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Compiled: Wim van Herk, AAFC

Contents

ABRAM: Successful overwintering of a released biological control agent of Japanese Beetle in BC

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Problem: The Japanese beetle (*Popillia japonica*), an invasive pest in that has been in North America for over 100 years, was detected for the first time in British Columbia in 2017. Eradication efforts in Metro Vancouver include using insecticides on larvae, pheromone traps for adults, and restricting plant and soil movement to limit its spread. These tactics are working well to reduce beetle populations to low densities, but additional tactics such as biological control had not been tested as complementary methods yet. A parasitoid fly, *Istocheta aldrichi*, which specifically targets and kills Japanese beetles in Asia and Eastern North America, was identified as a candidate for biological control of *P. japonica* in British Columbia. The first releases of *I. aldrichi* were done in Port Coquitlam in 2023, where it was previously known to be absent. Parasitized beetles were collected by Canadian Food Inspection Agency (CFIA) monitoring traps near the release site after *I. aldrichi* releases in 2023, but it was not known if any parasitoid offspring in parasitized beetles that were not caught in traps (if any) would successfully overwinter.

Objectives of Research: The study, in collaboration with CFIA, aimed to determine whether releases done in 2023 would result in successful overwintering, as indicated by parasitized beetles caught in CFIA traps in 2024.

Summary of Results: A number of parasitized beetles were caught in CFIA traps in Port Coquitlam in 2024, on four consecutive weeks in July, representing about 4% of the total beetle trap catch in that area for the whole year. This indicates that offspring of the previous years' releases successfully overwintered, emerged, and found Japanese Beetle hosts to parasitize.

Continuing Research: We aim to document the possible establishment, spread, and biological control impact of *I. aldrichi* in British Columbia in the coming years. Mathematical modeling approaches are being developed to understand how percent parasitism translates into Japanese beetle population suppression by the biological control agent. A number of studies are underway to assure host specificity of *I. aldrichi* using multiple methods (surveys, crowdsourced online data, museum collections, etc.). This may help continue to build the scientific rationale for redistributing *I. aldrichi* to other parts of Canada and Europe where it is not yet present but Japanese Beetle is a pest issue.

Funders: Agriculture and Agri-Food Canada.

Contact: Paul Abram (paul.abram@agr.gc.ca)

ABRAM: Validation of the host specificity of a biological control agent of spotted-wing Drosophila, and its redistribution from British Columbia to Ontario

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Problem: Spotted wing Drosophila (*Drosophila suzukii*) continues to be a highly problematic invasive pest of several fruit crops in BC. In 2019, two parasitoid wasps from its native range (*Leptopilina japonica* and *Ganaspis kimorum*) were discovered for the first time in North America, in the Fraser Valley of BC. Because they were both candidates for intentional introduction to North America at the time, there was hope that their adventive establishment could contribute to reducing *D. suzukii* populations in BC. However, there was also concern about their potential to attack non-target Drosophilidae, especially *L. japonica* which is less host-specific than *G. kimorum*. This data was important for informing the redistribution of *G. kimorum* to other regions of Canada.

Objectives of Research: Completing the processing and identification of samples we collected at a variety of field sites (research farms, back yards, forests, etc.) in 2022 and 2023, we set out to determine whether *L. japonica* and *G. kimorum* are attacking other species of Drosophilidae in fresh or rotting fruit under field conditions. This involved the collection of naturally occurring rotting fruit and the deployment of 'sentinel' rotting fruit baits that were naturally colonized by Drosophilidae and their parasitoids at each site, and then reared out to determine host-parasitoid assocaitions.

Summary of Results: Our results show that while *L. japonica* attacks at least two species of Drosophilidae other than *D. suzukii* under field conditions in British Columbia, *G. kimorum* is only ever reared from *D. suzukii*, validating past laboratory studies indicating that it is highly specific. Based in part on these results, and a scientific peer review of the risks and benefits of *G. kimorum* as a biological control agent, the decision was made to redistribute *G. kimorum* from British Columbia to Ontario (where it was previously absent) for biological control of *D. suzukii*. Releases of *G. kimorum* began in Ontario in 2024.

Continuing research: Molecular diagnostic tools are being developed to tease out what exact Drosophilidae species belong to the species groups being attacked by *L. japonica*, and to construct more complete food webs showing the new *Drosophila*-parasitoid associations that have formed in British Columbia since the arrival of these unintentionally introduced parasitoids from Asia. These data will inform ongoing and future biological control redistributions and releases against spotted wing Drosophila in other regions of Canada, as well as other countries.

