OPMC Ontario Pest Management Conference 2018

16th Annual

Natural Selection: Getting a Grip on Resistance

November 6, 2018

Victoria Park East Golf Course
1096 Victoria Road South
(1 km south of Stone Road E.)

Website: www.opmconference.ca

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Robert Nurse, Agriculture and Agri-Food Canada, Harrow
Cynthia Scott-Dupree, School of Environmental Sciences, University of Guelph
Harold Wright, Syngenta Canada

OPMC Logo and Banner Design by Doug Schaefer

AGENDA

8:30 a.m – 9:00 a.m **Registration and Coffee**
Poster Set Up

MORNING SESSION

Morning Session Chair: Chris Duyvelshoff, Ontario Fruit & Vegetable Growers Association

9:00 am **Welcome: Kristen Obeid**, Chair, Ontario Pest Management Conference
Opening Remarks and Introduction of Student Poster Presenters

9:15 am Local and landscape factors drive arthropod assembly in agricultural landscapes. **Aleksandra Dolezal,** E. Esch and A. MacDougall. (Student Competition)

9:30 am Efficacy testing of low risk products for the control of dollar spot (*Clarireedia jacksonii*). **Katherine Stone** and T. Hsiang. (Student Competition)

9:45 am Herbicide interactions and control of annual weeds in isoxaflutole-resistant soybean. **Andrea Smith,** A. Kaastra, D. Hooker, D. Robinson and P. Sikkema. (Student Competition)

10:00 am – 10:30 am **Coffee Break and Poster Viewing**

10:30 am Plenary Speaker:

Dr. Janna Beckerman
Professor, Department of Botany and Plant Pathology
Purdue University

"How IPM contributed to the current fungicide resistance crisis in apple disease management"

11:15 am When and where: Building a population dynamics model to understand outbreaks of an invasive midge. **Jenny Liu,** B. Mori, R. Weiss, O. Olfert, J. Newman and R.Hallett. (Student Competition)

11:30 am Occurrence and distribution of waterhemp (*Amaranthus tuberculatus* var. *rudis*) from Ontario and Quebec resistant to herbicides spanning four modes-of-action and control using HPPD-inhibiting herbicides. **Lauren Benoit,** B. Hedges, M. Schryver, N. Soltani, D. Hooker, D. Robinson, M. Laforest, B. Soufaine, P. Tranel, D. Giacomini and P. Sikkema. (Student Competition)

11:45 am Elevore – A new herbicide for preplant control of glyphosate-resistant weeds. **Dave Kloppenburg,** Corteva Agriscience. (Industry Speaker)

12:00 pm - 1:00 pm **Lunch and Poster Viewing**

AFTERNOON SESSION

Afternoon Session Chair: Dr. Tahera Sultana, Agriculture and Agri-Food Canada

1:00 pm Control of multiple-resistant Canada fleabane (*Conyza Canadensis* L. Cronq.) and waterhemp (*Amaranthus tuberculatus* var. *rudis*) with tolpyralate. **Brendan Metzger,** A. Raeder, D. Hooker, D. Robinson and P. Sikkema. (Student Competition)

1:15 pm Inactivation of *Rhizoctonia solani* in irrigation water using regenerative *in situ* electrochemical hypochlorination. **Serge Lévesque** and M. Dixon. (Student Competition)

1:30 pm Fitness and pleiotropism: Implication for the management of glyphosate-resistant common ragweed (*Ambrosia artemisifolia* L.). **Eric Page**, Agriculture and Agri-Food Canada. (Invited Speaker)

2:00 pm-2:30 pm **Coffee Break and Poster Viewing**

2:30 pm **Panel Discussion**

Natural selection: Getting a grip on resistance

Moderator: Rob Hannam (Synthesis Agri-food Network)

Panellists: Dr. Janna Beckerman (Purdue University),
Dr. John Andaloro (FMC)
Brian Rideout (Manitree Farms)
Mike Cowbrough (OMAFRA)

3:45 pm **Presentation of Student Competition Award Winners – Harold Wright**, CropLife Canada

Closing Remarks and Adjourn

PLENARY, PANELIST AND INVITED SPEAKER BIOGRAPHIES

Dr. Janna Beckerman - Professor, Department of Botany and Plant Pathology, Purdue University

Janna Beckerman is a professor and extension plant pathologist specializing in diseases of horticultural crops at Purdue University. She obtained her Ph.D. in plant pathology from Texas A&M University, and her M.S. and B.S. in biology from the State University of New York College of Environmental Science and Forestry, in Syracuse, NY. Dr. Beckerman has developed research and extension plant pathology programs on ornamentals, fruit crops, and hemp. In collaboration with Dr. Cliff Sadof, she developed four apps on plant pest diagnosis that are available in the iTunes store and Google Play (www.purdueplantdoctor.com); which have ranked as high as #2 in the Reference category. Her research focuses on developing environmentally sound disease management strategies that are economically feasible for growers of specialty crops, from apples to hemp to zinnia. The goal of her extension program is to enable commercial growers to effectively and sustainably manage both chemical (fungicide) and genetic (disease resistance) resources while protecting the environment. Janna went into plant pathology due to her natural gifts, namely a very black thumb, and although she tries not to take her work home with her, her yard and garden indicate that this is not the case. This is actually where she gets the best photos for her apps and other publications.

Dr.Eric Page - Research Scienctist, Agriculture and Agri-food Canada-Harrow

Eric Page is a Research Scientist in Weed Ecology and Crop Physiology at AAFC's Harrow Research and Development Centre. His work focuses on the study of herbicide resistant weeds and the interaction of cropping systems diversity and integrated weed management strategies. His research aims at providing a better understanding of the molecular mechanisms conferring resistance and exploring how pleiotropic effects may influence the persistence and spread of herbicide resistant traits. It is hoped that this will lead to more efficient ways to identify herbicide resistance in the field and help to improve management practices. Another area of research is the diversification of cropping systems in Southwestern Ontario. He is investigating how alternate winter crops, such as canola and peas, could be used to help diversify cropping systems and offer alternative strategies for managing herbicide resistant weeds. Eric holds a BSc Hons. degree in Ecology and Evolution from Western University, an MSc degree in Crop Science from Washington State University and a PhD in Plant Agriculture from the University of Guelph. He serves as Associate Editor for the Canadian Journal of Plant Science and is currently the President of the Canadian Weed Science Society.

Rob Hannam – Client Director, Synthesis Agri-food Network

Rob's passion for agriculture was cultivated while growing up on his family's grain farm near Guelph, Ontario. He is the President and Client Director of Synthesis Agri-Food Network, which provides consulting and communications services to clients in the agriculture sector. Rob is also the Co-Founder of AgNition Inc, a software development business that specializes in decision support tools apps for farmers.

Mike Cowbrough – Weed Management Specialist – Field Crops, OMAFRA

Mike is the Field Crops Weed Management Specialist for the Ontario Ministry of Agriculture, Food and Rural Affairs based in Guelph. His goal is to identify the major weed management issues facing the Ontario growers and then work with an awesome team of weed researchers to provide practical, economical and environmentally responsible solutions.

