MINUTES of the 51ST ANNUAL MEETING
WESTERN COMMITTEE ON CROP PESTS
Tuesday October 18th, 2011
The Grand Okanagan Hotel
Kelowna, BC

1.0 Welcome and Introductions – meeting called to order at 0810 h.

Chair: Susanna Acheampong, BC Ministry of Agriculture, Kelowna
Secretary: Hugh Philip, IPM 2 GO Consulting Service, Kelowna, BC

List of attendees (30)

Name	Affiliation	Email/Contact
Susanna Acheampong	BCMA	Susanna.acheampong@gov.bc.ca
Saghir Alam	E.I. du Pont Canada	Saghir.alam@can.dupont.com
Kari Bredahl		Kari.bredahl@gmail.com
Hector Carcamo	AAFC, Lethbridge	Hector.carcamo@agr.gc.ca
Marjo Dessureault	E.S. Cropconsult	Marjo@escrop.com
Lloyd Dosdall	Univ. of Alberta	Lloyd.dosdall@ualberta.ca
Christopher P. Dufault	PMRA	Christopher.p.dufault@hc-sc.gc.ca
John Gavloski	MAFRI	John.gavloski@gov.mb.ca
Don Hare	Dow AgroSciences	Ddhare@dow.com
David Holden	CFIA, Burnaby	David.holden@inspection.gc.ca
Tracy Hueppelsheuser	BCMA	Tracy.hueppelsheuser@gov.bc.ca
Kristine Johnson	E.S. Cropconsult	Kristine@escrop.com
Scott MacDonald	BASF	Scott.r.macdonald@basf.com
Alejandro Matus	Bayer CropScience	Alex.matus@bayer.com
Scott Meers	AARD	Scott.meers@gov.ab.ca
Nancy Melynchuk	AA-FC, Saskatoon	Nancy.melynchuk@agr.gc.ca
Dean Morewood	PMRA	Dean.morewood@hc-sc.gc.ca
David Nield	AAFC, Summerland	David.nield@agr.gc.ca
Chris Noske	UAP	Cnoske@uap.ca
Owen Olfert	AAFC, Saskatoon	Owen.olfert@agr.gc.ca
Jennifer Otani	AAFC, Beaverlodge	Jennifer.otani@agr.gc.ca
Camilla Persson	Lantmännen, Sweden	Camilla.persson@lantmannen.com http://lantmannen.com/en/
Hugh Philip	IPM 2 GO Consul. Service	ipm2go@shaw.ca
Troy Prosofsky	Canola Council of Canada	Prosofskyt@canolacouncil.org
Gregor Sekulic	Canola Council of Canada	Sekulicg@canolacouncil.org
Julie Soroka	AAFC, Saskatoon	Julie.soroka@agr.gc.ca
Jim Tansey	Dow AgroSciences	Tansey@dow.com
Peter Walsh	Lakeland College	Peter.walsh@lakelandcollege.ca
Gabriella Zilahi-Balogh	CFIA, Kelowna	Gabriella.Zilahi-Balogh@inspection.gc.ca

2.0 Additions to Agenda

- Addition to Product Update: Beleaf, Chris Noske (UAP)

Motion to accept agenda (Gavloski/Olfert) – CARRIED

3.0 Review and Approval of Agenda

Typos were corrected and additional changes made:

- 6.0 Further discussion: Cereal leaf beetles are present in the Swan River and the parasitoid *Tetrastichus julis* was detected.
- 10.0 WCCP Guide agenda item was out of order (move to p. 7)

4.0 Business Arising from the Minutes

None.

5.0 Appointment of Resolutions Committee

John Gavloski and Owen Olfert volunteered to be the Resolutions Committee.

6.0 Provincial Insect Pest Summaries for 2011 (see Appendix 1)

6.1 BC – Susanna Acheampong, BCMA
6.2 Alberta – Scott Meers, AARD
6.3 Saskatchewan – Julie Soroka, AAFC (for Scott Hartley)
6.4 Manitoba – John Gavloski, MAFRI

Copies of the reports were distributed and discussed. In general pest problems were lower except for isolated infestations as noted in the reports. This could in part be related to the later spring and cooler start to the summer in most regions. Concern was expressed about the lack of correlation between Bertha armyworm pheromone captures (SK, MB) and cabbage seed pod weevil sweeping (AB, SK) and subsequent larval prevalence in nearby canola crops. Work is underway to possibly develop a Bertha armyworm trap that would exclude bumble bees (AB). Wheat midge was reported for the first time in the Peace River region. Cutworm outbreaks continued in most provinces prompting discussion on the need for improved surveillance and earlier recognition of potential outbreaks, along with improved field larval identification resources. Grey garden slug infestation in MB destroyed a late-seeded canola crop.

6.5 Appointment of Summarizers for 2012 – no changes

7.0 Provincial Entomology Research Summaries for 2011 (see Appendix 2)

7.1 BC – Tracy Hueppelsheuser, BCMA (for Bob Vernon)
7.2 Alberta – Jim Tansey, Dow AgroSciences
7.3 Saskatchewan – Owen Olfert, AA-FC (for Chrystel Olivier)
7.4 Manitoba – John Gavloski, MAFRI (for Ian Wise)
7.5 Appointment of summarizers for 2012 – no changes

Meeting adjourned for lunch and re-convened at 1305 h. Sponsors were recognized for their generous support for the Western Forum and its member committees, and for their contribution to the discussions.

8.0 Agency Reports

8.1 Canadian Food Inspection Agency Insect Surveillance Report – Dave Holden, Burnaby

Dave reported on the results of surveillance programs conducted across Canada;

Blueberry maggot – 82 traps (20 sites) in BC were once again negative.

European grapevine moth – 208 traps (104 sites) in BC were once again negative.

Apple maggot – 430 ammonium carbonate-baited traps in the BC Southern Interior were again negative for this important pest of apple which is present in the Fraser Valley and Prairies.

Japanese beetle – 284 traps in New Westminster and Delta areas were negative; imported turf from the eastern US (for green roofing of buildings) was inspected although certified as free from the pest.

Oriental fruit moth – no detections in 122 pheromone traps in BC except for fruit imported from China (eggs).

Gypsy moth – 5 positive areas in BC (4359 traps) and 3 in MB (986 traps); no detections in AB or SK (1412 traps).

Emerald ash borer – surveillance across Canada (124 traps in MB, SK, AB; 0 in BC) involved improved adult trapping system along with ground surveys for larval infestations and ash decline.

Pea leafminer – none reared from samples collected in 10 production greenhouses; an attempt to conduct a national survey of production greenhouses to create a baseline for presence of greenhouse pests was not supported by owners.

Chili thrips – none found in Canada after detections in SE US; this pest would be subject to regulation by the US if found in Canada.

Macrolophus melatoma – surveys were negative for this biocontrol agent of whiteflies on greenhouse tomatoes but will also attack plants if prey is lacking; actionable pest by US.

Spotted wing drosophila – no CFIA surveys in 2011; new detection reported from NS.

Khapra beetle – quarantine pest of cereal grains; increased interceptions in some imported host crops and re-exported rice from India increasing the risk of escape; attendees were alerted to be on the lookout for this important pest and report any suspicious detections to the CFIA.

European fire ant – detected in the lower mainland of BC.

Brown marmorated stink bug – several specimens were collected at a Hamilton, ON residence after presence reported by homeowner; pest considered established in the area. This pest is a very serious threat to apple and peach production, as well as several other fruits and berries. Present in NE US and detected in CA, OR and WA.

8.2 Pest Management Regulatory Agency – Dean Morewood, Insecticides Section, Ottawa (handout distributed)

Emergency Use registrations **–** 19 were granted over past year of 21 requests.

New Registrations (Cat A)

- Methyl anthranilate (Rejex-It Migrate), an agriculture and turf bird repellent (PRD2011-11).

- Icaridin (several trade names), personal use for biting insect and tick repellent (PRD2011-10)
- d-Limonene (ProCitra-DL and MotherEarth Crawling Insect Killer), for control of arthropod pests in and around structures (PRD2011-21)
- Thymol (Thymovar), for control of varroa mite in honey bee hives (PRD2011-18)
- Oxalic Acid Dihydrate (trade name same), for control of varroa mite in honey bee hives (PRD2011-12)

New registrations

- Flonicamid (Beleaf), granted full registration for control of aphids on field vegetables, hops and tree fruits (PRD2011-25)
- Spiromesifen (Forbid), for control of whiteflies on various greenhouse vegetables and ornamentals, indoors and outdoors, and (Oberon) on field vegetables, corn, alfalfa and strawberries (PRD 2011-19)
- *Metarhizium anisopliae* Strain F52 (Met 52), for control of black vine and strawberry root weevils on container-grown ornamentals.
- Chlorantraniliprole (Acelepryn, Altacor, Coragen) for various lepidoptera pests of turf, field crops, green house vegetables and tree fruits (PRD 2011-27)
- MCH (MCH Bubble Cap), pheromone for deterring attack by Douglas fir and spruce beetles.
- *Beauvaria bassiana* strain HF 23 (Balence ES), for control of house flies in poultry houses.

URMULE registrations – 54 completed over past year involving 16 actives and 25 products.

8.3 Product Updates

- **DowAgroSciences** (Don Hare): Sulfoxaflor, a new class of active ingredient (sulfoximines) with activity against sap-feeding/piercing-and-sucking insect pests with similar target site to but different mode of action than neonicotinoids. Anticipated registration in 2012 in Canada, US and Australia of two products – Closer™ (hort. crops) and Transform™ (field crops). Appears to have activity against the brown marmorated stink bug.
- **BASF** (Scott MacDonald): Ripcord™ EU permit for SWD on host crops and URMULE for European paper wasps in grapes; Fastac™ (combination of cypermethrin isomers) submitted for registration in US and to be submitted later this year in Canada; Nealta™ (cyflometofen), Group 25 miticide to be submitted end of 2011 for control of tetranychid mites on various horticultural crops.
- **UAP** (Chris Noske): Beleaf™ (flonicamid), Group 9 aphicide for control of aphids on field vegetables, hops and tree fruits. Reviewing rate on tree fruits after reported lack of expected performance in the Okanagan this year.

9.0 Special Reports

9.1 Balsam Woolly Adelgid – Gabriella Zilahi-Balogh

Gabriella described the life stages, biology, feeding behaviour and damage, distribution and history of this introduced pest of *Abies* spp. (alpine and sub-alpine fir) in BC. It is subject to provincial and federal regulation. The pest was detected west of the coastal quarantine zone in 2008 (Rossland) and in 2011 (Coquihalla Highway). The quarantine has kept sub-alpine zones free of the pest to date.

9.2 IPM in Sweden – Camilla Perrson

Camilla is a visiting agrologist from Sweden who delivers pest management advisory services to field crop producers through a private company. She described the legal (mandatory) requirements with which producers must comply if they are to receive EU subsidies for their harvested crops. These requirements include: 1) sprayer operator certification (1 week initial training, renewal every 3 years with 2-day course update); 2) compliance with PHI and application to recommended crop development stage; 3) use of drift-reducing nozzles; 4) maintaining accurate spray records; 5) pest monitoring to confirm need for and selection of pesticides (crop advisors give written recommendations); 6) proper sprayer filling stations to prevent pesticide escape (use biological active beds or sealed pads).

Voluntary IPM-related practices include sprayer calibration every 2 years, use of dosage keys to determine correct dosage for each pest group, calculate and apply buffer zones based on factors listed in a table designed to help producers calculate buffer zones for each spraying operation, leaving a no-spray (check) zone (minimum 10 x 10 m) for the season in each crop in order to assess efficacy of treatment and pest prevalence. Application of these practices also entitles producers to EU subsidies. Advisors can provide clients with an assessment of their carbon footprint based on production practices.

Advisors keep electronic records of each operation (including field maps) which are used to review current operations and plan for the next year.

9.3 Working Group on Foliar Insect Pests in Field Crops – John Gavloski

Role of the WG is to identify pest and crop management methods that reduce risks associated with pesticides used against field crop insects in Canada. Objective is to identify 5-6 priorities for investigation using funding provided through the PMC. Attendees were encouraged to email John (john.gavloski@gov.mb.ca) or Cezarina Kora (cezarina.kora@agr.gc.ca) with their suggested priorities.

10.0 WCCP GUIDE

After some discussion it was decided that Hugh Philip would contact each of the WCCP Guide section editors and request that each update their section and submit it to the Western Forum web master (Kelly Turkington; email: kelly.turkington@agr.gc.ca) for posting on the WF site by March 31, 2012. Any sections after that date that have not been updated since 2008 will be deleted.

11.0 New Business

No new business.

12.0 Election of 2012 WCCP Chair

Scott Hartley was elected Chair for the 2012 meeting in Saskatchewan, location likely in Regina or Moose Jaw.

13.0 Resolutions

Only one resolution was presented by the committee for approval.

Background

- The Bertha armyworm is a serious pest of canola with distinct cyclical outbreaks; and
- Bertha armyworm populations are distributed across the Prairie ecosystem and there are recorded instances of variable efficacy of pheromone traps for monitoring adult in isolated regions.

Recommendation

The Western Committee on Crop Pests inform appropriate funding and research agencies of the issues and perceived research needs described above and encourages the development of new initiatives to:

1. Assess the genetic variability of Bertha armyworm populations across the Prairie ecosystem, and
2. Determine the effectiveness of current monitoring protocols, and
3. Evaluate modifications to protocols that are designed to enhance the reliability of trap counts.

Disposition of the resolution:
Chair to send resolution to Canola Council of Canada, Western Grains Research Fund, Agriculture and Agri-Food Canada, and relevant Provincial funding programs.

Resolution was approved on a motion by L. Dosdall/H. Carcamo. CARRIED

14.0 Adjournment

Meeting adjourned 1640 h on a motion by J. Gavloski. CARRIED

BRITISH COLUMBIA MINISTRY OF AGRICULTURE

2011 INSECT PEST REPORT

WESTERN COMMITTEE ON CROP PESTS
October 17-19, 2011

SUMMARY

Spotted wing drosophila was monitored in tree fruit, berries and grapes with apple cider vinegar baited traps. Population levels were much lower than in 2010. There were no reports of damage to tree fruit and table grapes, and minimal damage was reported in berries. It has been a quiet year for grasshoppers. The grey tortrix moth, *Cnephasia stephansiana* caused damage to alfalfa in the Quesnel and Kesley regions. Apple clearwing moth was detected in Summerland in June, 2011. *Lyonetia prunifoliella* attacked apples, cherries and birch in Cherryville, North Okanagan. On Vancouver Island, wireworms and crane flies were a problem in forage and wireworms caused damage to garlic and tomatoes in coastal regions. B.C. remains free from Swede midge, a pest of cole crops in eastern North America, again in 2011. Root weevils of various species continue to plague perennial crops like blueberries, nursery stock, and landscapes in southern B.C, particularly on the coast.

FORAGE CROPS

Crane fly larvae were active in forage and in larger numbers than usual on Vancouver Island.

Grasshoppers were not an issue in the Southern Interior of B.C. this year.

Wireworms were a problem in forage and other crops on Vancouver Island and the Fraser Valley.

FIELD CROPS

Cnephasia stephansiana: grey tortrix caterpillars caused damage to alfalfa in the Williams Lake and Kersley regions of B.C. See factsheet for further information: http://www.agf.gov.bc.ca/cropprot/cnephasia.pdf

Cutworms: there was a report of cutworm infestation in pasture in North Okanagan.

Kootenays: it has been a quiet year for insect pests in the Kootenays.

Peace River region: There were no insect monitoring programs undertaken by the Ministry of Agriculture in 2011 for flea beetle, diamondback moth, bertha armyworm, lygus bug or grasshopper as this is no longer a Ministry of Agriculture function. Large numbers of aphids were observed due to an extended warm September.

HORTICULTURAL CROPS

Apple clearwing moth (*Synanthedon myopaeformis*) was found in the Prairie Valley area of Summerland in June, 2011. The pest seems to be spreading and continues to be an issue on apples in the Similkameen, South Okanagan Valleys and the Ellison area of Kelowna. Success and Entrust are registered for the control of apple clearwing moth.

***Lyonetia prunifoliella*:** lyonetid leafminers caused damage to apple, cherry and birch trees in Cherryville. Other hosts of this pest include plum and grape. Larvae feed on young leaves, causing blotch mines. For further information, see http://www.caf.wvu.edu/kearneysville/pest_month/insectfocussept.html

Root weevils: various species of root weevils (black vine weevil, *Otiorhynchus sulcatus*; clay coloured weevil, *O. Singularis*; strawberry root weevil, *O. ovatus*; rough strawberry root weevil, *O. Rugosotriatus*; obscure weevil *Sciopithes obscures*) caused damage to crops in Coastal B.C. These weevils are fruit contaminants in machine-harvested raspberries. Larvae feed on the roots of various plant species including blueberry, conifers, rhododendrons, nursery and landscape plants, leading to plant decline.

There are very limited control tools available for the larvae and adults of these pests. Emergency registration for a pre-harvest insecticide, Actara (thiamethoxam) in raspberries in 2011 gave limited control of black vine weevil.

***Serica sericea*:** adults of this June beetle species caused extensive feeding damage to raspberries in Oliver.

Spotted Wing Drosophila (*Drosophila suzukii*): monitoring of spotted wing drosophila was carried out in tree fruit, berries and grapes in B.C. Population levels were relatively low compared to 2010. There were no reports of damage to commercial tree fruit and table grapes in the Southern Interior and minimal damage was reported in berries in Coastal B.C. Emergency registration products for spotted wing drosophila control in B.C. in 2011 were Delegate, Entrust, Ripcord and Malathion. For further information refer to http://www.agf.gov.bc.ca/cropprot/swd.htm.

Swede midge (*Contarinia nasturtii*): A survey was undertaken in commercial cole crop fields in 2011 funded by a partnership of the cole crop/brassicae industry associations and the B.C. Ministry of Agriculture. Based on the survey results, B.C. remains free from Swede midge.

Wireworms (*Agriotes* sp): wireworms caused damage to tomatoes, garlic, and potatoes on Vancouver Island and the Fraser Valley, largely in backyards and small plantings.

EXTENSION PROGRAMS

Factsheets: A new factsheet on *Cnephasia stephansiana* was published by the Ministry of Agriculture (http://www.agf.gov.bc.ca/cropprot/cnephasia.pdf), and spotted wing drosophila factsheets were updated http://www.agf.gov.bc.ca/cropprot/swd.htm

Okanagan Sterile Insect Release Program: to address grower concerns with established and emerging invasive pest species and also to increase its value and sustainability, the SIR program has requested for an amendment to legislation administered by the Minister of Community, Sports and Culture to include other pests. The program is exploring other area-wide management technologies (e.g. mating disruption) for the control of codling moth, leafroller, budmoth, and other insect pests.

Compiled by Susanna Acheampong, B.C. Ministry of Agriculture , 200 - 1690 Powick Road, BC, V1X 7G5, Phone: (250) 861-7230, Susanna.Acheampong@gov.bc.ca and Tracy Hueppelsheuser, B.C. Ministry of Agriculture, 1767 Angus Campbell Road, Abbotsford, BC, V3G 2M3, Phone: (604) 556-3031, Tracy.Hueppelsheuser@gov.bc.ca, with contributions from Kerry Clark, Jim Forbes, Wayne Haddow, Jill Hatfield, Rob Kline, Darrell Smith and Carl Withler.

ALBERTA CROP INSECT UPDATE 2011

SUMMARY

Insect issues were generally lower in 2011 than previous years. Cabbage seedpod weevil (*Ceutorhynchus obstrictus*) was much less of a pest. The same can be said of pea leaf weevil (*Sitona lineatus*) which was late coming into pea fields and numbers were generally lower. Cutworms were a common complaint in 2011 causing severe damage in individual fields across the province. Wireworms continued to cause crop damage in 2011. Cereal leaf beetle (*Oulema melanopus*) is still showing up mostly below economic threshold levels. Grasshoppers continue to cause some problems in the Peace and Central Alberta.

OILSEED INSECTS

The cabbage seedpod weevil (*Ceutorhynchus obstrictus*) was much less of a problem in southern Alberta than in previous years. Although scouting and spraying are now routine management practices for canola producers south of the Trans-Canada Highway, many producers did not have to treat their fields in 2011. Spraying was still common in the Lethbridge region but weevil numbers were also generally lower there as well. There were no fields sprayed for CSPW in the northern reaches of its range unlike in 2010. CSPW did not expand its range in Alberta.

Bertha armyworm (*Mamestra configurata*) numbers were generally higher in pheromone traps throughout most of the province. A total of 146 monitoring sites were set up through excellent cooperation with the agricultural industry. Economic levels of larvae were found in the far northern reaches of the Peace and in

NE central Alberta and were sprayed. Area sprayed in 2011 is likely under 10,000 acres. This does suggest a possible further increase for 2012.

Diamondback moth (*Plutella xylostella*) was monitored in Alberta at 22 sites across the province. Very low numbers persisted throughout the season.

Striped (*Phyllotreta striolata*) and crucifer flea beetle (*P. cruciferae*) once again caused damage in areas of the Peace. Flea beetles caused little concern in the balance of the province in 2011.

Lygus bugs were found in canola in moderate to high densities in the early flowering stage throughout much of southern Alberta. This is despite the traditional thinking that dry weather favors lygus buildup. There were high levels of lygus in many fields as swathing time approached in southern Alberta. Some fields were sprayed while other producers elected to push the swathing date forward a few days. There was some concern of very high lygus numbers in canola late in the season in situations where there was no prior indication of lygus.

