribution to sustainability, and any related social or economic impacts. The value assessment ensures that the pesticide contributes to managing pest problems and helps to minimize risks associated with its use by ensuring that appropriate use rates and directions appear on the product label.

The Environmental Assessment Directorate evaluates data on the environmental toxicology (i.e., pesticide toxicity to organisms such as fish, plants, bees and birds) and environmental fate (i.e., what happens to the pesticide once it enters the environment). This information is used to assess the risk to the environment and develop risk mitigation and risk management options to address environmental concerns that may arise from the intended use.

The Health Evaluation Directorate evaluates data pertaining to health effects associated with pesticides. This includes identifying and characterizing the health hazards related to a given pesticide, as well as estimating the potential levels of exposure to pesticides from both dietary and non-dietary sources. These are integrated into the human health risk assessment, which includes an assessment of available risk mitigation and risk management options.

Upon completion, the results of the scientific evaluations are integrated so an overall assessment can be made. Consideration is given to the completeness and adequacy of the data base, potential complicating factors, and risk mitigation and risk management measures. Once a regulatory decision has been proposed, public consultation occurs. Comments received during the consultation period are considered and assessments are revised as necessary prior to a final decision being made.

NSERC Partnering with Industry Workshop

Lynda Wood, Ph.D. - *As a Portfolio Manager in NSERC's Research Partnerships Programs Division, Lynda Wood is responsible for managing a portfolio of open and closed competitions including the CRD program, IRC program, Synergy Awards for Innovation, Innovation Challenge Awards, and the Strategic Projects and Networks programs. She works closely with researchers by providing guidance in the preparation of applications, and in recruiting and selecting highly qualified peer reviewers from the academic, government and industrial sectors. Responsibilities also include monitoring progress on ongoing scientific and technical projects, consulting external scientific advisors, making recommendations on the renewal of project funding and phasing out ongoing awards where progress is inadequate. Lynda starting her career at NSERC in the Discovery Grants Division, working with the Space and Astronomy GSC and the Evolution and Ecology GSC.*

Before joining NSERC, Lynda worked on contract at the Canadian Museum of Civilization collecting data on skeletal remains being prepared for reburial. She also worked on contract at the University of Ottawa, teaching human anatomy to nursing and medical students. Prior to this, Lynda completed a Ph.D. in human anatomy. Her dissertation research involved examination of skeletal collections at the Canadian Museum of Civilization, Smithsonian Institution and the University of Copenhagen.

Lynda completed her Ph.D. at Queen's University, her Master's at the University of Manitoba and her B.Sc. at the University of Toronto.

Catherine Vardy - *As a Research and Innovation Development Officer for NSERC-Atlantic, Catherine Vardy tries to encourage academic-industry partnerships throughout Atlantic Canada. Working with scientists, industry and government officials, she acts as a "matchmaker" to align potential collaborators with NSERC's academic-industry funding programs.*

Before joining NSERC in 2004, Catherine worked as a Science Liaison Officer for Fisheries and Oceans Canada in Moncton. Prior to that, she worked as a science journalist for the Discovery Channel, CBC Radio, the Times & Transcript newspaper and several magazines. Prior to working as a science journalist, she spent many years working as a scientific research assistant in the lab and in several field camps throughout the arctic.

Catherine completed her Bachelor of Science degree at Queen's University (1991) and her Bachelor of Journalism degree at the University of King's College (2000).

[8] How to prepare a winning NSERC Collaborative Research and Development grant application. Lynda Wood, NSERC, Ottawa, Ontario and Catherine Vardy, NSERC-Atlantic, Moncton, New Brunswick

No amount of care and effort in preparing a grant application will compensate for a weak research program. However, a poorly prepared application can prevent a strong research program from being supported. This workshop will highlight the steps and key pointers when submitting an application for NSERC's Collaborative Research and Development Grants.

The Collaborative Research and Development (CRD) Grants Program supports well-defined projects undertaken by university researchers and their private-sector partners. CRD awards cover up to half of the total eligible direct project costs, with the industrial partner(s) providing the balance in cash and in kind. Projects may range from one year to five years in duration, but most awards are for two or three years.

CRD projects can be at any point in the R&D spectrum that is consistent with the university's research, training, and technology transfer mandate. Eligible collaborations include focused projects with specific short- to medium-term objectives, as well as discrete phases in a program of longer-range research. All proposals require evidence of detailed planning and sound budget justification, and must clearly spell out the underlying assumptions, intended approaches, milestones, and deliverables.

The most critical piece of advice is to prepare a first draft early and seek feedback from colleagues, the Research Grants Office or NSERC staff.

[9] NSERC funding programs; encouraging academic-industry partnerships. Catherine Vardy, NSERC-Atlantic, Moncton, New Brunswick, and Lynda Wood, NSERC, Ottawa, Ontario

NSERC's Research Partnerships Programs (RPP) foster collaborations between university researchers, colleges and other sectors, including government and industry. These collaborations help develop new knowledge and expertise, and transfer this knowledge and expertise to Canadian-based companies.

In an average year, NSERC and Canadian companies together fund hundreds research projects and people; this benefits researchers, students and Canadian companies. Programs include Collaborative R&D Project Grants (CRD), Idea to Innovation (I2I), Strategic Workshops Program (SWP) and Industrial Research Chairs (IRC).

NSERC also offers scholarships for industrially-sponsored students at the undergraduate and graduate level, as well as fellowships for researchers at the postdoctoral level.

Regionally, NSERC manages a **Regional Opportunities Fund (ROF)** which supports special events and activities related to the natural sciences and engineering. In Atlantic Canada the four target areas are:

- Activities that encourage research collaborations between post-secondary institutions and Canadian businesses.

- Activities that encourage applications to NSERC research partnerships and industrial scholarships programs.
- Bridging of proof-of-concept activities from Springboard Atlantic to the NSERC Idea-to-Innovation Program.
- Non-recurring science and engineering networking activities with pan-Atlantic reach and impact.

This presentation will provide an overview of each of the NSERC Research Partnerships Programs and will highlight several examples of recently funded projects.

Mental Models Project

Dr. Doug Doohan*- Dr. Doohan is a Professor and State Specialist in the Department of Horticulture & Crop Science, The Ohio State University. He is located at the Ohio Agricultural Research and Development Center in Wooster and holds a 75% appointment with OSU Extension. Dr. Doohan grew up in Nova Scotia and New Brunswick. He received his training at The Nova Scotia Agricultural College, University of Guelph, and North Carolina State University. Prior to joining Ohio State, he was Provincial Weed Specialist in New Brunswick and IPM Team Leader in Nova Scotia.*

Since joining OSU Dr. Doohan has taught weed management and good food safety practices to approximately 8000 fruit and vegetable farmers throughout the central and eastern United States and Canada. He has authored 18 OSU Extension Bulletins, 52 newsletter articles, and 14 farm magazine articles. In 2007 he received the Education Award from the North Central Weed Science Society for his contributions to weed management outreach.

Dr. Doohan is the author (or co-author) of 40 peer-reviewed articles and 2 book chapters. He and his colleagues have received more than $6.8 million in competitive funding in the past seven years for their research. His interest in decision making by farmers led to development of the OSU Agricultural Risk Analysis Program. Risk analysis has provided a robust platform from which to address diverse topics ranging from row crop weed management to food safety education. Recent research has shown that in depth understanding of farmers' knowledge, values, and attitudes is needed to design and deliver high impact extension programs.

[10] What farmers think and why it is important. Dr. Douglas Doohan, Ohio State University, Wooster, Ohio

The human dimension of farming is most evident when farmers make decisions contrary to science-based recommendations. Why do farmers resist adopting practices that will delay phenomena such as pest resistance, or those that will prevent catastrophic events such as the recent outbreaks of *Salmonella* and *E. coli* 0157:H7 food poisoning? Agricultural scientists for the most part have ignored such questions or considered them beyond their domain and expertise; continuing to focus instead on fundamental science and technology. Recent, pressing concerns about sustainability of current practices and acceptability of emerging technologies, necessitates a closer look at the farmer decision-making process and the role that scientists play in that process. Here we present a circular risk analysis framework characterized by regular interaction with, and input from farmers. The framework utilizes mental models to probe the deeply held beliefs of farmers regarding topics of interest. A mental model is a complex, often hidden web of perceptions and attitudes that govern how we understand and respond to our world. One's mental model may limit the ability to develop new insights and adopt new ways of management. Mental models research employs structured open-ended interviews that enable the investigator to exhaust the subjects thinking regarding the topic. Drawing on recent case studies in weed management and food safety we illustrate farmers' compliance with the fundamental attribution error; whereby, they attribute problems primarily to factors outside of their control. Farmers were also likely to comply with the typical inverse relationship between perception of risk and benefit. We expect that increased dialogue with farmers will lead to a deeper understanding of their decision process, ultimately facilitating the development of audience-specific outreach programs that will enhance the probability of higher quality management decisions.

Graduate Student Presentations

Wednesday, November 25, 2009

[11] Gene flow and co-existence of genetically engineered and conventional flax (*Linum usitatissimum* L.) in western Canada. Jhala, A.J.[1 *], Bhatt, H.[2], Topinka, K.[1] and Hall, L.M.[1] [1]Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB, [2]Clinical Research Support Unit, College of Medicine, University of Saskatchewan, Saskatoon, SK (*Corresponding author: jhala@ualberta.ca)

[12] **Use of genotypic variation of oat *(Avena sativa* L.) cultivars to suppress wild oat (*Avena fatua* L.*)* competition.** Benaragama, D.I.D.S.[1], Shirtliffe, S.J.[1], and Rossnagel, B.G.[2] [1] Dept. Plant Sciences, Univ. of Saskatchewan, Saskatoon, SK and [2] Crop Development Center, Univ. of Saskatchewan, Saskatoon, SK

[13] **Development of a Best Management Plan for Spreading Dogbane (*Apocynum androsaemifolium* L.) in Blueberry Fields.** Wu, L., Boyd, N., Sampson, G., and Olson, R. Department of Environmental Sciences, Nova Scotia Agricultural College, Truro, NS

[14] **Effect of selected herbicides on common weed species growing under different soil nitrogen levels.** Sønderskov, M. Department of Plant Agriculture, University of Guelph, Guelph, ON

[15] **Emergence and development of sheep sorrel (*Rumex acetosella* L.) ramets in wild blueberry (*Vaccinium angustifolium* Ait.).** White, S.N.[1], Van Acker, R.C.[1], and Boyd, N.S.[2] [1]Department of Plant Agriculture, University of Guelph, Guelph, ON and [2]Department of Environmental Science, Nova Scotia Agricultural College, Truro, NS

[16] **Implications of Light Quality for Weed Control.** Cressman, S.T., Lee, E.A., Tollenaar, M.T., and Swanton, C.J. Department of Plant Agriculture, University of Guelph, Guelph ON

[17] **Shade avoidance increases plant-to-plant variability and reduces soybean fitness.** Green-Tracewicz, E. Department of Plant Agriculture, University of Guelph, Guelph, ON

[18] **Sheep sorrel (*Rumex acetosella*) pollen may enhance *Botrytis cinerea* in lowbush blueberry fields.** Hughes, A. Department of Environmental Science, Nova Scotia Agricultural College, Truro, NS

[19] **Stage of crop development distinguishes intra- and interspecific competitions in maize *(Zea mays* L.).** Page, E. Department of Plant Agriculture, University of Guelph, Guelph, ON

[20] **Management of Ticklegrass (*Agrostis hyemalis*) in Wild Blueberry (*Vaccinium* spp.) Fields.** Rao, K., Boyd, N., Gray, B., and Burton, D. Department of Environmental Sciences, Nova Scotia Agricultural College, Truro, NS

[**21**] **Exploring postemergence interactions of saflufenacil in corn.** Moran, M.[1], Swanton, C.[1], and Sikkema, P.[2] [1]Department of Plant Agriculture, University of Guelph, Guelph ON and [2] University of Guelph, Ridgetown Campus, Ridgetown, ON

[22] **Utilisation de la fève adzuki (*Vigna angularis*), du radis huileux (*Raphanus sativus*) et du seigle d'automne (*Secale cereale*), combinés ou non à des doses faibles ou moyennes d'herbicides pour le contrôle des mauvaises herbes annuelles dans le maïs sucré (*Zea mays* L.).** Mensah, K.E.R.[1], Leroux, G.D.[1], et Nurse, R.[2] [1]Département de phytologie, Université Laval, Québec, QC and [2]Centre de recherche sur les cultures abritées et industrielles, Agriculture et Agroalimentaire Canada, Harrow, ON

[23] **Site specific management study of fertilizers and herbicides in lowbush blueberry.** Rojas, M.A., Boyd, N., and Brewster, G. Department of Environmental Science. Nova Scotia Agricultural College, Truro, NS

[24] **Generation and variety affect ecological traits of volunteer *Brassica napus.*** Seerey, N. Department of Plant Science, University of Saskatchewan, Saskatoon, SK

[11] Gene flow and co-existence of genetically engineered and conventional flax (*Linum usitatissimum* L.) in western Canada. Jhala, A.J.[1 *], Bhatt, H.[2], Topinka, K.[1], and Hall, L.M.[1] [1]Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB, [2]Clinical Research Support Unit, College of Medicine, University of Saskatchewan, Saskatoon, SK (*Corresponding author: jhala@ualberta.ca)

Flax (*Linum usitatissimum* L.) is multipurpose oilseed crop in which product diversity and utility could be enhanced for industrial, nutraceutical and pharmaceutical markets through genetic engineering. If genetically engineered (GE) flax will be released commercially, pollen-mediated gene flow will determine in part whether GE flax could co-exist without compromising other markets. As a part of pre-commercialization risk assessment, pollen-mediated gene flow between two cultivars of flax was quantified. Field experiments were conducted at four locations during 2006 and 2007 in western Canada using a concentric donor (20x20 m) receptor (120x120 m) design. Gene flow was detected through the xenia effect of dominant alleles of high α-linolenic acid (ALA; $18{:}3^{cis\Delta 9,12,15}$) to the low ALA trait. Seeds were harvested from the pollen recipient plots up to a distance of 50 m in eight directions from the pollen donor. High ALA seeds were identified by TBA tests and served as a marker for gene flow. Binomial distribution and power analysis were used to predict the minimum number of seeds required statistically to detect the frequency of gene flow at specific α (confidence interval) and power (1-β) values. Because of the low frequency of gene flow, approximately 4 million seeds were screened to derive sufficient accuracy. Gene flow was highest near the source, 0.0185 at 0.1 m, but declined rapidly with distance, 0.0013 and 0.00003 at 3 and 35 m, respectively. Gene flow was reduced to 50% (O_{50}) and 90% (O_{90}) between 0.85 to 2.64 m, and 5.68 to 17.56 m, respectively. No gene flow was detected at any site or year at greater than 35 m distance from the pollen source, suggesting that frequency of gene flow was ≤ 0.00003 (P = 0.95). While it is not possible to eliminate all movement of (trans) genes via pollen, through field blending and the use of buffer zones between GE and conventional flax fields, it seems likely that pollen-mediated gene flow could be reduced to very low level and therefore, GE, conventional and organic flax could co-exist.

[12] Use of genotypic variation of oat *(Avena sativa* L.) cultivars to suppress wild oat (*Avena fatua* L.*)* competition. Benaragama, D.I.D.S.[1], Shirtliffe, S.J.[1], and Rossnagel, B.G.[2] [1] Dept. Plant Sciences, Univ. of Saskatchewan, Saskatoon, SK and [2] Crop Development Center, Univ. of Saskatchewan, Saskatoon, SK

Wild oat (*Avena fatua* L.*)* is a troublesome weed in oat due to the lack of herbicides. Although tall and leafy crop cultivars often suppress weeds better than high yielding semi-dwarf varieties, their yield under weed-free conditions is reduced. A possible solution would be to combine the competitive traits of a tall leafy crop variety with those of a semi-dwarf variety. The objective of this research is to evaluate seven oat genotypes generated from a cross of the tall forage oat, CDC Baler, and a high yielding semi-dwarf oat, Ronald, for competition with wild oat. The genotypes were grown with and without wild oat (250 plants m^{-2}) at two locations in Saskatchewan over two years. Early vigor, plant height, light interception, weed and crop biomass, as well as grain yield data were measured. Plant height differed between genotypes (p<0.05) with CDC Baler, SA050498 and SA050479 being the tallest varieties, Ronald being shorter than Baler and the progeny being intermediate in height.

Despite these differences in height, overall there was no overall difference in wild oat suppression. However at one location, the three taller varieties SA050479, SA050498 and Baler allowed the lowest wild oat shoot biomass ($p<0.001$. Averaged over all site years grain yield did not differ between genotypes, nor was there an interaction between wild oat presence and genotypes. However for two of the site years, grain yield under wild oat competition was higher in Baler ($p<0.05$) indicating a greater crop tolerance. Among the genotypes, none of the other traits measured consistently contributing to the greater crop tolerance or weed suppression. Breeding for high yielding, competitive crop genotypes are difficult because of inconsistencies in competitive ability between environments. Furthermore differences between tall and short genotypes in competition with weeds may not be as great as believed.

