WESTERN COMMITEE ON CROP PESTS

42ND ANNUAL MEETING

October 4th, 2002

Delta Winnipeg Hotel

Winnipeg, Manitoba

Minutes

Prepared by Ian Wise, Secretary WCCP

1.0 Welcome and Introductions

Chairperson John Gavloski, Manitoba Agriculture welcomed all members. Thirty-three members signed the attendance list.

Muhammad Ashfaq	Jon Bell	George Bonnefoy
Lorraine Braun	Jim Broatch	Gary Byrtus
James Calpas	Héctor Cárcamo	Suzanne Chalifour
Larry Charlet	Lyle DePauw	Don Dixon
Lloyd Dosdall	Brent Elliott	Martin Erlandson
Paul Fields	Ken Fry	Terry Galloway
John Gavloski	Mike Hardman	Lloyd Harris
Scott Hartley	Robert Hornford	Gord Knight
Janet Knodel	Ted Labrun	Peter Mason
Rod McLeod	Owen Olfert	Jennifer Otani
Hugh Philip	Dave Raworth	Brian Rex
Julie Soroka	Neil Wagner	Dave Wall
Ian Wise		

2.0 Additions to the agenda

Two reports added to 9.0: PMRA report by Suzanne Chalifour and ECORC update by Peter Mason.

3.0 Approval of 2001 Minutes

Motion to accept the Minutes: Philip/Otani CARRIED

4.0 Business arising from 2001 minutes

4.1 Archiving of WCCP minutes - Owen Olfert

Minutes of WCCP back to 1985 and documentation going back to 1975 are present at Saskatoon Research Station. A complete set back to 1966 under the Western Committee on Pesticides will be photocopied and a copy retained in Saskatoon. Earlier copies before 1966 were requested from members for archiving.

5.0 Appointment of Resolution Committee

Lloyd Dosdall was appointed Chairperson of Resolution Committee.

6.0 Provincial Insect Pest Summaries

See Appendix I for reports from British Columbia, Alberta, Saskatchewan, and Manitoba.

7.0 North Dakota Insect Pest Summary

Janet Knodel, North Dakota State University presented report.

The cereal leaf beetle populations were very low and it has not spread from 2 counties in the western part of the state. Cutworms (redbacked and dingy) and the wheat midge were found but in low numbers. Growers treated with Lorsban against the midge if they sprayed for fusarium head blight (scab). European corn borer populations were up this year as corn acres increased.

In canola, flea beetles were the worst problem. Adult counts in the fall were very high, and an emergency registration was obtained for Mustang. Over 70% of fields were seed treated with Helix Extra. Pheromone traps were set upon for the Bertha armyworm. Adult counts averaged about 250 per site and the flight was late. Larvae stayed in lower canopy and did not damage pods. The sunflower beetle continued to drop in numbers which started in 1999. The banded sunflower moth has become more common since spraying for the seed weevil decreased. The red sunflower seed weevil was high in the south part of the state. Lygus were identified as causing brown spot on confectionary seed. This imparts an off taste to the seed. Damaging lygus populations are <1 lygus per head. The spotted stem weevil increased in numbers in dry south areas.

The soybean aphid is now known to be in 8 eastern counties. No spraying has been done against this pest. The sugar beet maggot continues to be an annual problem. Scouting is needed to determine the severity of the alfalfa weevil.

8.0 Provincial Entomology Research Summaries

See Appendix II for reports from British Columbia, Alberta, Saskatchewan, and Manitoba.

9.0 Other Agency Reports

9.1 Canadian Food Inspection Agency Quarantine Update - Jon Bell

Updates were given on 10 serious exotic insect pests.

1)Swede midge (*Contarinia nasturtii)* - initially found in Ontario on cruciferous vegetables in 2000. Larvae damages seedlings by causing distorted auxillary bud growth.

2)Brown spruce longhorn beetle (*Tetropium fuscum*) - found in Halifax killing spruce in city park. Eradication program undertaken by cutting infested trees.

Pest has spread as far as Sackville. Numbers are dropping.

3)Cereal leaf beetle (*Oulema melanpus*) - beetle is established in eastern Canada and Creston Valley, BC. It has recently been found in the east Kootnays of BC. Hay is being allowed into BC (except Peace River) effective October 31 from infested areas of US Pacific Northwest, but hay must be consumed before March 31, 2003. Maps of distribution of beetle is available on National Agricultural Pest Information System web site.

4)European chafer - now found in New Westminster, BC. Causes severe damage to lawns by feeding on roots.

5)Hemerocallis gall midge - larvae destroys flower. Only known control is to pick off early blooms.

6)European poplar shoot borer - currently found in Washington state.

7)Emerald ash borer - found in Ontario in 2002. Attacks and kills many species of ash. Trees are girdled by larvae and produce produce many suckers before dieing.
8)Gall mite - attacks sea buckthorn. Distribution is unknown, and originally was found in Newfoundland.
9)Asian gypsy moth - not established in Canada. Egg masses are found on ships from Japan in Vancouver. Eradication programs have prevented their spread.
10)Japanese beetle - found in Halifax. Granular insecticide treatments in trap crops of new turf has reduced numbers in the past 2 years.

9.2 PMRA Report - Suzanne Chalifour

Three recent initiatives were reviewed.
1)Expanded evaluation of reduced risk products - time lines have been reduced from 18 to 15 months for new products (microbials and pheromones). EPA definition of these products is now accepted. Evaluation and acceptance of microbials and mating disruption pheromones are not slowed if products have reduced efficacy.
2)Joint review programs - time lines have been reduced through joint review of product with EPA. URMULE will also accept EPA reviews.
3) Emergency registrations - granted for strychnine (ground squirrels), coumophos (mites on bees), chlorpyrifos (wireworms in potatos), Matador (swede midge and soybean aphid). A number of URMULE's were granted.

9.3 ECORC Update - Peter Mason

Insect pests found this year in eastern Canada were reviewed. The most serious concern for western Canada is the distribution status of the pollen beetle on canola. Its furthest western distribution presently is south of Montreal. Surveys of this insect are continuing. ECORC is collaborating on the parasite program for lygus (Henri Goulet) and for markers in parasites of house flies (Bob Foottit). Approval has been given to hire an insect taxonomist.

10.0 Special Reports

10.1 Pests of stored grain - Paul Fields

A)The problem - rusty grain beetle (90% of infestations in western Canada). Other problems include mould and their mycotoxins and mites (mainly the grain mite *Acarus siro*) if grain is moist, and the red flour beetle. Both grain beetles feed on broken seed and can increase 60-70 fold per month. Six other insect pests in grain and processed products are less common.

B)The solution - three approaches:
1)Prevention - clean and treat empty bins, dispose of sweepings, maintain low humidity in bins, dry grain and aerate, and measure $C0_2$.
2)Detection - signs of infestation are the heating of grain, buildup of moisture, or mouldy smells. Insects can be detected on farm with probe of cone pitfall traps and at the elevator by sifting or use of Berlese funnels. An electronic grain probe counter is now in use in the United States.

3)Control - no control for moulds except prevention of moisture buildup. For insects, methods include cold temperatures, phosphine, $C0_2$, malathion, diatomaceous earth (DE), and impact pneumatic conveyors. Cold temperatures achieved by turning and aerating grain. Phosphine fumigation now requires licence to use. Malathion effectiveness is declining because of resistance. $C0_2$ and 2% gaseous phosphine to be registered. New DE products allow lower amounts to be added to grain, reducing problems of grade reduction and equipment wear. Parasitiods for use in processed products and pea protein in grain are being investigated. Grain storage CD-ROM is available upon request.

10.2 Pesticides and Bees - Don Dixon, Manitoba Agriculture and Food

In western Canada honey is produced from the end of June to the beginning of August (beekeepers maintain bee colonies all year). Bees typically forage up to 2 miles from hive (8038 acres). Pesticide toxicity to bees and its impact is difficult to monitor. Spraying for western equine encephalitis in early 1980's in Manitoba allowed for the monitoring of the effect of insecticide spraying on bees - mostly honey bees (some alfalfa leaf cutting bees). Toxicity higher to leaf cutting bees because more contact with treated surfaces. In caged trials, there was a strong correlation between observed application rate and mortality of honey bees. Bee poisoning symptoms include decreased numbers, dead bees at entrance to hive, decreased honey production,
increased aggression, regurgitation, unusual behaviour, and abnormal brood patterns.

Spraying a major crop, i.e. canola, in bloom will always kill bees. Damage can almost always be avoided if producer and beekeepers communicate. Manitoba Agriculture has produced a pamphlet to increase awareness of bee toxicity to producers. Pamphlets are passed out by beekeepers. Honey bee colonies are placed at research demonstration sites to make producers aware of the importance of bees in pollination and the effects bee toxicity can have on their crop productivity. Posters and newspaper ads are also run to increase awareness. Information conveyed to producers are to spray in the evening, avoid drift, and to use least toxic product. Evening sprays allow better settling of the insecticide and can provide repellent effects. Moving hives before spraying is difficult because of their weight, and confining bees to hives can result in extensive death by hyperthermia.

10.3 Grasshopper control using bran baits - Neil Wagner (peacockwagner@sasktel.net), Peacock Industries

Leaflets were handed out and are available upon request. Bran baits originated as a cost cutting measure. EcoBran, Peacock Industries formulation, was registered in 1999. A 2% (carbaryl) formulation registered in Canada and a 2% and 5% (for control of Mormon crickets) in the United States. Home and garden registration obtained in US. Application made by a shaker dispenser. In Canada, a $70 bag will treat 11-44 acres. Treating only one-half of infested area can be effective. EcoBran also allows the treatment to be made to areas surrounding the source of grasshoppers and not to the entire area. Cost is as low as 50¢/acre when application is made to egg sites. Application to fields made by blowers manufactured by Peacock Industries. Nymphs can be killed after the consumption of 1/4 of a flake. Adults require about 5-6 flakes. One pound of bait is capable of killing 200 pound of grasshoppers.

The bait is very selective to grasshoppers. There are no known mortality to birds or beneficial insects. The odor of a dead grasshopper is applied to the bran to attract grasshopper. Bran has to stay dry and be mold free to be effective. The bait can also control cutworms, armyworms, and cockroaches. A registration is being pursued as a crack and crevice treatment.

10.4 Methods of gopher control - George Bonnefoy, Manitoba Forage Council

Over 160,000 ha infested by pocket gophers in Manitoba. The northern pocket gopher is most common. The plains pocket gopher is also present and is twice as large as northern pocket gopher. Northern pocket gophers are <0.5 lb in size, bear 2-3 young per year, feed on roots exclusively underground, and are solitary. They can construct tunnels up to 600 ft in length.

Forage crops seeded on sandy soils can be destroyed by gophers in 2 years. Yield losses by gophers in alfalfa typically average 20-25%. They also reduce stand longevity, increase machine wear and breakdowns, and reduce speed of harvest. Gophers will also attack and completely destroy newly planted shelterbelts. Gophers populations have been increased because of fewer predators and increased alfalfa acreage.

Gophers are difficult to kill with bait because they feed exclusively on forage roots. Treatment with a furrow bait using the Gofer applicator allows for application at 5-6 mph at a depth of 6 in. An ARDI grant allowed for the testing of a number of methods for control of gophers. The oldest system, trapping, was found to be the most effective. However, to reduce gopher populations by trapping, co-operation amongst growers is needed.

10.5 Insects damaging sunflower seeds - Dr. Larry Charlet, USDA, Fargo, North Dakota

The banded sunflower moth is the most severe pest of confectionary sunflower seeds in North Dakota. Adults lay eggs on bracts in early July, and larvae feed on developing seeds until dropping to the soil in August. Larvae consume the entire seed contents and exit from the end of the seed. A pheromone tested in North Dakota was not effective because it was too attractive. An attractant for the female moth is being developed. Control methods include delayed planting, predator and parasites, and treating sunflowers at the R5.1 stage.

The red sunflower seed weevil lay eggs in the seed. Larvae consume about 1/3 of the seed and exit from the side of the seed. Damage is widespread throughout sunflower growing areas with most severely infested areas suffering 6-10% seed damage.

The sunflower moth can not overwinter in North Dakota and is often blown in. Adults lay eggs on heads in flower. Larvae consume up to 100 florets and 3-12 seeds. Damage is often associated with head rot. It is only an occasional pest.

Lygus bugs have recently been identified as the cause of brown spot on confectionary seed. *Lygus lineolaris* is the most common species. On confectionary seed the tolerance for brown spot is only 0.5%. A lygus survey in 2001 in North Dakota found a mean of 3.3 adults per 50 heads. Damage was found throughout all sunflower growing areas, and the only sunflower species with lygus were *Helianthus annuus.* Economic injury level studies are being evaluated. Damage to seeds occurs at all stages of head development from R5.1 to R7. Heads are being treated at R5.1. Two sprays of FMC has been the only treatment to reduce damage below the 0.5% tolerance limit.

11.0 Issues regarding WCCP Guide

Chapter authors (Appendix III) - the number of co-chair authors per chapter to be increased to a minimum of two per chapter with large chapters having as many as three. A number of changes to the chairs were made;

1)Ken Fry and Brent Elliott new chairs of Berrys

2)Bob Vernon resigned as chair of Berrys and Mushrooms

3)Bob Costello to be asked to take over as chair of Mushrooms and be co-chair of Greenhouse crops

4)Scott Hartley to be asked to take over as chair of Special Crops

5)Don Reynard to replace Bruce Neill as chair of Shelterbelts

6)John Gavloski added as co-chair of Oilseeds

Proper citation for separate chairs - issue deferred

Categories to establish for each pest - chairs to add alternate control measures, i.e biological, cultural, threshold and sampling methods, etc. for each pest where applicable

Display of actual efficacy data - issue clouded by use of biologicals which may not be as efficacious as insecticides. Compete control of pest not necessarily needed. Pest management recommendations needed for effective use of insecticide alternatives.

Deleting rates - since there is no liability associated with listing rates, providing they abide with label recommendations, this issue was left unchanged.

12.0 New Business

Motion: Hugh Philip/Ken Fry : That Dan Johnson be reimbursed $100.00 US by the WCCP for expenses in registering the WCCP web site address. CARRIED

Motion: John Gavloski/Gary Byrtus: That the mailing list of the WCCP be updated. CARRIED

13.0 Election of 2003 WCCP Executive

Chair: Hugh Philip Secretary: To be determined by Chair

14.0 Resolutions

None reported by Lloyd Dosdall

15.0 Adjournment

Hugh Philip/ Ken Fry motion to adjourn meeting at 6:20 PM. CARRIED

Appendix I - provincial insect pest summaries

BRITISH COLUMBIA MINISTRY OF AGRICULTURE , FOOD & FISHERIES 2002 INSECT PEST REPORT

Summary: BC farmers did not face many significant pest problems in 2002. The cereal leaf beetle has moved into the east Kootenays (adjacent to SW Alberta) where there is little if any cereal production. A larval parasitoid of this new pest has been released in the Creston Valley. The alfalfa weevil continues to require control in Creston Valley and Okanagan alfalfa crops. Some vineyards experienced problems with cutworms and click beetles attacking emerging buds. Four new insect pests have been reported in BC: European chafer, Viburnum leaf beetle, Hemerocallis gall midge, and Andromeda lace bug.

CEREAL CROPS

Cereal leaf beetle (*Oulema melanopus*) has been confirmed in the Regional District of East Kootenay. Local hay shippers will have to fumigate any hay destined for the Prairies or other parts of southern BC except to the adjacent Regional District of Central Kootenay where the beetle was first confirmed in 1998. The CFIA has recently announced a pilot program to allow shipment of unfumigated hay under permit from Oct. 1/02 to March 31/03 within BC (excl. Peace River region) from infested areas of BC and the US. *Tetrastichus julis*, a larval parasitoid of CLB, has been released for the first time in the Creston Valley in an attempt to introduce a biological control component to the management of this new pest. Many cereal crops in the Creston Valley are sprayed with Sevin when CLB larvae are present, based mainly I suspect on the appearance of economic injury rather than on the economic threshold.

FORAGE CROPS

Alfalfa weevil (*Hypera postica*) continues to plaque alfalfa growers in Creston valley and parts of Okanagan. In discussion with one producer, the alfalfa is cut just prior to bloom when fibre content is highest. However the lower parts of plants have not begun to senesce, leaving a food source for larvae when the crop is harvested. The larvae continue to feed on the second growth that often requires treatment. In the past the alfalfa was harvested in early bloom before significant feeding damage had occurred but after the lower plant parts had senesced, leaving no or little green tissue to sustain the larvae.

HORTICULTURAL CROPS

Codling moths (*Cydia pomonella*) exposed to reduced irradiation were released for the first time in central and north Okanagan Valley as part of the area-wide codling moth sterile insect release

program. The reduced irradiation dosage was used to improve the competitiveness of the irradiated males, however sterility drops to about 65% from the previous level of >98% (females remain 100% sterile). Increased fruit damage was reported by many growers who blamed the increase on the release of thousands of partially fertile males.

Obliquebanded Leafroller (*Choristoneura rosaceana*) , Threelined Leafroller (*Pandemis limitata*) and Eyespotted Bud Moth (*Spilonota ocellana*) - summer generation larvae caused noticeable feeding injury in many apple orchards. It is suspected gravid females moved in from nearby unmanaged host trees. Success™ (spinosad) was registered this year in time for use against OBLR on apple. Initial reports on efficacy were very favourable.

