

Survey of Susceptibility to Diagnostic Concentrations of Registered Insecticides in Canadian Colorado Potato Beetle Populations

AgriInnovation Program – Industry-led Research and Development Stream

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Activity Objectives (as per approved workplan):

This project will conduct a survey of susceptibility to diagnostic concentrations of registered insecticides in Canadian Colorado Potato Beetle (CPB), *Leptinotarsa decemlineata* Say populations: a) the spinosyn insecticides spinosad (ENTRUST™ 80) and spinetoram (Delegate™); b) the neonicotinoid insecticides thiamethoxam (ACTARA® 240 SC) and clothianidin (TITAN™); and c) the anthranilic diamide insecticides chlorantraniliprole (CORAGEN™) and cyantraniliprole (CYAZYPYR®) in 20-25 Canadian populations of Colorado potato beetle and:

1. Determine the LC₅₀ and LC₉₅ for registered active ingredients, for 1st instar larvae of the insecticide-susceptible CPB. The LC₉₅ will be utilized as the Diagnostic Concentration (DC) in a survey to determine the range of susceptibility to the insecticide in collected CPB populations;
2. Collect or arrange collection of adult or late instar CPB larvae from 20-25 selected organic and conventional potato fields in major production regions from western, central and eastern provinces;
3. Maintain collections for production of eggs and 1st instar larvae for toxicity bioassay;
4. Use the DC for each insecticide to screen the susceptibility in the lab-maintained strains (> 70% mortality=susceptible; <70% and >30%=tolerant; <30% mortality=resistant);
5. Determine LC₅₀ and LC₉₅ values for the 6 insecticides for the 20-25 field collections if considered tolerant/resistant compare with similar values generated for the reference, insecticide-susceptible CPB strain;
6. At the end of the field season in November-January, prepare a report summarizing results and submit to The Agent.

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Research Progress to Date (use plain language):

Twenty five CPB populations were collected in 2017 from four participating provinces (Manitoba, Ontario, Quebec and PEI). Of the 25 populations, 17 were tested to assess susceptibility to two insecticides in the neonicotinoid class, and approximately 1/3 of those populations were tested with representative insecticides from the spinosyn and diamide classes. In PEI and Quebec, resistance and reduced susceptibility to the neonicotinoid products were observed with CPB collected from conventional potato production sites where neonicotinoid products were applied during the previous five seasons. Unfortunately only limited information on neonicotinoid susceptibility in Manitoba CPB populations was obtained - one population was determined to have reduced susceptibility to Titan (clothianidin). In Ontario, 3 of the 4 collected populations were from organic farms where no insecticides were applied. The one conventional potato farm population tested was resistant to Actara (thiamethoxam). Five populations were tested with spinosyn products, Delegate and Entrust, and the diamides, Coragen and Verimark. The CPB populations tested remained susceptible to spinosyns, but only one remained susceptible to the diamides.

Extension Activities:**Conference Abstracts**

- 1) Scott, I.M. 2018. *Insecticide resistance and the Colorado potato beetle: An update for 2018*. Invited presentation at the Biochemistry Department, University of Moncton, Moncton NB, April 27th.
- 2) Scott, I.M. 2018. *Slowing down the treadmill: How to manage insecticide resistance in Ontario vegetable pests*. Ontario Fruit and Vegetable Convention, Niagara Falls ON, February 22nd.

Interviews and News Releases

- 1) *New strategies are needed for the Colorado potato beetle*. Article in **Ontario Farmer**. May 1, 2018. Page 16.
- 2) *Battling Colorado potato beetle*. Article in **Potatoes in Canada**. Spring 2018. Pages 5-7.
- 3) *Survey results for Colorado potato beetle reveal increased resistance*. Article in **The Grower**. February 2018. Page B8.

Early Outcomes (if any) or Challenges:**Outcomes:**

Insecticide use history - An insecticide use survey was completed by 19 of 25 respondents and indicated that most had applied neonicotinoid insecticides, 79% (15/19), over the previous five years. A significant number of respondents had also used spinosyns, 47% (9/19), pyrethroids, 37% (7/19), and anthranilic diamides, 37% (7/19). At three locations the application of other products was reported, one CPB population was exposed to organophosphate insecticides and at three locations no insecticides were applied (organic potato production). Of the three research farm respondents, only one used three or more classes of insecticide over the past five years. Fifty percent (8/16) of the conventional farms used three or more insecticide classes and another 13% (2/16) used two or more.

Insecticide susceptibility - The bioassay results with neonicotinoid products where larvae have been tested with the DCs indicate that 40% of the populations are resistant to Actara (thiamethoxam) and 10% are resistant to Titan (clothianidin). All of the CPB populations (5) tested with spinosyn (Entrust and Delegate) DCs were found to be susceptible. In all cases, those five populations were also shown to be resistant or have reduced susceptibility to the neonicotinoids. This indicates that cross-resistance between spinosyns and those two classes may not be a concern. This was not the case for results of the diamide DC bioassays, as only 50% of the populations tested with Coragen (chlorantraniliprole) remained susceptible, and the one population tested with Verimark (cyantraniliprole) was resistant. Cross-resistance between neonicotinoids and diamides was not observed in previous CPB resistance monitoring, however these limited survey findings suggest that this may become a concern in Ontario and Quebec, especially the latter where diamides were used more often than the other provinces.

Challenges:

The 25 collected CPB populations were maintained in an insectary at LoRDC. Due to several factors (late season collection, disease and limited potato plant production) several of the populations were lost or did not produce eggs/larvae to allow for insecticide testing. By the end of the experiments in March 2018, the six insecticides had been tested with at least one of 17 populations with >10 larvae. Since the CPB populations that indicated tolerance or resistance could not be maintained satisfactorily, the 5th activity on the workplan – “determine LC₅₀ and LC₉₅ values for the 6 insecticides with field strains” - could not be accomplished.

Key Message(s):

The insecticide susceptibility survey in 17 Canadian populations of Colorado potato beetle (CPB) determined that 40% of the tested CPB populations were resistant to the neonicotinoid insecticide, ACTARA[®] (thiamethoxam). A further fifty to sixty percent of the populations could be considered to have reduced susceptibility to thiamethoxam and a second neonicotinoid, TITAN[™] (clothianidin), respectively. These results are not surprising as over 76% of the populations were collected from fields where neonicotinoid products have been applied within the past five years. Only thirty percent of the CPB populations collected were tested with spinosyn (ENTRUST[™] and DELEGATE[®]) and anthranilic diamide (CORAGEN[™] and VERIMARK[®]) insecticides. All of these populations were susceptible to spinosyns, but only 20% remained susceptible to the diamides. In the three cases where susceptibility to diamides was reduced or resistance was observed, either diamide products had previously been applied or there was reduced susceptibility or resistance to neonicotinoid products in the same populations. Based on the survey findings, cross-resistance among insecticide classes, and possibly between classes, should be an issue of concern for potato growers in the coming season.

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