The suspicious midge from the Vegreville area turned out to NOT be Swede midge

CEREAL INSECTS

Wireworm (Elateridae) was once again a concern in 2011. Reports from several individual producers frustrated with poor control of wireworm using registered seed treatments. This is likely due to the long period of cool temperatures and slow growth experienced this spring. Some producers are getting a little bit frantic trying to find something that works reliably. We really need more work on this insect/ insect complex. Conversely there were several reports from producers in 2011 that were happy with the level of protection provided by seed treatments.

Severity of wheat stem sawfly (*Cephus cinctus*) damage was low in much of southern Alberta. There are still some areas of concern left in southern Alberta around Foremost and west of Brooks. Otherwise populations are greatly reduced from previous years with only small pockets remaining.

Orange wheat blossom midge (*Sitodiplosis mosellana*) occurred in increased numbers this year with some but generally very little spraying taking place. It was, however another good year for midge development and we should expect a further resurgence in the midge population. The wheat midge survey sampling is well under way but there are no results to report at this time. Midge has been found throughout the Peace and the survey has expanded into that area. Many thanks to Kristina Pohlziehn (Viterra) and Jennifer Otani (AAFC) for bringing this to the attention of the industry and their support in northern Alberta. The wheat midge was initially indentified through threshing head samples prior to harvest. We continue to take samples in irrigated areas of southern Alberta and have expanded the survey into dryland wheat in southern Alberta as well. In other words we now survey the entire province and will process over 300 samples this year.

Cereal leaf beetle (*Oulema melanopus*) is established in southern Alberta. There are more and more reports of CLB activity but still very few if any fields with economically damaging levels.

Cutworms (Noctuidae) were the number one call in Alberta again in 2011 and were the biggest acreage pest. Cutworm damage was noted from all crop production areas. There were generally fewer calls from the Peace and cutworms were still a concern in central Alberta. There were several cases of very severe damage in southern Alberta where fields were damaged so badly they had to be plowed down. Producers and agrologists will need to continue to be diligent in scouting to avoid cutworm damage in the future. Species being implicated are dingy (*Feltia* spp.), redbacked (*Euxoa ochrogaster*) and pale western (*Agrotis orthogonia*) cutworms.

Aphids started showing up in cereal crops near the end of the season in very high but generally at below threshold levels and no control measures were needed. High levels of lady bird beetles were also reported.

PULSE CROP INSECTS

In 2011, pea leaf weevil (*Sitona lineatus*) damage was found in the same general area with no real change in the range since 2007. Damage was generally less severe than in previous years. Spring flights were much later due to the cool wet spring and damage levels were generally low.

GRASS CROPS, PASTURES AND GENERAL INSECTS

Once again several reports of slug damage in crops. One report was very severe on a late seeded canola crop in central Alberta. This is most likely the common grey garden slug (*Derocerus reticulates*).

Alberta Spotted Wing Drosophila (SWD) Report from Jim Broatch (Oct 14th, 2011)

> In Alberta there were seven (7) trapping sites established. The sites were located at: Grande Prairie (traps operated by Jim Donnely , City of GP), Dunvegan Gardens (Michelle Holden , Peace Agriculture Research & Demonstration Association), Smokey Lake (Don Christensen, Linda's Market Garden), Lacombe (Art Rauhala, AAFC) Innisfail (Jim Broatch, AARD), Sylvan Lake (Jim Broatch, AARD), Olds (Ken Fry, Olds College).
>
> Traps consisted of the standard Contech trap for SWD. Apple cider vinegar was used as the bait. Traps operated from late May until mid-September, maintained on a weekly basis. Traps were located primarily in strawberry and raspberry, but cranberry, Saskatoon, apple, cherry and cull piles were also utilized at various trap locations. No SWD were observed in collections to this date. All traps have been subsampled and inspected but in several trapping sites, (predominantly central Alberta) there were many (hundreds) wood gnats (Sylvicola fenestralis (Anisopodidae) and a more thorough processing will need to occur in October/November. At that time other Diptera captured will also be ID'd to species. SWD trapping/monitoring/surveillance will continue in 2012, with an expansion of sites to include more southerly locations.
>
> Thanks to Rob Spencer for initiating contacts with producers and with pick up of samples.

Grasshopper (*Melanoplus* spp and *Camnula pellucida*) numbers and concerns relating to damage increased this year in central Alberta and in the Peace River region. The main area of the province affected by grasshoppers was the Peace River area. Several producers in this region reported high populations, and in some cases producers sprayed crops with insecticide repeatedly.

From Dan Johnson (I really appreciate the context Dan brings to the grasshopper discussion and think his comments are best included exactly how they were sent):

General observations of grasshopper species during 2011 (Orthoptera: Acrididae), and their relatives, Conocephalinae, Tettigoniinae, Phaneropterinae, and Oecanthinae (Orthoptera: Tettigoniidae), and Gryllinae (Orthoptera: Gryllidae)

Pests:

Cool weather during spring and early summer again delayed grasshopper hatching, and resulted in additional mortality in the embryos and hatchlings from the already low numbers of eggs. Some shifts in relative commonness of grasshopper species occurred. Clear-winged grasshopper was relatively lacking in southern Alberta, but in north-central locations, this grass-feeding species is making a comeback. Bruner's spur-throated grasshopper also continued an increase in the central and north-central areas, but remains absent in the south. Northern grasshopper and certain montane grasshopper species declined in western AB from a peak during 2005-2009 but could still be found. The two-striped grasshopper remains a common member of the grasshopper pest community across southern SK and in south and central agricultural AB. Successful breeding by this species and also limited numbers of Packard's grasshopper was observed, and resurgence over the coming years is possible. The lesser migratory grasshopper has still not recovered anywhere near the prominence of the 1980's and 1990's in AB, although it is common in southern BC. No regular survey of parasites exists, but several thousand living grasshoppers brought into the lab for examination and rearing during late 2011 were found to have rates of fly parasitism of less than 10% of most previous years. The top 15 species of rangeland grasshoppers were all very low in numbers in 2011, as in the last 3 years.

Non-pests:

Non-pests grasshopper species have almost disappeared in some areas, and the food resource for grassland bird populations is clearly reduced to a tiny fraction of normal. One non-pest species, the marsh meadow grasshopper, seems to increasing some areas; this mesophilic species is typically found when conditions are not very dry and hot. Certain other meadow katydids were also relatively abundant, compared to the very low numbers of short-horned grasshoppers. Early-season short-horned grasshopper species that normally emerge in April (but present no risk to crops) were also exceptionally low in numbers in 2011. Mormon cricket was very rare on the prairies in 2009-2011, unlike dense outbreaks observed during 2002-2004. Tree crickets were audible in late summer, 2011, at some locations (mainly one species currently) but at much lower numbers than during 2000-2006, according to sweepnet and beating samples. Highly visible non-pests that are noticed by the public, including some large katydid species, have been reduced to almost nothing, compared to the big increases in their numbers between 2000 and 2005. No organized survey of ground crickets is conducted, but general observations indicated lower numbers of spring and fall field crickets, than during 2000-2009.

Dan Johnson dan.johnson@uleth.ca

Many thanks to those that contributed to the compilation of this report: Shelley Barkley, Jennifer Otani, Dan Johnson, Harry Brook, Tim Dietzler, Hector Carcamo, Jim Broatch and Carrie Butterwick.

Report Compiled by Scott Meers

Alberta Agriculture and Rural Development
Crop Diversification Centre South
301 Horticultural Station Road East
Brooks, AB T1R 1E6

scott.meers@gov.ab.ca

Alberta Crop Area

Crops	2010 Seeded	2010 Harvested	2011p Seeded	2011p Harvested
	('000 acres)		('000 acres)	
Winter Wheat	175.0	175.0	160.0	160.0
Spring Wheat	6,000.0	5,885.0	6,215.0	6,060.0
Durum Wheat	360.0	350.0	525.0	520.0
All Wheat	**6,535.0**	**6,410.0**	**6,900.0**	**6,740.0**
Oats	950.0	530.0	785.0	500.0
Barley	3,750.0	3,125.0	3,680.0	3,100.0
Fall Rye	45.0	45.0	30.0	30.0
Flaxseed	40.0	38.0	60.0	60.0
Canola	5,550.0	5,500.0	6,150.0	5,935.0
Dry Peas	935.0	925.0	710.0	675.0
Total	**17,805.0**	**16,573.0**	**18,315.0**	**17,040.0**

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Source: Statistics Canada, September Estimates of Production of Principal Field Crops,

Canada, 2011

Prepared by: Alberta Agriculture and Rural Development, Economics and Competitiveness

Division, Statistics and Data Development Branch, 2011

2011 Saskatchewan Insect Report
Western Committee for Crop Pests
October 18, 2011
Kelowna, British Columbia

Summary

Excess moisture (wet) and below normal temperatures were key factors contributing to slow development of insects in 2011. Southern regions of Saskatchewan had the most precipitation, particularly the Southeast Region. The Central and Northern Regions particularly the Northwest and West Central Regions received less precipitation early in the season. The cool, wet conditions in the spring were not favourable to many above-ground insects. However subsurface insects such as wireworms and cutworms were less affected by below normal ambient temperatures. Precipitation was much lower in July, August and accompanied with generally high temperatures. Similar conditions through September provided an extended period for harvest of crops, many of which were late-seeded due to the wet spring.

Depending on the crop and region of the province, insect pests of note in 2011 included cutworms, pea leaf weevil, cabbage seedpod weevil, aphids, grasshoppers, wheat midge, diamondback moth and bertha armyworm. The wet conditions contributed to infestations of slugs for some producers. Richardson's ground squirrels populations were greatly reduced in 2011 likely due to past control measures, increased predator populations (mammalian and avian), and the wet cool conditions in the spring for most areas, especially the southwest.

Cereal Insects:

Orthoptera: grasshoppers (various species) - two-striped (*Melanoplus bivitattus*) most dominant species for most of the Province) – Grasshoppers were not expected to be a major pest in 2011 although hot spots were noted in the forecast, primarily in the southwest (south of Swift Current). A few other higher risk areas were identified south of Watrous and southwest of Saskatoon (Central and West Central Regions). There were reports of higher numbers of grasshoppers, near economic threshold levels in the Meadow Lake area (NW - species identification was not definitive but possibly *Melanoplus dawsonii*). The Agriculture Knowledge Centre (AKC) in Moose Jaw reported queries on grasshopper infestations in winter wheat in September.

A grasshopper survey was conducted by Saskatchewan Crop Insurance field staff in August and September. A grasshopper risk map will be generated from the data and posted on the Saskatchewan Ministry of Agriculture website.

Diptera: Cecidomyiidae - *Sitodiplosis mosellana* (Gehin) - wheat midge – The wet conditions in 2010 favoured the build-up of wheat midge populations resulting in an increased risk as indicated in the 2011 wheat midge forecast. The cool spring conditions resulted in a slow development of degree days and associated wheat midge development. As a result, the emergence of the wheat midge adult flies was later than most years. Normally first emergence of the midge is in southern regions in late June. In 2011, emergence did not commence until July.

Wet conditions affected seeding in most areas. Although there was midge damage reported by the Canadian Grain Commission, crops escaped injury to the midge when susceptibility did not coincide with midge emergence – in some cases by completing anthesis before the midge emerged and later seed crops did not reach a susceptible stage until after peak midge emergence. Insecticide application was required for populations in several areas including the north central and northwest. Even with higher midge pressure in 2011 the AKC reported a reduction in inquiries on wheat midge from 2010.

The introduction of midge tolerant wheat varieties will also reduce the effect of midge damage. Information on midge tolerant wheat, including resistance management through the refuge system and available varieties is available at www.midgetolerantwheat.ca.

A fall soil survey was conducted by a private contractor in September and October. Wheat midge cocoons will be extracted from the soil samples (approx. 400) and dissected for parasitism levels. Data from the survey will be used to generate a risk map to be posted on the Saskatchewan Ministry website.

Oilseed Insects:

Coleoptera: Chrysomelidae: Alticinae – primarily *Phyllotreta cruciferae* (Goeze) crucifer flea beetle, *P. striolata* (Fabricus) striped flea beetle - There were a few queries on flea beetles from Central and Northern Regions early in 2011 but no significant problems were reported in the spring. There were reports of problems with flea beetles in late seeded canola in June.

The Ministry of Agriculture cooperated with Dr. Julie Soroka of Agriculture and Agri-Food Canada (AAFC), Saskatoon for the fourth consecutive year in collecting flea beetles with sticky cards to investigate species shift (crucifer and two-striped flea beetles) to determine changes in population composition. After placing cards out, some sites became inaccessible due to wet conditions for a few weeks. Dr. Soroka's study has noted an increase in striped flea beetle populations over the past four ears.

Curculionidae – Ceutorhynchinae – *Ceutorhyncus obstrictus* – cabbage seedpod weevil –Although this insect pest continues to expand its range north and primarily eastward, the most severe infestations

remain concentrated in the southwest. The main crop host for this pest is canola and to date the main canola producing region of the Province remain free of the cabbage seedpod weevil. In 2011, there were potential economic infestations identified near Moose Jaw. In this case fields were monitored in June (sweep net) but no significant populations were noted. However at harvest, exit holes in pods were very noticeable and a concern for the producer. It is possible that sweep net sampling was done in windy conditions that are not conducive to picking up the beetles since they tend to keep low during periods of high winds (Carcamo, Dosdall).

AAFC, Saskatoon coordinates and conducts an annual survey for this weevil with assistance from Saskatchewan Agriculture. Results are posted on the Saskatchewan Ministry of Agriculture website.

Diptera: Anthomyiidae: *Delia radicum* (L.) - Cabbage root maggot – Wet conditions in both 2010 and 2011 were favourable for an increase in root maggots. The larvae were readily found in most fields sampled. With no options for control after seeding, increased seeding rates or crop rotation were recommended. The value of canola resulted in increased canola acreage and likely less preference for crop rotation in 2011.

Lepidoptera: Noctuidae – cutworms, various species (*Euxoa ochrogaster* (Guenee) –redbacked cutworm generally in eastern regions, *Agrotis orthogonia* Morrison / pale western cutworm more commonly in western regions, and *Feltia jaculifera* (Gn.) dingy cutworm) – Cutworms were a widespread problem and likely the most significant insect pest in Saskatchewan in 2011, with some species causing damage through to at least the end of June. Several species, both subsurface and foliar feeding, and chemical control measures were reported. Synthetic pyrethroids (e.g. permethrin) and chlorpyrifos (e.g. Lorsban) were reportedly the most common control products used, depending on registration in the crop. Canola was again the most common crop reported with cutworm infestations according to the AKC. Infestations are difficult to predict and scouting the crop next season will be key in determining if control is required.

Plutellidae – Diamondback moth – *Plutella xylostella* (Linnaeus) – Since the level of diamondback moth infestations depend on winds favourable to bringing the adults north from the southern United States and Mexico during the growing season, monitoring programs attempt to identify potential problems using Environment Canada data (wind currents) and utilizing pheromone traps set up starting in late April with some trap collections continuing into July. Spraying for control of the diamondback moth larvae was reported in various locations throughout the Province in June, continuing into late July.

Noctuidae – Hadeninae – *Mamestra configurata* Walker - bertha armyworm – Bertha armyworm populations appear to be on the increase with a few areas with economic populations in 2011. Insecticide application was required for control of infestations primarily in Northwest and East Central Regions. There were also reports of spraying in the Prince Albert / Shellbrook area (North Central). This may be an indication that this pest wil be of increased risk in some areas in 2012. Bertha armyworm adult emergence is monitored during the growing season with pheromone traps (160 traps in 2011) providing an estimate of risk prior to damaging larval stages of the insect.

Pieridae - *Pieris rapae* (L.) - imported cabbageworm - This is the larval stage of the cabbage butterfly. This insect is generally not considered of economic importance but the high populations across the province in 2011 caused concern for canola producers especially if foliage was limited or feeding was on pods. There were some reports of insecticide control for this pest.

Phylum Mollusca: Class Gastropoda – Pulmonata – terrestrial slugs – Wet conditions were favourable for slugs. There have been reports in previous years in various areas in the Province. However infestations were largely restricted to low lying, wetter areas of fields. In 2011 reports of infestations included large portions to full fields. Some reports were from the south west, a normally semi-arid region of the Province. There are control options but not economically viable on a large field-scale situation.

Other Crops

Dry Pea – Coleoptera: Curculionidae - *Sitona lineatus* (L.) – pea leaf weevil –In 2011, economically damaging populations of the pea leaf weevil were confined to southwest Saskatchewan. This insect is a pest of pea and faba bean so crop rotation to a non-host crop is a viable management option. However, if the pea leaf weevil was noted in fields in 2011 and pea is planned for 2012, a seed treatment registered for pea leaf weevil is recommended. Research at AAFC, Lethbridge showed that nitrogen application in the spring can also reduce the effects of pea leaf weevil feeding. This may be an option for organic producers if the form of nitrogen is acceptable for organic production.

Ministry of Agriculture personnel (Crops and Regional Services Branches) conducted a pea leaf weevil survey in early to mid-June.

Lentil – **Homoptera: Aphids –** In July, aphids were reported at economic levels in a number of crops. In Saskatchewan, canaryseed and pea crops are most commonly affected by aphids, but in 2011 infestations of aphids in lentil were most common queries, particularly in the southwest, a prime lentil growing region. The majority of calls were related to economic thresholds and the susceptible stage of lentil.

Although there are some over-wintering aphid populations, this is another pest whose population levels tend to be dependent on influx from the south and favourable (humid) climatic conditions during the growing season. Therefore, it is difficult to predict levels of aphids. Reports of infestations in the northern U.S. (Minnesota, North Dakota) have been beneficial in warning of impending aphid problems in Saskatchewan.

Grasshoppers - The AKC received queries on grasshoppers from the Northwest and West Central Regions in late seeded lentil fields in August.

Forage Insects

Contributions from: Dr. Juliana Soroka (AAFC, Saskatoon), Lorne Klein (Sask. Ministry of Agriculture, Weyburn), Clayton Myhre (PickSeed, Nipawin)

A Forage Insect Survey was conducted in 2011, coordinated by Dr. Juliana Soroka (AAFC, Saskatoon) and conducted by Regional Services Branch Forage Crop Specialists. Samples are currently being processed by AAFC. This survey was initiated due to concerns of increasing distribution and numbers of alfalfa weevil (Coleoptera: Curculionidae - *Hypera postica* (Gyll.) noted in the Province but the survey also includes information on other alfalfa insects – pest and beneficial.

Summary of Results: In 2010 48 alfalfa fields and in 2011 45 alfalfa fields across Saskatchewan were swept and the insects sent to Dr. Soroka's laboratory for identification. The excess moisture and generally cool weather in 2010 resulted in excellent alfalfa growth and poor insect development over the season. Alfalfa stands were lush and pest insect numbers were low over most of the province in this year. Even the highest alfalfa weevil numbers, 6.2 larvae/sweep near Cupar, SK, were much lower than published economic thresholds. In 2011 alfalfa weevil numbers in 33 of 45 fields were higher to much higher than found in the previous year, with five locations having weevil numbers greater than 30 larvae per sweep, and one field near Churchbridge having a high of 135 larvae / sweep. In 2010, samples from 19 locations had no alfalfa weevils, while in 2011, 10 locations were weevil-free. Most of these were in the western and northern areas of the province. The specialist parasitoid wasp *Bathyplectes curculionis* (Thomson) was reared from alfalfa weevil, a first Saskatchewan record. The numbers of *Bathyplectes* wasps and the numbers of locations from which they were collected were much lower in 2011 than in 2010, in inverse proportion to the number of weevils found in the two years.

Notes from the **North East Region** - Lesser clover leaf weevil (*Hypera nigrirostris*) was found in red clover fields in the northeast, with some spraying undertaken for control, although levels were generally lower than in years past. Brome grass seed midge (*Contarinia bromicola*) continues to be a concern.

Report to the Insects and Diseases Committee
Saskatchewan Advisory Council on Forage Crops
D.W. Goerzen, Executive Director
Saskatchewan Alfalfa Seed Producers Development Commission
December, 2011

Insects and diseases in Saskatchewan alfalfa leafcutting bee populations

The alfalfa leafcutting bee, *Megachile rotundata*, is an important pollinator of alfalfa for seed production in western Canada. Infestations of the chalcid parasitoid *Pteromalus venustus* are currently a problem in some alfalfa leafcutting bee populations. Another factor which may limit alfalfa leafcutting bee production is the occurrence of chalkbrood disease, *Ascosphaera aggregata*.

Occurrence of the chalcid parasitoid, *P. venustus*, was evaluated in the 2010 - 2011 winter survey of Saskatchewan alfalfa leafcutting bee populations. The parasitoid was detected in 0.35% (range 0.00 - 3.50% / sd 0.56%) of bee cells analysed from individual samples submitted by Saskatchewan alfalfa seed producers (n = 97). *P. venustus* was present in 56.7% of alfalfa leafcutting bee populations surveyed.

Chalcid parasitoids have traditionally been controlled during the spring alfalfa leafcutting bee incubation period with dichlorvos resin strips; dichlorvos has been implicated in alfalfa leafcutting bee mortality and this compound is also among the organophosphate insecticides under review by the PMRA and the EPA. Research is currently being undertaken to identify and evaluate alternative compounds which might be efficacious for control of the chalcid parasitoid, *P. venustus*, in *M. rotundata* populations.