Western Cherry Fruit Fly (*Rhagoletis indifferens*) infestations caused some sweet cherry shipments to be turned back by the packinghouses. Admire™ (imidacloprid) received URMULE registration this year which was welcomed by sweet cherry growers facing restrictions on the use of conventional products due to market standards (Britain) or government regulations (Taiwan).

Cutworms (*Abagrotis* spp. to be confirmed) caused significant feeding damage to grape buds this spring. Some vineyards also had to contend with similar feeding damage due to adult click beetles, tentatively identified by Dr. Bob Vernon as the Pacific Coast wireworm (*Limonius canus*) and the Western Field wireworm (*Limonius infuscatus*).

NEW PESTS

Visit our web site http://www.agf.gov.bc.ca/cropprot/nonnativepests.htm to view the many non-native, invasive pests that threaten British Columbia's economy, including the agriculture and forest industries, and the environment.

Links are provided for more information on serious pests that have either not been detected in BC (e.g. Plum Pox Virus), or are present but not widely distributed or under official control programs (e.g. gypsy moth).

Recent introductions into BC include the European Chafer (*Rhizotrogus majalis)*, a serious pest of turf in eastern North America. In 2001 it was found for the first time in BC in New Westminster in lawns and boulevards. Unfortunately the pest arrives just as recommended lawn insecticide products such as diazinon are being withdrawn from the market.

Other new introductions include:

1) Viburnum Leaf Beetle, (*Pyrrhalta viburni*), a threat to European highbush cranberry.
2) Hemerocallis Gall Midge (*Contarinia quinquenotata*), a pest of daylily
3) Andromeda Lace Bug (*Stephanitis takeyai*), a pest of *Pieris japonica* (Japanese pieris), and perhaps rhododendron and azalea.

EXTENSION PROGRAMS

Work continues on compiling useful web sites for various commodities for inclusion in the free INFOBASKET service available online at http://infobasket.gov.bc.ca/Infoman/communities/community.asp?UserID=2&.
Field Crops and Tree Fruits will soon join Ornamentals, Special Crops, Organics, Agroforestry, etc. on the web site.

The BC Fruit Growers' Association continues to make progress in the development and implementation of a voluntary tree fruit certification program under the banner 'Growing With Care'. The Tree Fruit Production Guide will become the Integrated Fruit Production manual containing all recommended Good Agricultural Practices with which growers must comply in order for their fruit to be marketed through this certification program. World-wide produce buyers are demanding product trace back capability and/or certification similar to a recognized production protocol (e.g. EUREPGAP, IOBC). The BCFGA will be seeking a regulation similar to the BRITISH COLUMBIA CERTIFIED ORGANIC PRODUCTION OPERATION POLICIES AND MANAGEMENT STANDARDS (http://www.certifiedorganic.bc.ca/Standards/index.html) under the BC Agri-Food Food Choice and Quality Act. The purpose of the Act is to allow a person engaged in the food or agriculture industry to obtain certification that the agri-food product they produce or the practices they follow in the production and selling of agri-food products meet prescribed standards; and on the issuance of a certificate, to advertise the agri-food product as meeting the prescribed standards or being produced and sold in accordance with the prescribed standards.

ISSUES

The Canadian Food Inspection Agency (CFIA) issued a new Directive (02-09) - **Hay and Straw - Import and Domestic Movement Requirements to Prevent the Introduction and Spread of Cereal Leaf Beetle (*Oulema melanopus*)** on August 26, 2002 that required fumigation of grass hay moving from any CLB-infested areas to areas free of CLB. This directive was generated as a result of the Hay West program that involved hay shipments from Ontario (CLB-infested) to Alberta (CLB-free). Up until this time grass hay movement had not been regulated for CLB. Due to no prior consultation by the CFIA with BCMAFF or BC forage producers, dealers and buyers, there was no time to conduct a survey southern BC to establish CLB-free and infested areas, to arrange for fumigation facilities, product or licensed fumigators, or for buyers to find alternate hay sources that would not require fumigation (important to organic dairies). The additional cost of fumigation came at a time of record high forage prices due to drought-reduced forage supplies across North America. Dairymen and cow/calf operators were at risk of having no forage available for days at a time as hay dealers in the Fraser Valley and hay producers in Washington State and the Creston Valley scrambled to get hay fumigated.

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BCMAFF Home Page: http://www.gov.bc.ca/agf/
Pest Management information: http://www.agf.gov.bc.ca/cropprot/index.htm

ALBERTA INSECT PEST REPORT, 2002

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CEREAL CROPS

Grasshoppers

The 2001 grasshopper forecast map predicted severe grasshopper infestations throughout the province. The hatch was delayed due to a cool spring. Some fifth-stage immature grasshoppers were present in early September, which is unusual so late in the season.

Significant infestations developed throughout the province, especially in the south and central regions. The severe drought conditions in the east central region compounded the problem, with all accounts indicating that the drought caused the most crop damage with the grasshoppers taking what was left. Southern Alberta received exceptional moisture in spring and considerable grasshopper spraying occurred. Isolated problems reported in the Peace, primarily concerning the B.C. side.

The dominant species were the two-striped grasshopper (*Melanoplus bivittatus*) and the clear-winged grasshopper (*Camnula pellucida*). The migratory grasshopper and Packard's grasshopper, which were common in the extensive outbreaks in the 1980's occurred in very low numbers. In east-central Alberta, the clear-winged species was dominant (up to 90%) near the Castor-Coronation-Oyen areas, with the two-striped grasshopper also common.

Grasshopper counts were taken as part of summer grasshopper survey in support of the Province's grasshopper assistance program. Typical numbers in east-central Alberta, were in the range of 10 to 30 grasshoppers per square metre in roadsides to 15 to 30 per square metre in the fields.

Alberta Agriculture, Food and Rural Development's grasshopper assistance program received 947 applications with 808,490 acres claimed. The bulk of the applications came from east-central Alberta, M.D. 52 (Provost), and Special Areas 3 (Oyen).

Wheat midge (*Sitodiplosis mosellana*)

Wheat midge was not a concern in 2002. Pheromone traps placed throughout the expected range of this advancing pest (Stettler, Lacombe, Vegreville) revealed low numbers of adults. The severe drought conditions throughout these areas effectively removed the host crop. A fall soil survey is currently being organized to try to complete the picture of the 2002 wheat midge situation.

Cereal Leaf Beetle (*Oulema melanopus*)

Fields throughout southern Alberta were surveyed for the cereal leaf beetle by the Canadian Food Inspection Agency (CFIA), no infestations were reported. Considerable leaf beetle related activity occurred in association with the Hay West campaign as the CFIA ensured that all hay coming into Alberta from eastern Canada was fumigated for beetle control at the point of shipping. Alberta continues to be surrounded by this pest as it is present and active in the Creston Valley of B.C. and neighbouring U.S. states.

Wheat Stem Sawfly (*Cephus cinctus*)

Sawfly numbers were estimated to be as high as they have been over the past two years. Severe infestations were reported throughout the south, Blackie, Brooks, Medicine Hat, Lethbridge and Milk River.

The improved moisture conditions in southern Alberta allowed for better pith expression in the solid stem wheat varieties such as AC Abbey and AC Eatonia over last year. The drought in the year previous saw poor pith construction in favour of seed set, with a resulting increase of sawfly cutting in these varieties of 15%.

The effectiveness of late seeded crops escaping sawfly infestation was observed in several fields this year. Sawfly passed over a number of moisture delayed, late seeded fields in preference for earlier seeded, more mature wheat crops.

For the same reason, higher sawfly infestations were seen in winter wheat crops that were more advanced than late seeded spring wheat crops. The Alberta sawfly population is still primarily synchronized with spring wheat because of the predominance of spring wheat acreage. However, the sawfly has synchronized to winter wheat in eastern Montana where winter wheat is the predominant wheat crop. The lesson is that going to winter wheat is not a control for sawfly, although winter wheat crops will likely continue to escape sawfly damage as long as the wheat acreage continues to be dominated by spring wheat.

Wheat Head Armyworm (*Pseudaletia inipuncta*)

Minor impact this year, one report received from the Brooks area in southern Alberta.

Hessian Fly (*Mayetiola destructor*)

A few reports of damage in the Peace country with some unconfirmed reports in southern Alberta. Suspected samples cereal variety plots at Beaverlodge have been sent to the Cereal Research Centre (Winnipeg) for confirmation.

Russian Wheat Aphid (*Diuraphis noxia*)

Reports of Russian wheat aphid in northern Montana have raised the expectations that this pest might also be present in southern Alberta. Extension agronomists will continue to monitor some of the earlier seeded winter wheat crops over the next few weeks.

OILSEED CROPS

Cabbage Seedpod Weevil (*Ceutorhynchus obstrictus*)

Two years of severe drought in southern Alberta (2000 and 2001) hampered development of cabbage seedpod weevil populations. Survey results throughout central and southern Alberta determined that weevil densities in canola were lower than in previous years. However, significant infestations were still observed in many fields, especially those that flowered early and/or were grown under irrigation. A number of fields were sprayed with insecticide to reduce infestations of cabbage seedpod weevil, but the acreage sprayed was considerably less than in 1999 to 2001. In total, approximately 5,000 acres were sprayed in southern Alberta to reduce crop loss from this pest. After steadily increasing its geographical range from southern to central Alberta from 1999 to 2001, the range of the weevil appeared to diminish in central Alberta in 2002. This was undoubtedly due to severe drought conditions and this has given a chance for parasitoids to expand their range and increase their effectiveness for weevil control.

Lygus Bugs (*Lygus* spp.)

Lygus bug infestations throughout Alberta were the greatest that have been observed since the massive province-wide outbreak of 1998. Overwintering adult populations were high, and economic threshold numbers were exceeded in many fields throughout Alberta. Generally, little spraying was observed, mainly because of the drought conditions bringing low expectation for crop survival.

The central corridor from the Lacombe area to Vulcan seemed to have the highest numbers. Isolated outbreaks were reported from the Peace although numbers were generally low in most canola fields. Numbers were high in later maturing crops in and around Lethbridge with some insecticide applied.

Flea beetles (*Phyllotreta* spp.)

Spring numbers were low and beetles were late to emerge due to the cool spring. Numbers increased to high levels in late summer, most reports coming from southern Alberta, south of the number one highway. High late season populations were also reported from the Peace. The high late season flea beetle numbers raise concern for next year's crop.

Peace country reports of feeding damage in fields treated with insecticide seed treatment however no foliar insecticide treatments were required. Some flea beetle spray went down on *B. juncea* (brown/oriental mustard) in the South.

Red-backed Cutworm (*Euxoa ochrogaster*)

A severe outbreak of redbacked cutworm occurred throughout Alberta in 2002. The outbreak was associated with population densities of cutworm larvae that exceeded 50 per square meter in many locations. The highest numbers were reported from the Camrose area with the areas hardest hit ranging from Edmonton to Ponoka. Some damage reports from the south, the moist conditions helping to minimize the damage.

Although the red-backed cutworm was the primary species, the pale western cutworm (*Agrotis orthogonia*) and army cutworm (*Euxoa auxiliaries*) also reached high numbers in some fields.

Most of the insecticide applied to control the outbreak comprised chlorpyrifos, but substantial quantities of deltamethrin and cyhalothrin-lambda were also applied. A wide range in developmental stages of larval cutworms occurred, causing the outbreak to extend over quite a lengthy period. The cutworm outbreak affected primarily canola crops.

There were some observations indicating that cutworm damage was less in fields seeded with carry-over lindane treated seed.

Bertha armyworm (*Mamestra configurata*)

Larval numbers generally low throughout the province, no reports of control being required. Pheromone traps indicating adult population spikes in the Lacombe area, with the cumulative numbers just exceeding the 300 mark. This still represented a relatively low Bertha risk.

Diamondback moth (*Plutella xylostella*)

Low numbers reported throughout the province, no control was necessary

Red Turnip Beetle (*Entomoscelis americana*)

Isolated problems reported around Beaverlodge in the Peace region. Control was required.

Beet Webworm (*Loxostege sticticalis*)

One damaging report of this pest was received from the Bodo (Provost) area.

Root Maggots (*Delia* spp.)

No reports of damage. This was consistent with expectations of minimal root maggot activity due to the severe drought throughout most of the province.

FORAGE CROPS

Alfalfa plant bugs (*Adelphocoris lineolatus*)

Reports of spraying for control coming only from alfalfa seed fields around Falher in the Peace region.

POTATO

Colorado potato beetle (*Leptinotarsa decemlineata*)

Numbers were up over last year in fields across the province. Fields in which phorate (in-furrow) was not used at planting generally saw higher numbers than fields that were treated with phorate. Beetle populations were noticed approximately two weeks earlier than in previous years. Insecticide sprays were required with endosulfan and permethrin primarily used.

Aphids (primarily *Myzus persicae*)

Populations began to build in potato fields once canola fields were swathed. It was not known if *Myzus persicae* was vectoring potato leaf roll virus (PLRV).

GREENHOUSE VEGETABLE CROPS

Nothing out of the ordinary, no new pest species were reported in greenhouse crops in Alberta. The main greenhouse pests are: greenhouse whitefly (*Trialeurodes vaporariorum*), western flower thrips (*Frankliniella occidentalis*), two-spotted spider mite (*Tetranychus urticae*) and aphids (*Myzus persicae*)

FIELD VEGETABLE CROPS

Greenhouse whitefly was reported to be attacking field vegetable crops in southern Alberta. This remains to be substantiated.

BUSH FRUIT CROPS

Grasshoppers were again feeding on saskatoon berry fruit this year. The currant fruit fly, *Epochra canadensis*, attacked commercial black currant orchards severely in central Alberta. Spider mites were also a big problem in some black currant cultivars, especially Tirran.

CONTRIBUTORS

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2002 Saskatchewan Insect Report
Western Committee on Crop Pests

Summary

The months leading into the 2002 growing season, March, April and May, were the coldest / coolest in over 100 years of data collected by Environment Canada. This resulted in slow development for both crops and insect pests. Early season pests included flea beetles that devastated canola seedlings that were not treated with seed treatments containing insecticides. Wireworms were an issue in canola, chickpea, sunflowers and cereal crops. Extremely dry conditions in the southwest and west central regions of the province resulted in less canola being seeded in these areas and therefore the "trap-line" for the bertha armyworm monitoring system was reduced and some mustard fields were used for trap placement. Bertha armyworm populations continued to increase in 2002 with a few high risk areas identified near Regina and in the southeast. As temperatures started to reach more normal to above average temperatures by the middle of June grasshoppers became more of an issue and infestations plagued producers for the remainder of the growing season resulting in economic infestations in later stages of most crops. Wheat midge were not observed in economic levels in most of the province so spraying for this pest was insignificant compared to most other years. Wheat stem sawfly was and will continue to be a major concern to wheat growers populations continue to increase across the south and central regions of the province with most areas within the sawfly range reporting serious cutting across full fields.

Cereal Insects:

Orthoptera: grasshoppers – As in the past few years the 2002 grasshopper forecast indicated increasing grasshopper populations in the province with the highest numbers to be in the west central and especially the southwest regions of the province. Favourable environmental conditions in 2001 contributed to successful grasshopper development leading into 2002 and this appears likely to continue into 2003. Preliminary data from the fall 2002 survey suggests a general increase over most of the province.

Estimates of populations in the southwest from the 2002 forecast included very severe regions nearest the U.S. border north toward Shaunavon and Gravelbourg. In June the southern part of the province, generally south of the South Saskatchewan River, had more precipitation and had given crops, pasture and rangeland a bit of an advantage in out-growing grasshopper feeding. Heavy rains in some of the regions that had been forecast to have the most severe infestations reduced the risk for a period of time. However, the cool conditions had resulted in a limited hatch by early June and continued hot, dry conditions were very good for grasshopper development throughout Saskatchewan. By mid-July there was an increase in reports from most

areas with severe infestations in most crops and pasture, including crops such as peas and canaryseed that are not normally preferred by grasshoppers. Where rangeland or pasture is depleted of green growth, grasshoppers moved into annual crops.

In the west central and northwest, poor crop stands meant producers had to make difficult decisions with respect to control of insect populations. In many cases it appeared that grasshopper control was not economically viable and producers had to consider Crop Insurance as a more or only economically viable option.

In some areas in the east central and northeast where grasshoppers are not a problem in most years, grasshopper infestations were at low to moderate levels with control measures required to a lesser degree. Control of field margins was often sufficient.

Humid conditions in the south resulted in fungal diseases affecting the grasshoppers in August but generally it was too late in the year to be of much assistance to producers for 2002.

There was considerable concern for producers fall seeding crops with the late infestations of grasshoppers. Due to continued feeding the thought was that as the crops emerged they would be the greenest food source and would be most susceptible to grasshopper feeding. Bran baits were recommended as reasonably economical and would provide some residual control.

Later in the season some producers in the extremely dry areas were considering grasshopper control, not as crop protection as this was not economically viable, but to protect the soil by maintaining some plant cover to prevent erosion.

Organic producers are probably most at risk from grasshopper infestations as there are no control options for outbreak situations. Some organic producers are attempting to get a biological control product (*Nosema locustae* Canning) registered in Canada for grasshopper control.

There were no plans to implement a program with financial assistance for Saskatchewan producers to control grasshoppers, similar to the programs implemented in this province in the late 1980's when infestations were more severe.

Wherever possible, producers are provided with economic or risk thresholds to assist in control decisions. In many cases the information is not available and many of the currently recommended thresholds are static and do not cover all scenarios such as variations in cost of application and fluctuations in commodity prices. In attempt to provide some guidelines for producers, a number of threshold values for grasshopper infestations were suggested.