[13] Development of a Best Management Plan for Spreading Dogbane (*Apocynum androsaemifolium* L.) in Blueberry Fields. Wu, L., Boyd, N., Sampson, G., and Olson, R. Department of Environmental Sciences, Nova Scotia Agricultural College, Truro, NS

Spreading dogbane (*Apocynum androsaemifolium* L.) is a native perennial herb that is considered a serious problem because it is a strong competitor, interferes with harvest and spreads rapidly once established in blueberry field. Effective means of controlling spreading dogbane must be developed to optimize yields and profits. A variety of experiments were conducted in commercial blueberry fields to develop a best management plan for spreading dogbane. A study into the emergence patterns and timing of flowering of spreading dogbane was undertaken to predict the optimum herbicide application timing. Damage rate and dogbane biomass was observed from plants with recommended herbicides and different control techniques (spot spray and broadcast application), and was compared with control plants to determine blueberry tolerance and herbicide efficacy, to identify effective management options for spreading dogbane. Preliminary results suggested that unsatisfactory control was obtained with all summer broadcast treatments evaluated. But fall broadcast applications of nicosulfuron (0.025 kg ai ha^{-1}) plus dicamba (0.288 kg ai ha^{-1}) effectively control spreading dogbane. For spot spray, optimal control of spreading dogbane was achieved in 3 of 4 sites when dicama was applied at 3.4 kg ai ha^{-1}, with the minimum blueberry damage.

[14] Effect of selected herbicides on common weed species growing under different soil nitrogen levels. Sønderskov, M. Department of Plant Agriculture, University of Guelph, Guelph, ON

In order to reduce leaching of nitrogen to surface waters and the groundwater the use of nitrogen fertilizers is strictly regulated in Denmark and the use of nitrogen fertilizers is therefore significantly lower than in neighbouring countries. A question often raised by farmers and advisors is whether the reduced amounts of nitrogen will affect the performance of herbicides. The aim of this study was to investigate if reducing the nitrogen availability affects the efficiency of selected herbicides. Three different weed species (*Chenopodium album* (L.), *Tripleurospermum inodorum* (L.) and *Anagallis arvensis* (L.)) were grown outdoors in pots supplied with four levels of nitrogen at sowing. Plants were sprayed with a range of herbicide dosages of tribenuron-methyl or ioxynil+bromoxynil at the 2-4 leaf-stage. Field experiments with tribenuron-methyl were conducted on natural populations of *C. album* in spring barley fertilised with different levels of nitrogen during two growth seasons. Effects were recorded as height of weed plants, development stage and dry weight. The results showed that the effect of soil nitrogen level on herbicide efficiency depended on the weed species and the herbicide.

[15] Emergence and development of sheep sorrel (*Rumex acetosella* L.) ramets in wild blueberry (*Vaccinium angustifolium* Ait.). White, S.N.[1], Van Acker, R.C.[1], and Boyd, N.S.[2] [1]Department of Plant Agriculture, University of Guelph, Guelph, ON and [2]Department of Environmental Science, Nova Scotia Agricultural College, Truro, NS

An experiment was established to monitor the emergence and development of sheep sorrel and blueberry ramet populations in two sprout year wild blueberry fields in Collingwood, Nova Scotia in 2009. Blueberry and sheep sorrel ramet emergence was monitored in four $0.09m^2$ quadrats at each site. Sheep sorrel emergence was also monitored in four $0.09m^2$ quadrats established in bare soil patches at each site. Air and soil temperature and soil moisture were monitored at each site with Hobo data loggers. Newly emerged blueberry and sheep sorrel ramets were counted and marked with colored elastic bands once or twice weekly from early May until November. Dead ramets were counted and elastics were removed. Phenological development of ramets was monitored, and ramets that exhibited specific growth stages (i.e. flowering) were counted and marked with paper clips or elastic bands. Blueberry ramets began to emerge around mid-May (day of year 132) and reached 90% emergence by mid to late June (day of year 173). Emergence followed a sigmoid pattern. Blueberry ramet populations were stable with an average of 1328 new ramets m^{-2}, of which only 99 died (survival rate of 93%). New sheep sorrel ramets began to emerge in early May (day of year 127) and reached 90% emergence in late September (day of year 254). Emergence followed a linear pattern. Survival of sheep sorrel ramets in blueberry patches was about twice that of ramets in bare soil patches. As of mid-October, an average of 1097 sheep sorrel ramets m^{-2} emerged in blueberry patches, of which 235 died (survival rate of 79%). In bare soil patches an average of 891 ramets m^{-2} emerged and 491 died (survival rate of 45%).

[16] **Implications of Light Quality for Weed Control.** Cressman, S.T., Lee, E.A., Tollenaar, M.T., and Swanton, C.J. Department of Plant Agriculture, University of Guelph, Guelph ON

It is well established that crop seedlings detect and respond to the presence of neighbouring competitors through the phytochrome-mediate shade avoidance response. Little research, however, has examined how knowledge of light quality signals (i.e., the ratio of red to far red light or R:FR) and the shade avoidance response can be integrated into weed control practices. Herbicide-tolerant crops have shifted weed control practices from soil applied to post-emergence. Laboratory experiments were conducted to test the hypotheses: 1) that weeds treated with selected post-emergence herbicides differ in the longevity of the R:FR ratio reflected from their leaf surfaces, and 2) herbicide dose will also affect the longevity of this signal. Herbicides selected for this experiment included; paraquat (fast kill), glufosinate (moderate kill time), and glyphosate (slow kill). These interactions were tested using velvetleaf (Abutilon theophrasti Medic.) as a model weed species. The results of this study confirmed that the rate at which a herbicide controls a weed and herbicide does will influence the longevity of the R:FR signal being reflected from a leaf surface. This information is important for the selection and use pattern of herbicides used in production agriculture.

[17] **Shade avoidance increases plant-to-plant variability and reduces soybean fitness.**
Green-Tracewicz, E. Department of Plant Agriculture, University of Guelph, Guelph, ON

Recent studies have suggested that the shade avoidance response is pre-emptive to resource limiting competition in agronomic settings. While several studies indicate that soybeans (*Glycine max* L. Merr.) express this shade avoidance caused by the low R: FR (red: far-red) ratio, no information has been published to determine whether this response provides morphological benefits or is maladaptive to soybean plants when in competition with weeds. We tested the hypothesis that the shade avoidance response constrains phenotypic plasticity and fitness in soybeans grown under non-liming resource conditions. Soybeans were grown in a fertigation system in the field in 2007 and 2008 at the Arkell Research Station, University of Guelph, Guelph Ontario, under two light quality treatments: (1) high R: FR ratio (i.e., weed-free) i.e., upward reflected light from a baked clay medium (Turface MVP®), or (2) low R: FR ratio (i.e., weedy) of upward reflected light, from commercial turfgrass. Results from this study show that the shade avoidance response increased height and internode length as early as 8 DAE in soybean seedlings. While changes in height and internode length were temporal, the shade avoidance response permanently reduced phenological development, total plant biomass accumulation, leaf area and fitness. At physiological maturity, soybeans that had expressed the shade avoidance response early in development were lower in pod number, seed number and seed yield per plant. Interestingly, the plant-to-plant variability between individuals of these plants increased when these yield components were considered. These results suggest that while the shade avoidance response demonstrates plasticity, i.e., a temporal increase in height and internode length, permanent effects to phenological development, biomass accumulation and leaf area can decrease soybean stand uniformity and constrain fitness. We therefore suggest that the shade avoidance response be considered as an integral component of crop-weed competition and that this may have maladaptive implications for reproductive fitness.

[18] Sheep sorrel (*Rumex acetosella*) pollen may enhance *Botrytis cinerea* in lowbush blueberry fields. Hughes, A. Department of Environmental Science, Nova Scotia Agricultural College, Truro, NS

Botrytis cinerea is a destructive fungal pathogen of many crops including lowbush blueberry. In lowbush blueberry, the fungus primarily infects the flowers which become susceptible to infection just prior to opening. It is also known that blueberry pollen increases spore germination, but the role of other pollens from weed species typically found in blueberry fields is not known. Sheep sorrel (*Rumex acetosella*) is a common, wind pollinated weed of blueberry fields that produces copious amounts of pollen during the bloom period of blueberry. Pollen from male sheep sorrel flowers can coat blueberry leaves and flowers and may trigger increased infection. To study this, spore suspensions were made to determine if increasing concentrations of sheep sorrel pollen would increase germination of *B. cinerea* spores. Ten increasing sheep sorrel pollen concentrations (16 000 to 31.5 pollen grains/mL) were mixed with *B. cinerea* spores (105 spores/mL). Droplets of the spore/pollen suspensions were placed on plastic Petri dishes and incubated for 20 hours at 20 C. The dishes were then frozen to stop germination and subsequently thawed to microscopically assess incidence of spore germination. A preliminary observation with three arbitrary pollen concentrations were also spray inoculated onto greenhouse-grown blueberry plants with developing flowers. The inoculated plants were incubated at 20 C in a moist chamber for 72 hours after which the incidence of infected flowers was assessed. Germination of spores increased markedly with increasing concentrations of sheep sorrel pollen, but the incidence of diseased blueberry flowers did not increase. Sheep sorrel control and interference with pollination success in the blueberry field will also be studied.

[19] Stage of crop development distinguishes intra- and interspecific competitions in maize *(Zea mays* L.). Page, E. Department of Plant Agriculture, University of Guelph, Guelph, ON

In production agriculture, it is not uncommon for a crop to experience both intra- and interspecific competition during the normal course of development. Although the competition between crop plants (i.e., intraspecifc) is often considered independently of crop-weed competition (i.e., interspecific), the mechanisms through which yields are reduced may be common to both. The objective of this study was to use the experimental structure of a critical period for weed control to examine the timing and effect of intraspecific competition on maize biomass accumulation and phenological development. A field trial was conducted in which maize stands were thinned from a higher to a lower density at six stages of development encompassing the critical period for weed control (CPWC). Results indicated that intraspecific competition at densities of 8 and 16 plants m^{-2} did not have a lasting impact on maize biomass accumulation until the 14^{th} and 12^{th} leaf tip stages, respectively. Changes in specific leaf area and the rate of leaf appearance documented just prior to these stages suggest that the reductions in the rate of biomass and leaf area accumulation were associated with the onset of intraspecific competition for light quantity. Based on these results, we conclude that both inter- and intraspecific competition are powerful forces influencing crop phenological development. We contend that these two forms of competition are distinguished primarily by the stage of development at which they occur; interspecific competition occurring as defined by the CPWC and intraspecific competition occurring in the stages just prior to and including canopy closure.

[20] Management of Ticklegrass (*Agrostis hyemalis*) in Wild Blueberry (*Vaccinium* spp.) Fields. Rao, K., Boyd, N., Gray, B., and Burton, D. Department of Environmental Sciences, Nova Scotia Agricultural College, Truro, NS

Wild blueberries (*Vaccinium* spp.) are the most important fruit crop in the Atlantic provinces. Weeds are a major constraint in wild blueberry production. They compete with blueberry plants for necessary resources such as water, sunlight, nutrients and space. Continuous use of hexazinone, which is a predominate herbicide used for weed control in wild blueberry fields, has produced fields with numerous barren areas, altered the weed flora, and led to the development of resistance. The impact of nitrogen inputs on blueberry yield is highly variable. Tickle grass (*Agrostis hyemalis*) is a common weed in blueberry fields. It has high reproductive ability, the strong ability to spread, and the tolerance to hexazinone. There is an urgent need to further understand tickle grass growth dynamics and find new, effective tickle grass management technologies. The objectives of this project include: (1). Evaluate multiple new and reduced risk herbicide products for tickle grass control efficacy and blueberry safety. (2). Measure the impacts of tickle grass control across a range of fertility levels in sprout year, crop year, and both years on i) blueberry stem density, fruit bud development, flowering, and berry yields, and ii) tickle grass biomass, ground cover, and damage ratings.

Keywords: wild blueberry, tickle grass, weed control, herbicide application, fertilizer application

[21] Exploring postemergence interactions of saflufenacil in corn. Moran, M.[1], Swanton, C.[1], and Sikkema, P.[2] [1]Department of Plant Agriculture, University of Guelph, Guelph ON and [2] University of Guelph, Ridgetown Campus, Ridgetown, ON

Integrity, containing the PPO inhibitor saflufenacil and dimethenamid-p, is a preemergence herbicide submitted for registration in corn. Previous research has shown that application of saflufenacil beyond the spike stage causes crop injury. Field studies were conducted to explore the extent of crop injury and associated yield loss when Integrity was applied at the preemergence, spike-2, and 3-4 leaf stages of corn growth. Laboratory studies were also conducted to determine if bentazon provides a safening effect for saflufenacil applied postemergence. Saflufenacil, dimethenamid-p, and Integrity, were applied at their recommended field rates (1x) and twice the recommended field rate (2x). Visual injury ratings indicated that saflufenacil caused injury at spike-2 leaf (15-20%) and 3-4 leaf (25-35%). Integrity caused injury at the spike-2 leaf stage (20-45%) and unacceptable injury at the 3-4 leaf stage (>75%). However, despite the level of injury, corn plants recovered and yields in 2008 were similar to the control for all treatments with the exception of the 3-4 leaf treatment of Integrity at only one location. Laboratory studies indicated that bentazon could decrease visual injury to corn and increase plant dry weight when applied in a tank mixture with saflufenacil at the 4 leaf stage of corn growth. A one year field study was conducted with bentazon sprayed alone at 600, 1200 and 2400 g ai/ha, saflufenacil alone at 1x and 2x, and all combinations thereof. On average, all rates of bentazon reduced saflufenacil injury at the 1x rate by 25% and the 2x rate by 35%.

[22] Utilisation de la fève adzuki (*Vigna angularis*), du radis huileux (*Raphanus sativus*) et du seigle d'automne (*Secale cereale*), combinés ou non à des doses faibles ou moyennes d'herbicides pour le contrôle des mauvaises herbes annuelles dans le maïs sucré (*Zea mays* L.). Mensah, K.E.R.[1], Leroux, G.D.[1] et Nurse, R.[2] [1]Département de phytologie, Université Laval, Québec, QC and [2]Centre de recherche sur les cultures abritées et industrielles, Agriculture et Agroalimentaire Canada, Harrow, ON

Les producteurs de maïs sucré ont de la difficulté à contrôler certaines mauvaises herbes et surtout les graminées annuelles qui sont souvent les plus problématiques. Certaines espèces peuvent servir de cultures de couverture dans le maïs sucré afin de profiter de leur rôle physique et allélopathique contre les mauvaises herbes. L'objectif de ce projet consiste donc à évaluer l'efficacité de trois cultures de couverture, combinées ou non, avec trois traitements herbicides contre les mauvaises herbes annuelles dans le maïs sucré en 2008 et 2009 à Harrow, On. et à Saint-Augustin de-Desmaures, Qc. Les cultures de couverture sont la fève adzuki, le radis huileux et le seigle d'automne. Les traitements herbicides consistent en l'application en prélevée: 1) d'une dose faible s-métolachlore/benoxacor + une dose réduite de linuron; 2) d'une dose moyenne de saflufénacil; et 3) d'une dose faible de pendiméthaline. Ces combinaisons de culture de couverture avec ou non des herbicides sont comparées à un traitement herbicide standard de s-métolachlore/bénoxacor/atrazine en prélevée + nicosulfuron en postlevée du maïs sucré. Tous les traitements ont été sécuritaires pour le maïs sucré, résultant en une absence de phytotoxicité. Deux traitements ont été très efficaces contre les mauvaises herbes annuelles. Il s'agit du traitement standard qui a procuré une répression adéquate des mauvaises herbes et de la fève adzuki combinée à une dose faible de s-métolachlore/benoxacor (1,14 kg m.a. ha^{-1}) + une dose réduite de linuron (0,55 kg m.a. ha^{-1}). À Harrow, les meilleurs rendements vendables ont été obtenus par le radis huileux sans herbicide et la combinaison radis huileux/dose faible de pendiméthaline (1,68 kg m.a. ha^{-1}). À Saint-Augustin, les rendements vendables élevés de maïs sucré ont été obtenus par les deux traitements ayant procuré les meilleures répressions des mauvaises herbes. Ces résultats démontrent l'excellent potentiel du radis huileux et de la fève adzuki, combinés respectivement, à une dose faible de pendiméthaline et de s-métolachlore/benoxacor + linuron, à réprimer aussi efficacement les mauvaises herbes annuelles que le traitement standard.

[23] Site specific management study of fertilizers and herbicides in lowbush blueberry. Rojas, M.A., Boyd, N., and Brewster, G. Department of Environmental Science. Nova Scotia Agricultural College, Truro, NS

An experiment analyzing the effects of site specific application of fertilizers and herbicides in comparison to broadcast applications was conducted in two commercial blueberry fields in Earltown and Mount Thom, Nova Scotia. A randomized complete block design with six treatments and four blocks in a plot size of 10m x 10m was used. The treatments included fertilizer application methods (broadcast vs site specific in blueberry patches) and herbicide applications (broadcast vs site specific in weed patches vs site specific in weeds growing within blueberry patches). Blueberry and weed areas were mapped using GIS technologies. Stem height, fruit bud density, blueberry and weed biomass, and number of individuals responded differently at each site. Site specific fertilization stimulated blueberry area

extension, increased fruit bud density, and induced more proliferation of weeds within blueberry clones. Site specific herbicide application had significant effects on weed population: Weed control in blueberry patches favored emergence of weeds in weed patches while appearance of weeds within blueberry patches was favored by herbicide applications in weed patches.

[24] Generation and variety affect ecological traits of volunteer *Brassica napus.* Seerey, N. Department of Plant Science, University of Saskatchewan, Saskatoon, SK

Volunteer Canola (*Brassica napus*) has become an abundant weed in western Canadian cropping systems. The use of hybrid breeding as a commercial production technique for B. napus varieties impacts the general ecology of this weed. As a result of trait segregation, and hybrid vigour breakdown in the initial crop, subsequent generations of volunteer *B. napus* may display differing levels of fitness, and other traits. Three successive generations of two hybrid cultivars, and one open –pollinated cultivar of *B. napus* were evaluated for several traits important to the fitness and ferality of *B. napus*. Individual plants were grown and evaluated as a weed in a competitive stand of *Triticum aestivum*. Traits of interest included: seed production, dormancy, biomass, and pod production. In all traits, the first generation crop displayed greater mean values than the volunteer generations. Hybrids commonly showed high mean values of various traits in the first generation, lowest mean values in the second generation, and third generation populations with mean values intermediate to the first and second generations. The open-pollinated variety displayed mean values for all traits which did not vary across generations. Overall, volunteer generations were not as fit as the initial crop, but may respond to selection pressure and produce increasingly fit feral populations over time.