Occurrence of chalkbrood disease (*A. aggregata*) was also evaluated in the 2010 - 2011 winter survey of Saskatchewan alfalfa leafcutting bee populations. The disease was present at an extremely low level in bee cells analysed from samples submitted by Saskatchewan alfalfa seed producers (n = 97), with occurrence of the sporulating form of chalkbrood disease at 0.003% overall (range 0.00 - 0.32% / sd 0.032%) and occurrence of the non-sporulating form of chalkbrood disease at 0.016% overall (range 0.00 - 0.79% / sd 0.087%). Paraformaldehyde fumigation and bleach dipping treatment of alfalfa leafcutting bee nest material / alfalfa leafcutting bee cells are two methods currently utilized for control of a broad range of microflora, including *Ascosphaera* spp., occurring in alfalfa leafcutting bee populations.

Research to monitor parasitoid and disease levels in Saskatchewan alfalfa leafcutting bee populations and to develop strategies which will assist alfalfa seed producers in controlling these problems is ongoing.

D.W Goerzen

Saskatchewan Alfalfa Seed Producers Development Commission
127 E - 116 Research Drive
Saskatoon, SK S7N 3R3
tel (306) 651-7275
e-mail: goerzenw@innovationplace.com

TREE & SMALL FRUIT REPORT

Forrest Scharf, Philip Northover, and Scott Hartley Saskatchewan Agriculture

I. PEST SITUATION REPORT

The 2011 crop year was filled with a diverse range of pest problems. In most locations, above average snow accumulation occurred over winter. The snowpack provided insulation that helped some species (like strawberries) survive low winter temperatures, but it also created flooding that caused drowning (especially in the Qu'Appelle Valley and other low-lying areas in the southeast). Some snow drifts were high enough to allow deer and rabbits to pass over orchard fencing to forage on plants. Due to limited ability to source nutrients from below the snow, the animals caused very extensive damage to stem and branch tissues above the snowline. In apples where scion wood was budded onto dwarfing rootstock, most of the foraging and subsequent death of top-growth occurred above the graft union. This means that in most cases growers will not have to replant rootstock, or re-bud scion wood onto the rootstock. The majority of the damaged trees sent out vigorous new top-growth over the summer, but it will take two years before significant yield from new branches can be expected.

Common insects could be found at low levels within most orchards but most growers were able to spray to control them (unlike in 2010 when many growers could not enter their orchards due to overly wet conditions).

Apples: Aphid populations were well above average; apple maggot population was average, dock sawfly caused economic loss in a few isolated locations in the north-west, and apple curculio was present in low numbers but in many locations. Deer and rabbit browsing caused extensive damage in two orchards, setting orchard development back at least two to three years. Mouse damage was minimal.

Cherries: Dwarf sour cherries displayed unique responses to high snow levels and flooding. Cherry branches below the snowline flowered earlier and slightly more profusely than exposed branches. In regard to flooding, cherries thought to have drowned in low-lying areas were observed to re-establish themselves later. In some locations the plants were in standing water for over a month, but when the water drained new growth appeared on tissues that were not killed. Western and Black Cherry Fruit Fly were present at low levels throughout the province. Black cherry aphid was also pervasive but did not cause significant economic loss. American Robins have been widely reported to be foraging on sour cherries, and their presence appears to be a good indicator that the fruit is ripe. Growers are questioning if better pollination is required, and whether bumble bees (or other wild bees) would be a better choice to attempt to improve pollination as the bloom period is usually slightly too cold for *Apis mellifera*. Browsing by deer caused more damage than usual due to limited food supplies in early spring and over winter. Mouse damage was minimal.

Haskap: No significant insect pests have been reported. Cedar waxwings and possibly American Robins have been reported to have caused significant yield loss. Coyotes have also been sighted teaching their offspring to eat berries, but yield loss has not been significant to date.

Raspberry: Raspberry yields were exceptionally good in 2011, likely because the year started with plenty of water and was followed with consistent sunshine and heat through July and August. Raspberry fruitworm is spreading to new locations; however population levels in most patches are very low. Raspberry sawfly was pervasive but did not cause significant economic loss. Mite infestations were present, but in the majority of sites populations were at low levels. All other insect populations were at very low levels. No other non-disease pests were noted. Symptoms of Spotted Wing Drosophila were not found, but no traps were used (some traps will be employed at select locations in 2012).

Saskatoons and other native fruits: Saskatoon yields were above average in most orchards. Chokecherry yields were below average with some fruit infected by Chokecherry gall midge (more often in wild stands than commercial orchards). Apple curculio, hawthorn lace bug, ugly nest caterpillars, and fall webworm were all present at low levels in commercial orchards. Ugly nest caterpillars and fall webworm populations were well above average in many wild chokecherry stands. Round-headed Apple Tree Borer was reported in one saskatoon berry orchard in the eastern-central region. No suspected Maple Leafcutter infestations were reported.

Strawberries: Strawberry yields were average, but much later than normal (at least two weeks behind) and the fruit was slightly smaller than normal. Strawberry cutworms were noted in several patches, but were isolated and the populations were low in number. Two spotted and Cyclamen mites were present (more in the southern part of the province), and population growth was slower to progress than average (perhaps due to cooler spring conditions). Aphids, thrips, tarnished plant bugs, and clipper weevil populations were average (but late developing). Slug populations were above average in a few patches and seem to be more prevalent in the central to northwest regions.

Birds remained a constant drain on yield, but most large scale producers employed control tools to mitigate the loss (bird scarers, etc.).

Mosquitoes and West Nile Virus:

There were low levels of West Nile virus activity circulating in the environment in 2011, at least partly related to the climatic conditions in the spring. This year was the first year with no human cases of West Nile virus reported in Saskatchewan since 2003. There were four cases in horses, four positive mosquito pools and one bird case reported.

Compiled by:
Scott Hartley
Provincial Specialist – Insect and Vertebrate Pests
Saskatchewan Ministry of Agriculture
125 – 3085 Albert Street
Regina, Saskatchewan S4S 0B1
Telephone: 306 – 787 – 4669 Email address: scott.hartley@gov.sk.ca

2011 Manitoba Insect Pest Report to the Western Committee on Crop Pests October 18, 2011 Kelowna, British Columbia

Compiled by:

Field Crops

John Gavloski; Entomologist;
Manitoba Agriculture, Food and Rural Initiatives

Box 1149, Carman, MB, ROG OJO Initiatives
Phone: (204) 745-5668 Fax: (204) 745-5690
John.Gavloski@gov.mb.ca

Horticultural and Forage Crops

Brent Elliott; Entomologist
Manitoba Agriculture, Food and Rural Initiatives
Box 1149, Carman, MB, ROG OJO
Phone: (204) 745-5669 Fax: (204) 745-5690

Abbreviations used: The following abbreviations will be used in this document to indicate the following agricultural regions in Manitoba; NW=Northwest, SW=Southwest, C=Central, E=Eastern, I=Interlake.

Estimated acres: Estimated acres grown in Manitoba in 2011 (shown in brackets under each commodity title) are from the Manitoba Crop Insurance Corporations 2011 Variety Market Share Report. The symbol ↑ indicates an increase in acres from 2010, whereas ↓ indicates a decrease in acres from 2010.

Summary: The biggest insect concerns in cereal crops in 2011 were aphids, armyworms (*Mythimna unipuncta*), and thrips. Diamondback moth (*Plutella xylostella*) and Lygus bugs were widespread concerns in canola, and there were localized problems with bertha armyworm, *Mamestra configurata*. High levels of striped flea beetle, *Phyllotreta striolata*, in some canola fields in eastern Manitoba in mid- and late-July was an unusual occurrence. Soybean aphid, *Aphis glycines*, populations were at economic levels in many soybean fields from late-July to late-August. Levels of zebra caterpillar, *Melanchra picta*, were high and a concern to some canola and flax growers in late-August and early-September.

SMALL GRAIN CEREALS

Wheat (spring)-1,809,931 acres↓ + 3,096 acres organic↑; **Wheat (Winter)**-195,943↓;

Barley-247,986 acres↓; **Oats**-417,565 acres↓ + 1,363 acres organic↓; **Fall Rye**-47,535 acres↓)

Wireworms: There were no reports of wireworm damage in small grain cereals in 2011.

Cutworms: There were no reports of cutworm damage or control in small grain cereals in 2011.

Aphids: Aphids were a concern in some fields of small grain cereals. Both English grain aphid (*Sitobion avenae*) and oat-birdcherry aphid (*Rhopalosiphum padi*) were first noticed in late-June, while sampling cereal fields. High populations of aphids were reported during July from cereal fields in the Central, Interlake and Southwest regions. Cases of barley yellow dwarf virus were reported from the Central and Southwest regions.

Thrips: Thrips feeding, and some insecticide applications to control thrips, were reported during July for wheat and barley fields in the Eastern and Central regions of Manitoba.

Wheat midge (*Sitodiplosis mosellana*): There was some insecticide applied for wheat midge in the Northwest region. The wheat midge resistant variety blends Unity, Goodeve and Fieldstar were seeded on about 40,765 acres, about 2.4% of the red spring wheat acres in Manitoba in 2011.

Grasshoppers: No grasshopper problems in small grains were reported in 2011.

Cereal Leaf Beetle (*Oulema melanopus*): There were some reports of cereal leaf beetles and their feeding being noticed in the Swan River and Minitonas areas of the Northwest in July.

Armyworm (*Mythimna* [formerly *Pseudaletia*] *unipuncta*): Armyworm larvae began to be noticed in mid- June. Some fields in the Morden (C), Winkler (C) and Whitemouth/Elma (E) areas were sprayed with insecticide in July to control armyworms. High populations of armyworms and some insecticide applications were also reported for fields near Beausejour (E) and in the Interlake and Northwest regions.

CORN

(177,946 acres grain corn↑; 37,051 acres silage corn↓)

Armyworm (*Mythimna unipuncta*): Some corn in the Whitemouth/Elma area was sprayed to control armyworms.

European corn borer (*Ostrinia nubilalis*): In 2011, acres of grain corn seeded to *Bt* varieties dropped to 40.8 %, and acres of silage corn seeded to *Bt* varieties increased slightly to 21.2%. Some higher populations of European corn borer were noted in a few fields of corn in the Central region.

Western Bean Cutworm (*Striacosta albicosta*): Western bean cutworm has never been detected in Manitoba, but has been confirmed in Minnesota and North Dakota, both of which border Manitoba. Pheromone-baited unitraps were set up at eight locations from July 4 to August 28 to monitor for the presence of moths of western bean cutworm in Manitoba. No western bean cutworms were found in any of the traps, although there are still some moths collected from these traps that need identification. Some moths with markings similar to western bean cutworm are captured by these traps.

Fourspotted Sap Beetles (*Glischrochilus quadrisignatu*s): High levels of sap beetles were reported from some corn fields in the Central region from mid-August through early-September.

Spider Mites: High populations of spider mites were reported from a corn field near Altona.

CANOLA and MUSTARD

(**Argentine canola**-2,662,256 acres↓; **Polish canola**-3,725 acres↑; **Mustard**-1,222 acres↓)

Flea beetles (*Phyllotreta* spp.): Use of seed treatments containing neonicotinoid insecticides to manage early-season flea beetle populations continues to be common. Even with use of these seed treatments, high populations of flea beetles and foliar insecticide applications for flea beetles were reported from many areas of Manitoba in mid- and late-June. In some of these fields uneven emergence and slow early-season growth were increasing the vulnerability of the plants to injury from flea beetles.

High populations of striped flea beetles in mid- and late-July in the eastern part of Manitoba was an unusual event. There were some reports of high levels of flea beetles on canola in early-September as well.

Cutworms: Reports of cutworm damage in canola was down slightly this year, but cutworms were still a concern in localized areas. Insecticides were applied to control cutworms in a couple of canola field in the Swan River (NW) area, and a canola field near Neepawa (SW) had to be reseeded because of cutworm

damage.

Root Maggots (*Delia* spp.): The presence of root maggots was noted in some canola fields in the Northwest region, but there were few reports of root maggots or root maggot damage to canola.

Bertha Armyworm (*Mamestra configurata*): Pheromone-baited traps to monitor adult moths of bertha armyworm were set up at 54 locations in Manitoba in 2011. The monitoring period was June 6th to July 31st. Cumulative moth counts suggested populations were at low to moderate risk of being problematic in most regions of Manitoba in 2011. Table 1 shows the highest trap counts for 2011.

Table 1. Highest cumulative counts of bertha armyworm (*Mamestra configurata*) in pheromone-baited traps in Manitoba in 2011.

Nearest town	**Region**	**Trap Count**	**Risk Category**
Durban	Northwest	1,051	Moderate
Minitonas	Northwest	365	Uncertain
Bowsman	Northwest	330	Uncertain
Neepawa	Southwest	320	Uncertain

Peak trap catches occurred in most traps during the weeks of July 4-10th and July 11-17th. The highest trap catch in a single week was 390 at the trap near Durban on the week of July 4-10th.

Although trap counts for adult moths were generally not high, there were some areas of Manitoba that had high levels of larvae of bertha armyworm or insecticides being applied to control them in late-July until mid-August. In the Central region, insecticides were applied to control bertha armyworm in canola fields near Glenboro, Holland, Treherne, Mariapolis and Austin. There were some canola fields in the Interlake near Arborg that were also sprayed to control bertha armyworm. High populations were also reported from the Melita, Virden and Oak Lake areas in Southwest Manitoba.

Diamondback moth (*Plutella xylostella*): Pheromone-baited traps for adult moths were set up at 62 locations in Manitoba in 2011. The monitoring period was generally from May 2nd to June 19th. Table 2 summarizes the results.

Table2. Dates of first detection of diamondback moth (*Plutella xylostella*) in pheromone-baited traps in Manitoba in 2011.

Region	**Week of first diamondback moth in traps**	**Week when trap (s) from region first reports cumulative count of > 10**	**Week when trap (s) from region first reports cumulative count of > 100.**	**Highest cumulative count from region and location**

Eastern	May 9-15	May 16-22	June 6-12	175 Beausejour 1 trap >100
Interlake	May 30-June 5	--	--	2 Teulon
Central	May 2-8	May 9-15	June 13-19	239 Morris 1 trap > 100
Southwest	May 9-15	--	--	6 Boissevain
Northwest	May 16-22	June 6-12	--	13 The Pas

The highest single week count was 94 near Morris (C) during the week of June 13-19. Highest trap catches were in the eastern and central parts of Manitoba.

In mid- and late-July reports started to come in of high populations of diamondback moth in Eastern Manitoba. Populations seemed particularly high in the Beausejour (E) area, where a lot of canola fields were sprayed. In late-July high populations and some control was reported from the Swan River Valley, an area that had low adult trap catches. Then in early August reports started coming in of higher levels of larvae and some insecticide applications to control diamondback moth in the Central and Interlake regions. High levels of diamondback moth larvae were also reported west of Dauphin (NW) and near Brunkild (C). Reports of high populations of diamondback larvae and control stopped about mid-August.

On August 10, diamondback moth larvae from 4 fields in Central Manitoba were collected using a sweep net, aspirated, and shipped to Dr. Lloyd Dosdall at the University of Alberta where they were reared for parasitoids. Results are indicated in the table below:

Table 3. Parasitoids reared from diamondback moth larvae collected in Manitoba on August 10, 2011.

Nearest Location	**Total larvae collected**	**Larvae dead from unknown causes**	**Larvae parasitized by *Cotesia* sp.**	**Larvae parasitized by *Microplitis plutellae***	**Larvae parasitized by *Diadegma* sp.**	**Larvae nonparasitized, emerged as adults**	**Overall % parasitism**
Lasalle	226	87	113	4	1	20	**85.6**
Carman	83	50	9	3	8	11	**66.7**
Sanford	146	52	55	18	5	16	**83.0**
Sperling	167	62	77	1	7	19	**81.9**

In 3 of the 4 fields sampled the overall % parasitism was over 80%, with *Cotesia* sp. being the dominant parasitoid.

Lygus bugs (*Lygus* spp.): Levels of *Lygus* bugs became economical in many canola fields across Manitoba starting in early-August. Economical populations were widespread and continued into mid-September. There were reports of insecticide applications for *Lygus* bugs or populations above economic threshold in canola fields near Beausejour (E), Niverville (E), Ile des Chenes (E), Arnaud (E), Emerson (E), Morris (C), Altona (C), Thornhill (C), Elm Creek (C), Bagot (C), MacGregor (C), St. Claude (C), Rossendale (C), Portage la Prairie (C), Dauphin (NW) and Laurier (NW). Above normal dockage due to *Lygus* bug damage was reported by some producers in the Interlake.

Zebra caterpillar (*Melanchra picta*): In late-August and early-September, much high than normal populations of zebra caterpillar occurred, with canola being one of the host plants they were feeding on. Some spraying of zebra caterpillars in canola was reported for fields near Arborg (I) and Fisher Branch (I). Zebra caterpillar was also reported from canola near Portage la Prairie. Some indicated that they were feeding on the pods and seeds. This is the first year that I can recall where zebra caterpillar populations were being controlled in canola.

FLAX

(Flax-84,232 acres↓ + 2,216 acres organic flax↑)

Potato aphid (*Macrosiphum euphorbiae*): There were no reports of aphids at threshold levels in flax in Manitoba in 2011.

Zebra caterpillar (*Melanchra picta*): There were some reports of high levels of zebra caterpillars in flax in the Interlake, and at least one flax field in the Interlake had insecticide applied to control zebra caterpillars. One report indicated that leaves were being fed on and there were some bolls on the ground.

SUNFLOWERS

(20,005 acres non-oil↓; 15,207 acres oil↓)

Sunflower beetle (*Zygogramma exclamationis*): No high population or spraying for sunflower beetles was reported in 2011.

Sunflower midge (*Contarinia schulzi*): Some distorted heads from feeding by sunflower midge larvae were found in some sunflower fields across Manitoba. Economic losses were minimal.

Seedhead Insects

Many fields of confection sunflowers were again treated with insecticides during early flowering to control seedhead insects such as ***Lygus* bugs** (*Lygus* spp.) and **banded sunflower moth** (*Cochylis hospes*). Populations of **Red sunflower seed weevil** (*Smicronyx fulvus*) were very low again this year, and usually hard to find when scouting for insects on sunflower heads.

Monitoring of Lepidoptera: Pheromone-baited traps for banded sunflower moth and *Cochylis arthuri* were placed in 6 sunflower fields as part of a program to monitor the emergence and relative abundance

of these moths.

BEANS (Dry Edible)

(51,182 acres↓: White pea (navy)-20,131 acres↓, pinto-13,342 acres↓, black-9,804 acres↓, kidney-4,465 acres↓, cranberry-1,443 acres↓, other dry ebible-1,997 acres)

Green Cloverworm (*Hypena scabra*): Green cloverworms were present in some fields of edible beans in the Central region, but at levels below economical importance.

PEAS (Field)

(18,996 acres↓)

Pea aphids (*Acyrthosiphon pisum*): There were little or no insecticide applications for aphids in peas in Manitoba in 2011.

SOYBEANS

(587,382 acres↑)

Soybean Aphid (*Aphis glycines*): The first report of soybean aphids in Manitoba in 2011 was on July 5th, from a couple of sites in the Carman area. This is about 2 weeks earlier than the first reports of soybean aphids in 2010. Populations of soybean aphids got larger in many fields through July, and by late-July populations had reached economical levels in some fields. Insecticide applications for soybean aphids were widespread through August. By mid-August the levels of natural enemies, particularly lady beetles and hover fly larvae, were very large in some fields, and had halted the increase in soybean aphid numbers and resulted in very noticeable decreases in soybean aphid numbers in some fields.

Green Cloverworm (*Hypena scabra*): Green cloverworms were present in some fields of soybeans in the Central region, but at levels below economical importance.

Spider mites: Spider mites and their feeding were noticeable in some soybean fields in the Central and Eastern regions of Manitoba.

FABABEANS

(1,986 acres↓)

No insect concerns were reported from fababeans in Manitoba in 2011.

LENTILS

(892 acres↓)

No insect concerns were reported from lentils in Manitoba in 2011.

CANARYSEED

(10,179 acres↓)

There were no reports of concerns over insects in canaryseed in Manitoba in 2011.

HEMP

(4,692 acres for grain↓)

No economical insect concerns were reported from hemp in 2011.

FORAGES AND FORAGE SEED

Alfalfa weevil (*Hypera postica*): Populations of alfalfa weevil continue to decline to a degree in areas that only a few years ago were significantly damaged. Timing for control in the Interlake region is well coordinated with control of plant bugs prior to placement of leafcutter bees in the field, so management is not requiring additional insecticide application at this time. Natural enemies seem to have brought populations nearly under control but no formal surveys have confirmed this to be the cause at this time.

Plant bugs: Many alfalfa seed fields were treated for one of or a combination of Lygus bugs (*Lygus* spp.), alfalfa plant bugs (*Adelphocoris lineolatus*) and alfalfa weevil.

Zebra caterpillar (*Melanchra picta*): A very noticeable level of zebra caterpillars was reported from a trefoil field in early-September. There was some defoliation and feeding on pods, but not at economical levels.

POTATOES

Colorado potato beetle (*Leptinotarsa decemlineata*): Populations remain very low in Manitoba thanks largely due to continued use of neonicotinoid insecticide seed treatments. Populations are so low that it is proving difficult to find populations for resistance testing outside of research plots (e.g. Canada-Manitoba Crop Diversification Centre sites).

Aphids (various species): Aphid populations were moderate this year. The timing of when populations of **green peach aphid** (*Myzus persicae*) typically show up in potato crops anecdotally seems coincident with the swathing of canola. Due to a prolonged harvest of canola this year owing to poor seeding conditions

early in the year, green peach aphid was detected in our monitoring program for longer than it is in typical years.