As a result of the late season feeding, there were a number of questions regarding the effect of grasshopper chewing on the flag leaf. There are no established economic thresholds for this stage of growth but since the flag leaf is one of the last remaining green parts of the plant it is responsible for a significant amount of the filling of the head. The flag leaf and the leaf below may account for as much as 80% of the filling. Therefore if this is the part of the plant being attacked, the lower end of the economic threshold should be used. (i.e. if the cereals range is 7 - 12 hoppers /sq. m., 7 hoppers would be a more relevant ET if the flag leaf is being affected). There were numerous reports of fields completely stripped of green leaves with only the head remaining.

General Grasshopper Control Considerations: (This was put together in consultation with A.A.F.C. (Lethbridge and Saskatoon) to address economic thresholds for grasshoppers in a variety of situations. Some are based on research and others are educated guesses to provide guidelines for control decisions, especially where information is lacking.)

Economic thresholds will depend on crop but the densities of grasshoppers (or insects in general) listed as economic or risk thresholds should be considered as a gauge rather than as exact. Later instars, generally the 3rd to 5th immature stages are responsible for the most severe damage. These stages are more mobile and are capable of consuming more plant material.

Use 8 to 13 grasshoppers per square metre as a guideline for considering control in cereals. Dr. Dan Johnson of Lethbridge Research Centre (AAFC) has provided some additional comments based on his years of experience with this insect pest. This (8 - 13) range fits best for cereals during June and July. However earlier in the season, when grasshoppers are small 18 hoppers per square metre and visible crop damage may be more appropriate. Small grasshoppers do not consume as much plant material as older hoppers and vigorously growing plants can outgrow a fair amount of hopper feeding. Conversely, stressed plants in dry warm conditions will be more significantly affected by lower levels of infestation.

Late in the season when the grasshoppers are large, only 8 hoppers per square metre, with visible damage may require control. Later in the season, grasshoppers can feed on the flag leaf (responsible for most of the head filling), kernels and even clip heads. The lower estimated economic threshold reflects the fact that at this point the grasshoppers can have a more direct affect on the yield. Insecticide options are reduced later in the year because of the various pre-harvest intervals associated with the insecticides.

Canola is not a preferred host crop for grasshoppers but young canola plants have been severely damaged by migratory, two-striped and clear-winged grasshoppers. Greater than 15 grasshoppers per square metre have caused significant damage. This will depend on the stage of

the plant and thickness of the stand. Generally grasshopper infestations and therefore, control measures will be largely confined to field edges in canola.

Oats is not a preferred crop for grasshoppers and tends to reduce their egg-laying (biotic) potential. However if there is a lack of food choices and the weather is hot and dry oats will suffer significant damage.

Controlling field margins will often be adequate in field crops, especially in lentil and canola. This will reduce costs as compared to full field insecticide applications and will also reduce negative impacts on beneficial insects in the field.

Controlling grasshoppers in hay has not been considered to be economically viable in most years. However dry conditions have reduced pasture growth as well as forage reserves. Therefore hay, including annual crops to be used as greenfeed have gained in value. A rough estimate for an economic threshold for grasshoppers in crops to be used as greenfeed has been suggested at 20 grasshoppers per square metre or higher. Insecticides used for this purpose must be registered for the specific crop. Preharvest intervals become very important to consider in the case of feed since there is generally a shorter time before animal consumption than harvesting of grain.

Hymenoptera: *Cephus cinctus* Norton – Wheat stem sawfly – Serious sawfly problems continue to increase in the central and southern regions of the province. A sawfly factsheet was published with the combined efforts of the western provinces and a researcher in Montana (USDA). There was a technician from Montana conducting a survey of adult sawfly in Saskatchewan and Alberta in July and hopefully we will get some valuable information from this project. A Saskatchewan survey for sawfly is being considered as a possible strategy for assisting in management of this pest. As there are no insecticide options for control of this pest, management of sawfly populations is solely based on non-chemical strategies. There was a report of a producer in the southwest who felt he had reduced problems with sawfly as a result of insecticides applied for grasshopper control. This was not based on any accepted scientific methods but is not altogether unlikely as there was a lot of insecticide application for grasshoppers in 2002.

Coleoptera: Chrysomelidae - *Oulema melanopus* (Linnaeus) – cereal leaf beetle – The Canadian Food Inspection Agency has been surveying for this beetle across the prairies for the past few years. The presence of the cereal leaf beetle has not been determined in Saskatchewan. The potential presence of the beetle in hay shipments from Ontario this past summer delayed movement of the hay until it was fumigated.

Diptera: *Sitodiplosis mosellana* (Gehin) - wheat midge – By mid-July it was apparent that a lot of wheat would escape midge damage either by heading out too late or by growing through the susceptible stage prior to midge emergence. There was very little spraying for wheat midge in 2002.

The wheat midge forecast map for 2002 indicated populations of this insect continue to be low for most regions of Saskatchewan. Over the past few years the wheat midge forecast maps have shown significant reductions in wheat midge densities. Except for a few isolated pockets of higher infestations, the 2002 forecast suggested an even more dramatic decline in population levels. As a result, the infestation level of greater than 1800 cocoons per square metre has been removed from the map for this year and the areas suggesting no infestation have increased.

The highest populations were identified in traditional wheat midge areas on the eastern side of the province near the Saskatchewan - Manitoba border. The highest risk areas appear to be east of Yorkton and Melville and just south of the Qu'Appelle valley. Some pockets of greater than 600 to 1200 midge per square metre were found in the southeast between Regina and Estevan and in the northwest near North Battleford. Perhaps most notable for 2002 are the areas suggesting no infestation of the wheat midge. The west side of the province, relatively new to economic midge population levels, had regions that had no cocoons found during the fall survey and therefore appears to have returned to no infestation. In the northeast there is another area showing no infestation. This is the first time such low levels have been identified for this region since the midge became established in Saskatchewan in the mid-1980's.

Other information that producers may need to consider includes the affect on tillers within the crop. In most field situations there will be varying degrees of tillering. Recommendation for increased seeding rates is meant to address this issue and will provide a more uniform stage throughout the crop. Variations in wheat stages within a field present a problem deciding whether the crop would be considered to be susceptible to midge damage. In response to inquiries about the value of tillers as yield components in a wheat crop, Saskatoon Research Centre provided assistance in this area. Research at AAFC (Saskatoon) on Katepwa seeded at 1.5 bushels per acre provides **estimates** as to the value of tillers with respect to yield. Two soil types indicated some variation in yield components for tillers. Results suggest:

Light texture – Main stem – 41%
1st tiller – 41%
2nd tiller – 18%

Heavy texture – Main stem – 45%
1st tiller – 36%
2nd tiller - 18%

Although this is not comprehensive for all wheat varieties and soil types it does provide a gauge with which to measure the value of tillers. The trend indicates that the most important yield components of the wheat plant will be in the main stem and first two tillers.

Oilseed insects

Coleoptera: Chrysomelidae: Alticinae – Crucifer flea beetle – *Phyllotreta cruciferae* (Goeze) –

Flea beetles were problematic across the province in varying levels of infestation. Due to the withdrawal of the lindane based canola seed treatments from the market in July 2001, producers had to consider more expensive insecticide seed treatment alternatives or rely on a foliar spray if flea beetle control was required in 2002. Although the use of seed treated with lindane was allowed for 2002, the uncertainty of the marketability of the end product contributed to a reduction in canola acreage protected with both fungicide and insecticide components.

Mustard is not usually considered to be as greatly affected by flea beetle feeding, however in 2002 there were a number of reports of mustard crops being devastated by the beetles.

A site east of Saskatoon reported the loss of most of a field of canola that was treated with Foundation Lite (i.e. no insecticide component). Some adjacent plots treated with Helix were fine. There was some confusion as no plant tissue remained above, only "pinched-off stubs" of the seedlings were found below the soil surface. Also no flea beetles were found. Probably the best explanation is a combination of factors. High flea beetle feeding pressure would not be required to have a significant effect on a stressed crop and the fact that the seedlings treated with an insecticide were OK suggests that there was a population of the beetles in the field. However, in absence of food the beetles will have moved on. After the flea beetle feeding damaged the seedlings, desiccation and high winds may have played a role in clearing the field. This emphasizes the importance of regular monitoring for insects and insect damage. However in this case a foliar spray would have been required and the high winds would certainly have limited the opportunities for spraying. Since flea beetles like warm/hot temperatures they are more active in the day and therefore control would also be optimum during the warmer daytime periods. This means effective control of the beetles would have been limited at best. Another consideration is how fast the damage is occurring. Dr. Julie Soroka (AAFC, S'toon) reported that in some of their research plots, emergence of plants was noted one day and the next day there was nothing showing at all, as a result of the feeding and other factors as stated above.

By early August there were already reports of flea beetles in high numbers on podded canola. There are no established economic thresholds for flea beetles attacking canola at this stage although significant damage has been noted in the past. The result of pod feeding may be premature shattering or by opening another entrance for disease, affecting quality or grade. There have been suggestions of 3 to 5 beetles per pod - if damage is observed - but again this is

not supported by research. Malathion was recommended for flea beetles on podded canola due to the short pre harvest interval.

Lepidoptera: Plutellidae – Diamondback moth – *Plutella xylostella* (Linnaeus) – Unlike 2001, Diamondback moths were insignificant in Saskatchewan in 2002. Although there were diamondback moths collected in low numbers fairly early in the season, cruciferous weeds were the main food source available since the seeded crops were so slow to emerge.

Noctuidae – Hadeninae – *Mamestra configurata* Walker - Bertha armyworm – Due to the cool spring the pheromone "trap-line" was set up about mid-June with very few moths collected in June. Male moths counts increased rapidly as temperatures increased in some areas and still peaked in numbers around mid-July. After the slow start there were a few notable areas - RM's 220 , 250, northwest of Regina and eventually to the southest of Regina where chemical control was required in some fields. There was a record of in excess of 1000 moths reported in a site south of Indian Head in one week.

Noctuidae – cutworms - In early June cutworm infestations were noted in many areas of the province including Moosomin, Carnduff, Redvers, Regina, Moose Jaw and Nipawin. Most of the problems were in canola crops. The dry conditions were favourable to the increase and general success in development of these insects. Control options are listed by crop in the Guide to Crop Protection 2002. Chlorpyrifos (Lorsban, Nufos, Pyrinex) products and Pounce are the most common options for control, although other products may be registered, depending on the crop. Higher water volumes are recommended. With chlorpyrifos products, under dry conditions, light harrowing may increase efficacy. However, with Pounce the soil is to be left undisturbed for 5 days after treatment. It is recommended that insecticide applications should be made in the evening. However, if temperatures are likely to exceed 25 degrees Celsius, Pounce or other synthetic pyrethroids should not be used.

Coleoptera: Elateridae – wireworms - Wireworms were reported (in significant numbers in some areas - notably canola east of Saskatoon) on chickpea, sunflowers (RM31) and canola. Gustafson has suggested that Gaucho acts more as a repellent for wireworms and does not result in reduced wireworm populations. Lindane based seed treatments are more effective in reducing wireworm numbers. Syngenta suggests that Helix does reduce wireworm populations.

Coleoptera: Curculionidae – Ceutorhynchinae – *Ceutorhyncus obstrictus* – cabbage seedpod weevil –Surveying for the weevil continues in Saskatchewan, coordinated by AAFC, Saskatoon. The survey was reduced due to reduced canola acreage in the west central and southwest. Populations are still small and the results of the survey are incomplete at the time of this report but it would appear that the weevil has reached the main canola growing region, in the Lloydminster area. Monitoring for this pest will continue in 2003.

Pulse and Specialty Crop Insects

Orthoptera: grasshoppers – Grasshoppers continue to be a problem in lentil production, largely due to the relatively low economic threshold compared to cereal crops. As reported in previous years there are also reports of grasshopper feeding on chickpea. Insects have not been considered to be a problem in chickpea due to the secretion of malic acid that tends to make the plant less attractive to insects. However, as with lentil, although grasshoppers tend to not feed on the foliage of the plant, they appear to do significant damage to developing pods. Research is still required in this area.

Due to the high populations of grasshoppers, problems with increased dockage in peas were reported as a result of grasshopper body parts contaminating the harvested product.

There was a lentil shipment turned back to Canada in late 2001 as a result of excess residues of chlorpyrifos. Details were unobtainable as to exact origin of the harvested lentil and what was the reason for the excess – i.e. too high of rate of chlorpyrifos used, too many applications or applied within the pre-harvest interval or simply due to trade related issues.

Other **pulse crop** insects noted in 2002 –

Lepidoptera: - *Loxostege sticticalis* (Linnaeus) – beet webworm – An economic infestation of beet webworms was reported in peas in theTisdale area.

Coleoptera: Elateridae – wireworms – Wireworms were a significant problem in chickpea, in isolated areas and use of seed treatments containing insecticides may become an important decision in future years.

Other Specialty crop insects of note in 2002 –

Homoptera: - Aphids (various species but largely bird cherry oat, *Rhopalisiphum padi* (L.) and English grain, *Sitobion avenae* (Fabricus)) were at economic levels in **canaryseed**, in some regions. These insects tend to be a significant pest annually

Forage crop insects

Coleoptera: Curculionidae – Hyperinae – *Hypera postica* (Gyllenhal) - alfalfa weevil – The alfalfa weevil was not as significant in 2002 as it has been for the past few years however weevils are still a problem in eastern Saskatchewan.

Other forage insects - The **sweet clover casebearer (*Coleophora trifolii*) (Lepidoptera)** caused economic damaging to seed production in sweet clover again in 2002.

Future Considerations and Concerns

Absence of the Tri-Provincial monitoring group – AAFC, Saskatoon's assistance has been greatly appreciated in 2002

Management of wheat stem sawfly over most of the wheat growing areas of Saskatchewan

Possibility of new insect pests – cereal leaf beetle and swede midge *Contarinia nastutii* (Kieffer)

Insect control options in "newer" crops in Saskatchewan – e.g. chickpea

Stored grain insect control with tighter restrictions on purchase and application of fumigants.

West Nile Virus and the mosquito vectors

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Manitoba Agriculture and Food
2002 Insect Pest Report
to the
Western Committee on Crop Pests
October 4, 2002 Winnipeg, Manitoba

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Summary: Early season insect problems in canola in Manitoba included flea beetles, cutworms, and wireworms. Later in the season, lygus bugs had to be controlled in some canola fields. A lot of sunflower fields in Manitoba were sprayed to control seedhead insects, although proper scouting techniques and economic thresholds were not always used. Grasshoppers were the biggest problem in cereal crops in 2002 in Manitoba. Soybean aphid is now found on soybeans throughout most of the soybean growing area of Manitoba. Aphids were a problem in many canaryseed fields. At least 100 horses in Manitoba died from West Nile Virus, which is vectored by mosquitoes, in 2002.

CANOLA

Flea beetles (*Phyllotreta* spp.): Flea beetle feeding on canola was heavy across Manitoba in May and June. Some canola fields had to be reseeded because of flea beetle feeding. Foliar spraying of flea beetles was necessary in some fields; in some fields only the edges were sprayed, while in other instances the whole field was sprayed. Because of the slow development of canola this year, canola plants remained in the susceptible stages (below the 3 to 4 leaf stage) for quite long periods of time in some fields. Some fields had the edges sprayed multiple times for flea beetles. There were some instances of canola fields that had a seed treatment containing an insecticide (Helix) still needing to be sprayed with a foliar insecticide to control flea beetles. Some flea beetle feeding on the buds of canola was reported. Flea beetle populations were also high in canola in late summer, and at least 1 field was sprayed to control late summer flea beetles.

Cutworms: Cutworms had to be controlled on canola in the southwest, northwest, and central regions. Some reseeding of canola due to cutworm damage was necessary in the Dauphin and Somerset areas.

Wireworms: A canola field in the southwest of Manitoba had to be reseeded because of wireworm damage.

Lygus bugs: Lygus bugs had to be controlled on canola in the Swan River, Somerset, Beausejour, and Niverville areas.

Bertha Armyworm (*Mamestra configurata*): In spite of the high levels of bertha armyworm adults in pheromone traps in some areas of Manitoba, populations of larvae were not high enough to warrant control. Over 1200 bertha armyworm moths in the pheromone baited traps over a 6-week monitoring period is considered a high risk of bertha armyworm larvae infesting a field. After 5 weeks of trapping, a trap near Waskada had captured 1441 bertha armyworm adults, and a trap near Melita had captured 1339 adults. After 7 weeks of trapping, a trap near Russell had 1204 bertha armyworm adults.

SUNFLOWERS

Banded Sunflower Moth (*Cochylis hospes*): Some banded sunflower moth larvae were found, although not in high numbers. However, many of the fields of confection sunflowers in Manitoba were sprayed to control banded sunflower moth. Much of this spraying was the result of processors of confection sunflower seeds sending letters to growers indicating that they should be spraying for seedhead insects.

Wireworms: Some sunflower fields in the southwest and central regions of Manitoba were damaged by wireworms to the point where reseeding was necessary. There are currently no registered insecticides for wireworms in sunflowers.

Sunflower Bud Moth (*Suleima helianthana*): Damage by sunflower bud moth was quite noticeable in many sunflower fields this year. Some confused this with stem weevil. There is at least 1 incident in the province where insecticides were applied to try to control sunflower bud moth, but it is not likely that this was effective or economical.