Abstracts for 2009 Oral Presentations

Cereals, Oilseeds and Pulses Section

[25] **Selecting for weed resistance: herbicide rotation and mixture.** Beckie, H.J. Agriculture & Agri-Food Canada (AAFC), Saskatoon, SK

[26] **BASF stewardship guidelines-best management practices for Imidazolinone herbicides.** Bertholet, J.[1], Forster, G., Hornford, R., Oostlander, M., Vander Kant, C., and Schaad, M. [1]BASF, Saskatoon, SK

[27] Selective Weed Control in Pulse Crops with Fe3C and C12H23. Johnson, E.N.[1] and Shirtliffe, S.[2] [1]Agriculture and Agri-Food Canada, Scott, SK; [2]Unviersity of Saskatchewan, Saskatoon, SK

[28] **What seeding rate will optimize yield, quality and weed management in barley?** O'Donovan, J. Agriculture and Agri-Food Canada (AAFC), Lacombe, AB

[29] Wild oat populations after four years in a low-input barley-canola rotation. Harker, K.N.[1], Brandt, S.[3], O'Donovan, J.T.[1], Blackshaw, R.E.[2], Johnson, E.N.[3], Turkington, T.K.[1], Kutcher, R.[4], and Clayton, G.W.[2] [1]Agriculture and Agri-Food Canada (AAFC), Lacombe, AB; [2]AAFC Lethbridge, AB; [3]AAFC Scott, SK; and [4]AAFC Melfort, SK

[30] **Control of white cockle (*Silene alba*) in spring wheat (*Triticum aestivum*).** Sapsford, K.L.[1], Holm, F.A.[1], Raatz, L.[2], and Hall, L.[2] [1]University of Saskatchewan, Saskatoon, SK and [2]Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB

[31] **DuPont Canada – Precision Pac - Designing custom herbicides.** Livingston, P. DuPont Canada

[32] **Roller crimping to terminate organic green manure crops.** Shirtliffe, S.J. Department of Plant Sciences, University of Saskatchewan, Saskatoon, SK

[33] **Characterization of wind turbulence near New Zealand shelterbelts.** Wolf, T.M.[1], Caldwell, B.C.[1], Pyke, N.[2], and Connell, R.[3] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]Foundation for Arable Research, Lincoln, New Zealand; and [3] Lincoln Ventures, Lincoln, New Zealand

Forage, Rangeland, Forestry and Industrial Vegetation Section

[34] **Reclaim TM Herbicide for management and control of woody species in range and pasture in Canada.** Hare, D. Dow AgroSciences Canada Inc., Edmonton, AB

Soybean, Corn and Edible Beans Section

[35] **Studies on giant ragweed surviving glyphosate application in the field.** Tardif, F.J.[1], Soltani, N.[2], Smith, P.J.[1], Shropshire, C.[2], Lawton, M.B.[3], and Sikkema, P.H.[2] [1]Department of Plant Agriculture, University of Guelph, Guelph, ON; [2]University of Guelph, Ridgetown Campus, Ridgetown, ON; and [3] Monsanto Canada, Guelph, ON

[36] **Liberty Herbicide – for LibertyLink corn, InVigor canola and now LibertyLink soybeans.** Kaastra, A. and Barrie, K. Bayer CropScience

[37] **A commentary on plant competition.** Swanton, C.J. and Page, E.R. Department of Plant Agriculture, University of Guelph, ON

Error! Reference source not found.] **Eragon for pre-plant weed control.** Kraus, T.E. and Wilson, G. BASF Canada, Mississauga, ON

[39] **Integrity, a new soil applied corn herbicide.** Kraus, T.E. and Wilson, G., BASF Canada, Mississauga, ON

[40] **OPTIMUM™ GAT™ TRAIT new technology for weed management in row crops.** Saghir, A., E.I. DuPont Canada Company

Horticulture & Special Crops Section

[41] **Mowing carrots for weed control: possible alternative strategy.** Benoit, D.L. and Fortin, S. Agriculture and Agri-Food Canada, Saint-Jean-sur-Richelieu, QB

[42] **Cover crop crimping/rolling in organic cucumber: Does time of cover crop rolling influence weed emergence and cucumber yield?** Robinson, D. Department of Plant Agriculture, University of Guelph, Ridgetown Campus, Ridgetown, ON

[43] **New Brunswick Department of Agriculture and Aquaculture horticultural weed research update**. Graham, G.L. New Brunswick Department of Agriculture and Aquaculture, Fredericton, NB

[44] **AAFC's Pest Management Centre: Update on successes in weed science.** Kora, C. Pest Management Centre, Agriculture and Agri-Food Canada, Ottawa, ON

[45] **Impact of weed management intensity on weed and blueberry growth in an early establishment wild blueberry field**. Boyd, N.S. and MacEachern, M. Department of Environmental Sciences, Nova Scotia Agricultural College, Truro, NS

Weed Biology & Ecology/Invasive & Noxious Weeds Section

[46] **Weed Seeds Order Consultation**. Gilmer, A. Weed Seeds, Seed Section, Canadian Food Inspection Agency, Ottawa, ON

[47] **Weed-related activities at the Canadian Food Inspection Agency: An update.** Asbil, W. Plant Health and Biosecurity Directorate, Canadian Food Inspection Agency, Ottawa, ON

[48] **A tale of two cranberry species: native (Vaccinium oxycoccus) vs. non-native (V. macrocarpon).** Clements, D. and Steunenberg, S. Biology and Environmental Studies, Trinity Western University, Langley, BC

[49] **Confirmation of R/FR ratio signal effect on corn shoot and root structure**. Afifi, M. University of Guelph, Department of Plant Agriculture, Guelph, ON

[50] **Woolly cupgrass (*Eriochloa villosa*) response to management in Québec : 1st year results.** Simard, M.-J.[1], Darbyshire, S.J.[2], and Nurse, R.E.[3] Agriculture and Agri-Food Canada, [1]Québec, QC; [2]Ottawa, ON; and [3]Harrow, ON

Regulatory Issues –Pest Management Regulatory Agent (PMRA)

[51] PMRA Update. **Downs, M.P. Pest Management Regulatory Agency (PMRA), Ottawa, ON**

Cereals, Oilseeds and Pulses Section

[25] Selecting for weed resistance: herbicide rotation and mixture. Beckie, H.J. Agriculture & Agri-Food Canada (AAFC), Saskatoon, SK

Herbicide rotations and mixtures are widely recommended to manage herbicide resistance. However, little research has quantified how these practices actually affect the selection of herbicide resistance in weeds. A 4-yr experiment was conducted in western Canada from 2004 to 2007 to examine the impact of herbicide rotation and mixture in selecting for acetolactate synthase (ALS) inhibitor resistance in the annual broadleaf weed, field pennycress, co-occurring in wheat. Treatments consisted of the ALS-inhibitor herbicide, ethametsulfuron, applied in a mixture with bromoxynil/MCPA formulated herbicide (photosystem-II inhibitor/synthetic auxin), or in rotation with the non-ALS inhibitor at an ALS inhibitor application frequency of 0, 25, 50, 75, and 100% (i.e., zero to four applications, respectively) over the 4-yr period. The field pennycress seed bank at the start of the experiment contained 5% ethametsulfuron-resistant seed. Although weed control was only marginally reduced, resistance frequency of progeny of survivors increased markedly after one ALS inhibitor application. At the end of the experiment, the level of resistance in the seed bank was buffered by susceptible seed, increasing from 29% of recruited seedlings after one application to 85% after four applications of the ALS inhibitor. The level of resistance in the seed bank for the mixture treatment after 4 yr remained similar to that of the nontreated (weedy) control or 0% ALS inhibitor rotation frequency treatment. The results of this study demonstrate how rapidly ALS inhibitor resistance can evolve as a consequence of repeated application of herbicides with this site of action, and supports epidemiological information from farmer questionnaire surveys and modeling simulations that mixtures are more effective than rotations in mitigating resistance evolution through herbicide selection.

[26] BASF stewardship guidelines-best management practices for Imidazolinone herbicides. Bertholet, J.[1], Forster, G., Hornford, R., Oostlander, M., Vander Kant, C., and Schaad, M. [1]BASF, Saskatoon, SK

Resistance of weeds to ALS/AHAS inhibitors has been expanding in both number and geographic location across western Canada over the past decade. Along with ACCase graminicides as the only two major graminicide groups in western Canada for cereals, pulses, flax, and mustard, Group 2 herbicides are an essential weed control tool for western Canadian farmers. Stewardship of Group 2 chemistry is essential to ensure these herbicides remain viable tools for western Canadian farmers. BASF has developed a set of guiding principles for Group 2 herbicides, to limit the spread and further development of ALS/AHAS inhibitor resistance in western Canada. These stewardship guidelines for ALS/AHAS inhibitors are meant to provide growers with simple solutions for determining the best agronomic choice on his/her farm for weed control options.

Western Canadian growers need to develop long-term strategic crop rotations to maximize returns on the farm and maintain sustainability by avoiding the development of resistance. Alternatively, these crop rotations are essential to properly manage weed resistance that they may already have on the farm. To delay the development of ALS/AHAS inhibitor resistance, BASF suggests using a maximum of two Group 2 herbicides on any one field in a four year period. A grower should use only one application of a Group 2 throughout a growing season. Growers should minimize the use of group 2 products in pre-seed burn-offs. Growers should continue to utilize herbicides with multiple modes of action, including group 4, 6, and 27 herbicides in cereals, and eliminate the use of Group 2 products in the rotation that provide broadleaf weed control only. Growers should also utilize full label rates to optimize herbicide performance to keep weed populations numerically low. These guiding principles will help western Canadian farmers make strong agronomic decisions for the sustainability of the Group 2 chemistry in western Canada.

[27] Selective Weed Control in Pulse Crops with Fe3C and C12H23. Johnson, E.N.[1] and Shirtliffe, S.[2] [1]Agriculture and Agri-Food Canada, Scott, SK; [2]University of Saskatchewan, Saskatoon, SK

[28] What seeding rate will optimize yield, quality and weed management in barley?

O'Donovan, J. Agriculture and Agri-Food Canada (AAFC), Lacombe, AB

Barley is a relatively strong competitor with weeds and research studies have shown that seeding barley to achieve relatively high plant densities can improve competition with weeds and enhance herbicide performance. In addition, relatively high barley densities can reduce the number of days to seed maturity and improve certain malting barley quality parameters. However, our studies have also shown that, on occasion, seeding barley at high densities can reduce yield. At present, barley growers in western Canada are advised to seed barley to obtain densities of approximately 210 plants per square metre. However, guidelines on the seeding rate required to obtain this density are lacking. Field experiments were conducted under no-tillage at three locations in Alberta, Canada over three years to quantify the relationship between barley seeding rate and plant density in a hulled (AC Harper) and hull-less (Peregrine) variety seeded at two depths (2.5 and 6.25 cm). Regression analysis indicated that barley emergence as a function of seeding rate was consistently better with the hulled variety and at the shallower depth. Predictive equations were developed and can help determine appropriate barley seeding rates required to obtain desired plant densities. Equations were: $x = (y - 18.7)/0.64$ (hulled variety at 2.5 cm depth), $x = (y – 26.4)/0.54$ (hulled variety at 6.25 cm depth); and $x = (y – 21.0)/0.48$ (hull-less variety at 2.5 cm depth), $x = (y – 11.7)/0.37$ (hull-less variety at 6.25 cm depth) where x is the number of seeds required to obtain a desired plant density (y).

[29] Wild oat populations after four years in a low-input barley-canola rotation.

Harker, K.N.[1], Brandt, S.[3], O'Donovan, J.T.[1], Blackshaw, R.E.[2], Johnson, E.N.[3], Turkington, T.K.[1], Kutcher, R.[4], and Clayton, G.W.[2] [1]Agriculture and Agri-Food Canada (AAFC), Lacombe, AB; [2]AAFC Lethbridge, AB; [3]AAFC Scott, SK; and [4]AAFC Melfort, SK

Crop inputs influence weed and crop yield outcomes as well as net returns. A study was conducted at five western Canada locations (Lacombe, AB; Lethbridge, AB; Beaverlodge, AB; Scott, SK; and Melfort, SK) to determine the impact of crop input levels on weed biomass and crop yields in a barley-canola rotation with each rotation phase present each year. Inputs and their respective levels were as follows: cultivar (barley – 'AC Metcalfe' or 'Harrington', canola – 'InVigor 5020' or '84S00LL'), seeding rate (barley – 150 or 300 seeds m-2, canola – 75 or 150 seeds m-2), fertilizer rate (0, 50, or 100% of recommended), and herbicide rate (0, 50, or 100% of recommended). Higher levels of individual inputs were added to the lowest input combination and lower levels of individual inputs were removed from the highest input combination in each crop. All possible treatment combinations were not employed. The same input levels were applied to the same plots for four consecutive years. In general, high input levels were more necessary for high net returns in canola than in barley, and reduced fertilizer and herbicide inputs were most detrimental to crop yield (especially by year 3 and 4). In year five, full inputs in barley or RR canola were applied to respective rotational phase plots to determine "recovery" from the previous four years of cumulative treatment effects. A surprising number of plots had similar yield and weed biomass to the plots subjected to full inputs for the previous four years. The best yield recovery in year five low-input treatments were in plots that included 100% herbicide rates in previous years. The highest weed biomass in year 5 plots was from low input plots with fertilizer applied in the absence of other inputs for the previous 4 years, or from high input plots with no herbicide applied for the previous 4 years. Another year of "recovery" is planned.

[30] Control of white cockle (*Silene alba*) in spring wheat (*Triticum aestivum*). Sapsford, K.L.[1], Holm, F.A.[1], Raatz, L.[2], and Hall, L.[2] [1]University of Saskatchewan, Saskatoon, SK and [2]Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB

White Cockle (*Silene alba*) is an annual, biennial or short lived perennial weed that can be a serious problem in the lighter textured soils of the black soil zone. It is a dioecious species, with separate male and female plants, which is often confused with night-flowering catchfly (*Silene noctiflora*) as the plants look very similar and difficult to distinguish before the plants flower. Two sites were established in 2008 to evaluate herbicide treatments for control of both seedling and perennial plants. One site was near Meath Park, north east of Prince Albert, SK and the other near Bruderheim north of Edmonton Ab. In 2008 three trials, 1) pre-seed control, 2) post-emergent control and 3) pre and post harvest control were conducted. The 4 best pre-seed treatments and the 5 best post-emergent treatments from 2008 plus a no in-crop treatment were combined into a 4 by 6 factorial trial at both sites in 2009. The pre-seed treatments were: 1) glyphosate @ 450 gai/ha (Roundup Weathermax®), 2) glyphosate + florasulam @ 450 + 5 gai/ha (PrePass®), 3) glyphosate + tribenuron + metsulfuron @ 450 + 7.5 +1.5 gai/ha (Roundup Weathermax® + Express Pro®) and 4) glyphosate + 2,4-D ester @ 450 +700 gai/ha (Roundup Weathemax® + 2,4-D LV700). The post-emergent treatments included: 1) No herbicide, 2) dicloroprop + MCPA + mecoprop-p @ 310 + 160 + 130 gai/ha (Optica Trio®), 3) thifensulfuron + tribenuron + metsulfuron @ 7.5 + 7.5 + 1.5 gai/ha (PP23235®), 4) tribenuron + 2,4-D ester + dicamba @ 7.5 + 396 + 53 gai/ha Triton K®, 5) thifensulfuron + tribenuron + MCPA ester @ 7.5 + 7.5 + 280 gai/ha (PP2525® + MCPA) and 6) mecoprop-p @ 1037 gai/ha (Compitox®). In 2009 all pre-seed treatments provided similar control of white cockle (>45% in SK and >70% in AB, prior to post-e application). Post-emergent treatments of: PP23235®, Triton K® and PP2525® + MCPA provided over 80% control of white cockle at both sites in 2009 regardless of pre-seed treatment. Post-emergent treatments of the group 4 products, Compitox® and Optica Trio® provided 80% control of white cockle at the SaSK site but were not much better than the no herbicide treatments at the Alta. site.

[31] DuPont Canada – Precision Pac - Designing custom herbicides. Livingston, P. DuPont Canada

Introducing DuPont Precision Pac Technology and Concept. This automated herbicide dispensing unit provides growers with weed control that is completely customized to fit their exact needs by field. Growers can pick the product blends that suit their exact weed species and exact acres for the field or tank size. They can choose non-residual or extended weed control and manage resistance by choosing multiple herbicide groups.
Approved products through Precision Pac include individual products such as Express SG, Refine SG and multiple blends of products such as Triton K and Harmony K. PPAC machines only allow registered mixes to be dispensed.

This unit has safe guards that prevent the wrong product from being accidentally dispensed and has individual labels and chips for each field container so they cannot be reused. This system is simple for the grower, uses less packaging and saves time and money for both growers and retailers.