Dr. John T. Andaloro, Global Technical Product Manager, FMC Agricultural Solutions

John is a Sr. Research Fellow with FMC Ag Solutions at Stine Research Center in Newark, Delaware. He recently joined FMC after 35 years with the DuPont Company. As the Global Technical Product Mgr for Rynaxypyr® and indoxacarb insect control products, he manages global development programs, maintains their technical foundation, and transfers technical knowledge. John leads the FMC corporate effort to maintain pest susceptibility to its insecticide portfolio. John is an active leader in the International Insecticide Resistance Action Committee (IRAC) and led the effort to create intercompany resistance action teams in over 20 countries who develop and implement Insecticide Resistance Management (IRM) programs. He is also engaged at aligning company product labels with stewardship/ sustainability values and champions the incorporation of IRM into corporate business plans and culture. John initiated and coordinated the New York State Vegetable IPM programs in New York State while a member of the Entomology Staff at Cornell Univ (1978-82). His interest in economic entomology originated while participating in the production and crop protection of 20 vegetable crops on his family's 150 acre farm in New Jersey, USA. This led to John acquiring a Ph.D. in Entomology at the Univ of Massachusetts in 1978 following B.S. and M.S. degree efforts at Rutgers Univ.

Brian Rideout, Farm Manager, Manitree Fruit Farms and Director, Ontario Apple Growers

Brian farms with his wife's family, Rusty and Jean Smith in Chatham-Kent on the North shore of Lake Erie, where Brian has been the Field Manager for the last 20 years. His responsibilities are managing the growing and harvesting of the crop. The farm consists of 250 acres of fruit trees, tender fruit and apples. With 10 -15 acres of strawberries, 5 - 10 acres of field tomatoes and 40 acres of winter squash and melons. They also have a controlled atmosphere storage for 2500 bins of apples and 1000 bins of winter squash. Brian is a director with the Ontario Apple Growers, and has attended the Minor Use Priority Setting meetings in Ottawa on their behalf for the last 3 years.

–CROPLIFE STUDENT COMPETITION–

Student Oral Presentations:

OP-1 Local and landscape factors drive arthropod assembly in agricultural landscapes. **Aleksandra Dolezal,** E. Esch and A. MacDougall. **(Presentation Time: 9:15-9:30 am)**

OP-2 Efficacy testing of low risk products for the control of dollar spot (*Clarireedia jacksonii*). **Katherine Stone** and T. Hsiang. **(Presentation Time: 9:30-9:45 am)**

OP-3 Herbicide interactions and control of annual weeds in isoxaflutole-resistant soybean. **Andrea Smith,** A. Kaastra, D. Hooker, D. Robinson and P. Sikkema. **(Presentation Time: 9:45-10:00 am)**

OP-4 When and where: Building a population dynamics model to understand outbreaks of an invasive midge. **Jenny Liu,** B. Mori, R. Weiss, O. Olfert, J. Newman and R.Hallett. **(Presentation Time: 11:15-11:30 am)**

OP-5 Occurrence and distribution of waterhemp (*Amaranthus tuberculatus* var. *rudis*) from Ontario and Quebec resistant to herbicides spanning four modes-of-action and control using HPPD-inhibiting herbicides. **Lauren Benoit,** B. Hedges, M. Schryver, N. Soltani, D. Hooker, D. Robinson, M. Laforest, B. Soufaine, P. Tranel, D. Giacomini and P. Sikkema. **(Presentation Time: 11:30-11:45 am)**

OP-6 Control of multiple-resistant Canada fleabane (*Conyza Canadensis* L. Cronq.) and waterhemp (*Amaranthus tuberculatus* var. *rudis*) with tolpyralate. **Brendan Metzger,** A. Raeder, D. Hooker, D. Robinson and P. Sikkema. **(Presentation Time: 1:00-1:15 pm)**

OP-7 Inactivation of *Rhizoctonia solani* in irrigation water using regenerative *in situ* electrochemical hypochlorination. **Serge Lévesque** and M. Dixon. **(Presentation Time: 1:15-1:30 pm)**

Judges: Sean Westerveld - OMAFRA and Roselynne Labbé - AAFC (Judging Supervisors)

1. Jason Deveau – OMAFRA
2. John Purdy – Abacus Consulting Services Limited
3. Hannah Fraser – OMAFRA
4. Scott Hodgins – BASF

Student Poster Presentations:

GP-1 Fungicide application timing for the control of Stemphylium leaf blight of onion. **Sara Stricker**, B. Gossen and M.R. McDonald. **(Time of judging 9:15-9:30 am**)

GP-2 Evaluation of the effectiveness of experimental seed treatments on the management of soybean cyst nematode (*Heterodera glycines* Ichinohe; SCN) in dry bean (*Phaseolous vulgaris* L.). **Trust Katsande** and C. Gillard. **(Time of judging 11:15 am -11:30 pm)**

GP-3 Enhancing uncultivated canal berms to support natural enemy populations in the Holland Marsh agroecosystem. **Dillon Muldoon**, A. Stinson, M.R. McDonald and C. Scott-Dupree. **(Time of judging 1:00-1:15 pm)**

GP-4 Identifying clubroot resistance in canola and vegetable cultivars. **Sarah Drury**, B. Gossen and M.R. McDonald. **(Time of judging 9:45-10:00 am)**

GP-5 Timing is everything: Insecticide application timing to mitigate carrot weevil (*Listronotus oregonensis*) and carrot rust fly (*Psila rosae*) damage on carrots at the Holland Marsh, Ontario. **Alexandra Stinson**, D. Muldoon, M.R. McDonald and C. Scott-Dupree. **(Time of judging 11:30-11:45 am)**

GP-6 Potential for cultural control of bacterial spot (*Xanthomonas gardneri*) in field tomatoes (*Solanum lycopersicum* L) of southwestern Ontario. **Tina Simonton**, D. Robinson, C. Gillard, K. Jordan and C. Trueman. **(Time of judging 1:15 –1:30 pm)**

GP-7 Control of pathogens of *Triticum aestivum* using disease resistance activators. **Abdurraouf Abaya** and T. Hsiang **(Time of judging 9:30-9:45 am)**

GP-8 Avoiding a sticky situation: Can pepper weevil escape sticky traps? **Cassandra Russell** and R. Hallett. **(Time of judging 11:45 am -12:00 pm)**

**** Judging time - Students should be present at their poster at the time indicated.***

Judges: Sean Westerveld - OMAFRA and Roselynne Labbé - AAFC (Judging Supervisors)

1. Travis Cranmer - OMAFRA
2. Ashley Dickson – Syngenta Canada
3. Asifa Munawar – University of Guelph
4. Amanda Tracey – OMAFRA

-REGULAR POSTER PRESENTATIONS-

RP-1 Survey of clubroot (*Plasmodiophora brassicae*) pathotypes in canola and Brassica vegetable fields in Ontario in 2017. **Fadi Al-Daoud**, M. Moran, T. Cranmer, M. Celetti, B. Gossen, A. Tenuta and M.R. McDonald.

RP-2 The effect of wireworm, *Limonius agonus,* feeding on buckwheat roots. **Sophie Krowlikowski,** Y. Bohorquez, R. Renaud, T. McDowell and I.M. Scott.

RP-3 Incidence and management of hop downy mildew in Ontario in 2016 and 2017. **Asifa Munawar**, M. Filotas, C. Bakker, M.R. McDonald and K. Jordan.

RP-4 Assessment of transmission pathways for the presence of the cucumber downy mildew pathogen, *Pseudoperonospora cubensis*. **Asifa Munawar**, C. Bakker, C. McCreary and K. Jordan.

RP-5 Assessing incidence of eastern filbert blight in Ontario hazelnuts**. Asifa Munawar**, M. Filotas, C. Bakker and K. Jordan.