Leafhoppers: **Potato leafhopper** (*Empoasca fabae*) populations were low in 2011. There were some dubious reports of **aster leafhopper** (*Macrosteles quadrilineatus*) being an issue late in the season in potatoes. While it is possible that populations were present, general indications were that populations were low, phytoplasma levels were moderate at best and the timing of the populations was sufficiently late that transmission of the phytoplasma likely would not have resulted in any expression of the disease.

Potato flea beetle (*Epitrix cucumeris*): Populations were low.

Wireworm (various spp.): No sampling for wireworms was done formally this year however growers and processors remain concerned about this pest as populations seem to be on the rise based on anecdotal reporting.

SWEET CORN, CARROTS, COLE CROPS AND OTHER VEGETABLE CROPS

Populations of **European corn borer** (*Ostrinia nubilalis*) were low to moderate this year with limited problems reported. Most growers are relying on calendar spraying for management of this pest in sweet corn. Spraying could be reduced with increased consumer tolerance of "worms" but this is unlikely to happen.

Diamondback moth (*Plutella xylostella*) populations were moderate this year, an increase over recent years. Populations of **imported cabbageworm** (*Pieris rapae*) are on the increase again after a number of years of lower populations. Many Cole crop fields were sprayed to control populations from July through early September.

Populations of **aster leafhopper** (*Macrosteles quadrilineatus*) were low to moderate in carrots through most of the summer months but increased significantly in late August and remained high until harvest. It appeared levels of infection were relatively low early in the season as evidenced by a lack of symptoms in carrots through August. The increase in the fall resulted in an increase in visible symptoms in carrots through September. In some fields being sampled it appeared as though fields that were well managed through the summer were no longer being managed during the fall even though harvest was delayed for a lengthy period of time allowing for transmission of phytoplasma. **Wireworms** and **carrot** weevil (*Listronotus oregonensis*) also caused damage in some fields in 2011.

ISSUES:

Economic thresholds

An economic threshold for **diamondback moth** in canola (at various stages of growth) is needed. The current thresholds are essentially nominal thresholds, with no data to relate numbers of diamondback moth to expected yield loss.

Insecticides

No insecticides are registered in Canada for **banded sunflower moths** in sunflowers.

Insect Monitoring

Information is needed on how to relate levels of **banded sunflower moth** caught in pheromone-baited traps to risk levels of economic damage.

FUTURE PLANS:

Traps to detect **western bean cutworm** will again be placed in a small number of fields in 2012.

RESEARCH PROGRESS ON INTEGRATED PEST MANAGEMENT IN BRITISH COLUMBIA - 2011

Compiled by R. S. Vernon and M. Clodius
Pacific Agri-Food Research Centre, AAFC
6947 #7 Hwy. - P.O. Box 1000
Agassiz, B.C. V0M 1A0
Bob.Vernon@agr.gc.ca

Agriculture & Agri-Food Canada, PARC Agassiz: 2011 Insect Pest Research Report

Title 1: Canada-wide wireworm surveys.

Author and Associates: Wim van Herk and Bob Vernon (AAFC, Agassiz)

Problem: Several species of wireworms in Canada are known to cause crop damage. These species span several genera, and can have quite different life histories, morphologies and behavior. This makes developing control strategies more complicated, and our lab has determined that insecticide efficacy, LD_{50}s and behavioral responses to pesticides (e.g. repellency) can vary significantly between species. Because of these differences, control strategies in the future may require that we know what species are present.

Objective of Research: The objective of this project is to collect and identify wireworms from infested crops across Canada, and to gradually construct a wireworm species map that can be used to aid in IPM strategies in the future. This is currently being achieved through collections made by a consortium of grower, government and agri-business field personnel.

Summary of Results: Thanks largely to the cooperation of Syngenta Crop Protection Canada, Bayer Crop Science, and the Quebec Ministry of Agriculture (MAPAQ), wireworms have been collected from over 400 locations across Canada and submitted to PARC, Agassiz for identification, in 2010 and 2011. So far this survey has revealed species not previously described, and has allowed us to map out the "genetic diversity and phylogenetic relationships of economically important Elaterid species in Canada", in cooperation with Dr. Carly Benefer of Plymouth, UK (MS in press). It is expected that the survey will take several more years to complete.

Continuing Research: The survey will continue indefinitely, and there is an ongoing need for samples to be collected from damaged fields by grower, extension and field personnel. Thank you to all who submitted samples so far, and please do send us more! For more information or contributions to the cause you can contact the address below.

Contact:

Dr. Wim van Herk
Pacific Agri-Food Research Centre
P.O. Box 1000 - 6947 #7 Highway
Agassiz, BC V0M 1A0

Tel: (604) 796-1738
Fax: (604) 796-0359
e-mail: wim.vanherk@agr.gc.ca

Title 2: Minor Use Pesticides Program

Author and Associates: Markus Clodius and Bob Vernon (AAFC, Agassiz)

Problem: The Minor Use Pesticides Program exists to support growers and the general public by improving farmers' access to new crop protection tools and technologies. The program works with growers, 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: Despite the problems caused by an unusually cool, wet spring, fifteen residue trials and four efficacy trials were successfully conducted at Agassiz this season. Notable among this list are: five residue trials on raspberries, including the miticide Oberon; five residue trials on field vegetables of a proposed new fungicide, in collaboration with IR-4; and an efficacy trial against *Drosophila suzukii* on highbush blueberries.

Summary of Results: Analysis of residue levels and product efficacy are still in process.

Continuing Research: Some trials planned for this year (e.g. Movento on cranberry girdler) had to be postponed, and will be conducted in 2012 instead. Other trials will be selected over the winter, based on the priorities identified by growers in November. In total, we hope to run another 20 to 25 trials in the coming year.

Contact:

Markus Clodius
Pacific Agri-Food Research Centre
P.O. Box 1000 - 6947 #7 Highway
Agassiz, BC V0M 1A0

Tel: (604) 796-1745
Fax: (604) 796-0359
e-mail: Markus.Clodius@agr.gc.ca

Title 3: Evaluating various insecticides for control of wireworms in potatoes (2010-2011).

Author and Associates: Bob Vernon, Wim van Herk, Markus Clodius, and Victoria Brookes (AAFC, Agassiz).

Problem: Wireworms of various species continue to cause increasing problems in the major potato growing provinces of Canada. East of BC, growers rely almost exclusively on the organophosphate Thimet 15G (phorate), which, until recently, was scheduled to be withdrawn from Canada in 2012. Due to no replacements for Thimet being available, however, Thimet has now been extended by the PMRA to 2015. The main problems facing wireworm researchers (mostly AAFC) in finding replacements for Thimet, have been in finding insecticides that work consistently on all pest wireworm species (about 30) across Canada, or that are currently facing registration hurdles.

The neonicotinoids Poncho 600FS (clothianidin) and Cruiser 5FS (thiamethoxam) applied as potato seed piece treatments were found to consistently reduce tuber damage by *A. obscurus* in BC, but the effectiveness of these products was more variable on other species in Ontario, Nova Scotia and PEI. Since these insecticides 'reversibly' intoxicate, rather than kill wireworms, population levels are also not reduced. A Canada-wide Minor Use Registration has been obtained for clothianidin (Titan) as a potato seed piece treatment for wireworm damage 'suppression'. Full registration has also been obtained for thiamethoxam (Cruiser, Actara) as an in-furrow spray at planting and as a seed piece treatment, but wireworms are not on the label. Clothianidin and thiamethoxam, however, are both systemic, and provide excellent control of above-ground insect pests of potato (i.e. aphids, Colorado potato beetles, flea beetles, etc). Between 2007 and 2009, the USA-registered pyrethroid bifenthrin (Capture 2EC) was evaluated as an in-furrow spray at planting by AAFC in BC, Ontario and PEI, and was generally found to be effective in reducing wireworm blemishes to an acceptable degree. In BC trials, numbers of wireworms were also reduced to levels similar to Thimet 15G. Bifenthrin, therefore, is currently a leading candidate for management of wireworm damage in potatoes.

It was also found in 2008 and 2009 studies in BC, Ontario and PEI, that combinations of clothianidin (seed piece treatments) or thiamethoxam (in-furrow sprays), with in-furrow sprays of bifenthrin, provided wireworm damage control generally as good as Thimet 15G, with no phytotoxicity, and very low levels of wireworms detected in the plots the following year (in BC). The data also showed that the rates of the combined treatments could be reduced. These combinations of neonicotinoids (which are systemic) and bifenthrin (which is non-systemic), appear to be strong broad spectrum candidates to replace Thimet 15G for wireworm and above ground potato pest control, and another pyrethroid, lambda cyhalothrin (Matador 120EC) also has shown promise.

Objective of Research: To evaluate candidate insecticides and application methods for control of wireworms in potatoes. The focus of the study was to determine the efficacy of these various treatments in: a) protecting daughter tubers from damage; and b) reducing wireworm populations. The main objective is to determine if bifenthrin and lambda cyhalothrin can be used either alone or in combination with other products (neonicotinoids) as acceptable substitutes for Thimet 15G, and provide efficacy data in support of various new registrations in Canada.

Summary of Results: Studies were established in 2010 at the Pacific Agri-Food Research Center in Agassiz, B.C. (*Agriotes obscurus*)(Drs. Vernon and van Herk) and AAFC, London, ONT, (e.g. *Melanotus* spp.) (Dr. Jeff Tolman, AAFC). In BC, it was once again found that combinations of clothianidin as either a seed piece treatment (i.e. Poncho 600FS) or in-furrow spray (i.e. Clutch), with in-furrow sprays of bifenthrin, provided wireworm damage control generally as good as Thimet 15G, with very low levels of wireworms detected in the plots the following year. Promising results were also observed with combinations of thiamethoxam and lambda cyhalothrin applied as in-furrow sprays. An attract and kill strategy, consisting of wheat seed treated with a confidential blend of insecticides and placed in furrow at planting, provided similar blemish reduction as Thimet, and virtually eliminated wireworms from the plots. Similar results to those in BC were found in the Ontario trial in 2010.

Continuing Research: Potato wireworm efficacy trials were not conducted by AAFC in 2011 due to lack of funding. A joint AAFC and Canadian Horticulture Council project is currently being developed to continue with potato wireworm efficacy work in 2011.

Contact:

Dr. Bob Vernon
Pacific Agri-Food Research Centre
P.O. Box 1000 - 6947 #7 Highway
Agassiz, BC V0M 1A0
Tel: (604) 796-2221 (local 212)
Fax: (604) 796-0359
e-mail: vernonbs@agr.gc.ca

Title 4: Evaluating various insecticides for control of the wireworm *Agriotes obscurus* in wheat.

Author and Associates: Bob Vernon, Wim van Herk (AAFC, Agassiz).

Problem: Various species of wireworms are known to cause serious damage to cereal crops across Canada. Problems with wireworms in general are increasing in many Canadian farming systems, especially on the prairies where cereal crops abound. This increase in damage has been attributed, at least in part, to the loss of the organochlorine insecticide lindane as a cereal and forage crop seed treatment. Studies have been underway at PARC, Agassiz to find lower risk insecticides to replace lindane.

Objective of Research: Between 2002-2010, studies in Agassiz have focused on a number of low risk (imidacloprid, clothianidin, thiamethoxam) to moderate risk (tefluthrin, fipronil) candidate insecticides as seed treatments for management of the dusky wireworm, *Agriotes obscurus*, in wheat. In addition, various combinations of insecticides have also been tested in attempts to improve efficacy and reduce wireworm numbers to levels achieved by the former lindane seed treatments. Efficacy is measured by observing the impacts of wireworms on the crop (i.e. crop stand establishment and yield), as well as the effects of candidate insecticides on wireworm populations (i.e. by sampling wireworms in plots the following spring). The focus has been on products that have current or pending registration status in Canada (i.e. tefluthrin, imidacloprid, clothianidin and thiamethoxam) to facilitate pursuit of Full or Minor Use registrations in cereals for wireworm control. In addition, it has been found that fipronil (not currently registered in Canada), will dramatically reduce wireworm populations when applied to wheat

seed at very low levels. This effect is enhanced when fipronil is combined with other seed treatments, and a major objective of the current research is to determine the lowest dosage of combined wheat seed treatments that will provide optimal crop stand and yield, as well as reducing populations of resident and neonate wireworm populations.

Summary of Results: An optimal wheat seed treatment consisting of a blend of a neonicotinoid insecticide and fipronil has been developed and tested over 4 years (2007-2010) that provides optimal crop stand and yield, and reduces populations of resident and neonate wireworm populations better than the former lindane standard (i.e. Vitavax Dual). Two additional field studies are underway at AAFC, Agassiz, B.C. to evaluate wheat seed treated with this blend in a number of novel push-pull strategies, whereby blend-treated seed is sown in mixtures with other wheat seeds treated with behavior-modifying chemicals. The intent of these seed mixtures is to attract wireworms to seeded rows and ultimately direct their movements to the lethal seeds, thus reducing the amount of insecticides required per hectare. A number of excellent seed mixtures have been identified that provide optimal wheat stands, and plots will be sampled in spring of 2012 to determine whether these treatments significantly reduce wireworm populations.

Continuing Research: It is expected that this work will continue for at least one more year.

Contact:

Dr. Bob Vernon
Pacific Agri-Food Research Centre
P.O. Box 1000 - 6947 #7 Highway
Agassiz, BC V0M 1A0

Tel: (604) 796-2221 (local 212)
Fax: (604) 796-0359
e-mail: vernonbs@agr.gc.ca

Title 5: Controlling wireworms in potatoes and other crops by pre-emptively killing them during wheat rotations.

Author and Associates: Bob Vernon, Wim van Herk (AAFC, Agassiz), Hector Carcamo, Brian Beres (AAFC, Lethbridge), Ian Wise (AAFC, Winnipeg), Doug Waterer (U of Sask), Zenaida Ganga (Cavendish Farms, PEI) .

Problem: Wireworms of most, if not all, pest species can build up to enormous economic levels during years when fields are planted to either grass or cereal crops. Although neonicotinoid insecticides are often used as seed treatments in cereal crops, these insecticides do not kill resident wireworms and do not kill neonate wireworms arising from click beetle oviposition later in the growing season. As a result, economic populations are sometimes carried over to subsequent rotational crops such as potatoes, sugar beets, and other higher value crops. In past, lindane (e.g. Vitavax Dual) applied to seed of cereal crops and forages (corn) would reduce resident and neonate wireworms in fields to sub-economic levels for 3-4 years. Since the removal of lindane from Canada in 2004, however, wireworm populations are becoming more of a chronic, yearly threat in many agricultural regions of Canada. This is especially true in the Prairies and Atlantic Canada, where wheat or other cereal crops are grown in rotation with potatoes. The development of alternative lethal seed treatments to lindane would alleviate this increasing problem, and reduce the reliance of growers on the highly toxic Thimet 15G, currently used to control wireworms in potatoes.

Objective of Research: To evaluate a number of AAFC-developed lethal wheat seed treatments with the objective of eliminating the threat of all economic species of wireworms in fields for 3-4 years. To accomplish this objective, research sites were established in BC (2 sites in Agassiz), Alberta (Vauxhall and Taber), Saskachewan (Saskatoon), Manitoba (Winnipeg) and PEI (2 sites near Charlottetown) in 2011. Sites were selected so as to target the key wireworm species in Canada. Up to 10 treatments were planted in randomized blocks at each site in spring, 2011. These sites will be baited in spring, 2012, to determine the mortality of wireworms by the various treatments relative to untreated checks and the lindane standard. At some of these sites, potatoes will be planted within the treatment plots to determine if wireworm damage to tubers can be prevented by removing wireworms during the wheat rotation.

Summary of Results: The efficacy of the various treatments in reducing wireworms to sub economic levels will be determined by bait trapping plots in spring, 2012, and by grading potatoes planted in those plots in fall, 2012.

Continuing Research: It is expected that this work will continue for at least one more year.

Contact:
Dr. Bob Vernon
Pacific Agri-Food Research Centre
P.O. Box 1000 - 6947 #7 Highway
Agassiz, BC V0M 1A0
Tel: (604) 796-2221 (local 212)
Fax: (604) 796-0359
e-mail: vernonbs@agr.gc.ca

Title 6: Controlling wireworms in potatoes by killing them with lethal cereal crops planted in the previous fall.

Author and Associates: Bob Vernon, Wim van Herk (AAFC, Agassiz) and Christine Noronha (AAFC, Charlottetown).

Problem: Wireworms are known to feed voraciously on spring-planted cereal crops. From our studies on wireworms, we estimate that nearly 100% of wireworms of all stages feed at some point in spring when temperatures reach about 10 degrees C. We have also shown that we can functionally eradicate wireworm populations in spring with a number of newly developed wheat seed treatments. The question has arisen, however, whether or not wireworm populations can be significantly reduced with these and other seed treatments in fall plantings of cereal crops? The question actually has two parts: a) what proportion of a wireworm population comes up to feed in the fall; and b) how effective are candidate treatments in killing the fall feeders? If the proportion of fall feeders is high (>70%), and if certain treatments will kill the majority of this feeding population, then fall plantings of lethal cereal crops can be used as a method to pre-emptively control wireworms in advance of subsequent crops, such as potato.

Objective of Research: The objectives are to determine the proportion of a wireworm population that comes to the surface to feed in the fall, and determine the efficacy of candidate lethal wheat seed treatments in killing the fall-feeding population. Two sites have been established in BC, and 3 sites in PEI, whereby wheat treated with candidate insecticides have been planted in fields with high wireworm populations. These sites will be baited in the spring, 2012, to determine the number of surviving wireworms in the various treatments. Depending on funding, some of these sites and treatments will be

planted with potatoes to determine if the fall-planting reduced wireworms sufficiently to prevent tuber damage.

Summary of Results: The efficacy of the various treatments in reducing wireworms to sub economic levels will be determined by bait trapping plots in spring, 2012, and by grading potatoes planted in those plots in fall, 2012.

Continuing Research: It is expected that this work will continue for at least one more year.

Contact:

Dr. Bob Vernon
Pacific Agri-Food Research Centre
P.O. Box 1000 - 6947 #7 Highway
Agassiz, BC V0M 1A0

Tel: (604) 796-2221 (local 212)
Fax: (604) 796-0359
e-mail: vernonbs@agr.gc.ca

2011 Alberta Research Report

Compiled by James Tansey
For the Western Committee of Crop Pests
Kelowna, BC, 18 October 2011

Agriculture and Agri-Food Canada
Lethbridge Research Centre

1. Title: Biological control of lygus bugs using *Peristenus* nymphal parasitoids in the Prairies.

Author and Associates: H. Cárcamo, Carolyn Herle and Tara Gariepy (AAFC, London Ontario)

Problem: Lygus bugs are generalist pests attacking several valuable crops such as canola and alfalfa. The European parasitoid *Peristenus digoneutis* has reduced lygus populations in eastern USA and the has migrated to eastern Canada. However, introducing exotics to control native pests can be an environmentally risky strategy; therefore, ecological interactions and efficacy of exotics need to be established prior to introductions.

Objective of Research: (1) To understand the ecology of native *Peristenus* species and their impact on lygus bugs (2) determine the efficacy of *Peristenus digoneutis* in controlling lygus bugs and (3) potential non target impacts

Summary of Results: Three species of lygus bugs (*L. keltoni, L. elisus and L. lineolaris*) have been cultured using artificial diet packs for over a year at LRC to support studies with Peristenus wasps. In 2011, we collected a total of 689 lygus nymphs and reared 165 Peristenus cocoons. A new weedy alfalfa site was located that had almost 40% parasitism. We are collaborating with the new AAFC biocontrol scientist at London, ON (T. Gariepy) who has provided us specimens of *P. digoneutis* to determine their efficacy to attack *L. keltoni*.

Continuing Research: This is a long term study, subject to funding availability.

Contact: Héctor A. Cárcamo

2. Title: Managing lygus bugs and cabbage seedpod weevils (CSW) – a commercial scale farm study

Author and Associates: H. Cárcamo and Scott Meers

Problem: Lygus bugs are pest generalists attacking several valuable crops such as canola and alfalfa. CSW is more specialized on *Brassica* seed crops. They are managed with insecticides but the recommended timing according to plot data differs: early and end of flower for weevil and lygus, respectively.

Objective of Research: To determine if lygus bugs are reduced at the pod stage in canola fields sprayed for CSW at early flower and assess economic impacts (yield) as well as abundance of key beneficial insects.

Summary of Results: From 2010 to 2011 around forty canola fields have been sampled by sweeping to collect weevils and lygus bugs from early flower to mid pod (5.2) south of highway 1 to the US border. Because of the late season lygus outbreak, in 2011 some southern fields were also swept again at the late pod stage. In 2010, all strips in fields sprayed at early flower for weevils had fewer lygus numbers at the pod stage. Results for 2011 are preliminary but the same trend seems to hold.

Continuing Research: This study will continue subject to funding till 2013.

Contact: Héctor A. Cárcamo

3. <u>Title</u>: Spider species diversity in Alberta canola farms

Author and Associates: H. Cárcamo, Lloyd Dosdall and Scott Meers

Problem: This study is part of a larger initiative led by L. Dosdall on arthropod diversity in canola agroecosystems. The portion conducted at LRC will address an important group of generalists predators - spiders.

Objective of Research: To begin to document the spider fauna in commercial canola fields.

