Summary of Presentations

From the

XXV International Congress of Entomology

Orlando, Florida September 25-30, 2016

Summarized by: John Gavloski, Entomologist, Manitoba Agriculture.

The following are highlights from some of the presentations most pertinent to agronomists and farmers in Manitoba. Please contact me for further information on these presentations or meetings. Due to there being concurrent sessions at these meetings, there were many more presentations than what is presented in this summary. These were selected because of their relevance or potential interest to those working in agriculture in Manitoba. I have categorized the presentation reported by commodity group or discipline.

The information presented is a combination of material from oral presentations, poster presentations and provided as abstracts for the various symposiums. Many presentations have multiple authors, however only the presenting author is reported in this summary.

Pulse Crops

Field demonstration of different insecticide strategies for management of soybean aphids, *Aphis glycines*
Janet Knodel , North Dakota State University

- Soybean producers need to scout fields for seasonal aphid populations, and apply foliar insecticides at the established economic threshold (E.T.) of 250 aphids per plant to prevent yield losses.
- The goal of this research was to determine which management strategy provided the best management of soybean aphid: foliar-applied insecticides, an insecticide applied as a seed treatment, or a *Rag1* aphid resistant soybean variety. 3 different insecticide mode of actions were evaluated pyrethroid (lambda-cyhalothrin), organophosphate (chlorpyrifos) and pyrethroid + neonicotinoid (beta-cyfluthrin + imidacloprid).
- Insecticide treatments were applied at R1 (beginning bloom) and at E.T. This study was conducted at 3 field sites each year from 2012 to 2015.
- Results indicated that application timing was more important than insecticide mode of action. **The best timing for foliar insecticide application was at the economic threshold**, because there was no significant yield gain from spraying before the economic threshold was reached.
- **The use of an insecticide seed treatment did not keep soybean aphids from reaching the economic thrshold**, and there was no demonstrated yield advantage to using an insecticide seed treatment.

Length of thiamethoxam seed treatment activity against soybean aphid (*Aphis glycines*)
Carlos Esquivel **,** Entomology, Ohio State University.

- Controversially, neonicotinoid seed coating apparently does not provide significant control of aphids during the vegetative growth of soybeans, and its prophylactic use has been questioned (Johnson et al. 2009, Magalhaes et al. 2009). Thus, this study focuses on quantify the control efficiency of aphids by neonicotinoid seed coating in soybeans.

- In brief, we used the neonicotinoid-treated soybean material CruiserMaxx Beans® (Syngenta®, Greensboro, NC), and soybean aphids Biotype-1 and Biotype-4. Seed coating was removed from seeds as control treatment. Soybean plants were grown under greenhouse conditions at the Ohio Agricultural Research and Development Center, Wooster, Ohio. Plants were infested with aphids at 7, 14, 28, 35, and 42 days after sowing. Soybean survival was recorded every 24 h the following three days after infesting.
- At early stages of the crop, aphids showed significant lower survival on seed-coated treatments than control. In contrast, at 35 days after planting aphid survival was similar between all treatments. Aphid Biotype-1 and Biotype-4 performed similarly on all treatments.
- **Our study suggests that neonicotinoid seed coating begins to lose its efficacy to control aphids around 35 days after planting.**

The influence of landscape complexity and natural enemy movement on soybean aphid populations in Manitoba, Canada

Ishan Samaranayake**,** Department of Entomology, University of Manitoba.

- Transient generalist predators have been shown to strongly suppress soybean aphid (*Aphis glycines)* populations in North America. The movement of generalist predators between neighbouring fields has rarely been quantified however.
- We assessed how agricultural landscape complexity and the patterns of predator movement affected soybean aphid suppression in 27 soybean fields in Manitoba over a two year period. We quantified soybean aphid suppression using predator exclusion cages, predator movement by using bidirectional malaise trapping and landscape complexity by digitally mapping land cover in a 2 km radius from focal fields.
- We observed strong to moderate suppression of soybean aphids across the province during both years. Soybeans, cereals, and canola were the major land-cover types found across landscapes.
- The proportion of cereal crops and between-field movement of Coccinellids (Lady beetles) and aphidophagous green lacewings had a negative relationship with aphids exposed to predation, suggesting that incipient aphid colonies in soybeans may be subject to high levels of predation in landscapes dominated by cereal crops.
- Alternately, field border grass and natural vegetation showed a positive association with soybean aphids suggesting that predators move back to non-crop habitats when aphid populations are negligible in soybean fields.