[32] Roller crimping to terminate organic green manure crops. Shirtliffe, S. J. Department of Plant Sciences, University of Saskatchewan, Saskatoon, SK

Green manure crops are used by organic farmers to supply nutrients to subsequent crops and to aid in the suppression of weed populations. A roller crimper (blade roller) has the potential to terminate these crops without the normal tillage operations, thus reducing erosion and conserving energy. The objective of this research is to determine the efficacy of a roller crimper on annual green manure termination and the effect on subsequent crops. To determine this, faba bean and pea were terminated at three stages by a roller crimper, flail mower and tandem diSK Crop biomass, crop and weed re-growth as well as subsequent wheat yield and quality were measured. In the first year of research pea accumulated much more biomass than faba bean before crop termination. Pea also appeared more suitable for roller crimper termination as it had less re-growth than the faba bean following termination. Overall the blade roller reduced crop and weed re-growth compared to tillage but was similar to mowing. The blade roller was much more effective at suppressing pea re-growth at the early flower termination stage compared to the other termination methods. The effect of the termination method and timing on the subsequent wheat crop will be discussed. Although this research has not been completed, faba bean appears to be a poor candidate for an annual green manure crop.

[33] Characterization of wind turbulence near New Zealand shelterbelts. Wolf, T.M.[1], Caldwell, B.C.[1], Pyke, N.[2] and Connell, R.[3] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]Foundation for Arable Research, Lincoln, New Zealand; and [3]Lincoln Ventures, Lincoln, New Zealand

Studies were conducted to characterize the flow-field near shelterbelts to understand the atmospheric transport and diffusion of airborne agricultural particulates such as spray drift, pollen, and dust. Sonic 3-D anemometers collected velocity data at 10 Hz for five minutes each at four heights and five locations downwind and six locations upwind of a 5-m tall (=H) deciduous shelterbelt. Velocity vectors, turbulence intensities, and turbulence scales were calculated to determine air flow direction, energy transfer, and eddy size. Results showed that the approaching flow field diverged at the shelterbelt, with increased downward and upward flow compared to an open field. In the lee of the shelterbelt, the flow remained non-laminar with lower turbulence intensity to 3H. There was considerable reduction in the size of the turbulent structures behind the shelterbelt that reached a minimum at about 2H downwind of the shelterbelt. Turbulence intensity reached a maximum at about 6H, likely due to re-attachment of the stream that had deflected over the top of the shelterbelt. This information will be incorporated into models that can account for particle capture by shelterbelt canopies to better predict atmospheric transport of agricultural pollutants, and to identify the impact of agroforestry on such phenomena.

Forage, Rangeland, Forestry and Industrial Vegetation Section

[34] Reclaim TM Herbicide for management and control of woody species in range and pasture in Canada. Hare, D. Dow AgroSciences Canada Inc., Edmonton, AB

Reclaim TM Herbicide is a new herbicide that has been designed by Dow AgroSciences for management and extended control of undesirable woody species populations present in rangelands in Canada. During 2004-2008 Dow AgroSciences field research team conducted 128 trials to determine what various combinations of products and molecules would deliver consistent and extended control of 4 major woody brush species, including: Buckbrush (Western Snowberry) (*Symphoricarpos occidentalis*), Prairie Wild Rose (*Rosa arkansana*), Shrubby Cinquefoil, (*Potentilla fruiticosa*) and Wolf Willow (Silverberry) (*Elaeagnus commutate*). The combination of products and molecules tested included: Milestone (Aminopyralid), 2,4-D, Grazon (Picloram+2,4-D) and Escort (Metsulfuron-methyl). Reclaim Herbicide provided superior control of target species Western Snowberry (96%), Wild Rose (93%), Shrubby Cinquefoil (89%), and Silverberry (98%) when evaluated 24-27 MAA. This level of control exceeded the control delivered by any commercial standard on these species, including Escort, 2,4-D or Grazon. Overall, trial data was collected for 58 species consisting of 604 individual species trial data points, including 213 data points on six woody shrub species and 391 data points on 32 herbaceous annual and perennial weed species.

Soybean, Corn and Edible Beans Section

[35] Studies on giant ragweed surviving glyphosate application in the field. Tardif, F.J.[1], Soltani, N.[2], Smith, P.J.[1], Shropshire, C.[2], Lawton, M.B.[3], and Sikkema, P.H.[2]
[1]Department of Plant Agriculture, University of Guelph, Guelph, ON; [2]University of Guelph, Ridgetown Campus, Ridgetown, ON; and [3]Monsanto Canada, Guelph, ON

Giant ragweed (*Ambrosia trifida*) is a competitive weed with an early and prolonged emergence pattern in southwestern Ontario. Wide spread adoption of glyphosate-tolerant corn and soybean has increased the reliance on glyphosate for weed management. A population of giant ragweed from a field near Windsor, Ontario was not controlled by glyphosate in 2008. Seeds were collected and greenhouse experiments were conducted during the winter of 2009. Plants from the Windsor population were able to survive rates of glyphosate up to two times the field rate while plants from other locations were completely killed by rates as low as a quarter of the field rate. The Windsor population was also able to survive the Group 2 herbicide such as cloransulam-methyl suggesting multiple-resistance. Five field trials conducted during the summer of 2009 confirmed that this biotype of giant ragweed could survive after application of glyphosate at rates as high as 10800 g ae ha^{-1}. Glyphosate plus dicamba/diflufenzopyr, dicamba/atrazine, bromoxynil + atrazine, mesotrione + atrazine, chlorimuron-ethyl, cloransulam-methyl, and fomesafen applied postemergence controlled giant ragweed 78, 79, 71, 70, 52, 54, and 54%, reduced giant ragweed density 82, 74, 69, 67, 33, 33, and 31% and reduced giant ragweed shoot dry weight 96, 92, 94, 92, 57, 65, and 71%, respectively. Based on these preliminary results, dicamba based herbicides provide the best control in corn but options in soybeans are limited. Seeds were collected from surviving plants and they will be tested to confirm resistance. Heritability studies are underway to confirm the glyphosate resistant status of this giant ragweed population.

[36] Liberty Herbicide – for LibertyLink corn, InVigor canola and now LibertyLink soybeans. Kaastra, A. and Barrie, K. Bayer CropScience

Liberty Herbicide (glufosinate ammonium) is a Group 10 contact herbicide. It has been registered since 1998 in Canada for use on glufosniate ammonium tolerant corn, canola and soybeans. Up until now, only LibertyLink corn hybrids and InVigor canola hybrids have been available to growers. In 2010, LibertyLink soybeans will be launched in Canada. With this addition to the LibertyLink/InVigor system there are new opportunities for growers; a choice in herbicide tolerant soybeans and a valuable resistance management strategy. Best practices for utilizing Liberty and a look into the performance of LibertyLink soybeans will be the focus of this presentation.

[37] A commentary on plant competition. Swanton, C.J. and Page, E.R. Department of Plant Agriculture, University of Guelph, ON

Plant competition is a powerful biological variable influencing crop yield loss and plant community structure. Competition is traditionally viewed as a series of interrelated events involving both resource dependant and resource independent processes. Resource dependant processes, such as direct competition for light water and nutrients has been the focus of the majority of competition studies. While there is no doubt that resource limitation is a major factor influencing yield loss from weed competition, resource independent effects such as light quality will also influence the onset and outcome of plant competition. We propose that shade avoidance triggered by the R:FR ratio should be viewed as an integral component of the process of competition. Weeds present at the time of crop emergence trigger the expression of shade avoidance in the crop, and destabilize stand productivity by increasing plant-to-plant variability in reproductive effort. This resource independent response precedes and conditions the crop seedling for the onset of intra-specific and resource dependant competition. Understanding how the early detection of weedy neighbors influences the development of the individual plant and the crop stand as a whole is critical to our comprehension of the basic mechanisms underlying crop and weed competition.

[38] Eragon for pre-plant weed control. Kraus, T.E. and Wilson, G. BASF Canada, Mississauga, ON

Kixor (saflufenacil), an innovative new active ingredient under development by BASF, is a protoporphyrinogrn-IX-oxidase (PPO) inhibitor and belongs to the pyrimidinedione class of chemistry. Kixor represents a new standard for broadleaf weed control that has burndown and residual control. Eragon is a new herbicide containing Kixor. Eragon enhances the speed and spectrum of weeds controlled when tank mixed with glyphoste and applied prior to planting soybeans. In addition, Eragon provides an alternative mode of action for glyphosate stewardship. Research shows that Eragon is very crop safe and provides excellent control of diverse spectrum of broadleaf weeds in combination with glyphosate.

[39] Integrity, a new soil applied corn herbicide. Kraus, T.E. and Wilson, G., BASF Canada, Mississauga, ON

Kixor (saflufenacil), an innovative new active ingredient under development by BASF, is a protoporphyrinogrn-IX-oxidase (PPO) inhibitor and belongs to the pyrimidinedione class of chemistry. Kixor represents a new standard for broadleaf weed control that has burndown and residual control. Integrity herbicide is a co-formulated mixture of Kixor and dimethenamid-p. Integrity brings a new mode of action for weed management in corn and can be applied anytime prior to corn emergence. Integrity provides season long control of annual grass and broadleaf weeds without the need for atrazine. Research results demonstrate the efficacy of this product and its utility in various corn production systems.

[40] OPTIMUM™ GAT™ TRAIT new technology for weed management in row crops. Saghir, A., E.I. DuPont Canada Company

Glyphosate ALS Tolerance Trait that provides tolerance to both glyphosate and ALS herbicides.

Glyphosate – Wide range of rates, formulations, and application timings

ALS – Increased tolerance to virtually all families of ALS inhibitor chemistries, including 48 evaluated active ingredients.

Horticulture & Special Crops Section

[41] Mowing carrots for weed control: possible alternative strategy. Benoit, D.L. and Fortin, S. Agriculture and Agri-Food Canada, Saint-Jean-sur-Richelieu, QB

Differences in phenological development between carrots and broadleaved weeds make mowing feasible as a physical weed control method. The objective of the experiment was to evaluate the impact of mowing on carrot growth and yield. The experiment was set up as RCB design with 4 repetitions over two years in organic soil at the AAFC Ste-Clotilde experimental farm, Quebec. Plots were seeded with 3 carrot rows 40 cm apart (var. Apache) at 100 seeds/m. Plot size was 1.8 m wide and 5 m long. Cutting height was adjusted at ~6 cm above ground. Five and 3 seedlings of carrots were monitored weekly on 2007 and 2008, respectively. Height and BBCH stage was recorded for each seedling and carrot density was determined in 20 m x 50 cm quadrats prior to each cut and nine days after cutting. Carrot biomass and density and seedling height were recorded 14 days after last treatment. Following biomass evaluation, all plots were hand weeded and fungicide applied in 2008 but not in 2007. Total and marketable carrot yield was measured on central 1 m row in each plot. Linuron applied preemergence and combined with cutting at 3 leaves carrot stage had minimal impact on carrot growth and biomass. All other treatments significantly reduced biomass accumulation. When comparing the treatments of cutting alone with their respective alternatives (i.e. Cutting + vinegar or linuron + cutting), there was a progression toward higher yield when weed competition was reduced by another control method: cutting alone < cutting + vinegar applied 4 days after < linuron followed by cutting. Cutting alone is not a viable weed control method for carrots. However, if cutting is combined with other techniques to suppress weed competition, it may be a useful weed control practice in organic soil where herbicide resistant ragweed occurs.

[42] Cover crop crimping/rolling in organic cucumber: Does time of cover crop rolling influence weed emergence and cucumber yield? Robinson, D. Department of Plant Agriculture, University of Guelph, Ridgetown Campus, Ridgetown, ON

Two studies were established to examine the use of cover crop rolling in cucumber and squash. In the fall prior to growing each vegetable crop, fall rye was planted at 100 or 150 kg/ha. The following spring, the fall rye was rolled prior to flowering, and at 25%, 50%, 75% and 100% flowering, at each of the two fall rye seeding rates and planted with either cucumber or squash. Additional treatments included mowing or disking-under the fall rye prior to planting. Our objective was to determine the effect of time of cover crop rolling on soil moisture and fertility in cucumber and squash. Percent weed control at 28 and 56 days after crop emergence, weed biomass at 56 days after emergence and marketable yield were determined. Weed biomass was greatest in those treatments where the fall rye was disked, mowed, rolled prior to, or at 25% bloom, and squash and cucumber yield were less in these treatments, than when fall rye was rolled at 50% bloom or later. Squash yields ranged from 17-20 T/ha, while cucumber yields ranged from 7-10 T/ha in those treatments where fall rye was rolled at 50% bloom or later. The integration of cover crop rolling with organic herbicides and/or compost or mulches may provide the basis for a weed management system in organic vegetable production.

[43] New Brunswick Department of Agriculture and Aquaculture horticultural weed research update. Graham, G.L. New Brunswick Department of Agriculture and Aquaculture, Fredericton, NB

The New Brunswick Department of Agriculture and Aquaculture (NBDAA) conducted fourteen separate research trials over the 2009 growing season for weed control in horticultural crops. The majority of the research was completed within lowbush blueberry (*Vaccinium angustifolium*), further split into research for newly cleared land or established blueberry stands. Trials in newly cleared land focused on lambkill (*Kalmia angustifolia*) and rhodora (*Rhododendron canadense*) control. Dicamba applied in the fall, either applied alone or mixed with 2,4-D ester, had the best combination of blueberry tolerance and weed control, although results were variable. Glyphosate applied in the fall was promising for lambkill control. In established blueberry fields, trial work focused on Canada bluegrass (*Poa compressa*), ticklegrass (*Agrostis scabra*), sheep sorrel (*Rumex acetosella*) and black bulrush (*Scirpus atrovirens*) product screening. Mesotrione, including tank mixes with various graminicides, was applied successfully in multiple trials in blueberry. An additional trial examined flumioxazin use for hair-cap moss (*Polytrichum commune*) control. Trial work in cranberry (*Vaccinium macrocarpon*) focused on chlorimuron-ethyl, nicosulfuron/rimsulfuron, quinoclorac and mesotrione tank mixes. All products had excellent crop tolerance, although the weed control spectrum will need to be refined through future trials. Results from repeated herbicide applications for groundsel (*Senecio vulgaris*) control in strawberry (*Fragaria × ananassa*) were inconsistent and timing specific. All trials were supported through the Enabling Agricultural Research and Innovation Program, a component of Growing Forward. Specific trial abstracts will be available on the NBDAA website, www.gnb.ca/agriculture.

[44] AAFC's Pest Management Centre: Update on successes in weed science. Kora, C. Pest Management Centre, Agriculture and Agri-Food Canada, Ottawa, ON

The PMC's Minor Use Pesticides and Pesticide Risk Reduction Programs work together to improve grower access to new uses of minor use pesticides and reduced risk pest management tools in grower-identified priority areas. The Minor Use Pesticides Program partners with grower organizations, AAFC Research Branch, the US IR-4 program, provinces and pesticide registrants to address grower requests for more pest control products for pest priorities of specialty crops. The Pesticide Risk Reduction Program (PRRP) , a joint initiative of AAFC and the Health Canada's Pest Management Regulatory Agency facilitates the development of reduced risk strategies and pest management tools as well as the dissemination of these tools to growers. The PRRP partners with grower organizations, researchers, provinces and the crop protection industry to generate data and knowledge to support the adoption of pest management approaches which reduce pesticide risks to human health and the environment. The presentation will highlight accomplishments achieved to date for the Canadian growers through the activities supported by these programs since their inception in 2003. For more information on activities and results of the PMC, please visit the website at www.agr.gc.ca/prrmup.

[45] Impact of weed management intensity on weed and blueberry growth in an early establishment wild blueberry field. Boyd, N.S. and MacEachern, M. Department of Environmental Sciences, Nova Scotia Agricultural College, Truro, NS

An experiment was initiated in 2008 to evaluate the impact of sprout year applications of herbicides and 14-18-10 fertilizer (0 versus 214 kg ha^{-1}) on weed and blueberry cover, density, and diversity. Tree removal had occurred eight years prior to project initiation and the field had been mowed on a biannual basis. Sprout year herbicide treatments included: (i) no herbicide input, (ii) industry standard (hexazinone), (iii) attempt to remove all weeds (hexazinone, terbacil, diuron, and tribenuron methyl), and (iv) removal of weeds above the blueberry canopy (wiping with glyphosate). All herbicides were applied using the recommended label rate. Initial results suggest that broadcast herbicide applications in the sprout year significantly reduced weed diversity in the sprout year but differences largely disappeared in the crop year. Wild blueberry density and ground cover in the sprout year tended to be higher in treatments with broadcast herbicide applications. Blueberry ground cover but not density was lower where fertilizer was applied. In the crop year, the most intensive weed management treatment plus fertilizer resulted in the highest blueberry coverage. Fertilizer inputs tended to increase weed cover and density and this increase could only be overcome by intensive herbicide inputs.

CFIA Weed Seed Consultation Session

[46] Weed Seeds Order Review Proposal. Gilmer, A. Weed Seeds, Seed Section, Canadian Food Inspection Agency, Ottawa, ON

The Canadian Food Inspection Agency is currently consulting on proposed amendments to the Weed Seeds Order (WSO).

The Canadian Weed Science Society and its members represent an important stakeholder group for federal seed legislation and input from this group was solicited and encouraged.

The CFIA presentation outlined the role of the WSO, described the rational for the proposed changes, and highlighted individual species proposed for listing.

The Weed Seeds Order (WSO) classifies weed species within six classes for the purposes of establishing purity standards for seed in Canada. The WSO plays a critical role in the prevention of intentional (as a crop) and unintentional (as a seed contaminant) introductions of new weeds into Canada. Classification of weed species regulates their movement, thereby helping to slow the spread of weedy species within Canada. The regulation of seed for purity is an important aspect of seed standards and most countries regulate seed for purity in a similar manner.

The WSO may be considered to have primarily an agricultural context; however, the Seeds Act applies to all seeds and non-agricultural products must comply with its regulations. Seed products marketed as wildflower mixtures, wildlife baiting mixtures and land reclamation mixtures, for example, are subject to the Seeds Regulations and the WSO.