RP-6 Evaluation of remote weather station data for use in onion disease forecasting. **Jake Carson**, B. Gossen, A. Gadsden, P. Daggupati, M.R. McDonald.

RP-7 Recommendations for semi-field risk assessment protocols using the alfalfa leafcutting bee (*Megachile rotundata*) as a representative solitary bee. **Graham Ansell**, A. Frewin, A. Gradish and C. Scott-Dupree.

RP-8 Evaluation of new chemistries for the control of stem and bulb nematode in garlic. **Lilleth Ives,** M. Celetti, K. Jordan and M.R. McDonald.

RP-9 Managing anthracnose leaf curl (*Colletotrichum fioriniae*) of celery in Ontario through cultivar selection and disease forecasting. **Stephen Reynolds**, M. Celetti, K. Jordan and M.R. McDonald.

ORAL PRESENTATION ABSTRACTS
MORNING SESSION

CROPLIFE STUDENT COMPETITION (OP-1):

Local and landscape factors drive arthropod assembly in agricultural landscapes

Aleksandra Dolezal, E. Esch and A. MacDougall
Integrative Biology, University of Guelph, Guelph, ON

Increased homogeneity of agricultural landscapes in the last century has led to a loss of biodiversity and ecosystem services. However, management practices such as restored prairie grasslands and other semi-natural areas can offer supplementary resources to many beneficial arthropods. What remains unclear is what factors drive the persistence of arthropods in agricultural landscapes, and whether factors across different spatial scales and landscape contexts affect this. We assembled an extensive data set of arthropods in 22 study sites with a gradient of land use type to determine what drives abundance and richness of important arthropod groups and the factors that drive these responses. We quantified the local effects of plant diversification, on-farm effects and landscape effects on abundance and richness of four agriculturally important functional groups: herbivores, predators, parasitoids, and pollinators. We found that the dominant driver of arthropods on agricultural landscapes is plant diversity from all spatial scales. On the local scale, responses mainly depended on local habitat characteristics in restored prairie habitats such as plant composition and percent cover of C3 grasses, C4 grasses and forbs. On the farm scale, results differed by habitat type, with prairie grasslands delivering the greatest response, followed by woodlots and lastly crop habitats. Prairie restorations adjacent to crop also translated to 50% reduction of crop leaf damage. On the landscape scale, a positive relationship between percentage semi-natural areas surrounding study sites and arthropod abundance and richness was found. The opposite relationship was found with a higher percentage of crop land surrounding study sites. This study is significant because understanding mechanisms underlying the maintenance of arthropod assembly in agricultural landscapes can serve as an important model for understanding the ecological factors determining arthropod assembly more generally, while providing a framework for developing conservation plans.

CROPLIFE STUDENT COMPETITION (OP-2):

Efficacy testing of low risk products for the control of dollar spot (*Clarireedia jacksonii*)

Katherine Stone and T. Hsiang
School of Environmental Sciences, University of Guelph, Guelph, Ontario

Clarireedia jacksonii is a fungal pathogen that causes the disease dollar spot which inflicts significant aesthetic and economic damage to lawns and golf courses. Management of dollar spot is complex as some jurisdictions have pesticide regulations limiting use of pesticides for cosmetic purposes. The Ontario Ministry of Environment, Conservation and Parks defines Class 11 products as low risk and allows Class 11 products for cosmetic use. The objective of this research was to investigate whether select low risk products could reduce the damage caused by dollar spot on lab and field grown creeping bentgrass (*Agrostis stolonifera*). In lab tests and field plots, grasses were treated with ten compounds selected from the Class 11 list, Banner Maxx as a conventional fungicide control, and water as a control, and then inoculated with *C. jacksonii*. Lab tests were visually evaluated for percent yellowing at 7 and 14 days post inoculation (DPI), and field plots evaluated weekly up to 5 weeks following inoculation. Lab treatments were more effective at 14 DPI than 7 DPI with significant suppression by Banner Maxx, Sunlight dish soap, acetic acid, sodium chloride, hydrogen peroxide, phosphite, garlic powder, and ferric sulphate compared to the inoculated control. For field trials in

2017 and 2018, only Banner Maxx and ferric sulphate gave significant reductions in disease. Subsequent field trials focusing on ferric sulfate revealed the optimum concentration for dollar spot control was 261 g/100 m^2 with phytotoxicity starting to occur at 453 g/100 m^2 on creeping bentgrass.

CROPLIFE STUDENT COMPETITION (OP-3):

Herbicide interactions and control of annual weeds in isoxaflutole-resistant soybean

Andrea Smith[1], A. Kaastra[2], D. Hooker[1], D. Robinson[1] and P. Sikkema[1]
[1] Department of Plant Agriculture, University of Guelph, Ridgetown, ON
[2] Bayer CropScience, Guelph, ON

Herbicide-resistant (HR) weed biotypes are a growing concern globally. In response, transgenic crops are being developed with HR traits to provide innovative control options. Soybean cultivars with transgenes that confer resistance to the group 27 herbicide; isoxaflutole, are currently under development and will provide a novel herbicide mode-of-action for use in soybean. Field experiments were conducted in 2017 and 2018 using isoxaflutole-resistant soybean to determine the control of common annual grass and broadleaf weeds and to evaluate herbicide interactions between isoxaflutole (52.5, 79, and 104g a.i. ha^{-1}) and metribuzin (210, 315, and 420g a.i. ha^{-1}) on five unique soil types and to assess the efficacy of a two-pass herbicide program with a preemergence application of isoxaflutole plus metribuzin followed by glyphosate applied postemergence when weed escapes were 7.5cm tall. In these studies, isoxaflutole plus metribuzin (1:4 ratio), applied preemergence resulted in additive or a synergistic increase in weed control. Weed control differed across locations as influenced by rainfall, weed species composition and density, and soil type. Reduced weed control occurred when there was inadequate rainfall to activate the herbicides. Application of isoxaflutole plus metribuzin, applied preemergence, followed by glyphosate, applied postemergence, provided excellent full-season weed control. The judicious use of isoxaflutole-resistant soybean in a diverse, integrated crop/weed management program, can be a valuable tool reduce the selection intensity for additional HR weeds.

PLENARY PRESENTATION:

" How IPM contributed to the current fungicide resistance crisis in apple disease management "

Dr. Janna Beckerman
Professor, Department of Botany and Plant Pathology, Purdue University, West Lafayette, IN

One goal of integrated pest management (IPM) as it is currently practiced is an overall reduction in fungicide use in the management of plant disease. Repeated and long-term success of the early broad-spectrum fungicides led to optimism about the capabilities of fungicides, but to an underestimation of the risk of fungicide resistance within agriculture. In 1913, Paul Ehrlich recognized that it was best to 'hit hard and hit early' to prevent microbes from evolving resistance to treatment. This tenet conflicts with the fungicide reduction strategies that have been widely promoted over the past 40 years as integral to IPM. The authors hypothesize that the approaches used to implement IPM have contributed to fungicide resistance problems and may still be driving that process in apple scab management and in IPM requests for proposals. This paper also proposes that IPM as it is currently practiced for plant diseases of perennial systems has been based on the wrong model, and that conceptual shifts in thinking are needed to address the problem of fungicide resistance.