Effects of defoliation on Mississippi soybean yields

Benjamin Thrash, Mississippi State University.

- Previous research has shown that excessive foliage loss that occurs during the R3-R5 growth stages can have devastating effects on yield. The objective of these tests were to refine the current treatment recommendations by simulating situations commonly encountered by producers.
- Tests were conducted during the 2015 growing season in the hills and delta region of Mississippi. Soybeans were defoliated at various levels and growth stages throughout the growing season to mimic the effects of compounding defoliation. Leaf area index and heights were recorded periodically throughout the season, as well as, yields at the end of the season.
- Compounding defoliation resulted in yield loss that was additive in effect and lowered leaf area index values which correlated with lower soybean yields.

- **Soybeans planted later in the season had larger yield reductions when defoliated at V4 than those planted earlier in the season.** These tests could help producers by creating a variable threshold based on planting date or defoliation that occurred during previous growth stages.

Integrated pest management in dry bean production in California
Rachael Long**,** University of California.

- In California, U.S., we produce 4 classes of beans: garbanzos (chickpeas), limas (baby and large), cowpeas (blackeyes), and common beans (such as kidney and cranberry) planted on 50,000 acres and valued at $70 million.
- The western tarnished plant bug Lygus, *Lygus hesperus*, is the major pest of dry beans in California, affecting yield and seed quality. Insecticides are currently the primary means for managing this pest due limited alternative control methods.
- 5 years of research data on cowpea and lima beans showed that pyrethroids are working well for lygus control, as well as the insect growth regulator novaluron mixed with a pyrethroid to control the adults. Dimethoate and indoxacarb were moderate for lygus management.
- The non-registered material flonicamid was less effective on lygus; however, clothianidin and sulfoxaflor, showed potential for managing lygus in dry beans with increased bean yields.

Effects of surrounding landscape complexity on bee communities and pollination to soybean
Ashley St. Clair, Iowa State University.

- Pollinators are experiencing declines due to habitat loss. Part of this loss is due to increased agricultural land use, and it is vital to understand how pollinators utilize agricultural areas.
- Surrounding landscape complexity affects non-pollinator insect communities in soybeans, but the extent to which landscape complexity affects wild and managed pollinators, and resulting pollination to soybean, is unknown. It is also not yet known if managed honey bee hives near soybean fields will increase visits by honey bees (Hymenoptera: Apidae, *Apis mellifera*) to soybean flowers nor the effects of these hives on wild bee abundance and diversity.
- To better understand the dynamics between wild and managed pollinators, the surrounding soybean landscape, and pollination services, we identified commercial soybean fields surrounded by either a simple (73% or greater comprised of soybean and corn within 1.6 km radius) or complex (46% or less corn or soybean habitat within 1.6 km radius) landscape in central Iowa.
- On a subset of each landscape type, we placed four honey bee hives adjacent to soybean fields. Pan traps ("bee-bowls") were used to estimate the diversity and abundance of pollinators, with a focus on bees and flies. In addition, we also examined whether the presence of honey bee hives positively affected soybean yield.
- Preliminary results from the first year of a three year study suggest managed honey bee hives are associated with increased honey bee foraging activity and increased yield.
- Additional notes: Iowa State STRIPs Program **(**Science-based Trials of Rowcrops Integrated with Prairie Strips**)** - https://www.nrem.iastate.edu/research/STRIPs/ was discussed.
- The website for this program states that prairie strips are an affordable option for farmers and farm landowners seeking to garner multiple benefits. By converting just 10% of a crop field to diverse, native perennials farmers and farmland owners can reduce the amount of soil leaving their fields by 90% and the amount of nitrogen leaving

their fields through surface runoff by up to 85%. Prairie strips also provide potential habitat for wildlife, including pollinators and other beneficial insects.

Canola

A three-year field study on the biological control of diamondback moth (*Plutella xylostella*) in Saskatchewan, Canada

Md Habibullah Bahar, Agriculture and Agri-Food Canada, Charlottetown.

