CONTROL OF PEACHTREE BORER USING ENTOMOPATHOGENIC NEMATODES

by Stanton Gill, John A. Davidson, Michael J. Raupp

Abstract. Peachtree borers, *Synanthedon exitiosa*, in 10 cherry laurel shrubs growing in a landscape setting were treated with the nematode, *Steinernema carpocapsae* (strain All). Ten infested cherry laurel were controls in the trial. Nematodes were applied in April using a backpack sprayer. Applications of entomopathic nematodes significantly reduced (66%) the number of living larvae associated with the plants.

The ability of a plant to survive or cope with insect attacks is tied to the health of the plant. Plants in urban sites are often grown in soils that are non-homogenous, with varying pH levels, low in organic content, compacted, poorly drained, and generally lacking in macro- and micronutrients. Commonly, landscape plants placed in urban sites receive physical wounding from power equipment, root injury from over mulching, and are planted where they receive excessive amounts of both reflected light and heat from paved areas. Plants growing in such conditions often fall prey to insects that cause the decline and death of the plant.

Clearwing moths (Lepidoptera: Sesiidae) are commonly found infesting stressed plant material (9). Clearwing moth larvae tunnel and feed in cambial and vascular tissue of the plant. The disruption of the vascular system results in foliar discoloration with eventual dieback of the crown. Trees planted in locations receiving full sun exposure have been reported to be three times as likely to be infested as those in full shade (9).

A traditional control for insects boring in trees and shrubs is the application of broad spectrum chemical insecticides applied to the trunk and branches just before the borer eggs hatch. Insecticidal bark sprays are effective only if a lethal residue is present during the brief interval between the time when larvae hatch and before the larvae enter the tree. The use of pheromone traps has made timing applications of synthetic insecticides more efficient (1, 8, 9). Unfortunately, pheromone traps are under utilized by many arborists and pesticide applications are often made on predetermined schedules. This approach can result in borer larvae successfully penetrating the bark before a pesticide application is made or after the chemical has broken down to a sub-lethal level. Once the larvae are under the bark, pest control options are severely limited.

An alternative control method for dealing with clearwing borers is through the use of entomopathogenic nematodes (5). Entomopathogenic nematodes infect only insects or related arthropods. As a biological control agent, entomopathogenic nematodes offer two major advantages. The first is their ability to attack borer larvae after they have entered the plant. The second advantage is that nematodes are safe for the pesticide applicator and have no adverse impact on non-target sites (10). Several commercial companies are marketing nematodes for use in controlling insects in the landscape and nursery. These products contain infective juvenile nematodes in the "dauer" stage or J3 stage and are formulated for application as sprays or drenches. The J3 stage nematodes enter through the mouth, anus or breathing tubes (spiracles) of the insect (2). After penetrating the insect, the nematodes release bacteria that enter the insect's blood stream. The nematodes then feed on these bacteria as they multiply and the insect dies of bacterial septicemia. These entomopathogenic nematodes and their associated bacteria, *Xenorhabdus nematophilus* and *X. luminescens*, have been extensively tested for toxicity to non-target organisms, and they are considered to be nontoxic and nonpathogenic to plants and mammals (10).

The peachtree borer, *Synanthedon exitiosa*, is a clearwing moth borer that attacks trees and shrubs in the genus *Prunus*. Peachtree borer larvae have been reported infecting peach (*P. persica*), flowering cherry (*P. serrulata*) and purpleleaf sand cherry (*P.* x *cistena*) (4). In Maryland in 1989, peachtree borer larvae were found infesting cherry laurel (*P. laurocerasus*).

In Maryland adult peachtree borer emergence occurs over a relatively long period, generally starting in June and extending through September (6). In South Carolina, peachtree borer adult males have been captured as early as May 14 and as late as October 26 (1). In West Virginia peachtree borer adult moths emerge as early as June, peak in August, and decline to zero by early October (3). Female peachtree borers mate and start laying eggs soon after they emerge (8). Eggs are laid on the stems of shrubs or tree trunks. The larva of the peachtree borer feeds in the cambium, usually at the root crown, where it girdles the plant. The larvae feed in the trunk until late fall, are dormant for the winter, start feeding again in the spring and pupate in June and July. Pfeiffer et al. (8) indicate that a few larvae overwinter a second time and require two years to complete their life cycle.

Materials and Methods

A shopping mall in Fairlakes, Virginia with an extensive landscape planting of cherry laurel (*P. laurocerasus*), was utilized in this study. Shrubs had been planted at the site in the spring of 1987. At the time of this study, the shrubs varied in size from 34 cm to 81 cm in height. Plants were in a continuous planting bed surrounded by parking lots and road ways on all sides. Plants were exposed to full sun. A landscape company that maintained the landscape site in 1990 noticed dieback of several of the shrubs in March of 1991. The plants were examined in April of 1991 and found to be mulched with over 10 cm of hardwood mulch, with the mulch piled over the main stems of the shrubs. When the mulch was removed from the base of the plants, a heavy sap flow (gummosis) was found on the stems. Using a probe, the mulch, jelled sap and loose bark were removed to expose the borer larvae. The number of larvae recovered in the original investigation varied from 3 to as many as 12 in a single plant. The larvae were preserved in alcohol, examined, and identified as the peachtree borer by the authors. The majority of the 62 plants showed varying levels of infestation. The most heavily infested plants showed severe plant browning of foliage and dieback of the plant. The mall management company's concern over the use of synthetic pesticides in an area heavily used by people made this an ideal site for testing of entomopathogenic nematodes as a control tactic.

