Final Project Report to the NYS IPM Program, Agricultural IPM 2000 – 2001

Title:
Biological control of viburnum leaf beetle

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Biological control and pest biology

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Northeastern U.S.

Abstract:
The overall goal of this project was to evaluate field efficacy of several bioloigical control agents identified in the laboratory as having potential for biological control of viburnum leaf beetle, a recently introduced pest in the U.S. Although the pest can be controlled effectively with insecticides, biological control would be preferable for long term management and for limiting pest damage to susceptible plants in naturalized settings. We previously identified two generalist predators (*Chrysoperla carnea* and *Harmonia axyridis*) and a pathogenic nematode (*Heterorhabditis bacteriophora*) in laboratory trials that appear to have potential for controlling viburnum leaf beetle; in this project we tested these organisms to the field to see if their efficacy extended to this setting. In addition, we sampled soil near host viburnums in the field for the presence of endemic nematodes. Both species of predators significantly reduced the amount of damage sustained by the caged viburnums compared to the control. In the case of *H. axyridis*, the percent reduction was an impressive 75% or more. We were unable to ascertain the efficacy of the nematode because adult emergence from the plots was too low. Results from the soil sampling for nematodes was equivocal; the incidence of nematodes was very low, perhaps because soil moisture was rather low compared to 2000.

The results of this study indicate that augmenting populations of predators with commercially available insects, especially *H. axyridis*, may dramatically limit the amount of feeding by viburnum leaf beetle larvae on susceptible viburnums (and likely reduce adult populations by a similar extent since the larvae are being eliminated by the predator). Pesticides needed for control of the pest would be correspondingly decreased. Further evaluation is necessary, however, because the cages used in this study may have resulted in greater predatory efficiency since the predators were not able to leave the host plants. In addition, further field testing of the nematode is needed to determine what their efficacy might

be under more typical conditions than those used in this study (e.g. utilizing ground covers or mulch).

Background and justification:

Viburnum leaf beetle, *Pyrrhalta viburni* (Paykull), is a relatively new landscape pest in New York and the U.S. As its common name suggests, this pest has a host range that is restricted primarily to plants in the genus *Viburnum*. This insect is very destructive to its host plant because the larvae feed extensively on new foliage in the spring, and the adults, which emerge in early summer, consume considerable portions of the second flush of foliage produced by the plant following defoliation by the larvae. Left uncontrolled, the beetle typically kills susceptible viburnums after 2-3 years. The first record of the insect in New York State was from a planting of native viburnums along the shore of Lake Ontario in 1996 (Rick Hoebeke, personal communication), and the species has spread quickly through counties bordering the lake. As of 2000, the insect had spread through 27 counties of New York State in addition to 2 counties in neighboring portions of Vermont and Pennsylvania (Hoebeke and Weston, unpublished data). Given the rapid spread and the extent of damage observed to date, it seems likely that viburnum leaf beetle will soon pose a serious threat to viburnums throughout the Northeast and beyond.

Viburnums are widely used as landscape plants, and their loss from established plantings is very costly in terms of dollars and emotional damage as well as aesthetic devaluation of the landscape. Viburnum leaf beetle poses a real threat to natural landscapes as well; native stands of viburnums can be completely wiped out by the pest (personal observation.). Loss of viburnums, which are common understory plants in much of New York and surrounding states, from native habitats would result in more than just aesthetic damage; their destruction would result in loss of habitat and a food source for wildlife (especially important since viburnum fruit is consumed by birds at a time when few other fruits are available) and would lead to changes in ecosystem structure as other plants recolonize areas formerly inhabited by viburnums.

Based on laboratory trials conducted in 2000, we know of several biological control agents that might be effective in limiting population growth of *P. viburni* in both managed and native landscapes. In our laboratory trial, we found adult *Harmonia axyridis* and larval *Chrysoperla carnea* to be quite effective in consuming larval viburnum leaf beetle. In addition, the parasitic nematode *Heterorhabditis bacteriophora* was quite effective in killing viburnum leaf beetle in the larval or pupal stage; mortality was at least 74%. We suspect that a parasitic nematode may have been responsible for the lack of adult *P. viburni* in the Rochester area in 2000; abundant larvae were seen in the spring, but virtually no adults were seen in much of the area during the summer. Given that: 1) larval populations in Rochester were quite high in spring 2000, 2) larvae burrow into the soil to pupate, and 3) soil moisture levels were very high in Rochester in 2000 because of a very wet spring, it seems most likely that a soil-dwelling pathogen or nematode was responsible for the near absence of adult *P. viburni* in the Rochester area last year. Because one cannot always count on endemic biological control agents to be present, and these agents often lag several years after the arrival of an exotic pest in a new area, seeking to augment natural enemies is still a worthwhile endeavor.