The CFIA is proposing a revision of the WSO at this time for several reasons.

- Control of the introduction of new weeds is important to Canada’s economy and environment. Established weed species increase the cost of crop production. Weedy species introduced into natural areas can reduce biodiversity and habitat. Weeds present as contaminants of seed represent a high risk pathway, as they are placed in an optimum environment for survival.

- A review of the WSO is needed in order to remove species that no longer meet the definition of a Prohibited Noxious weed species, add new species of concern to the WSO and review the classifications of all species currently listed in the WSO.

- New species intentionally or unintentionally established in Canada may result in decreased markets for Canadian products.

Several of the species proposed for inclusion in the WSO are also proposed for regulation by the CFIA under the Plant Protection Act and Regulations as quarantine pests. A separate and distinct consultation in this regard will be undertaken by the CFIA.

[47] Update on Activities Related to Weed Science at the Canadian Food Inspection Agency. Asbil, W. National Manager, Invasive Plants section, Plant Health and Biosecurity Directorate

This information session will provide a summary of Canadian Food Inspection Agency (CFIA) activities with respect to invasive plants and other weed-related issues. The expertise embodied by the Canadian Weed Science Society could significantly contribute to the development of regulatory programs as well as the resolution of weed-related issues.

Among the activities are continued development of the Invasive Plants program. Key components of the program include: 1. an over-arching Invasive Plants policy which builds on past efforts of the *Plant Protection Act* and the *Seeds Act* to prevent the introduction of invasive plants and to limit their spread in Canada; 2. a pilot project entitled Least Wanted Invasive Plants to identify and evaluate high risk terrestrial plants that have the potential to be regulated as quarantine pests in Canada; and, 3. a partnership and stakeholder engagement strategy. The policy indicates how pest plant species will be regulated in a manner consistent with the risk they pose to Canada's plant resource base and with international guidelines (e.g. World Trade Organization). Under the policy, invasive plants identified through the process refined in the Least Wanted Plants pilot project would be regulated in the same way as other plant pests, such as insects and pathogens, in the agriculture, horticulture and forestry sectors.

Research needs to support regulatory activities, develop and enhance market access, contribute to policy development and review as well as to facilitate operational activities have been identified by the CFIA. Key needs include: weed biology (soil weed seed bank, climatic/edaphic conditions, hosting other pests), weed distribution within Canada, incidence and prevalence of weed species in the field and in export-ready commodities, early detection, identification, surveillance and monitoring techniques, economic impact, treatments (eradication, containment, control) and weed seed risk mitigation measures (e.g. efficacy of cleaning, cleaning techniques, devitalisation methods).

A Plant Health and Biosecurity Curriculum project is underway at the CFIA to work with post-secondary educational institutions to promote education, outreach, and recruitment activities related to plant biosecurity. The main objectives are to increase awareness of and interest in career opportunities in plant biosecurity as well as reciprocal sharing of experience, skills and knowledge between staff at the CFIA and academic institutions.

Weed Biology & Ecology/Invasive & Noxious Weeds Section

[48] A tale of two cranberry species: native (*Vaccinium oxycoccus*) vs. non-native (*V. macrocarpon*). Clements, D. and Steunenberg, S. Biology and Environmental Studies, Trinity Western University, Langley, BC

Bog habitats support unique vascular plant communities that are vulnerable to invasive species when disturbed by peat mining. Cranberry species are characteristic of bogs across North America, but the cultivated variety, *Vaccinium macrocarpon* is only native to Eastern North America. It invades western bogs, potentially competing with its native congener, *V. oxycoccus*. We compared the ecological characteristics of both cranberry species growing within a 96 ha bog near Langley, BC Fields of *V. macrocarpon* grow adjacent to the bog. Surveys revealed that *V. macrocarpon* was most abundant within channels created by peat mining of the bog between 1968 and 1980. In an unmined section of the bog, no *V. macrocarpon* was present; on the west side of the bog it comprised 20% of cranberry cover in the channels and 1% on the ridges. On the east side of the bog it comprised 56% in the channels and 33% on the ridges. *Vaccinium macrocarpon* produced 2.5 times as many flowers per upright stem as *V. oxycoccus* but aborted about 50% of its fruit as compared to only 25% for *V. oxycoccus* resulting in virtually the same number of fruits produced per upright. However, the average of 14 seeds per fruit of *V. macrocarpon* was twice the average for *V. oxycoccus*. The germination rate for *V. macrocarpon* was also higher than for *V. oxycoccus* (58% vs. 35%). Because *V. macrocarpon* shows higher values for nearly all reproductive parameters measured, it appears that the non-native cranberry has the potential to outcompete its native counterpart. However, at this point *V. oxycoccus* is the more prevalent species throughout the bog except in the east side channels. Thus there is an opportunity for restoration if an effective means to remove *V. macrocarpon* from channels can be devised.

[49] Confirmation of R/FR ratio signal effect on corn shoot and root structure. Afifi, M. University of Guelph, Department of Plant Agriculture, Guelph, ON

The red to far-red ratio (R/FR) plays a key role in inducing classic morphological changes in plants. This study was conducted to confirm that the low R/FR signal, reflected from the leaf surfaces of weeds, is responsible for the expression of shade-avoidance in corn. In addition, we explored the effect of R/FR ratio on root architecture and biomass. Corn has several different and distinct root systems. The radical and the seminal roots originate from the seed. The crown roots originate from the stem. We tested the hypothesis that roots emerging from the stem i.e. late emerging roots would be influenced more by the low R/FR ratio than early emerging roots from the seed. Laboratory experiments were conducted using selective light blockers to alter the R/FR ratio surrounding the corn seedling. Weedy and weed-free treatments were used without blockers as control. Our results confirmed that the low R/FR ratio caused by the presence of weeds surrounding the corn seedlings was responsible for the expression of shade avoidance characteristics by corn. This low R/FR ratio also reduced total root volume and biomass. No structural changes were observed in the radical root. Seminal roots differed only in diameter. The effect of the low R/FR ratio, however, was most apparent with crown roots. Crown root number, volume, diameter and surface area were all reduced.

[50] Woolly cupgrass (*Eriochloa villosa*) response to management in Québec : 1st year results. Simard, M.-J.[1], Darbyshire, S.J.[2], and Nurse, R.E.[3] Agriculture and Agri-Food Canada, [1]Québec, QC; [2]Ottawa, ON; and [3]Harrow, ON

Eriochloa villosa (Thunb.) Kunth is an annual grass from East Asia that is now present in corn production areas of the United-States. Discovered in Canada for the first time in 2001, it is now known at four locations in southern Québec (Montérégie area), and is prohibited in seed commodities under the Seeds Act. In 2009, experimental plots were established at one farm where woolly cupgrass field edge densities were high. Different management strategies where tested in small plots (1 m^2). The experimental design included height treatments randomly set in four blocks aligned along the field edge. The treatments included: 1) no intervention; 2) chemical fallow (glyphosate application + tillage); 3) mowing at flowering (evaluated for field border management); 4) metam sodium (for germination control); 5) alfalfa + sethoxydim application; 6) clover + sethoxydim; 7) glyphosate resistant canola (*Brassica napus*) + glyphosate; and, 8) glyphosate resistant soybean + glyphosate. Woolly cupgrass emergence, density, biomass and seed production were evaluated in the centre of each plot. Emergence started on May 5th and ended in July. Heading started in mid-august. First year results suggest that, as in the U.S., sequential control measures (herbicide applications or other) are necessary to control *Eriochloa villosa* seed production in most crops. The highest reductions in seed production were observed in glyphosate resistant canola where plants emerging after a single glyphosate application were ploughed immediately after canola harvest (mid-august) before any mature seed was produced. Further examination in subsequent years will be necessary to confirm these results.

Regulatory Issues –Pest Management Regulatory Agent (PMRA)

[51] PMRA Update. Downs, M.P. Pest Management Regulatory Agency (PMRA), Ottawa, ON

The Pest Management Regulatory Agency (PMRA) has issued a revised policy regarding the use of unlabelled tank mixes of commercial class pest control products used for crop production or vegetation management. In the past, in order for anyone to advertise, recommend or apply one such tank mix, it was required that the specific directions for use appear on at least one of the tank mix partner labels. Under the revised policy, unlabelled tank mixes of commercial class pest control products used for crop production or vegetation management may be recommended, advertised, packaged and applied, subject to the conditions outlined in the policy document.

Abstracts for the 2009 Poster Session

2009 Poster Session – Cereals, Oilseeds and Pulses Section

[52] **Can the bioherbicide *Phoma macrostoma* control agricultural weeds?** Bailey, K.L.[1], Derby, J.[1], and Johnson, E.[2] [1]Agriculture & Agri-Food Canada (AAFC), Saskatoon, SK, [2]AAFC, Scott, SK

[53] **Weed resistance in Alberta: 6 years later.** Beckie, H.J. Agriculture and Agri-Food Canada, Saskatoon, SK

[54] **A brief history of herbicide use in western Canada.** Holm, F.A.[1] and Johnson, E.N.[2] [1]Plant Sciences Dept., University of Saskatchewan, Saskatoon, SK and [2]Agriculture and Agri-Food Canada Research Farm, Scott, SK

[55] **Broad-spectrum weed control in pulse crops with saflufenacil and sulfentrazone.** Johnson, E.N.[1], Blackshaw, R.E.[2], Holm, F.A.[3], and Sapsford, K.[3] [1]Agriculture and Agri-Food Canada, Scott, AB; [2]Agriculture and Agri-Food Canada, Lethbridge, AB; and [3]University of Saskatchewan, SK

[56] **Control of Group 2 (ALS) resistant kochia (*Kochia scoparia*).** Sapsford, K.L.[1], Holm, F.A.[1], Johnson, E.N.[2] and Beckie, H.J.[3] [1]University of Saskatchewan, Saskatoon, SK; [2]Agriculture Agri-Food Canada (AAFC), Scott, AB; and [3]AAFC Saskatoon, SK

[57] **2009 Weed survey of irrigated land in Alberta.** Leeson, J.Y.[1], Neeser, C.[2], Kimmel, N.[3], and Thomas, A.G.[1] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]Alberta Agriculture and Rural Development (AARD), Brooks, AB; and [3]AARD, Edmonton, AB

[58] **Ten years after - weed seedbanks under reduced in-crop herbicide use.** Lewis, D.W.[1], Froese, J.C.[1], Van Acker, R.C.[2], Martens. G.B.[1], Entz, M.H.[1], Derksen, D.A.[3], Bell, L.W.[4] & Gulden, R.H.[1] [1]Department of Plant Science, University of Manitoba, Winnipeg, MB; [2]Department of Plant Agriculture, University of Guelph, Guelph, ON; and [3]Agriculture and Agri-Food Canada, Brandon, MB; [4]CSIRO, Sustainable Ecosystems, Toowoomba, Qld, Australia, e-mail: gulden@cc.umanitoba.ca

[59] **Biobeds – first results from field studies using four herbicides.** Wolf, T.M.[1], Caldwell, B.C.[1], Cessna, A.[2], Knight, D.[3], Farrell, R.[3], and Ngombe, D.L.[1,3] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]National Hydrology Research Centre, Environment Canada, Saskatoon, SK; and [3]Dept. of Soil Science, University of Saskatchewan, Saskatoon, SK

2009 Poster Session – Soybean, Corn and Edible Beans Section

[60] **Weed seedbank response to seven continuous years of Roundup Ready (RR) corn.** Blackshaw, R.E. and Postman, B. Agriculture and Agri-Food Canada, Lethbridge, AB

[61] **Physiological basis of decreased weed sensitivity to glyphosate under low nitrogen conditions.** Jugulam, M., Swanton, C.J., and Hall, J.C. Department of Plant Agriculture, University of Guelph, Guelph, ON

[62] **Cocklebur control in corn.** Sikkema, P.H., Shropshire, C., and Soltani, N. Department of Plant Agriculture, University of Guelph Ridgetown Campus, Ridgetown, ON

[63] **Yellow nutsedge (*Cyperus esculentus*) is a persistent weed in Ontario with a limited number of effective herbicide options.** Smith, P.J. and Tardif, F.J. University of Guelph, ON

[64] **Response of dry bean to preemergence and postemergence applications of cloransulam-methyl.** Soltani, N., Nurse, R.E., Shropshire, C., and Sikkema, P.H. Department of Plant Agriculture, University of Guelph Ridgetown Campus, Ridgetown, ON

[65] **Impact of late herbicide applications in soybean.** Soltani, N.[1], Nurse, R.E.[2], and Sikkema, P.H.[1] [1]Department of Plant Agriculture, University of Guelph Ridgetown Campus, Ridgetown, ON; and [2]Greenhouse and Processing Crops Research Centre, Agriculture and Agri-Food Canada, Harrow, ON

2009 Poster Session – Horticulture & Special Crops Section

[66 **] Weed control in strawberries**. Brookes, V. Agriculture and Agri-Food Canada.

[67 **] Time of cover crop crimping/rolling affects monthly soil nitrogen and moisture availability during transition to organic production in cucumber.** Robinson, D. Department of Plant Agriculture, University of Guelph, Guelph, ON

[68 **] Banding low risk herbicides for weed control in carrots.** Sanderson, K., Ivany, J., Dickson, B., and Main, D. Agriculture and Agri-Food Canada Charlottetown, PEI

[69 **] The critical weed-free period in carrots.** Swanton, C.J., Chandler, K., O'Sullivan, J., and Robinson, D. Department of Plant Agriculture, University of Guelph, Guelph, ON

[70 **] Screening herbicides to control cleavers (*Galium aparine* L.) in carrots and potatoes.** Ulrich, D.J., Johnson, E.N., and Ford, G.A. Agriculture Agri-Food Canada, Scott, AB

2009 Poster Session – Weed Biology & Ecology/Invasive & Noxious Weeds Section

[71] **Weed Seeds Order – Revision**. Gilmer, A. CFIA.

[72] **Improvements to the pesta formulation to promote survival and dispersal of *Pseudomonas fluorescens* BRG100, green foxtail bioherbicide.** Hynes, R.K., Boyetchko, S.M., Sawchyn, K., Hupka, D., and Geissler, J. Agriculture and Agri-Food Canada, Research Centre, Saskatoon, SK

[73] **Influence of climate on weed distribution in the Prairie Provinces.** Leeson, J.Y. and Beckie, H.J. Agriculture and Agri-Food Canada, Saskatoon, SK

[74] **Hemp-nettle (*Galeopsis tetrahit* L.) and stork's-bill (*Erodium cicutarium* (L.) L'Her. ex Ait.): new (?) kids on the old no-till block.** Légère, A.[1], Stevenson, F.C.[2], Lalonde O.[3], and Vanasse, A.[3] [1]AAFC Saskatoon, SK; [2]Private Consultant, Saskatoon, SK; and [3]Université Laval, Québec, QC, email: anne.legere@agr.gc.ca

[75] ***Berteroa incana* (hoary alyssum) soil seed banks and the influence of temperature on its seed germination behaviour.** Madani, H., Stopps, G., and Upadhyaya, M.K., University of British Columbia, Vancouver, BC

[76] **Kudzu (*Pueraria montana* var. *lobata*): Now present in Canada.** Nurse, R.E.[1], Darbyshire, S.J.[2], Cowbrough, M.[3], Tenuta, A.[4], Callow, K.[4] and Simard, M.-J.[5] Agriculture and Agri-Food Canada, [1]Harrow, ON; [2]Ottawa, ON; [3]OMAFRA, Guelph,ON; [4]OMAFRA Ridgetown, ON; and [5]Québec, QC

[77] **The potential of *Phoma* sp. for control of kochia.** Peng, G., McGregor, L., Laprairie, R., and James, B. Saskatoon Research Center, Agriculture and Agri-Food Canada, Saskatoon, SK

[78] **The potential of *Fusarium oxysporum* for control of chickweed**. Peng, G., McGregor, L., Laprairie, R., and James, B. Saskatoon Research Center, Agriculture and Agri-Food Canada, Saskatoon, SK

[79] **Acetolactate synthase (ALS) inhibitor resistance on the rise: Russian thistle and wild buckwheat HR biotypes.** Warwick, S.I.[1], Beckie, H.J.[2], Sauder, C.[1] [1]Agriculture and Agri-Food Canada (AAFC), Ottawa, ON and [2]AAFC-Saskatoon, Saskatoon, SK

[80] **Range expansion of kochia in North America under a changing climate**. Weiss, R.M., Beckie, H.J., Leeson, J.Y., and Olfert, O. Agriculture and Agri-Food Canada, Saskatoon, SK

[81] **Emergence timing and density impact intraspecific pollen-mediated gene flow between conspecific *Triticum aestivum* L. populations.** Willenborg, C.J.[1], Brûlé-Babel, A.L.[2],Van Acker, R.C.[3] [1]Alberta Agriculture and Rural Development, University of Alberta, Edmonton, AB; [2]University of Manitoba, Winnipeg, MB; and [3]University of Guelph, Guelph, ON

2009 Poster Session – Cereals, Oilseeds and Pulses Section

[52] Can the bioherbicide *Phoma macrostoma* control agricultural weeds? Bailey, K.L.[1], Derby, J.[1], and Johnson, E.[2] [1]Agriculture & Agri-Food Canada (AAFC), Saskatoon, SK, [2]AAFC, Scott, SK

Phoma macrostoma is a fungal bioherbicide being developed to control broadleaved weeds in turfgrass. A study was undertaken to determine if the bioherbicide could control broadleaved weeds important in western Canadian agriculture. The study determined what common broadleaved weeds in wheat were controlled by a pre-emergent broadcast application of the bioherbicide at a single rate in two locations. It also determined the least effective rate to control Canada thistle (*Cirsium arvense* (L.) Scop.; pre-emergently and post-emergently at one location) and wild mustard (*Sinapis arvensis* L., pre-emergently at one location). The bioherbicide reduced foliar biomass of dandelion (*Taraxacum officinale* Weber in F.H. Wigg., 68%) and field bindweed (*Convolvulus arvensis* L., 60%) in Melfort and annual sow thistle (*Sonchus asper* (L.) Hill, 97%) in Prince Albert. There was 40-50% biomass reduction in Canada thistle, false cleavers (*Galium spurium* L.), and hemp nettle (*Galeopsis tetrahit* L.); Brassica volunteers were reduced by 27%. The bioherbicide had no effect on stinkweed (*Thlaspi arvense* L.), lambs quarters (*Chenopodium album* L.), and wild oat (*Avena fatua* L.). In Saskatoon, the pre-emergent application reduced the number of Canada thistle plants relative to the untreated plot by 63% at the 0.7X rate and 74% at the 1.0X rate. Biomass was reduced by 71-74%. The post-emergent application reduced the number of Canada thistle plants by 49% at the 0.7X and 67% at the 1.7X. Biomass was reduced by 62-70%. In Scott, the number of wild mustard plants was reduced by 89% at 0.7X, 89% at 1.0X, 86% at 1.3X, 92% at 1.7X, and 93% by the 2,4-D ester herbicide relative to the untreated. Biomass was reduced by 57-92%. The bioherbicide did control several broadleaved agricultural weeds. The bioherbicide worked best to control emerging seedlings and was less effective on mature weeds using a single application.

