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# Don't Fear the Weevil! Managing the Annual Bluegrass Weevil

When we went out to survey annual bluegrass weevil populations in 2004 we missed the mark. The small black insects were more anxious than we were to get their activities off the ground on the fairways where we had chosen to study their seasonal fluctuations. At one of our two sites, adults were already detected on the first survey date April 17th. And we were off the mark again in 2005, not because we had not learned our lesson and gotten to the course soon after snowmelt, but because populations were so low that they were barely detectable. Yet one fairway over, they had emerged in such serious numbers that we could almost feel the reverberations of their boring and chewing as they laid into the margins of the tee box and the fairway edge. The superintendent had never seen such severe problems in that sector of the course before.

In fact, golf course superintendents throughout NY and the Northeast were sobered by the ravages of annual bluegrass weevil in 2005. Many experienced the weevils outbreaking in areas where they had not been problematic the previous years. Others experienced such an unpredictable recolonization by overwintering adults, and such a chaotic development of the spring and summer generations, that it was dizzying to ascertain where the insect was in its life cycle. These are "where" and "when" targeting issues: predicting *in space* which areas of the golf course will have problems, and predicting *in time* the opportune moment to target susceptible life stages with controls. The unpredictability of 2005 meant damage to high visibility areas (like the edges of tees, greens and fairways), and it meant laying out control applications not once, but two or three times against the same generation, sometimes five times over the course of the summer. The upshot: stress on already tight insecticide budgets and another reason to fall short of exaggerated golfer expectations.

Why is this insect so challenging to manage and what strategies should we pursue to improve our chances of keeping it in check? In this article we summarize the problem, the challenges and the perspectives for annual bluegrass weevil management. We will also

*continued on page 6*

## This Times



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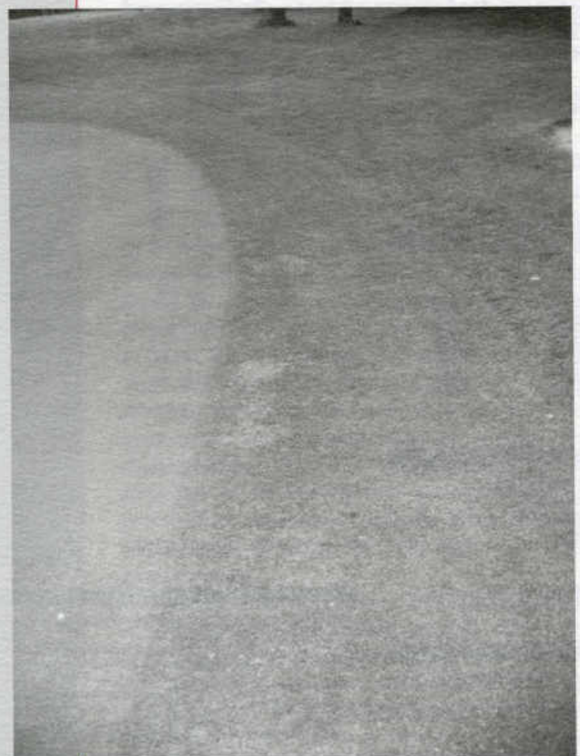
## Feature Story

continued from page 1

outline our ecological approach to address this issue, and the implications we expect our results to have for improved management of annual bluegrass weevil in *Poa annua*.



*Annual bluegrass weevil damage obvious in collar and other perimeter areas where annual bluegrasses may be under stress.*

**The Problem**

The annual bluegrass weevil is an increasing pest problem, in a high value and risk-adverse commodity, whose management relies completely on chemical insecticides. Many superintendents still refer to it as the "Hyperodes" weevil, a name that conjures up the "metropolitan nightmare" that haunted Downstate superintendents in its heyday. The insect is most precisely known as *Listronotus maculicollis*, or the annual bluegrass weevil (ABW). The name "Hyperodes" refers to its former taxonomic classification, and since that classification has changed, we should discourage referring to it by that name.

ABW is a native insect, born and raised in the U.S., and reportedly occurs in some 40 states. It was first linked to turfgrass injury in Connecticut 75 years ago (1931). Since then its area of impact has broadened immensely. In the past 10-15 years, ABW has burgeoned to become one of the most problematic pests of high-maintenance turf throughout the Northeast. Mid-Atlantic states like Maryland and New Jersey have recently joined NY, PA, New England, Ontario and Quebec in hosting damaging outbreaks.