Funders: Agriculture and Agri-Food Canada. Contact: Paul Abram (paul.abram@agr.gc.ca)

ABRAM: Initiating the development of biological control and monitoring strategies for invasive stink bugs in greenhouse peppers in British Columbia

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Problem: In the last three years, two invasive stink bugs have emerged as a new problem in greenhouse-grown sweet peppers in British Columbia: the brown marmorated stink bug (*Halyomorpha halys*; BMSB) and the southern green stink bug (*Nezara viridula*; SGSB). BMSB was first detected in BC in 2015 is now widespread outdoors throughout many regions of BC, and is thought to fly into pepper greenhouses from outdoor populations. SGSB was first found in BC in 2019 and is only known to be established in restricted urban areas in Metro Vancouver, where urban 'heat islands' may be acting as a foothold for its establishment and, possibly, serving as sources for greenhouse invasions. There are also two species of native stink bugs, *Chlorochroa ligata* and *Euschistus conspersus*, that are sporadic issues in some locations and form 'pest complexes' with the invasive stink bug species. The development of monitoring and biological control strategies for stink bugs is now a high priority for some greenhouse pepper growers in BC. There are no biological control agents available to control stink bugs, and chemical control options that do not disrupt biological control of other pests in greenhouses (where biological control forms the basis of many pest management programmes) are lacking.

Objectives of Research: To begin to develop trapping and biological control strategies that could be effective for monitoring and control of stink bugs in British Columbia. Pheromone traps have been developed for field monitoring of BMSB, but it was unknown if they would be effective in greenhouse settings. *Trissolcus japonicus*, an egg parasitoid that is now well-established in British Columbia, was tested as a candidate augmentative biological control agent. Initial trapping and parasitoid release trials were done in two commercial pepper greenhouses in British Columbia from June to November 2024.

Summary of Results: Pheromone traps were remarkably ineffective at capturing stink bugs in 2024, even in pepper houses where they were detected by greenhouse workers. Only a single BMSB adult was caught in one trap the whole season. Likewise, despite repeatedly releasing *T. japonicus* at industry-recommended rates used for other *Trissolcus* species in greenhouses in Europe, and monitoring for them with a method that is normally reliable (deployment and re-collection of cold-sterilized sentinel egg masses), no parasitism resulting from these releases was detected .

Continuing research: Research trials under smaller-scale, more controlled conditions will be done to identify the factors that may have contributed to the surprising inefficacy of biological control releases. Multi-modal attractants will be trialed to improve stink bug trap captures in a greenhouse setting. Trials in commercial settings will resume next year, applying lessons learned from previous research results.

Funders: Agriculture and Agri-Food Canada Contact: Paul Abram (paul.abram@agr.gc.ca)

CLODIUS: Minor Use Pesticides Program, Agassiz Research and Development Centre, AAFC

Author and Associates: Markus Clodius, Seth Nussbaum, Dr. Wim van Herk

Problem: The Minor Use Pesticides Program exists to improve Canadian growers' access to new crop protection tools and technologies. The program works with farmers, the provinces, manufacturers and the U.S. IR-4 Specialty Crops program to establish grower-selected crop/pest needs, and match them with potential solutions (particularly reduced-risk products such as microbial pesticides). AAFC then conducts field and greenhouse trials to collect the required efficacy and residue information, and drafts submissions to PMRA for the registration of new 'minor' uses for a given product.

Objective of Research: In the 2023 field season, Agassiz was one of four AAFC sites participating in studies on pesticide sprays with aerial drones. The objective of these studies was to gather information on residue levels and spray drift, compared to ground-based sprays, in four different crop canopies and with different models of drones. In 2024, only GH cucumbers were part of an insecticide study at Agassiz: our remaining trials on field berries and vegetables were mostly done with fungicides.

Summary of Results: Analyses of residue levels, spray drift profiles and product efficacy are still in process.

Continuing Research: Trial work in the 2025 season will be guided by the pest/crop/product solutions chosen by the growers present at the 2024 priority meeting.

Funders:

This work is funded by the Government of Canada, under the Sustainable Canadian Agricultural Partnership agreement.

Contact:

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FRANKLIN: Developments in aphid diversity and virus transmission in highbush blueberry in British Columbia

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Abstract: Aphids present a dual threat to agricultural crops, both as phloem-feeding insect pests and as vectors of plant viruses. In British Columbia (BC), aphids feeding on highbush blueberry (*Vaccinium corymbosum* L.) are known to transmit Blueberry Scorch Virus (BlScV) and are suspected to transmit two novel blueberry-infecting *Luteoviruses*. To assess aphid-mediated viral transmission, molecular assays are being developed to identify the viruses in blueberry plants and their associated aphids by PCR, and to quantify viral titre in these corresponding samples by real-time quantitative PCR. A pilot study has identified two blueberry-feeding aphid species, *Ericaphis fimbriata* (Richards) and *Illinoia azaleae* (Mason), as carriers of all three viruses, and a current study aims to confirm if these species transmit these viruses between blueberry plants. In an effort to identify blueberry genotypes with reduced aphid susceptibility, we estimated aphid abundance on blueberry varieties from the BC Berry Breeding Program and identified 13 genotypes for further testing. In order to update our knowledge of aphid species diversity in BC blueberry fields, we conducted pan and suction trapping in blueberry fields in the Fraser Valley of BC in 2024, and aphid specimens are currently being sorted and identified. Additionally, to further characterize BC's aphids and their associated parasitoid pressures, we reared field-collected aphid samples for parasitoid emergence. Parasitoids and associated aphid mummies were collected and will be identified to begin defining species composition and aphid-parasitoid interactions in BC blueberry fields.