[53] Weed resistance in Alberta: 6 years later. Beckie, H.J. Agriculture and Agri-Food Canada, Saskatoon, SK

A weed resistance survey of 300 randomly-selected fields was conducted across the major ecoregions of Alberta in 2007. All residual weed species with viable seeds were mapped and sampled before harvest. Selected fields were cropped to cereals, oilseeds, or pulses (field pea). Samples of 35 weed species were subsequently screened in the greenhouse with herbicides belonging to various groups. In addition, an early spring survey was conducted to document resistance in kochia and Russian thistle. Of 179 fields where wild oat samples were collected, 39% had Group 1-resistant wild oat and 12% had Group 2-resistant wild oat. Therefore, Group 1 resistance in wild oat has increased sharply since 2001 (11% of fields), but Group 2 resistance has remained at the same field frequency. Most of the fields with either resistant biotype originated in the Aspen Parkland ecoregion, attributed to historically high frequency of use of products from these groups. Most Group 1-resistant wild oat populations exhibited broad cross-resistance to herbicides from the three chemical classes – fop, dim, den. Group 2-resistant populations also exhibited broad cross- resistance across three classes. Group 1 resistance was documented in two green foxtail populations; resistance in this weed was not found in the 2001 survey. Group 2 resistance was documented in 40% of 30 fields with chickweed (four fields in 2001), all 11 fields with spiny annual sow-thistle (four fields in 2001), 17% of 30 fields with cleavers (not reported in 2001), and one field with wild buckwheat, the first global report. Thus, resistance is steadily increasing in chickweed and spiny annual sow-thistle, and most recently, cleavers. Of 95 fields where kochia was sampled, nearly 90% had Group 2-resistant populations, whereas only 1 of 14 fields had a Russian thistle population that was Group 2-resistant. However, all kochia populations were susceptible to dicamba, a Group 4 herbicide. Group 2 resistance in broadleaf weeds will pose a increasingly weed control challenge for pulse crop producers. Monitoring for weed resistance in an integral component of product stewardship and serves as an warning system for farmers to adopt integrated practices to delay or manage resistance and for industry to develop solutions to emerging weed problems. Farmers save money and reduce herbicide use by not applying ineffective herbicides on resistant weed populations; thus, the sustainability of Alberta's crop production in the medium- and long-term can only be enhanced.

[54] A brief history of herbicide use in western Canada. Holm, F.A.[1] and Johnson, E.N.[2]
[1]Plant Sciences Dept., University of Saskatchewan, Saskatoon, SK and [2]Agriculture and Agri-Food Canada Research Farm, Scott, SK

Early 20th century attempts at chemical weed control in western Canada consisted of using various soil residual salts at extremely high rates for non-selective control persistent perennial weeds and various inorganic compounds for selective control of annual broadleaved weeds in cereals. The widespread use of herbicides became a significant factor in crop production after the 1950s. Farmers in western Canada spent approximately $800 million on herbicides in 2006. The modern "Selective Herbicide Era" began in 1945with the introduction of 2, 4-D which controlled many annual broadleaved weeds in cereal crops and was adopted very rapidly. In 1946, it was applied to about 40 ha of research/demonstration plots. By 1949 and 1962 it was used on 3.2 and >10 million ha, respectively. Many other synthetic auxin herbicides have been introduced since and they remain very popular. The rate of introduction of new products peaked in the '60s and '70s when 10 different modes of action were introduced. Since then, only five new MOAs have been commercialized. Herbicide use has enabled significant diversification in crop types and a major shift to farming systems that are much more soil and water conserving and energy efficient. Herbicide resistance indicates a need for new modes of action but the introduction of new MOAs has slowed as the market has matured, development costs escalate, and glyphosate continues to dominate global herbicide sales. Therefore, we must make more judicious use of existing products to protect and prolong their utility. To do this will require a new emphasis on the development of cost-effective integrated weed management strategies to ensure that effective weed control can be achieved on a sustainable basis into the future.

[55] Broad-spectrum weed control in pulse crops with saflufenacil and sulfentrazone.
Johnson, E.N.[1], Blackshaw, R.E.[2], Holm, F.A.[3], and Sapsford, K.[3] [1]Agriculture and Agri-Food Canada, Scott, AB; [2]Agriculture and Agri-Food Canada, Lethbridge, AB; and [3]University of Saskatchewan, SK

Pulse crops such as field pea (*Pisum aestivum* L.) and chickpea (*Cicer arientum* L.) have limited broadleaf weed control options. Field pea is highly reliant on ALS inhibitor herbicides; however, weed resistance to these herbicides is evolving quickly. Sulfentrazone and saflufencil are protoporphyrinogen oxidase inhibitor herbicides which is a relatively unique mode of action to Western Canada. Sulfentrazone has a conditional registration in chickpea in Saskatchewan and Alberta. Sulfentrazone controls kochia [*Kochia scoparia* (L.) Schrad.], wild buckwheat (*Polygonum convolvulus* L.), redroot pigweed (*Amaranthus retroflexus* L.), and lambs-quarters (*Chenopodium album* L.) but does not provide sufficient control of cruciferous weeds. Saflufenacil is a new herbicide which has both contact and residual activity; however, residual activity is rate dependent. Studies were conducted at Lethbridge, AB (2008), Scott, SK (2008, 2009) and Saskatoon, SK (2008, 2009) to determine if combinations of sulfentrazone and saflufenacil could control a number of broadleaf weeds in chickpea. Treatments included sulfentrazone applied at rates of 70 and 140 g ai/ha; saflufenacil applied at rates of 18, 36, 50, and 100 g ai/ha; and sulfentrazone / saflufenacil combinations applied at rates of 70/18, 70/36, 70/50, 140/18, 140/36, and 140/50 g ai/ha. Chickpea was tolerant to all herbicide treatments. Sulfentrazone when applied alone did not control wild mustard (*Sinapis arvensis* L.) at Lethbridge in 2008 or Scott in 2008 or 2009. It also did not control stinkweed (*Thlapsi arvense* L.) in Saskatoon in 2008 or 2009. Saflufenacil and saflufenacil / sulfentrazone combinations provided higher levels of control of wild mustard than sulfentrazone alone, but control levels varied from 50 to over 80%. Saflufenacil and saflufenacil / sulfentrazone combinations controlled stinkweed in Saskatoon in both 2008 and 2009. Sulfentrazone and saflufenacil / sulfentrazone combinations were effective in controlling kochia and wild buckwheat. A similar study was conducted in field pea in 2009 at Lethbridge and Scott. Saflufenacil / sulfentrazone combinations controlled wild mustard, kochia, wild buckwheat, and redroot pigweed. Combinations of saflufenacil and sulfentrazone have potential to control a number of broadleaf weeds in field pea and chickpea; however, further refinement of rates is required.

[56] Control of Group 2 (ALS) resistant kochia (*Kochia scoparia*). Sapsford, K.L.[1], Holm, F.A.[1], Johnson, E.N.[2] and Beckie, H.J.[3] [1]University of Saskatchewan, Saskatoon, SK; [2]Agriculture Agri-Food Canada (AAFC), Scott, AB; and [3]AAFC Saskatoon, SK

In the 20 years since Group 2 herbicide-resistant kochia was identified on the Prairies, the resistant biotype has spread dramatically from its original area of adaptation in the Brown and Dark Brown soil zones to the Black soil zone. A survey of over 100 fields across the Prairies conducted by AAFC in 2007, revealed that about 90 percent of the fields contained Group 2-resistant kochia biotypes. At least three different target-site mutations in kochia confer resistance to Group 2 herbicides. In addition, kochia is an out-crossing species, so the dominant resistance gene can spread throughout a population quickly. Prolific seed production, a low level of seed dormancy and kochia's tumbleweed seed dispersal mechanism also contribute to rapid spread of resistant biotypes. Trials were established at Scott and

Elstow, SK in 2006, 2007 and 2008. Kochia at the Scott site was all Group 2 susceptible whereas at Elstow it was Group 2 resistant. At each location a four replicate RCBD trial was conducted in hard red spring wheat. The treatments were applied when the kochia was 5 to 10 cm. tall. Visual ratings were done at 7-14 and 21-28 days after application. Conclusions: Unless you know otherwise, assume kochia infestations on the prairies contain Group 2-resistant biotypes. Group 4 herbicides that control susceptible kochia will control Group 2-resistant biotypes equally well. Herbicide products that contain Group 2 and 4 modes of action may not contain enough of the Group 4 component to control kochia. Two Herbicides that contain Group 2 and 4 modes of action and control Group 2- resistant kochia are Triton K® (tribenuron methyl + dicamba) and Stellar® (fluroxypyr + florasulam). Infinity® (pyrasulfotole + bromoxynil), a Group 6 and 28 mode of action herbicide, controls group 2-resistant kochia.

[57] 2009 Weed survey of irrigated land in Alberta. Leeson, J.Y.[1], Neeser, C.[2], Kimmel, N.[3], and Thomas, A.G.[1] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]Alberta Agriculture and Rural Development (AARD), Brooks, AB; and [3]AARD, Edmonton, AB

Half a million hectares of irrigated land are located in the South Saskatchewan River Basin in southern Alberta, accounting for over half of the irrigated agricultural land in Canada. While irrigated fields have been included in some provincial weed surveys, a separate weed survey of irrigated fields has not been previously conducted in Alberta. In 2009, a survey was conducted of 571 fields of common irrigated crops including annual cereals (spring wheat, barley, corn), annual broad-leaved crops (canola, sugar beets, dry beans, potatoes) and perennial crops (alfalfa, grass hay). Fields were selected using a stratified random sampling procedure. In each field, weeds were identified and counted in twenty 0.5 m x.0.5 m quadrats placed in an inverted W-pattern. The relative abundance of each species was determined based on density, uniformity and frequency. Wild oats (*Avena fatua* L.), kochia (*Kochia scoparia* (L.) Schrad.), wild buckwheat (*Polygonum convolvulus* L.), lamb's-quarters (*Chenopodium album* L.) and redroot pigweed (*Amaranthus retroflexus* L.) were the five most abundant species in the annual broad-leaved crops. These species also were the top species in the cereal crops; however, the ranks differed. Dandelion (*Taraxacum officinale* G. H. Weber ex Wiggers), Canada thistle (*Cirsium arvense* (L.) Scop.), lamb's-quarters, kochia and green foxtail (*Setaria viridis* (L.) P. Beauv.) were five most abundant species in the perennial crops. The total weed density was lowest and the number of weed-free quadrats was highest in the annual broad-leaved crops.

[58] Ten years after - weed seedbanks under reduced in-crop herbicide use. Lewis, D.W.[1], Froese, J.C.[1], Van Acker, R.C.[2], Martens. G.B.[1], Entz, M.H.[1], Derksen, D.A.[3], Bell, L.W.[4] & Gulden, R.H.[1] [1]Department of Plant Science, University of Manitoba, Winnipeg, MB; [2]Department of Plant Agriculture, University of Guelph, Guelph, ON; and [3]Agriculture and Agri-Food Canada, Brandon, MB; [4]CSIRO, Sustainable Ecosystems, Toowoomba, Qld, Australia, e-mail: gulden@cc.umanitoba.ca

Ten years ago, a long-term field study investigating the impacts of reduced in-crop herbicide use was initiated at the University of Manitoba. The study is a fully phased experiment with

an annual (canola-wheat-flax-oats) and a perennial crop rotation (alfalfa-alfalfa-flax-oats) replicated three times. In the control rotations, all annual crops were treated with in-crop herbicides. In the other replications of the rotations, in-crop herbicides were excluded in the oat crop only, or in both oats and flax. The objectives of this study were to investigate the seedbank composition among treatments after ten years of implementing these herbicide use patterns. Soil was sampled in the spring to a depth of 15cm and seedbank grow-outs were conducted in the greenhouse. Weed seedlings were identified by species recorded and the soil was stirred after each count. Three cycles of grow-out have been completed. Trays were stored in the freezer for three weeks between each grow-out. Initial results indicate omission of in-crop herbicides in flax significantly increased the weed seed density in the seedbank in all crops throughout both rotations. In the annual rotation, flax had significantly greater weed seedbank densities and in the perennial rotation, second year alfalfa had significantly lower weed seedbank densities than all other crops. Weed species community assembly will be examined in the future.

[59] Biobeds – first results from field studies using four herbicides. Wolf, T.M.[1], Caldwell, B.C.[1], Cessna, A.[2], Knight, D.[3], Farrell, R.[3], and Ngombe, D.L.[1,3] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]National Hydrology Research Centre, Environment Canada, Saskatoon, SK; and [3]Dept. of Soil Science, University of Saskatchewan, Saskatoon, SK

A biobed is a mixture of topsoil, compost and cereal straw (1:1:2 v/v/v) used to degrade pesticide waste. The biomix provides high water holding capacity as well as high sorption and microbial breakdown of pesticides. The objective of this study was to quantify the leaching of four herbicides (2,4-D amine, thifensulfuron-methyl (THI), tribenuron-methyl (TRI), and metsulfuron-methyl (MET) from 1.4 m^3 biobeds under outdoor Saskatchewan conditions over 2 years. The herbicides were applied at two concentrations, 10% and 1% of the label field rate for Saskatchewan, in 10 L of water. Applications were done weekly for 5 weeks in June and July of 2008 and 2009. A grass layer was established on top of the biobeds in 2009. Leachate was sampled weekly throughout June to September and analyzed for herbicide. Leachate exiting the biobeds contained herbicides at concentrations (averaged for all herbicides and sampling times) of 4.1% of that applied in 2008, and 2.3% in 2009. Herbicide concentrations in leachate depended on the herbicide, with 2,4-D concentrations reduced the most in 2009 (to 0.045% of applied), followed by THI (0.11%), TRI (1.9%), and MET (6.1%). Water balance was an important aspect of biobed operation. Each biobed received a total of 430 L water from herbicide applications and rain in 2009, and an average of 350 L evapotranspired from each tank. These studies will be continued in various larger field biobed installations in 2010.

2009 Poster Session – Soybean, Corn and Edible Beans Section

[60] Weed seedbank response to seven continuous years of Roundup Ready (RR) corn.
Blackshaw, R.E. and Postman, B. Agriculture and Agri-Food Canada, Lethbridge, AB

A field study was conducted from 2000 to 2007 to examine potential weed population responses to various cropping frequencies of RR corn. Treatments included 1) continuous RR corn, 2) continuous conventional corn, 3) RR corn - RR canola - Bt corn - RR canola grown in rotation, and 4) corn - canola - corn - canola (all conventional crops) grown in rotation. Herbicides were glyphosate (890 g ae ha^{-1}) in RR corn, glyphosate (445 g ha^{-1}) in RR canola, ethalfluralin (1100 g ai ha^{-1}) + quizalofop-P (45 g ai ha^{-1}) + ethametsulfuron (22 g ai ha^{-1}) + clopyralid (200 g ai ha^{-1}) in conventional canola, EPTC (4350 g ai ha^{-1}) + bromoxynil/MCPA (560 g ai ha^{-1}) or atrazine (1180 g ai ha^{-1}) + nicosulfuron (25 g ai ha^{-1}) applied in alternate years in continuous conventional corn, and EPTC (4350 g ha^{-1}) + bromoxynil/MCPA (560 g ha^{-1}) applied in conventional and Bt corn when grown in the rotation treatments. Weed seedbank data collected at the conclusion of the study indicated that the total weed seedbank was lower with continuous RR corn than with continuous conventional corn. However, the seedbank of some individual species such as lamb's-quarters (*Chenopodium album*) and round-leaved mallow (*Malva pusilla*) was higher, while others such dandelion (*Taraxacum officinale*), kochia (*Kochia scoparia*), stinkweed (*Thlaspi arvense*), and stork's-bill (*Erodium cicutarium*) was lower, with continuous RR corn than with continuous conventional corn. The seedbank of redroot pigweed (*Amaranthus retroflexus*), wild buckwheat (*Polygonum convolvulus*), and wild mustard (*Sinapis arvensis*) was similar with continuous RR and conventional corn. Weed seedbanks were often lower in rotation treatments compared with either of the continuous corn treatments. Diversified crop rotations can be expected to mitigate potential weed population responses to GE crops and should be strongly encouraged in the agricultural community.