CROPLIFE STUDENT COMPETITION (OP-4):

When and where: Building a population dynamics model to understand outbreaks of an invasive midge

Jenny Liu[1], B. Mori[2], R. Weiss[2], O. Olfert[2], J. Newman[3], and R. Hallett[1]
[1]School of Environmental Sciences, University of Guelph, Guelph, ON
[2]Agriculture and Agri-Food Canada, Saskatoon, SK
[3]Department of Integrative Biology, University of Guelph, Guelph, ON

The presence of swede midge (*Contarinia nasturtii* Kieffer), an invasive insect from Eurasia, has caused a decline of over 60% of Ontario's canola acreage since 2011. If unchecked, it may spread into the Canadian prairies and have grave ramifications for Canada's $26.7 billion canola industry. New Ontario-specific swede midge development information were used to build a population dynamics model for reliable forecasting of swede midge emergence. Iterative changes were then made to model parameters (e.g. pupal development, diapause breaking temperature, etc.), in accordance with a partial set of robust pheromone trap data from Elora, Ontario. Finally, the model was validated against the remaining Elora trap data. Given several weather scenarios (i.e. warmer, unchanging, cooler), the model accurately predicts economically-damaging peaks of swede midge emergence throughout the growing season. Furthermore, the model uses long-term, regional climate data to provide a better understanding of the conditions under which midge outbreaks occur. This information may help mitigate future outbreaks and economic damage caused by this invasive midge.

CROPLIFE STUDENT COMPETITION (OP-5):

Occurrence and distribution of waterhemp (Amaranthus tuberculatus var. rudis) from Ontario and Quebec resistant to herbicides spanning four modes-of-action and control using HPPD-inhibiting herbicides

Lauren Benoit[1], B. Hedges[1], M. Schryver[1], N. Soltani[1], D. Hooker[1], D. Robinson[1], M. Laforest[2], B. Soufaine[3], P. Tranel[4], D. Giacomini[4] and P. Sikkema[1].
[1]Department of Plant Agriculture, University of Guelph-Ridgetown Campus, Ridgetown, ON.
[2]Agriculture and Agri-Food Canada, St-Jean-sur-Richelieu, QC.
[3]Départment de Chimie-Biologie, Université du Québec à Trois-Rivières, Trois-Rivières, QC.
[4]Department of Crop Science, University of Illinois, Urbana, IL, USA.

Multiple-resistant (MR) waterhemp (*Amaranthus tuberculatus* var. rudis) resistant to four herbicide modes-of-action (WSSA Groups 2, 5, 9, and 14) was confirmed by survey work completed in 2015, 2016 and 2017. In 2016 and 2017, waterhemp seed was collected from 22 locations in Ontario and 3 locations in Quebec, and screened for resistance to imazethapyr, atrazine, and glyphosate, respectively. Of the 25 seed lots tested, 100% were resistant to imazethapyr, 88% were resistant to atrazine, and 84% were resistant to glyphosate. Multiple resistance to imazethapyr, atrazine, and glyphosate was confirmed in 80% of the 25 seed lots screened. In 2015, 2016, and 2017, waterhemp seed was collected from 74 locations in Ontario or Quebec and screened for resistance to lactofen. Of the 74 seed lots screened in the greenhouse, 28% had individuals that showed some regrowth following the application of lactofen. Plant tissue from surviving 2017 plants was analyzed for the presence of the codon deletion that confers resistance to PPO-inhibiting (Group 14) herbicides. Of the 11 surviving 2017 populations that were tested for the codon deletion, four were positive. At 4 weeks after application (WAA), isoxaflutole + atrazine and mesotrione + atrazine, applied preemeergence, controlled waterhemp 93 and 91%, respectively. At 4 WAA, topramezone + atrazine and mesotrione + atrazine, applied postemergence, controlled waterhemp 87 and 93%, respectively.

INDUSTRY PRESENTATION:

Elevore – A new herbicide for preplant control of glyphosate-resistant weeds

Dave Kloppenburg
Corteva Agriscience

Elevore™ containing the active ingredient halauxifen is a new preplant herbicide option for soybean and field corn growers in Eastern Canada. Halauxifen is a member of the arylpicolinate class of synthetic auxin herbicides. This new class of auxins demonstrate a high binding affinity to the target site as well as favourable environmental profile. Elevore is highly active on broadleaf weeds at low use rates and exhibits rapid uptake and good phloem mobility leading to consistent performance on several key broadleaf species. In particular, Elevore is highly effective for burndown control of Canada fleabane (*Conyza canadensis*) including glyphosate resistant biotypes.

AFTERNOON SESSION

CROPLIFE STUDENT COMPETITION (OP-6):

Control of multiple-resistant Canada fleabane (*Conyza canadensis* L. Cronq.) and waterhemp (*Amaranthus tuberculatus* var. *rudis*) with tolpyralate

Brendan A. Metzger[1], A. Raeder[2], D. Hooker[1], D. Robinson[1] and P. Sikkema[1]
[1]Department of Plant Agriculture, University of Guelph, Ridgetown Campus, Ridgetown, ON
[2]ISK Biosciences Inc., Concord, OH

Tolpyralate, a recently commercialized herbicide, inhibits the 4-hydroxyphenylpyruvate dioxygenase (HPPD) enzyme in susceptible plants. Applied postemergence (POST), alone or in tank-mixtures with atrazine, tolpyralate provides control of several annual grass and broadleaf weed species in corn. Multiple-resistant (MR) Canada fleabane (Groups 2 and 9), and MR waterhemp (Groups 2, 5, 9 and 14), are an evolving weed management challenge for Ontario farmers. Field studies to examine tolpyralate dose response in these species, and compare to commercial standard herbicides were conducted in Ontario in 2017/2018 at four locations with populations of MR Canada fleabane, and at three locations with infestations of MR waterhemp. Treatments included six rates of tolpyralate from 3.75-120 g ai ha^{-1} applied alone or with atrazine in a 1:33.3 tank-mix ratio. Commercial standards included dicamba/atrazine (1500 g ai ha^{-1}) and bromoxynil + atrazine (280 + 1500 g ai ha^{-1}) for control of MR Canada fleabane, and dicamba/atrazine (1500 g ai ha^{-1}) and mesotrione + atrazine (100 + 280 g ai ha^{-1}) for control of MR waterhemp. Tolpyralate + atrazine applied at 50% of the label rate provided ≥90% control of GR Canada fleabane; however, a higher dose of tolpyralate was required for ≥90% control when applied alone. Similarly, tolpyralate + atrazine applied at the label rate provided ≥90% control of MR waterhemp; tolpyralate alone required a comparatively higher dose for equivalent control. Overall, these studies conclude that tolpyralate + atrazine provides excellent control of MR Canada fleabane and waterhemp in corn, and could be one part of an effective management strategy for these species.

CROPLIFE STUDENT COMPETITION (OP-7):

Inactivation of *Rhizoctonia solani* in irrigation water using regenerative *in situ* electrochemical hypochlorination

Serge Lévesque[1], M. Dixon[1], T. Graham[1], D. Bejan[2], J. Lawson[1] and P. Zhang[1]
[1] Controlled Environment Systems Research Facility (CESRF), School of Environmental Science, University of Guelph, Guelph, ON
[2]Electrochemical systems consultant for CESRF, Guelph, ON

Recirculating greenhouse irrigation water serves as a vital process to improve economic and environmental aspects in the industry. However, recirculating irrigation water poses a risk to crops due to pathogen proliferation, recalcitrant organic pollutants, and nutrient imbalances during operation. Water treatment technologies are used to treat irrigation water, although there are still challenges that arise with the use of these systems. Electrochemistry can be used in treating irrigation water in situ and regenerate disinfection products to limit pathogens with a high chlorine demand through mediated electrolysis, which allows irrigation water to be recycled more sustainably. An electrochemical flow cell (EFC) with Dimensionally Stable Anodes (DSA) (RuO2) was explored for its effectiveness against the mycelial plant pathogen Rhizoctonia solani. The EFC showed a log-reduction of 3.81 using 1.5 amps for a 1-minute contact time and log-reduction of 3.79 using 3 amps for a 30 seconds contact time. Effluent free chlorine concentrations were 20 times lower than the phytotoxic threshold for the majority of plants. A low concentration of effluent free chlorine is due to breakpoint chlorination with ammonium/ammonia in the irrigation solution. However, no significant changes to essential ions for plant growth have been found following treatment within these parameters.

