



# SUSTAINABLE CROP PROTECTION

*Results from the Pesticide Risk Reduction Program*

## REDUCED-RISK WIREWORM MANAGEMENT IN POTATO

Wireworms, the larvae of click beetles, live in the soil and cause damage to the underground parts of plants. For potatoes, underground feeding reduces yields and causes cosmetic injury, making the product unmarketable.

Traditionally, organophosphate insecticides have been used to control wireworms. In Canada, many of these older, broad-spectrum products are no longer available or are being phased out. Consequently, wireworms have re-emerged as a serious problem in many regions and there are few effective controls.

The Pesticide Risk Reduction (PRR) Program's strategy for wireworm control is a national initiative. It was developed collaboratively through consultations with industry stakeholders, leading researchers in the field of wireworm management, and provincial crop specialists. It has been given the support of the federal PRR Program, delivered jointly by AAFC and Health Canada's Pest Management Regulatory Agency (PMRA) and provincial government programs. The objective of this strategy is to promote economic wireworm control, while reducing human health and environmental risks associated with insecticide use. This factsheet highlights some of the work that has been conducted with the support of the PRR Program and presents the status of these efforts.



**Photo 1.** A healthy potato tuber (left) compared to one damaged (right) from late summer feeding  
Image by R. S. Vernon



**Photo 2.** Severely-damaged potato: the result of wireworm feeding early in tuber growth  
Image by R. S. Vernon

## Identification of wireworm species across regions

There are more than 800 species of wireworm worldwide, but only a small number of these are serious agricultural threats that cause economic losses. Approximately 30 species are recognised as pests in Canada, many of which are found in potato fields. A nation-wide species survey was launched in 2008 in collaboration with Agriculture and Agri-Food Canada (AAFC), growers, and crop specialists. Field material was collected using various methods and wireworms sent to AAFC-Agassiz BC for identification. The survey continued in 2009. Already, differences in species composition across different regions in Canada are being identified from preliminary results. The first draft of the national species distribution map will soon be published, and should eventually help growers select the most effective control methods for the species in their regions.



**Photo 3.** Two of the wireworm species identified from a 2008-2009 national survey.  
Top: *Limonius canus* larva and adult;  
bottom: *Agriotes obscurus* larva and adult  
Top image by W. van Herk, bottom images by R. S. Vernon

## Insecticide screening

Wireworm species respond to insecticides in various ways. Some products kill wireworms, while others may repel the larvae or paralyze them for long periods. Due in part to the complex biology of these pests (larvae may live 2-6 years), pesticide screening is a challenging endeavour. Methods



**Photo 4.** Typical setting of a screening trial designed to generate efficacy data  
Image by R. S. Vernon

and protocols were developed to enable the handling and storage of these organisms. Toxicity and behavioural bioassays were established to allow for proper testing. These were implemented in laboratory and field trials aimed at identifying promising, reduced-risk products for registration.

As a result of these efforts, two products were submitted to the federal pesticides regulator, PMRA, for national registration:

- **Titan (clothianidin):** Efficacy data were generated in field trials to support a minor-use label expansion. Review by the PMRA was completed in November 2008, and the product was registered for use as of February 2009. Clothianidin, which works through long-term reversible intoxication of wireworms, is registered as 'suppressing' wireworm damage.
- **Capture (bifenthrin):** Efficacy data were generated in field trials to support a Category-A submission by the registrant. The product is registered for wireworm control in potatoes in the USA, and is currently under evaluation at the PMRA.

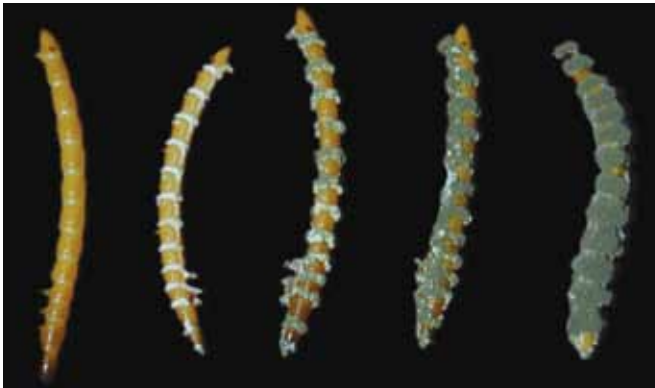
## Biopesticide evaluation

Two products were evaluated as potential biopesticides to control wireworms:

### (1) Pathogenic fungus - *Metarhizium anisopliae*

A highly virulent isolate of *Metarhizium anisopliae* Sorokin (Hypocreales: Clavicipitaceae) was found in BC and has

been developed for use as the active ingredient of a prospective pest control product. Known as LRC112, the isolate was demonstrated to infect and kill wireworms in the lab and under field conditions. Still an experimental product, its efficacy depends heavily on environmental conditions (i.e. temperature and soil moisture). More work related to challenges with increasing production of this biocontrol agent is needed.



**Photo 5.** A dead wireworm (left) as a result of infection by *Metarhizium anisopliae* (Agassiz strain). The progress to mycelial growth (second left) and heavy sporulation (right).  
Image by T. Kabaluk

## (2) CA-1: mustard-based product

Testing of CA-1 suggested that this commercially available product might have a repellent effect on wireworms. Laboratory and field trials determined that the product does not cause mortality, but may cause the pest to retreat deeper into the soil. This could potentially be used to keep wireworms away from the soil layers where most damage occurs. Timing appears to be critical, as early application may result in phytotoxic effects on the potatoes. The approach is still experimental and requires further study to assess its suitability.

## Innovative application technology

Blended insecticides and application procedures were tested in laboratory and field studies. Proprietary technology based on an attract-and-kill strategy was developed by AAFC and submitted for worldwide patent in 2009. The technology uses insecticides at rates that would pose negligible risks to human health or the environment, but would result in crop protection equivalent to or better than the current standard, Thimet. AAFC is working with an industry partner, and registration and marketing are expected within 5 years.

## Optimized crop rotation

Crop rotation is a pest management practice recommended to potato growers for wireworm management. AAFC is conducting a study aimed at identifying crops that are non-preferred hosts for wireworms. When serving as rotational crops, these have the potential to reduce female beetle egg-laying, thus decreasing larval populations for the following season. Rotational crops may also affect the survival of larvae developing in these sites. Field trials started in 2008 and continued in 2009 and four crops were tested: brown mustard, buckwheat, alfalfa, and barley. Differences in wireworm populations between the various crops are apparent in preliminary results. Final results may support new recommendations for this well-established cropping tradition.



**Photo 6.** Mustard crop tested for rotation with potato. Trial site near Charlottetown, PEI  
Image by C. Noronha

## For more information:

### Species survey, insecticide screening and proprietary application technology:

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### Biopesticides – *Metarhizium*

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#### About the Pesticide Risk Reduction Program at Agriculture and Agri-Food Canada

The Pesticide Risk Reduction Program delivers viable solutions for Canadian growers to reduce pesticide risks in the agricultural and agri-food industry. In partnership with the Pest Management Regulatory Agency of Health Canada (PMRA), the Program achieves this goal by coordinating and funding integrated pest management strategies developed through consultation with stakeholders and pest management experts.

The Pesticide Risk Reduction Program is actively pursuing the development and implementation of strategies which are key to reducing pesticide risks in the agricultural environment. To view our program's current priorities and the issues being addressed, visit [www.agr.gc.ca/prrmup](http://www.agr.gc.ca/prrmup). To consult other factsheets in this series, please visit [www.agr.gc.ca/sustainable-crop-protection](http://www.agr.gc.ca/sustainable-crop-protection).



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