[61] **Physiological basis of decreased weed sensitivity to glyphosate under low nitrogen conditions.** Jugulam, M., Swanton, C.J., and Hall, J.C. Department of Plant Agriculture, University of Guelph, Guelph, ON

Growth room studies were conducted to determine the physiological basis of reduced glyphosate efficacy under low soil nitrogen [N] using velvetleaf, ragweed and common lambsquarters as model species. Dose-response experiments of weeds grown under low (1.5 mM) and high (15 mM) soil [N] suggest that glyphosate doses of 225 g ai/ha or higher were required for a significant reduction in both velvetleaf and lambsquarters biomass grown under low [N] as opposed to 112.5 g ai/ha glyphosate required for a similar reduction when grown under high soil [N]. However, when ragweed was grown under low or high soil [N] there was no significant difference in response to glyphosate at all doses tested. The reduced efficacy of glyphosate in velvetleaf and lambsquarters under low [N] was not caused by reduced uptake but was primarily due to decreased translocation of the herbicide to the meristem. It appears that low [N] may decrease the net assimilation of carbon in plants resulting in a decrease in the net export of sugars and hence glyphosate from mature leaves. Understanding the relationship between soil [N] and herbicide efficacy may help explain observed weed control failures with glyphosate and may contribute to our knowledge of the occurrence of weed patchiness in fields. This is the first report illustrating a physiological basis for decreased glyphosate efficacy under low soil [N] in the selected weed species.

[62] Cocklebur control in corn. Sikkema, P.H., Shropshire, C., and Soltani, N. Department of Plant Agriculture, University of Guelph Ridgetown Campus, Ridgetown, ON

Nine field trials (5 with PRE- and 4 with POST-emergence herbicides) were conducted in 2006 to 2009 on various Ontario farms with heavy infestations of cocklebur to determine the effectiveness of PRE- and POST-emergence herbicides for the control of cocklebur in corn. There was no injury to corn from PRE herbicides evaluated. Atrazine, dicamba, dicamba/atrazine, isoxaflutole + atrazine, mesotrione + atrazine, saflufenacil and saflufenacil/dimethenamid-p applied PRE provided 30-78, 41-76, 46-84, 45-82, 60-82, 85-96 and 85-90% control of cocklebur in corn, respectively. Cocklebur density was reduced only with isoxaflutole + atrazine (62%), saflufenacil (78%) and saflufenacil/dimethenamid-p (74%). Cocklebur shoot dry weight was reduced 68, 80, 79, 75, and 84% with dicamba/atrazine, isoxaflutole + atrazine, mesotrione + atrazine, saflufenacil and saflufenacil/dimethenamid-p, respectively. There was no effect on yield with PRE herbicides evaluated. Atrazine, dicamba, dicamba/diflufenzopyr, dicamba/atrazine, 2,4-D/atrazine, bromoxynil + atrazine, prosulfuron + dicamba, primisulfuron/dicamba, mesotrione + atrazine, topramezone + atrazine and bentazon + atrazine applied POST injured corn as much as 3, 9, 1, 7, 5, 28, 1, 6, 1, 2 and, 0.4% and reduced cocklebur shoot dry weight 55-85, 92-100, 75-100, 92-100, 45-99, 49-99, 78-99, 57-100, 75-99, 44-92 and 53-72%, respectively. Cocklebur density results were similar to shoot dry weight. All POST herbicide treatments increased corn yield compared to the untreated check. Based on these results, saflufenacil and saflufenacil/dimethenamid-p applied PRE and dicamba, dicamba/diflufenzopyr, dicamba/atrazine, 2,4-D/atrazine, prosulfuron + dicamba, primisulfuron/dicamba, mesotrione + atrazine, and topramezone + atrazine applied POST have potential to provide good to excellent control of cocklebur in corn under Ontario environmental conditions.

[63] Yellow nutsedge (*Cyperus esculentus*) is a persistent weed in Ontario with a limited number of effective herbicide options. Smith, P.J. and Tardif, F.J. University of Guelph, ON

A field experiment was conducted in 2008 at Elora, ON, Canada to evaluate control of yellow nutsedge with pre-emergence and post-emergence herbicides. Eleven herbicide treatments were included based on documented or claimed efficacy on nutsedge. Visual control ratings were recorded in the year of application and one year after treatment. Tubers greater than 3mm diam. were counted and weighed in the second year. Halosulfuron and chlorimuron-ethyl, applied postemergence, provided control similar to the weed free check (93 to 100% control). Tuber counts and fresh weights were statistically similar between the weed free check and halosulfuron or chlorimuron-ethyl treatments whereas imazethapyr (pre and post), mesotrione (pre and post), bentazon (post) and s-metolachlor/benoxacor (pre) did not provide effective control of this weed. These results provide options for control of yellow nutsedge as well as their effect on tuber production and recruitment one year after treatment.

[64] Response of dry bean to preemergence and postemergence applications of cloransulam-methyl. Soltani, N., Nurse, R.E., Shropshire, C., and Sikkema, P.H. Department of Plant Agriculture, University of Guelph Ridgetown Campus, Ridgetown, ON

Tolerance of various market classes of dry bean to cloransulam-methyl is not known. Three field studies were conducted in Ontario during 2007 and 2008 to determine tolerance of black, cranberry, kidney and white bean to the pre-emergence (PRE) and post-emergence (POST) application of cloransulam-methyl applied at 17.5, 35, and 70 g ai ha^{-1}. Cloransulam-methyl applied at 17.5, 35, and 70 g ha^{-1} caused between 13 and 23% injury in black, cranberry, kidney, and white bean, respectively. Cloransulam-methyl applied at 17.5, 35, and 70 g ha^{-1} reduced shoot dry weight between 16 and 28% compared to the untreated control. Cloransulam-methyl applied PRE reduced black bean height 27% and cranberry bean height 25% at 70 g ha^{-1} and reduced white bean height 19% at 35 g ha^{-1} and 37 % at 70 g ha^{-1}. Cloransulam-methyl applied PRE reduced the yield of black bean 29% at 35 g ha^{-1} and 43% at 70 g ha^{-1}, cranberry bean 43% at 70 g ha^{-1} and white bean 36% at 35 g ha^{-1} and 54% at 70 g ha^{-1}. Based on these results, there is not an adequate margin of crop safety for the PRE and POST application of cloransulam-methyl in black, cranberry, kidney and white bean at the rates evaluated.

[65] Impact of late herbicide applications in soybean. Soltani, N.[1], Nurse, R.E.[2], and Sikkema, P.H.[1] [1]Department of Plant Agriculture, University of Guelph Ridgetown Campus, Ridgetown, ON; and [2]Greenhouse and Processing Crops Research Centre, Agriculture and Agri-Food Canada, Harrow, ON

Three field trials were conducted between 2007 and 2009 in Ontario to evaluate the response of soybean to various postemergence herbicides applied at the seven trifoliate leaf-stage which is past the recommended application timing. The application of glyphosate as a single (1X) and overlap (2X) application caused no injury in soybean when evaluated 3, 7, 14, 21, 28 and 56 days after treatment (DAT). There was also no decrease in plant height (14 and 28 DAT) or yield except for the 2X rate which decreased yield 3%. Imazethapyr caused 3 to 25% injury, reduced height up to19%, and decreased yield up to 11%. Chlorimuron-ethyl caused 2 to 21% injury, reduced height up to 12% and decreased yield up to 5%. Thifensulfuron-methyl caused 16 to 48% injury, reduced height up to 28%, and decreased yield up to 11%. Cloransulam-methyl caused 4 to 13% injury, reduced height up to 14% but had no effect on yield at 1X or 2X rates. Fomesafen caused 0 to 14% injury, had no effect on height but decreased yield 3% at the 2X rate. Bentazon caused 0 to 14% injury, had no effect on height but decreased yield 3% at the 2X rate. Quizalofop-p-ethyl caused 0 to 4% injury and had no effect on height or yield of soybean. Based on these results, glyphosate and quizalofop-p-ethyl can be safely applied at the seven trifoliate leaf-stage in soybean.

2009 Poster Session – Horticulture & Special Crops Section

[66] Weed control in strawberries. Brookes, V. Agriculture and Agri-Food Canada

A summary of three years of research on various herbicides alone and in combination on newly planted strawberries.

[67] Time of cover crop crimping/rolling affects monthly soil nitrogen and moisture availability during transition to organic production in cucumber. Robinson, D. Department of Plant Agriculture, University of Guelph, Guelph, ON

Two studies were established to examine the use of cover crop rolling in cucumber and squash. In the fall prior to growing each vegetable crop, fall rye was planted at 100 or 150 kg/ha. The following spring, the fall rye was rolled prior to flowering, and at 25%, 50%, 75% and 100% flowering, at each of the two fall rye seeding rates and planted with either cucumber or squash. Additional treatments included mowing or disking-under the fall rye prior to planting. Our objective was to determine the effect of time of cover crop rolling on soil moisture and fertility in cucumber and squash. Volumetric soil moisture was determined on ten 50cm3 samples per plot, and compared with available moisture using time-domain reflectometry. Ten soil samples per treatment were taken every month, and analyzed for plant available ammonium and nitrate at 10cm depth. There was a decrease in volumetric soil moisture in the 100 kg/ha, disked fall rye treatment compared with all other treatments in the August sampling period. Otherwise, volumetric soil moisture did not differ among any of the treatments at either the July or August sampling period. Changes in soil nitrate did vary depending on fall rye management – negative linear coefficients indicate a decrease in available soil nitrate, while positive linear coefficients indicate an increase in available soil nitrate. When fall rye was rolled prior to, or at 25% bloom, we did not observe a consistent increase or decrease in soil nitrate levels. In those treatments where fall rye was rolled at 50%, 75% or 100% flowering, soil nitrate levels increased. Where fall rye was mowed, soil nitrate levels decreased or remained level throughout the growing season, and when fall rye was disked, soil nitrate levels decreased significantly in both cucumber and squash. This is an important finding, as one of the arguments against rolling a fall rye cover crop has been the perceived potential for tying up nitrogen in the soil, though there are no data to support this hypothesis. Our data show that net loss of soil nitrate did not occur in the treatments where fall rye was rolled at 50% bloom or later; rather, more nitrate was available in these treatments as the season progressed.

[68] Banding low risk herbicides for weed control in carrots. Sanderson, K., Ivany, J., Dickson, B., and Main, D. Agriculture and Agri-Food Canada Charlottetown, PEI

Carrot growers are continually faced with pressure to reduce pesticide use. In 2008 and 2009, a low risk herbicide trial was carried out to evaluate banding herbicides in conjunction with between row mechanical cultivation on carrots. The experiment was split-plot design with 2 planting dates, approximately June 9 and 25. Rows consisted of preformed hills spaced 90 cm apart. The banded treatments were linuron, flaming, Ecoclear, Matran®, and Nature's

Avenger™ applied as a 30 cm wide band directly over the row. The banded treatments were compared to a broadcast application of linuron. All treatments were applied pre-emergence, except for the linuron which was also applied post-emergence. All banded treatments had between row weeds removed by cultivation. Weed biomass by species, was determined using two quadrats on the top of each row. All treatments reduced weed biomass on top of the carrot bed at the June 25 planting compared to June 8-9 planting date. Linuron applied either broadcast or as a band, reduced weed biomass compared to the other treatments, but were not different from each other. Propane flaming and the three low risk herbicides provided comparable weed control in the early planting; however, flaming was not as effective in the later planting. Side knives and s-tines with duck-foot sweep were very effective in controlling weeds between the beds. Planting date did not affect yield. Applying linuron either as a broadcast or in a band did not affect total or marketable yield. The low risk strategies which included flaming, Ecoclear, Matran®, and Nature's Avenger™ were not different from each other but had lower total yield compared to linuron treatments. Nature's Avenger™ was intermediate and nor different from banded linuron. Banding treatments on top of the bed reduced all herbicide and propane use by 66%, thus reducing cost and environmental impact.

[69] The critical weed-free period in carrots. Swanton, C.J., Chandler, K., O'Sullivan, J., and Robinson, D. Department of Plant Agriculture, University of Guelph, Guelph ON

Seeding date, the severity of weed infestation and the duration of weed emergence influenced the duration of the critical weed-free period in carrot. The critical weed-free period extended up to 1067 GDD (growing degree days), until carrot was at the 12 leaf stage, when carrot was seeded early and weed infestation was severe. In comparison, the critical weed-free period was short and lasted 414 GDD, until carrot was at the 4 leaf stage, when seeded later and weed infestation was moderate. It is important for growers to scout fields for weeds until carrot is at the 12 leaf stage to protect the yield potential of the carrot crop. Grower surveys conducted in coordination with tours of the trials indicated that growers had an accurate appreciation of the impact of weed control on carrot yield but were intolerant to weeds because of concerns over crop harvestability and future weed and pest management.

[70] Screening herbicides to control cleavers (*Galium aparine* L.) in carrots and potatoes. Ulrich, D.J., Johnson, E.N., and Ford, G.A. Agriculture Agri-Food Canada, Scott AB

The federal pesticide minor use program has identified cleavers as a major pest in carrot and potato through the priority setting process. Field screening studies were initiated at the Scott research farm to identify herbicides that exhibit acceptable crop safety and cleaver suppression/control in potato and carrot. Trials were conducted on a medium textured loam soil with 3.6% organic matter and pH of 5.4. Ethofumesate at rates of 1080, 2160, and 4320 g ai ha^{-1} was applied to carrot pre-plant and incorporated. Clomazone in carrot and potato and sulfentrazone in potato were applied pre-emergence at rates of 140, 280, and 560 g ai ha^{-1} with sulfentrazone in carrot applied at 70, 140, 280 g ai ha^{-1}. Quinclorac in carrot and potato (rates of 100 and 200 g ai ha^{-1}), carfentrazone-ethyl in carrot (rates of 11, 22, and 44 g ai ha^{-1}) and rimsulfuron (15 g ai ha^{-1}) in potato were applied post emerge. Assessments of visual crop injury, cleaver control and measurement of harvest yield was conducted. In carrot sulfentrazone provided acceptable crop injury at 280 g ai ha^{-1} and cleaver control at rates as low as 140 g ai ha^{-1}. Clomazone injury in carrot was acceptable at 560 g ai ha^{-1} with cleavers controlled at 280 g ai ha^{-1} and suppressed at 140 g ai ha^{-1}. Ethofumesate was safe on carrots up to 4320 g ai ha^{-1}, controlled cleavers at 4320 g ai ha^{-1} and suppressed cleavers at rates as low as 1080 g ai ha^{-1}. Carfentrazone-ethyl at the low rate of 11 g ai ha^{-1} caused significant carrot injury (leaf necrosis, stunting and plant mortality) while quinclorac provided unacceptable cleaver control and unacceptable carrot wilting at 100 g ai ha^{-1}. Quinclorac and carfentrazone-ethyl produced generally lower but not significant (p=0.05) carrot yields relative to the weed free check. In potato sulfentrazone provided acceptable crop injury at 560 g ai ha^{-1}, cleaver control and suppression at 280 g ai ha^{-1} and 140 g ai ha^{-1} respectively. Clomazone suppressed cleavers at 140-280 g ai ha^{-1} but produced unacceptable late season bleaching at 560 g ai ha^{-1}. Quinclorac provided unacceptable potato leaf cupping and stunting at 100 g ai ha^{-1}. Rimsulfuron registered for use on potato did not control cleavers. Only quinclorac produced significantly lower potato yields relative to the weed free check (P=0.05). Sulfentrazone, clomazone and ethofumesate in carrot and sulfentrazone and clomazone in potato exhibited sufficient crop safety and cleaver suppression/control to be considered candidates for potential user requested minor use (URMULE) registration.

2009 Poster Session – Weed Biology & Ecology/Invasive & Noxious Weeds Section

[71] Weed Seeds Order – Revision. Gilmer, A. CFIA

Consultations on Proposed Amendments to the *Weed Seeds Order*

The Canadian Food Inspection Agency (CFIA) is currently conducting consultations on proposed amendments to the *Weed Seeds Order*.

The consultation document can be requested by sending an email to SeedSemence@inspection.gc.ca

The *Weed Seeds Order* (WSO), a ministerial order under the *Seeds Act*, classifies weed species within six classes for the purposes of establishing purity standards for seed in Canada. The WSO plays a critical role in the prevention of intentional (as a crop) and unintentional (as a seed contaminant) introductions of new weeds into Canada and contributes to the CFIA's mandate of protecting the plant resource base.

The CFIA is currently conducting consultations on revisions to the WSO including proposed class definitions, WSO structure and species placement.

The CFIA requests feedback on the proposed revision to the WSO **prior to January 15th, 2010**.

Consultations sur les Modifications Proposées à L'*Arrêté sur les graines de mauvaises herbes*

L'Agence canadienne d'inspection des aliments (ACIA) tient actuellement des consultations sur les modifications proposées à L'*Arrêté sur les graines de mauvaises herbes* (AGMH).

On peut obtenir ce document en envoyant un courriel à l'adresse suivante : SeedSemence@inspection.gc.ca

L'AGMH classe les espèces de mauvaises herbes en six catégories qui permettent d'établir des normes de pureté régissant les semences au Canada. L'AGMH joue un rôle essentiel quant à la prévention de l'introduction intentionnelle (sous la forme de champs cultivés) et non intentionnelle (sous la forme de contaminants de semences) de nouvelles mauvaises herbes au Canada, tout en collaborant au mandat de l'ACIA qui vise à protéger les ressources végétales du Canada.

L'ACIA tient actuellement des consultations qui portent sur les révisions de l'AGMH, notamment sur les définitions proposées pour les catégories, la structure de l'*Arrêté* et le classement des espèces.

S'il vous plaît répondre avec vos commentaires sur les modifications proposées à L'AGMH d'ici **le 15 janvier, 2010**.

