62nd Annual Meeting
November 25th-27th, 2008

62ième Réunion annuelle
25 au 27 novembre 2008

Fairmont Banff Springs Hotel

Banff

Alberta

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Canadian Weed Science Society
Société canadienne de malherbologie

Proceedings of the 2008 National Meeting

62nd Annual Meeting November 25th-27th, 2008 Fairmont Banff Springs Hotel, Banff, AB

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Short biographies of Plenary Session Speakers

"Politics and Public Perceptions of GMOs" by Simon Barber, Syngenta Seeds, London, Ontario

"Glyphosate Ecotoxicology - The Critical Importance of Real World Exposure Levels and Probabilities" by Dean G. Thompson, Canadian Forest Service, Natural Resources Canada, Sault St. Marie, Ontario (Research Scientist and Team Leader - Ecosystem Impacts Research Team
H.BSc.Biology (1980) Wilfrid Laurier University, MSc Environmental Biology (1983) University of Guelph, PhD Environmental Biology (1992) University of Guelph)

Dean G. Thompson joined the Canadian Forest Service in 1986 where he has since pursued research interests spanning fundamental and applied aspects of environmental chemistry, ecotoxicology and ecology as they relate to sustainable forest management and protection of ecological integrity. Supported by a cadre of excellent technical staff, graduate students and summer students, Dean's research program currently focuses on the environmental fate and ecotoxicology of pesticides in Canadian forests, understanding structure and function of wetlands as critical elements of healthy forest ecosystems and assessing the potential for native amphibians as unique indicators of environmental health at the terrestrial/aquatic interface. To date, Dean and co-workers have authored more than 60 peer-reviewed journal papers and book chapters and presented more than 100 oral and poster presentations to regional, national and international scientific conferences and workshops. Dean holds an adjunct professor in the Department of Environmental Biology, University of Guelph and in the Department of Biology at the University of New Brunswick – St. John. He is also an active member of the Society of Environmental Toxicology and Chemistry and Ecological Society of America. .

"An Industry Perspective on Product Development Hurdles" by Iain Kelly, Bayer CropScience, Raleigh, North Carolina

Product Safety Manager with Bayer CropScience, managing the cross-functional interactions necessary to produce a consolidated human health and environmental safety assessment for crop protection chemicals. Worked in the agrochemical industry for over 30 years, holding a variety of positions in residue chemistry, metabolism, environmental fate, ecotoxicology, regulatory affairs and risk assessment. Currently serving on several industry committees. Member of the ILSI steering committee for CARES (cumulative and aggregate risk evaluation system). Member of several CropLife America work groups dealing with ecological risk issues including the Environmental Risk Assessment Committee. Born in Glasgow, Scotland. Ph.D. in Biochemistry/Biophysics from Leeds University, England. Moved to the United States in 1986 and now a citizen.

"Climate Change and Weeds" by Barry Smit, University of Guelph, Guelph, Ontario

Dr Barry Smit is Professor of Geography and Canada Research Chair in Global Environmental Change/ at the University of Guelph. He explores the relationships between socio-economic systems and environmental change, notably climate change and agriculture. He has worked across Canada, in Asia, Africa, the Americas, the Pacific and the Arctic. He has advised international organizations including the FAO, federal departments, the Senate, several provincial governments and business

groups. His recent book is Farming in a Changing Climate. He is a member of Ontario's Expert Panel on Climate Change Adaptation and is a co-recipient of the 2007 Nobel Peace Prize for his role on the Intergovernmental Panel on Climate Change (IPCC).

"Are the Best Biofuel Crops Potential Invasive Species?" by Jacob Barney, University of California, Davis

Jacob received a BS in chemistry from the University of Kentucky, and an MS in weed science and a PhD in weed ecology from Cornell University. Jacob is currently a postdoctoral scholar at UC Davis where he leads a project on the invasive potential of biofuel crops. In general, Jacob is interested in the factors that lead to invasiveness in plants.

"Transgene Incorporation into Non-Target Species" by Rob Gulden, University of Manitoba, Winnipeg

-Grew up on family farms in Germany and Manitoba
-Undergraduate from Univ. of Manitoba (Plant Science)
-MSc, Univ. of Manitoba, Plant-microbe interactions (N-fixation in peas and soybean)
-Worked as research associate in plant physiology and agronomy at Univ. of Manitoba for 3 years
-PhD, Univ. of Saskatchewan, Weed Science (Seedbank ecology of volunteer canola)
-Post Doc, Univ. Of Guelph, Weed Science (Fate of plant transgenes in the soil environment, weed control and communities in Roundup Ready cropping systems)
-currently (Sept. 2007) Assistant Prof. Weed Science Univ. of Manitoba

"Urban Pesticide Use: Challenges & Problems" by Robin McLeod, The Coalition for a Healthy Calgary, Alberta

Robin McLeod is the current chair of the Coalition for a Healthy Calgary. Robin brings to the Coalition a wide variety of work experiences. With a background in Economics and Political Science from Queens University she went on to attain the Chartered Financial Analyst designation in 1986. As a CFA Robin worked for a number of investment firms and a private corporate finance company in Calgary for 10 years concentrating in the junior oil and gas segment of the oil industry. During child raising years she left the pressure cooker, suit environment of downtown Calgary for the ski slopes organizing fundraising ski races across Canada for cystic fibrosis under Ken Read, one of Canada's Crazy Canucks. A project at her childrens' elementary school lead to a job with Evergreen helping schools green their school grounds with native plants and outdoor learning experiences. In 2007 Robin was a runner-up for an Emerald Award in Alberta recognizing individual contribution to the environment and was awarded a Calgary Award for environmental achievement in Calgary. Robin currently works for the River Valleys Committee, Parks Foundation Calgary, and in whatever spare time is left is involved in environmental and community initiatives.

Short Biographies of Continuing Education Workshops Speakers

Session 1: Statistics by Rong-Cai Yang

Dr. Rong-Cai Yang is currently a Research Scientist with Agriculture Research Division, Alberta Agriculture and Rural Development (ARD). He has held this position since 1997. He has been responsible for providing a high-level advice and support in statistical design and analysis of research experiments conducted by ARD scientists and their partners in other research organizations. Dr. Yang is currently also holding a co-location appointment as ARD Professor of statistical genomics at the Department of Agricultural, Food and Nutritional Science, University of Alberta. His education includes a BSc degree in plant protection from Nanjing Agricultural University (China), a MSc degree in plant breeding for disease resistance and a PhD degree in statistical genetics both from the University of Saskatchewan.

Dr. Yang has maintained a very active research program in statistical genomics related to crop and animal improvement as well as population genetics. He has held a Natural Sciences and Engineering Research Council of Canada (NSERC) discovery grant since 1996. His current research interests and activities include: (i) the development of mixed-model methodology for studying genotype-environment interactions and evaluation of long-term crop variety trials in western Canada; (ii) population responses to climate change in crops and forest trees; (iii) population genetics of natural hybrids; (iv) modeling gene-gene and gene-environment interactions; and (v) the development of new statistical methods for the analyses of plant and animal genomic data, more specifically for the Alberta Bovine Genomics Program. Dr. Yang has published extensively in various research areas including statistical genetics and genomics, plant breeding, agronomy, population genetics and evolution. He has been an associate editor for Crop Science (2008-2010), and the journal statistician and an associate editor for Canadian Journal of Plant Science (2008-2010).

Session 2: "CSI for Weed Science" by Emile de Milliano and Keith Mills

Currently, **Emile de Milliano** is Manager of Agronomic Services (MAS) for Viterra in the Edmonton Market centres covering much of north central Alberta. Emile has over 25 years of crop advising experience with his origin in Alberta Agriculture in the early 80's before joining Westco Fertilizers and affiliated companies in 1996. Emile is a graduate of the University of Alberta and has always had a keen interest in all facets of crop production. He particularly enjoys in field crop diagnostics where solving the mystery is the challenge. Emile is a Certified Crop Advisor and has spent a number of years with the Prairie CCA Board and the International CCA exam policy and procedures committee.

Session 3: Biotech Primer by Judy Strommer

Judy Strommer will be the speaker at the Biotech Primer session for the Continuing Education Workshop on Tuesday afternoon. The focus of her work is fundamental molecular biological studies (genome organization and gene function).

Graduate Student Presentations

Wednesday, November 26, 2008

Estimation of genetic diversities among different feral alfalfa (*Medicago sativa* L.) populations occurring in Southern Manitoba, Canada using SSR markers. Bagavathiannan, M.V.[1], Julier, B.[2], Barre, P.[2], and Van Acker, R.C.[3 1]Department of Plant Science, University of Manitoba, Winnipeg, MB; [2]INRA, UR4 Unité de Recherche Pluridisciplinaire Prairies et Plantes Fourragères, Lusignan, France; [3]Department of Plant Agriculture, University of Guelph, Guelph, ON

Alfalfa (*Medicago sativa* L.) is an important forage crop in North America and apart from cultivated fields, alfalfa plants are also observed in road verges as feral populations. However, little information is available on the genetic nature and structure of these populations and such information will be helpful in the risk assessment of alfalfa containing novel traits. The primary objective of this experiment was to estimate the genetic differences among different feral and cultivated alfalfa populations. In total, about 750 individuals belonging to 23 populations (12 ferals and 11 cultivars) were subjected to DNA fingerprinting using seven neutral Simple Sequence Repeat (SSR) markers. Preliminary results revealed that all feral populations studied were at genetic equilibrium and act as real populations suggesting that the populations were persistent for long time allowing frequent allele exchange among the individuals. There were no genetic differences observed between feral alfalfa populations and alfalfa cultivars. This suggests that seed escaped from cultivated varieties have primarily contributed to the occurrence of feral populations. Adaptive selection may have occurred and this could be evaluated based on morphological differences among the populations. The level of strucutration among feral populations was low both within and among locations but higher levels of diversities were observed among the individuals within a feral population. These findings suggest that the likelihoods of extinction of escaped transgene(s) into the feral populations are remote.

Glyphosate and tillage system effects on fusarium head blight in wheat and barley. Bérubé, M.-E.[1], Vanasse, A.[1], Rioux, S.[2], Bourget, N.[2], Tremblay, G.[3], and Dion, Y.[3] [1]Department of Phytology, Laval University, Quebec City, QC, Canada, G1V 0A6; [2]Centre de recherche sur les grains, Quebec City, QC, Canada, G1P 3W8; [3]Centre de recherche sur les grains, Saint-Mathieu-de-Beloeil, QC (Corresponding author: anne.vanasse@fsaa.ulaval.ca)

Fusarium head blight (FHB) is an important disease of wheat and barley, particularly in the wet conditions of eastern Canada. The principal pathogen associated with FHB is *Fusarium graminearum*. This fungus produces deoxynivalenol (DON), a mycotoxin that makes the grain unfit for food or feed. In a recent survey conducted in eastern Saskatchewan, glyphosate application in the previous 18 months within minimum-till system was significantly associated with higher FHB levels in wheat. Our objectives were to determine the glyphosate effect, used on soybean as the previous crop, on the FHB incidence in wheat and barley under three different tillage systems: conventional-till, minimum-till and no-till and to characterize the inoculum production of *F. graminearum* and *F. avenaceum* emerging from soybeans residues that received glyphosate or another herbicide. Six field experiments (two species × three tillage systems) were conducted at two experimental stations, one in Quebec City area (Saint-Augustin-de-Desmaures) and the other in Montreal area (Saint-Mathieu-de-Beloeil). The first year, glyphosate or another herbicide was applied as main plot treatments on RoundUp Ready™ soybean. The following year, three wheat and three barley cultivars with a

distinct FHB resistance level were seeded in the main herbicide plots, constituting the subplots. Three Petri plates containing a *Fusarium*-selective medium were placed in each main plot. Two of them were facing the ground, into the canopy, in order to capture the spores coming from the residues, while the other one was facing the sky, above the canopy, in order to capture the spores coming from the air. Whatever the field experiments and locations, there were no herbicide × cultivar interactions, along with no significant effects of herbicide on DON content. In fact, there was no difference on DON content by using glyphosate or another herbicide on soybean as the previous crop. However, in most of the field experiments, there was a significant effect of cultivar on DON content. In barley, Oceanik was the least affected cultivar, while Perseis was the most affected. In wheat, AC Barrie was the least affected, and SS Fundy, the most affected. These results follow the FHB resistance levels known for each cultivar. There were higher DON contents in Saint-Mathieu, compared to Saint-Augustin, which can be explained by inoculum characterization in time. In fact, there are great differences between the two locations, regarding this data. In Saint-Augustin, *F. graminearum* appeared late in the season, after the critical period of infection of wheat and barley, which is during the flowering-heading period. However, in Saint-Mathieu, a constant presence of the fungus leaded to an important inoculum at this critical period. About *F. avenaceum*, it was more present in Saint-Augustin than in Saint-Mathieu. This species does not produce deoxynivalenol, which can also explain the lower DON contents in this location. Finally, except for a few days, the herbicide treatment did not seem to have a significant effect on the inoculum production of *F. graminearum* and *F. avenaceum*.

Why is early-season weed control important in maize (*Zea mays* (L.))? Page, E.R., Lee, E.A., Tollenaar, M.T., Lukens, L., and Swanton, C.J. Department of Plant Agriculture, University of Guelph, Guelph, ON

Weed competition in crops is a major challenge to crop production in North America. This competition has been regarded traditionally as a struggle for resources that limit plant growth and development. However, it has also been hypothesized that early detection of weeds through reflected light quality (i.e. the ratio of red to far-red light or R:FR) occurs prior to onset of resource competition and thus, may determine the onset and outcome of crop-weed competition. Our preliminary research on weed competition in maize (*Zea mays* L.) indicated that the rate of seedling biomass accumulation decreased as the time spent in a low R:FR environment increased. Moreover, transfer to low R:FR following a period of high R:FR (i.e., weed-addition) had little impact on biomass or leaf area accumulation. The objective of our current research was to quantify the impact of early weed competition on season-long biomass accumulation and crop yield. A maize hybrid was grown in a field hydroponics system under ambient and reduced R:FR conditions, simulating weed-free and weedy conditions, respectively. These light quality treatments were established by planting maize seeds in buckets surrounded by turface (a baked clay medium with ambient R:FR) or commercial sod (low R:FR), such that there was no below ground competition. When the treatments were removed at the 10 leaf-tip stage biomass accumulation in the low R:FR treatment had been reduced by 10 % and this difference was maintained through to silking. At maturity, kernel number in the low R:FR treatment was reduced by 6%, however this effect was offset by a 4% increase in thousand kernel weight, such that yield was only reduced by 2%. These results suggest that early shade avoidance in maize may come at a cost to kernel number per plant and thus, crop yield potential.