Grasshoppers: Some grasshopper control was necessary in sunflowers in the Portage La Prairie area.

Sunflower maggot (*Neotephritis finalis*): Sunflower maggot pupae were abundant on many sunflower heads at the same time that sunflower fields were being scouted for insects that can cause damage to the seeds. Many were concerned that they were one of the insects that will cause seeds to be downgraded because of insect damage.

CEREAL CROPS

Grasshoppers: Grasshoppers had to be controlled in some cereal fields. Some grasshopper control was necessary in September in fall rye which was being established in the southwest region.

Wheat midge (*Sitodiplosis mosellana*): Populations of wheat midge were high in some areas of the southwest, although I am not aware of any spraying for wheat midge having occurred this year.

Thrips: Thrips were quite noticeable on wheat in June in the southwest and central regions of Manitoba, with heavy thrips damage to wheat being reported in the Gladstone area.

CANARYSEED

Aphids: Many canaryseed fields in central and eastern Manitoba were sprayed with insecticides to control aphids.

FLAX

Grasshoppers: Some flax fields were sprayed to control grasshoppers. Grasshopper feeding on flax bolls was reported.

Cutworms: Cutworm damage to flax was heavy in some areas.

DRY BEANS

Seedcorn maggot (*Delia platura*): Some dry bean growers used dual purpose seed treatments to control seedcorn maggot and other early season pests of dry beans.

Cutworms: Some bean fields were treated for cutworms.

Grasshoppers: Some dry beans were sprayed to control grasshoppers near Elm Creek.

Lygus Bugs: Insecticides were applied to control lygus bugs in some dry bean fields. There is still a lot of uncertainty regarding what levels of lygus bugs are economical to control in dry beans. Alfalfa plant bugs were found in some of the dry bean fields as well, and there is still confusion over whether to group them with lygus bugs when determining economic thresholds, since no research has been done on what feeding, if any, alfalfa plant bugs are doing on dry beans.

PEAS

Aphids: Insecticides were used to control aphids in some pea fields.

SOYBEANS

Grasshoppers: Some grasshopper control was necessary in soybeans in the Portage La Prairie area. There are currently no insecticides registered for grasshopper control in soybeans in Canada.

Soybean Aphid (*Aphis glycines*): Soybean aphid was found on soybeans throughout most of the soybean growing area of Manitoba. Control was not necessary in any fields. This is the second year that soybean aphid has been found in Manitoba. There are currently no insecticides registered for control of soybean aphid in Canada, although Ontario has submitted a minor use for matador for soybean aphids for all of Canada.

FORAGES AND FORAGE SEED

Plant Bugs: Many alfalfa seed fields were sprayed with insecticides to control plant bugs (lygus bugs and alfalfa plant bugs).

Grasshoppers: Some pastures and hayfields were treated to prevent damage by grasshoppers.

Alfalfa Weevil: Alfalfa weevil damage was noticeable near Somerset. Early cutting of hay provided adequate control.

POTATOES

Colorado Potato Beetle *(Leptinotarsa decemlineata*): Most growers applied two or three insecticide applications (two early season, one late) for control of Colorado potato beetles. Acreage treated with in-furrow Admire increased substantially. A small survey indicated widespread resistance to older chemistries, though which family was variable by location (and farm history)

Aphids: Green peach aphid monitoring program continued. Seed fields were sprayed twice each. Processing fields were sprayed once each and possibly twice, depending on local aphid populations.

Wireworms: Complaints were minimal, though more damage will be determined as shipments arrive at processors. There is a great deal of concern over the loss of Thimet and no replacement product.

BUCKWHEAT

Lygus bugs: Some buckwheat in the central region of Manitoba was treated with insecticides to control lygus bugs. Whether lygus bugs damage buckwheat and what an economic threshold should be are still uncertain.

LIVESTOCK

Mosquitoes: At least 100 horses in Manitoba died from West Nile Virus in 2002, and at least 500 horses were infected with the virus. The southwest part of Manitoba was the hardest hit by West Nile Virus this year since this is where the most horses are. A vaccination program for horses to build immunity to West Nile Virus has been established. *Culex tarsalis* is the main mosquito being looked at as a vector of the disease, although other mosquito species are also involved. Aside from horses, a commercial goose flock near Winkler was infected and about 1,000 out of 3,000 geese died. There were also deaths in a research flock of mallard ducks at Delta Marsh (on the south shore of Lake Manitoba) because of West Nile Virus. Deaths due to West Nile Virus in these animals may be less next year since immunity would have been built up in many animals this year.

BENEFICIAL INSECTS

Leafy Spurge Hawkmoth (*Hyles euphorbiae*): Larvae of the leafy spurge hawkmoth were frequently observed eating leafy spurge. Reports of it this year have come from as far north in Manitoba as Binscarth (near Russell). The only known release of this insect in Manitoba occurred near Morden in 1985.

ISSUES

Lack of control options:

There are several examples of specific insects damaging crops this year and insecticides being used to control them, but no insecticides being registered for those particular situations. In one particular case the spraying was very widespread. Some of these examples include:

Sunflowers – Banded sunflower moth, wireworms, grasshoppers
Soybeans - Grasshoppers

In each of these cases insecticides are registered in neighbouring states for the control of these insects on these crops.

Also note that there are no insecticides currently registered for the control of soybean aphid. Should we have an outbreak such as Ontario did in 2001, there would be widespread spraying for aphids in soybeans, but no insecticide with a registration for this purpose.

Research Needs: Research on the following topics are needed:

1) Economic threshold for lygus bugs in dry beans.
2) Will alfalfa plant bug damage dry beans or canola, and if so are they counted when doing threshold counts.

FUTURE PLANS

Monitoring Banded Sunflower Moth: A small-scale program to determine when adult banded sunflower moths are emerging, and in what numbers, will be established.

Cereal Leaf Beetle (*Oulema melanopus*): Monitoring for cereal leaf beetle was performed again in 2002 in the southern part of the province. No evidence of cereal leaf beetle being in Manitoba was found. This monitoring program will continue in 2003.

Appendix II - Provincial research progress reports

RESEARCH PROGRESS ON INTEGRATED PEST MANAGEMENT IN BRITISH COLUMBIA - 2002

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Agriculture and Agri-Food Canada, PARC, Summerland:
2002 Insect Pest Research Report

Title 1: Orchard leafroller parasitoids

Author: Joan Cossentine

Summary: Four leafroller species are found as common secondary pests of apples in British Columbian orchards. A large complex of indigenous parasitoids have been found in leafroller populations in organically managed orchards. Six key parasitoid species of the obliquebanded leafroller have been colonized in the laboratory and are being evaluated as potential candidates for introduction and/or augmentation. Biological assessment of one of the ichneumonid species is essentially finished and has found the species to parasitize hosts in their earliest instars as well as host feed. A single female has the potential to parasitize over 200 hosts in a lifetime and the parasitized host=s potential to feed is reduced in it=s last instar. This research will be continued and field releases carried out and evaluated.

Title 2: Biological control of cherry bark tortrix

Author: Joan Cossentine

Collaborators:
CABI Bioscience Centre: Ulrich Kuhlmann
Washington State University: Lynell Tanigoshi; Oregon Department of Agriculture: Barry Bai,

Summary: The cherry bark tortrix is an introduced exotic pest that poses a threat to nursery and orchard industries as well as to the natural landscape plants in North America. The species is native to the Palaeartic regions of Europe, Siberia and possibly central Asia. It was first found infesting cherry in the lower mainland in British Columbia in 1989 and Washington State in 1991. The infestation is spreading as adults were found for the first time in Oregon and in the

interior of British Columbia in 2000. High parasitism rates, combined with a low pest status of the species in Europe, initiated a study of the natural enemies of the cherry bark tortrix by the team in 2000. Only two percent parasitism of the host has been found in surveys in Washington State and BritishColumbia. Study was continued in 2002 by a Canadian graduate student at the CABI laboratory in Switzerland on the biology of a key cherry bark tortrix parasitoid. 2002 pheromone surveys in British Columbia found adult cherry bark tortrix approximately 15 kilometers south of it=s previous record in the Shuswap. Indigenous parasitism and host range of the pest was continued in British Columbia. An entomopathogen was found associated with cherry bark tortrix in Vancouver and Victoria.

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Agriculture and Agri-Food Canada, PARC, Agassiz:
2002 Insect Pest Research Report

Title 1: Blueberry Scorch Virus in the Fraser Valley, BC: year 2.

Collaborators:
AAFC, PARC, BC: David Raworth, Chris French, Tom Lowery;
BCMAFF, BC: Andrea Buonassisi, Leslie MacDonald, Lisa Wegener, Bob Costello, Mark Sweeney;
USDA/ARS, OR: Bob Martin
WSU Puyallup Research and Extension Center, WA: Pete Bristow
Rutgers University, NJ: Peter Oudemans

Technical staff: Mairi Robertson, Riann Batch, Mike Bernardy

Problem: The BCMAFF first found Blueberry Scorch Virus in 20 fields in the Fraser Valley, BC during the summer 2000. It has now been recorded in 76 fields, and according to BCMAFF data, symptom expression suggests that most occurrences are the New Jersey strain of the virus. The New Jersey strain affects all cultivars except Jersey. Infection leads progressively to significant yield reduction during a 4-5 year period. Aphids vector the virus.

Objective of Research: To determine: what aphid species vector the virus; the probability of transmission in the field; and the seasonality of transmission. Given this information and the life-history of the vectors, to develop an aphid and virus management strategy.

Summary of Results: Water pan trap data, leaf samples, and trap plant data during 2 years have been used to develop a list of aphid species that should be studied for ability to transmit the virus. The list includes *Euceraphis betulae*, and *Rhopalosiphum padi*. The data have also been used to develop a control strategy for *Ericaphis fimbriata*, the dominant resident aphid, and a known vector of the virus. The

control strategy will be tested in 2003. PARC B Summerland is assessing different aphid species for efficiency of virus transmission; testing trap plants for virus; and determining alternate hosts for the virus.

Continuing Research: The work will continue for at least one more year.

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Title 2: Development of *Metarhizium anisopliae* as a biological control for wireworms

Author and Associates: Todd Kabaluk (AAFC; Pacific Agri-Food Research Centre, Agassiz), Mark Goettel (AAFC; Lethbridge Research Centre), Gary Bullard (BioCare Technology Ltd, Australia), Bob Vernon (AAFC; Pacific Agri-Food Research Centre, Agassiz).

Problem: Wireworms are a primary pest of several agricultural crops throughout the world, and nationally in potato and root crops, grain crops, and strawberry. In potato, chemical controls are nearly non-existent in BC due to their withdrawal from the market. Furthermore, previous chemical controls have been linked to poisonings of waterfowl and raptor species. This has likely been heightened by cover cropping, a practice that conserves soil and provides food to waterfowl, but also provides food for wireworms and egg laying sites for the adult stage (click beetles), thereby creating the need for chemical control.

Objective of Research: In 1999, an isolate of *Metarhizium anisopliae* pathogenic to wireworms was discovered near Agassiz, BC. Research conducted in 2000 concluded that the isolates pathogenicity is sufficient to warrant the pursuit of its development as a wireworm biocontrol. The objective of current research is to conduct basic field and laboratory studies to identify pathogenicity of related isolates, the host range of those isolates (different wireworm species and non target organisms), its persistence under field conditions, and efficacy under different methods of field application.

Results to Date: The Agassiz isolate is the most pathogenic of those tested to date. It is persistent in slightly acidic sandy loam soil and recovers to original application levels within six months. Its use in the field has shown a reduction in wireworm feeding damage to potato seed tubers. Its use in determining wireworm mortality in the field have shown a 20% reduction in wireworm populations, with 55% dying after incubation following transfer from the field to the lab. Mortality in laboratory bioassays have approached 100%. Also, 100% of wireworms died from *M. anisopliae* infections in stock collections. While this thwarted laboratory bioassays, it showed the potential of the fungus as a pest control product. Results relating to its field efficacy in 2001 were inconclusive. Results from 2002 field trials are currently being assessed.

Title 3: Revised Sampling Plans for the Green Peach Aphid in Potato

Author and Associates: Todd Kabaluk and Bob Vernon, Agriculture and Agri-Food Canada

Problem: In south coastal BC, full count sampling for the green peach aphid in potato is carried out by pest management companies without knowledge of the level of precision of sample means or the required minimum number of samples. The outcome of the current plan could result in redundant effort on the part of the pest management company, erroneous spray recommendations and over application of pesticides, yield loss, or aphid-mediated potato leaf-roll virus transmission.
Objectives of Research: Using three years of aphid monitoring data provided by a pest management company, analysis based on accepted sampling theory was performed to evaluate the precision of the current plan, and to develop more precise and efficient alternatives.

Results to Date: The status of the current sampling plan has been reviewed and the results have been submitted for publication, along with suggested, new, sampling plants based on binomial counts.

Continuing Research: Temporal and spatial aphid population trends revealed by further exploration of the monitoring data have been examined, and unnecessary and redundant sampling practices identified. The sampling plan will be further revised. Additionally, a novel GIS-based method for characterizing aphid distribution will be explored.

Title 4: Preliminary investigation into the fungicidal properties of *Geranium robertianum*

Author: Todd Kabaluk, Agriculture and Agri-Food Canada

Problem: Late blight (*Phytophera infestans*) of potato is a serious and well-known disease worldwide. The only spray-based option for growers of organic potatoes is by applications of various fixed copper products. Efficacy of non spray-based control efforts is lacking. Given that some efficacy of various plant extracts and soil-incorporated plant material has been shown to suppress late blight infections, a preliminary investigation into fungicidal properties of *G. robertianum* extracts will be carried out.

Objectives of Research: To determine fungicidal activity of *G. robertianum* extracts against spores of *P. infestans.* To investigate whether extracts of *G. robertianum* can suppress late blight lesion growth.

Results to Date: *G. robertianum* has been collected from forests in south coastal British Columbia.

Continuing Research: Further research will depend on the outcome of the current study.

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Title 5: Development of pheromone traps for the click beetles *Agriotes obscurus* and *A. lineatus*

Author and Associates: Bob Vernon and Andrea Atanaka, (PARC, Agassiz), Dave Wakerchuk and Steve Burke (PheroTech Inc.)

Problem: Two European wireworms, *Agriotes obscurus* and *A. lineatus,* were introduced to Canada about century ago, and are now major pests of many crops in areas of BC and the Maritimes. Sampling methods exist for the wireworm stage of this pest, but they are too time consuming and variable in efficacy for use in identifying fields that may be at economic risk. Pheromone traps for the adult, or click beetle stage of these species have been developed at PARC, Agassiz and are now commercially available.

Objective of Research: The objectives of the ongoing research are:) to determine if catches of click beetles in pheromone traps are predictive of wireworm levels in the same fields; b) to study various parameters related to the deployment and interpretation of these pheromone traps; and c) to develop a blended *A. lineatus* and *A. obscurus* pheromone bait to simultaneously catch both species.

Summary of Results: Pheromone trap data (for click beetles) and bait trap data (for wireworms) have now been collected from several strawberry fields for 3 consecutive years. This data is currently being analyzed to determine whether pheromone trap catches are predictive of wireworm levels in fields in the current year, or over consecutive years. Studies have been completed to determine the optimal number and spatial placement of pheromone traps in strawberry and potato fields. This data is currently being analyzed. Various blended pheromone traps tested in 2002 were as attractive to *A. lineatus* as the *A. lineatus* pheromone traps alone, but were only about 25-50% as attractive to *A. obscurus*. A new, less expensive pheromone trap was also developed for mass trapping purposes in 2002.

Continuing Research: Research will continue to improve aspects of pheromone trap efficacy, including trap design and improved pheromone blends. Traps are currently available through PheroTech Inc.

Title 6: Evaluating various insecticides for control of the wireworms *Agriotes obscurus* and *A. lineatus* in potatoes.

Author and Associates: Bob Vernon and Victoria Brookes (PARC, Agassiz).

Problem: The European wireworms, *Agriotes obscurus* and *A. lineatus,* are insects of major concern to the potato industry in B.C.. Growers have traditionally applied granular insecticides for control of this pest, and during the past decade have relied almost exclusively on the organophosphates Thimet (phorate) and Dyfonate (fonofos). Thimet, has been withdrawn from

use in B.C. by the parent company, however, and Dyfonate is no longer manufactured worldwide. Potato growers in B.C. and Nova Scotia were granted an emergency use registration for Pyrifos (chlorpyrifos) 15G from 2000 to 2002, but the availability of this product or any other wireworm control in the near future is quite uncertain. The testing of new insecticides and alternative approaches for wireworm control in potatoes is therefore a priority at PARC, Agassiz.

Objective of Research: Insecticides for control of European wireworms in potatoes were evaluated in two studies in a field near Agassiz, B.C. in 2002. Insecticidal formulations were applied to seeding furrows as granules (fonofos = Dyfonate 15G; chlorpyrifos = Pyrifos 15G; phorate = Thimet 15G; and ethoprop = Mocap) as sprays (chlorpyrifos = Pyrinex; bifenthrin = Capture 2EC; and fipronil = Canon 200SC) as potato seed treatments (imidacloprid = Gaucho LO289-A1 at 500 g and 750 g product/100 kg seed and clothianidin at 6.25 and 12.5 g **ai**/100 kg seed) or as wheat seed treatments (lindane = Vitavax Dual; and fipronil = Canon) with the treated wheat seed sown in-furrow with the potato seed.

Summary of Results: Potatoes from the two sites have been harvested and are presently being graded.