[72] Improvements to the pesta formulation to promote survival and dispersal of *Pseudomonas fluorescens* BRG100, green foxtail bioherbicide. Hynes, R.K., Boyetchko, S.M., Sawchyn, K., Hupka, D., and Geissler, J. Agriculture and Agri-Food Canada, Research Centre, Saskatoon, SK

A modified pesta granule was developed for *Pseudomonas fluorescens* BRG100, bioherbicidal bacteria for grass weeds, green foxtail (*Setaria viridis*) and wild oat (*Avena fatua*). This study reports i) the effect of formulation water activity (aw) on survival of *P. fluorescens* BRG100 and, ii) the effect of starch on disintegration and dispersal of a green fluorescent protein transformant of *P. fluorescens* BRG100 from pesta in laboratory sand columns. Survival of *P. fluorescens* BRG100 was examined in fluidized bed dried pesta to 0.3, 0.5 and 0.8 aw stored at 6ºC for 16 months. Drying pesta to 0.3 aw stabilized the population of *P. fluorescens* BRG100 for 16 months at 8.5 log10 cfu/g, initial population 9 log10 cfu/g. When pesta was dried to 0.8 aw, *P. fluorescens* BRG100 population decreased to 7.3 log10 cfu/g over six months. These results suggest that some of the difficulties that up until now have hindered development of non-spore forming bacteria as biopesticidal products in granular formulations maybe overcome by drying pesta granules to aw of 0.3. Corn, pea, rice or potato starch, 26 and 13% wgt/wgt amendment to pesta modified the disintegration rate. The order of fast to slow disintegration following starch amendment was pea>potato>corn> rice. Increasing pea, potato and corn starch content from 13 to 26% promoted disintegration of pesta, conversely, increasing rice starch content decreased disintegration. Pea starch amended pesta (26%) promoted most rapid disintegration, two minutes, rice starch (26%) amended pesta was slowest, 10 minutes and non-amended pesta disintegrated in 7 minutes. *P. fluorescens* BRG100gfp was detected 2 hr earlier in the middle and bottom sections of the sand columns from corn starch amended (26%) pesta than from non-amended pesta.

[73] Influence of climate on weed distribution in the Prairie Provinces. Leeson, J.Y. and Beckie, H.J. Agriculture and Agri-Food Canada, Saskatoon, SK

The influence of climate on the distribution of weeds in the Prairie Provinces is determined using weed survey data from the 1970s to 2000s. During this time period, over 17,800 fields located throughout the agricultural area in the three Prairie Provinces have been surveyed. Redundancy analysis is used to determine the association of the 60 most common weed species with climatic factors. Growing season temperature is the main climatic factor determining weed species distribution. Species positively associated with warm growing seasons include redroot pigweed (*Amaranthus retroflexus* L.), kochia (*Kochia scoparia* (L.) Schrad.), Russian thistle (*Salsola tragus* L.), and green foxtail (*Setaria viridis* (L.) P. Beauv.). Additionally, kochia and Russian thistle are associated with extended growing seasons. An increase in average temperatures may facilitate the northward expansion of these species. Hemp-nettle (*Galeopsis tetrahit* L.), field horsetail (*Equisetum arvense* L.) and perennial sow-thistle (*Sonchus arvensis* L.) are associated with a high annual rainfall. Change in precipitation patterns may be expected to influence the distribution of these species.

[74] Hemp-nettle (*Galeopsis tetrahit* L.) and stork's-bill (*Erodium cicutarium* (L.) L'Her. ex Ait.): new (?) kids on the old no-till block. Légère, A.[1], Stevenson, F.C.[2], Lalonde O.[3], and Vanasse, A.[3] [1]AAFC Saskatoon, SK; [2]Private Consultant, Saskatoon, SK; and [3]Université Laval, Québec, QC, email: **anne.legere@agr.gc.ca**

Assessments of weed populations in the 22nd year of a conservation tillage study at La Pocatière, Québec, is suggesting the potential comeback of hemp-nettle and the introduction of stork's-bill. The study is currently exploring the effects of cropping system (conventional crops; genetically modified crops: GM; pesticide-free: PF; organic) and tillage (moldboard plow: MP; chisel plow: CH; no-till: NT) on weeds, carabid beetles and crops. Weed communities in the corn crop were sampled twice (June, July) in two 50 by 75 cm quadrats per plot. The 2009 data for both species were compared to that from previous years (1989-2008). This is the first stork's-bill observation for this site, for both above ground populations and seedbanks. Stork's-bill was found in one NT (12 plants m^{-2}) and two CP (2 plants m^{-2}) plots. We hypothesize that the stork's-bill seed may have originated from red clover seed used in the previous year to improve the forage stand. Hemp-nettle density (pre-weed control) averaged zero in MP and CP treatments but reached 25 plants m^{-2} in the NT-GM system and 3 plants m^{-2} in the NT-PF system. In the early years of the study (1989-1996), hemp-nettle density (post-weed control) ranged between 2-5 plants m^{-2} but somewhat greater densities were occasionally observed in MP (23 plants m^{-2}) or CP (17 plants m^{-2}) plots. Hemp-nettle seedbanks averaged 100 seed m^{-2} between 1989 and 1996, regardless of tillage. By 2006, hemp-nettle seedbanks had dropped to 19 (MP) and 5 (CP and NT) seed m^{-2}. The presence of hemp-nettle in the 2009 NT plots is attributed to the disturbance caused by the Hiniker cultivator used at seeding to ensure proper seed placement. This confirms the role of tillage in stimulating hemp-nettle emergence and the persistence (10-15 years) of its seedbank.

[75] *Berteroa incana* (hoary alyssum) soil seed banks and the influence of temperature on its seed germination behaviour. Madani, H., Stopps, G., and Upadhyaya, M.K., University of British Columbia, Vancouver, BC

Berteroa incana (hoary alyssum), a rangeland weed of BC, is a prolific seed producer. Knowledge of spatial and temporal dynamics of seed banks and factors affecting them is essential to understand the persistence strategy of this weed. Little information on distribution of B. incana seeds in the soil profile, seed dormancy, and modification of germination behaviour by climatic factors is available. The distribution of B. incana seeds in the soil profile, its seed dormancy, and the influence of temperature on seed germination and seedling growth were investigated. Distribution of seeds in the soil profile was studied by taking 15 soil cores (10 cm diam, 10 cm deep) and estimating the size of the soil seed bank. Effects of temperature on seed germination and seedling growth and of dry heat on seed viability were studied in Petri dish assays. B. incana seeds showed little primary dormancy, 94% of the seeds in soil banks were present in the top 4 cm of the soil profile, the estimated size of the seed bank ranged from 0-123.5 million seeds/ha, seeds did not exhibit long-term dormancy, 30 C was the optimal temperature for germination, germination did not occur at 40 C and above, exposure to dry heat (80 or 90 C) for 8 hr significantly reduced seed germination at 25 C, and radicle and epicotyl growth was almost completely inhibited at 40 C. The maximum epicotyl length attained in the darkness (approx. 1.9 cm) suggests that seedlings from seeds

buried below 2 cm may not emerge. While 1 to 3 d of anaerobiosis delayed seed germination (by ~1 d) upon their subsequent incubation in Petri dishes at 25 C, it did not induce dormancy. A 5-d anaerobiosis reduced germination by 47 %. Of the seeds that did not germinate, 19 % were dead and 28 percent alive (tetrazolium test) and presumably dormant. A 10-d anaerobiosis killed 97% of seeds; 3 % of seeds were alive, possibly dormant.

[76] Kudzu (*Pueraria montana* var. *lobata*): Now present in Canada. Nurse, R.E.[1], Darbyshire, S.J.[2], Cowbrough, M.[3], Tenuta, A.[4], Callow, K.[4] and Simard, M.-J.[5] Agriculture and Agri-Food Canada, [1]Harrow, ON; [2]Ottawa, ON; [3]OMAFRA, Guelph,ON; [4]OMAFRA Ridgetown, ON; and [5]Québec, QC

Pueraria monatana var. *lobata*, a member of the Fabaceae, is a vine native to southern Japan and southeast China. Kudzu was originally introduced into the United States in 1876 as a forage crop, but has also been used for erosion control. Climatic conditions in the southern United States facilitated its naturalization as a weed in the 1950s. It is now known to invade more than 3 million hectares in the United States. In 2009, the first known population of kudzu (0.3 ha) was identified in Canada along the shores of Lake Erie in Ontario. The Canadian population is estimated to be at least 8 years old; but the method of introduction remains unclear. Kudzu produces seed; however, percent viability is low. Therefore, the main mode of reproduction is considered to be through deeply buried rhizomes and rooting at the nodes of runners. Kudzu can quickly invade areas of native vegetation, largely due to its high growth rate, which has been estimated to be about 30cm of new vine growth per day. Generally kudzu is not a problem on disturbed agricultural land; however, runners have been observed invading an adjacent soybean field in Ontario. More importantly, it may serve as an additional host and reservoir for soybean rust. Several herbicides have been identified that provide excellent control (>95%) of this species, including glyphosate and aminopyralid. We present a biological description of kudzu along with important identification characteristics, to help increase the awareness of this species in Canada.

[77] The potential of *Phoma* sp. for control of kochia. Peng, G., McGregor, L., Laprairie, R., and James, B. Saskatoon Research Center, Agriculture and Agri-Food Canada, Saskatoon, SK

A fungal pathogen obtained from diseased kochia plants in Saskatchewan was highly efficacious against the weed in greenhouse trials. A crude granular formulation was made from fungus-colonized barley grains, and tested for weed control under field conditions. The formulation was applied at 0, 32, 64, and 128 g with weed seed into 3 furrows in a 0.5 × 0.5 m plot. In addition, the 64-g rate was applied along the seeding row as a post-emergent treatment when kochia plants were at the 2-3 leaf stage. The field trial was conducted twice in 2009. Weed emergence and plant fresh weight were assessed 21 d and 50 d after seeding, respectively. Overall, the highest application rate (128 g) showed the greatest efficacy, with an average of 87% fresh-weight reduction in two separate trials. At the 64-g rate, the pre-emergent treatment was consistently more efficacious than the post-emergent application. The impact of fungal formulation was more pronounced on plant fresh weight than on weed emergence, indicating continuous effect of the fungus on emerged kochia seedlings. Improvements on fungal formulation are required to make this treatment practical. Recent greenhouse tests showed that the rate of application could be reduced by 80% when a finer fungal granular formulation was used. At the highest rate, the formulation may reduce the growth of flax slightly while showing little negative impact on other field crop species.

[78] The potential of *Fusarium oxysporum* for control of chickweed. Peng, G., McGregor, L., Laprairie, R., and James, B. Saskatoon Research Center, Agriculture and Agri-Food Canada, Saskatoon, SK

An isolate of *Fusarium oxysporum*, obtained from a diseased chickweed plant in Saskatchewan, showed high efficacy of chickweed control in greenhouse conditions. A granular formulation was made from fungus-colonized barley grains, and evaluated for weed control under prairie field conditions. This fungal formulation was applied at 0, 32, 64, and 128 g with weed seed in 3 furrows in a 0.5 × 0.5 m plot. The 64-g rate was also applied along the seeding row as a post-emergent treatment when chickweed plants were at the 2-3 leaf stage. The field trial was conducted twice in 2009. Weed emergence and plant fresh weight were assessed 21 d and 50 d after seeding, respectively. Pre-emergent soil applications at a rate greater than 64 g reduced the emergence by 90%, and eventually the fresh weight by 80% when compared to untreated controls. Efficacy differences between the 128-g and 64-g rates of application were generally insignificant. At the 64-g rate, a pre-emergent application was consistently more effective than post-emergent applications. Improvements on fungal formulation are necessary to make this treatment more practical. At the highest rate, the formulation is also effective against redroot pigweed and Russian thistle while reduces the growth of flax, lentil, and turf grasses slightly.

[79] Acetolactate synthase (ALS) inhibitor resistance on the rise: Russian thistle and wild buckwheat HR biotypes. Warwick, S.I.[1], Beckie, H.J.[2], Sauder, C.[1] [1]Agriculture and Agri-Food Canada (AAFC), Ottawa, ON and [2]AAFC-Saskatoon, Saskatoon, SK

ALS inhibitor herbicide resistant weeds are the fastest growing class of herbicide resistant (HR) weeds, with 102 species reported worldwide. Canadian ALS inhibitor resistant biotypes of Russian thistle (*Salsola tragus* L.) and wild buckwheat (*Polygonum convolvulus* L.) were first reported in 1989 and 2007, respectively. The molecular basis for ALS-inhibitor resistance is unknown for Canadian populations of these species, and was determined in this study for one Alberta and two Saskatchewan HR Russian thistle populations and one wild buckwheat population from Alberta. HR plants survived spray application of the ALS-inhibitor herbicide thifensulfuron:tribenuron mixture in the greenhouse. All three HR Russian thistle populations were heterogeneous and contained both HR and HS individuals, whereas the wild buckwheat HR population was homogeneous HR. The molecular basis for resistance was determined by sequencing the ALS gene and/or conducting a TaqMan genotyping assay for single nucleotide polymorphism (SNP) for the Trp574Leu mutation. Two target-site mutations were observed in Russian thistle: Trp574Leu [554 individuals] and Pro197Glu [one individual], suggesting multiple-founding events for Russian thistle HR populations in western Canada. Segregation patterns among F1 and F2 progeny arrays of Russian thistle HR lines sprayed under greenhouse conditions varied; some segregated (i.e. had HR and HS progeny), whereas other lines were exclusively HR. In contrast, no molecular segregation of HR types, i.e. Trp574, Trp/Leu574 and Leu574, as would be expected in the progeny of a segregating heterozygote plant, was observed. Such lack of segregation likely reflects the polyploidy genome of Russian thistle. This study is the first to identify the mechanism of resistance in this species. One target-site mutation was observed in wild buckwheat: Trp574Leu [19 individuals], confirming the first global report of resistance in this weed. Future monitoring of resistance in wild buckwheat is warranted as it is the most abundant broadleaf weed in the prairies.

[80] Range expansion of kochia in North America under a changing climate. Weiss, R.M., Beckie, H.J., Leeson, J.Y., and Olfert, O. Agriculture and Agri-Food Canada, Saskatoon, SK

Global mean annual temperature is predicted to rise by 1.5 to 4 C by 2100, as a consequence of increased atmospheric levels of greenhouse gases such as CO2. Although elevated levels of CO2 generally increase the growth or competitive ability of C3 plants more than that of C4 plants, a concomitant warmer climate will likely offset this advantage or even result in the opposite effect. The range expansion of many weeds into higher latitudes may accelerate with global warming. High latitude limits of temperate annual species are primarily set by the accumulated heat units (degree days) during the growing season. In the Prairies, the growing season has increased by 1 to 4 days over the past 40 years. Kochia [Kochia scoparia (L.) Schrad.] is an invasive alien C4 weed commonly found in crop production systems and ruderal areas in semiarid to arid regions of North America. The range of kochia is expanding northward in the Prairies as indicated by weed surveys conducted from the 1970s to early 2000s. Most kochia populations are now ALS inhibitor-resistant; a pleiotropic effect of the

ALS mutation is germination at cooler soil temperatures, another factor that may favor its northerly range expansion. Moreover, ALS-inhibitor herbicide use is highest in the northern Prairies, thereby conferring a fitness or selective advantage for resistant relative to susceptible biotypes. Bioclimatic modeling is useful in assessing the impact of changes in climate on pest population distribution. In this study, we delineate the future suitability of specific prairie agroecosystems for self-sustaining kochia populations under selected climate-change scenarios, based on experimentally-derived or published biological and ecological data for the species. Model simulation results presented will provide advanced warning of the potential spread of this invasive weed into the Parkland region of the Prairies, allowing a wide window of opportunity for researchers to develop and producers to implement integrated best management practices to mitigate population expansion.

[81] Emergence timing and density impact intraspecific pollen-mediated gene flow between conspecific *Triticum aestivum* L. populations. Willenborg, C.J.[1], Brûlé-Babel, A.L.[2],Van Acker, R.C.[3] [1]Alberta Agriculture and Rural Development, University of Alberta, Edmonton, AB; [2]University of Manitoba, Winnipeg, MB; and [3]University of Guelph, Guelph, ON

The development of wheat genotypes with novel traits has raised concerns regarding the presence of volunteer wheat populations and the role they may play in facilitating transgene movement. Although research has demonstrated the potential for spatial isolation to reduce intraspecific pollen-mediated gene flow (PMGF) in wheat, spatial isolation is not possible where conspecific populations of volunteer wheat are present within wheat crops. Therefore, other mitigation measures will have to be employed to minimize gene flow between T. aestivum conspecifics in areas where they coexist. In this paper, we report the results of two field experiments designed to quantify PMGF between volunteer wheat populations and spring wheat crops. Field experiments and empirical modeling conducted between 2005 and 2006 revealed varying rates of PMGF between volunteer and cropped spring wheat that were dependent on volunteer and cropped wheat densities and emergence timing. Maximum observed PMGF was always less than 0.6% and did not exceed a 0.9% EU-labeling threshold in any case. The frequency of PMGF in spring wheat decreased exponentially from a high of 0.31% to a low of 0.0002% with increasing crop (receptor) plant population density, but showed no dependence on either crop genotype or height. A 125 growing degree day hybridization window was also identified that produced dramatic declines in PMGF from a high of 0.51% to a low of 0.0003%, and will serve to temporally isolate a given wheat crop from neighbouring transgenic crops or from volunteers growing within. Taken together, the results suggest that ensuring volunteers emerge greater than 50 GDD on either side of the crop could be a viable method to reduce PMGF between conspecific wheat populations, provided an adequate plant stand has been achieved in the spring wheat crop.

List of Authors