canolacouncil OF CANADA

ANNUAL FINAL REPORT
Canola Agronomic Research Program (CARP)

The Annual Final Report should fully describe the work completed for the year and note the personnel involved. It should also note any deviations from the original plan and next and/or corrective steps as may be required if deviations are noted. The report should also provide an update on the status of the Project including forecasted date of completion. A complete statement of expenses should be included. In the event major changes are anticipated within the budget supporting notes along with a proposed budget should also be included. The report should also capture a complete summary of activity for the year.

Project Title: Biocontrol of canola cutworms: Identification and attraction of parasitoids

Research Team Information

Lead Researchers:		
Name	**Institution**	**Expertise Added**
Barbara Sharanowski	University of Manitoba	Insect Taxonomy
Research Team Members		
Name	**Name**	**Name**
Dr. Yvonne Lawley	University of Manitoba	Agronomy

Project Start Date: **April 1, 2012** **Project Completion Date:** **March 31, 2015**

Reporting Period: **April 1, 2012** **to** **March 31, 2015**

CARP Project Number: **2012-18**

Instructions: This Annual Report shall be completed and submitted on or about March 31st of each fiscal year that the agreement is in effect. The Lead Researcher of the project in question shall complete and submit the report on behalf of his/her complete research team.

This Report is a means by which to provide a detailed update on the status of the project and summarize project activities. Details may be general in nature unless major issues or changes arise (e.g., change of scientists, significant change or delay of activities) including impacts on budgets. Please note that financial reports of major impact on budgets.

The following template is provided to assist you in completing this task. Please forward the completed document electronically to your appropriate CCC contact.

1. Forecasted Date of Completion:

August 2015

2. Status of Activity: (please check one)

_____ Ahead of Schedule _____ On Schedule ___X__Behind Schedule ____ _ Completed

Comment:

All research is completed and data analyzed, except the key to parasitoids of cutworms, which will be completed by the end of summer 2015. The key has been completed but images are being added to it and it will be published in an online journal as well as disseminated on the web to growers. All other data and major deliverables are reported here.

3. Completed actions, deliverables and results; any major issues or variance between planned and actual activities.

See Attached Report

4. Significant Progress/Accomplishments

Summaries from the attached report are listed here for each deliverable (for detailed data, see the attached report):

1. **Determine species and biology of parasitoids (through sampling, rearing, and dissection)**

   Sixteen different species of Hymenopteran parasitoids were found attacking cutworms in the Canadian Prairies. Several of these represent new host records. Overall parasitism rates ranged from 3-26%, with the highest rates found in Alberta. Parasitism rates in Manitoba were especially low. Of the parasitoids, *Copidosoma* spp. were the most common parasitoids, although their parasitism rates may still not be enough to reduce cutworms below economic levels. Entomopathogenic fungi were found to cause higher mortality than any of the parasitoid species and should be investigated for further studies as a viable control option.

2. **Characterizing flowering cover crop species for potential use in conservation biocontrol**

   Eleven plant species were evaluated as potential cover crops to attract parasitoids of cutworms at two locations (Carman, and Portage la Prairie, MB) in 2013 and 2014. Three cover crop mixtures were also evaluated. When grown in as a single species cover crops that flowered early in the growing season included: wild mustard, field pennycress, brown mustard, canola, tillage radish, and buckwheat. Later flowering species included: camelina, phacelia, hairy vetch, chickling vetch and berseem clover. Many of the cover crops species that flowered earliest also flowered for a relatively short period of time, for example field pennycress and wild mustard. Some cover crop species that flowered later also flowered for a longer period of time, for example phaselia and hairy vetch. Some plant species flowered for extended periods of time that were terminated only by the first fall frost. Buckwheat was exceptional as it flowered early and continued to flower for a long period of time. Growing these cover crops species in mixtures resulted in earlier flowering and longer flowering periods on average. Growing plants in mixtures also increased the overall flowering period duration by overlapping the complimentary flowering periods of individual species. With the information learned in this study about the relative flowing periods and durations for each species and the observation that growing cover crops as mixtures extends flowering period, it would be possible to design cover crop mixtures to compliment the life cycles of known parasitoids, such as *C. cuproviridis*.