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

Title 7: Development of alternative control methods for the wireworms *Agriotes obscurus* and *A. lineatus* in potatoes.

Author and Associates: Bob Vernon (PARC, Agassiz); Marcus Merkins and Heather Niven (Delta Farmland and Wildlife Trust)

Problem: Organic farmers in the Fraser Valley of B.C. often lose entire crops of vegetables to the European wireworms, *Agriotes obscurus* and *A. lineatus.* Fields coming out of long term pasture or grassland set aside programs are at greatest risk, and organic growers have no proven current season methods for controlling wireworms. In addition, certain areas of the Fraser Valley where wireworms are of major concern to conventional growers are also important as winter waterfowl habitat. Efforts to control wireworms with granular insecticides in these areas have resulted in accidental waterfowl and raptor deaths in the past decade. There is a need, therefore, to develop alternative methods of wireworm control for the organic and conventional farming industries.

Objective of Research: It is possible for certain farms in the Fraser Valley to flood their fields in the winter, provided the fields have been laser leveled and burmed along the edges. In the winter of 2001/2002, an organically certified field with a severe wireworm problem was flooded, and wireworm sampling conducted before and after flooding in it and in an adjacent, non-

flooded field. Wireworm sampling is also currently being conducted in another pair of organic fields, one of which will be flooded in the winter of 2002/2003.
Another study is underway to determine if pheromone traps can be used to mass trap male *A. obscurus* and reduce oviposition in confined areas of grassland.

Summary of Results: Wireworm sampling in the field flooded last winter indicated that wireworms were abundant throughout the field before flooding (the field was flooded for about 3 months), but were confined only to the burmed areas of the field after flooding.
The first year of the mass trapping study was successfully completed, and will be continued over 3 years to determine the effect on wireworm populations in the field plots.

Continuing Research: It is expected that the field flooding and mass trapping studies will continue for several more years.

Title 8: Determination of flight activity of *Agriotes obscurus* and *A. lineatus*.

Author and Associates: Steve Crozier (Simon Fraser University, Burnaby, B.C.) and Bob Vernon (PARC, Agassiz)

Problem: It has often been reported in earlier Canadian research and extension publications that the European wireworms, *Agriotes obscurus* and *A. lineatus* do not fly as adults. There are conflicting reports from Europe, however, that both species will fly. This is an important question, since the ability of these species to fly would potentially reduce the efficacy of certain control options, such as exclusion devices and mass trapping strategies.

Objective of Research: Through field observations and laboratory studies, to determine if it is possible for *Agriotes obscurus* and *A. lineatus* to fly, and if so, to determine the prerequisites for flight activity.

Summary of Results: Both species were observed in flight in 2001 and 2002. Both sexes of both species could be induced to fly in the lab by raising the temperature to about 26 degrees C.

Continuing Research: Temperature records for the Fraser Valley will be compared to periods of adult activity as determined by pheromone trap catches over the past 3 years. The number of days over 26 degrees C. will provide data on the frequency of flight, and how this means of dispersion could affect various physical and semiochemical control strategies under consideration.

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Title 9: Dicyphus hesperus as a generalist natural enemy in Greenhouse vegetable culture

Author and Associates: Gillespie, DR; VanLaerhoven, S; McGregor, RR; (PARC, Agassiz) Sanchez Sanchez, JA; Luczynski, A; and others.

Objective of Research and Summary of Results: The predatory mirid *Dicyphus hesperus* (Heteroptera: Miridae) continues to show promise as a biological control for pests of greenhouse-grown tomato and pepper. In particular, greenhouse whitefly (*Trialeurodes vaporariorum*) is attacked on greenhouse tomato. Commercial applications of this natural enemy in greenhouses have been most successful in the presence of an alternative plant community, usually mullein, *Verbascum thapsus* (Scrophulariaceae). It appears that the alternative plant community, selected from among plants that are highly preferred by the predator, provide important refuges in the absence of prey, and help to sustain predator populations at effective numbers. Research is focusing on the role of these plants in the biology and foraging behaviour of *D. hesperus* and on movement and prey location cues in *D. hesperus*.

British Columbia Ministry of Agriculture, Food and Fisheries
Food safety & Quality Branch, Kelowna

Title 1: Biological control of cereal leaf beetle

Author: Hugh Philip

Summary: Cereal leaf beetle has reached economic levels in cereal crops the Creston Valley. Biological control offers a long-term opportunity to keep CLB populations at sub-economic levels based on the history of biological control programs in eastern North America. .In 2002, CLB larvae, parasitized by *Tetrastichus julis,* were collected near Missoula MT and released in a crop of wheat near Creston when CLB larval populations were at their peak. This release site will be managed to preserve the parasitoid for eventual redistribution in the valley. A field insectary near the same site is planned pending funding support to further propagate *T. julis* for redistribution in 3 years.

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2002 Alberta Research Report
Compiled by Jennifer Otani

Agriculture and Agri-Food Canada
Lethbridge Research Centre

1. Title: Overwintering biology of cabbage seedpod weevil.

Author and Associates: Héctor A. Cárcamo, Carolyn Herle, Sean McGinn, Rick Butts, Owen Olfert, and Jennifer Otani.

Problem: Populations of insects in the spring are determined by the size of the fall population and abiotic overwintering conditions. Knowledge of the overwintering ecology of cabbage seedpod weevils will assist to predict their pest status and potential range extension.

Objective of Research: To determine overwintering sites, survivorship, cold hardiness and effects of sublethal temperatures on reproductive potential of csw.

Summary of Results: Cabbage seedpod weevils overwinter mainly in tree shelters and to a lesser extent in ditches and alfalfa. Laboratory and field studies suggest that these habitats allow high survivorship since temperatures below leaf litter seldom reach lethal temperatures (around -7°C) for extended periods. Exposure to -5°C for 8 weeks reduced their survivorship. Weevils collected in the fall of 2001 and overwintered at +5□C up to 18 weeks had similar survivorship and reproductive potential compared to those overwintered at this temperature for 8 weeks. At –5□C, survivorship and realized fecundity was lower than at +5□C.

Continuing Research: Field and laboratory studies will be repeated during the winter of 2002-03. The impact of sublethal temperatures on reproductive potential will be repeated in the green house.

***Contact*:** Héctor A. Cárcamo

2. Title: Effect of lygus and cabbage seedpod weevil combinations on canola yields.

Author and Associates: Héctor A. Cárcamo, Rick Butts and Owen Olfert.

Problem: Both cabbage seedpod weevils and lygus bugs co-occur in canola and may reduce yields at densities below the economic thresholds for individual pests.

Objective of Research: To develop economic thresholds and management recommendations for cabbage seedpod weevils and lygus bugs pest combinations.

Summary of Results: Drought conditions in 2000 caused reduced plant growth. Nevertheless, seed yield was significantly lower in cages with high weevil/lygus combinations than in control cages or those with only one pest. In 2001 the study was destroyed by drought and flea beetles. The study was completed successfully in 2002.

***Contact*:** Héctor A. Cárcamo

3. Title: Trap cropping the cabbage seedpod weevil in canola

Author and Associates: Héctor A. Cárcamo, Rob Dunn, Bob Byers, Doug Moisey and Owen Olfert.

Problem: Cabbage seedpod weevils and lygus bugs often require insecticide treatment at different stages of canola and significantly reduce growers' financial margins. Alternative methods of pest control are required to reduce control costs.

Objective of Research: To concentrate and control the cabbage seedpod weevil in trap strips of earlier flowering canola.

Summary of Results: Four canola fields (each ca. 200-300 acres) had trap strips established by fall planting or earlier seeding in the spring relative to the main crop. Three of the trap strips were sprayed after weevils reached 4-10 weevils per sweep. The main crops of these fields and none of the check fields needed spraying as weevils remained below 4 weevils per sweep.

Continuing Research: This research is ongoing.

***Contact*:** Héctor A. Cárcamo

4. Title: Insect pest damage to herbicide-tolerant and conventional canolas

Author and Associates: Héctor A. Cárcamo and Bob Blackshaw.

Problem: Insect pests have become an agronomic problem of canola, particularly in southern Alberta where the cabbage seedpod weevil has reached outbreak levels along with high numbers of flea beetles and lygus bugs. There is currently no published information comparing damage by this insect pest complex to herbicide tolerant and conventional canolas

Objective of Research: To compare abundance of flea beetles, lygus bugs, cabbage seedpod weevils and their feeding damage in herbicide-tolerant and conventional canolas.

Summary of Results: Herbicide-tolerant (Round Up Ready™, Liberty Link™) and conventional (Q2) canolas were grown without insecticide treatment and sampled for flea beetles, cabbage seedpod weevils, lygus abundance and assessed for feeding damage. Results from 2002 are not available.

***Contact*:** Héctor A. Cárcamo

5. Title: Assessment of resistance to cabbage seedpod weevil in Brassicacea germplasm

Author and Associates: Héctor A. Cárcamo, Owen Olfert and Lloyd Dosdall.

Problem: Some mustards are known to have resistance to the cabbage seedpod weevil. It is unknown if current mustard cultivars developed by Agriculture and Agri-Food Canada are resistant to the cabbage seedpod weevil.

Objective of Research: To compare levels of resistance to cabbage seedpod weevils among selected cultivars of *Sinapis alba*, *Brassica juncea*, *B. napus*, *B. rapa*, *Crambe spp* and *Camelina sativa*.

Summary of Results: Results have not been tabulated but overall weevil pressure was much lower than in past years.

Continuing Research: Ongoing.

***Contact*:** Héctor A. Cárcamo

6. Title: Effect of cultivar on population dynamics of the wheat stem sawfly *Cephus cinctus* v Norton (Hymenoptera, Cephidae).

Author and Associates: H. Cárcamo[1], B. Beres[1], R. Byers[1], F. Clarke[2] and R. DePauw[2].
1. AAFC - Lethbridge, AB. 2. AAFC- Swift Current, SK.

Problem: From 1999 to 2002, the wheat stem sawfly has caused substantial damage in southern Alberta and Saskatchewan.

Objective of Research: To determine effects of selected wheat cultivars on weights and fecundity of the wheat stem sawfly.

Summary of Results: Our 2 year study confirmed that AC Abbey and AC Eatonia will reduce populations of this pest by reducing larval size and female fecundity. McKenzie, a cultivar with inconsistent pith expression in Alberta, produced variable larval sizes across sites; however, females developed at Skiff and Coalhurst, from this cultivar had low fecundity and similar to those produced by AC Abbey at the same sites. Hollow-stemmed cultivars and durum wheats, such as Kyle, can sustain high levels of cutting and produce large larvae that will develop into very fecund females. These cultivars should be avoided in areas of high sawfly infestation and replaced by solid stemmed varieties.

Continuing Research: Future studies will focus on novel wheat germplasm being developed at AAFC - Swift Current.

***Contact*:** Héctor A. Cárcamo

7. Title: Development of Microbial Control as a Component of IPM and Insecticide Resistance Management of the Colorado Potato Beetle

Author and Associates: Mark S. Goettel, Christine Noronha and David W.A. Hunt

Problem: The Colorado potato beetle, *Leptinotarsa decemlineata,* is the most destructive insect pest of potatoes. Until recently it was managed exclusively by the use of insecticides but the beetle has developed resistance to most of the insecticides registered for its control. For the first time in western Canada, resistance has become widespread in Manitoba and is starting to appear in Alberta. In order to delay the development of resistance to newly registered insecticides, resistance management and IPM programs must be implemented.

Objective of Research: To determine the effectiveness of an insect pathogenic fungus, *Beauveria bassiana*, in reducing beetle populations and evaluate its use in an insecticide resistance management program.

Summary of Results: The project commenced in 1997. Initial studies were conducted to determine the damage potential of the beetle in Alberta and to determine the extent of resistance to chemical insecticides. Untreated potato plots had yield reductions in the order of 30 to 40%. Resistance in Manitoba was widespread whereas evidence of resistance buildup was found in Alberta.

Laboratory dose/mortality assays on beetles pupating in *Beauveria* inoculated soils demonstrated that the pupating larvae were highly susceptible. Adult beetles were also found to be susceptible to the fungus. Field plots have been established in Prince Edward Island, Ontario and Alberta to evaluate the effectiveness of *B. bassiana* for inducing mortality in overwintering beetle populations. Emergence of adults will be monitored in the spring.

Laboratory assays will continue to evaluate the importance of dose, temperature, soil type and moisture.

Continuing Research: Field plots have been established in Prince Edward Island, Ontario and Alberta to evaluate the effectiveness of *B. bassiana* for inducing mortality in pupating and overwintering beetle populations. Spores were applied to the surface of the soil and at a depth of 10 cm. Emergence of adults from pupae was monitored. Emergence of overwintering adults will be monitored in the spring. Laboratory assays will continue to evaluate the importance of dose, temperature, soil type and moisture.

***Contact*:** Mark Goettel

8. Title: Improved forecasting and control of grasshoppers and related grassland insects

Author and Associates: Dan L. Johnson; main collaborator regarding applied value of the study is Jim Calpas, AAFRD

Problem: The risk of grasshopper damage increased greatly during the past two years in Alberta and Saskatchewan. Descriptions of the causes of the increase for various species are available at http://res2.agr.ca/lethbridge/scitech/dlj/dlj01.htm . Damage to cereal crops, hay and pastures is caused by 3 to 5 species, depending on the region and year. Damage to rangeland is caused by high populations of 3 to 9 species of grasshoppers. In 2001 and 2002, some species, such as the lesser migratory grasshopper and Packard's grasshopper, actually declined to sub-economic levels in many areas. Other species, such as the clear-winged and two-striped grasshopper, increased to near-record densities, causing severe losses in crops, hay and grazing potential. Farmers in drought-stricken regions report that although the drought was a severe problem, "if it wasn't for the grasshoppers, we would have had hay for feed", and similar comments.

Objective of Research:
In 2002, we conducted a joint survey to assess grasshopper more precisely outline species composition, survival, development, field population pathology, and potential egg-laying at approximately 200 sites in Alberta and Saskatchewan. Surveys are not normally conducted in such detail or as research projects, but this special case will assess the value of more detailed information, beyond the reports of general activities and densities of grasshoppers as a whole.

Summary of Results: Identification of specimens and analysis of data is in progress during October and November, 2002, and will be distributed in draft form in November.

Continuing Research: In 2003, continuing include

a) the assessment of changes in species composition as a function of weather and vegetation (a continuation of the main study described above)

b) safety and effectiveness of microbial control of grasshoppers. Recent results are reported in: Johnson, D.L., J.S. Smits, S.T. Jaronski and D.K. Weaver. Accepted 2001. Assessment of health and growth of ring-necked pheasants following consumption of infected insects or conidia of entomopathogenic fungi, *Metarhizium anisopliae* var *acridum* and *Beauveria bassiana,* from Madagascar and North America. Journal of Toxicology and Environmental Health (in press)

c) ecology of biological control agents: the relationship of four taxonomic families of dipteran parasitoids to four species of grasshoppers (with T. Danyk)

d) the third year of sampling of rangeland insects in a study of the impact of grazing practices (with W. Willms)

e) laboratory experiments on feeding preference, behavior and survival, for various species

g) laboratory and field experiments of sublethal effects of low rates of control agents

h) a search for natural control agents, for example from extracts of toxic plants (with M. Majak and M. Benn; a recent paper is: Johnson, D.L., W. Majak and M.H. Benn. Submitted/accepted 2001. Excretion of miserotoxin and detoxification of the aglycone by grasshoppers (Orthoptera: Acrididae). Phytochemistry 58: 739-742.)
i) summaries of biodiversity of grassland insects; published guides to pest and non-pests

j) research on the impact of weather sequences and events on the survival, reproduction and activity of grasshoppers and other Prairie pest insect species

k) a new study, initiated in June - September 2002, on the role and diversity of soil microarthropods in composting

***Contact*:** Dan Johnson

Agriculture and Agri-Food Canada
Beaverlodge Research Farm

1. <u>Title</u>: Insects in fall seeded, Round-Up Ready™ canola grown in the Peace River region.

Author and Associates: J. O'Donovan and J.K. Otani.

Problem: High densities of *Lygus* can affect canola development and time to maturity, yield, and seed quality. In addition, other insect pests of commonly occurring in canola in the Peace region including Cabbage root maggot, Bertha armyworm and crucifer and striped flea beetles can cause economically significant yield losses. These insect pests need to be monitored to determine if fall seeded canola will escape or attract insect pests.

Objective of Research: To determine if infestations of *Lygus* and other insect pests are affected by the early phenology of fall seeded canola and by management practices used to improve yield.

Summary of Results: In 2001, greater flea beetle feeding damage plus higher numbers of *Lygus* and Diamondback larvae were observed in spring versus fall seeded canola in Beaverlodge and Fort Vermilion sites. Despite treatments comparing degree and timing of tillage plus rates of nitrogen and phosphorous, no differences were observed in amount of flea beetle damage, *Lygus* populations or Diamondback larvae numbers in 2001 at either location.

Continuing Research: This three-year study will be completed in the 2002 field season.

Contact: Jennifer Otani

2. Title: *Lygus* oviposition patterns, egg and nymph survivorship to adults in canola treated with seed insecticides.

Author and Associates: J.K. Otani

Problem: Preliminary observations by Gustafson and Alberta Agriculture, Food and Rural Development indicates that lower *Lygus* populations were present in canola stands treated with imidacloprid (Gaucho® 480FL) compared to stands treated with lindane (Vitavax®). This study examines *Lygus* oviposition patterns and subsequent nymph populations under greenhouse conditions to determine if reproduction is affected by seed-insecticide treatments including Gaucho Canola System® (imidacloprid 480gAI/100kg), Gaucho Platinum® (imidacloprid 800gAI/100kg), Vitavax RS® (Carbathiin + Thiram + Metalaxyl), Titan® (clothianidan 600gAI/100kg).