Problem: BlScV causes serious plant blighting causing large-scale yield losses in highbush blueberry throughout British Columbia (BC), where the majority of Canada's highbush blueberry is grown. The symptomatic latency period (1-2 years) for this virus has made it difficult to monitor and manage in BC's blueberry plants. Current management relies on testing and removal of BlScV infected plants; however, infections continue to spread due to the virus' latency and asymptomatic infections. Aphid-management practices relevant to BlScV reduction are informed solely by our understanding of aphid population dynamics and rely on pre-bloom and post-bloom insecticide applications for the management of aphids in blueberry fields. Two new Luteoviruses have also been detected in blueberry plants in BC fields, however the disease symptoms, if any, remain unknown. Control of aphid-vectored plant viruses in blueberry could benefit from an improved understanding of aphid-virus dynamics in the highbush blueberry system throughout the growing season, and a fuller understanding of which aphid species may be responsible for transmission of these viruses.

Objectives of Research:

1) Develop new molecular tools by which BIScV and the novel Luteoviruses can be detected and quantified in aphids.

2) Determine the aphid species that vector blueberry plant viruses in BC blueberries.

3) Identify blueberry genotypes with aphid resistance that can be used in the future by the BC Berry Breeding Program.

4) Determine the composition of aphid species found in BC blueberry fields, by morphology and by DNA barcoding.

5) Evaluate aphid pest-parasitoid interactions and determine current species composition of aphid parasitoids in BC agroecosystems with chemical interference compared to organic blueberry farms.

Summary of Results:

- Molecular tools for identifying BlScV and the novel Luteoviruses in highbush blueberry have been designed and are being extended to aphids.
- An RT-qPCR assay has been designed to quantify viral titre in positive plant samples, and is being extended to aphids as well.
- These techniques are being used to identify which aphid species are found carrying BlScV and the novel Luteoviruses, and which of these species are capable of effectively transmitting one or more of the viruses.
- A second consecutive year of blueberry cultivar screening data highlights nine new blueberry varieties which show evidence of aphid resistance, and will be screened further.
- 4 of 13 varieties from screening in 2023 continued to show evidence of aphid resistance in 2024.
- Aphids associated with blueberry in BC's Fraser Valley were surveyed over the 2024 growing season using suction traps and will be used to characterize the current composition of BC blueberry-related aphid fauna in order to identify new aphid vectors.
- Assembly of an updated species profile is underway for aphid parasitoid species in blueberry, along with a comparison of parasitoid abundance and emergence rates in organic versus conventional blueberry fields.

Continuing Research: Once fully examined, the up-to-date aphid species survey should inform next steps in aphid-virus testing and may lead to discovering aphid species, apart from *E. fimbriata* and *Illinoia azaleae*, as carriers of these viruses. The RT-qPCR assay will be used to used to determine when aphid-vectored virus transmission peaks within the growing season in order to better inform pest management strategies. Future studies into BlScV mitigation include research into cultural control of aphids through testing of aphid resistant highbush blueberry cultivars. Research into the viability of biological control agents and the impact of chemical control on parasitoid populations is ongoing, and will provide insights into the relationship between parasitoid species diversity and aphid populations.

Funding: Agriculture and Agri-Food Canada

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FRANKLIN: Updates on strawberry blossom weevil surveillance methods and biological control.

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Abstract: Strawberry blossom weevil (*Anthonomus rubi*) was first detected in British Columbia (BC) in 2019 and has since been found to be established throughout the Fraser Valley of BC and northwest Washington State. A two-year study has been conducted to compare *A. rubi* trap captures on pheromone-baited and unbaited sticky card traps. Preliminary results indicate that the addition of an *A. rubi* pheromone lure improves the detection of weevils on sticky cards. We discovered a new natural enemy of *A. rubi* in the invaded range through bud collection surveys and monitoring for parasitoid emergence (2020-2023). A description of the new species, *Pteromalus quadridentatus* Gibson n. sp. has been published in Zootaxa[1]. A comprehensive survey for natural enemies of *A. rubi* in this pests' native range was conducted from 2021 to 2024 in 10 European countries and morphological and molecular identification of parasitoids is underway. To date, parasitoids from five families have been identified, with those from the families Braconidae and Pteromalidae being most common. Overall, parasitism levels remain relatively low in Switzerland and Germany, where extensive collections have been completed. We plan to conduct a population genomic study to help determine the origin of our invasive BC and Washington State *A. rubi* populations, which will help to inform our search area for further foreign exploration work.