Wild oat (*Avena fatua*) seed banks: A product of past and present weed management Polziehn, K.B.[1] , Harker, K.N.[2] , O'Donovan, J.T.[2], Clayton, G.W.[3], and Hall, L.M.[1,4] [1]Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB.; [2]Agriculture and Agri-Food Canada (AAFC), Lacombe, AB.; [3]AAFC, Lethbridge, AB.; [4]Bio-Industrial Crops, Alberta Agriculture and Food, Edmonton, AB

The prevalence of wild oat throughout western Canada can be attributed in part to its persistent seed bank. An integrated approach to managing wild oat utilizes agronomic practices that provide long-term weed control through increased crop competitiveness and reduced herbicide use. The influence of short or tall barley cultivars, seeded at normal or double rates in either continuous barley or barley-canola-barley-pea rotation under quarter, half and full wild oat herbicide rates were assessed in 2006 and 2007 at Beaverlodge, Fort Vermilion and Lacombe, Alberta. In 2006, rotation treatments were seeded to canola, followed by barley in 2007. Cumulative effects of high management (diverse crop rotation, double seeding rate and tall barley cultivar) was contrasted with low management (continuous rotation, normal seeding rate and short barley cultivar). Wild oat seed banks were significantly different, particularly when quarter rates of herbicides were used. The 2006 and 2007 spring seed bank contained 88% less wild oat seeds under quarter herbicide rates in a high management compared to low management regime. For example, in 2006 and 2007, under low management and quarter herbicide rates, wild oat seed banks reached 3893 and 4123 seeds m^{-2}, respectively, but with the use of a full herbicide rate there were 124 and 121 seeds m^{-2}, respectively; however, the use of high management at quarter herbicide rates, seed banks were maintained at 483 and 482 seeds m^{-2}, respectively. Fall seed banks were considerably higher than spring seed banks, indicating a loss of viable seed over winter. Between fall of 2006 and spring of 2007, seed bank densities declined between 30 and 60% among quarter herbicide rate treatments, with greater decline under crop rotation treatments. Integrating agronomic practices that are economic and environmentally sustainable can be effectively used to reduce wild oat seed banks and subsequent wild oat populations.

Biological strategies of sheep sorrel (*Rumex acetosella* L.) under two blueberry management techniques. Kennedy, K., Boyd, N., Nams, V.O., and Olson, A.R. Department of Environmental Sciences, Nova Scotia Agricultural College, Truro, NS

Sheep sorrel (*Rumex acetosella* L.) is an invasive, dioecious, perennial weed of Nova Scotia's wild blueberry fields. Weeds compete with blueberries for space, nutrients, moisture, and light, which contribute to decreasing blueberry yields. Little research has been conducted on sheep sorrel biology and root morphology, thus the objective of this study was to determine how management modifies the biology of sheep sorrel with respect to root growth, biomass production, and seed production. The effects of $(NH_4)SO_2$ fertilizer (three levels: 0, 20, 40 kg N/ha; applied as a 14-18-10 mix) and Velpar (hexazinone) (two levels: presence/absence) on sheep sorrel growth were investigated. The experiment was conducted at four different sites with the whole plant harvest conducted at three sites. Treatment effects on root length differed at all three sites. For Site 1 neither Velpar nor fertilizer had an effect on root length. At Site 2 fertilizer produced a non-linear effect on mean total root length, producing a root system of 87 cm with 20 kg N/ha. At Site 3, Velpar decreased mean total root length of sheep sorrel plants, producing root lengths of 0.85cm, compared to 74cm for plots not

treated with Velpar. Total biomass of sheep sorrel plants was affected at only one site (Site 4), where Velpar significantly decreased biomass. Seed head collections were conducted at all four sites to determine treatment effects on seed production. An interaction between Velpar and fertilizer was observed at Site 4 on the number of seeds produced per shoot. The largest number of seeds per shoot was 231 seeds for the No Velpar +40 kg N/ha treatment combination, while 0 seeds per shoot was produced in all Velpar-treated plots for all fertility levels. The effects of Velpar and fertilizer on sheep sorrel root growth, biomass production, and seed production vary across sites.

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] Dep. of Plant Sciences, Univ. of Saskatchewan, Saskatoon, SK, [2] Crop Development Center, Univ. of Saskatchewan, Saskatoon, SK

Wild oat (*Avena fatua* L.*)* is one of the most troublesome weeds in oat cultivation due to its difficulty to control using herbicides. Genotypic variation in oat cultivars can be used as a potential strategy to suppress the wild oat competition. Nine oat lines generated from a cross of the forage oat CDC Bell and the semi-dwarf oat, Ronald were evaluated for the competitive ability with wild oat. The lines were grown with and without wild oat at 250plants m^{-2} at two locations in 2008. Crop emergence, plant height, shoot biomass, and grain yield data were recorded. According to the preliminary data analysis the selected cop genotypes shows a significant ($P =<0.05$) difference in plant height among the genotypes. Also there was a significant variation among grain yields among all the treatments. Therefore from these preliminary studies there may be variation in competitive ability between selected oat genotypes.

Potential introgression of transgenic flax with wild and weedy relatives in Canada. Jhala, A.J.[1], Hall, J.C.[2], and Hall, L.M.[1] [1]Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB, Canada; [2]Department of Biological Sciences, Biological Sciences Center, University of Alberta, Edmonton, AB

Genetically engineered flax is in the process of development for various input and output traits in Canada and in other parts of the world. Canada has a science based system for regulating plants with novel traits (PNTs) and any novel cultivar of flax is subject to environmental risk assessment before its unconfined release in environment. One concern about the commercial release of transgenic flax is the movement of transgenes in the environment through hybridization and introgression with weedy and wild relatives. A meta-analysis was conducted to predict the transgene introgression from transgenic flax to wild and weedy relatives in Canada. The taxonomy and phylogeny, occurrence, cytogenetics and interspecific hybridization of flax and its closely related species was reviewed. The genus *Linum* contains approximately 230 species which are distributed in many parts of the world, however only eight species of *Linum* has been reported to occur in six provinces of Canada. The Canadian Prairie is the largest flax growing region in the world, and three closely related species of flax (*L. lewisii, L. rigidum* and *L. sulcatum*) are found in this region. Two of them, *L. rigidum* and *L. sulcatum* have the same chromosome number as cultivated flax (n=15). While interspecific hybridization has not been documented for these species, hybridization of flax with other n=15 species suggests outcrossing may occur. Further research is required on flowering time, preferred habitat, population density, and interspecific hybridization of these three species with transgenic flax

under the natural agro-ecosystem in Canada.

Response to light quality as a competitive mechanism: biomass partitioning associated with shade avoidance characteristics in *Glycine max* L. Merr. (Soybean) Error! Reference source not found., E., Lee, E.A., Lukens, L., Rajcan, I., Tollenaar, M., and Swanton, C. J., Department of Plant Agriculture, University of Guelph, Guelph, ON

It has recently been proposed that plants can detect surrounding plants by perceiving differences in light quality or red: far-red (R: FR ratio). Research has yet to link the reduced light quality of weedy environments to the shade avoidance response as a mechanism of competition in crops. Shade avoidance responses, such as stem elongation, altered flowering time, and increased apical dominance allow for successful reproduction in natural systems. In agricultural systems, these mechanisms are proposed to give crops a competitive advantage over weeds. Whether this competitive response affects reproductive fitness (yield), or above and below ground resource partitioning, remains unknown. We hypothesize that soybean plants will initiate shade avoidance as a competitive response due to changes in light quality when weeds are present. As a result, biomass allocation may be altered, at a potential cost to reproductive fitness. To address these hypotheses, field experiments were conducted in 2007 and 2008 at the Arkell Research Station, where soybean plants were grown using a fertigation system, in two light quality environments: (1) High R: FR and (2) Low R: FR representing weed-free and weedy conditions respectively. Soybean plants grown in weedy conditions were planted with turfgrass (a weed simulator). To prevent direct competition for light water and nutrients, soybean plants were not shaded, and root systems of soybean plants and turfgrass were self-contained. Within this design, the effects of light as an indirect competitive variable were isolated, and the impact of high and low R: FR ratios were examined on: (1) total height, internode elongation and stage of development, (2) biomass partitioning measured through a sequential harvest, and (3) yield components. At early developmental stages, in the presence of weedy competitors, soybean plants had greater total height, hypocotyl and epicotyl elongation, leaf area and stem biomass compared to soybean plants grown in weed-free conditions. At later developmental stages, soybean plants grown in the presence of weeds were developmentally delayed by 0.5-2 trifoliate stages, while soybean plants grown in weed-free conditions had greater total height, leaf area, and stem biomass. Root biomass of soybean plants grown in weed-free conditions was consistently greater than that of soybean plants grown in weedy conditions throughout the duration of the life cycle. These results provide insight to the mechanisms of weed induced yield losses and shade avoidance as a competitive response in agricultural systems.

Generation and genotypic effects on volunteer *Brassica napus* (Canola) population dynamics.
Seerey, N.J., and Shirtliffe, S.J. Department of Plant Science, University of Saskatchewan, Saskatoon, SK

Population dynamics of volunteer canola are largely dependent on the fecundity of volunteers, as affected by traits such as male sterility, seed size and seed production. These traits are used in the production of hybrid seed, and thus will segregate producing new unknown phenotypes as the volunteer generations proceed. The amount of seed produced by a single canola plant in a canola field is known to be variable, but that amount of seed a volunteer canola plant can produce in competition with wheat is unknown. The objective of this study is how generation and genotype

affect fecundity and other traits related to fitness in volunteer canola. Three consecutive generations of two hybrid cultivars and 1 open pollinated cultivar of canola were grown in a competitive stand of wheat in 2007 and 2008. Each plant was individually hand harvested and seed number, height, flowering characteristics and plant biomass were recorded. Preliminary analysis indicates that the number of seeds produced varied across generation, genotype, location, and year. Hybrid F1 seed was able to produce more seeds per plant in 2008 than F2 and F3 populations. Plants exhibiting a male sterile phenotype produced less seeds than fully fertile plants. Seeds size was consistent across locations, and years. F1 hybrids were able to produce larger plants, with many more pods and seeds than the F2 and F3 generations. Male sterility and the ability to produce large amounts of seed appear to be reduced in subsequent generations of hybrid canola populations.

Row *vs* inter-row weed seedling infestations in corn as detected by image analysis. Longchamps, L.[1], Panneton, B.[2], Brouillard, M.[2], Simard, M.-J.[3], and Leroux, G.D.[1] [1]Department of phytology, Laval University, Quebec, QC; [2]Agriculture and Agri-Food Canada (AACF), St-Jean-sur-Richelieu, QC; [3]AACF, St-Foy, QC

Weeds do not occur uniformly or randomly in crop fields, but rather they form patches. This opens the possibility of herbicide savings using spot spraying. To achieve spot spraying, proper weed mapping should be performed using appropriate sampling strategies based on some knowledge of the spatial distribution of weeds. To study the spatial distribution of weeds in corn fields, nine 1-hectare field sections located in different commercial corn fields of Quebec were exhaustively photographed (image size: 3 m x 2 m; precision: *ca* 1 pixel / mm^2) at the 3-5 leaf stage of corn. The weed infestation data of each photo was extrapolated from the inter-rows (corn free areas). Valid data will result from this procedure only if infestations between corn rows do not differ from the ones on the rows. To verify this hypothesis, a sample was extracted from 20 % of the photographs. Samples consisted of a narrow band (750 mm wide by 3 mm high) with its center exactly on the row, covering three regions: inter-row, corn row and inter-row compacted by the tractor wheel at seeding. When comparing these three regions, it appeared clearly that inter-rows were about 40% less infested than the corn rows or the wheel-compacted inter-rows. Same conclusion was reached when examining data sets from fields planted to soybean using a cereal seeder from which, one out of two seeding units was left empty at planting. In the middle of each inter-row, where the press wheel of the empty seeding unit passed, there were more weed seedlings than where in inter-row with no passage of the seeders. In conclusion, there is more weed emergence on both the crop row and the inter-row where the tractor wheels rolled possibly because the slight compaction promoted weed germination. Our weed infestation detection procedure will be revised.

Effects of reduced rates of glyphosate and glufosinate on weed seedbank in corn and soybean rotation. Rouane, S.[1], Leroux, G.D.[1], and Simard, M.-J.[2] [1]Département de phytologie, Université Laval, Québec, QC; [2] Agriculture et Agri-Food Canada, Québec, QC

The introduction of glyphosate and glufosinate-tolerant crops has increased the use of these herbicides in corn and soybean. In order to prevent herbicide resistance, these two herbicides could be used alternately. Additionally, lower than labelled rates of glyphosate and glufosinate could be used to lower herbicide treatment cost and environmental impact. However, the effect of reduced rates on weed seedbanks has not been evaluated and important increases in weed seed density could

preclude the long term use of reduced rates. Field studies were conducted using reduced rates of glyphosate and glufosinate to evaluate if, and how, reduced rates of these herbicides would increase the weed seed bank in transgenic corn-soybean rotations. The factorial experiment included: 2 herbicides, 4 herbicide rates (0X, 1/2 X, 3/4X and 1X), 8 (2-yr) rotations and 4 replicates. The seedbank was evaluated by washing and fine sieving samples to remove most of the soil (seed separation) and allowing the seeds to geminate and emerge in a growth chamber (seedling emergence) on a very thin layer of soil. These concentrated samples were allowed to germinate during two 42-day periods at alternating temperature (day/night: 22°C-36°C/15°C – 15h/9h). Seed viability tests indicated 74 to 91% of viable seeds emerged. After two years of reduced rates, total weed seed density significantly increased (P<0,05) in the 1/2 X and 3/4X treatments compared to the full herbicide rate. This was observed for both herbicides and all rotations.

Determination of Sulfonylurea herbicide residues in wetland sediments using LC/MS/MS. Xu, D.[1], Cessna, A.J.[2], Raina, R.[3], Farenhorst, A[4], and Pennock, D.J.[1] [1] University of Saskatchewan, 51 Campus Drive, Saskatoon, SK; [2] Environment Canada, 11 Innovation Boulevard, Saskatoon, SK; [3] University of Regina, 3737 Wascana Parkway, Regina, SK; [4] University of Manitoba, 362 Ellis Building, Winnipeg MB

A multi-residue analysis method was developed for quantifying seven sulfonylurea herbicides including: nicosulfuron, thifensulfuron-methyl, metsulfuron-methyl, ethametsulfuron-methyl, rimsulfuron, tribenuron-methyl and sulfosulfuron. Analyates were extracted from wetland sediment samples with deionized water using accelerated solvent extraction. Extract clean up was done using solid phase extraction with Oasis HLB extraction cartridge. Determination and quantification were performed using liquid chromatography positive ion electrospray tandem mass spectrometry with selective reaction monitoring. Limit of detection ranged between 1.0 - 2.0 ppb for the seven sulfonylurea herbicides. This method was used to quantify sulfonylurea herbicide residues in sediments collected from 17 wetlands in St. Denis, Saskatchewan and Brandon, Manitoba. The 17 wetlands were selected based on the land use in the catchment area as well as the riparian characteristics. The concentrations of herbicides detected ranged from 0 to 17.9 ppb, although most detected herbicide residues were in the sub ppb range, all of the wetlands confirmed the detections of one or more of the seven sulfonylurea herbicides analyzed. Ethametsulfuron-methyl, sulfosulfuron and nicosulfuron were more frequently detected in the sediment. Based on the results of this study, the herbicide contamination in these wetlands likely came from atmospheric deposition and/or snowmelt runoff.