Objective of Research:
- To examine *Lygus* oviposition patterns on canola grown under greenhouse conditions.
- To examine and compare subsequent oviposition patterns, nymph survival and number of adults developing on canola plants treated with Gaucho Canola System® (imidacloprid 480gAI/100kg), Gaucho Platinum® (imidacloprid 800gAI/100kg), Vitavax RS® (Carbathiin + Thiram + Metalaxyl), Titan® (clothianidan 600gAI/100kg).

Summary of Results: In progress - Results not yet available.

Continuing Research: This study was completed during the 2002 field season.

Contact: Jennifer Otani

3. Title: Effect of cultivar, seeding date, and pesticide inputs on predominant insects and diseases of canola.

Author and Associates: J.K. Otani, N. Harker, G. Clayton, K. Turkington, J. O'Donovan, R. Blackshaw, L. Dosdall, J. Broatch, H. Cárcamo

Problem: Recent innovations in the areas of seeding, canola variety, and tillage methods combined with insect and disease pest management strategies are being examined for overall impact on insects. Flea beetles (*Phyllotreata cruciferae* and *P. striolata*), lygus bugs (*Lygus* spp.), and cabbage root maggots (*Delia* spp.) are economically significant pests of Argentine (*Brassica napus*) and Polish (*B. rapa*) canola grown in Alberta. A series of canola experiments conducted in Beaverlodge, Lacombe, and Lethbridge are concurrently examining disease and insect pests, yield, seed quality and respective economic costs of associated agronomic practices.
Objective of Research: The goal of this study is to comparatively assess the economics of canola production managed by cultivar, seeding date and pesticide regimes, and their impact on diseases, insect pests, and beneficial insects. Insect damage and seasonal population data will be collected for three canola pests naturally occurring in Beaverlodge (i.e., flea beetles, *Lygus*, and cabbage root maggots).

Summary of Results: Fall seeded plots suffered from poor germination in 2001. Over five sweep-net sampling dates, higher numbers of *Lygus* and Diamondback were observed in fall versus spring seeded Hysyn 110 and Q2 varieties of canola in Beaverlodge in 2001. Over these same sampling dates, higher numbers of *Lygus* and Diamondback were observed in plots that were treated with Matador (cyhalothrin lambda at 34ml/ac) or a combination of Matador plus Ronilan EG (Vinclozolin) versus plots treated with only Ronilan EG or no pesticides.

Continuing Research: The third year of this three-year study will be completed in 2003.

Contact: Jennifer Otani

4. Title: The overwintering biology of *Lygus*.

Author and Associates: J.K. Otani and Héctor A. Cárcamo

Problem: Overwintering habitat, tolerance to cold, and the effect of freezing temperature on native *Lygus* are not known. While feeding damage occurs in canola during the spring and summer months, overwintering mortality and temperature thresholds affecting pest establishment and population growth are important for *Lygus* and cabbage seedpod weevils. Information on overwintering biology will help predict spring populations and determine which canola growing regions may be at risk of *Lygus* and/or cabbage seedpod weevil damage.

Objective of Research:
1. To determine overwintering habitats of *Lygus*.
2. To evaluate the cold-hardiness of *Lygus*.
3. To determine *Lygus* overwintering survivorship under field conditions.
4. To provide predictive information, based on overwintering success, on the likelihood of outbreaks of *Lygus*.

Summary of Results:
Microcosm cages were constructed and stocked with adult *Lygus* collected from the field in November 2001. Microcosm cages containing the overwintering *Lygus* were placed in various habitats on the Beaverlodge Research Farm and retrieved at three intervals during the winter months. The number of surviving *Lygus* within the microcosm cages ranged from 70-90% (N=10 per cage, replicates=3 per interval) despite overwintering temperatures that ranged from 9 to -25°C (measured air temperature), and 2 to -6°C (measured at 0 and -4 cm in soil profile). Our first-year results indicate that *Lygus* survive in the field at temperatures down to -6 °C which the insulative layers of leaf/grass litter and snow provided during the winter in Beaverlodge in 2001.

Continuing Research: Overwintering microcosms will be placed in the field in October 2002 and temperature, humidity, plus snow pack data will be collected in the vicinity of the overwintering *Lygus* until April 2003. This is part of a three-year study anticipated to end in 2004.

***Contact*:** Jennifer Otani

Alberta Agriculture, Food and Rural Development

Crop Diversification Centre - North

1. Title: Control of Tarnished Plant Bug (*Lygus lineolaris*) and Western Flower Thrips *Frankliniella occidentalis* Perg.) in Strawberries and Saskatoons in Alberta- IPM Approach.

Author and Associates: Kwesi Ampong-Nyarko, Kenneth Fry, Mike Hardman, Mark S. Goettel

Problem: The berry fruit industry in Alberta is a multimillion venture, with strawberries (*Fragaria x ananassa* Duch) being the largest commodity and saskatoons (*Amelanchier alnifolia* Nutt.) becoming a second. Insects and mites constitute major threats to strawberry and saskatoons producers, reducing yields or berry quality by direct injury to roots, leaves and fruits. For many years, the strawberry industry has relied on chemicals to control the pests. In Alberta, a steady increase in tarnished plant bug populations in strawberry and saskatoon fields has been observed over last several years. The other insect on the rise in Alberta strawberry plantations is western flower thrips. Western flower thrips cause fruit russeting around the calyx and, when feeding occurs on strawberry blossom may cause the stigmas and anthers to turn brown and wither.

Objective of Research: To develop an effective IPM program to control tarnished plant bugs and western flower thrips in strawberries and saskatoons based on practical sampling methods, economic thresholds, narrow-spectrum insecticides and biological controls.

Summary of Results: Another study confirmed the critical phase of the saskatoon fruiting cycle that is most susceptible to lygus damage. In strawberry, 30 or more thrips per strawberry flower produced catfaced berries.

Continuing Research: This is the last year of a 3-year project

Contact: **Kwesi Ampong-Nyarko**

Alberta Agriculture, Food and Rural Development

University of Alberta

1. Title: The Effect of Agronomic Practices on Root Maggot Infestations

Author and Associates: L. Dosdall, G. Clayton, N. Harker, K. Turkington, J. O'Donovan, J. Otani, J. Broatch

Problem: A number of agronomic studies are being undertaken to identify cropping practices that minimize damage to canola by larval root maggots (*Delia* spp.) and infestations of weeds and diseases. The aim is to develop integrated crop management practices for root maggots, diseases, and weeds in canola. Field studies are underway to determine the effects of fertility regime, crop cultivar, time of weed removal, and seeding date on yields and infestation levels of weeds, diseases and root maggots.

Objective of Research: To investigate integrated crop management strategies for root maggots, diseases, and weeds in canola.

Summary of Results: Root maggot infestation levels are influenced by time of weed removal: removing weeds later in the growing season (6-leaf stage of canola development) was associated with less damage by these pests than removing weeds earlier (in the 2- and 4-leaf stages of canola development). However, the yield benefit gained from early weed removal exceeded any advantage obtained by lowered root maggot pressure when weeds were removed later. Infestation levels of root maggots on fall-seeded canola were variable: in some years and in some sites, root maggot infestations were higher in fall-seeded canola than in spring-seeded plots, but in other sites and years the opposite relationship was observed. Studies on other agronomic practices have only begun.

Continuing Research: Future research will focus on assembling a larger data set for infestation levels of root maggots, weeds and diseases under different agronomic management regimes.

***Contact*:** Lloyd M. Dosdall

2. Title: Integrated Management of the Cabbage Seedpod Weevil in Canola

Author and Associates: L. Dosdall, H. Cárcamo, R. Dunn, K. Fry, A. Good, A. Keddie, L. Kott, U. Kuhlmann, P. Mason, J. McCaffrey, R. McKenzie, D. Moisey, O. Olfert, H. Philip, G. Stringam

Problem: Populations of cabbage seedpod weevil (*Ceutorhynchus obstrictus* (Marsham) (Coleoptera: Curculionidae) have increased dramatically since the species was first found

infesting canola in Alberta in 1995. Significant damage to flower buds is caused by overwintered adults, and the problem is exacerbated by larval feeding on developing seeds. Larval exit holes may be invaded by fungal pathogens, with damage to many more ripening seeds. Late in the season, new generation adults feed on ripening pods, also causing significant crop damage. At present, broad-spectrum insecticide application is the only control strategy available to growers.

Objective of Research: To develop and field-test cultural, chemical, and biological control strategies for cabbage seedpod weevil in canola, and to initiate studies aimed at developing canola germplasm resistant to attack by the weevil.

Summary of Results: The project was initiated in 2001. Results have shown that delaying seeding date may reduce infestation levels of weevils in canola. Adult weevils invade the crop in the bud stage and maximum abundance occurs in early flowering. Differences in susceptibility to infestation by cabbage seedpod weevil occur among and within species of Brassicaceae. Some intergeneric hybrids derived from crosses of resistant (*Sinapis alba*) and susceptible (*Brassica napus*) germplasm appear to harbour resistance to the weevil. In the past two years, parasitoids have become increasingly important for reducing infestation levels of cabbage seedpod weevil. The distribution and abundance of cabbage seedpod weevil have increased from 1997-2001, but severe drought in 2002 reduced its dispersal success.

Continuing Research: Future research will focus on co-ordinating an interdisciplinary research group to facilitate integrated management of the cabbage seedpod weevil in canola.

***Contact*:** Lloyd M. Dosdall

Alberta Research Council

Vegreville

1. Title: Evaluation of the sub-lethal effects of the entomopathogenic fungus *Beauveria bassiana* on biological control agents used in greenhouse crop management.

Author and Associates: Josh Litwinowich, Sunil Rajput, Ken Fry, and Andrew Keddie

Problem: The entomopathogenic fungus *Beauveria bassiana* has been shown to be effective for managing many greenhouse insect pests. Unfortunately, the fungus has also been shown to cause mortality in biological control agents such as predators and parasitoids.

Objective of Research: Investigate the sub-lethal effects of *B. bassiana* against the predators and parasitoids commonly used for managing aphid, thrips and whiteflies. Life history parameters to be studied include fecundity, longevity, and host/prey finding efficiency.

Summary of Results: This project is supported by the NSEC Biocontrol Network. Plants and insect colonies have been established in preparation for bioassay or *B. bassiana* strains. *Beauveria bassiana* strains have been cultured under different regimens to elicit beauvericin and oosporein production in preparation for bioassay.

Continuing Research: The predator and parasitoid complexes for other insect pests will be tested for impact of *B. bassiana* use as time and funds permit.

***Contact*:** Ken Fry

2. Title: Spatial Distribution and impact of Thrips in Canola.

Author and Associates: Ken Fry

Problem: During intensive sampling for *Lygus* spp. in canola, moderate to high populations of thrips were observed on canola. Several anecdotal reports of pod curling, coupled with the sampling data highlighted a lack of information regarding species composition, distribution and density of thrips in canola and what impact thrips have on plant health and yield.

Objective of Research: To determine within-field distribution and density of thrips in canola and to determine mechanism of damage of thrips to canola.

Summary of Results: Transects through canola fields were sampled for distribution and population structure of thrips in canola. Greenhouse bioassays were also conducted to determine impact of thrips on flowering, seed set and yield. Data are currently being analysed.

Continuing Research: The provincial survey has been concluded. Future work includes timing of dispersal into and within fields, extent of reproduction in fields, determination of refuge/alternate hosts, and determination of economic thresholds. This work is funded by ARC and AAFRD.

***Contact*:** Ken Fry

3. Title: Evaluation of the Impact of Woolly Elm Aphid on Yield in Saskatoon Berry Orchards.

Author and Associates: Ken Fry, Kris Pruski, Kwesi Ampong-Nyarko

Problem: The Woolly Elm Aphid (WE), *Eriosoma americanum* (Riley), is considered by saskatoon growers to be the most serious insect pest attacking saskatoon seedlings. Prior to 1994, there was very little known about the biology of the WE and few methods for managing WE existed. No data has been collected on the impact WE has on yield in mature orchards.

Objective of Research: To determine the impact of WEA on yield in newly established and mature orchards.

Summary of Results: Five blocks of 10 plants for each of control and WE-free plants were established in 1997. Treated plants were kept WEA-free by applying Orthene® via injection to the root zone. Yield did not significantly differ between treated and control plants in the newly established orchard in the first year all plants bore fruit (2001) and in the second year of fruit development (2002). Six blocks of control and two treatment levels of an Orthene® drench have been examined over 4 years. There is no significant difference in fruit yield between treated and control plants. It is not recommended to treat for WEA in young or mature orchards.

Continuing Research: This project is discontinued. Funding from ARC and AAFRD is acknowledged.

***Contact*:** Ken Fry

4. Title: Potential Environmental Impact of Genetically Modified Organisms.

Author and Associates: Ken Fry, Abdul Rashid, and Larry Roy

Problem: Agroecosystems cover a significant portion of the land in Alberta, so any new management practice employed in primary production has the potential to significantly impact the environment. Given the widespread adoption of genetically modified (GM) herbicide tolerant canola grown in the province there is concern about its use on the sustainability of agroecosystems and adjacent unmanaged ecosystems.

Objective of Research: This project examined the impact of GM canola on the various trophic levels found in agricultural fields and undamaged ecosystems, and separate this impact from that of management practices already in current use on non-GM canola. This is the second year of the project.

Summary of Results: Three pairs of 80+ acre fields, 1 Roundup ready® (RR) canola field and 1 non-herbicide tolerant (non-HT) canola field per pair, were monitored for weed, insect and small mammal abundance and diversity. Bordering unmanaged woodlot were also sampled. Weed abundance and diversity were lower in the RR fields as compared to the non-

HT fields. Small mammal abundance appears to be lower in RR fields. Full analysis of material is underway.

Continuing Research: It is hoped to replicate the work over 3 years and in three different growing regions in Alberta. This project was solely funded by ARC.

***Contact*:** Ken Fry

5. Title: Integrated Crop Management of Black Currents in Alberta.

Author and Associates: Ken Fry, Lloyd Hausher, Ieuan Evans, Elston Solberg, and Chris Neeser

Problem: Black currant, a highly productive crop with more juice per acre than oranges, a higher source of vitamin C, is a preferred confection and fruit drink flavour in Europe. White pine blister rust disease prohibits production in eastern Canada and B.C. Powdery mildew resistant varieties, natural resistance to birds, deer and mouse browsing, and suitability to prairie climate are all factors greatly favouring black currant production in Alberta. Major hurdles to production are insect pests and a lack of integrated crop management tools under Alberta growing conditions.

Objective of Research: We propose to develop a comprehensive integrated production program for black currants in Alberta. The objectives are 1) to determine action thresholds for aphids, currant fruit fly, and imported currant worm, 2) assess and refine chemical and biological control methods for insect pests and pursue minor use registration or label expansion of effective products, 3) to diagnose and test control measures for plant disease, especially white pine blister rust, and 4) to refine current agronomic practices to optimize plant growth and yield.

Summary of Results: For the insect work, the currant fruit fly was abundant and will pose a substantial threat to production. Spidermites were most abundant in cv Tirran. Pest monitoring technique data are currently being analysed.

Continuing Research: This was the first year of a three-year project funded by AARI.
***Contact*:** Ken Fry

6. Title: Control of Tarnished Plant Bug and Western Flower Thrips in Strawberries and Saskatoons in Alberta – An IPM Approach.

Author and Associates: K. Pruski and K. Ampong-Nyarko, K. Fry, M. Goettel, and M. Hardman.

Problem: Tarnished Plant Bug and Western Flower Thrips are among the most damaging insect pests of strawberries. Both insects also affect saskatoon berry orchards. Strawberry growers, who have previously relied on chemical insecticides for pest management, seek an integrated management plan to offset insecticide resistance, withdrawal of chemical registrations, and an increasing market for organic production.

Objective of Research: To examine the effectiveness of *Beauveria bassiana* against T.B. and WFT in strawberries and saskatoon berry as part of an IPM program for insect pests of fruit.

Summary of Results: Neem, Matador, and Decis gave excellent control of lygus but Botanigard was ineffective.

Continuing Research: The project is complete. Funding from AARI, FGSA, AMGA, Westgro Horticulture Supply, and the APHGCF is acknowledged.

***Contact*:** Ken Fry

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SASKATCHEWAN
2002 INSECT PEST RESEARCH REPORT

Prepared by Martin Erlandson
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SASKATCHEWAN ALFALFA SEED PRODUCERS ASSOCIATION

Title: Research on parasitoids and diseases 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. Infestations of a chalcid parasitoid, *Pteromalus venustus*, are currently a major problem in some Saskatchewan alfalfa leafcutting bee populations. Another factor which may limit alfalfa leafcutting bee production is chalkbrood disease, *Ascosphaera aggregata*, and the occurrence of the related fungal pathogen *Ascosphaera larvis,* which has recently been identified in Saskatchewan alfalfa leafcutting bee populations.