Control in native landscapes is likely to be very important in limiting the spread of *P. viburni* since native viburnums are widely distributed in areas where we have seen the most rapid spread of *P. viburni* and are very likely a reservoir of this pest. Biological control is really the only viable form of pest control in native landscapes because of environmental and economic considerations.

We have an opportunity to reduce pesticide usage for and slow the spread of a very destructive pest that has been newly introduced to the U.S.; information about biological control of this pest resulting from this project should be directly useful in management in both managed landscapes and native habitats. Using effective biological control agents would result in significant reduction in pesticide usage; at present, insecticides are required to protect susceptible viburnums from the ravages of *P. viburni* where the pest has become established.

Objectives:

1) Evaluate the efficacy of two generalist predators (*Harmonia axyridis* and *Chrysoperla carnea*) and the parasitic nematode *Heterorhabditis bacteriophora* against viburnum leaf beetle larvae in the field.

2) Screen soils from the Rochester area for the presence of entomopathogenic nematodes.

Procedures:

*Objective 1. Evaluate the efficacy of two generalist predators (*Harmonia axyridis *and* Chrysoperla carnea*) and the parasitic nematode* Heterorhabditis bacteriophora *against viburnum leaf beetle larvae in the field.* Trials were conducted on susceptible viburnums (arrowwood viburnum, *V. dentatum*) (40-50 cm tall) artificially infested with eggs of viburnum leaf beetle. Infestation was accomplished by attaching egg-infested twigs from infested viburnums to the experimental plants with twist ties. Test plants were individually caged in screen enclosures (60 cm x 60 cm x 60 cm) to facilitate trapping of emerging adults and to keep out stray insects that might feed on viburnum or on viburnum leaf beetle larvae. The treatments evaluated were: 1) untreated control, 2) adult *Harmonia axyridis*, 3) larval *Chrysoperla carnea,* and 4) soil applied *Heterorhabditis bacteriophora*. Predators were applied at the rate of 50 individuals per plant, and nematodes were applied to the soil at the rate of 1 million per 50 square feet, the standard recommended application rate. We attached 50 egg masses per plant, which should have resulted in a larval infestation level of 300 per plant since oviposition sites usually contain roughly 6 eggs each. Having an untreated control allowed us to predict adult emergence in the absence of the experimental treatments. Five replicates were used per treatment, requiring a total of twenty plants for the trial. Efficacy of the various treatments was evaluated by visually estimating feeding damage by larvae and counting all adults emerging from each caged plant.

Objective 2. Screen soils from the Rochester area for the presence of entomopathogenic nematodes. Soil was collected from 15 sites scattered around the Rochester area, 17 sites from the Geneva area, 4 sites in Sampson State Park(ca. 10 km south of Geneva), and 5 from the Ithaca area. Soil was collected from the area under susceptible viburnums in each location. From each site, three soil cores (2.2 cm dia x 10 cm) were collected and transported back the the lab in zip-lock bags. Back in the lab, wax moth larvae (5 per sample) were placed in containers with the cores, and kept at 22°C. Wax moth larvae are the standard test organism used for detecting the presence of entomopathogenic nematodes in soil because they are susceptible to nematodes and turn bright orange after being infected. After one week, larvae were inspected for presence of nematodes. Percent infection was calculated for each site.

Results and discussion:

Both species of predators (*C. carnea* and *H. axyridis*) significantly decreased defoliation by viburnum leaf beetle larvae in the caged field bioassay, *C carnea* by 50% and *H. axyridis* by >75% (Table 1). Defoliation by larvae in the nematode treatment was not significantly different from that in the control, which was expected because the nematode is soil-dwelling and attacks larvae only after they burrow into the soil to pupate (following completion of larval development). Unfortunately, adult emergence was very low and could not be analyzed. This was likely the result of very hot, dry weather during the period when larvae would have been burrowing into the soil to pupate. The shrubs used in this experiment were in full sun, and no ground cover or mulch was present around the base of the plants. In a more typical setting, the shrubs would have had either a layer of leaf litter (in a naturalized setting) or mulch (in a managed landscape) at the base of the plants, either of which would have helped retain soil moisture and reduce heating of the soil by the sun.

