Nonchemical options for controlling the annual bluegrass weevil

Some biological controls for annual bluegrass weevil control hold promise.

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The annual bluegrass weevil (*Listronotus maculicollis*), often referred to as the Hyperodes weevil, has been a major insect pest on golf courses in the metropolitan New York City area for more than 40 years. The larvae feed inside the stems of annual bluegrass and some creeping bentgrass stands and then move to the crown of the plant, where they sever stems and kill plants outright. (The biology of the insect and a brief explanation of the traditional control strategies appeared in the May 2005 issue of *GCM*.)

During the last 40 years, turf management techniques have changed tremendously on golf courses throughout the United States. Mowing heights have been reduced precipitously. Green speeds in the late 1970s were measured at about 8 feet on the Stimpmeter — and that was on high-end private courses hosting professional tournaments. As mowing heights have decreased, physiological stresses have led to additional challenges for the turfgrass. These plants are less able to withstand pressure from insects or diseases. The end result is that some insects that were minor nuisances in the 1960s have become major pests in the 1990s and early 21st century, simply because the turfgrass is being grown at such low mowing heights and has less recuperative potential.

Annual bluegrass weevil

The annual bluegrass weevil is one such insect. Many superintendents in the New York City area apply insecticides three to five times each season to try to minimize damage from the annual bluegrass weevil. For nearly 30 years, the materials of choice have been chlorpyrifos (Dursban) or one of the pyrethroids, such as bifenthrin (Talstar), cyfluthrin (Tempo), lambda-cyhalothrin (Battle or Scimitar) or deltamethrin (Deltagard). Most superintendents would like to be able to eliminate one or more of these applications, in part because there is increasing pressure from neighbors and environmental organizations to reduce the use of pesticides on golf courses. In addition, some annual bluegrass weevil populations in the Northeast may have developed resistance to at least one of the pyrethroids. If this is confirmed, it will have a major impact on efforts to control populations in areas where the resistance occurs.

Figure 1. Insect-attacking nematodes (*Steinernema carpocapsae* in this photo) reproduce in the insect cadaver and release infective juveniles that can move small distances in search of the next insect to attack.

Photos by Randy Gaugler, Rutgers University

Figure 2. Insect-attacking nematodes (*Steinernema carpocapsae* in this photo) penetrate the host insect and release a bacterium, which then breaks down much of the insect tissue. Some people have referred to these insects as "living hypodermic needles."

Cultural strategies

A few cultural strategies may help minimize damage caused by the annual bluegrass weevil. First and foremost, any steps that reduce the amount of annual bluegrass in the critical areas (edges of fairways, greens, tees and collars) will reduce annual bluegrass weevil activity or at least minimize damage. Even though the annual bluegrass weevil will feed on creeping bentgrass, it strongly prefers annual bluegrass as a host, and damage is much more evident on annual bluegrass. It stands to reason that reducing annual bluegrass will reduce evidence of annual bluegrass weevil activity. (Unfortunately, the annual bluegrass weevils may still be there, but at least their feeding will not be as obvious.)

Similarly, annual bluegrass weevil adults spend the winter in somewhat protected areas around the golf course. One of their favorite hiding places is in pine litter underneath white pine trees (*Pinus strobis*). Some superintendents have begun to remove pine litter from those trees in late fall or early spring, figuring they might be removing some of the adults at the same time. Although no controlled studies have documented the effectiveness of removing the litter, several superintendents are convinced that it helps. Certainly it does no harm. (Note that pine trees contain flammable resin, so do not succumb to the temptation to burn the litter. Instead, rake it up and haul it to a site well away from sensitive areas.)

Meanwhile, over the years we have conducted field trials looking at a variety of biological control strategies, including entomopathogenic nematodes, a strain of *Bacillus thuringiensis* and spinosad. An overview of those findings is presented here.

Entomopathogenic nematodes

Entomopathogenic nematodes penetrate a target insect and release a bacterium in the body cavity. The bacterium breaks down the internal tissue and ultimately kills the insect

(Figure 1). The nematodes then reproduce in the insect cadaver, and infective juveniles move away in search of additional victims (Figure 2). Several species of nematodes are commercially available. We have tested two of those nematodes over the years.