INVITED SPEAKER:

Fitness and pleiotropism: implication for the management of glyphosate resistant common ragweed (*Ambrosia artemisiifolia* L.)

Eric Page[1], J. Bae[2] and R. Nurse[1]
[1] Agriculture and Agri-Food Canada, Harrow, ON
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The evolution of herbicide resistance confers a selectable advantage in the presence of the herbicide. In the absence of the herbicide, however, it has been hypothesize that negative pleiotropic effects associated with resistance may confer a fitness penalty, which could lead to the decline of the resistant biotype if the use of the herbicide was precluded. While fitness penalties have been demonstrated for mutations to herbicide target sites involved in photosynthetic electron transport, most recent attempts at quantifying fitness penalties associated with resistance to other modes of action have failed to measure an effect. In such cases, pleiotropic effects on weed phenology or physiology may play a more important role in determining the fate of the resistance trait. The objective of this research was to evaluate the link between glyphosate resistance and fitness in common ragweed and to determine what, if any, pleiotropic effects may be associated with the resistance trait. Following the introgression of the resistance trait into the susceptible background, the full life cycle of the second backcross generation (R_{BC2}) was compared to the parental susceptible biotype (PS). At maturity, no differences in seed number or seed weight were observed, however, the R_{BC2} plants were 26 cm shorter, accumulated 32% less biomass and flowered 13 d earlier than PS. These results indicate that, while there was no fitness cost associate with glyphosate resistance in common ragweed, the accelerated seed set and maturation associated with the resistance trait might influence the selection and efficacy of alternate weed control practices.

PANEL DISCUSSION:

Natural selection: Getting a grip on resistance

Moderator: Rob Hannam (Synthesis Agri-food Network)
Panellists: Dr. Janna Beckerman (Purdue University), Dr. John Andaloro (FMC), Brian Rideout (Manitree Farms), Mike Cowbrough (OMAFRA)

Resistance development to many existing products is exacerbated by a lack of new crop protection products coming to market. It is further compounded by regulatory requirements, including changes that have already resulted in the withdrawal or restricted use of some products. As the variety of available crop protection products declines, the likelihood of more pathogens, insects and weeds developing resistance to the fewer remaining products becomes higher as greater use is made of them. This panel discussion brings together an expert grower and professionals in resistance management from the fields of entomology, pathology and weed science. The overall objective is to develop a white paper with new ideas on how to counter resistance development and enhance the effectiveness and extend the lifetime of existing crop protection products, or optimize the future us of new ones.

POSTER PRESENTATION ABSTRACTS

STUDENT POSTER COMPETITION

GP-1:

Fungicide application timing for the control of Stemphylium leaf blight of onion

Sara Stricker[1], B. Goseen[2] and M.R.McDonald[1]
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Stemphylium leaf blight of onion, caused by *Stemphylium vesicarium*, can cause complete defoliation and lead to small, unmarketable bulbs. Growers typically use a calendar-based schedule to apply fungicides, which does not depend on weather conditions or pathogen biology. This can result in more applications than necessary, which is not economical for the grower and increases the risk of fungicide insensitivity developing. A field trial was established at the Muck Crops Research Station, King, Ontario, to evaluate the efficacy of seven fungicide timing treatments compared to an untreated check. Onion cv. LaSalle was direct seeded into organic soil. The treatments consisted of two pelleted fungicide seed treatments (Ergol Prime [penflufen] or Dynasty [azoxystrobin]) followed by sprays every 7–10 days, weekly sprays with two starting dates (2-leaf or 4-leaf growth stage), a mineral oil drench at emergence followed by weekly sprays, and two forecasting models (modified versions of TOMcast or BSPcast). The foliar fungicide treatment was Quadris Top (difenoconazole and azoxystrobin) alternated with Luna Tranquility (fluopyram and pyrimethanil). The weekly schedules resulted in five or seven applications of fungicides. The disease pressure for the 2018 season was high, and the forecasting models recommended five applications for TOMcast and six applications for BSPcast. The forecasting model treatments resulted in comparable disease as the weekly calendar sprays and used less fungicide product. Weekly foliar applications were unable to suppress blight incidence and severity, but fungicide seed treatment in combination with weekly foliar sprays can decrease foliar symptoms by 20-39% compared with the control.

GP-2:

Evaluation of the effectiveness of experimental seed treatments on the management of soybean cyst nematode (*Heterodera glycines* Ichinohe; SCN) in dry bean (*Phaseolous vulgaris* L.)

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Dry bean is a high value crop grown worldwide. Canada is the fourth largest dry bean exporter, making it a dry bean producer of global importance. SCN infestation is a major cause of yield loss in soybean (*Glycine max* (L.) Merr.), and dry bean is an alternate host of this pest. Unfortunately, knowledge of this threat to dry bean is limited, and there are no control measures currently available. The main objective of this study was to evaluate the effectiveness of the seed treatments BAS576AAS (BASF, Mississauga ON), *Bacillus amyloliquefaciens* (Valent, Guelph ON), *Pasteuria nishizawae* (Syngenta Crop Protection Inc., Guelph ON), *Bacillus firmus* and fluopyram (Bayer Crop Science Inc., Mississauga ON) for the control of SCN in a representative cultivar in the black and kidney bean market classes. Two field studies were conducted on naturally infested soils at Highgate and Rodney ON. Cyst counts, plant emergence and vigour, root rot and plant development data were collected. Two controlled environment studies were conducted in a growth cabinet, with each experimental unit inoculated with 4000 SCN eggs obtained from the Rodney site. The plants were grown for 30 days at 27^{O}C and a photoperiod of 16/8 h (day/night). SCN population numbers, plant development and above ground plant dry weight were measured at harvest. Results from each study will be discussed.

GP-3:

Enhancing uncultivated canal berms to support natural enemy populations in the Holland Marsh agroecosystem

Dillon Muldoon[1], A. Stinson[1], M.R. McDonald[2] and C. Scott-Dupree[1]
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The Holland Marsh (HM), Ontario, is an agroecosystem noted for vegetable production with a primary focus on carrots and onions. Sale of vegetable crops from the HM yields over $1 billion CDN annually. This is an intensively cultivated agroecosystem with negligible uncultivated habitat to support natural enemies of insect pests. Recent upgrades to the HM drainage system have provided an opportunity to investigate how enhancements to the uncultivated canal berms can affect beneficial insect complexes that include natural enemies. Five berm plots were established at the HM, each with 3 treatments. The three treatments were: (1) non-managed baseline control – grasses that were planted on the berms after construction to reduce erosion; (2) managed floral enhancement - a pollinator seed mix which includes clover, timothy, birdsfoot trefoil, common tansy, and butterfly milkweed; and, (3) managed floral and shrub enhancement – combination of the pollinator seed mix, butterfly milkweed, and two herbaceous shrubs species, red currant and haskap. Active and passive trapping was used to determine the abundance and diversity of natural enemies throughout the growing season. Insect pest populations were also monitored at the different berm sites. The goal of this project is to develop best management practices for the utilization and restoration of uncultivated canal berms at the HM focused on enhancing natural enemy populations to support conservation biological control and to ensure long term sustainability of this unique agroecosystem.