Problem: First detected in 2019, *Anthonomus rubi* (Coleoptera: Curculionidae) has established throughout the Fraser Valley of BC and northwest Washington State. Adult weevils feed on flowers, leaves, and fruit of plants from the family Rosaceae, including important horticultural crops such as strawberries and raspberries. In addition, female weevils lay their eggs inside of closed developing flower buds, then partially sever the stem below preventing further flower development. The immature larvae feed and develop inside of buds and emerge as adult weevils. A Federal Order (DA-2021-25) was put in place on September 14, 2021, by the United States Department of Agriculture, Animal, and Plant Health Inspection Service and continues to remain in effect. Due to this order *Fragaria* spp. *Rosa* spp., and *Rubus* spp. for planting that move from Canada to the US require a phytosanitary certificate indicating that they were produced in a pest-free place of production or pest free production site for *A. rubi.*

Objectives of Research: 1) to continue to compare the attraction of pheromone baited and unbaited sticky card traps for *A. rubi* over the growing season in strawberry and raspberry crops in BC; 2) provide a description of the new parasitoid species that was found to parasitize *A. rubi* in the invaded regions of BC and Washington State; 3) continue to conduct foreign exploration surveys to identify parasitoid species and rates of parasitism for *A. rubi* in the native range.

Summary of Results:

- Two years (2023-2024) of trial data have been collected comparing *A. rubi* pheromone baited sticky cards to those with no lure over the growing season in strawberries and raspberries. Weevil counts for 2024 are currently being completed. Preliminary results from 2023 indicate that *A. rubi* lures increased weevil detection.

- A paper has been published in the journal Zootaxa describing a new parasitoid species, *Pteromalus quadridentatus* Gibson n. sp.[1] This species was named after its characteristic 4:4 mandibular dentition.

- In collaboration with the Centre for Agriculture and Biosciences International (CABI), *A. rubi* infested buds were collected from 2021 to 2024 from 10 European countries. We are combining identification based on morphological characters and DNA barcodes to inform the species composition of the parasitoids that attack *A. rubi.* Parasitoids have been identified from five families, with parasitoids from the families Braconidae, Pteromalidae being most abundant.

Continuing Research:

- The identification of parasitoid species from Europe is ongoing. A database of COI barcodes will be generated to aid in future identifications. Non-target testing is planned on select parasitoids that show evidence of a narrow host range based on review of the literature.

- We will perform a population genetic study of *A. rubi* to determine the potential origin of the invasive populations that are established in BC and Washington State.

Funders: Agriculture and Agri-Food Canada; British Columbia Ministry of Agriculture and Food; Lower Mainland Horticulture Improvement Association, Canadian Agriculture Partnership

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[1]https://mapress.com/zt/article/view/zootaxa.5501.2.1

HUBER: Landscape effects on forage crops in fields surrounded by forests in BC's central interior

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Abstract: Many fields in BC's central interior tend to be small and surrounded on most or all sides by stands of trees. We are investigating the effect of surrounding forests on forage crop pests and their natural enemies by sampling replicated transects into the fields, in the forested areas adjacent to the fields, and along the field-forest margins. As part of this work, we are also compiling much needed information on the arthropod fauna associated with these unique agroecosystems in fields ranging from Dunster to Prince George to Vanderhoof to Telkwa. We used pitfall traps and consistent effort sweep netting in 14 fields in 2022, and sweep netting at 15 sites in 2023, ranging across several hundred kilometers of the Highway 16 corridor. Trapping and netting transects were mostly 75 m long except in a few cases where site limitations required 15 m transects in forested areas. There were two transects into each field, two transects into each surrounding forest, and one long (150 m) transect along each field-forest margin. Traps were placed at 25 m intervals (or 5 m in the 15 m transects) and sweeps were made at 1 m intervals. Spider webs and, when possible, associated spiders were also collected along the transects and stored in ethanol for downstream eDNA analyses to learn more about specific predator-prey interactions in the fields and surrounding areas. Field and forest landscape characteristics were assessed with arial photographs and onsite measurements, and vegetation plots were assessed near the transects.

Problem: Producers in BC's central interior have expressed the need to know more about the pests that are present in their crops and the natural enemies that might help to control them. Forage crops in the region are often surrounded by forested land on most or all sides, and that feature may affect the pest and beneficial arthropods present in the crop, particularly near to the edges of fields. In addition, this region is generally relatively undersurveyed for arthropod biodiversity.