Summary of Results: This study uses the sweep samples from study Number 2 above. A list of spider species is not available yet but the dominant groups are the flower spiders of the family Philodromidae (e.g. Tibellus oblongus, Thanatus sp) and crap spiders (family Thomisidae, genus Xysticus) and *Dictyna* species (Dictynidae). Less common species included money spiders (Linyphiidae, including Erigone), jumping spiders (Salticidae), orb-weavers (Araneus sp) and even the ground dwelling Lycosidae (Pardosa spp). In 2011 we have also placed pitfall traps in 2 fields to increase spider catches. Results are not available at this time.

Continuing Research: This study will continue subject to funding till 2013.

Contact: Héctor A. Cárcamo

4. Title: Cereal leaf beetle biocontrol in Manitoba.

Author and Associates: Héctor Cárcamo, Lloyd Dosdall, John Gavloski, Swaroop Kher.

Problem: The cereal leaf beetle (*Oulema melanopus*) is a Eurasian chrysomelid, considered a serious pest of cereals, that was reported in NE North America in 1962 and has spread to most western states, except California. It was found in Alberta in 2005 near Lethbridge and in west central Manitoba in 2009. *Tetrastichus julis* has followed the beetle to Alberta but apparently not to Manitoba.

Objective of Research: to redistribute *T. julis* from Lethbridge to Manitoba for biological control of the cereal leaf beetle.

Summary of Results: In 2009 and 2010 cereal leaf beetle larvae were collected from sites in southern Alberta known to be parasitized by *T. julis* and released in the Swan River region of Manitoba. In 2011, Steph Jersak and Erika Brandson of MAFRI sent 103 CLB larvae to LRC and we observed parasitism by *T. julis* in 22 of them. The results are encouraging and suggest the parasitoid has an established population in that region.

Continuing Research: Subject to resource availability the release sites will be monitored.

Contact: Héctor Cárcamo

5. Title: A deployed Neural Net to predict the in-season tolerance of solid-stemmed wheat to wheat stem sawfly cutting.

Author and Associates: Brian Beres, Bernie Hill.

Problem: The use of solid-stemmed cultivars is a critical component of an integrated crop management strategy to manage wheat stem sawfly (WSS). The mechanism of host plant resistance is the development of pith inside the culm of the wheat stem, thereby creating a solid stem and restricting movement and feeding of the larva. However, the expression of genes responsible for pith development is photoperiod sensitive, which can create inconsistent pith development.

Objective of Research:

1) Proof of Concept. Using weather parameters and infestation data from the period 1949-1978 at Lethbridge, AB, create a Neural Net (NN) that improves the precision of the multiple regression model reported in Holmes, N. D., Can. Ent. 116:677-684 (1984).

2) Upon proof of the concept, update model with recent infestation and climatic data from all possible test locations in wheat stem sawfly distribution area.

Summary of Results: Proof of concept was realized as a deployed Neural Net was created that predicts the in-season tolerance level for solid-stemmed wheat from 6 rain-related inputs (days with precipitation and accumulated precipitation divided into 3 biweekly subsets for the period May 25

– July 5). The estimated R^2 of 0.78 (average of five 20% cross-validation sets) is an improvement from the multiple regression models reported by Holmes (R^2=0.55). The user-interface and NN code have been compiled into one simple-to-use 'exe' file. The exe allows manual entry of the 6 rain-related inputs allows the user to automatically select typical inputs for high and low %Stems Cut. Model validation was more rigorously performed in 2010 by correlating model predictions of '% stems cut' with stem solidness ratings for Bow Island, Foremost, Coaldale and Lethbridge in Alberta, and for Indian Head, Scott, and Swift Current in Saskatchewan (Table 2, Fig. 2). The R^2 of 0.84 (n=7) indicates that the model could predict pith expression, and therefore susceptibility to stem cutting by sawfly in solid-stemmed wheat with a high degree of accuracy.

Continuing Research: The third generation of this model is available at ftp://ftp.agr.gc.ca/pub/outgoing/rb-bh. The research objective has been expanded to include sites in Montana and North Dakota – see next summary.

Contact: Brian Beres

6. Title: Variations in physiological response of solid-stemmed spring wheat cultivars across diverse growing environments

Author and Associates: Brian Beres, Bernie Hill, David Weaver, Hector Carcamo, Ron DePauw, Fran Clarke, Jan Knodel, Peggy Lamb, Perry Miller, Ross McKenzie, Eric Ericksmoen, and Luther Talbert.

Problem: The wheat stem sawfly, *Cephus cinctus* (Hymenoptera, Cephidae) is a major pest of wheat in the northern Great Plains of North America. Yield losses occur from the combined effects of larvae mining inside the pith and subsequent cutting of the stem at the end of the summer. The use of solid-stemmed cultivars is an important management tool for wheat growers. However, the inconsistent pith expression, first noted with the release of 'Rescue', has been observed as recently as with 'Lillian' (B. Beres, personal observations). Given the extensive hectares planted to solid-stemmed wheat, a model that can accurately predict pith expression could serve as a vital quality assurance tool to prevent losses by alerting producers if in-season precipitation patterns have caused less than ideal pith expression in a solid-stemmed cultivar. Such a tool would allow for preventative measures to be deployed such as swathing ahead of harvest to prevent the loss of cut stems. Work to date suggests that Montana varieties respond differently to the precipitation related weather that directly effects pith expression.

Objective of Research:

1) Determine effects of environment on pith expression in S615 derived cultivars.

Summary of Results: We have just completed the first year of this study. Stem cutting was low at Swift Current and Lethbridge, but cutting pressure was reported to be high at the Montana sites. Differential responses between the S615 derived cultivars was noted and will be summarized in 2012. ***Contact***: Brian Beres

Agriculture and Agri-Food Canada

Beaverlodge Research Farm

7. Species distribution and time of emergence of flea beetles in canola in the Peace River region.

Author and Associates: Bob Elliott & Jennifer Otani

Problem:

Flea beetles continue to be problematic throughout the prairies. *Phyllotreta cruciferae, P. striolata* and occasionally *Psylliodes punctulata* are present in mustard or canola. Seedling feeding, despite the use of seed treatments, can result yield losses when flea populations are high. This study is designed to examine (i) the species composition of flea beetles and (ii) the timing or corresponding degree-day heat units required for pupating flea beetles to emerge from *B. napus* varieties treated with Helix XTra® grown in the Peace River region.

Objectives of Research:

1) Does seeding date affect the species composition and timing of flea beetle emergence?
2) Do different varieties of *B. napus* treated with Helix XTra® affect the species composition and timing of flea beetle eclosion?
3) Do *Phyl. striolata* adults pupate and emerge earlier than *Phyl. cruciferae* or *Psyl. punctulata*?

Summary of Results: Plots seeded in 2011 suffered from dry seeding conditions which delayed but also staggered emergence in early and late seeded plots of *B. napus* (cv. 45H21, Banner), *B. juncea* (cv. 8571, Dutchess), and *Sinapis alba* (cv. Andante). Dry, cool weather was accompanied by flea beetle feeding pressure in plots. At time of reporting, only 20 flea beetles were collected from emergence traps placed within plots. The dominant species appears to be *Phyl. striolata* which is consistent with data collected in 2010. Newly pupating adults will be collected until the end of October 2011.

Continuing Research: This field study runs from 2010-2012.

Contact: Jennifer Otani

8. Title: Investigating pest management strategies for the red clover casebearer (*Coleophora deuaratella*) in seed production.

Author and Associates: Jennifer Otani

Problem: Insect monitoring in red clover seed production fields in the Peace River region between 2006-2007 revealed that *Coleophora deauratella* Lienig & Zeller (Lepidoptera: Coleophoridae) is now established throughout the region and is the primary pest causing significant yield losses in both first- and second-year seed stands. In 2007, red clover seed producers in this same area opted to eliminate second-year seed stands of red clover since yield losses were generally severe. This

represents an abrupt change to common management practices in the region and is solely attributed to the impact of *C. deauratella*.

The objectives of the described project are to continue studies examining the biology of this new insect pest and to further characterize the nature of the insect-plant association between *C. deauratella* in both red and alsike clovers grown for seed production.

Objectives of Research:

1) To examine the phenology of *C. deauratella* in relation to red and alsike clover seed production.
2) To investigate yield and seed quality losses in red clover due to natural infestations of *C. deauratella*.
3) To investigate natural enemies of *C. deauratella*.

Summary of Results: Red clover casebearer continue to affect seed production acres and cause seed losses in first-year seed stands in the Peace River region. In addition to yield losses, honey producers have observed lower yields from fields infested with casebearers. Field plot studies conducted from 2006-2010 near Falher AB revealed foliar insecticides (e.g., deltamethrin, spinosad, rynaxypyr), applied at any crop stage, failed to produce economic gains. Recent research by Mori & Evenden (U of A) investigating the isolation of a mating pheromone for *C. deauratella* has shown evidence that mating disruption could be a useful control strategy in red clover seed production for *C. deauratella*. Since 2006 repeated efforts to survey and rear natural enemies generated a single parasitoid wasp (Mori, 2009, pers.com.). More recently, fall-collected cases collected in 2010 yielded 36 parasitoid specimens, however, preliminary taxonomic details suggest most are general parasitoids (Huber 2011, pers. com.; Gibson 2011, pers. com.). It is interesting to note that red clover casebearer densities were lower in 2010 and 2011 compared to densities of 4-6 cases per 10 sweeps in 2007-2008.

Continuing Research: This study will be continued until 2013.

Contact: Jennifer Otani

9. Title: Arthropod pest surveying in grass and legume seed production systems.

Author and Associates: Jennifer Otani

Problem: The proposed studies aim to address old pests occurring in current forage seed production systems plus new, introduced pest species occurring in newer varieties grown using newer technologies. The aim of the included pest management studies is to improve yield and quality of Canadian grass and legume seed production.

Objectives of Research:

1) Identify pest species occurring in grass and legume seed production systems.
2) To characterize yield or forage losses associated with grass and legume production.

Summary of Results: Timothy grown near Nampa AB for compressed hay export to Japan again suffered cutworm damage in late May of 2011. Damaged patches of timothy were obvious in eight fields and cutworm and sod webworm larvae were collected for rearing. Seed fields of creeping red fescue near Falher, Rycroft, and Spirit River and Blueberry Mountain AB all suffered cutworm damage and specimens were retrieved for identification and rearing. Initial identifications of larvae suggested bristly (*Lacinipolia renigera*), dingy (*Feltia jaculifera*) and yellow-headed cutworms (*Apamea* spp.) along with a few sod webworms. Larvae collected from affected fields were reared then preserved to confirm identifications (yet to be determined 2010 and 2011).

Continuing Research: Grass and legume seed pest surveying will be continued until 2013 with surveying focused on collecting current information on introduced arthropod species.

Contact: Jennifer Otani

10. Title: Identification of contaminant bee species occurring in bertha armyworm pheromone traps in the Peace River region.

Author and Associates: Jennifer Otani & Ken Richards

Problem:

Each year, pheromone traps designed to monitor Bertha armyworm (*Mamestra configurata*) are deployed across the prairies. Although developers of the current pheromone lure and trap strove to reduce contaminant species and protect beneficial insects, native bees are routinely caught in Bertha armyworm pheromone traps deployed in the Peace River region. Contaminant bee species were identified and counted in an effort to (i) optimize samples already being collected, and (ii) document the species diversity of native bees occurring in commercial fields of canola.

Objectives of Research:

1) To determine what species of bumble bees can occur in commercial fields of canola grown in the Peace River region.
2) Compare the seasonal phenology of bee species in canola.

Summary of Results: Single pheromone traps were deployed in six canola fields located within a 25 km radius of Beaverlodge AB. Traps were monitored weekly from 9 June to 3 August in 2011. At time of reporting, bee counts and species identifications were not completed. Preliminary observations indicate the majority of bees collected were again *Bombus rufocinctus* queens in 2011. In the initial 25 samples processed, a total of 758 bees were sorted for washing and preservation (mean 30.3 bees per trap per week, range 1- 155 bees per trap per week). However, preliminary densities appear to vary greatly by site suggesting that trap placement could be refined to reduce mortality of native pollinators.

Continuing Research: This study runs from 2010-2012. A Ph.D. candidate at Dalhousie, Andony Melathopoulos (formerly of the AAFC-Apiculture Program), is interested in investigating agroecosystem habitats in relation to pollinators.

Contact: Jennifer Otani

11. Title: Estimating the impact of arthropod predators on lygus nymphs.

Author and Associates: Jennifer Otani & Letitia DaRos

Problem:

Native, general predators occur in commercial fields of canola yet the impact of these arthropods on lygus bugs is not known. This laboratory study employed field collected individuals occurring naturally in canola grown near Beaverlodge AB. Species and juvenile plus adults stages belonging to four general predator categories were examined to estimate the quantity and preference of lygus nymphs preyed upon or consumed when individuals were isolated for a 24 hr period within a 100mm (dia.) x 15 mm petri dish.

Objectives of Research:

1) To determine which predator species consumes or preys upon lygus nymphs.
2) To examine if predators show a preference for specific stages of nymphal prey.

Summary of Results: The four general predators in this study included:
(i) ladybird beetles (*Coccinella septempunctata*, *C. trifasciata*),
(ii) damselbugs (*Nabis roseipennis* long-winged and short-winged morphs, *N. alternatus*),
(iii) lacewings (*Meleoma emuncta*), and
(iv) crab spiders (*Misumena vatia*).

All the predators (N=112) observed in **no-choice** tests consumed or preyed upon at least one of 15 lygus nymphs. Some of the above predators consumed up to seven *Lygus* nymphs in an 24hr period. *Nabis* spp. and *M. emuncta* larvae were the most voracious predators of *Lygus* nymphs. *Coccinella trifasciata* were indiscriminate predators showing no preference for any particular *Lygus* instar stage. The other predators exhibited a preference for 4th and 5th instar *Lygus* nymphs rather than feeding on comparatively greater numbers of 3rd instar *Lygus* nymphs. *Meleoma emuncta* showed a preference for 5th instar *Lygus* nymphs while *N. roseipennis* (long-winged morph) consumed equal amounts of 4th and 5th instar *Lygus*. The worst predator of *Lygus* nymphs was *C. septempunctata* which consumed the fewest *Lygus* nymphs.

Continuing Research: This study will be conducted from 2010-2012.

Contact: Letitia Da Ros & J. Otani

University of Alberta, Department of Biological Sciences

12. Title: Development of a pheromone-based monitoring and potential management tool for the red clover casebearer on clover

Author and Associates: Boyd Mori (Graduate student), Maya Evenden, Jennifer Otani and Calvin Yoder

Problem: The red clover casebearer, *Coleophora deauratella* (Coleophoridae: Lepidoptera), is an invasive pest of clover throughout Canada. In particular, larval feeding on red clover in the Peace River Region of Alberta caused 99% seed losses in 2006-7 and continues to be a major problem affecting seed yield and honey production in the area. Initial insecticide trials against *C. deauratella* illustrated that the cost of application was not offset by increased seed yield after treatment and there are no registered insecticides available to producers. Integrated pest management tactics need to be developed as chemical control threatens pollinators and honey production. Pheromone-baited traps can be used to monitor and detect *C. deauratella* populations (Evenden et al. 2010) and can form the basis of an integrated pest management program. As well, pheromone-based control methods should be explored to reduce the damage caused by this insect.

Objective: The overall objective of this research is to develop a pheromone-based monitoring system for *C. deauratella* on red clover in Alberta. This research is designed to establish a system to help producers detect adult populations and predict the damaging larval population densities. A secondary objective is to determine if pheromone-based mating disruption can be used to control *C. deauratella*.

Summary of Results (of work completed): Initial studies identified the female *C. deauratella* sex pheromone, thus enabling a synthetic version to be produced. The sex pheromone consists of two components in a 100:10 ratio, (*Z*)-7-dodecenyl acetate and (*Z)*-5-dodecenyl acetate, with both components needed to attract males. Experiments were designed to evaluate the most attractive synthetic lure, the optimal trap type and position in the field and to determine if male moth capture in pheromone-baited traps could predict subsequent larval densities.

In 2009, field experiments were setup near Falher, AB, in the Peace River Region. Both red and grey rubber septa lures (Contech Inc.) were loaded with sex pheromone (100 and 10 µg of the two components, respectively) and placed into green unitraps (Contech Inc.). There was no difference in trap capture between the two different lure types. In a second experiment, different trap types (wing, delta, diamond and green unitraps (Contech Inc.)) were baited with the pheromone and deployed in the field for two weeks. The non-saturating green unitraps caught significantly more moths than wing, delta or diamond traps on which males are captured on a sticky insert.

In 2010, field experiments were conducted across the Peace Region from Beaverlodge in the west, Hines Creek in the north, and Guy in the East. Pheromone-baited green unitraps were deployed in the field in early June, and checked biweekly until the middle of August when clover was

harvested. Trap catch peaked in the middle of July. *Coleophora deauratella* larval samples were taken at the beginning of August, and sites were assessed for seed damage in the middle of August. Trap catch was significantly related to numbers of larvae sampled at all sites, but was not related to damage. Interestingly, although adult male *C. deauratella* were captured throughout the summer in alsike clover fields, no larvae were found in these fields.

Small plot pheromone-based communication disruption (mating disruption) was conducted in 2010 as a proof of concept experiment. Pheromone puffers (Suterra Inc.) and twist-tie rope dispensers (Shin-Etsu Chemical Co. Ltd.) were placed in ¼ hectare plots. Synthetic sex pheromone-baited unitraps were used to assess the communication disruption in these plots as compared to untreated control plots. The number of *C. deauratella* capture in traps was reduced by ~60% in plots treated with puffers releasing pheromone compared to the untreated control. Treatment with twist-tie rope dispensers reduced the number of *C. deauratella* captured in traps up to ~99% compared to the untreated control. These results indicate that pheromone-based communication disruption may be a feasible integrated pest management tactic against *C. deauratella*, but further experiments are needed to determine if damage is reduced.

In 2011, field experiments were again carried out across the Peace Region with most experiments concentrated around the towns of Beaverlodge, Debolt and Falher. Pheromone-baited green unitraps were deployed in the field in early June, and checked biweekly until the middle of August when clover was harvested. Trap catch peaked in the beginning of August. *Coleophora deauratella* larval samples were taken at the beginning of August, and plots were assessed for seed damage in the middle of August. Trap catch was significantly related to numbers of larvae sampled at all sites, and results are still pending in relation to damage. The summer of 2011 was much cooler and had more rain than 2010 and set larval development and peak flight back compared to 2010. An overall predictive model, that incorporates climatic parameters, is being developed. We conducted another experiment to determine the optimal trap height and location within the field on *C. deauratella* capture. Neither trap height nor location in the field significantly affected the number of moths captured. Thus, we are suggesting green-unitraps baited with grey rubber septa lures containing 100:10 µg of the two *C. deauratella* pheromone components be placed 35 cm above the soil, and 5 m from the field edge for monitoring. Two traps per field should suffice in giving an accurate capture rate.

We continued with further small plot (¼ hectare) pheromone-based communication disruption (mating disruption) trials again in 2011. We conducted two different experiments, the first, tested the density of pheromone rope dispensers needed to successfully disrupt *C. deauratella*. Three different dispenser densities were evaluated (250,500, 1000 dispensers/ha) and all three reduced *C. deauratella* capture in traps up to ~99% compared to the untreated controls. The second experiment tested whether the full pheromone blend or major component alone could disrupt *C. deauratella* at a density of 500 dispensers/ha. Both the full pheromone blend and the major component alone reduced *C. deauratella* trap capture up to ~99%. This may allow for formulations containing the major component only to be used for mating disruption and will reduce the cost of the application.

Continuing Research: Boyd Mori will continue this work as part of his PhD thesis. He plans to investigate mating disruption further with both large scale mating disruption trials and laboratory bioassays. He will also try and determine the origin of *C. deauratella* in North America and Alberta using molecular population genetics techniques.

Contact: Maya Evenden

13. Title: Refinement of the pheromone blend attractive to diamondback moths, *Plutella xylostella*.

Author and Associates: Caroline Whitehouse, Christine Fulkerth, Lloyd Dosdall and Maya Evenden

Problem: The diamondback moth, *Plutella xylostella* (Plutellidae: Lepidoptera), is a serious pest of canola in the Canadian prairies. Infestation of *P. xylostella* in the Canadian prairies is due primarily to migration of adult moths on wind currents from the south each spring. Pheromone-baited traps are used to monitor and detect male *P. xylostella* and a pheromone-trapping network is in place in the Prairie Provinces. However, female-baited traps routinely capture more male moths than synthetic traps indicating that the lures currently are not optimally attractive to male moths.

Objective: The overall objective of this research was to develop a semiochemical-based monitoring system for *P. xylostella* on canola in western Canada. The results of this research provided specific recommendations for canola producers and commercial producers of pheromone lures. Although this research is complete, a final contribution to this study was designed to refine the current female sex pheromone-baited lure used to monitor *P. xylostella* adult males.

Summary of Results (of work completed): In 2011, field experiments were conducted near Lethbridge, AB between 5 July and 18 August. Nine sites were established and Delta traps (Contech Inc.) with seven treatments and a solvent control were deployed in a Randomized Block Design and trap catch was monitored biweekly. The treatments consisted of varying ratios (Table 1) of the four components, (*Z*)-11-hexadecenal (*Z*11-16:Ald), (*Z*)-11-hexadecenyl acetate (*Z*11-16:Ac), (*Z*)-11-hexadecen-1-ol (*Z*11-16:OH), and (*Z*)-9-tetracen-1-ol (*Z*9-14:OH), that currently make up the commercially available lure to monitor male *P. xylostella* males in western Canada. The components were loaded onto grey rubber septa lures and produced by Contech Inc.