- Surveys on the insect parasitoids of diamondback moth (DBM) (*Plutella xylostella*) were conducted in canola-growing areas across four ecoregions, Boreal Transition, Aspen Parkland, Moist Mixed Grassland and Mixed Grassland in the province of Saskatchewan, Canada during the summers of 2012 to 2014. In each year forty canola fields 40 to 80 km apart were sampled.
- DBM larvae were collected using sweeping nets of 400 sweeps in each field, three times in each year at early, middle and late summer. DBM larvae were counted and reared in the laboratory until adult emergence to determine the parasitism.
- In all years, DBM abundance was highest in the Mixed Grassland, in the southern part of the province, and lowest in Boreal Transition, in the northern region of the province.
- Overall, DBM **larval parasitism was higher in the Boreal Transition than in the other three eco-regions**. **The high larval parasitism in the Boreal Transition can be explained by the fact that most of the agricultural lands in the ecoregion are surrounded by treed borders which may serve as resource areas for natural enemies.**
- In 2013, a scarcity of DBM larvae in mid-season reduced the number of parasitoids, and as a result, a high incidence of DBM was seen in late-season, suggesting that biological control is an important influence on DBM populations.
- In 2014, a parasitic wasp, *Diolocogaster claribitia* (Hymenoptera, Braconidae, Microgastrinae), was found, a new record for the province

Sunflowers

Neonicotinoids in sunflower (*Helianthus annuus*) extra-floral nectar: How are beneficial insects affected?

Mike Bredeson, South Dakota State University.

- The use of neonicotinoid insecticides as seed dressings has become nearly ubiquitous within conventional row crop agriculture. The extensive use of such products have conservationists and researchers concerned for the health of non-targeted organisms which might be exposed to the insecticide through a number of pathways.
- Over three site years, both insecticide treated (Cruiser®, rate: 0.25 mg a.i. (thiamethoxam)/seed) and untreated sunflower (*Helianthus annuus*) fields were planted in Eastern and Central South Dakota. Foliar predatory arthropod communities, as well as leaf-tissue insecticide content were examined regularly throughout the growing season to compare the two treatments. An additional greenhouse study was performed to collect and quantify toxins in extra-floral nectar (EFN) from treated and untreated sunflowers.
- **Predators visit sunflower extra-floral nectaries for nutrition**. These often found at the base of the leaf. The **extra-floral nectaries may keep beneficial insects around in case herbivores appear**. Lady beetles visit sunflower extra-floral nectaries frequently.
- Seed-treated fields had significantly fewer natural enemies than the untreated fields. Thiamethoxam and clothianidin (a toxic metabolite of thiamethoxam) were found at high

levels in sunflower leaf tissue early in the growing season (through V6) but levels quickly fell and remained relatively low for the remainder of plant growth.

- **Fewer Coccinellidae (lady beetles) were found in Cruiser treated sunflower fields.**
- Yields were unaffected by insecticidal seed treatments.
- Extra-floral nectar collected from treated plants in the greenhouse study contained thiamethoxam (ranging from 1.23 ± 0.09 ppb to 4.83 ± 0.63 ppb), but no clothianidin.
- The results demonstrated that neonicotinoid seed-treatments negatively impact beneficial insect communities. Toxin-laden EFN was identified as a potential route of exposure between predators and seed-applied neonicotinoids. In the future, the risks of using insecticidal seed treatments must be weighed against any benefits.

Corn

Effects of corn grown in organically and conventionally managed soil on Ostrinia nubilalis behavior and populations

Rebecca Schmidt-Jeffris, Entomology Department, Cornell University

- European corn borer (*Ostrinia nubilalis*) was once a highly common invasive pest of corn in the U.S. east of the Rocky Mountains. In recent decades, prevalence of this pest has sharply declined; population decreases have been attributed to widespread adoption of *Bt* corn varieties, especially in the central U.S., where *Bt* field corn is grown extensively.
- In the northeastern U.S., corn is also grown, but in a more diverse crop landscape. Therefore, it may be possible for some European corn borers to use alternative hosts and escape from *Bt* control. However, a previous study found that female European corn borers had higher rates of egg laying on corn in conventionally managed (vs. organic) soil.
- We hypothesize that the adoption of *Bt* technology created an unintentional "attract-and-kill" strategy, wherein female moths are more likely to lay eggs on conventional corn, which frequently contains the *Bt* trait that kills their feeding offspring. This hypothesis was tested in three ways. A greenhouse study was conducted to compare rates of egg laying in corn with and without the *Bt* trait grown in soil removed from organically and conventionally managed fields.
- Female responses to these corn plants were also tested in a flight tunnel. Finally, European corn borer trap catches near conventional and organic corn were compared.
- Corn in conventional fields produced differences in volatiles than organic fields, and attracted more European corn borers.