Volunteer Wheat (*Triticum aestivum* L.) competition and control in no-till corn (*Zea mays* L.). Wilson, G.C., Swanton, C.J., and Sikkema, P.H. Department of Plant Agriculture, University of Guelph, Guelph, ON

Volunteer crops can significantly reduce crop quality and yield. This can be the result of competition during crop development or grain contamination at harvest. There is little research showing the impact of volunteer wheat on corn yields, or how to control the volunteers in crop. The objectives of this study were to determine the threshold level of volunteer wheat in corn and to determine the best herbicide option and application timing for control. To examine the morphological impact of volunteer wheat on corn, eight field trials were conducted in 2006 and 2007. Populations ranging

from 1 to 20 plants/m^2 were seeded late in the fall prior to planting corn. The results showed that plant development and yield were reduced by very low populations of volunteer wheat and the affect was amplified with increasing populations. Seven field experiments were conducted to evaluate the performance of four acetolactate synthase (ALS)-inhibiting herbicides using registered rates. The treatments were applied at 1 and 3 leaf corn. Four cereal cultivars were seeded late in the fall, and were well established when the corn was planted. Results showed the earlier application timing was the most effective. Hard red winter wheat and fall rye were the most and least controlled cultivars, respectively. Herbicide treatments also differed in their performance. Foramsulfuron was the more efficacious treatment. To optimize yield, it is critical to understand the effect weed populations can have on crops. Based on this study, volunteer wheat can have a significant impact if not managed properly.

The occurrence and persistence of volunteer flax (*Linum usitatissimum* L.*)* in twenty Alberta fields. Dexter, J.E. and Hall, L.M. *, * Graduate Student, Associate Professor, Agricultural, Food and Nutritional Science, 410 Agriculture/Forestry Centre, University of Alberta, Edmonton, AB, Email: linda.hall@afhe.ualberta.ca

Flax is an oilseed crop currently being developed as a transgenic crop for bioproducts. Prior to its release in Canada quantification of gene flow, including seed- and volunteer-mediate gene flow is required. In western Canada, little is known about the persistence of volunteer flax in commercial agricultural fields. The objectives of this study were to quantify the frequency and persistence of volunteer flax in Alberta by surveying 20 fields for three years following a commercial flax crop grown in 2004 and to determine the effects of cropping system (tillage and crop type) on average volunteer flax densities. Volunteer flax plants were quantified in 0.25 m^{-2} quadrats every 25 m along an inverted-W pattern across the field five times during the growing season. Cropping system did not significantly affect volunteer density except in a few sampling periods. Volunteer flax plants were found in 100% of the fields surveyed in 2005 with average densities ranging from 0 to 102.6 plants m^{-2} before seeding to 0 to 11 plants m^{-2} post harvest. The average growth stage of observed volunteer flax plants in surveyed fields in 2005 ranged from growth stage 1 (cotyledon) to stage 5 (stem extension) and few plants set seed. Volunteer flax densities declined in the years after 2005 when similar survey periods were compared and were identified in only 15% and 0% of surveyed fields post-harvest in 2006 and 2007, respectively. In 2006 and 2007, volunteer flax was observed in the reproductive stages of growth (stages 7 and 9) after in-crop herbicide application suggesting that uncontrolled densities of volunteer flax may contribute to pollen- and seed-mediated gene flow in the environment. Volunteer flax may be effectively controlled in rotational commodity crops; however, it may persist for up to three years and contribute to temporal gene flow.

Development of flowering synchrony indices for volunteer and crop canola (*Brassica napus* L.) to measure density and planting date interactions. Sable, B.T. [1], and Van Acker, R.C.[2]
[1]Department of Plant Science, University of Manitoba, Winnipeg, MB; [2]Department of Plant Agriculture, University of Guelph, Guelph, ON

Flowering synchrony is frequently identified as a precursor for pollen-mediated gene flow but there is limited information on the factors that could potentially increase or decrease synchronization. In addition, previous studies measure synchrony based on overlap flowering days between populations.

These approaches are inadequate when analyzing flowering synchrony in the context of volunteer to crop gene flow in canola since it does not take into account directionality, flower abundance of gene source and pollen receptors, and timing of three main flowering phases. There is a need for a robust method to estimate flowering synchrony that includes these three factors especially in crops like canola that exhibit a mass-flowering pattern and indeterminate flower development. This study aims to: (1) develop robust estimates of flowering synchrony that take into account directionality, flowering abundance, duration overlap at the three flowering phases; and, (2) apply these indices to elucidate the effects of volunteer density, volunteer emergence dates, and crop planting date on flowering phenology of volunteer and crop canola relative to each other. Results show significant interactions among the three factors. Information from this study can contribute to the formulation of non-invasive and inexpensive weed management options to reduce genetic exchange between volunteers and crops, and facilitate identity preservation of seed lots.

Symposium Session Agenda
Soybean, Corn and Edible Beans Section - 2008 Oral Presentations
Wednesday, November 26th

Flumioxazin for control of broadleaf and grass weeds in soybean. Rieckenberg, R., Valent Canada Crop and Professional Products, Guelph, ON

Flumioxazin is a Group 14 herbicide that provides preemergence control of selected grass and broadleaf weeds by inhibiting the enzyme protoporphyrinogen oxidase (PPO). Flumioxazin has been registered and marketed on soybeans in the U.S. since 2001 and has been evaluated in Canada since 2004. Soybean trials in 2008 focused on evaluating the efficacy and crop tolerance of herbicide combinations of 71.4 gai/ha of flumioxazin with imazethapyr, imazethapyr + metribuzin, s-metolachlor/benoxacor + metribuzin, flumetsulam/metolachlor, and imazethapyr + pendimethalin. Treatments were applied at or just after planting on minimum tillage and no-till sites (with glyphosate) and on conventional tillage sites (without glyphosate). Most of the combinations provided excellent weed control of small-seed broadleaf weeds. Combinations with imazethapyr + pendimethalin gave good control of grass weeds as well. Crop response (stunting) was observed with combinations that included s-metolachlor, but only on the conventional tillage sites.

KIXOR for weed control in a corn, soybean and wheat rotation. Kraus, T.E., Wilson, G. and Bakker, M.. 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. Research trials were conducted between 2004 and 2008 in Eastern Canada and the United States. Kixor applied at 25gai/ha enhanced the speed and spectrum of weed burndown when tank mixed with glyphoste at 900gai/ha. The tank mix of Kixor and glyphosate can be safely be applied prior to planting cereal, soybean or corn crops. In corn, Kixor applied at rates up to 100gai/ha provided long term broadleaf residual control. Multiple application timings in corn, including early pre-plant, pre-plant incorporated and preemergence were tested. This research demonstrates that Kixor is a safe and effective herbicide that provides excellent control of a diverse spectrum of broadleaf weeds in corn, soybeans and wheat.

How long can various herbicides remain in the spray tank prior to application in the field? Nurse, R.E.[1]; and Sikkema, P.H.[2] [1]Agriculture and Agri-Food Canada (AAFC), Harrow, ON; [2] Ridgetown Campus, University of Guelph, Ridgetown, ON

Ten field trials were conducted at two locations in Southwestern Ontario between 2006 and 2008 to determine the length of time herbicides can remain in the spray tank prior to application in the field without impacting efficacy. Four preemergence and five postemergence herbicides were mixed at their labeled rates and then applied in field corn following label specifications. Herbicides were either applied immediately, or after being left for 1, 3 or 7 days in the spray tank. The most common

weed species in the trials were *Abutilon theophrasti*, *Amaranthus retroflexus*, *Ambrosia artemisiifolia*, and *Chenopodium album*. Delaying herbicide application did not affect the efficacy of postemergence herbicides in this study. Similarly, control of *A. retroflexus* and *C. album* was not affected by a delay in the application of preemergence herbicides. However, control of *A. theophrasti* was decreased when isoxaflutole + atrazine, dimethenamid + dicamba/atrazine, or rimsulfuron + s-metolachlor + dicamba applications were delayed by more than 1 day. Nonetheless, there were no decreases in yield for any treatment combinations. These data provide valuable information which growers can use to make informed decisions on whether to apply herbicides in non-ideal weather or postpone application. The results of this study suggest that for most herbicides and weed species it is better to postpone application rather than make applications under non-ideal conditions.

Effect of time of day of application on herbicide efficacy in corn. Sikkema, P.H.[1], Soltani, N.[1], and Nurse, R.E.[2] [1]University of Guelph Ridgetown Campus, Ridgetown, ON; [2]Agriculture and Agri-Food Canada, Harrow, ON

Field trials were conducted from 2005 to 2007 at two locations in southwestern Ontario to investigate how the timing of herbicide applications throughout the day affects weed control in corn. Weed control following the application of six postemergence (POST) herbicides (atrazine, bromoxynil, dicamba/diflufenzopyr, glyphosate, glufosinate, and nicosulfuron) at 600, 900, 1200, 1500, 1800, 2100 and 2400 hours was assessed. For many weed species herbicide efficacy was reduced when applications were made at 600, 2100, 2400 hours. Velvetleaf was the most sensitive to the time of day effect, followed by common ragweed, common lambsquarters and redroot pigweed. Annual grasses were not as sensitive to application timing; however, control of barnyardgrass and green foxtail was reduced in some environments at 600 hours and after 2100 hours. Only in the most severe cases was the grain yield of corn reduced due to reduced weed control. Changes in air temperature, relative humidity and light intensity throughout the day that cause species-specific physiological changes may account for the variation in weed control throughout the day. The results of this research suggest that there is a strong species-specific influence of ambient air temperature, light intensity and leaf orientation on the efficacy of POST herbicides. It is hoped that the results of this research will aid growers to apply herbicides when they are most efficacious, thus reducing costs associated with weed escapes.

Weed management systems in Roundup Ready® Corn 2. Dilk, S.B., Neyedley, R.A. and Legassicke, B. Monsanto Canada Inc., Winnipeg, MB

The use of Roundup Ready Corn 2 in Eastern Canada has numerous benefits including weed control, crop safety and flexibility in application timing. Roundup® brand agricultural herbicide can be applied at the best time for optimal weed management whether pre-plant, post plant or in crop. Additionally, tank mixes with Roundup brand agricultural herbicides for use in Roundup Ready Corn 2 can enhance weed control and provides an opportunity for weed resistance management. However, the use of a preplant tank mix partner with residual properties at a reduced rate in combination with a post plant application of Roundup brand agricultural herbicide has not been evaluated. This trial was established in 2007 at 8 locations in Eastern Canada. Sites were identified where a variety of weeds were present. Evaluation ratings included % weed control at early and late timings, crop tolerance

and yield.

Products with residual properties were tank mixed at 50% of registered field application rates with Roundup brand agricultural herbicide and applied prior to seeding. The treatments were evaluated to determine if the residual tank mix partner could provide some short term residual control. This could allow for greater flexibility in Roundup brand agricultural herbicide postplant applications without sacrificing yield. Product tank mixes with Roundup brand agricultural herbicide included Frontier® + Atrazine, Prowl® + Atrazine, Converge® PRO, and Primextra® II Magnum®. Roundup brand agricultural herbicide as a single and sequential application was included as checks.

All of the product tank mixes provided better weed control versus a single application of Roundup brand agricultural herbicide and in some instances provided better weed control over sequential postplant applications of Roundup brand agricultural herbicide in Roundup Ready Corn 2. Trials have been continued in 2008 but data is not available to date.

Delay in soybeans planting resulting from the application of selective corn herbicides.
Mashhadi, H.R.[1], Sikkema, P.H.[2], Mesgaran, M.B.[1], Cowbrough, M.[2], Chandler, K.[3] and Swanton, C.J.[3] [1]University of Tehran, College of Agronomy and Plant Breeding, Karaj, Iran; [2]University of Guelph, Ridgetown Campus, Ridgetown, Ontario, Canada; [3]University of Guelph, Department of Plant Agriculture, Guelph, ON, Email: cswanton@uoguelph.ca

It is unknown what re-cropping options exist for growers who have applied a preemergence corn herbicide and due to exceptional circumstances have uneconomical stands of corn. In many situations it is too late to re-plant to corn since the growing season has advanced past the stage where corn will able to reach maturity. Soybeans would be an ideal substitute as they can be planted later in the season and still reach maturity. There is no information on the response to soybean to soil-applied corn herbicides in the same growing season. A three year study conducted over 3 locations in Ontario evaluated the impact of planting soybeans at 0, 14, 28 and 42 days after the application of five commonly used soil applied corn herbicides on soybean crop injury and grain yield. Soybeans planted at 14 days or more after the application of s-metholachlor/benoxacor/atrazine and the tank-mix of s-metolachlor/benoxacor/atrazine + mesotrione had grain yields that were equivlant to the control. Soybeans planted after the application of isoxaflutole+atrazine, rimsulfuron + s-metolachlor/beonxacor + dicamba and dimethanamid + dicamba/atrazine had grain yields significantly lower than the control but the yields generally improved as the time between application and planting increased. (**Key words:** Herbicide carryover, plant back, yield, and injury)

Soybean, Corn and Edible Beans Section
2008 Poster Presentations

Response of various market classes of dry beans to halosulfuron. Soltani, N., Shropshire, C., and Sikkema, P.H. Department of Plant Agriculture, University of Guelph Ridgetown Campus, Ridgetown, ON

Four field trials were conducted over a two-year period (2006, 2007) in Ontario to evaluate the tolerance of black, cranberry, kidney, otebo, pink, pinto, small red Mexican (SRM), and white bean to halosulfuron applied preplant incorporated (PPI), preemergence (PRE), and postemergence (POST) at 35 and 70 g ai/ha. There was minimal visible injury (< 1%) in dry bean with halosulfuron applied PPI and PRE. Halosulfuron applied post at 35 and 70 g ai/ha caused 2.7 to 4.7% and 3.8 to 7.5% visible injury in dry bean, respectively at 1 week after application (WAA). The injury was transient with no significant injury at 2 and 4 WAA. Halosulfuron applied PPI, PRE, and POST at 35 and 70 g ai/ha caused no decrease in plant height of the different market classes of dry bean except for kidney bean which was reduced by 4% at 35 and 70 g ai/ha. Halosulfuron applied PPI, PRE, and POST at 35 and 70 g ai/ha caused no decrease in yield of various market classes of dry bean except for yield of kidney bean which was reduced 9% at 35 g ai/ha and 8% at 70 g ai/ha and yield of otebo bean which was reduced 3% at 70 g ai/ha. Based on these results, there is an adequate margin of crop safety for halosulfuron applied PPI, PRE and POST in black, cranberry, pink, pinto, SRM and white bean in Ontario. However, further research is required to ascertain the tolerance of kidney and otebo bean to halosulfuron especially when applied POST and further research is needed to determine the tolerance of varieties within market classes of dry bean to halosulfuron.