GP-4:

Identifying clubroot resistance in canola and vegetable cultivars

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Clubroot, caused by the obligate parasite *Plasmodiophora brassicae* Woronin, can reduce the yield of canola and Brassica vegetables by up to 100%. Once *P. brassicae* is present in a field, eradication is difficult, and the use of resistant cultivars is a cost-effective and environmentally-friendly method of managing the disease. The resistance of five canola (*Brassica napus* L). cultivars from Bayer Crop Science and two control cultivars was evaluated in a field trial. Vegetables were evaluated in a second trial: cabbage (*B. oleracea* var. *capitata*), cauliflower (*B. oleracea* var. *botrytis*), broccoli (*B. oleracea* var. *italica*), napa cabbage (*B. rapa* var. *pekinensis* and *B. rapa* var. *chinensis*) and rutabaga (*B. napus* var. *napobrassica*). The trials were conducted in organic soil naturally infested with *P. brassicae* pathotype 2 at the Muck Crops Research Station, King, Ontario. Significant differences in incidence and disease severity index (DSI) were found among the cultivars in both trials. In the canola trial, the three resistant cultivars had an average DSI of 1.0% while four cultivars had an average DSI of 97.4%. The resistant canola cultivars had a 2.3-fold greater shoot fresh weight than the susceptible cultivars. In the vegetable trial, the broccoli cultivars were susceptible, the rutabaga cultivars had an intermediate resistance, and cabbage and cauliflower had both resistant and susceptible cultivars. The resistant cauliflower cultivar had a 2.8-fold greater shoot fresh weight than the susceptible cauliflower cultivar. This research will help Ontario growers to select cultivars if *P. brassicae* pathotype 2 is present in their fields.

GP-5:

Timing is everything: Insecticide application timing to mitigate carrot weevil (*Listronotus oregonensis*) and carrot rust fly (*Psila rosae*) damage on carrots at the Holland Marsh, Ontario

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and C. Scott-Dupree[1]
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Carrot weevil (CW) (*Listronotus oregonensis*) and carrot rust fly (*Psila rosae*) both cause direct damage to carrots grown at the Holland Marsh, Ontario, resulting in up to 40% yield loss. Results from the existing integrated pest management (IPM) program have shown that efficacy of the recommended control practices is decreasing, especially for CW. Potential causes for this decreasing efficacy are: 1) an increase in pest resistance to phosmet, the primary insecticide used to control CW; and, 2) emergence of novel behaviour in CW, including earlier spring activity and a possible 2^{nd} generation later in the season. In 2014, the insect growth regulator novaluron was registered for use on carrots and has proven to be significantly more effective at reducing CW damage than phosmet. Currently, the most effective application-timing schedule for novaluron is unknown. In 2018, trials with different timings of novaluron applications were conducted at the University of Guelph - Muck Crops Research Station, Holland Marsh, ON. Preliminary results indicated that carrots sprayed at the 2^{nd} true leaf stage (TLS) with novaluron had significantly less damage than untreated carrots, and carrots sprayed at both the 2^{nd} and 4^{th} TLS escaped almost all damage. This research will benefit growers by providing recommendations for the optimal timing of novaluron applications to effectively minimize damage from the CW and carrot rust fly, while preventing over application and reducing insecticide costs.

GP-6:

Potential for cultural control of bacterial spot (*Xanthomonas gardneri*) in field tomatoes (*Solanum lycopersicum* L*)* of Southwestern Ontario

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Bacterial spot (*Xanthomonas gardneri*) of tomatoes is a major issue in Ontario field tomato production. There is widespread tolerance to copper-based chemical controls and few effective alternatives. The importance of transmission at or just prior to transplanting is unknown. To evaluate this, *X. gardneri* movement in irrigated trailers and planting equipment was studied in controlled environments. In the first study, symptomatic seedlings were placed at the top of a simulated plug trailer with healthy seedlings placed 30.5, 61.0, 91.5, and 122 cm below in four separate replicated experiments with different irrigation treatments. The Irrigation treatments (top to bottom, bottom to top, tray dip) were applied and trays were incubated overnight inside the trailer. Disease incidence (percent seedlings with symptoms) in the top to bottom (3.9%) and bottom to top (5.4%) irrigation treatments were equivalent and greater than the dip treatment (0.4%) 14 days after irrigation. All irrigation treatments had higher disease incidence than the control. Symptoms were observed on seedlings located at all distances below the inoculation tray. In a separate study, wet or dry symptomatic seedlings were passed through a transplanter prior to healthy seedlings. Epiphytic *X. gardneri* (4,627 – 1,405 CFU/g of fresh tissue) was detected on healthy seedlings after 14 days on wet and dry treatments, demonstrating the potential for disease spread on transplanting equipment. Preliminary results indicate *X. gardneri* transmission is possible in plug trailers and during transplanting; this may play a role in field epidemics.

GP-7

Control of pathogens of *Triticum aestivum* using disease resistance activators

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This study was carried out to evaluate the effects of potential disease resistance activators humic acid (HA), phosphite (P), para aminobenzoic acid (PABA), salicylic acid (SA), and Civitas-Harmonizer (C-H), as well as the fungicide Banner Maxx on *Triticum aestivum* grown in 100 mL tubes for reducing disease caused by *Fusarium graminearum*, *Microdochium majus*, or *Waitea circinata* under controlled environment conditions. The treatment concentrations were as follows: HA (1% to 9%), P (1%), PABA (1 mM to 100 mM), SA (4 mM, 10 mM), C-H (0.2%, 1%, 2%, and 4%), and Banner (0.05%). These were sprayed onto wheat leaves (10 mL/plant at 3 to 4 leaf stage) twice with 5 days between, and then inoculated with mycelial plugs 5 days later. Disease severity (lesion length) was assessed at 3 to 12 days post inoculation. The results showed that disease caused by *F. graminearum* was significantly reduced by 30 mM PABA (86% disease reduction), 1% HA (85% reduction), 10 mM SA (79% reduction), 1% P (70% reduction), and 2% C-H (67% reduction). Disease caused by *M. majus* was significantly reduced by 0.2% C-H (94% reduction), 1% HA (70% reduction), and 1% P (37% reduction). Disease caused by *W. circinata* was significantly reduced by 30 mM PABA (96% reduction). Banner Maxx prevented disease entirely. Future work will investigate the mode of action of the potential disease resistance activators.

GP-8

Avoiding a sticky situation: Can pepper weevil escape sticky traps?

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The pepper weevil (*Anthonomus eugenii*) has become a significant pest of field and greenhouse peppers in southwestern Ontario. Current monitoring strategies fail to detect pepper weevil presence before economic damage occurs. The efficacy of the current commercially available pepper weevil trap is under scrutiny and a more effective trap design and lure are required. As part of a larger improved monitoring and management study, five brands of sticky cards and/or adhesives were assessed for the ability of weevils to move and escape from the traps. Weevils were able to move on all brands of sticky traps, so alternate trap designs should be considered for future monitoring programs.

REGULAR POSTERS

RP-1:

Survey of clubroot (*Plasmodiophora brassicae*) pathotypes in canola and Brassica vegetable fields in Ontario in 2017.

