

**The Effects of NOVODOR® (*Bacillus thuringiensis* subsp. *tenebrionis*) and ENTRUST® (Spinosad) on Reproduction and Feeding Activity of *Epitrix tuberis* (Coleoptera: Chrysomelidae) in Potato**

**Report to:  
Certified Organic Association of BC**

**Funding from: the Organic Sector Development Program- an Agri-Food Futures Fund from the Investment Agriculture Foundation and Fraserland Organics**

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December 2006**

## Executive Summary

Larval feeding by the tuber flea beetle, *Epitrix tuberis* Gentner, reduces quality and marketability of potato tubers. Two biologically derived insecticides containing *Bacillus thuringiensis* subspecies *tenebrionis* (Btt) and spinosad were explored as possible organic control options for tuber flea beetle in potatoes in coastal BC.

NOVODOR® (*Btt* strain NB 176), ENTRUST® (80% spinosad), or water (control) were sprayed to runoff in six replicated plots immediately prior to release of five mating pairs of tuber flea beetle adults (= 10 beetles/plot). Treated plants were covered with Remay cloth with edges buried with dirt for approximately one month before plant foliage was removed, and the Remay cover replaced with a plywood emergence trap. At harvest the number of tuber flea beetle larval feeding tunnels on each of ten tubers per treatment replicate was recorded, and the mean number of feeding tunnels was compared among all treatments.

Significantly fewer larval feeding tunnels were observed on tubers collected from Entrust plots than from the Control. Reduction in feeding damage in Entrust plots is most likely an indirect indication of higher mortality of the adult flea beetles originally added to plots. It is recommended that further work continue to examine timing of Entrust applications, and its impact on second-generation adults and feeding damage on harvestable tubers. Since conventional growers have had great success timing pesticide applications to target the first generation of Tuber flea beetle adults, a similar approach is proposed with Entrust, by pairing it with intensive crop monitoring throughout the season.

## **Introduction**

The tuber flea beetle, *Epitrix tuberis* Gentner, is considered a major pest of potatoes in British Columbia (Neilson et al., 1953). Larval feeding damages tubers and results in reduced marketability (Giles, 1987; Vernon & Mackenzie, 1991). Adult beetles also cause characteristic feeding damage on potato plant foliage resulting in a “shotholed” appearance (Vernon *et al.*, 1990).

Two biologically derived insecticides have elicited interest as possible organic control options for tuber flea beetles. *Bacillus thuringiensis* subspecies *tenebrionis* (Btt) has been shown to produce toxins effective in reducing coleopteran potato pest numbers (Ferro & Gelernter, 1989). Increased mortality and decreased feeding activity in larva were both reported in *Leptinotarsa decemlineata*, the Colorado potato beetle (Ferro & Gelernter, 1989). Spinosad formulations are another option for organic flea beetle management as they are very effective against foliar chewing insects. An advantage of both products is that they are relatively harmless to natural enemies.

The purpose of this study was to determine efficacy of NOVODOR® (formulation of Btt) and ENTRUST® (the organic formulation of spinosad) as potential organic approaches for reducing tuber flea beetle damage on potatoes.

## Methods

### *Study site and treatments*

An organic field of potatoes (var.: Russet Norkotah) was chosen as the site for the study. Plots for our trial were located nine rows in from the North edge of the field. Plots were spread out over three rows, with two buffer rows between. Within each row there were six study plots. Each plot measured 1 m by 0.6 m and consisted of 3 potato plants. Plots within each row were separated by 5m. Assignment of one of three treatments to each plot was random. The treatments consisted of 1) Control – water, 2) the Btt-formulation NOVODOR® - 25ml/L water, and 3) the spinosad formulation ENTRUST® - 0.211 g / L of water. Four Litres of each treatment were divided among plots receiving each treatment, and sprayed until runoff with a backpack sprayer on July 1, 2006. Treated plants were then covered with Remay cloth with the edges tucked in and buried with dirt (**Fig. 1**).

### *Tuber flea beetle collection and release*

Within 4 hours of treatment application tuber flea beetles were added to all plots underneath the Remay covers. One hundred and eighty tuber flea beetle adults (90 male: 90 female) were collected via aspirator from a potato field in Richmond, BC. These individuals were collected in mating pairs. Five mating pairs (five males: five females) were released into each plot. On August 4 plant foliage was removed, and the Remay cover replaced with a plywood emergence trap (**Fig. 2**), which provided a more secure cover and prevented additional flea beetles from moving in to treated areas.



**Figure 1** (left). Remay covered potato plants to contain flea beetles after they were first released. **Figure 2** (right). Emergence trap provided a more secure cover and prevented additional beetles from invading plots.