Detection of nematodes from soil samples was very low; only 6 out of the 37 locations sampled showed the presence of nematodes (Table 2). The number of positive sites was too low to permit further analysis, but there was no obvious pattern to distribution of infection sites (geographically or with respect to presence of viburnum leaf beetle or susceptible host plants). The level of soil moisture was much lower in 2001 than in 2000, so endemic levels of nematodes were likely much lower during the study year. This suggests that augmentation of nematodes as a control method is likely to be effective, if at all, only in moist years or in situations where soil moisture levels can be enhanced (by watering or addition of mulch.)

Augmentation of predators as a control method for viburnum leaf beetle seems promising. The major uncertainty is whether the added predators would remain on a plant if not confined by a cage. Lady beetles, in particular, are known to disperse from a plant if prey numbers are not adequate (lacewing larvae are much more likely to stay on a plant since they are wingless). The use of cages was necessary for the current study to obtain a best-case estimate of predatory efficiency and to keep feral predators and herbivores off the test plants, but the final test of efficacy would involve shrubs not contained within cages (and, incidentally, in settings where soil conditions are more typical than those of the current study, as per the discussion of nematode efficacy above). If reduction in numbers of larvae and adults of viburnum leaf beetle holds up in landscape-scale or nursery-scale evaluation of these natural enemies, pesticide usage for control of the pest could be greatly reduced. Currently, any susceptible viburnum in most of western New York needs to be treated if the owner/manager wants to keep the shrub alive (many nursery operators do not even bother with trying to grow the susceptible viburnums). Not only would pesticide usage be reduced, but additional income opportunities for nursery operators might be created or restored if susceptible viburnums once again become viable landscape plants in the region.

Table 1. Percent defoliation of caged arrowwood viburnums artificially infested with larvae of viburnum leaf beetle in the field. Means followed by different letters are significantly different as determined by lsd test following one way ANOVA of square-root transformed data.

	Percent defoliation		
Treatment	**Mean**	**S.D.**	
Control	14.0	7.4	a
H. bacteriophora	13.4	9.1	ab
Chrysoperla carnea	7.0	5.7	bc
Harmonia axyridis	3.2	1.6	c

Table 2. Percent infection of wax moth larvae with nematodes from soil samples collected from several locations in western New York populated with viburnum leaf beetle at different times.

Sample location		mean	S.D.	VLB?[1]	Host?[2]
Rochester sites:	EPP 1	0.0	0.0	--	--
	GR 1	0.0	0.0	--	--
	HA 1	0.0	0.0	--	X
	HA 2	0.0	0.0	--	X
	IR 1	0.0	0.0	--	X
	IR 2	0.0	0.0	--	X
	IR 3	6.7	11.5	--	X
	IR 4	0.0	0.0	--	X
	MPP 1	0.0	0.0	X	X
	MPP 2	26.7	46.2	--	X
	NPP 1	0.0	0.0	X	X
	NPP 2	0.0	0.0	X	X
	RIT 1	0.0	0.0	X	X
	RIT 2	0.0	0.0	X	X
	WCP 1	0.0	0.0	--	--
Geneva sites:	G1	0.0	0.0	X	X
	G2	0.0	0.0	--	X
	G3	0.0	0.0	--	*
	G4	0.0	0.0	--	X
	G5	0.0	0.0	--	*
	G6	0.0	0.0	X	X
	G7	0.0	0.0	X	X
	G8	0.0	0.0	X	X
	G9	0.0	0.0	--	X
	G10	0.0	0.0	--	--
	G11	0.0	0.0	X	X
	G12	6.7	11.5	X	X
	G13	0.0	0.0	X	X
Sampson SP sites:	S1	0.0	0.0	X	X
	S2	0.0	0.0	X	X
	S3	0.0	0.0	X	X
	S4	53.3	41.6	X	X
Ithaca sites:	Plant 1	20.0	34.6	--	X
	Plant 2	6.7	11.5	X	X
	Plant 3	0.0	0.0	--	X
	Plant 4	0.0	0.0	--	X
	Plant 5	0.0	0.0	--	X

[1] *Indicates whether viburnum leaf beetles or their damage was evident at the site; X – present, -- - absent*
[2] *Indicates whether host plant was in vicinity of soil sample. X – present, -- - absent, * - present, but likely had been treated with insecticide*