Effect of reduced herbicide rates on weed control and yield of corn. Soltani, N., Van Eerd, L.L., Vyn, R.J., Shropshire, C., and Sikkema, P.H. University of Guelph Ridgetown Campus, Ridgetown, ON

A study was conducted over a 3-yr period (2003, 2004, and 2005) to evaluate the effect of reduced herbicide rates, 20, 40, 60, 80 and 100% of the manufacturer's recommended rate (MRR) on weed control, environmental impact (EI), yield and profitability of corn in Ontario. The herbicide rate required to provide 90% or greater control of velvetleaf, redroot pigweed, common ragweed, common lamb's-quarters and annual grasses was 60, 20, 60, 40, and 60% of the MRR for isoxaflutole plus atrazine, 100, 20, 40, 20, and 80% of the MRR for dimethenamid plus dicamba/atrazine, <100, 20, 60, 60, and 60% of the MRR for glufosinate plus atrazine, and 20, 20, 20, 20, and 40% of the MRR for nicosulfuron/rimsulfuron plus dicamba/diflufenzopyr, respectively. Yield of corn was not affected when isoxaflutole plus atrazine, dimethenamid plus dicamba/atrazine, glufosinate plus atrazine, or nicosulfuron/ rimsulfuron plus dicamba/diflufenzopyr were used at 20, 40, 60, 80 and 100% of the MRR. Nicosulfuron/rimsulfuron + dicamba/diflufenzopyr had the lowest EI. The results of regression analysis suggested that the MRR rates do not always maximize profit margins. In most cases profit margins was optimized by applying only 60% of the MRR.

Simulated mesotrione drift followed by glyphosate, imazethapyr, bentazon or chlorimuron in soybean. Brown, L.R.[1], Robinson, D.E.[1], Chandler, K.[2], Swanton, C.J.[2], and Sikkema, P.H.[1]**.** [1]University of Guelph Ridgetown Campus, Ridgetown, Ontario, Canada, N0P 2C0; [2]University of

Guelph, Department of Plant Agriculture, Guelph, ON

Six field experiments were conducted between 2005 to 2007 at Elora, Ridgetown, and Woodstock, Ontario in order to determine the effects of simulated mesotrione drift followed by in-crop applications of glyphosate, imazethapyr, bentazon and glyphosate plus chlorimuron on glyphosate-tolerant soybean [*Glycine max* (L.) Merr.] visual crop injury, plant height, density, dry weight, and yield. As the rate of simulated mesotrione drift increased, there was an increase in soybean injury and a decrease in dry weight, height, and yield. The application of the simulated mesotrione drift followed by bentazon resulted in synergistic responses in injury shortly after application in some environments. This increase in injury was transient, with no synergistic responses in density, dry weight, and yield. In contrast, antagonistic responses were observed when glyphosate, imazethapyr, or glyphosate plus chlorimuron were applied after simulated mesotrione drift in some environments.

Performance interactions between topramezone and ALS-inhibiting herbicides for the control of annual grasses. Kaastra, A.C.[1], Swanton, C.J.[1], Tardif, F.J.[1], and Sikkema, P.H.[2]. [1]University of Guelph, Department of Plant Agriculture, Guelph, Ontario, Canada, N1G 2W1; [2]University of Guelph Ridgetown Campus, Ridgetown, ON

There is little information available on performance interactions for tank mixtures of topramezone and ALS-inhibiting herbicides. Controlled-environment and field experiments were conducted in 2006 and 2007 to determine the interactions of topramezone when tank-mixed with ALS-inhibiting herbicides. Controlled-environment experiments were conducted on four annual grass species treated at the five- to six-leaf stage. Dose–response curves for large crabgrass, barnyardgrass, yellow foxtail, and green foxtail were generated for nicosulfuron or foramsulfuron alone and in combination with label rates of topramezone or mesotrione. Eight field experiments were conducted using registered rates of two HPPD-inhibiting and three ALS inhibiting herbicides alone and in combination. All herbicide treatments in the field were applied at the two- to three-leaf and five- to six-leaf stages of barnyardgrass, green foxtail, giant green foxtail, and witchgrass. In both the controlled environment and field experiments, antagonistic interactions were found to be species specific. In the controlled environment, nicosulfuron antagonized topramezone for the control of large crabgrass and barnyardgrass, but did not influence control of yellow or green foxtail. This antagonism was overcome with the addition of atrazine or an increased dose of nicosulfuron. Antagonism was not observed with tank mixtures of topramezone and foramsulfuron on the species tested under controlled-environment or field conditions. In the field, antagonism was not influenced by growth stage of the annual grasses. Antagonistic interactions were observed when topramezone was tank-mixed with nicosulfuron or nicosulfuron + rimsulfuron for the control of barnyardgrass and, to a lesser extent, giant green foxtail.

Kixor as an Atrazine replacement for BC Corn production. McMillan, G.A.[1], and Coukell, G.B.[2], [1]Integrated Crop Management Services, Inc.(ICMS), Abbotsford, BC; [2]ICMS, Portage la Prairie, MB

Atrazine, a major weed control product in corn production, was recently deregistered for use in British Columbia. As a result, growers are left with a major void in their weed control options for sweet corn production. Kixor® is a new herbicide is currently in the registration process for use in sweet corn production in Eastern Canada and crop tolerance data was needed to expand the registration into British Columbia. In 2008, two field trials were conducted with the objective to evaluate six corn cultivars used in fresh and commercial sweet corn production for tolerance to Kixor®, Dimethenamid-p and Kixor® + Dimethenamid-p tank mix. The treatments had no effect on stand counts an marketable yield of any cultivar when compared to a weed-free untreated control. The corn cultivars ‘Peaches and Cream’, ‘Sheba’, ‘Precocious’, Seneca Horizon’, ‘Synergy’ and ‘Jubilee Supersweet’ had excellent crop tolerance to a pre-emergent application timing of Kixor®, Dimethenamid-p and Kixor® + Dimethenamid-p.

Symposium Session Agenda
Weed Biology & Ecology/Invasive & Noxious Weeds Section
- 2008 Oral Presentations
Wednesday, November 26, 2008

Seed bank responses to restoration techniques in an invaded semi-desert plant community. Clements, D.R.. Biology and Environmental Studies, Trinity Western University, Langley, BC

Plant communities in the interior region of British Columbia have been heavily invaded by a number of weed species, such as diffuse knapweed, *Centaurea diffusa* Lam. and cheatgrass, *Bromus tectorum* L. Grassland ecosystems are vulnerable to these invasive plants whose spread and effects are exacerbated by livestock grazing. Restoration techniques may involve both management of these weeds and seeding native species. Therefore it is useful to know how native or non-native seed bank species respond to such restoration techniques. The present study was conducted at the Osoyoos Desert Centre, a facility near Osoyoos, BC designed to research restoration of the antelope bitterbrush ecosystem and showcase the ecosystem to visitors. I monitored changes in the seed banks for various restoration treatments at the site by taking three 10 x 2.3 cm soil cores from each of the 300 plots in both 1999 and 2002. Seeds were separated from the soil using a soil floatation method, and hand sorted and counted using a dissecting microscope. One restoration treatment was solarisation using clear plastic sheets. This treatment failed to eliminate *C. diffusa*. Seed bank densities of the native grass, sand dropseed, *Sporobolus cryptandrus* (Torr.) A. Gray actually increased 4-fold in solorised plots. Likewise, *S. cryptandrus* seed bank densities increased in response to many of the other restoration treatments, and tended to be one of the dominant seed bank species in the restoration treatments, making it a good candidate for restoration plantings. By contrast, *C. diffusa* and *B. tectorum* tended to decrease in response to restoration plantings, and exhibit lower germination rates. The implication is if seed banking native species can be promoted by restoration techniques, ecological resistance to invasion will be enhanced.

Weedinfo.ca - A searchable weed identification, biology, ecology and management database for Canada. Cowbrough, M.J. Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph, ON

Losing the knowledge accumulated by Canadian Weed Scientists over the past several decades would be intellectually devastating and wasteful of public monies. In an attempt to capture historical and real time information on weeds, a searchable database called weedinfo.ca was launched in January of 2008. The goal of this database is to be a national repository for weed photography, taxonomy, ecology and management. Weedinfo.ca was set up as a community database similar to wikipedia.org thus encouraging weed scientists from across the county to contribute and regionalize if needed. A spin-off of the weedinfo.ca database, called ontarioweeds.com has been used to test additional features, such as a “weed ID services” module. This regionalized spin-off currently attracts over 2000 individuals per month without any formal promotion.

Modeling ramet dynamics of *Cornus canadensis* and *Maianthemum canadense* in wild blueberry fields. White, S.N.[1], Boyd, N.S.[1], and Astatkie, T.[2] [1]Department of Environmental Sciences, Nova Scotia Agricultural College, P.O. Box 550, Truro, Nova Scotia, B2N 5B1; [2]Department of Engineering, Nova Scotia Agricultural College, P.O. Box 550, Truro, NS

Bunchberry and wild lily of the valley are common perennial weeds in wild blueberry fields. In 2006 and 2007, experiments were conducted to develop ramet dynamic models for both species. Emerging ramets were counted weekly in four 1 m^2 quadrats randomly placed in two fields in 2006 and four fields in 2007. Soil moisture, soil water potential, soil temperature and air temperature data were also collected. Wild lily of the valley ramet dynamics were adequately explained with a four-parameter loglinear nonlinear regression model. Bunchberry ramet dynamics were adequately explained with a three-parameter loglinear nonlinear regression model. Growing degree day was used as the x-variable in the model (T_{base} = 0, biofix = April 1). Hydrothermal time was also calculated but did not further account for differences in emergence observed between sites. Wild lily of the valley emerged around 150 GDD and rapidly reached peak emergence by approximately 300 GDD. Ramet survival was less than 50% by final counts at most sites. Bunchberry emerged between 150 and 200 GDD. Peak bunchberry emergence occurred earlier in the sprout year (626 GDD) than in the crop year (780 – 1775 GDD). Ramet survival was greater than 50% by final counts at most sites. Based on emergence models, it is unlikely that wild lily of the valley would compete with wild blueberries and control is deemed unnecessary. Bunchberry ramet populations peaked later in the season and ramet survival was greater, so competition from this species is more likely. Bunchberry should be controlled in wild blueberries.

Identification and distribution of barnyard grass (*Echinochloa crus-galli* and *E. muricata*) in the Prairie Provinces. Darbyshire, S.J.[1], Thomas, A.G.[2], and Leeson, J.Y.[2] [1]Agriculture and Agri-Food Canada, Ottawa, ON; [2]Agriculture and Agri-Food Canada, Saskatoon, SK

The grass genus *Echinochloa* consists of about 40-50 tropical and temperate species distributed world-wide. Some species are used as cereals or forages and several are important weeds. Barnyard grass has become increasingly prevalent in agricultural fields of the Prairie Provinces during the past 50 years. The taxonomy and identification of the barnyard grasses has been difficult and controversial. At least two annual species occur as weeds in arable fields; the Eurasian *Echinochloa crus-galli* and the native *E. muricata*. Although they are relatively easy to distinguish from other Canadian grass weeds by the absence of a ligule, both exhibit considerable morphological variation and are often confused or simply reported as a single species, *E. crus-galli*. The two species can be distinguished using characteristics of the mature fertile lemmas. In *E. crus-galli* the top of the body of the lemma is broadly rounded with an irregular row of hairs. The short acute tip is abruptly different in colour and texture from the body of the lemma. The top of the lemma in *E. muricata* gradually and smoothly tapers into a pointed tip, without a shape contrast in texture, colour or pubescence. An examination of about 100 plants collected in 2007-8 and about 200 herbarium specimens indicated that the Eurasian *E. crus-galli* is less common in the Prairie Provinces than the native *E. muricata*. The distribution of the species was found to overlap and the two species were occasionally identified at the same site. In order to understand any ecological differences that may be important in their effective management, it is critical to be able to recognize the differences between the species in research and control programs. Inconsistencies in reported behaviours and responses, within Canada and other parts of the world, may be at least in part due to the confusion of these two

species.

Woolly cupgrass (*Eriochloa villosa*): A new weed to watch for in corn and soybean.
Simard, M.-J. [1], Darbyshire, S.J. [2] and Nurse, R.E. [3] Agriculture and Agri-Food Canada, [1]Québec, QC, [2]Ottawa, ON, [3]Harrow, ON.

Eriochloa villosa (Thunb.) Kunth is an annual grass of East Asian origin that is now present in 11 U.S. states, particularly in corn production areas. It is not consistently controlled by herbicides and the economic impact of the species is important enough for Midwest states to develop specific *Eriochloa villosa* management systems. *Eriochloa villosa* was discovered in Canada for the first time in 2001 in Saint-Hyacinthe, QC. Its introduction to Canada was probably via seed commodities from the United States. An eradication program was initiated at the Saint-Hyachinthe site by MAPAQ (provincial ministry of agriculture) and CFIA in 2002. In 2005, the species was added to the Canadian Weed Seeds Order. By 2007/08 the species had spread to additional locations on the original farm and was discovered on two new farms located 29 and 65 km to the south. *Eriochloa villosa* has not been found in Canada outside of those three sites in Québec. The species is not easily distinguished from other common grass species at the seedling stage. However, mature plants are easily identified by their large seeds (about 4-5 mm) with a cup-like bract at the base. We present a description of woolly cup grass along with important identification characteristics at different stages, to help increase the awareness and proper identification of this new species.

New DuPont herbicide for weed control in pasture and rangeland, Forsyth, P.
E.I. du Pont Canada, Camrose, AB

Weed Control in Pasture and Rangeland situations can be limited by the lack of herbicide options. MAT28 is a new compound currently being developed by E.I. du Pont Canada Company for this use pattern. DPX-MAT28 has the ability to control many woody and herbaceous species. Woody species currently tested include aspen, poplar, willow and snowberry. Research has shown that numerous forbs and herbaceous species are controlled by this product. The list includes; dandelions, Canada thistle, leafy spurge, common tansy, pasture sage, kochia and scentless chamomile. DuPont's sulfonylureas are being tested in combinations with the new compound in order to further broaden the weed control spectrum. Seedling and cool seasoned grasses being used for forage production including timothy, fescues, bluegrasses and brome grasses show excellent tolerance to DPX-MAT28. All studies to date indicate that the product has a very favorable environmental fate and toxicology profile. In the future this product will be an additional option for Canadian producers to utilize when managing their forage production.

