Final Project Report to the NYS IPM Program, Agricultural IPM 2002-2003

Title:
Biological control of viburnum leaf beetle

Project Leader(s):
Paul A. Weston, Department of Entomology, Cornell University, Ithaca, NY

Cooperator(s):
None

Type of grant:
Biological control and pest biology

Project location(s):
Throughout the Northeast (and beyond, as this pest spreads)

Abstract:
The overall goal of this project was to further evaluate field efficacy of several biological control agents identified by us in earlier projects 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. The specific objectives of this study were to test the efficacy of in open-field studies to determine if they can control the pest under these more rigorous, "real world" conditions. The evaluation of nematodes was inconclusive, and it was not possible to complete the evaluation of predators on uncaged plants because of very unusual weather conditions in 2002. The evaluations will be repeated in 2003.

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 2001, 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of New York State in addition to 2 counties in neighboring portions of Vermont and Pennsylvania (Hoebeke and Weston, unpublished data).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 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 (2000) and caged field trials (2001), 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 quite effective in consuming larval viburnum leaf beetle. In field trials with caged, susceptible vibrunums, *C. carnea* reduced defoliation by viburnum leaf beetle larvae by 50%, and *H. axyridis* decreased defoliation by an even more impressive 75%. In addition, the parasitic nematode *Heterorhabditis bacteriophora* was quite effective in killing viburnum leaf beetle in the larval or pupal stage in the laboratory; mortality was at least 74%. Unfortunately, we were unable to evaluate the efficacy of the nematode in our field trial because adult emergence from the caged plants was very low, likely because the summer was quite hot and dry, and no ground cover was present around the caged shrubs to retain soil moisture or moderate soil temperature.

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 production settings, 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 with unconfined shrubs.

2) Repeat a portion of the 2001 field trial with caged viburnums to estimate maximal efficacy of *H. bacteriophora*.

3) Project evaluation.

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 using susceptible viburnums (arrowwood viburnum, *V. dentatum*) at the Cornell Bluegrass Lane facility (formerly known as the Turf Farm) 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. The treatments to be 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. The number of egg masses was fixed at 50 per plant; this should have resulted in an infestation level of 300 larvae per plant, reflecting the fact that oviposition sites usually contain roughly 6 eggs each. Five replicates were used per treatment. Efficacy of the various treatments was evaluated by visually estimating feeding damage by larvae in June.

Objective 2. Repeat a portion of the 2001 field trial with caged viburnums to estimate maximal efficacy of H. bacteriophora. This objective was met using procedures similar to those of Objective 1, with the exception that the shrubs were enclosed in cages (2' x 2' x 2'), and the only treatments were the nematode applied at the recommended rate and an untreated control. Shrubs were mulched with wood chips. Five replicates of each treatment were used.

Objective 3. Project evaluation. The promise of the project for practical application was to be judged primarily by the degree to which the various biological control agents suppressed adult emergence of *P. viburni* and reduced foliar damage. However, we were able to evaluate only the efficacy of the nematode in suppressing larval populations (Objective 2) because of weather-related logistical problems that precluded completion of Objective 1 in 2002.

Results and discussion:

*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.* We were unable to complete Objective 1 in 2002 because of very unusual weather conditions at a critical time in the life cycle of viburnum leaf beetle. Abnormally warm weather in April accelerated the development of viburnum leaf beetle larvae, which typically emerge sometime toward the end of the 1st week in May. In 2002, larvae began emerging in the last week of April, almost two weeks early. We had planned our purchase and release of the biological control agents for the end of May, but by that point, most of the larvae had nearly completed their development. Thus, we plan to repeat this experiment in 2003.

2) *Repeat a portion of the 2001 field trial with caged viburnums to estimate maximal efficacy of* H. bacteriophora. Although we were able to successfully complete this objective, results were disappointing. The presence of nematodes had virtually no impact on the emergence of adult viburnum leaf beetles in the cages containing the test plants; an average of 65.0 $\pm$ 7.9 (mean $\pm$ S.E.) adults emerged in the treated cages compared to 70.8 $\pm$ 9.4 adults for the control cages. Given the dramatic efficacy seen in the laboratory trials, we do not believe these results represent the true potential of *H. bacteriophora* to control viburnum leaf beetle. Two complicating factors may have accounted for these disappointing results: poor timing or poor distribution of the nematodes. Because of the unusually early development of viburnum leaf beetle larvae in 2002 (as mentioned above), the larvae may have started to crawl into the soil to pupate before application of the nematodes was made. Alternatively, the presence of wood mulch around the base of the caged viburnums may have prevented adequate penetration of the solution containing the nematodes into the soil (the nematodes may have become "bound" to the mulch instead of leaching into the soil). A third possibility is that the nematodes were of poor viability. In any event, we will be repeating this experiment in 2003 as well to provide every opportunity within reason for these biocontrol agents to exhibit their true potential in controlling viburnum leaf beetle.

Objective 3. Project evaluation. As mentioned within the results for the other two objectives, it is not possible to draw firm conclusions about any of the biocontrol agents evaluated here. We will be repeating both experiments in 2003 at no cost to the NYS IPM program.