Treatment 5 attracted a significantly greater number of *P. xylostella* male moths (Fig. 1) compared to treatment 1, the industry standard. Traps baited with treatment 7 caught a similar number of moths to treatment 5 and to treatment 1. The data suggest that *Z*9-14:OH (which is not produced by female moths) is not essential for the attraction of male moths and can be removed from the commercial formulation. The inclusion of *Z*11-16:OH at a low level in treatment 5 lures may be responsible for the slightly higher, though not significantly, trap catch compared to treatment 7, which did not include this component. The significantly greater trap catch in treatment 5 compared to treatment 1, suggests that the 30:70 ratio of *Z*11-16:Ald to *Z*11-16:Ac is more attractive than the aldehyde-based lures that are currently the commercial standard.

Table 1.

Treatment	*Z*11-16:Ald	*Z*11-16:Ac	*Z*11-16:OH	*Z*9-14:OH
1*	70	30	1	10
2	70	30	1	0
3	70	30	10	0
4	70	30	0	0
5	30	70	1	0
6	30	70	10	0
7	30	70	0	0
8**	0	0	0	0

* Contech standard

** Solvent control

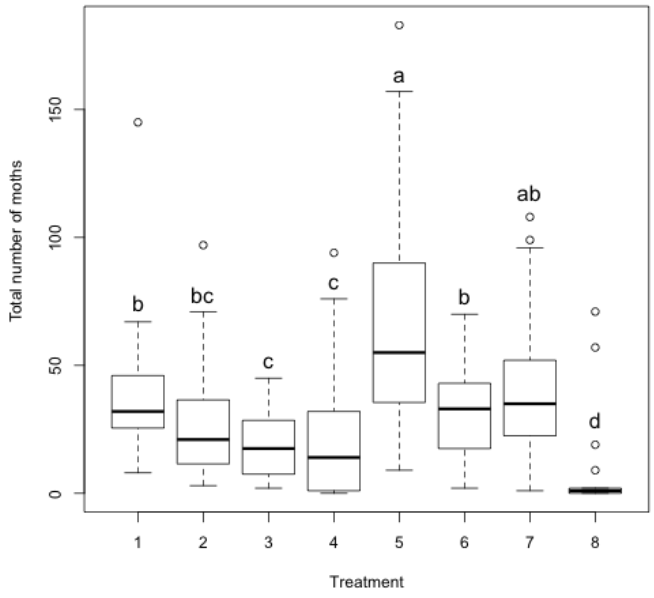

Fig. 1. The effect of lure treatment on *P. xylostella* adult male moth capture. Treatments followed by the same letter are not significantly different (Tukeys HSD with Benjamini and Hochberg adjusted P-values, P>0.05).

Continuing Research: This research is now complete and will be communicated to Contech for their consideration.

Contact: Maya Evenden

14. Title: Development of a semiochemical-based monitoring tool for the pea leaf weevil, *Sitona lineatus* L.

Author and Associates: Caroline Whitehouse, Héctor Cárcamo, Carolyn Herle, Scott Meers, Shelley Barkley, Kevin Wanner and Maya Evenden.

Problem: The pea leaf weevil, *Sitona lineatus* L. (Coleoptera: Curculionidae), is an invasive pest of cultivated and wild leguminous plants. The native range of *S. lineatus* is Europe and North Africa and the beetle has now become established in western Canada and north western United States. It was first recorded in southern Alberta in 1997 and has since exhibited a range expansion to the north and east. The main reproductive hosts of *S. lineatus* are field pea, *Pisum sativum* L. and faba bean, *Vicia faba* L.. Adults feed on foliage while larvae burrow into the soil and feed on *Rhizobium leguminosarum* Frank, a nitrogen-fixing bacteria that forms the root nodules. Severe foliar damage by feeding adults and root nodule damage incurred by larva can reduce yield by 27%. Field pea and faba bean crops are used in rotational farming practices because of their ability to fix nitrogen and larval feeding on *R. leguminosarum* not only decreases nitrogen uptake by the plant but also reduces the amount of fixed nitrogen left in the soil.

Sitona lineatus adults undertake two annual migration events: in the spring and in the fall. In the spring, adults migrate into pea or faba bean fields from overwintering sites and begin to feed and mate. The next generation of adults migrate out of these fields to overwintering sites in the fall. These two periods of migration provide an opportunity for monitoring *S. lineatus* populations. Research has established that male *S. lineatus* produce an aggregation pheromone, 4-methyl-3,5-haptanedoine, which is attractive to both sexes and that response is enhanced by bean volatiles (Blight et al. 1984, Blight and Wadhams 1987). Additional research incorporated the aggregation pheromone with traps as a monitoring tool for spring migration of weevils in Europe (Nielsen and Jensen 1993). At this time, the use of aggregation pheromone and bean volatiles as a monitoring tool has not been investigated. Further, the use of the aggregation pheromone and/or bean volatiles as tool to monitor density of weevils in the fall has not been tested. Monitoring populations in the fall may be an early indicator of spring population abundances, which would be important tool for farmers to help them judge whether insecticide-treated seed should be planted in the spring.

Objective: To conduct preliminary research which will indicate the usefulness of the aggregation pheromone in combination with bean volatiles as a semiochemical monitoring tool for *S. lineatus* populations in spring and fall.

Summary of Results (of work completed): In spring 2011, six sites were established near Brooks, AB, two near Lethbridge, AB and two sites in Montana. Modified Legget traps were loaded with one of four treatments: 1) aggregation pheromone; 2) bean volatiles; 3) aggregation pheromone and bean volatiles; and 4) blank control. The bean volatile treatment consisted of three volatiles: 1) *Z*-3-

hexen-1-yl acetate; 2) *Z*-3-hexen-1-ol; and 3) linalool. All semiochemicals were loaded in eppendorf tubes and produced by Contech Inc. Legget traps were deployed in early May and monitored weekly. By early June no adult *S. lineatus* were captured and it was discovered that the architecture of the traps allowed beetles to escape. Legget traps were then replaced with baited pitfall traps and proved to be successful in retaining trapped beetles. Spring monitoring continued until late June. Fall monitoring was conducted using new lures positioned in pitfall traps for August to mid-September at the same sites.

The results discussed hereafter refer to trap captures at Lethbridge and Brooks only as the Montana samples still need to be processed. Adult *S. lineatus* were caught during both monitoring periods which indicates that semiochemical-baited traps can be used to monitor populations in the fall, as well as spring. A greater median number of adult *S. lineatus* were captured in the fall but this likely an artefact of differences in the monitoring time period. In both spring and fall, traps baited with the aggregation pheromone alone and aggregation pheromone plus bean volatiles captured significantly more adult *S. lineatus* than did the bean volatiles alone and control traps (Fig. 1). In this preliminary study, the addition of bean volatiles to the aggregation pheromone did not significantly enhance trap captures compared to the aggregation pheromone alone.

Previous research did indicate that higher doses of the same bean volatiles further increased trap captures (Blight et al. 1984) and dose-dependent responses should be addressed. Interestingly, a greater median number of beetles were trapped in the aggregation pheromone plus bean volatile baited traps compared to aggregation pheromone baited traps in the fall versus the spring. This suggests that there may be seasonal differences in the response of *S. lineatus* adults to aggregation pheromone and aggregation pheromone plus bean volatiles and is worthy of further investigation. Bean volatile alone trap captures were similar to control trap captures in the spring and in the fall (Fig. 1).

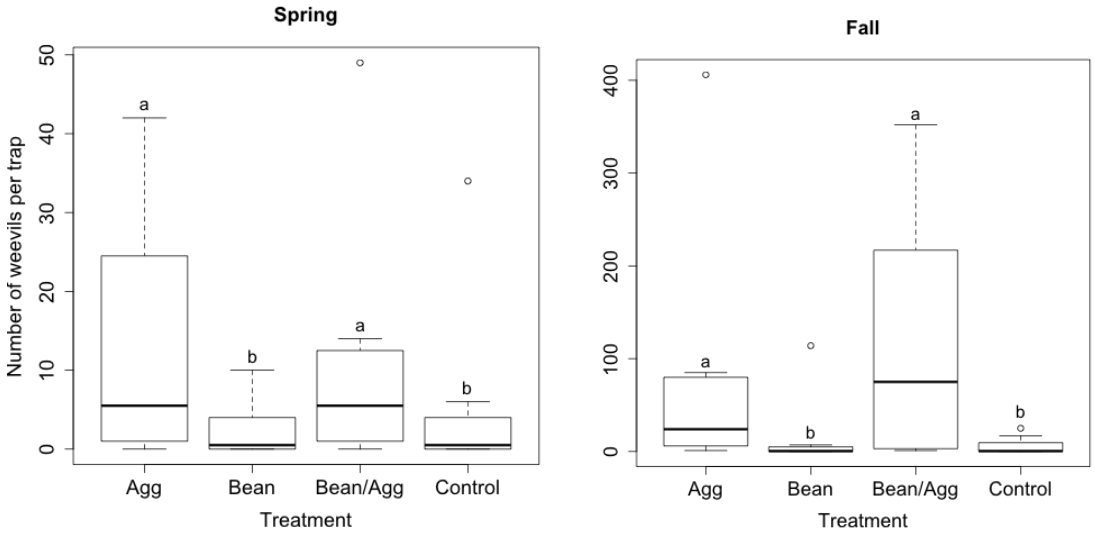

Fig. 1. The effect of lure treatment on *S. lineatus* adult capture in pitfall traps in the spring and fall 2011. Treatments followed by the same letter are not significantly different (Tukeys HSD, P>0.05).

Continuing Research: Currently, we are pursuing funding opportunities to continue this work. Further development of a semiochemical-based monitoring tool for the pea leaf weevil will assess attractiveness of various doses of pheromone and bean volatiles to male and female weevils during the two monitoring periods. A trap that retains weevils and is easier to manage than a pitfall trap needs to be developed. Plasticity of response to semiochemical cues will be studied in the laboratory using electrophysiological and behavioural assays.

Contact: Maya Evenden

University of Alberta, Faculty of Agriculture, Environmental and Life Sciences

15. Title: Determining Resistance Mechanisms in Root Maggot-Resistant Canola Genotypes

Author and Associates: L. Dosdall, J. Tansey, D. Stanton, L. Kott, A. Blake

Problem: Root maggots (*Delia* spp.) are important pests of brassicaceous oilseed crops, especially canola. White mustard, *Sinapis alba* L., is resistant to root maggots and was used as a source of resistance for introgression to *Brassica napus*. Introgression of *S. alba* x *B. napus* produced several accessions resistant to root maggot feeding and oviposition.

Objective of Research: We are investigating potential mechanisms of this resistance, including assessing differences in visual and olfactory cues among resistant and susceptible genotypes, and antixenosis and antibiosis resistance. Deployment strategies for resistant germplasm are being assessed to evaluate incorporation of susceptible refugia to promote long-term durability of resistance traits.

Summary of Results: Research can be grouped into three overall categories: 1) olfactometry tests, to determine responses of female and male flies to odors generated by root maggot-resistant and -susceptible genotypes; 2) antixenosis tests, to determine nonpreference responses of root maggot flies to the different canola genotypes; and 3) antibiosis tests, to determine the ability of resistant germplasm to cause negative effects on the survival or development of larval root maggots.

1) Olfactometry Tests: Responses of *Delia radicum* (the cabbage maggot) to odors of individual test plants, assessed using a Y-tube olfactometer, indicated that significantly more adult *D. radicum* responded to flowering than rosette test plants (χ^2 =3.95; *df* = 1; *P* = 0.047), and significantly more female than male *D. radicum* responded to tests plants (χ^2 =49.81; *df* = 1; *P* < 0.001). Differences in the responses of *D. radicum* adults to test plant lines were apparent (χ^2 =33.75; *df* = 13; *P* = 0.006) and an interaction of plant test line and fly sex was also apparent (χ^2 =29.14; *df* = 13; *P* = 0.029). Greater proportions of female flies were associated with the *B. napus* than *S. alba* parental lines and

several resistant accessions. A significant interaction of test plant line and plant growth stage was also apparent.

2) Antixenosis Tests: Differences in oviposition of mature *D. radium* females were compared among *B. napus*, *S. alba*, and several test plant lines derived from *S. alba* x *B. napus* in choice and no-choice tests. Significant differences in oviposition frequency were detected ($F_{4, 60} = 5.41$; $P < 0.001$); oviposition frequency was significantly greater on *B. napus* than certain resistant genotypes or the *S. alba* parental line ($P < 0.05$).

3) Antibiosis Tests: Specimens reared on the resistant and susceptible genotypes differed in survival and body mass. Significant differences in the numbers of puparia associated with each test plant line were apparent ($\chi^2 = 36.61$; $df = 8$; $P < 0.001$). Greatest numbers of puparia were found on *B. napus*. Significantly fewer puparia were associated with most of the resistant genotypes ($P < 0.05$ for all comparisons. Differences in eclosion times were also evident among test plant lines ($\chi^2 = 119.82$; $df = 8$; $P < 0.001$). Shortest times to eclosion were found for *B. napus*. Significantly longer times were associated with certain resistant genotypes and the *S. alba* parental line.

Continuing Research: This three-year study will continue for one additional year.

***Contact*:** Lloyd Dosdall

16. Title: The Role of Plant Quality in the Distribution Dynamics of the Cabbage Seedpod Weevil

Author and Associates: L. Dosdall, A. Blake, J. Tansey

Problem: The cabbage seedpod weevil damages canola crops through adult feeding on flower buds, feeding of larvae on seeds within pods, and direct feeding on maturing seeds through the pod walls by newly emerged adults. Larval exit holes may also provide an entry point for plant pathogens, and *C. obstrictus*-infested pods are predisposed to premature shattering. Field populations of both adults and larvae of the cabbage seedpod weevil are known to be aggregated in their distributions, but the causal mechanism for this clustering is not understood.

Objective of Research: We investigated the hypothesis that spatial distributions of *C. obstrictus* adults, larvae and their parasitoids were directly or indirectly related to host plant quality as indicated by leaf tissue nutrient contents. We varied nitrogen and sulfur contents in plants, and examined plants for susceptibility to infestation through the responses of adult weevils to visual and olfactory cues elicited by the leaves and flowers of fertilized and non-fertilized plants.

Summary of Results: Plants grown with a higher supply of nitrogen were preferred as hosts for cabbage seedpod weevil. Plants with a higher sulfur supply were also preferred but only in plants grown at lower nitrogen levels. In contrast, larval development time increased with increasing nitrogen levels although larval dry weights were unaffected. Possible causal mechanisms for the increase in development time include differences in oil, protein and glucosinolate contents of the seed. Fertilizer management regimes currently recommended were considered to be optimal for management of *C. obstrictus* as the yield benefits from higher rates of nitrogen fertilization would

more than compensate for increased level of infestation. We are examining changes in light reflectance from leaves and flowers of plants at varying levels of nutrition and how this correlates with weevil responses.

Continuing Research: This study will continue to completion in 2012.

***Contact*:** Lloyd Dosdall

17. Title: The Distribution and Biology of Parasitoids of the Diamondback Moth

Author and Associates: L. Dosdall, J. Soroka, O. Olfert, N. Harker, S. Munir, J. Gavloski

Problem: The diamondback moth outbreaks in 2003 and 2005 were terminated primarily through the activity of the parasitoid, *Diadegma insulare* (Hymenoptera: Ichneumonidae). Unfortunately many farmers needlessly sprayed their crops with insecticide in those outbreaks because they lacked appropriate forecasting information on the distribution and abundance of *D. insulare* populations. Two other parasitoid species, *Microplitis plutellae* (Hymenoptera: Braconidae) and *Diadromus subtilicornis* (Hymenoptera: Ichneumonidae), also attack diamondback moth in western Canada and sometimes inflict high levels of parasitism. However, in spite of the importance of *D. insulare*, *D. subtilicornis*, and *M. plutellae* in managing diamondback moth outbreaks in canola, very little is known of their life histories and habitat requirements, so the aim of this project is to develop forecasting strategies to predict their abundance levels and distributions.

Objective of Research: We are conducting surveys across western Canada of the parasitoid fauna of diamondback moth, in the larval, and pupal stages of diamondback moth hosts. Studies are being conducted (U of A, Edmonton) to determine the effects of canola plant stress on developmental biology of diamondback moth and its principal parasitoid, *D. insulare*. Studies at the U of A and Agriculture and Agri-Food Canada, Saskatoon are investigating the developmental biology of *D. insulare* at various constant and fluctuating temperature regimes, with the goal of assessing how climate change will impact the potential decoupling of phenologies of the pest and parasitoid.

Summary of Results: This study is in its early stages, but we have collected and reared specimens of *D. insulare*, *D. subtilicornis*, *M. plutellae*, and a number of other braconid, chalcid, and ichneumonid parasitoid species from diamondback moth host larvae and pupae.

Continuing Research: This study will continue to completion in 2013.

***Contact*:** Lloyd Dosdall

18. Title: The Arthropod Biodiversity of Canola Agroecosystems

Author and Associates: L. Dosdall, H. Cárcamo, J. Broatch, J. Spence

Problem: Arthropods are a very diverse group of organisms in canola cropping systems, and understanding their biodiversity can improve our ability to enhance the long-term sustainability of canola production. Although the major species of economically important insect herbivores that occur in canola are reasonably well known, species of lesser economic importance are poorly known, and species essential to some vital ecosystem processes are virtually unknown. The ultimate goal of this project is to develop a new database of information on arthropod biodiversity in canola cropping systems that can assist other realms of canola integrated crop management by using arthropods to assess ecosystem quality. In addition, we will use arthropods as key indicators to investigate the hypothesis that increasing vegetational and rotational diversity in canola will enhance arthropod biodiversity.

Objective of Research: Our objectives are to determine the species of arthropods that have been recorded in various published documents from canola agroecosystems, and identify where gaps exist in our knowledge of the taxonomy and biology of insect arthropods in canola. A further objective will be to determine how arthropods respond to variations in vegetational diversity in terms of weed:crop plant densities and varying rotational strategies in canola cropping systems.

Summary of Results: A total of 1037 arthropods were collected by sweeping canola fields in 2010, and many more were collected in 2011. The collection was dominated by Hymenoptera (parasitoid wasps, ~60%) and to a lesser extent spiders (13%), lady beetles (11%), and bees (9%). Nabid bugs, soft flower beetles and syrphid flies were less abundant (2-4%) and assasin bugs and lacewings were rare. The dominant spiders were *Dictyna* species (Dictynidae), and flower and crab spiders (Philodromidae and Thomisidae, respectively). Less common species included money spiders (Linyphiidae), jumping spiders (Salticidae), and orb-weavers (*Araneus* sp.).

Although there are no published records of foliage spiders in cultivated crops in the Prairies, the spider fauna in canola fields sampled from sweep nets appears rather low in abundance and species diversity – only about 136 individuals were collected from more than 3,000 sweep net samples or less than 0.04 spiders per sweep. By contrast, a survey of spiders from rangeland in Saskatchewan found hundreds of species. When all the beneficial arthropods were taken into account, their abundance was about 0.3 per sweep sample.

Continuing Research: This study will continue to completion in 2013.

***Contact*:** Lloyd Dosdall

19. Title: Determination of the Distribution, Abundance, and Phenology of Cereal Leaf Beetle in Alberta

Author and Associates: L. Dosdall, H. Cárcamo, S. Meers, O. Olfert, S. Hartley, S. Kher

Problem: The cereal leaf beetle is an alien, invasive insect pest native to Europe that was first discovered in Alberta in 2005. It attacks wheat, barley, oats, rye, and corn. In the U.S.A. crop losses without control measures have been documented at 55% in spring wheat, 23% in winter wheat, and 75% in oats and barley. Annual surveys to understand the spread and distribution of the beetle across

southern Alberta were initiated in 2006 and it is evident that the beetle has spread significantly across new regions of southern Alberta, and it is important to understand the dynamics of dispersal and hotspots of infestation. It is also important to understand the phenology of the beetle to develop insights into the time of occurrence of various life history events of the beetle.

Objective of Research: The objectives of the project are to determine the spatial distribution and relative abundance of the cereal leaf beetle throughout southern Alberta along with its principal biological control agent, *Tetrastichus julis*, a wasp that parasitizes cereal leaf beetle larvae. Another objective is to understand the levels of infestations in winter and spring cereals and to develop insights into pest dispersal from winter to cereal crops.

Summary of Results: In 2011, approximately 124 cereal fields (including winter and spring cereals both) were surveyed throughout southern Alberta, within a geographical area extending from Drumheller to the U.S.A. border. Exceptionally large numbers of adults were recorded at the beginning of May 2011 and the levels of infestation were particularly high in areas including Taber, Medicine Hat, Grassy Lake, and Bow Island. Spring wheat fields in Taber area harboured particularly higher numbers of beetles. However, the level of parasitization was also significant and no severe yield losses were recorded in the region. Higher beetle infestations were observed in mid-June to late July which also synchronized well with the activity of the parasitoid causing control of the cereal leaf beetle population. Surprisingly, the cereal leaf beetle was also discovered in a triticale research plot in Edmonton, AB and it is the first report of the pest being discovered so far north. Such an invasion might have resulted from the movement of agricultural material such as hay from infested areas. The numbers observed in Edmonton area were typically low but warrant further monitoring to check its establishment and dispersal.

Continuing Research: This research is funded by the Western Grains Research Foundation and the Alberta Crop Industry Fund, and will continue in 2012.