Objectives of Research: The main objective of this work is to provide producers with recommendations for landscape management tactics to reduce forage crop pests and to increase the presence of beneficial arthropods in their fields. We also aim to produce a checklist of arthropod fauna in and around forage crops in this region to serve as a baseline in the context of ongoing climate change.

Summary of Results:

Through 15,374 pitfall-trap-days (N = 355 traps), we have collected and sorted 41,606 individuals. These have been counted and identified to the family level and categorized into morphospecies. So far, 91 morphospecies have been identified to genus or species level through morphological keys and DNA barcoding at the Canadian Centre for DNA barcoding. Further identification is ongoing.

Some of the most common predators found in the pitfall traps belong to the Lycosidae (*Pardosa fuscula*), Linyphiidae (*Silometopus sp*), Thomisidae (*Xysticus ellipticus*), Carabidae, Staphylinidae, Opiliones (*Phalangium opilio*), and Formicidae (*Lasius pallitarsis).* Some of the potential dipteran parasitoids found were in the Sarcophagidae and Tachinidae, while there were various parasitoid Hymenoptera (mostly Ichneumonidae and Braconidae)

The number of potential pest species were generally low in the pitfall traps with only Elateridae captured (no species of elaterids yet identified as known pests or invasives) and Curculionidae.

In 2022 with a total of 6,705 sweeps, (N =120 transects) 12,578 individuals were counted and sorted into family for groups of interest. So far, 71 morphospecies have been identified to genus or species level through morphological keys and DNA barcoding at the Canadian Centre for DNA barcoding. Further identification is ongoing.

The most common predators found in the sweep collection included various Araneae (Linyphiidae, Tetragnathidae , Araneidae, Thomisidae), Nabidae, Syrphidae, Coccinellidae, and Pentatomidae. Like the pitfall traps, the parasitoid fauna was dominated by dipterans including the Sarcophagidae and Tachinidae, while there were various parasitoid Hymenoptera (mostly Ichneumonidae and Braconidae).

The most common pests found within the sweep collection in 2022 included Cicadellidae (*Macrosteles quadrilineatus*), Aphidoidea (various species), and Miridae (*Lygus* sp.). No Elateridae have been currently identified that are considered pests or invasive species.

In 2023, with 9,150 sweeps (N = 190 transects), we counted 229 individual grasshoppers and sorted them to family or genus level and then morphospecies. Five potential grasshoppers species of interest have been identified so far (*Melanoplus bruneri, Melanoplus sanguinipes, Melanoplus borealis, Melanoplus fasciatus and Camnula pellucida)*, with refinement of these identifications still ongoing. Overall, the grasshopper numbers were much higher in 2023 compared to low numbers in 2022 –the greatest number of them were found at the Vanderhoof sites.

Preliminary analysis of natural enemies and pests from pitfall traps and sweeps has not shown a relationship of arthropod communities to landscape features and environmental data (June data only assessed to date), but further analysis is ongoing for all sampling dates across the summers.

High levels of diversity were found on the edges between fields and forest. Vanderhoof sites had the highest biodiversity compared to the rest of the region.

As *Macrosteles quadrilineatus* was abundant across sites in 2022 we completed an analysis looking at a possible relationship between their abundances, landscape features, and regional temperatures, but no significant relationships were found.

In 2022 -2023, 662 spider webs were collected in total with 95 sent to the Canadian Centre for DNA barcoding for eDNA analysis. Bioinformatics analysis is ongoing.

Continuing Research: Arthropod trapping and netting data have been completely collected. Some DNA barcoding is still to be completed. Data analyses are ongoing.

Funders:

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MOFFAT: Pest management of Apple Clearwing Moth in British Columbia (2019–2024)

Authors and associations: Chandra E. Moffat, Tyler D. Nelson[1], Tim Haye[2], Tamara Richardson[3], Jesse MacDonald[1], Gary J. R. Judd[1] (retired)

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Abstract: Apple Clearwing Moth is an invasive pest of apple trees in British Columbia. We have been evaluating whether a classical biological control program for this pest could be initiated, and whether exclusion netting will prevent or reduce damage by the pest.

Problem: The Apple Clearwing Moth is an invasive pest of apple trees found in British Columbia and Ontario, Canada. Larvae feed under the bark of apple trees, generally reducing tree health or causing tree death. This species was first detected in BC in 2005, but our group recently determined that it has been present in the Okanagan since at least 2003. Apple Clearwing Moth appears to be associated with sudden apple decline, a rapid decline in apple tree vigor that can result in death; however, it is unclear whether this species is causing such decline or is instead a consequence of decline. Thus far, the main control measure of Apple Clearwing Moth in Canada has been insecticide applications that target the larval stage, but there has been interest in initiating a classical biological control program to supplement other control measures.