Steinernema carpocapsae

Steinernema carpocapsae is available from several suppliers. We first tested it in the late 1980s, using a golf course sprayer to treat large sections of fairways with a standard application rate of one billion nematodes per acre. The results were very disappointing, and we did not return to nematode investigations until the late 1990s. In 1999 we applied *S. carpocapsae* (formulated as Millenium by Certis U.S.A.) in small plots on a golf course in Westchester County, N.Y. We treated the plots on April 20, and one set of plots received a follow-up application on May 4. We used the labeled rate of nematodes (one billion per acre) and returned to sample the area in early June. These dates all fit the typical phenological pattern: the applications were made shortly after *Forsythia* full bloom, and plots were analyzed just after horse chestnut full bloom. None of the treatments reduced larval populations significantly compared to the untreated controls. Most of the treatments only reduced annual bluegrass weevil populations 20% or less. However, we conducted the study at a second site (same dates of application and sampling) and found that an application of two billion nematodes per acre provided almost 50% control of the annual bluegrass weevil larval population. This was still not significantly different from the control, but was encouraging.

We suspect that the level of control was compromised in part because the soil temperatures were still quite low (around 50 F [10 C]) at the time of application. Most nematodes are sensitive to cold temperatures, and the nematodes used in this study may have been fairly quiescent at the time of the application. But applications made in the summer are even more risky because most nematodes are very sensitive to high temperatures and low humidity and desiccate quickly. Therefore, it is difficult to time an application that makes sense relative to the insect life cycle when the temperatures are favorable. In addition, applications might have been more effective if they had been delayed until after adults had finished laying eggs so that young larvae were present.

Heterorhabditis bacteriophora

Heterorhabditis bacteriophora is another species of nematode that is available commercially and shows activity against Japanese beetle grubs, among other insects. We were hopeful that it might be better adapted to the annual bluegrass weevil, so we conducted two field trials in 2001. At one site, we applied nematodes at a rate of one or two billion nematodes per acre, and we treated on either May 8, when small larvae were present, or May 23, when most insects were medium-sized larvae. We collected samples on June 5, when most of the insects were large larvae and pupae. In that test, none of the treatments reduced larval populations significantly. The most effective combination was two billion nematodes per acre applied on May 8, and it only provided 30% control.

We also included the same nematodes (the "All" strain, supplied by Koppaert) at another site, but only treated on May 23. The untreated controls had 135 larvae/square foot (1,458/square meter). The higher application rate reduced the population 47%, which was statistically significant, but there were still 72 larvae/square foot (778/square meter) in the nematode-treated plots. This level of infestation is at the upper end of the accepted threshold for this insect, and these plots showed evidence of damage.

We are hopeful that we can find an appropriate combination of nematode and application date. For now, the field trials we have conducted suggest that we need to do a lot more work. There are various ecotypes or strains of some of these nematodes that are adapted to cooler climates, and a couple of species have shown promise against other similar insects, so

CONSERVE VS. ANNUAL BLUEGRASS WEEVIL

Treatment	Application rate (Fluid ounces/ 1,000 square feet)	Date	Larvae/ square foot*	% control
Untreated	—	—	72.2 f	—
Conserve	0.8	May 10	24.4 d	66.2
Conserve	1.0	May 10	20.3 cd	71.8
Conserve	1.2	May 10	45.7 e	36.6
Conserve	0.6	May 10 + June2	7.1 abc	90.2
Conserve	0.8	May 10 + June 2	8.1 abc	88.7
Conserve	0.8	June 2	5.1 ab	93.0
Conserve	1.0	June 2	4.1 ab	94.4
Conserve	1.2	June 2	2.0 a	97.2
Talstar	20.0	May 10	17.3 bcd	76.1

*Numbers followed by the same letter are not significantly different from each other.

Table 1. Treating annual bluegrass weevil with Conserve and Talstar in May and June 2005 near Hartford, Conn. Two treatments involved split applications.

we have not yet given up the search.

Bacillus thuringiensis var. *tenebrionis*

Bacillus thuringiensis (*Bt*) is a bacterium that produces an endotoxin that interferes with digestion in insects. The most common of the several strains of *Bt* is *B. t. kurstaki,* which is toxic to several kinds of caterpillars, including gypsy moths, and occasionally is used on golf courses against cutworms. *Bacillus t. tenebrionis* is normally used against leaf-feeding beetles and is labeled for use on several beetles in vegetables. After reading that *B. t. tenebrionis* looked promising against carrot weevils, which are in the same genus as the annual bluegrass weevil (*Listronotus*), we decided to test it on the annual bluegrass weevil in 2001.