Objective of Research:
This research project is designed to evaluate parasitoid and disease levels in Saskatchewan alfalfa leafcutting bee populations, to identify potential problems in these areas, 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 2001 - 2002 winter survey of alfalfa leafcutting bee populations in Saskatchewan. The chalcid parasitoid was detected in 0.58% (sd 0.79, range 0.0 - 3.94%) of bee cells analysed from samples submitted by alfalfa seed producers. *P. venustus* was present in 60.0% of all alfalfa leafcutting bee populations surveyed.

Chalcid parasitoids have traditionally been controlled during the spring alfalfa leafcutting bee incubation period with dichlorvos-impregnated resin strips; however, dichlorvos has been implicated in leafcutting bee mortality and it is also among the organophosphate insecticides currently under EPA review. In order to develop an alternative to dichlorvos, parasitoid control research has been undertaken on various compounds including pyrethrin aerosol formulations. In field-scale experiments undertaken during the 2002 field season, a comparison of the efficacy of pyrethrin aerosol formulation KN418 with the efficacy of dichlorvos resin strips for control of chalcid parasitoids demonstrated that use of pyrethrins resulted in levels of 0.0% leafcutting bee cell re-parasitism and 1.25% leafcutting bee pupal mortality due to parasitoid stinging; use of

dichlorvos resulted in levels of 0.50% leafcutting bee cell re-parasitism and 7.50% leafcutting bee pupal mortality due to parasitoid stinging.

Chalkbrood (*A. aggregata*) occurrence was also evaluated in the 2001 - 2002 Saskatchewan winter survey of alfalfa leafcutting bee populations. The disease was present at a low level (sporulating chalkbrood - 0.021% overall, sd 0.091, range 0.0 - 0.651%; non-sporulating chalkbrood - 0.025% overall, sd 0.122, range 0.0 - 0.781%); incidence of a related species (*A. larvis*) was significantly higher (0.974% overall, sd 1.471, range 0.0 - 9.230%).

Continuing Research:
Research to monitor parasitoid and disease levels in Saskatchewan alfalfa leafcutting bee populations, and to develop parasitoid and disease management strategies, is ongoing.

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AAFC SASKATOON RESEARCH CENTRE

1. Title: Follow-up monitoring of parasitoid release for wheat midge

Author and Associates: O. Olfert, M. Braun, J. Doane, L. Braun

Problem: Wheat midge *(Sitodiplosis mosellana*) is a major insect pest of wheat in Manitoba, Saskatchewan and, most recently, Alberta causing millions of dollars in losses and widespread application of insecticides during outbreaks. Currently, one parasitoid, *Macroglenes penetrans*, controls about 35-40% of wheat midge. A second species, *Platygaster tuberosula*, was released in the mid 1990's.

Objective of Research: To develop quantitative monitoring techniques and determine the rate of establishment of *Platygaster tuberosula* to control wheat midge.

Summary of Results: To date the project has successfully developed a de-awning technique to harvest midge larvae from wheat heads. The larvae are then cooled to break diapause and incubated to allow emergence of parasitoids. *Platygaster tuberosula* individuals were recovered at low numbers in follow-up monitoring programs in each of the last five years. In 2001, the parasitoid population density increased 5-fold at the release site and is showing signs of migrating into the surrounding area.

Continuing Research: Future plans are to continue the monitoring program to track the migration of the newly established parasitoid.

2. Title: Pest status of leafhoppers and their impact on aster yellows disease in canola

Author and Associates: C. Lefol, O. Olfert, and G.Seguin-Swartz

Problem: Aster yellows can cause considerable damage to a wide array of native and cultivated plant species including canola. The incidence of aster yellows disease appears to be increasing on the prairies in recent years and has become very evident in disease surveys of canola. Aster yellows in canola is presumed to be caused by a phytoplasma belonging to Group I, Subgroup A, which is transmitted by leafhoppers, specifically the six-spotted leafhopper (*Macrosteles fascifrons*).

Objectives of Research: (i) to determine the identity of the phytoplasma and the leafhopper, and the pest status (life cycle, ecology, infectivity) of the leafhopper; (ii) to determine the epidemiology and impact of the disease in canola; and (iii) to screen canola germplasm for resistance/tolerance to aster yellows.

Summary of Results: This is the second year of a three-year project. To date the project has concentrated on ecology (growth models/overwintering/migration) and the development of PCR-based techniques to detect phytoplasma infections in plant and in the insect vector.

Continuing Research: Future plans are to determine the epidemiology and impact of the disease in canola; and to screen canola germplasm for resistance or tolerance to aster yellows.

3. Title: Arthropod Diversity and Pest Dynamics As a Function of Production Input Levels and Cropping System Strategies.

Author and Associates: O. Olfert, M. Braun and R. Weiss

Problem: Economic viability and soil degradation are major issues facing farmers in the grassland eco-zone of the Northern Great Plains. Management strategies such as crop diversification, reduced fallow and reduced inputs are being promoted as solutions. Studies using a systems approach, applied as the experimental framework with which to monitor and assess alternate input and cropping strategies, are being conducted through the collaboration of crop, pest, economic and soil scientists**.** Sustainable management strategies, crop loss prevention and maintenance of soil health are central to our capacity to maintain the biological productivity of agricultural systems. Arthropods, including insects, spiders and mites, are integral to crop loss and to soil health because they include both beneficial and pest species.

Objectives of Research: The objective is to monitor and assess alternative input and cropping strategies based on three levels of production inputs and three levels of cropping diversity. In addition to the nine cropping systems, the diversity of arthropods is being evaluated in four uncultivated areas: native prairie, a 50-year old grass ecosystem, a 30-year old alfalfa/brome grass ecosystem; and the grassy margins next to the study site

Summary of Results: The design, data collection and evaluation are based on the collaborative efforts of crop, pest, economic and soil scientists. The collection to date involves approximately 300 guilds (Species, Family, Order, etc). All specimens have been preserved in alcohol, catalogued and coded for entry into a relational database as part of the overall long-term study. Soil mites have been of particular interest because of their ecological signficance. Abundance of mites was significantly higher in all the uncultivated sites than in the cropped area. Rotations within the reduced input system supported a greater number of soil mites than either the organic or high input systems.

Continuing Research: Future plans are to assess the direction and rate of change over time that is occurring in these components as a function of the different cropping systems. Evaluations will continue on an cyclical basis (at 6 year intervals).

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4. Title: Evaluating reduced rates of insecticide-treated seed for flea beetle control in canola.

Author and Associates: Julie Soroka, AAFC Saskatoon, Byron Irvine, AAFC Brandon, John Gavloski, Manitoba Agriculture and Food, Carman.

Problem: Flea beetles, *Phyllotreta* spp., are a chronic pest of canola production across the prairies.

Objective of Research: Insecticide seed dressings are a principal means of flea beetle control. If, instead of coating all seed with insecticide at seeding, the ratio of treated to untreated seed could be reduced without reducing the efficacy of flea beetle control, economic and environmental savings would accrue.

Summary of Results: In this first year of the trial, plots were established at Brandon and Saskatoon. There were five treatments: a bare-seeded control, and canola seeded in four different ratios of insecticide plus fungicide treated seed to fungicide alone treated seed - all seed, 2/3 seed, 1/3 seed and no seed treated with insecticide. At both sites the 2/3 insecticide plus fungicide:1/3 fungicide only-treated seed treatment had flea beetle feeding levels similar to those in plots in which all seeds had insecticide and fungicide. However, flea beetle pressure was so high that even the plots with every seed coated with insecticide had feeding levels above the economic threshold, and plant damage was severe in all treatments.

Continuing Research: 2002 was a very atypical summer. Research will be continued to determine the validity of 2002 results.

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5. Title: Male- specific compounds from *Phyllotreta* flea beetles.

Author and Associates: Julie Soroka, AAFC Saskatoon, and Robert J. Bartelt, Allard A. Cossé, Bruce W. Zilkowski, David Weisleder, and Frank A. Momany, all of USDA-ARS-NCAUR, 1815 N. University St., Peoria, Illinois 61604

Problem: Flea beetles, *Phyllotreta* spp., are a chronic pest of canola production across the prairies.

Objective of Research: Feeding males of *Phyllotreta crucifierae* flea beetles (Coleoptera: Chrysomelidae) emit blends of compounds that are absent from females. Eight compounds were identified, and racemic forms of six of these were synthesized. The objective of the experiment was to test the attractiveness of the synthetic blend to flea beetles in the field.

Summary of Results: Three trapping experiments were conducted in each of 2001 and 2001 in canola fields near Saskatoon that were infested with *P. cruciferae*. One trap bait was a mixture of synthetic compounds from male flea beetles, formulated in rubber septa to emit the compounds in the natural proportions. There were two release rates: "Hi Pher." ≈10 µg/day and "Lo Pher." ≈ 1 µg/day. The other trap bait was allyl isothiocyanate (AITC), a known, potent, host-derived attractant for *P. cruciferae,* at two release rates: "Hi AITC" ≈ 5000 µg/day and "Lo AITC" ≈300 µg/day. The pheromone and AITC baits were tested alone and in all possible combinations (8 treatments), with a ninth control treatment. Both the synthetic pheromone and AITC were significantly active. There was a positive dose response for each bait, and the two types of baits were additive or synergistic. In the field the pheromone was attractive to both sexes of *P. cruciferae*, indicating that the male-specific compounds constitute an aggregation pheromone.

Continuing Research: Research continues in synthesizing the entire complex of pheromone compounds.

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6. Title: Seed treatment evaluations in canola.

Authors: Bob Elliott, Larry Mann and Owen Olfert

Problem: Seed treatments are commonly used to control flea beetles (*Phyllotreta* species) in Polish canola, *Brassica rapa* L., and Argentine canola, *B. napus* L. With the de-registration of lindane-based seed treatments, studies were initiated in 2001 to evaluate the efficacy and agronomic benefits of newly registered products.

Objective of Research: Evaluate the effect of seed treatments on flea beetle damage and agronomic performance of Polish and Argentine canola.

Summary of Results: Seed treatments including Titan®, Helix®, Helix XTra® and Vitavax RS Flowable® had a significant effect on flea beetle damage and agronomic performance of Polish canola. Compared to untreated seeds, seed treatments reduced damage 15-40%, improved seedling establishment 15-30% and improved seedling fresh weight 5-12 times. Seeds treated with Helix XTra® had the least damage and highest biomass at bolting. In Argentine canola, seed treatments reduced flea beetle damage 5-60%, depending on the product. Damage was higher in the Vitavax RS® treatment than in the Titan®, Helix® or Helix XTra® treatments. The latter treatments improved seedling establishment 40-60% and seedling fresh weight 3-15 times. Seeds treated with Titan® or Helix XTra® had the highest biomass before bolting.

Continuing Research: Laboratory experiments are in progress to determine the effect of storage conditions on the viability of untreated and treated seed. Germination and seedling growth after 12 months storage at -17°C, 2°C and 19°C are currently being analyzed.

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7. Title: Seed-size evaluations in canola

Authors: Bob Elliott, Larry Mann and Owen Olfert

Problem: The crucifer flea beetle, *Phyllotreta cruciferae* (Goeze), is a major pest of Polish canola, *Brassica rapa* L., and Argentine canola, *B. napus* L., in western Canada. Adults attack young canola seedlings causing reduced plant stands, slower growth, delayed maturity and lower seed yield.

Objective of Research: Determine the effect of seed size on flea beetle damage and agronomic performance of Polish and Argentine canola.

Summary of Results: A three-year study was conducted on six varieties of synthetic Polish canola and herbicide-tolerant Argentine canola. Certified seed lots of each variety were sieved

through graded screens to obtain samples of small, medium and large seed. Seed diameters measured 1.4-1.6mm, 1.6-1.8mm and 1.8-2.0mm, respectively. Sized seeds were planted without chemical protectants in six-row plots at 200 seeds per 6.0m row.

In each species, seedlings grown from small seed had 5-10% more flea beetle damage than seedlings grown from large seed. Growth attributes improved as seed size increased. Compared to small seed, large seed improved seedling counts, fresh weight and seed yield 5-10%, 15-40% and 10-15%, respectively, in Polish canola and 15-30%, 55-70% and 20-25%, respectively, in Argentine canola. Improvements in agronomic performance with large seed were consistent among varieties within species and consistent from year to year. Results indicated that seedlings grown from large seed are more tolerant to flea beetle damage and agronomically superior to seedlings grown from medium or large seed.

Continuing Research: Current research is aimed at identifying methods of improving seed size in Polish and Argentine canola.

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8. Title: Lygus Plant Bugs

Author and Associates: M. Erlandson, M. Ashfaq, D. Hegedus, and L. Braun.

Problem: Recently molecular markers were developed for identification of *Lygus* spp. and their associated parasites. These tools have yet to be tested extensively with field populations of *Lygus* spp. nor have they been tested with respect to their effectiveness in estimating *Peristenus* spp. parasitsm rates in comparison to estimates from the dissection or rearing methods.

Objective of Research:
This project was initiated to compare the estimates of parasitism in Saskatchewan Lygus populations based on molecular, dissection and rearing techniques as well as to determine the species composition of Lygus populations and their associated parasites.

Summary of Results: Based on PCR determinations and subsequent adult identifications the *Lygus* population studied was 90% *L. borealis* the remaining being *L. lineolaris*. The rates of parasitism estimated by molecular techniques, dissection, and host/parasite rearing were 79, 60 and 29%, respectively. The estimate derived from nymphal rearing probably significantly underestimates parasitism rates due to early mortality of *Lygus* nymphs due to other causes. All *Peristenus* spp. parasitoids (dissected and intact hosts) were identified as *P. pallipies* using PCR analysis. In the rearing experiment, adult parasites emerged from 79% of overwintered parasitoid cocoons. However, 34% of these adults were identified as *Mesochorus* spp. and 66% were

Peristenus spp. *Mesochourus curvulus* was previously described as a hyperparasite of *Peristenus* spp. (Day, 2002 - *Ann. Entomol. Soc. Am.* **93:** 640-647). The male:female ratio of eclosing adult *Persitenus* was 3:1.

Continuing Research: It is proposed to continue studies on *Lygus* mitochondrial gene sequences in order to expand the range of *Lygus* species for which PCR markers are useful. Similarly, it will be useful to expand the list of *Persitenus* species for which PCR marker technology will be workable. The identification of hyperparasitism in Saskatchewan *Lygus* populations suggests that development of PCR primer sets to distinguish *Mesochorus* from *Peristenus* will also be critical in expanding the set of molecular markers available for the study of *Lygus*, parasitoid, and hyperparasitoid population dynamics in the field.

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RESEARCH PROGRESS REPORT - MANITOBA 2002

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CEREAL CROP RESEARCH

1)Title: Development of spring wheats with resistance to the **wheat midge**

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Problem: The wheat midge *Sitodiplosis mosellana* is a serious pest of spring wheat throughout most wheat-growing areas of western Canada. During outbreak years**,** the midge can reduce both the yield and quality of the seed. Host plant resistance offers the best means of preventing wheat midge damage because most infested fields suffer damage below the economic threshold.

Objective of Research: The discovery of a gene that renders wheat resistance to the midge offers an opportunity to control damage without the use of insecticides. The insertion of the gene into suitable spring wheat lines requires 1)multiple backcrossing to exclude undesirable extraneous genetic traits, and 2)development of management strategies to minimize the selection of virulent midge biotypes.

Summary of Results: Resistance to **wheat midge** has now been incorporated in advanced breeding lines of CPS, CWRS and CWWS classes of common wheat. The resistance is holding up well in multi-location field trials and the breeding process continues. A CWRS reached the second year of the 3-year registration trial in 2002, with a decision to advance it to the third year of trials due in February 2002. A number of other advanced CWRS and CPS are coming into the registration trials over the next few year or two.

Antixenotic resistance in the form of oviposition deterrence has been found in durum wheat. The backcrossing and selection process for durum wheats, to incorporate both antiobiosis and antixenosis resistance to **wheat midge**, continued in 2002. Lines with resistance from hexaploid wheat sources have been developed.

Inheritance of resistance to the **wheat midge** was investigated in spring wheats derived from nine resistant winter wheat cultivars. Doubled haploid populations were generated and these segregated in a ratio of 1 resistant :1 susceptible, indicating that a single gene confers the resistance. F_2 progeny from an intercross among spring wheats derived from the nine resistance sources did not segregate for resistance. Therefore, the same gene confers resistance in all nine sources of resistance. Susceptible plants were reliably discriminated from heterozygous or homozygous resistant ones in laboratory tests, based on the survival and development of wheat midge larvae on one or two spikes. The gene was named Sm1.

___Wheats being developed with antibiotic resistance to the **wheat midge** cause mortality to larvae in excess of 99%. When released for commercial use these wheats will put a substantial selection pressure on the wheat midge and will cause a comparable reduction in parasitoid populations. In 2002 we completed tests on plots with various proportions of resistant and susceptible wheats to identify a suitable seed mixture which will minimize crop damage and maximize the survival of avirulent wheat midge and parasitoids. Tests were replicated south of Winnipeg and in eastern Saskatchewan. Analysis of data conducted to date confirms that the method is promising.

Midge species in the Cecidomyiidae produce broods of varying sex ratios, with some species being almost exclusively monogenous (females produce either all female or all male offspring). Individual mated females were isolated on 1-2 wheat heads and the larvae from each female were overwintered separately. Adult sex ratios were determined from each brood to identify whether midges have mixed or unisexual broods. The wheat midge was found to produce strictly unisexual broods.