Objectives of Research: Our objectives for biological control of Apple Clearwing Moth have been twofold: 1) study the parasitoid community of this species in its native European range to find potential biological control agents, and 2) determine which clearwing species are present in British Columbia to inform future non-target testing should a potential agent be identified. In addition, Jesse MacDonald has been testing apple tree exclusion netting to prevent oviposition by the pest.

Summary of Results:

- In 2020–2021, we reared parasitoids from Apple Clearwing Moth larvae and pupae collected in Swiss apple orchards. We found several parasitoid species that had combined parasitism rates ranging between 5% and 25%.
- We reviewed the literature to determine the host range of the reared parasitoids. Most species were generalists that could develop on other moth families. One species, a larval wasp parasitoid *Liotryphon crassiseta*, may require taxonomic revision. It is known to feed on other clearwing moths and one tortricid species but some authors have reported its size varies considerably based on its host. This might indicate that certain cohorts of the species are indeed specific to Apple Clearwing Moth, or perhaps only to clearwing moths.
- Between 2019–2023, we collated and annotated records of all clearwing moth species from British Columbia. In total, we found that there are 22 species of clearwing moths known from the province based on nearly 2000 records. Phylogenetic proximity and host-use overlap suggests that three to five non-target species of clearwing moth may be at risk by biological control introductions. One of these species is another invasive pest.

Continuing Research: Jesse MacDonald has ongoing trials in Summerland to evaluate the efficacy of exclusion netting in preventing Apple Clearwing Moth oviposition. Research regarding the potential biological control program is currently dormant.

Funders: Agriculture and Agri-Food Canada

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MOFFAT: Monitoring Spotted Wing Drosophila in the Okanagan Valley of British Columbia (2023–2024)

Authors and associations: Chandra E. Moffat[1], Tyler D. Nelson[1], Bob Lalonde[2], Nicholas Hivon[1,2]

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Abstract: Spotted wing drosophila (*Drosophila suzukii* Matsumura, Diptera: Drosophilidae) is a substantial invasive pest of small fruits in British Columbia and beyond. We have been monitoring its abundance in traps and fruit hosts at a range of elevations in the Okanagan Valley, and studying other vinegar fly species found in the traps in or nearby agricultural settings.

Problem: Spotted wing drosophila is an invasive pest vinegar fly that feeds in several cultivated fruit host species in British Columbia, and can also complete its development on many native fruit-bearing plants found in the province. This species lays its eggs directly into ripening or fresh fruit, setting it apart from other vinegar fly species that generally oviposit in decaying fruit tissue or fungus. This is a concern for both the agriculture industry and Indigenous communities; many of the native fruit species on which the fly develops are important traditional foods of Indigenous groups in North America, so both cultural and economic losses are occurring. For several years, we have been monitoring spotted wing drosophila in cherry orchards, edge-row habitat adjacent to agricultural land, and at high-elevation traditional Indigenous fruit harvesting sites. In addition, we are working in collaboration with other scientists to determine whether any adventive parasitoid species of spotted wing drosophila have yet established in the Okanagan Valley.

Objectives of Research: Since 2018, we have been monitoring annual adult fluctuations in the spotted wing drosophila population in Summerland, BC using traps baited with apple cider vinegar. Should any adventive parasitoid species of spotted wing become established in the Okanagan, we will employ this long-term dataset to determine if the parasitoids are reducing adult fly abundance in the traps through time. We are also studying the bycatch vinegar fly species from our traps and preparing resources for their identification. In 2024, we continued studying spotted wing drosophila in areas of traditional Indigenous fruit cultivation. We have more than ten sites at which we are collecting and rearing native fruit hosts and trapping adults flies.

Summary of Results:

- We continued to collect spotted wing drosophila and other vinegar fly species from our five traps at the Summerland Research and Development Centre. The 2024 trapping season resembled the 2021 trapping season: in both years, adult Spotted Wing did not appear in traps until late June or early July and were not found in numbers greater than 10 flies/trap over a single week until mid- or late August. In other years, we have found that adults are present in low numbers in May or June and at abundances greater than 10/trap in June or July. 2022 was also exceptional; it also had later trap catch but had the lowest overall abundance of any year since we began trapping. We hypothesize that early spring conditions, whether unseasonably hot or cold and wet, delay trap catch.
- We continued to study the other vinegar flies found in our Summerland traps. We have been using an integrated approach that incorporates adult external morphology, high-resolution microscopy, DNA gene fragments, *Wolbachia* association, larval host use, and adult flight

phenology to study these flies. We have found at least 14 species in the traps in addition to spotted wing drosophila. Some of these species are members of species groups or species complexes and identification to species level has proven challenging, so there could be 21 or more total species in our traps.