Stored Grains Entomology

Minimizing insect infestations in grain storage facilities prior to harvest

Edmond L. Bonjour **,** Oklahoma State University.

- Steps taken before harvest to ensure grain quality in storage include sanitation, maintenance, and insecticide application.
- Sanitation involves cleaning all grain handling equipment, removing old grain and insect populations from the storage facility, and keeping a clear area around the outside of the structure.
- Maintenance of the facility for gaps, holes, cracks, or leaky areas is critical to prevent insects from entering the facility.
- After sanitation and maintenance has been completed, the application of an insecticide may aid in preventing insect infestations or to control insects in areas that are difficult to clean.

- Taking these steps will help to maintain grain quality while it is in storage.

Potatoes

Challenges of controlling wireworms with insecticides in potatoes in the mid-Atlantic U.S.
John D. Aigner**,** Department of Entomology, Virginia Polytechnic Institute and State University.

- Wireworms (Coleoptera: Elateridae) are a serious pest problem on potato [*Solanum tuberosum*] worldwide. Species complexes vary considerably across geographic regions.
- In the Mid-Atlantic Region of the U.S., the primary wireworms found in agricultural fields belong to the genera *Melanotus*, *Conoderus*, and *Aeolus*, with *Melanotus communis* being the dominant species attacking potato.
- For over 50 years, preventative at-planting applications of soil insecticides have been the most common tactic for managing these pests. However, all of the cyclodiene insecticides and most of the carbamates or organophosphates that were historically used for this purpose have lost U.S. registrations on food crops. Only ethoprop and phorate remain on potato and these can be difficult for growers to obtain.
- A decade of field efficacy experiments conducted on potatoes in Virginia (U.S.) have shown that the phenylpyrazole insecticide fipronil, as well the pyrethroid bifenthrin, and neonicotinoid compounds imidacloprid, thiamethoxam, and clothianidin all provide moderate control of wireworms in potato that is comparable to that of the organophophates, but that control failures also can occur.
- The biggest challenge is controlling wireworms that migrate to tubers later in the season. In this presentation we evaluate the efficacy of post-planting applications of bifenthrin and foliar applications of spirotetramat to improve the control efficacy of at-planting soil insecticides.
- Bifenthrin can be applied after planting when hilling potatoes.
- Movento (**spirotetramat**) **as a foliar spray appears to be giving about 70% control of wireworms**. The surfactant with the movento seems to be important for control.

Smells good but claims your life: An attract and kill strategy for wireworm control in potato.
Stefan Vidal**,** Georg-August-Universität, Göttingen, Germany

- Wireworms use carbon dioxide gradients, established by growing roots, to locate their host plants. The "attract and kill" approach (A&K) makes the larvae crawl to the control agent by combining the agent with capsules emitting CO_2.
- Methods: To make this strategy work under field conditions, the capsules need to build up CO_2 gradients significantly higher than the background CO_2 concentrations in the soil for at least several weeks. We formulated these capsules with an isolate of a wireworm effective entomopathogenic fungus (*M. brunneum*), acting as the kill component. Capsule field treatments were applied into the potato dams, either below or between the tubers during the growing season using fields with a high incidence of wireworm damage in previous years.
- Results/Conclusion: Application of different types of the A&K capsules resulted in significantly lower tuber damage in most, but not all fields, depending on capsule types and ways of application. Based on these results a final capsule type is now commercially available for a standardized application routine in potato fields; capsules can be applied by using equipment available for granulated insecticides.