Steinernema carpocapsae (strain All) were obtained from Biosys Company of Palo Alto, California. The nematodes supplied by Biosys were in the juvenile "J3" stage. These juvenile nematodes were immobilized in a clay alginate. A bio-activator containing sodium citrate and water were added to the suspended nematodes. The sodium citrate dissolves the clay alginate allowing the nematodes to move freely in the water.

Twenty of the shrubs that showed severe dieback (50% or more of foliar browning) were selected for use in this trial. A distance of at least 1 meter was maintained between each of the treatment shrubs. Two treatments, either *S. carpocapsae* or water, were made to the shrubs. Treatments were randomly selected with ten plants in each treatment.

Nematodes were mixed with 590 ml of well water that had a pH of 6.8. From the original mix, 8 ml of nematode solution was drawn with a pipet and mixed with 292 ml of water. The final solution was applied using a 19 liter Birschmeyer backpack sprayer. Water treated shrubs received 300 ml of water applied in a similar method. The main stems were sprayed to a height of 10 cm as were a 20 cm circle around the base of the plant. The nematode rate was 500 nematodes per 2.53/cm^2 of bark or ground area. The treatments were made on April 30, 1991, starting at 11:15 a.m. and completed by 11:55 a.m. Temperature and relative humidity were measured using an Omega RH-20 portable meter. Temperature was 25°C at 1 meter from ground level, and the relative humidity 57%. The temperature reading taken at ground level near the base of the plants was 21.5°C, and 72.4% relative humidity. Two days after treatments were made a nearby weather station reported 1.3 cm of rainfall.

Six days after the treatment application, on May 6, 1991, the twenty treated plants were removed from the site and transported to the research facility. As each root ball was dug, the soil was removed and any peachtree borer larvae found in the soil near the roots were placed in marked vials. These were taken back to the laboratory to be examined for infection with nematodes. The shrub and bare root balls were taken back to the University of Maryland Research and Education Center where the bark was stripped from the shrubs to expose larvae. The number of live larvae associated with each plant was recorded. Samples of dead and live larvae were sent to Biosys in California to confirm the presence of and identity of nematodes.

Results and Discussion

Examination of the untreated control plants confirmed heavy infestation of the peachtree borer. All plants had extensive injury to the stem at the root collar and above into the lower stems. In several instances, the stem was entirely girdled and plant death was eminent.

Application of entomopathogenic nematodes produced significant reductions in the number of living larvae associated with the plants (Kruskal-Wallace non parametric ANOVA, $p< 0.008$). The number of living larvae in untreated plants ranged from 0 to 18 with an average of 8.8 per plant. The number of living larvae in treated plants ranged from 0 to 7 with an average of 3.0 per plant (Figure 1). The application of nematodes reduced the number of borers associated with these plants by 66% on the average. Microscopic evaluations of living and dead larvae confirmed the presence of *S. carpocapsae* in dead larvae and the absence of nematodes in living larvae.

The results of this study supported findings of previous investigations of the efficacy of entomopathogenic nematodes against larvae of clearwing borers. Kaya and Brown (5) reported reductions of 84% when *S. feltiae* were hydraulically applied to the bark of alder trees infested with the borer *Synanthedon culiciformis*. Similarly, *S. feltiae* produced 61% mortality in the sycamore borer, *S. resplendens*, when nematodes were applied to the bark of trees.

The efficacy of nematodes as a control tactic for clearwing borers compares well with published accounts of efficacy associated with the use of conventional pesticides. For example, Nielsen and Dunlop (7) found that chlorpyrifos (Dursban and Lorsban) reduced peachtree borer abundance by 44 to 89%. Studies by other researchers with chlorpyifos found reductions in peachtree borer ranging from 40 to 100% (3). Our studies indicate that hydraulic applications of the nematode *S. carpocapsae* provides borer reductions comparable to those achieved by the use of synthetic organic pesticides. Due to the lack of effect of nematodes on non-target organisms and their relative safety to applicators and clients, entomopathogenic nematodes appear to be a viable management option for arborists attempting to control peachtree borer attacking cherry laurel.