***Contact*:** Lloyd Dosdall

20. Title: Studies on efficacy of BotaniGard™ (22WP) for the control of cereal leaf beetle

Author and Associates: H. Cárcamo, M. Goettel, G. Duke, L. Dosdall, S. Kher, C. Durand, C. Herle

Problem: The cereal leaf beetle is a destructive pest of cereals and was discovered in Alberta in 2005 and has spread considerably across the cereal growing regions of the southern Alberta. Although it is in its early dispersal phase, the availability of suitable hosts together with the favourable climate creates positive conditions for its establishment. The primary management method for this pest is biological control with a parasitoid, therefore, non-chemical methods are likely to be more compatible to develop an IPM strategy. The entomopathogenic fungus, *Beauveria bassiana* has been reported to have potential to control the beetle but there is a dearth of studies investigating the potential of this fungal bioagent in controlling the beetle.

Objective of Research: The main objective was to test the efficacy of the fungal bioagent for controlling cereal leaf beetle, and to study non-target effects of the fungal bioagent on the parasitic wasp *T. julis*.

Summary of Results: The commercial product, BotaniGard 22WP containing active conidia of the entomopathogenic fungus, *B. bassiana*, was used to conduct bioassays. The trials were conducted under laboratory and greenhouse conditions. Based on the results of these studies, spray treatments were designed for field bioassays. For laboratory and greenhouse studies, concentrations of BotaniGard used were 0g/L (Control), 2.5g/L, 5g/L and 10g/L. The higher the dose the higher was mortality in larval populations in both studies. A recommended dose for thrips and greenhouse pests of BotaniGard of 2.5g/L resulted in 59% and 83% of mortality under greenhouse and laboratory conditions and was further used as the base dose for laboratory studies conducted to study the effects of BotaniGard on *T. julis*. As a variety of factors determine the efficacy of mycoinsecticides under field conditions including temperature, relative humidity, UV index etc., a higher dose of BotaniGard was selected for field bioassays (5g/L). The selected dose had resulted in 78 and 83% mortality in greenhouse and laboratory studies, respectively. The concentrations of BotaniGard used for the field trials included water only (control), 5g/L (highest dose) and 0.5g/L (a dose 10-fold lower than the highest field dose), and these were applied randomly to open or caged field plots. Highest mortality was mainly found with the 5g/L dose. In laboratory studies, it was observed that parasitoid adults could emerge successfully from the larvae sprayed with BotaniGard spray treatments.

***Contact*:** Héctor Cárcamo

21. Title: Studies on biology and host range of cereal leaf beetle and exploration of host plant resistance

Author and Associates: L. Dosdall, H. Cárcamo, S. Kher, M. Bohssini

Problem: Cereal leaf beetle is a new invasive pest in the cereal cropping systems of western Canada. It is important to understand its biology and host preferences to understand its future dispersal. Also, host plant resistance can also act as an important component of sustainable pest management strategies and it is important to explore resistance mechanisms that can be of importance in future resistance management programmes.

Objective of the research: The objective of this research was to study the host range of the pest and to understand the putative resistance mechanisms in exotic germplasm of bread wheat.

Summary of results: The biology of the cereal leaf beetle was studied on live plants and excised leaf tissues of five cereal hosts namely winter wheat (cultivar: AC Radiant), oats (cultivar: Morgan), rye (cultivar: AC Remington), triticale (cultivar: Pronghorn) and sweet corn (cultivar: UT128B). Observations were recorded on survival, developmental time for each instar, total developmental time and adult weights. The most preferred crop was oat while the least preferred was corn. Seven promising germplasm lines with putative resistance traits obtained from the International Center for Agricultural Research in the Dry Areas (ICARDA), Syria were included in the antibiosis trial. Additionally, a local cultivar of oats (Waldern), speculated to possess antibiotic characters, was also included in the trials. Growth was slow and larval death was evident when larvae were reared on live

plants of cultivar Waldern. Similarly, some exotic germplasm lines were seen to exhibit both non-preference and antibiosis mechanisms against the cereal leaf beetle.

Contact: Lloyd Dosdall and Héctor Cárcamo

Olds College

22. Title: Biology and Distribution of an Alien Invasive Species new to Alberta, the Lily Leaf Beetle, *Lilioceris lilii* (Scopoli)

Author and Associates: Ken Fry (OC)

Problem: The alien invasive species, *Lilioceris lilii*, was first detected in North America in Montreal in 1943 (LeSage 1983) but has since spread to Ontario (Bouchard *et al*. 2008), the Maritimes (Majka & LeSage 2008), and Manitoba (Elliott & LeSage 2004). This beetle was reported from cultivated lilies in Airdrie, Alberta in 2006 (unpubl. res.). Both cultivated and native species of *Lilium* are threatened by this pest.

Objective of Research: The objective of this project is to determine the geographic distribution, phenology, and host range of the Lily Leaf Beetle in Alberta.

Summary of Results: Several sites in central and southern Alberta were visited to collect the beetle. All major lily growers and lily organizations have been contacted and the project advertised to horticultural and gardening societies. Reports of beetle infestations have been logged and verified. A geospatial database has been developed to track the distribution and spread of the beetle in Alberta. Rearing of the beetle to determine life history characteristics is on-going. The beetle's distribution is limited to as far north as Red Deer and as far south as Okotoks.

Continuing Research: Continued funding from the Alberta Regional Lily Society will allow for the survey and life history work to continue in 2012. In conjunction with Dr. N. Cappucino of Carleton University, a project involving the release and tracking of the parasitoid, *Terastichus setifer*, will occur in 2013.

Contact: Ken Fry

Contact Information

AGRICULTURE AND AGRI-FOOD CANADA

Beaverlodge Research Farm

OTANI, Jennifer. M.Sc.
Beaverlodge Research Farm
P.O. Box 29
Beaverlodge, Alberta T0H 0C0
Tel. 780-354-5132
E-mail: jennifer.otani@agr.gc.ca

Lethbridge Research Centre

CÁRCAMO, Héctor PhD

Lethbridge Research Centre
5403 - 1 Avenue South
PO BOX 3000
Lethbridge, Alberta T1J 4B1
Telephone: 403-317-2247
Email: hector.carcamo@agr.gc.ca

Lethbridge Research Centre

BERES, Brian PhD

5403 - 1 Avenue South
PO BOX 3000
Lethbridge, Alberta T1J 4B1
Telephone: 403-317-2251
Fax: 403-382-3156
Email: brian.beres@agr.gc.ca

UNIVERSITY OF ALBERTA

Department of Agricultural, Food and Nutritional Science	**DOSDALL, Lloyd PhD** University of Alberta 4-16E Agriculture/Forestry Ctr Edmonton, AB Canada T6G 2P5 Telephone: 780-492-6893 Fax: 780-492-4265 Email: lloyd.dosdall@ales.ualberta.ca
Department of Biological Sciences	**EVENDEN, Maya PhD** University of Alberta ES 214A, Biological Sciences Edmonton, AB Canada T6G 2P5 Telephone: 780-492-1873 Fax: 780-492-9234 Email: mevenden@ualberta.ca

OLDS COLLEGE

School of Environment	**FRY, Ken PhD** Olds College 4500, 50th St Olds, AB Canada T4H 1R6 Telephone: 403-556-8261 Fax: 403-556- 4713 Email: kfry@oldscollege.ca

2011 Saskatchewan Research Report

Western Committee on Crop Pests

Kelowna, BC, Oct. 18, 2011

SASKATCHEWAN ALFALFA SEED PRODUCERS ASSOCIATION

2011ECT PEST RESEARCH REPORT

1.Title: Research on parasitoids and disease in Saskatchewan alfalfa leafcutting bee populations.

Author: D.W. Goerzen

Problem:

The alfalfa leafcutting bee, *Megachile rotundata*, is an important pollinator of alfalfa for seed production in western Canada. Infestations of the chalcid parasitoid *Pteromalus venustus* are currently a problem in some alfalfa leafcutting bee populations. Another factor which may limit alfalfa leafcutting bee production is the occurrence of chalkbrood disease, *Ascosphaera aggregata*.

Objective of Research:

This research project is designed to evaluate parasitoid and disease levels in Saskatchewan alfalfa leafcutting bee populations, and to develop management strategies which will assist alfalfa seed producers in maintaining high quality alfalfa leafcutting bee populations in order to enhance alfalfa seed production and increase the value of the bees in export markets.

Summary of Results:

Occurrence of the chalcid parasitoid, *P. venustus*, was evaluated in the 2010 - 2011 winter survey of Saskatchewan alfalfa leafcutting bee populations. The parasitoid was detected in 0.35% (range 0.00 - 3.50% / sd 0.56%) of bee cells analysed from individual samples submitted by Saskatchewan alfalfa seed producers (n = 97). *P. venustus* was present in 56.7% of alfalfa leafcutting bee populations surveyed. Chalcid parasitoids have traditionally been controlled during the spring alfalfa leafcutting bee incubation period with dichlorvos resin strips; dichlorvos has been implicated in alfalfa leafcutting bee mortality and this compound is also among the organophosphate insecticides under review by the PMRA and the EPA. Research is currently being undertaken to identify and evaluate alternative compounds which might be efficacious for control of the chalcid parasitoid, *P. venustus*, in *M. rotundata* populations.

Occurrence of chalkbrood disease (*A. aggregata*) was also evaluated in the 2010 - 2011 winter survey of Saskatchewan alfalfa leafcutting bee populations. The disease was present at an extremely low level in bee cells analysed from samples submitted by Saskatchewan alfalfa seed producers (n = 97), with occurrence of the sporulating form of chalkbrood disease at 0.003% overall (range 0.00 - 0.32% / sd 0.032%) and occurrence of the non-sporulating form of chalkbrood disease at 0.016% overall (range 0.00 - 0.79% / sd 0.087%). Paraformaldehyde fumigation and bleach dipping treatment of alfalfa leafcutting bee nest material / alfalfa leafcutting bee cells are two methods currently utilized for control of a broad range of microflora, including *Ascosphaera* spp., occurring in alfalfa leafcutting bee populations.

Continuing Research:

Research to monitor parasitoid and disease levels in Saskatchewan alfalfa leafcutting bee populations, and to develop strategies which will assist alfalfa seed producers in controlling these problems, is ongoing.

Contact:

D.W Goerzen
Saskatchewan Alfalfa Seed Producers Association
127 E - 116 Research Drive
Saskatoon, SK S7N 3R3 e-mail: goerzenw@innovationplace.com

AGRICULTURE AND AGRI-FOOD CANADA
SASKATOON RESEARCH CENTER

1. Title: The influence of abiotic factors on an invasive pest of pulse crops, *Sitona lineatus* (L.) (Coleoptera: Curculionidae), in North America

Author and Associates: O. Olfert, R. Weiss, H. Carcamo, S. Meers

Problem: Pea leaf weevil, *Sitona lineatus* (L.), native to Europe and North Africa, has been introduced into many other countries around the word, including North America. Adults are oligophagous pests on leguminaceous plants. *Sitona lineatus* was first recorded in Canada in 1997, near Lethbridge, AB. Abiotic factors, primarily climate, constrain population growth and survival that ultimately affect species distribution and abundance. Bioclimatic simulation models have been used successfully to predict the distribution and extent of insect establishment in new environments. The models allow researchers to develop an overview of climatic factors that affect species distribution and abundance and permit identification of non-climatic factors that limit species distribution. Sensitivity analysis can be used to test hypotheses related to the effect of varying climate variables (i.e., warmer/cooler or wetter/dryer than normal conditions) on the species distribution and abundance.

Objective of Research: The objectives of the study were to develop a bioclimatic model to predict potential range and relative abundance of *S. lineatus*, identify areas in Canada that are at risk for future establishment of the pea leaf weevil, and to use the model to develop a better understanding of how a changing climate might potentially influence *S. lineatus* populations across North America.

Summary of Results: The bioclimate model predicted that the potential range of *S. lineatus* could extend well beyond current distributions in North America. Sensitivity analysis results suggested that *S. lineatus* populations are likely to respond less favourably in dry seasons and more favourably in wetter seasons. This conclusion may be based on conditions that occurred in the previous summer. That is, late May to July rainfall may be an important factor that determines mid-summer survival and potential number of adults available for the following season. Climate change projections (General Circulation Models) were then imposed on the bioclimate model of *S. lineatus*. Bioclimate model output varied for each of the three General Circulation Models. In terms of suitability for pest establishment (Ecoclimatic Index), the NCAR273 CCSM (+2.47 °C) climate data resulted in the most significant shift northward.

Continuing Research: Future plans are to continue to assess population density & distribution of both crop pests and their natural enemies over time. The data will be used to develop bioclimatic models of these populations and to assess the potential impact of climate change on this relationship.

Reference: Olfert, O. Weiss, R.M., Carcamo H., Meers, S. 2011. The influence of abiotic factors on an invasive pest of pulse crops, *Sitona lineatus* (L.) (Coleoptera: Curculionidae), in North America ***Psyche*** 2011: (in press)

2. Title: Bioclimatic analyses of distributions of a parasitoid, *Peristenus digoneutis* (Hymenoptera: Braconidae), and its host species, *Lygus* spp. (Hemiptera: Miridae)

Author and Associates: Haye, T. (CABI lead) AAFC researchers across Canada.

Problem: Plant bugs of the genus *Lygus* (Hemiptera: Miridae) are an invasive insect pest of field crops in most agricultural ecosystems throughout Europe and North America including vegetable and fruit crops, alfalfa**,** and canola**.** *Lygus* nymphs are commonly parasitized by various species of the genus *Peristenus* Förster (Hymenoptera: Braconidae). Introduced into North America to control *Lygus* populations, rates of parasitism by *Peristenus* species are higher in Europe than in North American. In Canada, overall parasitism is insufficient to significantly suppress the pest Lygus spp. Populations. Moreover, most parasitoid species attack nymphs of the first Lygus generation and subsequent generations were usually not significantly parasitized. As a result, programs were initiated to introduce a European species, *P. digoneutis* Loan to North America as a biological control agent of *Lygus*. It is now present in 11 northeastern states and the Canadian provinces of Ontario, Quebec and Nova Scotia but has failed to become established in western Canada..

Objectives of Research: The objectives of the study were to develop bioclimatic models to predict potential range and relative abundance of *P. digoneutis* and it's host *Lygus* spp. based on European faunal data, and to use the model to develop a better understanding of how climate affects the status of biological control efforts to manage *Lygus* populations using *P. digoneutis* in North America

Summary of Results. Across its current range in Europe and North America, *P. digoneutis* distribution is limited where the species can complete two reproductive generations and where its hosts, *Lygus rugulipennis* and *Lygus lineolaris* can complete two generations. A General Circulation Model, CSIRO Mark 3.0 (+2.11 ^{o}C) was obtained from the Intergovernmental Panel on Climate Change which estimates the amount of global warming for a doubling of the atmospheric CO2 compared with 1990 levels

The results of the study showed that range and distribution of the parasitoid and its host were positively and negatively affected based on specific combinations of temperature and precipitation. Similar to model results for Europe, cold stress did not appear to be a limiting factor for *P. digoneutis*. Species distribution would appear to be limited by constraints associated with the growing season, specifically the requirement of temperature conditions required to complete two generations. Sensitivity analysis indicated that *P. digoneutis* would likely continue to be successful even with the warmer temperatures predicted in future climates. For example, warmer temperatures may allow *P. digoneutis* to become established in northern agricultural regions such as Peace River, Canada.

Reference:

Olfert O, Haye, T, Weiss, R, Kuhlmann, U. 2011. A Role for Bioclimate Modelling in Development of IPM Strategies: Case Study - Classical Biological Control in a Changing Climate (Invited poster). ***OECD Workshop on IPM - Strategies for the adoption and implementation of IPM in agriculture contributing to the sustainable use of pesticides and to pesticide risk reduction***. 16-19 October 2011, Berlin, Germany.

Contact:

Owen Olfert, AAFC-Saskatoon
107 Science Place, Saskatoon, SK S7N 0X

Owen.Olfert@agr.gc.ca

3.Title: Finding resistance to Aster yellow in false flax.

Author and associates: I. Parkin (PI, AAFC-Saskatoon) and associates.

Problem: There is interest in false flax [*Camelina sativa* (L.) Crantz, Brassicaceae] as an alternative

oilseed crop because of its potential for food, feed and industrial applications. However, preliminary screening trials have established that *C. sativa* was susceptible to aster yellow diseases.

Objective of research: Identify phytoplasma strains present in false flax crops and their potential insect vectors

Summary of results: Fifteen accessions were tested for the presence of aster yellows (AY) phytoplasma in screening trials at the AAFC research farm in Saskatoon in 2011. Among the 15 accessions, three are considered to be AY tolerant based on the field trials from 2009 and 2010. In 2011, AY strains 16SrI-A & -B were detected in *C. sativa* stem leaves and seeds, as well as in the main AY vector, the aster leafhopper, *Macrosteles quadrilineatus*. The three accessions considered "tolerant" had low AY incidence. An experiment aiming at determining the cause of the AY tolerance (plant resistance to the phytoplasma or plant less attractive to leafhoppers) was set up. Results are being analyzed.

Continuing research: Data analysis to determine accession susceptibility are on going. Disease survey and screening trials of more accessions will continue in 2012.

Contact:
Chrystel Olivier, AAFC-Saskatoon Research Centre
107 Science Place, Saskatoon, Saskatchewan S7N 0X2, Canada
Chrystel.Olivier@agr.gc.ca

4.Title: Monitoring canola crops across the Plains for species distribution of flea beetles.

Author and Associates: Julie Soroka and co-operators

Problem: In previous laboratory studies striped flea beetles were found to have decreased mortality and increased feeding levels compared with crucifer flea beetles feeding on canola treated with neonicotinoid seed treatments. A field survey is being conducted to determine if this differential efficacy is changing flea beetle species distribution.

Objective of Research: To establish base lines of flea beetle species distributions in canola fields across the prairies.

Summary of Results: In the spring yellow sticky traps were distributed to co-operators in three provinces and one state across the northern grain belt. To date traps from 72 locations have been returned and those from 38 locations have been analyzed. In 2011 the proportion of striped flea beetles continued to increase over crucifer flea beetles in many locations surveyed. Numbers of other flea beetle species that were not

previously seen or were very infrequently recorded in canola fields also continued to increase. It should be noted that in 2010 and to date in 2011 *Phyllotreta cruciferae* was the dominant species collected in those fields with the highest numbers of flea beetles.

Continuing Research: Sample collection for this project is now complete. Flea beetle identification and sample analysis is ongoing.

5. Title: Mitigating risk to canola from flea beetle injury

Author and Associates: Julie Soroka, Bob Elliott, Owen Olfert, Chrystel Olivier, AAFC Saskatoon, Jennifer Otani, AAFC Beaverlodge, Lloyd Dosdall, U of Alberta

Problem: Flea beetles are the most chronic insect pest of prairie canola production, yet little research has been done in population forecasting.

Objective of Research: Determining how environmental factors affect distribution, overwintering survival and spring emergence, flight, feeding levels, oviposition and reproduction of the two principal crucifer-feeding flea beetle species.

Summary of Results: Flea beetle species seasonal flight height was determined at Saskatoon in 2011. In pan traps placed at 0, 0.5, 1.0, 2.0, 3.0, 4.0 and 6.0 m above ground, the greatest number of flea beetles were found at ground level. Pyramidal-shaped screen cages were placed on canola stubble (seeded early and late in 2010) and in a nearby pine shelterbelt at the Saskatoon Research farm prior to soil thaw in early April. Temperatures were monitored using probes placed inside and outside the cages, and flea beetles were collected weekly from April until the end of July and frozen for species and sex determination. By the end of July all overwintering flea beetles were deemed to have emerged, and the traps were moved to canola planted May 10 (early plots) and May 30 (late plots) of this year. Newly emerged flea beetles were collected from these cages from the end of July until the second week in October, when all activity ceased. Sample analysis is currently underway.

Continuing Research: The project monitoring flea beetle movement and environmental parameters will continue for two more years.

6.Title: Insect monitoring and surveying of Saskatchewan alfalfa fields.

Author and Associates: Julie Soroka, AAFC Saskatoon, and Saskatchewan Ministry of Agriculture Forage Specialists

Problem: Insects, particularly alfalfa weevil (*Hypera postica* Gyll.), have been of growing concern to alfalfa hay producers of Saskatchewan for the last several years. The current status of insect pests in the crop needs to be determined so that producers can be proactive in pest management.

Objective of Research: To determine the distribution of alfalfa weevil and other insects in alfalfa fields. Provincial forage specialists conducted a survey of alfalfa forage fields across Saskatchewan in late June-early July, 2010 and 2011.

Summary of Results: In 2010 48 alfalfa fields and in 2011 45 alfalfa fields across Saskatchewan were swept and the insects sent to Dr. Soroka's laboratory for identification. The excess moisture and generally cool weather in 2010 resulted in excellent alfalfa growth and poor insect development over the season. Alfalfa stands were lush and pest insect numbers were low over most of the province in this year. Even the highest alfalfa weevil numbers, 6.2 larvae/sweep near Cupar, SK, were much lower than published economic thresholds. In 2011 alfalfa weevil numbers in 33 of 45 fields were higher to much higher than found in the previous year, with five locations having weevil numbers greater than 30 larvae per sweep, and one field near Churchbridge having a high of 135 larvae/sweep. In 2010 samples from 19 locations had no alfalfa weevils, while in 2011 10 locations were weevil-free; most of these were in the western and northern areas of the province. The specialist parasitoid wasp *Bathyplectes curculionis* (Thomson) was reared from alfalfa weevil, a first Saskatchewan record. The numbers of *Bathyplectes* wasps and the numbers of locations from which they were collected were much lower in 2011 than in 2010, in inverse proportion to the number of weevils found in the two years.