Monitoring aphids and potato virus Y in seed and commercial potato fields in Oregon
Sudep Bag, Oregon State University, Hermiston, OR

- Aphids are sucking pests that cause damage to the plants by feeding and transmitting viral pathogens. In 2015, a multistate project was initiated to develop a comprehensive management strategy for Potato virus Y (PVY) in the Pacific Northwest- to test different types of traps to identify the presence of aphid species in potato fields; determine trap efficiency and correlation of aphid with PVY incidence.
- Seed and commercial potato fields in Klamath, Morrow, Union, and Umatilla Counties in Oregon were studied. The traps were placed in four different locations around fields.
- Aphids were collected weekly, counted and identified based on morphological characteristics.
- Initial analysis suggested that off the three types of traps tested, **yellow bucket traps were more efficient for capturing aphids compared to sticky cards or tile traps.** The abundance of aphids was higher in Klamath followed by Umatilla, Union, and Morrow County during May-September. It was also found that potato aphids and green peach aphids were less abundant than "other unidentified aphids". The role of "other aphids" is yet to be determined. Based on the serological analysis, higher PVY incidence was found in Klamath, followed by Umatilla, Union and Morrow County.
- Initial observations on the landscape suggests **border cropping is an effective measure in controlling aphids' infestation as compared to fields without trap border crops**. Also, fields adjacent to grains or fodder were more infested with aphids compared to fields adjacent to maize, mint, potato, sunflower or wheat.

Behavioral and developmental effects of mineral oil on potato pests

Andrew Galimberti**,** University of Maine.

- Mineral oil is an insecticide used to control a variety of pests and to reduce non-persistent virus transmission. Despite its use in potatoes for potato virus Y (PVY) control, its effects on other potato pests, such as Colorado potato beetle, have not been studied.
- Methods: In this study, we performed a series of laboratory experiments, including choice and no-choice bioassays and direct sprays, on Colorado potato beetle, green peach aphid, and potato aphid.
- Results/Conclusion: The results showed that mineral oil affected insect behavior. Both species of aphids, as well as adult and first-instar potato beetles, were less likely to feed on potato leaflets treated with oil. The results suggest that mineral oil may be able to contribute to control of aphids and Colorado potato beetle in potato.

Evolution of spinosad resistance in Colorado potato beetle, *Leptinotarsa decemlineata*, in the eastern US: Variation, dominance, and cross-resistance

Mitchell Baker, City University of New York Queens College.

- Spinosad is a naturally derived insecticide with formulations for both organic and conventional management of a wide variety of pests.
- Spinosad resistance in Colorado potato beetle, *Leptinotarsa decemlineata* (Say), evolved rapidly in Eastern NY, increasing from 10-fold variation in resistance ratios of LD_{50} relative to a laboratory susceptible strain to almost 6,000-fold variation in four years. At the same time resistance to neonicotinoids rose only slightly.
- Resistance was higher in organically managed farms that started using it earlier, and more frequently, than in conventional farms that have more alternative ingredients, including neonicotinoids.
- Cross resistance between spinosad and imidacloprid in a less resistant population was asymmetric, with selection for spinosad resistance also reducing susceptibility to imidacloprid, but selection for imidacloprid leaving spinosad resistance unchanged.

- Spinosad resistance in moderately resistant populations from Maine, Michigan, and New York is mostly additive, but in the most resistant population it is almost completely recessive.

Wireworms (general)

Wireworms of economic importance in Canada: Identification, distribution, and behavior.
Wim Van Herk, Pacific Agri-Food Research Station, Agassiz, BC, Canada

- Wireworms are often referred to as a single group, particularly in pest management. This is somewhat misleading, however, as there are approximately 20 species of economic importance in Canada, which vary in behavior, life history, susceptibility to insecticides, and distribution.
- 132 Elateridae are pests worldwide, 2 species have been used as biocontrol.
- To manage wireworms you need to know what species you have.
- Species identification is frequently based on larval morphology, but this is complicated by the limited number of species whose larvae have been described.
- Methods: Since 2004 we have collected and received wireworm samples from fields where crop damage was observed. These samples originate from all agricultural areas across Canada, and permit us to determine what species are currently of economic importance and how these are distributed. Identifications were based on morphology and confirmed with barcode analysis.
- Results/Conclusion: The composition and distribution of the wireworm pest complex in Canada has changed since previous surveys.
- The sugarbeet wireworm, *L*imonius *californicus* is considered a major pest in the prairie region of Canada. It is more common in the western prairies.
- **The prairie grain wireworm** (*Selatosomus destructor*) **is considered to be a secondary pest now in the prairies.**
- ***Hypnoidus bicolor* is common in the prairies, but its pest status not known.**

Fruit Crops

Spotted wing drosophila's natural enemies and the importance of landscape ecology for classical biological control
Kent M. Daane**,** University of California, Berkeley, CA