We used Novodor, a commercial product from Valent Corp. that is labeled for use in several vegetable crops. We used two rates of application (2 quarts of product/acre and 3 quarts/acre [4.7 and 7.0 liters/hectare]). Because we were not sure of the ideal timing for application, we set up one test on April 26, just after full bloom in *Forsythia,* as adults were laying eggs, and we set up a different test on May 23, when most insects were medium-sized larvae. We sampled both tests in early June. The larval populations were not significantly reduced in either of the tests at either application rate.

In 2003, we set up the same kind of test but delayed our application until most insects were medium or large larvae. The material was applied on June 3, and we sampled the plots on June 16. This time both application rates reduced larval populations significantly (50% to 64%). This is much more encouraging, and we hope to pursue this avenue in future field trials. Certainly the product appears to be more effective when applied to larvae that are feeding outside the plants.

Spinosad

Spinosad, sold as Conserve, is a soil actinomycete that has been formulated as a biorational insecticide. It is labeled for use against several species of caterpillars in turf. When the product was first being developed, we were asked to look at trial formulations and several application rates against the annual bluegrass weevil. Many of those combinations looked quite promising, and when the product finally received federal registration, we began to test it against annual bluegrass weevils in field conditions.

Over the years we have looked at several rates of application as well as early and late applications. In 2001 we applied Conserve on April 26 (again shortly after *Forsythia* full bloom, when adults were still laying eggs) and found that a rate of 1.2 fluid ounces/1,000 square feet (3.8 liters/hectare) provided more than 90% control. A slightly higher rate was significantly less effective. In 2003 we treated in early June, when most of the insects were medium-sized larvae, and sampled two weeks later. In this case, all three rates we tested provided more than 90% control.

In 2005 we established a large field trial near Hartford, Conn. We treated plots on May 10, just before dogwood full bloom, as the adults were laying eggs, or on June 2, when most insects were medium-sized larvae. Two treatments involved split applications. The results are shown in Table 1.

All of the June applications and the split applications reduced larval populations significantly and kept activity well below the damage threshold of 30 to 80 larvae/square foot (324-864/square meter). We have not had an opportunity to test Conserve in the summer, so we do not know whether it will be similarly effective against second- or third-generation larvae.

We are very encouraged by these results and believe that Conserve might eventually fit into the arsenal of products used to manage annual bluegrass weevils. However, there have been few field trials of the product, so we are still learning as we go. Note that our results are preliminary, and much work needs to be done before we can determine the best rate of application and the most efficient target date. The information presented here should not be construed as a recommendation in any form. Note that Dow AgroSciences has added annual bluegrass weevil to the label, which is an encouraging development.

So where are we?

At this point, spinosad, which is considered a biorational product by some and a synthetic insecticide by others, shows the most promise of the nontraditional products for consistently managing annual bluegrass weevil populations. More recently, several local GCSAA chapters have agreed to support Albrecht Koppenhofer's research at Rutgers University, and we are hopeful that his lab will be able to identify the most promising strategies. In particular, his lab group is surveying annual bluegrass weevil populations throughout the region, looking for natural populations of entomopathogenic nematodes. Additional support from other GCSAA chapters will enable other researchers to screen some of these materials in New England, New York and Pennsylvania.

Several of the strategies we have investigated have shown some promise, but we have not yet been able to look at all the possible combinations yet. The answer may lie in some combination of traditional insecticides and biorational products. If we are able to eliminate the need for even one insecticide application each season, we will consider it a victory.

THE RESEARCH says . . .

- **Some cultural strategies** such as reducing annual bluegrass and removing pine litter can help control the annual bluegrass weevil.
- **Given an appropriate** combination of nematode and application date, entomopathogenic nematodes may be useful for annual bluegrass weevil control.
- ***Bacillus thuringiensis* var. *tenebrionis*** has been used to control carrot weevil in the genus *Listronotus* and may be effective on annual bluegrass weevil.
- **Spinosad, sold under** the name Conserve, is a biorational insecticide that has received Federal federal registration for use against annual bluegrass weevil.

Acknowledgments

Although several products have been mentioned here, no endorsement is intended or implied by the author or the University of Massachusetts. It is the responsibility of the applicator to confirm the registration status of any pesticide before applying it.

No outside funding was provided for the Conserve test. Thanks to the New York State Turfgrass Association and the New England Regional Turfgrass Foundation (1999-2003) for funding my research program in general, and thanks to Tom Leahy, CGCS at Sleepy Hollow Country Club, Scarborough, N.Y., for providing space on a fairway for the past 10 years. Thanks also to Cindy Johnson, superintendent at Tumble Brook Country Club, Bloomfield, Conn., who has also been a great cooperator, providing space on a fairway for the past five years.

Reference

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