Weed Biology & Ecology/Invasive & Noxious Weeds Section
2008 Poster Presentations

Effect of cutting height on common ragweed (*Ambrosia artemisiifolia* L.) and redroot pigweed (*Amaranthus retroflexus* L.) regrowth. Benoit, D.L. Agriculture and Agri-Food Canada, Saint-Jean-sur-Richelieu, QC

Mowing is a weed control method which uses difference in phenological development and regrowth of weed species to achieve maximum damage to species difficult to control with minimal impact to other species. The aim of this research was to evaluate the effect of cutting height at early phenological stages of common ragweed (AMBEL) and redroot pigweed (AMARE) on their regrowth potential. The experiment was carried out under greenhouse and repeated in growth chambers. Pots filled with Pro-mix soil mixture were seeded with 10 seeds of each species, placed at 25 °C day and 15 °C night with a photoperiod of 16 hr day and 8 hr night. After emergence, seedlings were thinned to 6 seedlings per pot. Seedlings were cut at 5 different phenological stages (cotyledon, 2, 4, 6, and 8 leaves stage) and at various heights (below cotyledons (CS1), above cotyledons (CS2), 1st internode (CS3), 2nd internode (CS4), 3rd internode (CS5) and uncut control (T)). The treatments were completely randomized with 2 replicates. Plant height before and after cutting, cutting height, number of leaves and branches at 7 days intervals and aerial biomass 14 days after CS5 were recorded. Individuals grown in growth chambers were generally taller than those grown under winter greenhouse conditions regardless of phenological stage or species. The number of days to reach specific phenological stages was similar for individuals grown under greenhouse or growth chamber conditions and was consistent within species. AMARE had consistently a slower growth development rate than AMBEL. Cutting above the 1st internode (CS3) stimulated branching to a greater extent in AMBEL than in AMARE. More branching was stimulated when ragweed was cut at CS3 or higher. Based on these results it is extrapolated that cutting between CS2 and CS3 should be done at the 3 leaves stage of AMBEL and AMARE.

Occurrence of escaped alfalfa populations (*Medicago sativa* L.) along the road verges in southern Manitoba, Canada. Bagavathiannan, M.V.[1], Gulden, R.H.[1], and Van Acker, R.C.[2]
[1]Department of plant science, University of Manitoba, Winnipeg, MB; [2]Department of Plant Agriculture, University of Guelph, Guelph, ON

Alfalfa (*Medicago sativa* L.) is an important forage crop worldwide. Escaped alfalfa populations were commonly observed in road verges, field shoulders and other unmanaged habitats. However, little information is available on the nature and extent of these populations and such information will be useful in the risk assessment of alfalfa containing novel traits. A roadside survey was carried out in selected rural municipalities (Hanover, MacDonald and Springfield) in southern Manitoba to investigate the aspects of escaped alfalfa populations. The results revealed that escaped alfalfa plants were more prevalent in regions where alfalfa was widely cultivated and vice versa. This suggests that cultivation practices have a greater role in the occurrence of escaped alfalfa populations. On average, the nearest escaped population was located within about 87m (MacDonald), 210m (Hanover) and 328m (Springfield) from the cultivated alfalfa field, a distance that is sufficient for effecting cross-pollination in alfalfa. Flowering synchrony was observed with 25%, 32% and 37% of the hay production fields respectively in MacDonald, Hanover and Springfield and it was 100% with seed

production fields irrespective of the location. Escaped plants growing adjacent to the road shoulder were affected by mowing but the plants occurring at the field shoulder were not affected. As such, escaped populations can and will serve as genetic bridges for the movement of novel traits in the environment and will act as potential barriers for achieving co-existence of transgenic and non-transgenic alfalfa fields. Escaped populations should therefore be managed to prevent the movement and adventitious presence of novel traits in the environment.

Woolly cupgrass (*Eriochloa villosa*): A new weed to watch for in corn and soybean.

Simard, M.-J. [1], Darbyshire, S.J. [2] and Nurse, R.E. [3] Agriculture and Agri-Food Canada, [1]Québec, QC, [2]Ottawa, ON, [3]Harrow, ON

Eriochloa villosa (Thunb.) Kunth is an annual grass of East Asian origin that is now present in 11 U.S. states, particularly in corn production areas. It is not consistently controlled by herbicides and the economic impact of the species is important enough for Midwest states to develop specific *Eriochloa villosa* management systems. *Eriochloa villosa* was discovered in Canada for the first time in 2001 in Saint-Hyacinthe, QC. Its introduction to Canada was probably via seed commodities from the United States. An eradication program was initiated at the Saint-Hyachinthe site by MAPAQ (provincial ministry of agriculture) and CFIA in 2002. In 2005, the species was added to the Canadian Weed Seeds Order. By 2007/08 the species had spread to additional locations on the original farm and was discovered on two new farms located 29 and 65 km to the south. *Eriochloa villosa* is probably present elsewhere in Eastern Canada, but has yet to be properly identified. The species is not easily distinguished from other common grass species at the seedling stage. However, mature plants are easily identified by their large seeds (about 4-5 mm) with a cup-like bract at the base. We present a description of woolly cup grass along with important identification characteristics at different stages, to help increase the awareness and proper identification of this new species.

Session Agenda
Regulatory Issues/2008 Provincial Reports
Wednesday, November 26, 2008

Canadian Food Inspection Agency: Weed-Related Activities
Asbil, W, Gilmer, A. and Tibelius, C., Plant Health and Biosecurity Directorate, Canadian Food Inspection Agency, Ottawa, ON

An overview of the Canadian Food Inspection Agency's mandate and structure will be presented. Proposals for regulatory and policy change with respect to weeds in the Seeds, Invasive Plants and Grains and Oilseed sections will be discussed along with research needs required to support import, export and domestic phytosanitary policies. Updates on the *Weed Seeds Order* of the *Seeds Act and Regulations*, the Invasive Alien Species Strategy for Canada and on-going CFIA projects and initiatives will be provided.

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

The current Efficacy Guidelines for Plant Protection Products (DIR2003-04) are being revised. This document provides guidance to applicants regarding efficacy data requirements to register or amend the registration of pest control products used for plant protection in Canada, and guidance on the reporting of the Part 10 Value submission package, of which, efficacy is a component. The Pest Control Products Act (2002) broadened the definition of value. The revised guidelines are reflective of the broadened definition of value, and include updated information on presubmission consultation, level of control, social and economic impacts, efficacy extrapolation within crop/pest groupings, minor uses, tank mixes, adjuvants and spray volumes, as well as updated summary tables. The revised guidelines will be published for public comment in 2009.

Symposium Session Agenda
Cereals, Oilseeds and Pulses Section - 2008 Oral Presentations
Thursday, November 27th, 2008

Express® PRO – a new DuPont offering. Boddy, F., E.I. duPont Canada Company, MB

Express® PRO is a new offering from DuPont consisting of a physical blend of 7.5 g ai/ha tribenuron-methyl and 1.5 g ai/ha metsulfuron-methyl to be tank-mixed with glyphosate and applied pre-seed to cereals and in summerfallow applications. Advantages of tank-mixing Express® PRO with glyphosate include an increased level of efficacy on certain weed species and a period of residual control of dandelion, narrow-leaved hawk's-beard, cleavers and volunteer glyphosate tolerant canola. Express® PRO may be applied pre-seed to spring wheat, durum wheat, winter wheat, spring barley and oats. Express® PRO provides growers with recropping options to canola, peas and flax which can be planted 10 months after application with no restrictions on soil type or soil pH. Express® PRO will provide Western Canadian growers with a superior option for pre-seed to cereal and summerfallow weed control.

Thiencarbazone-methyl, a new herbicide active ingredient in Canada.
Veness, J. [1], Patzer, K.T.A. [1], and Steckler, M.K.[2*]. [1]Department of Research & Development, Bayer CropScience Canada, Calgary, AB., [2]Department of Research & Development, Bayer CropScience Canada, Saskatoon, SK

Thiencarbazone-methyl is a new ALS inhibitor labeled for use in spring and durum wheat in Western Canada. This new active ingredient will be formulated as an oil dispersion containing the active ingredient thiencarbazone-methyl combined with the Bayer CropScience safener mefenpyr-diethyl. Thiencarbazone-methyl will control a broad spectrum of weeds in spring and durum wheat with excellent crop safety. Thiencarbazone-methyl has a very favorable environmental and toxicological profile. It undergoes rapid microbial degradation in the soil, with a demonstrated half life of 18 - 36 days under field conditions. The rotational profile of thiencarbazone-methyl allows for recropping the following crops 10 months after application: spring, durum and winter wheat, barley, tame oats, corn, canaryseed, canola, mustard, flax, lentils, field peas, dry beans, soybeans, chickpeas, timothy and alfalfa. Thiencarbazone-methyl received registration eligibility in Canada on July 31, 2008.

Velocity M3 - a new cross spectrum cereal herbicide for Western Canada. Steckler, M.K.[1*], Patzer, K.T.A. [2], and Veness, J. [2 1]Department of Research & Development, Bayer CropScience Canada, Saskatoon, SK., [2]Department of Research & Development, Bayer CropScience Canada, Calgary, AB

Velocity M^3 combines the 2 newest herbicidal active ingredients from Bayer CropScience to provide very wide spectrum grass and broadleaf control in spring and durum wheat, while providing exceptional crop safety. Velocity M^3 brings together HPPD, ALS, and PSII inhibition chemistry to provide an excellent resistance management tool for broadleaf weeds that are resistant to existing modes of action. The combination of these active ingredients allows for a very flexible crop rotation

the year after application including spring and durum wheat, barley, oats, canary seed, canola, flax, peas, soybeans, alfalfa and field corn. Velocity M^3 is anticipated to be commercially available in the near future.

Postemergence broadleaf weed control with GF-184 herbicide in cereal crops in Canada. Juras, L. T., McGregor, W.R., Satchivi, N.M., Degenhardt, R.R., Turnbull, G.C., Hare, D.D., and Wintonyk, B.A., Dow AgroSciences Canada Inc., Calgary, AB

GF-184 is a new wide spectrum broadleaf cereal herbicide containing florasulam and fluroxypyr in a formulated mix. GF-184 applied alone at the proposed label rate of 102.5 g ai ha-1 provided consistent control of hard-to-control broadleaf weeds including: cleavers (Gallium spurium), wild buckwheat (Polygonum convolvulus); kochia (Kochia scoparia) including ALS-resistant biotypes, chickweed (Stellaria media); hempnettle (Galeopsis tetrahit), and volunteer flax (Linum usitatissimum). For additional broadleaf weed control GF-184 may be tankmixed with MCPA ester or 2,4-D ester at 350-420 g ae ha-1 . To include grassy weed control in a one-pass operation, GF-184 can be tankmixed with the following graminicides: pinoxaden (AxialTM); clodinafop-propargyl (HorizonTM); fenoxaprop-p-ethyl (Puma120 SuperTM); imazamethabenz (AssertTM); and flucarbazone-sodium (EverestTM). Spring wheat, durum wheat and barley from 3-leaf to stem elongation exhibited negligible crop injury when evaluated 1-2 weeks after herbicide application. GF-184-treated fields may be rotated to all commonly grown crops in western Canada including cereal crops, forage grasses, canola, flax, mustard, peas, beans, lentils, chickpeas, and alfalfa.

KIXOR: A new herbicide for broadleaf weed control in Chemfallow, and prior to seeding cereal and pulse crops. Oostlander, M, Forster, G., and Drew, L. , BASF Canada Inc., Missisauga, ON

Glyphosate is the most common pre-seed herbicide applied to control initial weed growth in a reduced tillage cropping system. With the increasing use of glyphosate tolerant crops (i.e., Roundup Ready canola), glyphosate alone is no longer sufficient to control all weed species. In addition, the level of control obtained from glyphosate at the relatively low use rates can be variable; therefore, a tank mix partner is often be added to increase the consistency and spectrum of control. The efficacy of a new developmental herbicide, KIXOR, was tested in combination with glyphosate as a pre-seed treatment prior to cereal and pulse crops, and as a chemfallow treatment. Trials were conducted from 2004 to 2008 in all the major ecozones of Western Canada, and across the cereal and pulse growing regions of the Western United States. KIXOR applied at rates from 18 to 50 g ai/ha, in combination with glyphosate, at 450g ai/ha provided excellent control of broadleaf weeds, including glyphosate tolerant species, in a preseed and chemfallow use pattern. KIXOR at the lower rate of 18 g/ha + glyphosate provided excellent control of all emerged broadleaf weeds. Increasing the rate to 50 g/ha provided control of emerged weeds plus the addition of residual activity on species such as wild mustard (*Sinapis arvensis*) and wild buckwheat (*Polygonum convolvulus*). Tolerance to KIXOR was assessed at rates from 18 to 100 g/ha over a wide range of climates and soil conditions. Cereals (spring wheat, durum wheat, barley, and oats) and pulse crops (field peas, chickpeas) showed excellent tolerance to KIXOR at rates up to 100 g/ha.

Kixor™ technology in Western Canada. Johnson, E.N., Blackshaw, R.E., Wolf, T.M., Caldwell,

B.C., Holm, F.A., and Sapsford, K.L. Agriculture and Agri-Food Canada, Scott, SK (Email: johnsone@agr.gc.ca)

Saflufenacil is a new Group 14 (ppo inhibitor) broadleaf herbicide that will be marketed as Kixor™ technology. Saflufenacil is applied as a pre-plant or pre-emergence partner with glyphosate to provide rapid burndown of glyphosate tolerant or resistant weeds. At higher rates, saflufenacil will provide residual control of certain broadleaf weed species. A number of efficacy and tolerance trials have been conducted by public institutions in Alberta and Saskatchewan. Chemical fallow trials have indicated that saflufenacil-glyphosate applications resulted in faster burndown of broadleaf species than glyphosate alone and glyphoste-florasulam and glyphosate-tribenuron methyl tank-mixes. Perennial weeds such as dandelion exhibited some re-growth from saflufenacil-glyphosate application, perhaps due to the rapid tissue desiccation inhibiting glyphosate translocation. Lentil (*Lens culinaris* L.) tolerance to pre-seed application of saflufenacil and residual weed control was rate dependent. Tank-mix combinations of saflufenacil and sulfentrazone were evaluated in chickpea (*Cicer arietinum* L.) to determine if saflufenacil could provide extended control of cruciferous weeds, which is a weakness of sulfentrazone. Results varied with excellent control of cruciferous weeds at Saskatoon, fair control at Scott, and poor control at Lethbridge. Application parameter studies were conducted at Scott and Saskatoon. Carrier volume and spray quality had no effect on kochia (*Kochia scoparia* L.) or volunteer canola (*Brassica napus* L.) control at Saskatoon. Carrier volume had more of an effect than spray quality on of kochia and volunteer canola control at Scott, with lower water volumes resulting in less control.

Weed community responses to small cereal cropping systems in the Northern Great Plains.