- The invasive spotted wing drosophila, *Drosophila suzukii*, is a native of Southeastern Asia and is now widely established in North America and Europe, where it is a serious invasive pest of small fruit crops.
- The lack of effective indigenous parasitoids of *D. suzukii* in the recently colonized regions prompted the first foreign exploration for co-evolved parasitoids in South Korea in 2013 and 2014. We collected seven larval parasitoid species and two pupal parasitoid species.
- From UC Berkeley quarantine records, mean percentage parasitism of the South Korean collected *D. suzukii* ranged from 0-17.1% and varied according to geography, season, and collection methods. *Asobara japonica* was the most common parasitoid species reared.
- More parasitoids were reared from samples originating from field-picked fruit as opposed to traps baited with uninfested fruit. Quarantine bioassays confirmed that all tested larval parasitoids readily developed from *D. suzukii* reared on artificial host diet or fruit.
- Female individuals of the endoparasitoid, *A. japonica*, were larger when reared on the larger *D. suzukii* larvae compared with those reared on the smaller larvae of *D.*

melanogaster Meigen. Larger parasitoid size was associated with longer developmental time.

- Several of the South Korean parasitoid species have the potential for use in classical biological control to contribute to the suppression of *D. suzukii* in the newly invaded regions.

Beneficial Insects

Assessing the efficacy of hymenopteran parasitoids as biological control agents of cutworms (Lepidoptera: Noctuidae) in field crops in Canada

Udari Wanigasekara, Department of Entomology, University of Manitoba.

- This study examined the hymenopteran parasitoids community attacking economically important cutworms in Canadian prairies. We collected larval cutworms from infested crop fields, and reared them in the laboratory.
- According to our results, *Copidosoma bakeri* is likely to be the most effective parasitoid for controlling cutworms, but parasitism rate is often too low to reduce cutworms below economic levels.
- Providing additional resources for parasitoids through habitat management has been shown as an effective method to increase parasitism rates in biocontrol agents. Based on flowering period and flower colour, we chose nine flowering plants including: flax, oriental mustard, phacelia, chickling vetch, camelina, buckwheat, tillage radish, field pennycress and canola for this experiment.
- We found food-inexperienced wasps were preferentially attracted to canola, camelina, mustard and buckwheat plants and they were significantly attracted to yellow and demonstrated a significant preference for brassicaceae flowers over camelina and buckwheat.
- Additionally, survival time of parasitoids on canola, camelina, mustard and buckwheat were similar to each other, however, camelina was preferred when the entire plant was offered in the multiple choice experiment.
- Thus, camelina is a suitable cover crop for cutworm control, and future research will examine how camelina enhances parasitism rates of *C. bakeri* on cutworms in the field.

Apiculture and Pollination Biology

Pesticide impacts on bees: From individual behaviour to pollination services

Nigel E. Raine, University of Guelph

- Here we report results from a series of laboratory and field studies of pesticide exposure on bumble bee (*Bombus terrestris*) behaviour and ecology.
- Results/Conclusion: Field-level neonicotinoid exposure has both acute and chronic effects on overall foraging activity, including changes to floral preferences and reductions in individual pollen collection efficiency.
- Chronic exposure also has negative impacts on the speed with which workers learn to associate floral odours as predictors of reward and their ability to remember these associations.
- These sublethal impacts on individual bee behaviour have knock-on effects for forager recruitment, worker losses and overall colony productivity.
- The pollination services provided by bumble bees can also be adversely affected following field-realistic exposure to neonicotinoids. This has widespread implications for the sustainable production of many pollinator limited crops and maintenance of wild plant biodiversity.

Red Listing America's bumble bees: Status and trends among *Bombus* spp. in the Western Hemisphere

Rich Hatfield, Conservation Biologist, The Xerces Society for Invertebrate Conservation, Portland, OR