Continuing Research: Data will be further analyzed for determination of distribution of alfalfa blotch leafminer *Agromyza frontella* (Rond.) and other alfalfa pests.

For all projects contact:

Name Julie Soroka
Agency Agriculture and Agri-Food Canada, Saskatoon Research Centre
Mailing address 107 Science Place, Saskatoon, SK S7N 0X2
E-mail Julie.Soroka@agr.gc.ca

RESEARCH PROGRESS REPORT - MANITOBA 2011

Prepared by Ian Wise, Cereal Research Centre
Agriculture and AgriFood Canada
Winnipeg, Manitoba
R3T 2M9
Email: ian.wise@agr.gc.ca

CEREAL CROP RESEARCH

Title 1: Development of spring wheats with resistance to the orange wheat blossom midge *Sitodiplosis mosellana*

Author and Associates: SL Fox, PD Brown, IL Wise (iwise@agr.gc.ca), and G. Humphreys, Cereal Research Centre, O.O. Olfert, AAFC Saskatoon and R. DePauw, AAFC Swift Current

Problem: The wheat midge is the most serious insect pest of spring wheat in western Canada. The *Sm1* R-gene confers resistance to the wheat midge and is now broadly distributed in spring wheat breeding programs. The *Sm1* gene, however, is the only known genetic source of resistance to the wheat midge. Screening land races of wheat for other resistant sources has not been successful.

Summary of Results: Four CWRS varietal blends Shaw, Unity, Goodeve and Fieldstar, the CWES blend Glencross, and the CPS blend Conquer are available as 90 R: 10 S varietal blends. An additional midge resistant CWRS cultivar Vesper will be available in 2012. Information on these cultivars is available at the following website:http://www.midgetolerantwheat.ca/.

Other resistant lines are found throughout the CWRS, CPS, and CWHW breeding programs. The proportion of midge resistant material in the breeding programs is now sufficient to reduce efforts of selection. This will result in midge resistant cultivars getting produced while allowing more lines with other desirable characteristics to be retained in the breeding program for producers who do not need or want midge resistant cultivars and will reduce the need for varietal blends.

Title 2. Genetic characterization of the orange wheat blossom midge resistance gene *Sm1*

Author and Associates: SL Fox, S. Cloutier, D. Procunier, J. Thomas, B. McCallum, G. Humphreys, and IL Wise (iwise@agr.gc.ca), Cereal Research Centre

Problem: The orange wheat blossom midge can cause yield losses in excess of $100 million per year to the wheat industry. Genetic resistance has been demonstrated for both antixenosis (oviposition deterrence) and antibiosis. To deter the development of virulence to wheat varieties with *Sm1*, varieties are released as varietal blends which require the varietal blend to maintain its R:S proportion through years of cultivation. To that end, molecular markers are needed to identify lines with and without *Sm1*.The cloning of *Sm1* would provide perfect markers and would also allow the understanding of the mode of action of the gene in preventing larval growth.

Summary of Results: *Sm1* is located on the short arm of chromosome 2BS proximal to leaf rust resistance gene *Lr16*. Genetic maps incorporating mostly microsatellite markers have been developed using populations that did not segregate for *Sm1*. This information now can be used to fine-map *Sm1* in new population clones. Some of the clones carry *Sm1* and *Lr16* in coupling, enabling the development of tightly linked markers for both genes. Over 350 selections from within these clones were field tested for their phenotypic response to midge attack in 2011. Results are pending

Title 3. Development of durum wheat with resistance to the wheat midge

Author and Associates: A.K. Singh (Asheesh.Singh@agr.gc.ca), R. Knox, R. DePauw, F. Clarke, AAFC Swift Current; C. Pozniak, CDC Saskatoon; IL Wise (iwise@agr.gc.ca), S.L. Fox, CRC

Problem: The insertion of the *Sm1* gene from hexaploid wheats into suitable tetraploid durum wheats creates major end-use quality issues that requires extensive phenotypic and genetic selection.

Summary of Results: Two durum breeding programs at Swift Current (AAFC) and Saskatoon (U of S) are well advanced towards the selection of durum wheats with superior agronomic, quality, and disease and midge resistance. Durum lines with *Sm1* gene for midge tolerance have progressed to the fourth year of Coop testing. Additional lines continue to be selected to provide a larger proportion of durum wheat lines with *Sm1* resistance in the breeding programs. The more advanced lines were tested at multiple sites in western Canada for their resistance to the midge and their agronomic traits.

Title 4: Development of management strategies to minimize the selection of virulent midge biotypes.

Author and Associates: MAH Smith (msmith@agr.gc.ca), SL Fox, IL Wise (iwise@agr.gc.ca), CRC

Problem: When used on a commercial scale, the new antibiotic midge-resistant wheat varieties will put a substantial selection pressure on the midge population, resulting in higher proportions of virulent midge that can survive on resistant wheat. New wheat midge resistant cultivars are available as varietal blends containing an interspersed refuge of 10% susceptible wheat to reduce this selection pressure. A second type of resistance that results in reduced wheat midge oviposition is present in some spring wheat and durum lines and could be used as an additional resistance management tool, and when combined with antibiotic resistance, can reduce both midge seed damage and selection pressure for virulent midge. However, the inheritance of oviposition deterrence is controlled by more than one gene, making it more difficult to incorporate into breeding programs.

Objectives of Research: 1) Determine or confirm the presence of oviposition deterrence to the wheat midge in third-year breeders' wheat lines.

2) Screen several doubled haploid wheat populations for potential oviposition deterrence.

Summary of Results: Oviposition deterrence was evaluated in six third-year breeders' lines in a three-replicate experiment at one site. Three of the lines had 50-65% as many midge eggs as the susceptible check, levels of oviposition deterrence that may be useful in management of wheat midge resistance and in reducing yield loss if the deterrence is consistent in other environments. One deterrent and one non-deterrent line also had 40-50% of the midge eggs laid on the rachis, as did the deterrent check, Waskada.

If larvae hatching from these eggs are at a disadvantage, overall seed damage could be reduced. Previously, the non-deterrent wheat line 5602HR had most of the midge eggs laid on the rachis in repeated tests and may be a cause of the consistently low levels of midge-damaged seed in harvested samples of 5602HR.

Crosses between oviposition-deterrent and non-deterrent parents have been made, and about 500 lines from three of the resulting double haploid populations were screened for oviposition deterrence. The proportion of midge damaged seeds in ripe spikes of each line was compared with midge damage in non-deterrent checks with similar heading dates. There was a wide range of responses within all three populations, from very deterrent to very susceptible. The variation in deterrence within populations and the large number of lines screened (140-200 per population) would make them useful for genetic analysis of oviposition deterrence.

Continuing Research: 1) The breeders' lines that had reduced midge oviposition will be tested in other environments, both laboratory and field, to determine if the deterrence is stable.

2) The test for oviposition deterrence in advanced breeders' lines and components of some recently registered midge-resistant wheat cultivars will be continued in 2012.

2) A project has been initiated at the CRC to study the genetics of midge resistance in wheat. One component of the study will examine two of the doubled-haploid populations that we used, to identify chromosome regions and DNA markers associated with oviposition deterrence. This will include repeated field screening for midge oviposition deterrence.

Title 5: Agronomic and quality impacts of midge (*Sitodiplosis mosellana*) on wheat

Author and associates: R. DePauw, SPARC AAFC, Swift Current (depauw@agr.gc.ca) ; S. Fox, AAFC CRC (sfox@agr.gc.ca), Vera, C., AAFC Melfort, Lukow, O., Procunier, D., M. Smith, and I. L. Wise, CRC.

Problem: Damage by midge larvae causes wheat kernels to shrivel, crack and become deformed. This reduces both the yield and the quality of the grain. A single antibiotic resistance gene (*Sm1*) has been transferred into spring wheat varieties by breeders in western Canada. As resistance based on a single gene is often short-lived, these resistant wheat lines have been proposed to be sold as the major component in varietal blends (90:10 RS) which will also include a small proportion of a susceptible cultivar, known as an interspersed refuge.

The stability of varietal blends has not been tested over time. Many producers use farm-saved seed to produce wheat crops. Varietal blend stability will be necessary for producers to assess the economic impact of using their own seed and to protect the long term utility of the Sm1 midge resistance gene.

Summary: Four varieties, Goodeve (BW841), Fieldstar (BW365), Unity (BW362) and Shaw (BW394), possessing the *Sm1* gene, were tested as varietal blends for four years (2007-2010) in agronomic trials at 8 locations in western Canada. The resistant blends varied in their effectiveness against midge, but all had less damage to kernels than cultivars without *Sm1* (see graph). Shaw had the least amount of damage to

the seed. Seeds damaged by midge to resistant lines are asymmetrically deformed, and are typically shorter and more rounded than undamaged seed. The stability of the blends was monitored over three generations with SNP markers. The blend ratios showed the expected 90 resistant: 10 susceptible ratio, within sampling error. Some locations/ genotypes have showed a 95:5 or 85:15 ratio which could be due to a very small genetic (cultivar) drift or sampling error. Waskada was discovered to have oviposition deterrence from these tests, with yield losses being up to 50% less than those of Katepwa, CDC Teal or AC Intrepid.

Title 6: Categorization of spring and durum wheat cultivars according to their degree of susceptibility to damage by the wheat midge

Authors and Associates: IL Wise and SL Fox, CRC

Problem: Spring wheat varieties with or without the *Sm1* R-gene can vary in their response to midge attack. Some susceptible cultivars deter oviposition or larval establishment and resistant cultivars can vary in damage to their seed that necessitate a rating scale to separate varietal differences.

Summary of results: Varieties with *Sm1* differ in the prevalence of midge-damaged seed at harvest. The seed is damaged when larvae attempt to feed on newly developed seed. The new variety Shaw suffers very little damage while Fieldstar can be moderately damaged in areas with high midge populations. These two cultivars form standards for seed damage to resistant cultivars. Unity, Goodeve, Conquer, and Glencross are intermediate in their response. Vesper is unique for a resistant cultivar in that it has ovipostion deterrence. Ovipositon deterrence was first identified in the susceptible cultivar Waskada. This cultivar is now used as the standard for this type of resistance. 5602HR also has been found to deter midge damage by reducing the ability of the larvae to establish on the seed. Both forms of resistance can reduce seed damage up to 70%, with oviposition deterrence being more consistent in all weather conditions. New sources of oviposition deterrence were quantified this year in the American varieties Reeder, Parshall, and Steele.

Title 7: Development of spring wheat germplasm with resistance to the wheat midge and the Hessian fly, *Mayetiola destructor*

Authors and Associates: IL Wise and SL Fox, CRC

Problem: The development of cultivars with specific agronomic traits is delayed if these traits have to be obtained from distant genetic sources. The Hessian fly is a minor insect pest to spring wheat in western Canada. Damage in the form of stem breakage is largely confined to late-seeded spring wheats.

Summary of Results: Lines of wheat in all classes with wheat midge resistance and *H3, H6* or **H18** gene genes for Hessian fly resistance were tested in the field for agronomic traits in 2011. Additional crosses of the *H18* gene into Shaw and Vesper germplasm were continued in 2011.

OILSEED, SPECIALITY AND VEGETABLE CROP RESEARCH

Title 8: Potato virus Y impact on potato cultivars and management through oil sprays and crop borders.

Author and Associates: D.L. McLaren, Crop Production Pathologist, Brandon Research Centre, AAFC, Brandon, MB; G. Boiteau, Potato Research Centre, AAFC, Fredericton, N.B.; B.G. Elliott, Manitoba Agriculture, Food and Rural Initiatives (MAFRI), Soils and Crops Branch, Carman, MB; R. Mohr and M. Khakbazan, Brandon Research Centre, AAFC, Brandon, MB; D. Tomasiewicz, Canada-Manitoba Crop Diversification Centre.

Funding and in-kind support: Seed Potato Growers' Association of Manitoba, Keystone Potato Producers Association, Manitoba Agriculture, Food and Rural Initiatives, Canada-Manitoba Crop Diversification Centre.

Objective of Research: The objectives are: a) to assess oil sprays and crop borders for PVY management in potato under Manitoba environmental conditions and b) to assess aphid populations in the Carberry potato production region for species that are important in the spread of PVY. Note that in 2011 most of the sites of the aphid trapping network were established and maintained by MAFRI and CMCDC. The Carberry site was monitored by AAFC-Brandon.

Progress: The aphid trapping network was established at 9 sites throughout the Manitoba potato producing regions and aphids were captured over approximately 10 sampling interval end dates. Green peach, potato, and buckthorn aphid identifications were conducted from samples collected from traps and leaves. In a replicated virus spread trial with known diseased plants, aphids were collected over the season, and tubers were collected for RT-PCR to assess oil spray and crop borders as management tools for PVY.

General observations, comments, conclusions to date: Aphid populations peaked at the Carberry site in late August of this year and the most efficient vector, the green peach aphid was first observed during the week ending August 8th. Potato and buckthorn aphids were captured from traps during the field season as were aphid species categorized as “others”. Data collection and assessment of management tools (oil and crop borders) for PVY are ongoing.

The Carberry location has been a research site from year to year where the aphid populations in potato are encouraged. All other sites within the aphid trapping network are commercially managed fields and fewer aphids are generally captured at these sites than at the Carberry location. For example, in 2011, during week 9 of the aphid monitoring network, approximately 700 aphids were captured at the Carberry site compared to a total of 78 aphids at all other sites. In 2011, aphid captures at Carberry were much higher in than in 2010. For example, in 2010 and 2011 during the last week of August, twenty-three and 1,052 aphids were captured, respectively at the same location (same number of traps). The hot, dry weather would likely have been a significant factor contributing to the increased populations and activity this year.

Title 9: Management of root maggots *Delia radicum* on oilseed rape in Manitoba

Author and Associates: N.J. Holliday (neil_holliday@umanitoba.ca), Dept. of Entomology, University of Manitoba, U. Kuhlmann, CABI Bioscience Centre, Switzerland.

Problem: The cabbage root maggot is a serious pest of canola in many parts of western Canada. Various tillage and seeding practices that lessen damage have been studied because insecticides can not be effectively applied.

Objective of Research: To assess the potential for introducing European parasitoids for control of root maggots (particularly *Delia radicum*) in canola in Canada. A candidate species, *Aleochara bipustulata*, is being studied for its efficacy and associated risk.

Summary of Results: The European species, *Aleochara bipustulata*, is a promising candidate for biological control of root maggots in canola. It does not have negative effects on parasitism of its native congener, *A. bilineata*: the rate of maggot parasitism from the two species is higher than for either alone, when both species are confined with cabbage maggot puparia. Tests on non-target Diptera, using 18 species in a no-choice system, found another anthomyiid, and four species with very small puparia which were unfit for adult *A. bipustulata* emergence were attacked. Further studies on interactions with other natural enemies and on the species range of prey taken by adult *A. bipustulata* were done in 2011. We have also examined the interactions between *A. bipustulata* adults, and Canadian predators of root maggots, *A. bilineata* and the carabid *Bembidion quadrimaculatum*. Molecular markers are being used to estimate consumption of root maggots and carabid egss by *A. bipustulata* adults. Interactions between the predators are additive in the arenas, suggesting that introduction of *A. bipustulata* would add to root maggot mortality. Field cage studies of interactions are in progress. The role of organic sulphur compounds in host and prey location and host and prey acceptance by adults and larvae of *A. bilineata* and *A. bipustulata* have been studied. The compounds cause larvae of both species to be arrested, and in the case of *A. bilineata*, can elevate levels of parasitism of *D. radicum* puparia.

Title 10: Economic significance of populations of mirid bugs in beans

Authors and Associates: N.J. Holliday (neil_holliday@umanitoba.ca), Dept of Entomology, U of Manitoba

Problem: In Manitoba, insecticides are often applied to control of lygus bugs and alfalfa plant bugs in dry edible beans. Lygus bugs can reduce yield quantity and quality in dry beans. Lygus bugs can also be found in soybeans, but its not known if they cause yield losses. No thresholds are available for assisting bean producers to make economically sound decisions about the need for control of plant bugs in dry beans or soybeans in Manitoba.

Objective of Research: To develop economic injury levels for lygus bugs (and if necessary alfalfa plant bugs) on dry edible beans and to document seasonal patterns of occurrence of plant bugs on dry eddible beans and soybeans.

Summary of Results: Field surveys of dry beans and soybeans since 2008 show that three species of lygus bugs and some alfalfa plant bugs were present. *Lygus lineolaris* and *Adelphocoris lineolatus* can reproduce and develop to adulthood in both crops. Plant bug numbers were much higher in 2010 than in

previous years, and samples of beans were harvested for yield quantity and quality estimates. Laboratory and field cage studies have been performed to characterize the injury inflicted on dry edible beans by *Lygus lineolaris*, and the consequences for yield. The main effects of lygus feeding are abortion of newly-developing plant structures.
Early in the stage of seed-filling, feeding injury appears to be concentrated at the funiculus, through which nutrients flow to the seed. As seeds near maturity, the main injury is pitting of the seed coat. In our field cage studies, we have been able to demonstrate strong relationships between lygus bug densities and yield quantity, and these relate well to our laboratory findings.

STORED GRAIN RESEARCH

Title 11: Feasibility of the application of electronic nose technology to detecting insect infestation in wheat

Authors and Associates: Jun Wu[1], Digvir S. Jayas[1,*], Qiang Zhang[1], Noel D.G. White[2], Roberta K. York[3]

[1] *Department of Biosystems Engineering University of Manitoba, Winnipeg, MB, R3T 5V6*
[2] *Cereal Research Centre, Agriculture and Agri-Food Canada, Winnipeg, MB, R3T 2M9*
[3] *Consultant, 2 Briarcliff Bay, Winnipeg, MB, R3T 3H7*

Objective: To detect insects in stored wheat using an electronic nose

Summary of Results: An Alpha MOS FOX-3000 electronic nose (e-nose) equipped with 12 metal oxide semiconductor (MOS) sensors was used to evaluate the presence of insects in wheat. Samples of Canada Western Red Spring (CWRS) wheat (cv. AC Barrie) infested with rusty grain beetle (RGB), *Cryptolestes ferrugineus* (Stephens) and red flour beetle (RFB), *Tribolium castaneum* (Herbst), were placed in glass jars fitted for the collection of headspace volatiles. Different insect densities (0, 1, 2, 10 and 20 insects/kg) were tested for each insect species in combination with three moisture content levels for wheat (14%, 16% and 18% wet mass basis). The headspace volatiles from insect-infested or non-infested wheat were sampled and injected into the e-nose. The response of e-nose sensors, in the form of a multi-dimensional matrix, was extracted and interpreted using AlphaSoft V8.0 software. The automated pattern recognition algorithms in the software (Principal Component Analysis, Discriminant Factorial Analysis and Partial Least Square) were used to evaluate the samples.

The e-nose could detect the presence of RFB in wheat with the high infestation level (20 insects/kg) at 14% and 16% moisture content. However, the e-nose did not detect the presence of RGB in wheat at either the low (1 insect/kg and 2 insects/kg) or the high infestation levels (10 insects/kg and 20 insects/kg). The e-nose also failed to detect the presence of RFB in wheat with the low (1 insect/kg and 2 insects/kg) and the high infestation levels (20 insects/kg) at 18% moisture content.

Title 12: Three-dimensional spatial distribution of adults of *Cryptolestes ferrugineus* (Coleoptera: Laemophloeidae) in stored wheat under different temperatures, moisture contents and adult densities

Authors and Associates: Fuji Jian[1,2], Ron Larson[2], Digvir S. Jayas[1,*], Noel D.G. White[3]
[1] *Department of Biosystems Engineering University of Manitoba, Winnipeg, MB, R3T 5V6*
[2] *OPI Systems Inc., 1216 36th Avenue NE, Calgary, AB, T2E 6M8*
[3] *Cereal Research Centre, Agriculture and Agri-Food Canada, Winnipeg, MB, R3T 2M9*

Objective: Determine the spatial distribution of rusty grain beetle adults in bulks of stored wheat

Summary of Results: Spatial and temporal distributions of adults of *Cryptolestes ferrugineus* in stored wheat were determined in a 1.5 t bin of wheat held at 20, 25 and 30EC and 11%, 13% and 15% grain moisture contents (wet basis). The introduced insect densities were 0.1 (low), 1.0 (medium) and 10.0 (high) adults/kg wheat and the 1.5 t of wheat was sampled at 5 locations with 45 kg in a sample unit (referred to as primary unit, about 15% of the wheat was sampled). At each location, the 45 kg sample unit was separated into three 15 kg vertical layers (referred to as subunits).

Geostatistical analysis showed that: 1) insect numbers at medium or high density and in the vertical direction were better correlated than that at low insect density and in the horizontal direction, respectively; 2) this correlation decreased with increasing grain temperatures; and 3) the temporal continuous property might not exist or there was a weak temporal continuity. Aggregation was the highest at the low insect density and then decreased with the increase of insect density due to a repelling effect amongst adults at high insect density. The normal distribution model was appropriate to the description of the count frequency in 32 out of 36 sampling sets (88.9%) when 15 kg subunit data were used. In addition, adults of *C. ferrugineus* had clumped distribution of about 95% of the time and uniform dispersion about 5% of the time. This is the first research illustrating the spatial and temporal distribution of adult *C. ferrugineus* using large sample units and known insect densities.