3. Correlating reproductive period of main parasitoid with prospective cover crops (choice tests with parasitoids and flowers)

Of the nine flower species tested in the multiple choice experiment, wasps were preferentially attracted to camelina, mustard, buckwheat, and canola. However, dietary state (fed or starved) significantly affected the preferences of *C. cuproviridis* to specific colours and odours. Food inexperienced *C. cuproviridis* significantly preferred yellow over green and white in the dual choice colour tests. Of the two yellow colours tested, *C. cuproviridis* preferred the bright yellow colour of mustard and canola flowers over the lighter yellow flowers of camelina. However, only food inexperienced parasitoids were significantly attracted to yellow over the other colors, suggesting strong innate preferences for yellow when starved. Additionally, wasps preferred canola and mustard odour over camelina and buckwheat, although significant differences were only noted for food inexperienced wasps. This may suggest an innate response to nectar foraging and a switch from food foraging to host foraging after nectar feeding, implying different olfactory gene expression with different physiological states.

Canola, a *Brassica*, is widely grown in the Canadian prairies as a cash crop. Both canola and mustard flower from mid June to mid August and we observed *C. cuproviridis* adults emerging from field collected cutworms from early July to early August. Thus, the flowering period of these plants coincides with the reproductive period of *C. cuproviridis*. This suggests that these wasps should have plentiful nectar producing flowering plants when they are searching for these additional food resources. Interestingly though, in the multiple choice experiment, food inexperienced *C. cuproviridis* was most attracted to camelina and significantly less so to mustard and canola, even though the latter plants were preferred in the colour and odour choice tests. In addition to dietary state (starved or fed), flower morphology, colour, odour, and nectar availability, as well as age and experience of the wasp can also influence the ability of a parasitoid to locate and utilize the plant as an additional nutritional source. As we utilized naïve, newly emerged wasps, experience would not have an effect. Thus, our results suggest that *C. cuproviridis* may utilize nectar from canola, mustard, and camelina, but mustard and canola may have a less attractive architecture compared to camelina.

Though proovigenic parasitoids, such as *C. cuproviridis*, have a finite egg load, as a benefit of increased longevity they get sufficient time to deposit eggs, especially if hosts are patchily distributed like cutworms. The survival time of *C. cuproviridis* was similar on all plants tested (canola, camelina, mustard and buckwheat), but reduced relative to honey. The additional nutritional resources provided by the tested cover crops did improve longevity and thus can maximize the efficiency of the parasitoid's ability to lay eggs.

Habitat diversification can be a valuable tool for integrated pest management practices and cover crops may offer an attractive alternative to field margin plantings given the dual economic and ecosystem benefits. Camelina, canola and mustard do attract *C. cuproviridis*. However, camelina was preferred when the entire plant was offered in a multiple choice experiment and may be a good option for a cover crop for cutworm control. Camelina has several benefits as a cover crop, including weed suppression and as a low-cost green manure. Unfortunately, adding a summer flowering Brassicaceae may lead to increased attraction of late season pests of canola, which may negate the benefits of cutworm control for the next season. Further studies would be required to test for plant architecture effects and interactions with other insect species before camelina is recommended as a habitat management tool for maximizing parasitism of cutworms.

4. Development of identification tools for parasitoids of cutworms

This key is being developed as a tool for researchers to identify all sixteen species of parasitoids found attacking cutworms in the Canadian Prairies. The key will be supported with high resolution images of character states to assist identification, and will be published in an online, open-access journal and website. The key will be completed at the end of August 2015. We have also amplified the barcoding gene fragment for several specimens f

Copidosoma and have discovered wither a cryptic species complex, or need for taxonomic revisions that would synonymize some species of *Copidosoma*. These results will also be completed by the end of 2015.

5. Research and Action Plans/Next Steps

We are completing the identification key for all parasitoid species of cutworms, as well as teasing apart the taxonomic issues with the prospective Copidosoma bakeri species complex. Additionally we are completing studies on assessing the effectiveness of entomopathogenic fungi (EPF) as a control tool for cutworms, as the parasitism rates are so low, that even with the addition of cover crops they may not reduce cutworm populations below economic levels. The latter studies on EPF were not a part of the original deliverables, but we feel that understanding what role EPFs may play in cutworm management in canola is an important aspect of developing sustainable and effective biocontrol programs. All research will be complete by the end of 2015.

6. Budget impacts in the event major issues or variance between planned and actual is noted:

None, although we have had to add in some molecular work to tease apart the cryptic species complex for *Copidosoma* spp. However, we were able to do this with the available research funding.

Please forward an electronic copy of this completed document to:

Gail M. Hoskins
Crop Production Administrator and CARP Coordinator
Canola Council of Canada
400 – 167 Lombard Ave.
Winnipeg, MB R3B 0T6
Phone: (204) 982-2102
Fax: (204) 942-1841
E-Mail: hoskinsg@canolacouncil.org