#### *Data collection and statistical analysis of results*

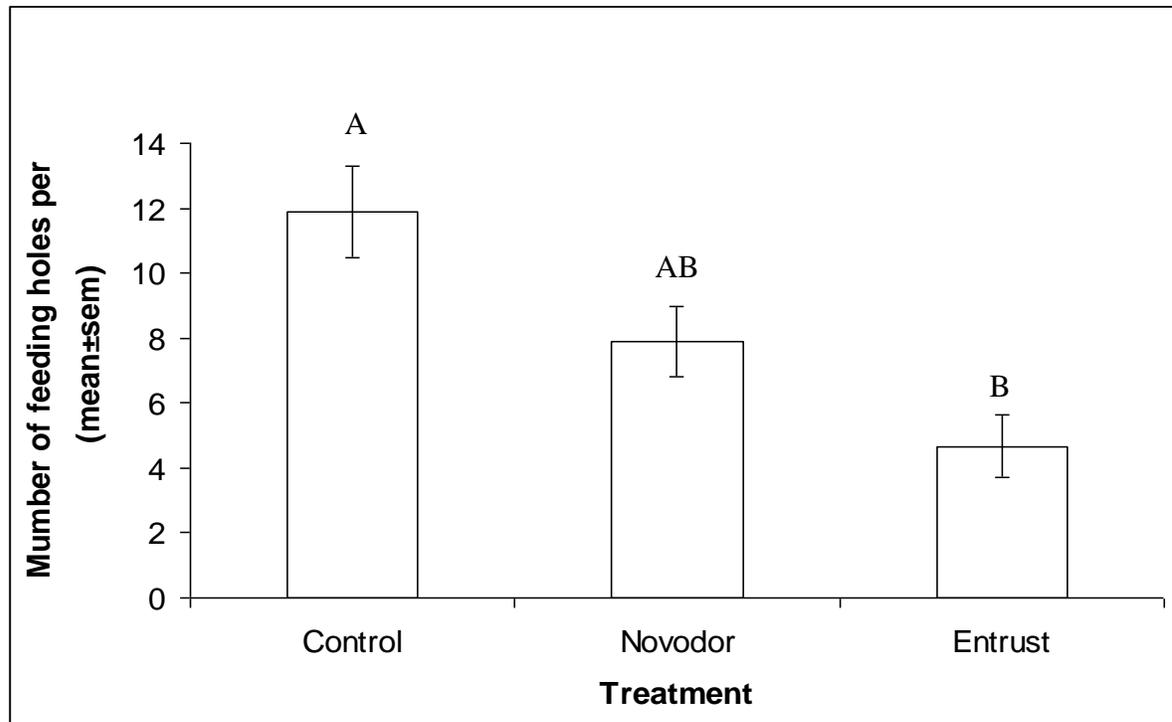
On September 14, 2006, ten tubers of equal size from each treatment plot were harvested and peeled. The number of tuber flea beetle larval feeding tunnels on each tuber was recorded. The mean number of feeding tunnels from ten tubers per treatment replicate was compared among all treatments. A one-way analysis of variance test followed by a Tukey *post-hoc* test was used to analyze the feeding damage dataset. All statistical analysis was done using JMP® version 5.0.1.2. (SAS Institute, 2005).

## Results and Discussion

There were significantly fewer feeding tunnels on the tubers collected from Entrust plots than from the Control (**Fig. 3**;  $F_{2, 15} = 9.54$ ,  $P = 0.002$ ). Reduction in feeding damage in Entrust plots is most likely an indirect indication of higher mortality of the adult flea beetles originally added to plots. Since spinosad has both contact and ingestion activity, the added beetles most likely died shortly after exposure to Entrust. This would be expected to result in fewer eggs and fewer larvae.

It is not surprising that Novodor treatment did not result in a reduction in tuber flea beetle larval feeding damage. Although, Btt formulations have been shown to reduce feeding damage by Colorado potato larvae (Ferro *et al.*, 1993; Hilbeck *et al.*, 1998; Nault *et al.*, 2000) an important difference between Colorado potato and tuber flea larvae are that Colorado larvae feed on leaves, whereas tuber flea larvae feed on tubers. Since Btt must be ingested by the larvae to be effective (Nault *et al.*, 2000) tuber flea beetle larvae will not be exposed to foliar applications. Adult beetles are not susceptible to Btt.

Further work is needed to develop the role of Entrust as a tool for organic flea beetle control. Future studies should continue to examine timing of Entrust applications and the impact on second generation adults and feeding damage on harvestable tubers. Since conventional growers have great success timing pesticide applications to target the first generation of Tuber flea beetle adults, a similar approach could be used with Entrust, by pairing it with intensive crop monitoring throughout the season.



**Figure 3.** Mean number of feeding tunnels per tuber by treatment. Significant differences between treatments are indicated by letters.

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