- Bumble bees are diverse and abundant pollinators in most ecosystems, particularly in high elevation and colder climates throughout the Western Hemisphere. Despite the important contribution these animals make to ecosystem services, we know little about their conservation status. What information is available indicates a subset of species are experiencing dramatic population declines. To better understand the current state of these important animals, the IUCN (International Union for Conservation of Nature) Bumble Bee Specialist Group was formed in 2011 to assess the status of all of the world's *Bombus* spp. Here we present the results of those assessments for North, South and Meso-America.
- Methods: In all of these regions, for each species with sufficient data, we used databased historic records to establish a historic range, and more recent collection efforts to calculate changes in range. We also assessed changes in relative abundance and persistence. Using average range loss, adjusted for differences in sampling effort between time periods, we applied IUCN criteria to our findings.
- Results/Conclusion: Our results indicate that more than one-quarter of the species in North America and nearly half of the species in Mesoamerica are in a category considered threatened by the IUCN. In South America there is insufficient data for many species to apply IUCN criteria and a recent concerted search effort is lacking. However, there is at least 1 species facing a high degree of extinction risk.
- These results suggest that bumble bees are experiencing continental scale threats potentially leading many of them toward extinction.

New Insecticides

Isoclast™ Active (Sulfoxaflor) for control of sap feeding insects in U.S. specialty crops

Alejandro Calixto, Dow AgroSciences, Wesley Chapel, FL

- Multiple insect species have become major pests in specialty crops in the US. A vast majority of these are sap feeding insects. These species cause significant economic damage to the crops leading to a reduction of plant health and also transmitting damaging pathogens. Several chemical tools have been developed over the years to achieve sustainable control and increase profits.
- Isoclast™ Active is a new and unique chemical class (Group 4C Sulfoximines) that targets key sap-feeding insects but also suppress several thrips species. Studies over the past years have shown excellent efficacy (knockdown and residual) against species such as *Myzus persicae* and *Aulacorthum solani* in leafy vegetables; *Lygus hesperus* in fruiting vegetables and strawberry; and *Diaphorina citri, Coccus pseudomagnoliarum* and *Scirtothrips citri* in citrus. Isoclast™ Active also has a fit in season long management programs for *Bemisia tabaci and Frankliniella spp.*
- Isoclast™ Active has unique interactions with the insect acetylcholine receptors (nAChR) that are distinct from those observed with neonicotinoids. It also has a robust lack of cross resistance with other insecticides including neonicotinoids. This new tool facilitates a multi-faceted approached that is required for sap-feeding insects but also helps to preserve the longevity of all other chemical controls.

- Isoclast™ Active has an excellent value and fit in IPM programs that includes proper use of different Mode of Actions (MOA), accurate species identification, adherence to economic threshold, and enhancement/preservation of natural enemies.

Inscalis™: A new insecticide for piercing-sucking pest management.
Joe Stout, BASF, Research Triangle Park, NC

- Inscalis™ is the latest insecticide innovation from BASF for control of piercing-sucking pests in a wide range of crops. Representing a novel chemical class, this new and innovative insecticide controls insects such as aphids, whiteflies, certain leafhoppers, psyllids, and scales, including those that have developed resistance to other insecticides.
- Key attributes of Inscalis™ include high potency at low use rates, favorable environmental profile, and low acute toxicity to pollinators and beneficial arthropods. These features highlight the versatility of this new insecticide as an effective option for resistance management and as a valuable tool within integrated pest management programs.

Sivanto Prime: Protecting sorghum and alfalfa from sugarcane aphid and blue alfalfa aphid while preserving beneficial insects
Amanda Beaudoin, Bayer CropScience, Research Triangle Park, NC

- Sivanto™ Prime is the first and only IRAC Group 4D product and provides excellent control of the sugarcane aphid, *Melanaphis sacchari*, in sorghum. Bayer's newest insecticide belongs to the butenolide chemical class, and Sivanto Prime provides quick feeding cessation while maintaining beneficial insect populations that continue to keep sugarcane aphid populations low after treatment.
- Recently developed economic thresholds allow growers to scout effectively and receive several weeks of residual control from a Sivanto Prime application, which protects sorghum yields during critical crop development stages. Field trials across the sorghum growing region show that Sivanto Prime is an excellent option for sugarcane aphid management, especially when used in conjunction with other Integrated Pest Management techniques including careful variety selection, planting date, seed treatment, and scouting.