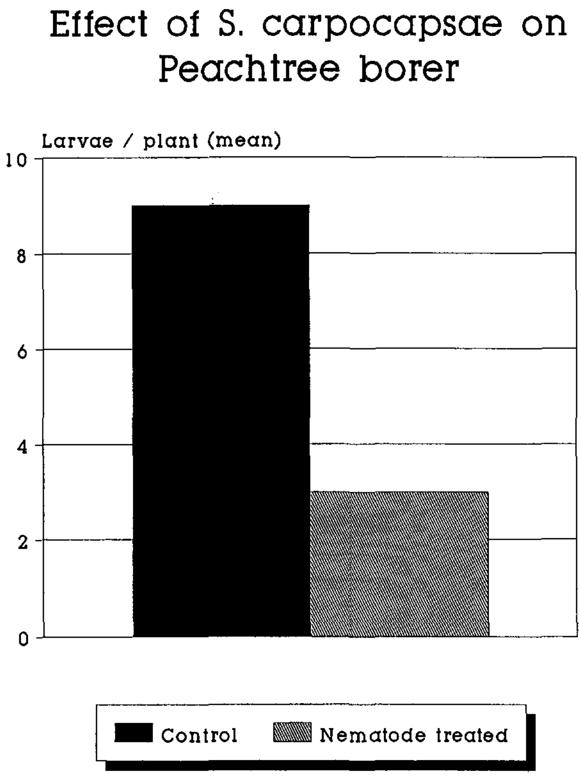

Figure 1. Number of peachtree borer larvae recovered from untreated (control) shrubs and shrubs treated with *S. carpocapsae* nematodes. Bars represent means.

Acknowledgments. We thank Carl Redmond for reviewing this paper. We are indebted to Steve Wolf of Wolf Landscape Company or Rockville, Maryland for obtaining the field testing site. This is Maryland Agricultural Experiment Station Contribution No. 8415, Scientific Article No 8415.

Literature Cited

1. Gentry, Curtis C., R.L. Holloway, and D.K. Pollet. 1978. *Pheromone monitoring of peachtree borer and lesser peachtree borer in South Carolina.* J. Econ. Entomol. 71(2): 247-253.
2. Hara, A.H, H.K. Kaya. 1983. *Susceptibility of Sprodopters exigua pupae from different pupation sites to the nematode Neoaplectana carpocapsae* J. Invertebr. Pathol. New York: Academic Press. 43(3): 418-420.
3. Hogmire, Henry W., Jr., B.A. Butt and E.H. Beers. 1981. *Peach tree borer and lesser peach tree borer control.* Virginia Fruit 70(6): 3,5,7,9.
4. Johnson, Warren T. and H. Lyon. 1976, 1988. Insects that Feed on Trees and Shrubs. Comstock Publishing Associates, Cornell University Press, 2nd Edition: 258-259.
5. Kaya, H.K. and L.R. Brown. 1986. *Field application of entomogenous nematodes for biological control of clearwing moth borers in alder and sycamore trees.* J. Arboric. 12(6): 150-154.
6. Neal, J.W. 1983. *Seasonal response of six male Sesiidae of woody ornamentals to clearwing borer (Lepidoptera: Sediidae) lure.* Environ. Entomol 12(1): 206-209.
7. Nielsen, D.G. and M.J. Dunlop. 1990. *Prunus,* peachtree borer control. Wayne Co. Ohio. Insect. Acara. Tests 15: 343.
8. Pfeiffer, Douglas G., J.C. Killian, E.G. Rajotte, L.A. Hull, and J. Wendell Snow. 1991. *Mating disruption for reduction of damage by lesser peachtree borer (Lepidoptera: Sesiidae) in Virginia and Pennsylvania peach orchards.* J. Econ. Entomol. 84(1): 218-223.
9. Potter, Daniel A. and G.M. Timmons. 1983. *Flight phenology of the dogwood borer (Lepidoptera: Sesiidae) and implications for control in Cornus florida L.* J. Econ. Entomol. 76(5): 1069-1074.
10. Weinzierl, R. and T. Henn. 1989. Microbial Insecticides. Univ. of Illinois Agric. Entm. Circular 1295: 8-9.

Regional Specialist and
Extension Specialists, respectively
Cooperative Extension Service
University of Maryland
College Park, Maryland 20742

Resumé. Les perceurs du pêcher, *Synanthedon exitiosa*, sur dix lauriers-cerises (*Prunus laurocerasus*) croissant dans un cadre paysagé, étaient traités avec le nématode *Steinernema carpocapsae* (souche All). Dix lauriers-cerises infestés servaient de contrôle pour l'essai. Les nématodes étaient appliqués en avril au moyen d'un vaporisateur portatif sur le dos. Les applications de nématodes entomopathiques réduisaient significativement (66%) le nombres de larves vivantes associé avec les plantes.

Zusammenfassung. Gegen den Pfirsich-Baum-Bohrer (*Synanthedon exitiosa*) an zehn Lorbeerkirschsträuchern wurden im Freiland Nematoden von *Steinernema carpocapsae* eingesetzt. Zehn befallene Lorbeerkirschen dienten als Kontrolle. Die Nematoden wurden im April mit einer Rüchenspritze appliziert. Diese Applikation von entomophagen Nematoden reduziert signifikant (66%) die Anzahl der lebenden Larven in befallenen Pflanzen.