Menalled, F.D., Pollnac, F.W., Harbuck, K.S.B., and Maxwell, B.
Department of Land Resources and Environmental Science, Montana State University
Bozeman, MT (Email address: menalled@montana.edu)

Despite their yield, grain quality, and biodiversity maintenance implications, very little research has been conducted on weed communities in the northern Great Plains region of the United States. This study evaluated the effects of management systems on the weed aboveground and seedbank abundance, species composition, and species diversity in small grain production systems. Weed communities were sampled over two years in organic and conventional no-tillage spring wheat production fields in Montana, USA. Aboveground weed communities were characterized along three 100 m transects per field by measuring percentage weed cover by species in 100 1m by 0.33m quadrats. The spatial pattern of weed distribution was compared across systems using a combination of aggregation measures and quadrat variance techniques. Eight 1m by 0.33 m quadrats were further selected in each field to assess the impact of cropping systems on weed seedbank communities. Higher species richness and diversity was detected in the organic fields than in the conventional no-tillage ones. Although aboveground weed cover was aggregated in both the conventional and the organic systems, the patterns of aggregation were different for the two systems. The number of seeds recovered from the soil samples were significantly affected by sampling year and an interaction between cropping system and sampling year. A multivariate ordination indicated that while year played a significant role in determining weed seedbank communities, management system had a role only during 2006. Finally, we failed to detect strong correlations between the aboveground and belowground weed communities. (**Keyword**s: agricultural management, weed seeds, weed

communities, no-tillage, organic agriculture)

How windbreaks protect themselves from drift damage. Wolf, T.M.[1], Caldwell, B.C.[1], Mazurek, K.[2], and Peterson, J.C.[3] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]Dept. of Civil and Geological Engineering, University of Saskatchewan, Saskatoon, SK; [3]UMA Engineering, Saskatoon, SK

Tree windbreaks, also known as shelterbelts, are traditionally used to prevent soil erosion and improve snow capture on agricultural fields in western Canada. While their effects on reducing wind speed at ground level are well documented, little is known about their impact on small particulate movement such as spray drift. This research investigated the movement of pesticide spray drift past a 5 m (H) tall chokecherry/caragana shelterbelt to quantify the influence of the shelterbelt on airborne drift movement and its downwind deposition. A Medium spray was applied via a 14.5 m wide boom that travelled 3H upwind of and parallel to the shelterbelt. Ground deposition and airborne concentration of drift was measured using collectors placed downwind of the spray boom. Compared to an open field, ground deposits increased on the upwind side and decreased on the downwind side of the shelterbelt. The reduction in ground deposition depended on the downwind distance, with a reduction of 60 % near the shelterbelt and dropping to 0 % by about 20H downwind of the shelterbelt. Spray concentration in the airborne drift cloud immediately downwind of the shelterbelt was reduced by 85%. There was a greater proportion of drift travelling over the top of the shelterbelt rather than passing through it, with the peak concentration occurring at 1.2H. It is suggested that the following mechanisms were at play: lower wind speeds upwind of the shelterbelt increased the proportion of spray particles that settled out before reaching the shelterbelt. Many of the remaining spray droplets accelerated and moved up and over the shelterbelt, returning to ground about 20 H downwind. The shelterbelt therefore received less spray dosage than would be predicted from traditional spray cloud models. These observations may be useful for determining other particulate flows, such as pollen.

Weed control in niger (*Guizotia abyssinica*). May, W.E. [1], Lafond, G.P. [1] and Holzapfel, C.B.[2] [1]Indian Head Research Farm, Agriculture and Agri-Food Canada, Indian Head, SK; [2]Indian Head Agricultural Research Foundation, Indian Head, SK

Niger (*Guizotia abyssinica* (L.f.) Cass.) is an oilseed crop that originates in the highlands of Ethiopia and is also grown in India. In North America and Europe it is imported and used as a birdfeed. Recently a breeder in Minnesota developed cultivars that would mature in Saskatchewan. After an initial evaluation it was apparent that weed control would have to be addressed if this crop was to be successfully grown on the Canadian prairies. Two experiments were conducted in 2004 and 2005 to screen for crop tolerance of niger to various herbicides. The herbicide screening indicated that ethalfluralin, trifluralin, flucarbazone, sulfentrazone and MCPA had potential while 2,4-D, imazamethabenz, and carfentrazone ethyl did not. In 2006 and 2007, ethalfluralin, flucarbazone, sulfentrazone and MCPA were tested alone and in combination. Crop tolerance was very good for ethalfluralin with no injury detected. Injury to the niger from flucarbazone at a rate of 20 g a.i. was 10% or less. Sulfentrazone at 280 g a.i. rate resulted in vegetative injury above 20% in 2 out of 8 trials on a heavy clay soil with no effect on seed yield in any trial in testing from 2004 to 2008.

MCPA caused excessive vegetative injury to the niger. No negative synergistic effects were observed from various herbicide combinations involving ethalfluralin, flucarbazone, and sulfentrazone. In 2007 and 2008, the appropriate crop development stage at which to apply flucarbazone was investigated more closely. As the application of flucarbazone was delayed from the 2 leaf stage to the bud stage, crop injury increased especially at the early bud stage. Applications of flucarbazone should be made at the 2 to 4 leaf stage of the niger crop. In conclusion, ethalfluralin, flucarbazone, and sulfentrazone are herbicides that niger tolerates and with further research, minor use registration of flucarbazone, and sulfentrazone may be possible.

Cereals, Oilseeds and Pulses Section
2008 Poster Presentations

Control of winter cereals in the spring with glyphosate. Sikkema, P.H., Shropshire, C., and Soltani, N. Department of Plant Agriculture, University of Guelph Ridgetown Campus, Ridgetown, ON

Field experiments were established at the Huron Research Station and at University of Guelph Ridgetown Campus in 2005 and 2006 to evaluate different formulations of glyphosate (Weathermax vs Touchdown) at different rates (225, 450, 675, 900, or 1350 g ai/ha) for the burn off of winter cereals [soft white winter wheat (SWW), soft red winter wheat (SRW), hard red winter wheat (HRW) and fall rye] in the spring at two application timings (late April vs early May). There was no difference between the glyphosate formulations (Weathermax vs Touchdown) for the control of winter cereals at 7, 14, 21, and 28 days after treatment (DAT). There was generally improved control of winter cereals with glyphosate applications made in early May compared to late April however results were not always statistically significant. Winter cereals control generally increased as the glyphosate rate was increased from 225 to 1350 g ai/ha. The minimum rate of glyphosate required to provide 90% or greater control of SWW, SRW, HRW, and fall rye was 675 g ai/ha at 28 DAT. Glyphosate applied at 675 g ai/ha caused 97, 96, 97, and 98% reduction in shoot dry weight of SWW, SRW, HRW, and fall rye, respectively. Based on this study glyphosate (Weathermax or Touchdown) applied in late April or early May can be use at rates as low as 675 g ai/ha to adequately control SWW, SRW, HRW, and fall rye in the spring.

Quantity of plant protection products used on the prairies: a comparison with the European Union. Thomas, A.G. and Leeson, J.Y. Agriculture and Agri-Food Canada, Saskatoon, SK

Canada has developed programs for the reduction of pesticide risks to human health and the environment. The development, availability, and adoption of sustainable pest management tools and practices in agriculture support these programs. Three aspects of risk are associated with pesticide usage: quantity of product applied, physical and chemical properties influencing persistence in the environment, and toxicity to organisms. Collection of reliable data on the use of pesticides is the first step in monitoring changes in risk. Pesticide usage in cereal and oilseed crops on the Prairies is compared to usage in the same crop types grown in Europe. Data for the prairies were obtained from the Prairie Weed Management Survey completed in 2001-2003 and data for the European Union (EU) were complied from pesticide sales in the same years from 24 member states. Herbicide applications represent most of the product applied with small proportions contributed by insecticides and fungicides. Southern, Northern and Eastern EU countries had lower usage (< 0.8 kg ha^{-1}) in cereals than the three Prairie Provinces (0.9 kg ha^{-1}); in contrast, Western Europe usage was much higher at 2.6 kg ha^{-1}. The rate of application combined with a large area in cereals resulted in a total product usage in Western Europe that was three times greater than on the Prairies. Usage in oilseeds on the prairies is higher than in cereals but similar to usage in oilseeds in Western Europe (1.5 kg ha^{-1}). The relatively smaller area devoted to oilseeds results in less total product usage compared to cereals. Pesticide usage on the prairies compares favourably with Western Europe even though many of these countries have introduced specific policies to decrease pesticide use and risk. Pesticide usage is an essential component in risk indicators such as those currently under development as part of the National Agri-Environmental Health Analysis and Reporting Program.

Changes in herbicide use patterns on the prairies evaluated by the environmental impact quotient. Leeson, J.Y., and Thomas, A.G. Agriculture and Agri-Food Canada, Saskatoon, SK

Herbicide use patterns in the Prairie Provinces have changed since the 1990s with the adoption of farm management systems that include new herbicide products, herbicide-tolerant crops and zero- and reduced-tillage. The objective of this study is to examine the environmental impact of these changes in herbicide usage. Herbicide use data are from the Prairie Weed Management Surveys conducted in common annual cereal, oilseed and pulse crops in 1995, 1997 and 2001 to 2003. These questionnaires contain information including rate and area of application for products applied prior to seeding and in-crop in the survey year as well as pre- and post-harvest in the preceding year. Data are used from 1405 and 2231 fields in the 1990s and 2000s, respectively, to determine the rate of application of each individual active ingredient applied within ecoregions in each province. This value was multiplied by the Environmental Impact Quotient (EIQ) for the active ingredient and summed across all ingredients to determine the environmental impact (EI) of herbicides in the survey year within an area. The EIQ measures the risk to producers, consumers and ecology posed by individual active ingredients. The EI was found to differ widely between ecoregions in both the 1990s and 2000s in Alberta and Saskatchewan. The EI was lowest in the Peace River Ecoregion in northern Alberta. Also, the change in EI was not consistent across the provinces. The total EI in Manitoba and southern Alberta declined from the 1900s to 2000s while it tended to increase or remain the same in the other areas. These differences may be partially attributable to uneven adoption rate of practices such as zero-tillage, different herbicide regimes associated with different crops and weather in the year of the survey. The evaluation of sustainable herbicide use must also consider risk to crop production as well as the environment.

Risk assessment of weed resistance in the prairies. Beckie, H.J.[1], Leeson, J.Y.[1], Thomas, A.G.[1], Hall, L.M.[2], and Brenzil, C.A.[3] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]University of Alberta, Edmonton, AB; [3]Saskatchewan Agriculture and Food, Regina, SK

Agricultural practices, other than herbicide use, can affect the rate of evolution of herbicide resistance in weeds. This study examined associations of farm management practices with the occurrence of herbicide (acetyl-CoA carboxylase or acetolactate synthase inhibitor)-resistant weeds, based upon a multi-year (2001-2003) random survey of 370 fields/growers from the Canadian Prairies. Herbicide-resistant weeds occurred in one-quarter of the surveyed fields. The primary herbicide-resistant weed species was wild oat (*Avena fatua* L.), with lesser occurrence of green foxtail (*Setaria viridis* L. Beauv.), kochia (*Kochia scoparia* L. Schrad), chickweed (*Stellaria media* L. Vill.), spiny sowthistle (*Sonchus asper* L. Hill), and redroot pigweed (*Amaranthus retroflexus* L.). The risk of weed resistance was greatest in fields with cereal-based rotations and least in fields with forage crops, fallow, or where three or more crop types were grown. Weed resistance risk also was greatest in conservation-tillage systems and particularly low soil disturbance no-tillage, possibly due to greater herbicide use or weed seed bank turnover. Large farms (> 400 ha) had a greater risk of weed resistance than smaller farms, although the reason for this association was unclear. The results of this study identify cropping system diversity as the foundation of proactive weed resistance management.

Using biobeds to remediate pesticide waste. Wolf, T.M.[1], Caldwell, B.C.[1], Cessna, A.J.[2], Knight, D.[3] and Farrell, R.[3] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]National Hydrology Research Centre, Environment Canada, Saskatoon, SK; [3]Dept. of Soil Science, University of Saskatchewan, Saskatoon, SK

Safe pesticide waste disposal is a continuing challenge in agricultural production because inappropriate disposal of sprayer tank contents can contribute to water and soil contamination. Simple, effective, and practical methods are needed to address this issue. A biobed is a mixture of topsoil, compost (or peat) and cereal straw (1:1:2 v/v/v) that provides high water holding capacity as well as high sorption and microbial breakdown of pesticides. The biobed mix is placed in a pit so it can receive pesticide rinsate. The objective of this study was to test the biobed concept for disposal of sprayer tank rinsate by quantifying the rate of breakdown of the herbicide 2,4-D in laboratory biobeds under various treatment regimes. Seven experiments evaluated herbicide concentration as well as biobed substrate, moisture content and temperature. Twenty-five g of biobed substrate was placed in petri-dishes to which 1 mL of a commercial formulation of 2,4-D amine, diluted in water, was added. The biobed substrate was incubated for up to 10 weeks and sampled weekly. 2,4-D was extracted with a mixture of acetonitrile, water, and acetic acid (70:29:1) and analyzed by LC-MS/MS. Initial results showed that the rate of herbicide breakdown was greater in biobeds than in soil by a factor of approximately 3- to 6-fold. 2,4-D degradation rates were somewhat greater when biobed substrate was previously inoculated with 2,4-D, but were not increased when alfalfa pellets were used to replace 50% of the straw component in the substrate. Low temperatures were detrimental to degradation, as expected, with little breakdown for incubation at 5ºC and the fastest breakdown at 25 and 35ºC. Substrate extracts from remaining experiments (moisture content, herbicide concentration, and herbicide formulation) are currently being analyzed. A field site has been prepared for larger scale biobed tests which commenced in 2008 and will be expanded in 2009.

Evaluating herbicides for control of Canada fleabane (*Conyza canadensis* L. Cronq.) in Western Canada. Sapsford, K.L. [1], Holm, F.A. [1], Johnson, E.N.[2], Neyedley, R. [3] and Dilk, S. [31]Department of Plant Sciences, University of Saskatchewan Saskatoon, Sask. [2]Agriculture and AgriFood Canada Scott, Sask. and [3]Monsanto Canada Inc., Winnipeg, MB

There are now 15 species of weeds that have known resistance to glyphosate around the world. However there are no known glyphosate resistant weed biotypes in Canada at this time. Most of the species that have shown resistance to glyphosate are not in western Canada. The one species that is present and has developed glyphosate resistance in 5 other countries (USA, Brazil, China, Spain and Czech Republic) is Canada fleabane (C*onyza canadensis*). This trial was established to evaluate other herbicide options available to producers for control of Canada fleabane in western Canada. The trials have been conducted over 3 years at 3 locations in Saskatchewan (2006 at Meota, 2007 & 2008 at North Battleford and Saskatoon). Sites were identified where Canada Fleabane was the dominant weed. Applications were made in the spring when the majority of the Canada fleabane was less than 5 cm. tall. Visual ratings were recorded at 7 to 10, 21-28 and >35 days after application. There was no crop seeded in the trials and the trials were terminated after the final rating. The treatments included dicamba @140 gai/ha, 2,4-D @ 560 and 700 gai/ha, clopyralid @ 75, 100 & 150 gai/ha, amitrol @ 1000 gai/ha, florasulam @ 5 gai/ha, pyrasulfotole + bromoxynil @ 202 gai/ha and BAS

800 @ 18 gai/ha. At 16 – 28 DAA, all treatments controlled Canada fleabane greater than 70%. Greater than 80% control was achieved with clopyralid @150 gai/ha, florasulam @ 5 gai/ha, pyrasulfotole + bromoxynil @ 202 gai/ha and BAS 800 @ 18 gai/ha. Greater than 90% control was achieved with amitrol @ 1000 gai/ha and glyphosate @ 675 gai/ha indicating that these populations of Canada fleabane were not resistant to glyphosate. By the final rating, control had fallen back on some of the treatments as some of the Canada fleabane began to regrow. Greater than 70% control was achieved with dicamba @ 140 gai/ha and clopyralid @ 75 and 100 gai/ha. Greater than 90% control was achieved with clopyralid @ 150 gai/ha, amitrol @ 1000 gai/ha and glyphosate @675 gai/ha. There are alternatives that will suppress and/or control Canada fleabane if glyphosate resistant biotypes appear in Western Canada. Future work should be considered to evaluate all of these products with crop competition and in-crop herbicides.