Annual bluegrass is often considered a weed, especially when it encroaches on bentgrass stands. Given its competitiveness, *P. annua* almost inexorably invades to dominate fairways, greens and tees. Because it can provide an acceptable playing surface, more and more golf course superintendents resort to managing it rather than combating it. And as those managed *P. annua* habitats expand, so do possibilities for problems with ABW.

Every spring, superintendents contend with adult movement from off-course overwintering sites to the greens, tees and fairways, resulting in heavy damage to *P. annua* in the collars and surrounding areas as the insect completes 2-3 generations. Females insert eggs between the leaf sheaths. Younger larvae feed within the stem whereas older larvae drop down to feed on the crown from crude burrows in the surface, killing up to 20 stems over the course of development. Feeding adults will notch grass blades but causes little or no damage as it is cut away in the next pass of the mower. Feeding injury due to larvae is expressed as growing areas of yellow and brown spots, usually first noticed around the collar and perimeter of the greens, tees or fairways. High populations will cause substantial areas of dead turf that severely impact the visual and functional quality of golf course turf.

**The Challenge**

ABW is a problem of growing concern because its principal host, *P. annua*, is increasingly accommodated rather than fought, and because there are no real control options other than pyrethroid insecticides, which may be applied 2-5 times a season. Under this scenario, there is an urgent need to develop other control alternatives; insecticide options will undoubtedly be more limited in the future due to new regulations and the likelihood of pesticide resistance development. We also need to better understand the association between ABW and the golf course landscape; in addition to better targeting control applications, a stronger basic foundation will uncover entirely new ways to intercept and suppress populations.

The overall challenge taken on by our research group at Cornell University is to strengthen our understanding of ABW's association with turfgrass habitats. By doing this, we hope to uncover new control opportunities and to develop novel management approaches that will reduce reliance on chemical insecticides. We therefore seek to (1) curb the increasing impact of ABW, (2) reduce our dependence on pyrethroids by developing new control alternatives, and (3) fill knowledge gaps to better understand the association between ABW and golf course landscape.

While our current best management practices are relatively straight forward, there are serious limitations to this approach. The overall traditional strategy has been to target adults with insecticides. To do this, adults must be targeted in the early spring after they have recolonized the fairway, greens and tees from their overwintering sites in off-play areas like tall grass and the litter along tree lines. The phenological window for this period is between the full bloom of Forsythia and flowering dogwood (or when Forsythia is half gold/half green). This is our best guess at the window when adults have recolonized and when they have started to lay eggs that will lead to the spring generation. Choose a relatively insoluble insecticide so it stays in thatch where adults are active. Synthetic pyrethroids (Bifenthrin, Cyfluthrin, lambda-Cyhalothrin, Deltamethrin) are the best options. Periphery sprays along low-mown turf, the areas most susceptible to damage, are usually sufficient. As required, the second generation of adults should be targeted around July 4.

A major limitation to this approach is reliance on one class of insecticides and the potential for resistance development. Indeed, preliminary data from the University of Connecticut support the idea that some ABW populations may harbor extremely high levels of resistance to pyrethroids. If this is the case, it is one factor that may have contributed to control failures in 2005. Another limitation is that there are no products with a proven track record against larvae. Nevertheless, the only established thresholds are based on numbers of larvae, not adults. If scouting shows a preponderance of larvae or pupae, then insecticide treatments should be withheld until they have matured into adults. Besides pyrethroids, no other alternative compounds or tactics can be recommended (other than removing *P. annua*). Under this scenario, success depends on timing. A best-case scenario is one well-timed perimeter spray; a more common scenario is 2-5 applications, sometimes with widespread fairway applications.

**The Perspectives**

Research advances have led us to identify three broad activity areas that will lead to more effective ABW control and promote reduced insecticide alternatives: (1) biology, ecology and behavior, (2) management alternatives, and (3) integrated pest management (IPM) tools.

First, we need to fill critical knowledge gaps in our basic understanding of ABW biology, behavior and ecology. Despite advances over the last ten years, certain critical gaps remain, especially in the face of our changing control environment. Our goal should be to fill bioecological information gaps to establish the foundation necessary to uncover and exploit new or enhanced control opportunities. Some priorities would be to (a) establish current geographical distribution in Northeastern and Mid-Atlantic states to monitor spread in impact, (b) describe the overwintering biology, (c) establish patterns of adult dispersal, population fluctuation and phenology, (d) describe and quantify reproductive biology, and (e) more firmly establish host plant associations such as adult oviposition and larval feeding preferences.