- We collected and reared blue elderberry fruits at two locations throughout September. Nearly all collections produced spotted wing drosophila adults but none have produced adventive Spotted Wing parasitoids.
- Generally, we have found that spotted wing drosophila abundance decreases at higher elevation trapping locations, and fewer or no adults are reared from native fruit collected from such sites.

Continuing Research: We will continue collecting all vinegar fly species from our five Summerland traps. We will also continue to monitor for adventive Spotted Wing parasitoids.

Funders: Agriculture and Agri-Food Canada, Organic Science Cluster 3 (The Organic Federation of Canada, The Organic Agriculture Centre of Canada at Dalhousie University, Agriculture and Agri-Food Canada)

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MOFFAT: Monitoring Ambrosia beetle apple pests in the Okanagan Valley of British Columbia (2023–2024)

Authors and associations: Chandra E. Moffat[1], Tyler D. Nelson[1], Jesse MacDonald[1], Justin Renkema[2]

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Abstract: Ambrosia beetles may pose a risk to apple orchards in the Okanagan. In our first year of this study, we aimed to determine which ambrosia beetle species may be pests of British Columbia apple trees.

Problem: Ambrosia beetles (Coleoptera: Curculionidae) can be pests of apple trees. They feed below the bark of trees and may decrease tree health and in some instances cause tree death. We are part of a collaboration to study the ambrosia beetle community associated with apple orchards and adjacent habitats across Canada.

Objectives of Research: Justin Rekema has found ambrosia beetles in high abundance in Ontario apple orchards in past years, so in our first year of study in British Columbia (2024) we aimed to determine which species are present in Okanagan apple orchards and if they are found in concerning abundance. To assess these species, we deployed ambrosia beetle traps in two orchards and reared apple wood from three.

Summary of Results:

- We constructed and deployed six ambrosia beetle traps in each of two Summerland apple orchards. One orchard was close to Okanagan Lake among broad-leaved trees and the other was about 150 metres higher in elevation among coniferous trees. The second orchard was presumably less humid than the first. Overall, we collected just over 50 ambrosia beetle specimens from traps, the majority of which we collected from the lower, more humid apple orchard. We have not yet identified these specimens, but they appear to be mainly two different species based on general morphology and size.
- We reared five total ambrosia beetles from one of the three apple wood sample collections.
- Abundance of ambrosia beetles was apparently very low this year.

Continuing Research: Our goal is to trap and rear beetles from additional locations in the coming years to determine if ambrosia beetles are generally found in low abundance in the Okanagan. We also aim to determine how land use and habitat adjacent to apple orchards contribute to the ambrosia beetle community associated with apples.

Funders: Canadian Agri-Science Cluster for Horticulture Four in collaboration with Agriculture and Agri-Food Canada (AAFC) and The Fruit and Vegetable Growers of Canada (FVGC)

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MOFFAT: Monitoring for Spotted Lanternfly in the Okanagan Region of British Columbia

Authors and associations: Chandra E. Moffat[1], Hester Williams[1], Christine Cock[1], Troy Kimoto[2], David Holden[2]

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[2] Canadian Food Inspection Agency

Abstract: Spotted lanternfly is an invasive planthopper which feeds on several economically important host plants. Although not yet detected in British Columbia, it has the potential to cause major damages to the wine, fruit and timber industries.

Problem: Spotted lanternfly (*Lycorma delicatula* White, Hemiptera: Fulgoridae) is an invasive planthopper native to Asia. In North America, it was first detected in Pennsylvania in 2014 and infestations now occur in several US states. There have been recent sightings of spotted lanternfly in Southern Ontario, but there are no known established populations in Canada. The pest feeds on more than 65 host plants, including grape, apple, hop, stone fruit, maple, and walnut. There is also a close association with the invasive tree of heaven, *Ailanthus altissima*; there is evidence of reduced fitness in spotted lanternfly when tree of heaven is not available as a host, and it is unclear whether spotted lanternfly populations can be sustained in the absence of tree of heaven. Damage from spotted lanternfly weakens its host plants directly through sap-feeding and facilitates mold growth from honeydew excretions. Although spotted lanternfly has not yet been detected in British Columbia, potential economic impacts to the wine, fruit and timber industries are substantial. Early detection and rapid response is essential to limiting such potential economic damages.

Objectives of Research: Since 2022 we have been monitoring for the presence of spotted lanternfly in the Okanagan region of British Columbia using a combination of circle trunk traps, BugBarrier Tree Bands, and visual inspections.

Summary of Results:

- In 2022 we deployed circle trunk traps on tree of heaven trees at 10 sites in the Okanagan. We selected 10 additional tree of heaven sites for visual inspections. Sites were visited approximately every 2 weeks. No spotted lanternfly were detected.
- In 2023 and 2024, we selected 5 priority sites in the Okanagan and deployed BugBarrier Tree Bands on tree of heaven trees. Traps were checked approximately every 3 weeks. No spotted lanternfly have been detected as of October 29, 2024.