Predicting air-borne droplet drift from agricultural areas. Cessna, A.J.[1], Leeson, J.Y.[1], McQueen, R.[2], Thomas, A.G.[1], and Wolf, T.M.[1] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]University of Manitoba, Winnipeg, MB

Under the National Agri-Environmental Health Analysis and Reporting Program of Agriculture and Agri-Food Canada, the agri-environmental Indicator of Risk of Water Contamination by Pesticides (IROWC-Pest) is being developed to provide information on spatial and temporal changes in the risk of pesticide contamination of ground and surface waters on a national basis. The proportion of applied pesticide transported in surface runoff as well as that leached through soil to a 1-m depth is estimated using the pesticide fate model PRZM (Pesticide Root Zone Model). However, a portion of each pesticide application is lost to the atmosphere as application drift and may subsequently impact water quality via atmospheric deposition. Sprayer configuration (nozzle type, boom height, travel speed, spray pressure and presence of shrouds or cones) is important in determining the magnitude of drift. Spray drift data from experimental trials conducted in Saskatchewan (1986 to 2004) are used to develop a model to predict air-borne drift at various wind speeds based on sprayer configurations identified for herbicide applications in 1563 fields included in the Prairie Weed Management Surveys conducted in Alberta (2001), Manitoba (2002) and Saskatchewan (2003). Simple multiple regression analysis was conducted on the drift data with spray quality, boom height, travel speed, boom shrouding, and wind speed as independent variables. Two models were developed, one using low (10 to 20 km/h, n=62) and another using intermediate (15 to 25 km/h, n=53) wind speeds. These models were applied to the weighted survey data to map the expected airborne drift (as a percent of the applied amount) on the Canadian Prairies at the time the surveys were conducted. Spray quality, travel speed and boom height and were the most important variables in determining the magnitude of pesticide drift. The magnitude of drift predicted by these models will be used with the IROWC-Pest indicator to better estimate the risk of water contamination by pesticides.

Flowering and seed-set phenology of transgenic *Brassica napus* cultivars: Effect on intraspecific gene flow. Simard, M-J.[1], Légère, A.[2] and Willenborg, C.J.[3] [1]Agriculture and Agri-Food Canada, Québec, QC, [2]Agriculture and Agri-Food Canada, Saskatoon, SK, [3]Dept. of Plant Science, University of Manitoba, Winnipeg, MB

Transgenes from novel crops are found in field grown and volunteer congeners as well as in

compatible weedy relatives. Gene flow in space is well documented and isolation distances are recommended to ensure genetic purity of pedigreed *Brassica napus* seedcrops. Isolation in time during the flowering period has not received comparable attention. We assessed the effect of asynchronous flowering periods on intraspecific *B. napus* gene flow (outcrossing) and we evaluated outcrossing frequencies and seed-set during the flowering period. Transgenic cultivars, either resistant to glyphosate or glufosinate, were seeded in adjacent plots at 0, 1, 2, 3 and 4 week intervals. Outcrossing frequencies were evaluated in the center of the first adjacent row. Manual crosses were also done in the greenhouse. Differences between hybrid cultivars in outcrossed offspring sired ranged from 1.3 in the greenhouse (manual crosses) to three-fold under field conditions. Flowers that opened during the last week of the flowering period contained 25% less outcrossed seed and produced little seed (<10%). Gene flow was reduced to the lowest level by a seeding interval of two weeks or more for the first seeded cultivar only. Increasing the temporal separation actually increased outcrossing frequencies for the later seeded cultivar up to a two week interval in seeding date. Variations in extraneous pollen load and potential seed set of pollinated flowers likely explain observed outcrossing rates at different intervals. Seeding date intervals and differences between cultivars can potentially be used to manage gene flow.

The persistence of triticale (*Triticosecale* X Wittmack) in the seedbank. Raatz, L.L. and Hall, L.M. Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB

Triticale is being evaluated as a crop for a number of bio-product and industrial crop initiatives, predicated on genetic transformation. However, prior to deployment, research is needed to fulfill regulatory requirements and development of best management practices for triticale containing a novel trait. Using conventional triticale, we examined the persistence of triticale in the seedbank following harvest. Field trials were initiated at two locations in Alberta in the fall of 2007 and 2008. Four triticale varieties and one wheat variety were inserted into nylon mesh bags and placed on the soil surface, buried at 2 cm, and buried at 10 cm to simulate harvest loss with no tillage, and shallow and conventional fall tillage operations, respectively. Bags were withdrawn five times during the growing season at four week intervals and seed viability was evaluated. Seeds that had either germinated or degraded over the season were considered to have been removed from the seedbank. Un-germinated intact seeds were placed in germination boxes and those that germinated were recorded as being viable. Remaining intact un-germinated seeds were tested for viability using tetrazolium. The frequency of viable triticale seeds left on the surface ranged from 0.04 to 0.33 early the following season and decreased to 0.002 to 0.04 by the end of the season at both locations. Seed viability was low the year following the shallow tillage treatment, ranging from 0.002 to 0.05. At 10 cm deep, none of the triticale or wheat varieties had viable seeds remaining in the seedbank at either site. We suggest that conventional fall tillage may be the most effective means of depleting triticale from the seedbank.

How to use crops to manage weeds: six IWM systems for the moist mixed grassland ecoregion. Légère, A.[1], Thomas, A.G.[1], Leeson, J.Y.[1], Stevenson, F.C.[2], Holm, F.A.[3], Gradin, B.[4], and Kratchmer, D.[5] [1]Agriculture and Agri-Food Canada, Saskatoon, SK; [2]Research Consultant, Saskatoon, SK; [3]Plant Sciences Department, University of Saskatchewan, Saskatoon, SK; [4]Pest Management Regulatory Agency, Saskatoon, SK; [5]Viterra, Watrous, SK

In order to address the need for integrated weed management (IWM) for prairie cropping systems, six IWM systems were compared in a wheat-canola-barley-pea rotation at Saskatoon and Watrous, Saskatchewan, Canada. Seeding rate and date, herbicide timing and rate, and tillage operations were selected so that IWM systems would result in similar weed management level. The IWM systems ranged from intensive herbicide/no tillage (12 herbicide applications at 1X rate in four years) to no herbicide/intensive tillage (11 tillage operations in four years). Changes in weed communities were assessed by monitoring weed density, biomass, and seedbanks. Both sites experienced a wide range of environmental conditions during the four years, with precipitation ranging from 43% below to 10% above average at Watrous, and 32% below and 13% above average at Saskatoon. All six systems resulted in residual weed communities, in accordance with IPM principles. Principal response curves indicated a gradual increase in stinkweed (*Thlaspi arvense* L.), lambsquarters (*Chenopodium album* L.), redroot pigweed (*Amaranthus retroflexus* L.) and wild buckwheat (*Polygonum convolvulus* L.) in the no herbicide/high tillage system. Winter and early spring annuals, and perennials increased in most systems but particularly in the low herbicide/zero tillage and medium herbicide/zero tillage systems. By the end of the four years, weed seedbanks had increased in all systems. Many species had large seed banks in the no herbicide/high tillage system but species such as narrow leaved hawk's-beard (*Crepis tectorum* L.), wood whitlow-grass (*Draba nemorosa* L.), spiny annual sow-thistle (*Sonchus asper* (L.) Hill) and wild oat (*Avena fatua* L.) had greater seedbanks in the four intermediate systems. Although five of the six IWM systems provided similar results, changes in weed communities would suggest that operations should be revised to improve the overall management of certain weeds and reduce seed return to the seedbank. This study confirms that IWM in various forms can be successfully implemented under the challenging conditions of the Canadian Prairies.

Control of Japanese brome in spring wheat, winter wheat, and durum wheat with pyroxsulam herbicide. Degenhardt, R.F., McGregor, W.R., Turnbull, G.C., Juras, L.T., and Wintonyk, B.A. Dow AgroSciences Canada Inc., Calgary, AB

Japanese brome (*Bromus japonicus* Thunb.) is an invasive winter or summer annual weed with an expanding distribution across western Canada and the north-western states of the USA. Japanese brome actively competes for nutrients and moisture, and frequently forms dense infestations (>100 plants m^{-2}) in summer and winter annual cereal crops. During the 2007 and 2008 growing seasons, fourteen small plot research trials were established in spring wheat, winter wheat, and durum wheat fields across Manitoba, Saskatchewan and Alberta to assess herbicide management options for control of natural infestations of Japanese brome. All herbicides were applied in the spring to summer annual Japanese brome at the one-leaf to seven-leaf stage. Pyroxsulam, a new Dow AgroSciences herbicide registered for use in spring and durum wheat, provided exceptional control of Japanese brome, averaging 89% at mid evaluations (4–5 weeks after application [WAA]), and 91% at late evaluations (6–10 WAA), when applied at the label rate of 15 g ai ha^{-1} with the mineral oil/surfactant blend adjuvant, Assist Oil Concentrate (0.8% v/v). Sulfosulfuron, applied at 35 g ai ha^{-1} with the surfactant Agral 90 (0.5% v/v), provided control of Japanese brome, averaging 85% and 88% at mid and late evaluations, respectively. Results indicate that post-emergence application of pyroxsulam is an effective strategy for managing Japanese brome in spring wheat, winter wheat, and durum wheat.

Effect of density and relative time of removal of volunteer canola (*Brassica rapa* L.) on yield loss of wheat (*Triticum aestivum* L). O'Donovan, J.T. and Harker, K.N. Agriculture & Agri-Food Canada, Lacombe, AB

Canola production in western Canada has increased dramatically since the introduction of herbicide-resistant canola in 1995. This has resulted in an increase in volunteer canola as a weed and has raised concerns on its impact on wheat and other crops grown in rotation with canola. There is little or no published information on the impact of volunteer canola on wheat or on the most effective time to remove the volunteers to avoid yield losses. This knowledge would facilitate making decisions on if and when it needs to be controlled to avoid financial losses. Field experiments were conducted at Lacombe, Alberta, Canada in 1976, 1978 and 1979 to determine the effects of density and time of removal of volunteer canola on yield loss of wheat. Nonlinear regression analysis of the data indicated that the effect of volunteer canola on wheat yield loss was variable. Initial slopes (% wheat yield loss at low canola densities) varied from 0.29% in 1979 to 2.44% in 1978. However, volunteer canola at densities of 47 (1976), 345 (1978) and 251 (1979) plants m^{-2} had little effect on wheat yield if the canola was removed at approximately 25 days after wheat emergence or earlier. Allowing canola to interfere beyond this time resulted in a sharp yield decrease for every day volunteer canola was allowed to remain in the crop.

Predicting N and P fertilizer effects on weed competitiveness with wheat. Blackshaw, R.E. and Brandt, R.N. Agriculture and Agri-Food Canada, Lethbridge, AB

Previous research has indicated that weed species are inherently quite different in their level of responsiveness to higher soil N and P levels. However, questions remain about how this information could best be utilized to improve weed management. Could we predict crop-weed competitive outcomes as affected by fertility programs using this information? Replacement series experiments were conducted under controlled environment conditions to examine the effect of three N (60, 120, and 240 mg N kg^{-1} soil) and three P (5, 15, and 45 mg P kg^{-1} soil) rates on the competitive ability of various weed species grown with wheat. Grass and broadleaf weed species were chosen to represent species that varied in their growth responsiveness to N and P. The competitive ability of the low N responsive species, Persian darnel (*Lolium persicum*) and Russian thistle (*Salsola iberica*), was not influenced by N rate; supporting our hypothesis that N rate would have little effect on the competitiveness of species responding minimally to N. Conversely, the competitiveness of the high N responsive species redroot pigweed (*Amaranthus retroflexus*) progressively improved as N rate increased. The competitive abilities of the low P responsive species, Persian darnel and kochia (*Kochia scoparia*), decreased as P rate increased; again supporting our hypothesis that the competitiveness of species responding minimally to P would remain unchanged or decrease at higher P levels. As expected, the competitiveness of the high P responsive species round-leaved mallow (*Malva pusilla*) progressively improved as P dose increased. However, results with wild oat (*Avena fatua*) did not support our working hypothesis as its competitiveness with wheat was unaffected by N or P rates used in this study even though it was previously categorized as being highly responsive to both of these nutrients. Thus, with five of six species, knowledge of weed growth responsiveness to N or P was useful information in predicting competitive outcomes with wheat at higher fertilizer rates. These results suggest that fertilizer management strategies that favour crops over weeds deserve greater attention when weed infestations consist of species known to be highly responsive to higher soil fertility levels. Information gained in this study will be used to advise farmers of the importance of strategic fertilizer management in terms of both weed management and crop yield.

Low-drift nozzles as agronomic tools to improve application timing. Johnson, E.N., Wolf, T.M., Caldwell, B.C., and Phelps, S.M. Agriculture and Agri-Food Canada, Scott, SK (Email: johnsone@agr.gc.ca)

Early removal of weeds generally results in higher crop yields and timely application of herbicides is often difficult due to windy conditions. Low-drift nozzles can be used in a wider range of environmental conditions than conventional flat fan nozzles; however, Coarse to Very Coarse spray qualities can sometimes be less efficacious, particularly with contact herbicides. There were two objectives to this study: to determine if timely spraying with low-drift sprays maintains crop yields and provides higher yields than later applied conventional sprays; and to determine if the response from timely application of low-drift sprays is consistent across crops with different levels of competitiveness. Field trials were conducted at the Scott Research Farm from 2004 to 2006. Four crops of different competitive abilities [flax (*Linum usitatissimum* L.), canaryseed (*Phalaris canariensis* L.), semi-dwarf wheat (*Triticum aestivum* L.), and barley (*Hordeum vulgare* L.) were seeded in separate blocks. A herbicide tank-mix of fenoxyprop-p-ethyl (92 g ai ha^{-1}) and bromoxynil / MCPA (580 g ai ha^{-1}) was applied to grass and broadleaf weeds in a factorial combination of spray

qualities (Fine, Medium, Very Coarse) and application timing (2-leaf, 4-leaf, and 6-leaf crop stage). Late application timing had a significant effect on grass weed biomass in flax, canaryseed, and wheat and broadleaf weed biomass in wheat and barley. Applying at the 6-leaf stage of the crop resulted in lower seed yields in flax and canaryseed compared to the 2- and 4-leaf stage. Very Coarse spray qualities sometimes resulted in higher weed biomass than Fine to Medium spray qualities; however, it did not result in lower crop yields. Timely application maintained crop yields independent of spray quality and application timing was more critical in less competitive crops. Low-drift nozzles can be used as an agronomic tool for timely application.