*Annual bluegrass weevil adults preparing to lay eggs in stems of annual bluegrass.*

Second, we need to pursue other management alternatives with the goal of identifying, developing and promoting new cultural, biological, chemical and genetic control options. Some priorities would be to determine the effect and role of (a) cultural practices such as mowing height, fertility and barrier strips of non-preferred grasses, (b) biologically-based approaches such as entomopathogenic nematodes, spinosad and Bt, (c) new chemical control products or new uses for current products, and (d) host plant resistance.

Third, we need to develop improved IPM decision tools with the goal of refining the targeting of control tactics, maximizing efficacy of controls, and reducing inputs of traditional chemical insecticides. Some priorities would be to (a) refine and validate a robust degree-day model for predicting ABW phenology, (b) refine action thresholds, (c) develop more efficient techniques for laboratory rearing and field

*continued on page 8*

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*Answering these questions will strengthen our understanding of the association between ABW and the turfgrass habitat. It will lead to new insights for management programs such as more robust forecasting to improve the targeting of control tactics and reduce insecticide use.*

sampling, and (d) conduct outreach to promote the most effective and least pesticide-intensive control tactics in the context of our best understanding of *P. annua* management.

**Our Approach**

As far as we are aware, no field studies have addressed this pest in Upstate NY. Studies conducted Downstate suggest specific phenological windows for targeting adults as they recolonize in the spring. Nevertheless, we have no measure of how applicable these generalizations are across other areas of the insect's range. Moreover, the resolution of previous population studies has not afforded a detailed look at when the life stages occur and how the generations develop over the course of the season. To really interpret the association between ABW and the golf course, we need to conduct highly detailed studies on how populations of the different life stages and generations develop in space and time, how the insect chooses overwintering sites, and how adults move between overwintering and developmental sites.

In response, we have launched a series of studies designed to interpret the association between ABW and the golf course landscape. Our expectation is to exploit this understanding to improve IPM. Our objectives are to (a) describe the patterns of variation in seasonal fluctuations and phenology, i.e. what goes on during the growing season at the developmental sites on low-mown turf?, (b) determine the factors that affect overwintering site selection and success, i.e. what goes on during the off season at the protective overwintering sites off the low-mown turf?, and (c) document the relationship between overwintering sites and developmental sites, i.e. how does the insect navigate between sites where it overwinters and sites where it feeds, reproduces and develops?

These studies are the subject of a Masters Thesis in Entomology conducted by Maria Derval Diaz at Cornell University. Over the last two years, her activities have involved (a) weekly population surveys through soap flushes and soil core sampling at two fairways in Upstate NY, (b) extracting and classifying all captured life stages to reconstruct the development of spring, summer and fall generations through space and time, (c) monitoring the directional movement of adults through captures in linear pitfall traps, (d) conducting distribution surveys to establish overwintering sites with respect to distance from the fairway and type of litter substrate, and (e) teasing out differences among overwintering substrates in terms of preference and survivability by forcing adults to overwinter under "choice" and "no-choice" experimental scenarios. Details of the results of her research will follow in a companion article slated for a future issue of CUTT.

**Implications**

Overall, we expect Diaz's research to provide new understanding of where the insect overwinters, how and when it recolonizes the golf course, and how population development proceeds over the course of the season. This specifically includes factors that influence in the selection of overwintering sites, number of generations a year, timing of the life stages, and fluctuations in abundance.

In our lab's broader research agenda, we are working to answer a series of questions related to three areas. First, regarding the patterns of variation in seasonal fluctuations and phenology: How do populations and generations develop in space and time? How much does abundance and phenology vary from site to site and year to year? Can this information help us identify patterns, new control opportunities, or better ways to target pesticides? Second, regarding factors that affect overwintering site selection and success: Can adults overwinter on greens? Is white pine litter a preferred substrate in which to overwinter? Could ABW be controlled at overwintering sites? And third, regarding the relationship between overwintering sites and developmental sites: How far will adults disperse? Are there times of the year when flight is important, or do they mostly move by walking? How is adult movement guided? How might adults be intercepted as they move in from overwintering sites or as they leave to overwintering sites?

Answering these questions will strengthen our understanding of the association between ABW and the turfgrass habitat. It will lead to new insights for management programs such as more robust forecasting to improve the targeting of control tactics and reduce insecticide use. And beyond golf courses and turf, it will contribute to our overall understanding of how landscapes might be interpreted and manipulated in managed ecosystems to improve pest management strategies.

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