The relative susceptibility to **wheat midge** of various species of rye, ryegrass, and some European grasses, *Elymus* and *Lolium* spp. were assessed in the field. The focus of work in genera other than *Triticum* of the subtribe Triticinae is to identify species on which the wheat midge may have evolved. This will assist us in identifying promising new sources of germ plasm for use in resistance studies. All rye (*Secale* spp.) and some rye and some related grasses were susceptible to wheat midge. The ability of the midge to colonize the related grasses was extremely low, and unlikely to sustain a population. Greenhouse studies to further separate species differences are to follow. A study on the susceptibility of barley cultivars to the wheat midge was completed. All barleys are susceptible to damage by the wheat midge but at levels substantially below any economic concern. Hullessness in barley has no effect on damage, but 6-rowed varieties are more susceptible than 2-rowed varieties of barley.

Continuing Research: 1)We have initiated a backcrossing program based on the research described in below, with the goal of combining wheat midge resistance and Hessian fly resistance in two advanced breeding lines of each of the three classes of common wheat. The first cross was completed in the summer of 2002, and the first backcross will be made in October 2002. These lines should be available as germplasm in 2004, after 5 or 6 backcrosses. 2)The germplasm is now part of the durum breeding program of John Clarke, at AAFC in Swift Current, SK. 3)Computer models are being developed to identify a refugia strategy to help preserve the resistance gene and to integrate biocontrol and crop resistance of wheat midge in spring wheat. The production of unisexual broods by the midge will be incorporated into the computer model being developed to help preserve the gene for resistance.

2)Title: Resistance to **Hessian fly,** *Mayetiola destructor* in spring wheats

Author and Associates: D. Brown, R J Lamb, IL Wise (iwise@agr.gc.ca), CRC, and J. Whistlecraft, AAFC, London, Ontario.

Problem: The **Hessian fly** is a sporadic pest of spring wheat throughout all wheat growing areas of western Canada. The pest can reduce yields of spring wheat by damaging the stem at the nodes, causing the stem to lodge. Various resistant genes have been bred into winter wheat

cultivars in the United States but none of these genes have been added to spring wheats grown in Canada.

Objective of Research: In 1997 we began a project to help wheat breeders incorporate the appropriate resistance genes into spring wheats for western Canada.

Summary of Results: Advanced breeding lines resistant to the wheat midge were screened for resistance to the **Hessian fly** both in the laboratory and in the field in 2000-2002. Several winter wheat cultivars that are well established as a control strategy for this pest in the USA have been used as a source of resistance to the wheat midge in spring wheat lines. Many wheat midge resistant lines retained resistance to the hessian fly. If any of these breeding lines meet quality and agronomic requirements, they will be registered with Hessian fly resistance being an additional benefit.

A number of registered cultivars showed varying degrees of tolerance to feeding by the Hessian fly. All CPS lines and most bread wheats were highly susceptible to stem breakage at the feeding site. AC Superb was the most tolerant registered cultivar with stem breakage being up to 5-fold less than that of AC Barrie in 2000 and 2002.

Continuing Research: Development of wheat lines resistant to the **Hessian fly** will be combined with breeding programs for **wheat midge** resistance.

DICOT CROP RESEARCH

1)Title: Potato virus Y and potato leafroll virus in seed potato production

Author and Associates: DL McLaren (dmclaren@agr.gc.ca) Crop Production Pathologist, Brandon Research Centre, AAFC, Brandon, BG Elliott and T. Shinners-Carnelley, Manitoba Agriculture and Food, Soils and Crops Branch, Carman

Objective of Research: The potato virology project was initiated in 1998 and is a collaborative study involving Agriculture and Agri-Food Canada, Manitoba Agriculture and Food, the Manitoba Crop Diversification Centre, the Seed Potato Growers Association of Manitoba, the Keystone Vegetable Producers Association, Westman Aerial Spraying, a number of other industry partners, and a number of commercial and seed potato growers.

Summary of Results: In 2002, 32 Manitoba potato fields were surveyed for the **aphid-vectored viruses**, potato leaf roll virus (PLRV) and potato virus Y (PVY). This survey included a visual assessment of both commercial and seed potato fields in early July. Fields were located in a number of areas including Austin, Bagot, Brookdale, Carberry, Gladstone, Glenboro, Graysville, Gretna, Kemnay, Holland, Neepawa, Portage, Shilo and Winkler. An aphid trapping network was established to assess aphid movement and virus content in both commercial and seed fields. A total of 37 traps were distributed in seed fields over 13 locations for approximately 13 sampling interval end dates. Aphids were collected from pan and suction traps and from leaf samples. **Green peach, potato** and **buckthorn aphid** identification was conducted from samples collected from all traps and leaves. Preliminary results indicate that levels of PVY and PLRV in potatoes sown in Manitoba were less than in previous years. Aphid populations in seed fields were slightly higher this year with an average of 7 aphids/trap/week (2002) compared to 5

aphids/trap/week in 2001. The higher aphid populations in 2002 may translate into greater spread of virus in those fields where virus was found but tuber results from selected fields are not available yet to confirm this.

2)Title: 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, J. Soroka, Saskatoon and P. Mason, Ottawa, AAFC, and U. Kuhlmann, CABI Bioscience, 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: This project started in 1999 with an examination of the effects of agronomic practices on the population biology of **root maggots** in canola and the damage to plants. In 2000, we began a three year project to assess the potential for introducing European parasitoids for control of **root maggots** (particularly *Delia radicum*) in canola in Canada.

Summary of Results: We have almost completed a study of the influence of tillage practices and seeding rates on maggot populations, parasitism rates and predator occurrence in large field plots. In collaboration with J. Gavlovski (Manitoba Agriculture and Food) and D. Maclaren (AAFC Brandon) we are examining the influence of production practices on maggot damage in commercial canola fields. We are also examining the spatial distribution of root maggots within large field plots and commercial fields, and have found evidence for elevated incidence of maggots and damage at field margins and influences of windbreaks on the pattern of distribution.

In summer 2000, weekly collections of immature *Delia* were made from canola at two sites in Alberta, one site in Saskatchewan and two sites in Manitoba. In fall, these collections were supplemented by mass pupal collections in the three provinces. As a result, we reared about 11,000 *Delia* from western Canada. Preliminary information suggests parasitism rates approach 50% in Manitoba, but are considerably less in Saskatchewan and Alberta. At least six parasitoid species are involved of which the most important are *Trybliographa rapae* and *Aleochara bilineata*. In summer of 2001 and 2002, a comparative study was made of *Delia* in Europe, with collections in oilseed rape from northern Germany and Switzerland, from mustard in the southern Rhine Valley and in vegetable brassicas in Switzerland. With a few exceptions, the guild of parasitoids in the prairies and in Europe did not differ. However, one European species has been identified that shows promise for introduction. This species, *Aleochara bipustulata*, has a northern distribution and appears well adapted to the small root maggot pupae typically found on canola.

Continuing Research: We plan to perform detailed studies on the characteristics of *A. bipustulata* to determine how it will interact with the prairie parasitoid guild and how well it would be synchronized with vulnerable stages of *D. radicum* in canola in the prairies.

3)Title: Economic significance of late season populations of **lygus bugs** in alfalfa and buckwheat

Authors and Associates: N.J. Holliday (neil_holliday@umanitoba.ca), Dept of Entomology, U of M, I.L Wise, CRC, and BG Elliott, Manitoba Agriculture and Food

Problem: A study initiated in 2001 found **lygus bugs** feed and reproduce on buckwheat and populations are distributed throughout the field. A large increase in adult populations was observed about the time of harvest of canola.

Objective of Research: In 2002, the U of M began a three year study of the economic implications for seed alfalfa and buckwheat of the large populations of adult lygus that enter these crops at about the time of harvest of canola. It seems reasonable to suppose that the adults are immigrants that are displaced by the loss of their canola habitat, and we shall be studying the influence of inter-field distance and topography on the numbers of immigrants, and investigating whether natural enemy manipulations can provide control of these populations.

Summary of Results: As for 2001, a second generation of **lygus bugs**, *Lygus lineolaris,* in Manitoba completed their development on buckwheat in commercial field and experimental plot studies. To assess economic damage in commercial fields of seed alfalfa, insecticides are used to produce three different levels of late season populations of lygus bugs, and the effects on yield quantity, quality and germination rate will be assessed. A parallel study in buckwheat, because of the absence of registered insecticides, are using caged flower heads in an experimental plot for the lygus treatments.

Continuing Research: Further assessments on economic injury in both crops will continue.

4)Title: Development of an integrated pest management scheme for seed alfalfa: population processes

Author and Associates: N.J. Holliday (neil_holliday@umanitoba.ca), P. MacKay, Dept. of Entomology, U of M

Objective of Research: To examine the populations of pests and beneficial insects in seed and hay alfalfa, and how they are related to current production practices. We are also examining the rates of pest colonization of seed fields sprayed with insecticides, and the role of predators in the dynamics of the major pests.

Summary of Results: Since 2000, large scale field trials have been conducted to determine whether natural enemies can be attracted from cut alfalfa hay fields to adjacent seed fields using aphid sex attractant pheromones. Adult males of some species of lacewings can be reliably attracted by this method, and there is some indication of an elevation of the predatory larvae of these species. Other allied chemicals show promise for both parasitoid and coccinellid attraction.

STORED PRODUCT RESEARCH

1)Title: The use of *Trichogramma* to control **Indian meal moth**.

Author and Associates: Paul Fields (pfields@agr.gc.ca), CRC, AAFC Winnipeg, Dr. Paul Flinn and Matt Grieshop, USDA, Manhattan, Kansas

Problem: The **Indian meal moth** *Plodia interpunctella* and the **Mediterranean flour moth** *Ephestia kuehniella* are serious pests in food processing facilities.

Objective of Research: An alternative method to control stored-product Lepidoptera is to release parasitoid wasps, *Trichogramma* spp., into the stored-product environment. These chalcid wasps lay their eggs inside moth eggs, thus killing the eggs and preventing the development of the pest. In Germany, control is achieved by releasing large quantities of *Trichogramma evanescens* using the inundative release strategy. Despite the wide spread use of parasitoids in field and glass house settings, this biological control has not be used commercially in North America to control warehouse and food processing insect pests.

Summary of Results: Trials in a petfood store and warehouse in Canada were begun in June 2002. *Trichogramma pretiosum* were released every 2 weeks in June and July and every week in August and September. In the warehouse one area was left untreated and the other area was treated. The *Trichogramma* treated area had reduced numbers of Indianmeal moth in traps compared to the untreated area. The release of *Trichogramma* in the pet food store may have reduced the Indian meal moth populations slightly but did not control the infestation. In the USA, 2 retail stores were treated with *Trichogramma* and 2 stores not treated. A preliminary analysis of the trap catches of Indian meal moth indicates there was a reduction in one store that received *Trichogramma,* but not the second store.
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2)Title: Laboratory selection for resistance to diatomaceous earth.

Author and Associates: Paul Fields, CRC, AAFC Winnipeg

Problem: Diatomaceous earth (DE) is an important means of controlling various insect pests in grain. Constant exposure to sub-lethal does may increase the rate DE-resistant populations develop.

Summary of Results: Three types of selection were used to test for the development of resistance to DE. Insects were constantly cultured on wheat with low dose of DE, or insects were constantly exposed to DE with twice the low dose but only in the top half of the wheat. In the third method of selection, adults of *Tribolium castaneum* (**red flour beetle**), *Cryptolestes ferrugineus* (**rusty grain beetle**) and *Sitophilus oryzae* (**rice weevil**) were exposed to a high dose of DE for 10-14 days that killed approximately 50 to 80% of the population approximately every 2-3 months.

Constant exposures to sublethal concentrations of DE, either mixed throughout the wheat or just the top half of the wheat, did not increase tolerance to DE over a 3-year period. Occasional high doses of DE that killed 50 to 80% of the population increased the tolerance of all 3 insects tested. At the end of the 3 years of selection, *T. castaneum* had a LD_{50} of 1004 (831, 1143) ppm, (2 times the control), *C. ferrugineus* had a LD_{50} of 379 (321 - 501) ppm, (3 times the control), *S. oryzae* had a LD_{50} of 1286 (1198, 1375), (4 times the control). This work

suggests that method of using diatomaceous earth will effect the rate that the DE-resistant populations develop.

3)Title: Soft X-ray image analysis to detect primary and secondary stored-product insects in grain

Authors and Associates: C. Karunakaaran, DS Jayas, Department of Biosystems Engineering, University of Manitoba, NDG White, Cereal Research Centre, AAFC

Problem: Insect infestations in stored wheat downgrade the chemical characteristics and baking qualities of wheat flour and insect-infested flours.

Objective of Research: The efficiency of a soft X-ray method (15KV potential, 65μA current) to detect infestations caused by *Cryptolestes ferrugineus* (Stephens) the **rusty grain beetle**, *Tribolium castaneum* (Herbst), the **red flour beetle**, *Plodia interpunctella* (Hubner), the **Indianmeal moth**, *Sitophilus oryzae (*L.), the **rice weevil** and *Rhyzopertha dominica* (F.), **lesser grain borer**, in wheat kernels was determined.

Summary of Results: Wheat kernels infested by different insects were prepared by artificial implantation of insect eggs or by introducing adult insects in wheat samples. Kernels infested by different stages of the insects were X-rayed until the adults emerged from the kernels. A total of 57 features using histogram and shape moments, and textural features were extracted from the X-ray images and a linear-function parametric classifier was used to identify the insect-infested kernels. The parametric classifier identified more that 84% of infestations due to *C. ferrugineus* and *T. castaneum* larvae. The infestations by *C. ferrugineus* pupae-adults and *P. interpunctella* larvae were identified with more than 96% accuracy by the classifier. Kernels infested by different stages of *S. oryzae* and *R. dominica* larvae were identified with more than 98% accuracy by the classifier. Using the Berlese funnel method, 67%, 51% and 81% of the first, second, and third instars of *C. ferrugineus,* respectively, were extracted in 6h. The parametric classifier identified kernels infested by external and internal grain feeders with more than 86% accuracy.

4)Title: Momentum-diffusive model for gas transfer in granular media

Author and Associates: S. Xu, DS Jayas, WE Muir, DBE, University of Manitoba, NDG White, CRC, AAFC Winnipeg

Problem: The development of controlled atmosphere storage technology (CO2) for insect control requires an accurate prediction of the distribution of introduced gases in bulk grain. The published models are based on either diffusion theory or convective-diffusion theory. The momentum transport of gases, which is a key driving force for the gas mixture movements, has been neglected.

Objective of Research: A momentum-diffusive model is proposed. The model is based on the combined effects of concentration gradients, pressure gradients, and gravity on the transport of gases in the bulk grain.

Summary of Results: The experimental data for CO2 transfer through connected columns of hot and cold wheat were used to validate the model. The equations were solved using the finite difference method, and the predictions from the proposed model were in good agreement with the experimental results.

5)Title: Mortality resulting from interaction between the **red flour beetle** and the **rusty grain beetle**

Author and Associates: NDG White, CRC, AAFC Winnipeg, S. Suresh, D.S. Jayas, R.B. Hulasare, DBE, University of Manitoba

Problem: *Tribolium castaneum* (Herbst,,) the **red flour beetle**, and *Cryptolestes ferruginieus* (Stephens), the **rusty grain beetle** both feed on damaged stored cereals and each are facultative predators/cannibals. They often occur together in farm granaries containing stored cereals.
Objective of Research: To measure the predatory and cannibalistic habits of the red flour beetle and the rusty grain beetle.
Summary of Results: Various immature stages of both species were exposed to adults or larvae of both species in the presence or absence of ground wheat at 25 or 30□C. In the absence of wheat, adults always consumed all 25 exposed immatures, regardless of stage or species, in 7 days. Predation/cannibalism was usually higher at 30 □C that at 25 □C with ground wheat present. Larvae of *C. ferrugineus* killed few *T. castaneum* pupae, but larvae of *T. castaneum* consumed many of their own pupae. Because *T. castaneum* adults are about 2.0 mg, wet weight, and *C. ferrugineus* adults are about 0.2 mg, wet weight, *T. castaneum* consumes more exposed individuals of both species in a given period. However, in grain bulks, the immature stages of *C. ferrugineus* are hidden under the germ seed coat and the adults are free to predate *T. castaneum* eggs and larvae.

APPENDIX III

SUBCOMMITTEES AND CHAIRS FOR 2002-3

Cereal crops and grain corn . . …… . . . J. Gavloski, O.O. Olfert
Oilseed crops. . . …… . . . . . I. Wise, L. Dosdall, J. Gavloski
Forage crops. . . . . ……..... J. Soroka, J. Otani
Special crops. . . . . ……... . . . . . S. Hartley, O. Olfert
Household pests. . ……. . . . . J. Byer
Home vegetable crops.. . . . ……. . . . . J. Broatch
Commercial vegetable crops. …….. . . . . R.S. Vernon, B. Elliott
Greenhouse crops. . . . . ……... . . . . R. Costello, K. Fry
Interior plantscapes and house plants…… . . . . . K. Fry
Mushrooms . . . . . …….. . . . . R. Costello
Berry crops . . . . . ……... . . . . . K. Fry, B. Elliott
Tree fruits . . . . . ……. . . . . H.G. Philip, B. Elliott
Shelterbelts, ornamental trees and shrubs . . . . . …….D. Reynard
Seasoned wood and timber structures . . . . . ……... H.G. Philip
Turf . . . . . …… G. Byrtus
Warehouse and farm-stored grain . . . . . …….. N.D.G. White
Hazards of applying insects to crops in bloom . . . . . ……J. Soroka

Production of the Guide to Integrated Control of Plant Pests, and WCCP website:

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