Continuing Research: We will continue to monitor for spotted lanternfly at priority sites, with particular focus on potential dispersal pathways.

Funders: Agriculture and Agri-Food Canada, Canadian Food Inspection Agency

VAN HERK: Evaluation of sex pheromones of native pest click beetles

Authors and Associations: Wim van Herk[1], Jennifer Otani[2], Regine Gries[3], Gerhard Gries[3].

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Problem: Multiple species of wireworms are significant pests of cereals, potato, etc. Due to the difficulty in determining population levels (i.e., risk to crops), farmers often apply insecticides (especially seed treatments) for wireworm management unnecessarily. Better monitoring tools, e.g., for the adult, beetle stage of the pest, can help reduce these unnecessary insecticide inputs. Click beetle monitoring is easy, when we can bait our pitfall traps with species-specific sex pheromones. However, until 2017, we only had pheromones for the three invasive *Agriotes* wireworms in Canada

Work on identifying sex pheromones of 20+ native Canadian pest click beetle species began recently, and to date we have identified the pheromones of three native *Agriotes* species, four *Limonius* species, and one *Selatosomus*. Some of these compounds are very similar to those known for the family (e.g. the pheromones of *A. mancus* and *A. pubescens*), while the pheromones for other (e.g. *Limonius* spp.) were new to science. For most pest genera, the pheromones of only a very few species have been identified (e.g. *Selatosomus, Limonius, Melanotus, Dalopius*), and of other genera nothing is known as yet (e.g. *Hypnoidus*). Complicating factors here are the absence of pheromone glands in most species, and the difficulty in finding virgin females (even in infested fields), (and the fact that field sites are often 3-4 hrs drive from home).

We collected males and females of *Dalopius maritimus* from Delta, BC, in 2022, and of *D. asellus* from the Spirit River, Alberta, in 2023. Both male and female beetles were aerated, and headspace volatiles analyzed using GC-MS and EAD. Two putative compounds were identified for each species, synthesized, and field tested, both singly and in combination, in BC (two locations in 2023, one location in 2024), and in Alberta (three experiments over two locations in 2024). The identified compounds are relatively similar to those known for *Agriotes* (probably the closest relatives of *Dalopius*), which extends our understanding of click beetle pheromones and of family relations. Neither *D. maritimus* or *D. asellus* is likely a significant pest of agriculture, but the latter is one of the most common elaterids on farmland in both the BC and Alberta Peace and the PNW.

Continuing Research: Will try to continue pheromone identification work, also with other pest click beetle species. We also need to determine the attractive range and longevity of these pheromones in the field, and how beetle numbers correlate with wireworm numbers and crop damage. This will allow us to use them more effectively in management programs.

Funders: Agriculture and Agri-Food Canada (APMS 2.0)

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VAN HERK: Evaluation of isocycloseram for managing wireworms (*Limonius californicus*) in wheat and barley in Alberta

Authors: Wim van Herk (AAFC—Agassiz), Bob Vernon (Sentinel IPM), Ted Labun (Syngenta Canada), Joshus Spies (Syngenta Canada).

Abstract: In Canada, there are few effective insecticides for managing wireworms in cereals, potatoes, and other crops. Most registered chemicals give only temporary protection and do not significantly reduce pest populations in the field. Insecticide efficacy studies with various crops are conducted annually at the Agassiz Research and Development Centre (AAFC), and in collaboration with partners offsite. Due to confidentiality agreements, etc., we generally cannot report on the results of these studies until the products tested are registered.

With the registration of isocycloseram, a novel isoxazoline insecticide, expected to occur soon, we can now report on the efficacy of this chemical for managing wireworms in cereal crops. This report deals with its ability to protect cereal crops from the sugarbeet wireworm, *Limonius californicus* (Mannerheim).

In wheat and barley field trials (n = 10) conducted in southern Alberta over 4 years (2014 – 2017) under extreme wireworm pressure, isocycloseram applied as a seed treatment at 5.0–7.5 g AI/100 kg seed was as effective as, or more effective than, the current industry standard thiamethoxam at 20.0 g AI/100 kg seed in protecting crop stand and yield. Isocycloseram also reduced neonate wireworms (produced from eggs during the growing season) and resident wireworms (in the field at the time of planting) to levels expected from the formerly used seed treatment lindane.

This report was recently published in J. Econ. Entomol. https://doi.org/10.1093/jee/toae170

Continuing Research: We intend to continue conducting insecticide efficacy studies to identify new effective compounds, and to monitor the effectiveness, use, and environmental impact of compounds currently registered for wireworm control.

Funders: Syngenta Crop Protection (Canada) Inc., and AAFC's CAP project ASC-18-19 "IPM Tools For Wireworms In Potatoes"

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