Beneficial Nematodes to Reduce Flea Beetle Population Size, 2019

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Background and Objectives

Flea beetles are a pervasive pest of brassica crops and are especially damaging to young brassica transplants and non-waxy brassica crops. Flea beetle adults lay their eggs at the base of brassica plants after mating. The eggs hatch and larvae feed on the fine roots for several weeks, pupate, and adults re-emerge from the soil to find new brassica leaf tissue to eat. Studies have shown that nematodes in the families *Steinermena* and *Heterorhabditidae* can attack the larval stage of flea beetles in the soil, thereby reducing the overall size of the population within a field over time. We wanted to know if this strategy would cause noticeable results in the field, and try to estimate the impact on flea beetle survival and reproduction. We used a mixture of 3 nematode species – *Steinermena carpocapsae* (SC), *S. feltiae* (SF), and *Heterorhabditis bacteriophora* (HB)—applied to the soil as a drench at the base of the plants and monitored adult flea beetle emergence from the soil over the following 5 weeks.

Our treatments were:

1. Untreated control
2. Low nematode rate: 3,125 SC + 3,125 SF + 3,125 HB/sq. ft. (93,750 of each species per plot)
3. High nematode rate: 13,935 SC + 13,925 SF + 13,925 HB/sq. ft (418,000 of each species per plot)
4. Entrust SC at 10 fl oz/A (the labeled rate for root maggot suppression via soil application)

From left to right: Nematode analysis in the lab; Nematodes under the microscope; Nematode application in the field; Emergence traps set up in the trial plots.

Methods

'Imperial' broccoli (Johnny's Selected Seeds, ME) was started in the greenhouse in mid-April. On May 17, 100# N/A and 125# K/A was applied in the form of organic 15-0-2 fertilizer and potash. On May 28, broccoli was transplanted by hand into staggered double rows 18 inches apart and 10-12 inch in-row spacing with one line of drip tape. 30# N/A was added in the form of calcium nitrate through the drip on

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both July 2 and July 16, and 3#/A of boron was also added on July 2. The field was drip irrigated and hand-weeded as needed throughout the course of the trial.

Nematodes were sourced from Koppert Biological Systems. On June 14, all 3 nematode species were re-constituted in water. Using microscopy, the number of living nematodes in these stock solutions were determined, and from these stock solutions, treatment solutions were made up at the high and low nematode rates. The *Steinermena carpocapsae* and *S. feltiae* were determined to be alive and were successfully applied to the soil on June 14. All *H. bacteriophora* nematodes were found to be dead on June 14 and so were re-ordered and were applied on June 18. Our positive control, Entrust, was also applied on June 18.

In preparation for the first year of this trial in 2018, the spray application method was tested to ensure that the method did not kill the nematodes—the treatment solutions were sprayed into a beaker and then re-analyzed. The application method was determined to be an effective way to apply living nematodes to the soil.

The field was divided into four replications of each of the four treatments, with plots consisting of 10 feet of bed with a 5-foot buffer between plots. Treatments were applied using a CO_2-powered backpack sprayer with a Floodjet nozzle (TeeJet TK-7.5) and no filter, set to 20 PSI. Emergence cages, which consisted of 1-foot diameter tube of no-se'em netting with a metal ring base, were set up over individual broccoli plants to capture flea beetles as they emerged from the soil below. Two traps were set up per plot. All plots were irrigated for ~24 hours after nematode application.

Flea beetle emergence was monitored using yellow sticky cards within each trap. Cards were checked and replaced once a week. No harvest or yield data was recorded because the plants were damaged from heat waves that occurred during head formation and most crowns were not marketable.

Results & Discussion

This trial was also conducted in 2018, but the 2018 trial did not capture a clear flush of flea beetle emergence, possibly because only one emergence trap per plot was used. Two emergence traps per plot were used in 2019 and a clear flush of flea beetle emergence beginning in mid-July and peaking on July 30 was captured (Figure 1). On average, the most flea beetles emerged from the untreated plots, but the differences observed were not significant, due to high levels of variability between trap numbers.

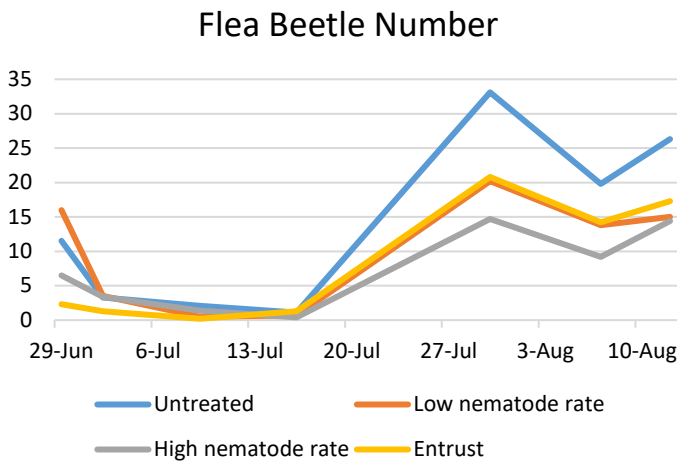

Figure 1. No significant differences in number of emerging flea beetles were observed across treatments.

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Numerically, the high nematode rate showed the lowest number of flea beetles while the low nematode rate and Entrust-treated plots behaved similarly.

Table 1. Number of flea beetles emerging from soil over time. No significant differences were observed, except at the beginning of the experiment.

	Flea Beetle Number							
	29-Jun[z]		2-Jul	9-Jul	16-Jul	30-Jul	7-Aug	12-Aug
Untreated	11.5	ab	3.3	2.1	1.1	33.1	19.8	26.3
Low nematode rate[w]	16	a	3.5	0.5	0.7	20.2	13.8	15
High nematode rate[x]	6.5	bc	3.4	1.4	0.4	14.7	9.2	14.4
Entrust[y]	2.3	c	1.3	0.2	1.3	20.8	14.2	17.3
p-value	0.0006		ns	ns	ns	ns	ns	ns

[w]Low nematode rate was 3,125 nematodes/sq ft each of *Steinermena carpocapsae*, *S. feltiae*, and *Heterorhabditis bacteriophora*.

[x]Low nematode rate was 13,935 nematodes/sq ft each of *Steinermena carpocapsae*, *S. feltiae*, and *Heterorhabditis bacteriophora*.

[y]Entrust was applied at a rate of 10 fl oz/A

[z]Data were analyzed using PROC GLM and means were separated using Tukey's HSD. Numbers within each column followed by the same letter are not significantly different from each other.

It remains possible that soil-applied nematodes can reduce numbers of the soil-dwelling life stage of flea beetles and help in the long-term management of this pest, but it's important to get the application method and field conditions right to give the nematodes the best chance at survival and control. Nematodes are aquatic organisms and live in the water between soil particles, so maintaining moist conditions (which may be achieved best using drip irrigation and/or mulches) is recommended. Flea beetles are very mobile insects and will move to and from brassica weeds and brassica crop fields to find host plants. Using nematodes for flea beetle control will not offer any protection against flea beetles moving into a field from outside, so nematodes would need to be used in combination with another means of control. This strategy also would not result in a quick change in flea beetle pressure, but rather, should be used as a long-term approach to be used in coordination with other strategies.

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