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Plasmodiophora brassicae Woronin causes clubroot on several economically important brassica crops in Canada. Clubroot is endemic on brassica vegetables in many regions of Ontario, and in 2016 it was reported for the first time on canola in Ontario. A previous clubroot survey in 1969 identified pathotype 6 on cabbage and cauliflower and pathotype 2 from a field of clubroot-infected rutabagas. The predominant pathotype of *P. brassicae* was assessed from six canola fields and seven vegetable fields in Ontario in 2017. The inoculum from clubbed roots was increased on a susceptible host (Shanghai pak choy cv. 'Mei Qing Choi', *Brassica rapa* var. *chinensis*). The resulting clubs were harvested at 6 weeks after inoculation and used to inoculate cultivars that comprise the Williams' differential set. Four replicates were used with 5–6 plants per experimental unit. Plants were rated for clubroot symptoms using a 0-3 scale at 5 wpi, and a disease severity index (DSI) was calculated. A host was resistant if DSI + 95% confidence interval < 50%; otherwise it was susceptible. Samples from four canola fields were pathotype 2, one was pathotype 5, and one was pathotype 8. Samples from four vegetable fields were pathotype 6, two were pathotype 5, and one was pathotype 2. Therefore, the most common pathotype in canola fields is pathotype 2 and in vegetable fields it is pathotype 6.

RP-2:

The effect of wireworm *Limonius agonus* feeding on buckwheat roots

Sophie Krowlikowski, Y. Bohorquez, R. Renaud, T. McDowell and I.M. Scott
Agriculture and Agri-Food Canada, London, ON

Buckwheat (*Fagopyrum esculentum*) roots possess chemicals that have allelopathic properties that supress weeds and certain soil dwelling insects. Planting buckwheat as a rotation crop before potatoes significantly reduces damage and increases marketable yield in wireworm-infested fields. Preliminary chemical characterization of buckwheat has indicated it possesses a complex array of phytochemical components, the majority of which remain unidentified. In order to determine which phytochemicals produced by the roots are associated with the anti-insect activity, field experiments were conducted for two consecutive years (2016-17). Half of the microplot tiles planted with buckwheat or barley (*Hordeum vulgare*) were infested with wireworms (*Limonius agonus*) three weeks after seeding. Soil and plants were sampled at 3, 6 and 9 weeks, while wireworm were sampled at 4.5 (2017 only), 6 and 9 weeks. In buckwheat tiles wireworm survival was lower after 6 or 9 weeks compared to barley. Most of the wireworm collected from all treatment tiles remained in the top two soil depths (0-10 cm and 10-20 cm) regardless of plant type. The roots were longer and weighed more within tiles infested by wireworm suggesting a plant growth over-compensation due to herbivory since the weight gain of surviving wireworm was no different between plant types. A metabolomic analysis approach determined chemical differences between plant types and growing periods. A comparison of compounds in the roots from both infested and un-infested tiles indicate induced chemical levels as well as different compounds present after herbivory which may explain the differences in wireworm survival.

RP-3:

Incidence and management of hop downy mildew in Ontario in 2016 and 2017

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Hop downy mildew (HDM), caused by *Pseudoperonospora humuli*, is one of the most devastating diseases of hops. The pathogen can overwinter in dormant buds or rhizomes causing a persistent systemic infection and subsequent infection of bines and cones. Due to the systemic nature of the infection, applying fungicides with systemic activity in the plant is an important management tool. The only systemic fungicide registered for hops in Canada is metalaxyl but resistance of *P. humuli* against this fungicide is unknown in Ontario. This project is designed to determine the incidence of HDM in Ontario commercial hop yards and to evaluate the resistance of the pathogen to metalaxyl. In 2016 and 2017, the incidence of HDM varied among cultivars and was greatly affected by weather conditions. Eighty-four rhizomes were screened for systemic presence of *P. humuli* through polymerase chain reaction (PCR) using primers designed for ribosomal internal transcribed spacer DNA of the fungus. Approximately 30% of the 84 rhizomes showed systemic infection in PCR and percentage of infection varied from yard to yard. In preliminary work on resistant populations of *P. humuli*, eight downy mildew infected spikes from a conventional hop yard and one spike from an organic hop yard was tested for metalaxyl sensitivity. All spikes from the conventional yard were found resistant to metalaxyl at 50 and 100 ug/ml, whereas the spike from the organic yard was sensitive to the fungicide at both tested concentrations. Future work will focus on testing *P. humuli* populations from more hop yards.

RP-4:

Assessment of transmission pathways for the presence of the cucumber downy mildew pathogen, *Pseudoperonospora cubensis*

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Pseudoperonospora cubensis (Berkeley & Curtis) Rostovtsev, is responsible for one of the most important foliar diseases of cucumber, namely downy mildew (DM). Symptoms include yellow angular lesions on the leaf surface and production of sporangia on the underside of the leaf. Control of DM depends on an intensive fungicide program which is not always feasible due to high cost of fungicides and evolution of resistant pathogen populations. The current project is focused on investigating cucumber seeds and fruit and alternative DM hosts as inoculum sources in a Canadian environment. In year 1-2 of the study, 295 fruit collected from infected cucumber fields were tested microscopically and none were found infected. Approximately, three-thousand cucumber seeds were grown for 4-weeks in a greenhouse under ideal conditions for DM symptom development. Leaves of 108 plants developed yellow lesions similar to DM but did not show sporulation. However, a polymerase chain reaction (PCR) showed all tested symptomatic leaf samples were positive for ribosomal internal transcribed spacer DNA of *Pseudoperonospora*. PCR analysis on individual seeds, harvested from fruit of severely infected cucumber plants showed 96% of them positive for *Pseudoperonospora*. Four cucurbits namely, golden-creeper, bitter-melon, wild and bur cucumber were tested as alternative hosts using a detached leaf inoculation method. All cucurbits developed DM symptoms 3-5 days after inoculation and showed sporangial production. The last year of this study will generate data to confirm cucumber fruit and seeds, and alternative hosts as possible inoculum sources for DM and provide recommendations for disease management.

RP-5:

Assessing incidence of eastern filbert blight in Ontario hazelnuts

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Eastern filbert blight (EFB), caused by the fungus *Anisogramma anomala* (Peck) E. Müller, is the main disease affecting hazelnut trees in eastern North America. This pathogen is an obligate, biotrophic parasite and is known to attack only species of the genus *Corylus* L. To support increased production of this crop in Ontario, there is a need to better understand the overall incidence and severity of this disease in commercial orchards in the province, and how that varies among cultivars, ages of orchards and management practices. It is also important to determine the incidence of latent infection in asymptomatic trees as symptom development usually takes place 1-1.5 years after the initial infection. Six hazelnut orchards in Ontario were scouted for visible symptoms of EFB infection from February-March 2018. The incidence of EFB varied from orchard to orchard and ranged from less than 1% to 12 %. The young trees in orchard 1-3 had severe cankers although the number of symptomatic trees was small. The cultivars 'Yamhill' and 'Jefferson' were also found infected although these cultivars are reported to be resistant in Oregan. The latent infection was assessed in the twigs of twenty-five asymptomatic trees from orchards 1-4 using polymerase chain reaction method. Orchard 1 had the highest percentage of latent infection (64 %) followed by orchard 3 (44 %) and orchard 4 (20%). Orchard 2 had the lowest infection (4%). The trees that tested positive for latent infection have been marked and will be monitored for symptom development in fall 2018.