Symposium Session Agenda
Horticulture & Special Crops Section - 2008 Oral Presentations
Thursday, November 27th

Prairie Carnation: support for Emerson's definition of a weed. Johnson, E.N. Watson, P.W., Shirtliffe, S.J., Blackshaw, R.E., and Légère, A. Agriculture and Agri-Food Canada, Scott, SK (Email: johnsone@agr.gc.ca)

Prairie Carnation™ is the proprietary Saponin Inc. brand name for *Saponaria vaccaria*, a species of plant that belongs to the Caryophyllaceae family. A landrace (named "Scott") of Prairie Carnation was developed from a wild-type population (commonly known as cow cockle) at the Scott Research Farm. The perisperm of Prairie Carnation™ seed contains primarily starch and protein, while the germ contains the majority of the secondary plant metabolites such as saponins, cyclopeptides and phenolics. The fine starch granules produced in the seed make it suitable for the cosmetic industry due to its fine physical texture. The seed contains 30 different Triterpenoid saponin molecules, which are commonly used as vaccine adjuvants and have applications in the food and medical industries. Cyclopeptides and phenolics found in the seed may also have medical applications. Agronomic research has been conducted at Agriculture and Agri-Food Canada and the Alberta Research Council (ARC) in Vegreville, Alberta and the University of Saskatchewan. Trials include seeding date, optimum seeding rate, fertility, fungicide application and crop tolerance to herbicides. In addition, studies are being initiated to understand the ecology of the plant, for example seed dormancy and seed persistence. Preliminary results indicate that Prairie Carnation™ has a number of desirable agronomic traits and potential to be a commercial crop.

Development and application of a lab bioassay for sulfentrazone detection in soil. Szmigielski, A.M., Schoenau, J.J., Johnson, E.N.*, Holm, F.A., and Sapsford, K.L. *presenter. Agriculture and Agri-Food Canada, Scott, SK (Email: johnsone@agr.gc.ca)

Sulfentrazone is a phenyl triazolinone herbicide which may persist in soil and may have residual activity beyond the season of application; therefore, a lab bioassay was developed for detection of sulfentrazone in soil. Root and shoot response of several crops was tested. Shoot length inhibition of sugar beet (*Beta vulgaris* L.), was found to be the most sensitive and reproducible parameter for measurement of soil-incorporated sulfentrazone. The sugar beet bioassay was then applied to examine the effect of soil properties on sulfentrazone phytotoxicity using ten Canadian prairie soils of contrasting soil properties. Concentrations corresponding to 50% inhibition (I_{50} values) were obtained from the dose-response curves constructed for the soils. Sulfentrazone phytotoxicity was strongly correlated to the percent organic carbon ($p = 0.01$) and also to percent clay content ($p = 0.05$), while correlation with soil pH was non-significant.

Perennial weed control with Callisto in wild blueberry. Boyd, N.S. and White, S. Department of Environmental Sciences, Nova Scotia Agricultural College, Truro, NS

Callisto efficacy on perennial weed species varies with time of application. Experiments were conducted in multiple commercially managed blueberry fields in 2007 and 2008 to determine the growth stage of goldenrods (*Solidago* spp.) and black bulrush (*Scirpus atrovirens* Willd.) most susceptible to post-emergent applications of Callisto and to determine if Callisto efficacy is greater following Velpar or Sinbar applications. Callisto was applied post emergence at 210 ml product / ha in 300 L/ha of water with 0.2% v/v Agral 90 when plants were 10cm tall, 30cm tall, at flower bud initiation, or when shoots were in full bloom. Velpar was applied before shoot emergence at 2.56 kg product/ha in 200 L/ha of water. Sixty percent control of goldenrod top-growth was achieved at all application timings before full flower. Applications at full flower were ineffective. Velpar significantly reduced goldenrod shoot density but there was no significant interaction between pre- and post emergent herbicide applications. A single application of Callisto did not effectively control established black bulrush tufts. Seventy percent control of black bulrush was achieved with two applications (early and late summer) of Callisto which is comparable to control levels achieved with the current industry recommendation. Callisto applied in the sprout year and fruit year of wild blueberry did not significantly affect fruit bud number or berry yields.

Effect of combining atrazine and mesotrione on carryover injury in vegetables. Robinson, D.E. Department of Plant Agriculture, University of Guelph, Ridgetown Campus, Ridgetown, ON

Trials were established in 2003, 2004 and 2005 in Ontario to determine the effects of residues of mesotrione, atrazine and mesotrione plus atrazine one and two years after application on broccoli, carrot, cucumber, onion and potato. One year after mesotrione application, injury was 43%, 37%, 18%, 24% and 0% in broccoli, carrot, cucumber, onion, and potato, respectively. The addition of atrazine to mesotrione in the year before planting increased injury to 55%, 53%, 30%, 42% and 3% in broccoli, carrot, cucumber, onion and potato, respectively. Plant dry weight and yield were also decreased by mesotrione residues the year after application in all crops except potato. The addition of atrazine to mesotrione accentuated the reduction in dry weight and yield in broccoli, carrot, cucumber and onion. There was no injury, or reductions in dry weight or yield in any crop planted two years after application of mesotrione alone or in tank mix with atrazine. A recropping interval of two years is recommended following applications of mesotrione or mesotrione plus atrazine for broccoli, carrot, cucumber and onion. Potato can be safely planted the year following application of mesotrione plus atrazine.

Horticulture & Special Crops Section
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2008 Fraser Valley strawberry weed control results. McMillan, G.A. [1] and Brookes, V.R.[2]
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Weed control in strawberry production is a limiting factor in the establishment year, causing poor crop establishment and yield reductions in subsequent fruiting years. There are currently few herbicides registered and those that are registered belong to groups known for the development of resistance. In addition, only one tank mix option exists between the products. In 2008, trials in Abbotsford, Agassiz, Langley and Delta, British Columbia were carried out on newly planted strawberry fields to identify new herbicide options and tank mix combinations. Herbicides tested included sulfentrazone, flumioxazin, napropamide, oxyflourfen, s-metolachlor, terbacil, pendimethalin and simazine either alone or in various combinations. The application timing was immediately after planting. At the Delta and Langley sites, very slight (<2%) crop injury was observed in the chemical treatments at 7 and 17 days after application (DAA) and no injury was observed at 28 and 64-67 DAA with the exception of 1% injury from the tank mix of flumioxazin (100 g prod/ha) + oxyflourfen (2.5 L prod/ha) at the Delta site. At the Agassiz and Langley sites, there were no differences in crop injury between treatments and the levels observed were within acceptable levels (<3%). Runner counts at the Delta and Langley sites indicated that the treatments did not affect the number of plants per meter or the number of runners produced per plant. It was observed that crown placement played a role in the level of crop injury observed between the trials. The crowns at the Delta site were placed lower in the soil than the Langley site. Crop injury at the Delta site was lower and more uniform. However, at the Agassiz and Langley sites, the crop injury was higher and more variable between replicates as the result of higher crown placement at planting. In summary, new strawberry plantings showed good tolerance to sulfentrazone, flumioxazin, napropamide, oxyflourfen, s-metolachlor, terbacil, pendimethalin and simazine either alone or in various combinations.

Control of volunteer glyphosate tolerant corn in glyphosate tolerant sugar beets using quizalofop-p-ethyl. Nurse, R.E.[1]; and Robinson, D.E.[2] [1]Agriculture and Agri-Food Canada (AAFC), Harrow, ON; [2] Ridgetown Campus, University of Guelph, Ridgetown, ON

Field trials were conducted at two locations in Southwestern Ontario in 2008 to examine potential control options for volunteer glyphosate tolerant (GT) field corn using quizalofop-p-ethyl. To simulate the contamination of the sugar beet trial with volunteer field corn; seeds from GT corn hybrids were collected at physiological maturity in 2007, stored and then sown at a rate of 45,000 seeds/ha over the entire sugar beet trial area in the spring of 2008. The trial compared five treatments 1) glyphosate (0.9 kg ae/ha); 2) quizalofop-p-ethyl (0.024 kg ai/ha) + Sure-Mix (0.5% v/v); 3) glyphosate + quizalofop-p-ethyl (0.9 kg ae/ha + 0.024 kg ai/ha); 4) glyphosate + quizalofop-p-ethyl (1.8 kg ae/ha + 0.048 kg ai/ha); and 5) a weed-free control. All other weeds in the trial were removed

using glyphosate and hand-hoeing as needed. All treatments were applied to the trial at the 3-4 leaf stage of the volunteer corn. There was no observable injury to the sugar beets resulting from the treatments, and tank-mixing glyphosate with quizalofop-p-ethyl did not result in any reduction in control. The control of volunteer GT corn was excellent (>85%) for all treatments containing quizalofop-p-ethyl. Furthermore, when quizalofop-p-ethyl was appled at 0.048 kg ai/ha, a 2x rate, control of volunteer corn was greater than 95%. The presence of volunteer corn in the plots where quizalofop-p-ethyl was not applied reduced sugar beet yield. The results of this study support that quizalofop-p-ethyl will be a viable control option for volunteer corn when GT sugar beets are grown in rotation with GT field corn.

Control options for linuron resistant pigweed in carrots. Tardif, F.J., and Smith, P.J. Department of Plant Agriculture, University of Guelph, Guelph, ON

Linuron is one of the few options carrot growers have for control of dicotyledonous weed. Linuron resistant pigweeds (*Amaranthus* sp.) have become widespread in carrot growing areas of Eastern Canada. Alternative herbicides are needed that must provide efficient control of pigweed while causing no crop injury. Two trials were established in a linuron resistant pigweed infested carrot field in Cedar Valley, Ontario, in May 2007. Twenty-three herbicides treatment were applied in PRE or POST emergence and were evaluated for pigweed control and carrot injury. Treatments that provided excellent weed control also caused too much crop injury while those treatments that did not cause crop injury did not provide enough control of pigweed. However, the exception was ethofumesate (Nortron), which provided 98 to 100 % control pigweed and caused little crop injury. As a result, carrot yield was the highest with this treatment. Ethofumesate would appear to be a promising herbicide for the control of linuron resistant pigweeds. Future research needs to be done in order to get registration of this product.

Saflufenacil tolerance in vegetables. Robinson, D.E. and Sikkema, P.H. Department of Plant Agriculture, University of Guelph, Ridgetown Campus, Ridgetown, ON

Trials were established in 2007 and 2008 in Ontario to determine the effect of saflufenacil applied pre-transplant to pepper, tomato, broccoli, cabbage and cauliflower and pre-emergent to potato. Saflufenacil was applied at rates of 25, 50 and 100 g a.i. ha^{-1}, and visual injury, plant dry weight at 42 days after emergence or transplanting, and marketable crop yield were measured under weed-free conditions. Saflufenacil caused commercially unacceptable (>10%) visual injury to broccoli and cauliflower at 100 g a.i. ha^{-1}, but injury was less than 10% at both 25 and 50 g a.i. ha^{-1}. Injury included stunting and leaf necrosis. Saflufenacil did not cause a reduction in dry weight, or head size of broccoli, cabbage or cauliflower, but cauliflower yield was reduced at the 100 g a.i. ha^{-1} rate. Saflufenacil caused commercially unacceptable (>10%) visual injury, and reductions in dry weight of pepper and tomato at 50 and 100 g a.i. ha^{-1}. Despite these reductions in dry weight of both crops, only pepper yield was less than the untreated check at the 100 g a.i. ha^{-1} rate of saflufenacil. Visual injury was less than 5% visual injury to potato, even at the 100 g a.i. ha^{-1} rate of saflufenacil and plant dry weight and yield were not less than the untreated check in any of the herbicide treatments. Saflufenacil tolerance in cole crops may be sufficient to justify further evaluation at the lower rates studied in the trial, however there is limited information on varietal differences and environmental

conditions, which may affect cole crop tolerance to the herbicide. Pepper and tomato showed little tolerance to pre-transplant applications of saflufenacil. Potato showed good tolerance at rates of saflufenacil from 25 to 100 g a.i. ha^{-1}, but again further study on different varieties, soil types and environments are needed to establish the crop's full range of tolerance to saflufenacil.

Reduced risk weed control strategies for carrot on mineral soils. Ivany, J.A.[1], Sanderson, K.[1], Main, D.[1], Dickson, B.[1], and Boyd, N.[2] [1]Agriculture and Agri-Food Canada, Charlottetown, PE, [2]Nova Scotia Agricultural College, Truro, NS

Carrots are poor competitors with weeds which are usually controlled with herbicides. Flamers and tillage implements can reduce weed biomass and density. This research compared herbicides, flaming, shallow tillage or acetic acid for weed control and carrot yield. Carrots were planted on beds formed 2 wks previously or on beds formed before planting. Treatments were applied in 30 cm band over the row with tillage on the sides of the hills. Data collected were: % weed control, crop emergence and damage; weed biomass; and crop yield and quality. Treatments were an un-weeded control; linuron pre at 600 and post at 1185 gai/ha when carrots were 8-15 cm tall (banded or broadcast); shallow pre-plant cultivation with Buddingh cultivator on top of beds and knives on side of beds; pre-plant flaming alone; pre-emergence flaming or acetic acid just before carrots emerge; linuron and side knives; pre-emergence flaming with post emergence cultivation; and pre-plant cultivation with knives on the side of beds. Predominant weeds were *Chenopodium album*, L., *Spergula arvensis*, L., and *Raphanus raphanistrum*, L. Linuron broadcast gave highest weed control and carrot yield. Linuron in a narrow band gave yield and weed control comparable to linuron applied broadcast. Banding reduced herbicide use 66% reducing cost and environmental impact. Flaming did not control weeds on hills formed at planting due to later weed emergence. When used on preformed (stale seedbed) hills, weed control was much improved although yields were reduced. Acetic acid (6.25%) showed promise for weed control but yields were reduced. All other treatments resulted in reduced yields. Carrot emergence was unaffected by treatment. This research was funded by the Pesticide Risk Reduction Strategies Initiative of the AAFC-Pest Management Centre and the AAFC-Crops and Livestock Research Centre, Charlottetown.

Pest Management Centre: partnering for results. O'Neill, G. Pest Management Centre, Agriculture and Agri-Food Canada, Ottawa, ON

The Pest Management Centre (PMC) of Agriculture and Agri-Food Canada (AAFC) is a program funded through the Agriculture Transformation Programs Directorate located within the Farm Financial Programs Branch. Created in 2003, the PMC consists of two initiatives called the Minor Use Pesticides Program and the Pesticide Risk Reduction Program.

The Minor Use Pesticides Program (MUPP) responds to requests from grower organizations to develop solutions for pest priorities of specialty crops with challenging pest control issues. The MUPP partners with producer organizations, AAFC Research Branch, the United States Interregional Research Project No.4 program (IR-4), provinces and pesticide registrants in the generation of data and/or the development of rationales to support new pesticide registrations for priority pest/crop concerns of Canadian producers.

The Pesticide Risk Reduction Program (PRRP), a joint program of AAFC and the Health Canada Pest Management Regulatory Agency (PMRA) facilitates the development of reduced risk pest management tools and the dissemination of these tools to Canadian producers. The PRRP partners with producer organizations, AAFC, 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.

To date, the herbicide team of the MUPP has completed 38 projects, securing 29 minor use registrations on 28 crops. The PRRP has supported a number of projects which are improving grower access to reduced risk weed control options. For more information on activities and results of the PMC, please visit the website at www.agr.gc.ca/prrmup.