Pesticide Toxicology

A common neonicotinoid pesticide, thiamethoxam, impairs honey bee flight performance (*Apis mellifera* L.)
Simone Tosi, Dipartimento di Scienze Agrarie, Università di Bologna, Bologna, Italy

- The common neonicotinoid pesticide thiamethoxam elicits a variety of sublethal effects on honey bees (*Apis mellifera* L.), including decreased homing success (Henry et al., 2012). However, it is unclear if neonicotinoids can reduce the ability of honey bees to fly.
- We used flight mills to test the effects of acute or chronic exposures to thiamethoxam upon the flight abilities of forager bees. Shortly after the administration of the neonicotinoid (1.34 ng/bee, as in Henry et al., 2012), foragers showed excitation and significantly increased the duration and distance of their flights. However, chronic exposures to lower (32.5 ppb) or higher (45 ppb) thiamethoxam concentrations, which resulted in field-relevant daily intakes, significantly decreased flight ability by reducing flight duration, distance, average velocity and maximum velocity.
- These results demonstrate that a neonicotinoid can significantly alter the physical ability of bees to fly after acute and chronic exposures. These sublethal exposures may therefore

alter foraging and homing behavior, which are vital to normal colony function and fitness.

A season long study of pesticide exposure in Ontario and Quebec

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- Experiments linking neonicotinoids and declining bee health have been criticised for not simulating ‘field-realistic' exposure. Here we quantified the duration and magnitude of neonicotinoid exposure near corn crops and used these data to design realistic experiments to investigate the effect of neonicotinoids on honey bees.
- Realistic experiments showed that chronic sublethal exposure to neonicotinoids affected the behaviour and longevity of individual workers, and was associated with declines in social immunity and increased queenlessness over time.
- We also discovered that the acute toxicity of neonicotinoids to honey bees significantly increases in the presence of field-realistic levels of a commonly encountered fungicide.
- Our work demonstrates that field realistic exposure to neonicotinoids can reduce honey bee health in corn-growing regions.

Non-target effects of neonicotinoid seed treatment in a three-year field crop rotation

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- Introduction: When neonicotinoid insecticides are applied as agricultural seed treatments, the majority of the active ingredient remains in the soil. Use of these products in the same field over consecutive years can lead to accumulation of higher concentrations of neonicotinoids in the soil relative to a single application, and may increase non-target effects over time.
- Methods: This study examines the effects of thiamethoxam and imidacloprid seed treatments on a three-year field crop rotation of soybean, winter wheat, double cropped soybean and corn at two sites in Maryland. Specifically, we are studying the effects of seed treatments on pestiferous arthropods and crop yield. Non-target impacts on beneficial arthropods and the soil microbial community is also being measured, along with the potential uptake of neonicotinoids from the soil by non-target plants, specifically the flowers of winter annual plants growing within the treatment plots.
- Results/Conclusion: In soybean, analysis of visual counts showed that treated plots had a significantly lower number of both herbivorous arthropods and predatory arthropods. However, there was no significant difference in yield.
- The prophylactic use of neonicotinoid seed treatments provides cheap insurance for Mid-Atlantic grain producers to control soil insect pests and certain aboveground insects during the seedling stage. However, the repeated use of these treatments may not be warranted or sustainable.

Integrated Pest Management

Monitoring, forecasting, and risk warning systems for field crop insects for the Canadian prairie ecoregion

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- The Prairie Pest Monitoring Network (PPMN) is a prairie-wide, coordinated insect monitoring program designed to keep the Canadian agriculture industry informed of the risks to crop production from pest species and to highlight and conserve their natural enemies. The Prairie Ecoregion contains a large expanse of approximately 29 million hectares of cropped land typically dominated by ~12 million hectares of wheat and ~6 million hectares of oilseed rape (canola) seeded annually.

- Given the periodic or cyclical nature of insect outbreaks, production risks associated with insect pests can be minimized through a coordinated monitoring program that provides decision-support to the agriculture industry in a timely manner. The PPMN is supported by researchers at the federal, provincial, and university levels and involves key agricultural industry partners.
- The PPMN's participants all strive to develop sustainable pest management strategies capable of maintaining the productivity and quality of agricultural field crops grown on the Canadian prairies.
- An additional, yet essential, component of the PPMN's activities includes the monitoring of beneficial organisms which contributes to their conservation but also to the development of reduced-risk strategies for the management of pest species.
- The PPMN has a 20-year history of prairie-wide collaboration, a website (http://www.westernforum.org/IPMNMain.html), and a new Blog (http://prairiepestmonitoring.blogspot.ca/) and ongoing efforts will continue to address climate change, new agronomic practices, new crops and the diversity of pest and beneficial arthropods that utilize field crop production systems in Canada.