RP-6:

Evaluation of remote weather station data for use in onion disease forecasting

Jake Carson[1], B. Gossen[2], A. Gadsden[3], P. Daggupati[3] and M.R. McDonald[1].
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Stemphylium leaf blight (SLB) caused by *Stemphylium vesicarium* and onion downy mildew (ODM) caused by *Peronospora destructor* can cause severe losses to onion crops in Ontario. The objective of this study was to determine if forecasting models for SLB and ODM could provide effective disease predictions based solely on local weather data. Disease forecasting models have been developed for ODM (gDowncast and dvgDowncast) and are in development for SLM based on TOMCast and BSPcast. The models recommend fungicide application based on environmental conditions favorable for disease development. This allows for precise timing of application, reducing both direct costs and the risk of development of fungicide insensitivity. Forecasting, in combination with scouting and spore trapping, has been used successfully to manage of ODM in the Holland Marsh. However, the models may be less effective for use at remote locations, where scouting and spore trapping are not feasible. One HOBO U30 Remote Monitoring System with smart sensors was placed in a commercial onion field in each of the Holland, Keswick, and Grand Bend marshes, where a majority of Ontario's onion production occurs. Data from the HOBOs was fed into TOMCast, BSPcast, gDowncast, and dvgDowncast to predict disease pressure. Incidence and severity were assessed weekly in plots (100 plants) in seven nearby fields. SLB incidence was 100% in each field, but severity varied by region. No onion downy mildew was found because growers applied fungicide when alerted to the risk of ODM development in their region.

RP-7:

Recommendations for semi-field risk assessment protocols using the alfalfa leafcutting bee (*Megachile rotundata*) as a representative solitary bee

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Solitary bees provide important pollination services to natural and agro-ecosystems. Solitary bees differ substantially from honey bees (*Apis mellifera*) most notably in sociality, nesting practices, and physiology. These differences indicate that current bee pesticide risk assessment practices which focus currently only on *A. mellifera* may not be sufficiently protective of solitary bees. Therefore, there is international effort to develop pesticide risk assessment methods for solitary bees. We conducted several experiments aimed at the development of a semi-field experimental design for use with the alfalfa leafcutting bee (ALB, *Megachile rotundata*), one of the purposed surrogate solitary bee species for risk assessment in North America. We discuss potential surrogate plants; optimal adult release rates; and techniques for measuring foraging activity, nesting behaviour, and reproduction for ALB semi-field experiments on small field plots and provide recommendations for the use of dimethoate as a toxic reference standard with ALB.

RP-8:

Evaluation of new chemistries for the control of stem and bulb nematode in garlic

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[2]Onario Ministry of Agriculture, Food and Rural Affairs, Guelph, ON

Stem and bulb nematodes (SBN), *Ditylenchus dipsaci*, are a problem for garlic growers in Ontario as this nematode reduces yield and infests seed cloves for successive planting. There are no resistant garlic cultivars and no nematicides registered for garlic seed cloves in Canada, thus chemical products must be evaluated for managing this nematode. Field trials were conducted on both muck (high organic matter) and mineral soil, in southern Ontario. The objective of these trials was to evaluate the efficacy of different chemical products as soak, seed fumigant or in-furrow drench treatments in garlic cloves naturally infested with SBN. The treatments were: abamectin, aluminum phosphide, flufensulfone, fluopyram, and thyme oil. An untreated check and a check of clean seed were also included. At harvest, bulbs were counted, weighed, and rated for nematode damage. Significant differences in total and marketable yields were found among the treatments at both sites. All treatments containing fluopyram resulted in significantly higher yields than the other treatments, including the clean seed. Differences in nematode counts from soil and plant tissue were found at both sites. Fluopyram applied as a soak or drench resulted in greatest reduction of nematodes recovered from plant and soil. Abamectin applied as a soak also provided good nematode control, while soil treatments with thyme oil and abamectin were ineffective. On muck soil there was a positive correlation between nematodes/kg soil and the disease severity index. These studies demonstrate that control of SBN may be obtained by soak and drench applications fluopyram.

RP9:

Managing anthracnose leaf curl (*Colletotrichum fioriniae*) of celery in Ontario through cultivar selection and disease forecasting

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Anthracnose leaf curl, caused by *Colletotrichum fioriniae*, is a relatively new disease on celery in Ontario. Chemical control is important for managing leaf curl, however, development of fungicide resistance is a major concern. The objectives were to improve disease management by identifying effective disease forecasting models for timing fungicide applications based on disease risk, and screening for cultivar resistance. Field experiments were conducted in 2016, 2017 and 2018 at the Holland Marsh. Disease forecasting models evaluated were: TOMCAST with a threshold of 15 DSV (disease severity value), TOMCAST 25 DSV, the strawberry anthracnose model (SAM) with a threshold of *INF* (predicted proportion of fruit) >0.15, SAM *INF* >0.50 and BOTCAST at a cumulative disease severity index of 21. A calendar spray and a no-spray control were included. The fungicide Quadris Flowable (azoxystrobin 25%) was alternated with Switch 62.5WG (cyprodinil 37.5% and fludioxonil 25.0%), and was applied when the models indicated. Disease pressure was high in 2016 and 2018, and TOMCAST models and SAM *INF* >0.50 were as effective as the calendar spray program, but with fewer sprays. In 2017, disease pressure was lower. TOMCAST and SAM were both effective, while BOTCAST was not suitable for predicting disease risk. Thirteen cultivars were evaluated for resistance to *C. fioriniae*. Cultivars ‘Balada’, ‘Geronimo’, ‘Merengo’, ‘TZ 6010’ and ‘Hadrian’ remained among the least susceptible, while cultivars ‘TZ 9779’, ‘Stetham’ and ‘Kelvin’ were the most susceptible. Leaf curl can be managed using TOMCAST and SAM, and selecting cultivars that are the least susceptible to infection.

Post Event Evaluation – Ontario Pest Management Conference

Background

Profession: (Please circle) Research Government Grower Consultant Industry Rep

Input Supplier (retail/distribution) Student Other_____________

Overall Feedback

1. How would you rate the following aspects of the conference? (circle the most appropriate number)

	Poor	Fair	Average	Good	Excellent
The content of the sessions	1	2	3	4	5
The speakers	1	2	3	4	5
The length of the sessions	1	2	3	4	5
The media used by the speakers	1	2	3	4	5
Practical information on pest management	1	2	3	4	5
The poster session	1	2	3	4	5

2. What session did you like the best/find most effective (and why)?

3. What sessions did you find the least helpful (and why)?

4. Please suggest changes we could make that would significantly improve the conference.

5. Please indicate the extent to which you agree or disagree with the following statements concerning the conference:

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Topics were current.	1	2	3	4	5
It improved my understanding of new directions in pest management.	1	2	3	4	5
The information will influence my planning/work within the next two years.	1	2	3	4	5
In the end, I got what I needed from the conference.	1	2	3	4	5
The registration process was convenient and easy to use.	1	2	3	4	5

6. Overall, how satisfied were you with the conference?

Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
1	2	3	4	5

Thank you very much for taking the time to complete this survey. Your feedback will help us in organizing future events. If you would like to be included in a draw to thank you for completing the survey, please fill out your name and contact information below, then detach it from this form and place it in the container provided.

OPMC
Ontario Pest Management Conference

DETACH AT DASHED LINE TO ENTER DRAW.

OPMC Survey Draw

NAME **EMAIL/PHONE NUMBER**