Although the use of compost may not control turfgrass diseases to a level that may replace fungicides, its integration along with current disease management practices may reduce fungicide use and associated problems such as resistance. Sufficient organic composts may be introduced into the soil-plant system in order to support microbial growth and activity. Naturally suppressive composts can be incorporated into normal turfgrass maintenance by replacing sphagnum peat or other organic materials used in topdressing mixtures (Figure 1). Compared to peat, compost can allow turfgrass to green-up quicker and increase the microbial activity in the soil.

Taking a look at how compost may be used as an alternative to fungicides for dollar spot control is a subject of ongoing research at the University of Georgia. The objectives of this research are to (1) evaluate the application of natural organic composts limiting the severity of dollar spot and decrease the over-wintering inoculum of *S. homoeocarpa*, (2) assess the effect of nitrogen on disease suppression along with the role of microbial populations and (3) determine if multiple applications of composts combined with recommended low rate fungicide applications provide acceptable disease control.

Field studies were initiated in 2011 on an established stand of Sea Isle Supreme seashore paspalum (*Paspalum vaginatum*) and on a one-year-old stand of SR-1020 bentgrass (*Agrostis stolonifera*). The cultivars SR-1020 and Sea Isle Supreme were chosen based on their susceptibility to dollar spot. Bentgrass plots are being maintained under golf course putting green conditions, while the paspalum plots are similar to golf course fairway conditions. Four different composts are being applied to plots once a month at 50 pounds per 1,000 square feet. Compost 1 (Sodpro) is a by-product of the sod industry in Georgia. Compost 2 (Carbon Peat) is a mined compost in Georgia. Compost 3 (Foothill) is a by-product of the nursery industry in Georgia. Compost 4 (Farm Meal) is a by-product of cricket waste in Georgia. To separate plots, the systemic fungicide Emerald (boscalid) is applied monthly at the low and high labeled rate. To serve as a fertilizer standard, sulfur-coated urea is applied once a month at 0.25 pounds N per 1,000 square feet. A non-treated control is also included. Plots are evaluated for disease severity, turfgrass quality and color. Digital imaging is being used to determine the percent of infected tissue.

Dollar spot can be destructive to turfgrass stands. It continues to be one of the more costly turfgrass diseases to manage on an annual basis. Through this project, we are attempting to provide the best information on dollar spot control and become less reliant on pesticides. Golf course superintendents and athletic field managers who are considering biocontrol, or may be pressured to implement more pesticide-free programs, should be able to apply information from this project to their facilities.

Dr. Clint Waltz is an associate professor and turfgrass specialist in the Department of Crop and Soil Science at the University of Georgia. He has statewide responsibilities for all areas of turfgrass management. J.B. Workman is a graduate research assistant at the University of Georgia. His MS research project is on alternative approaches to managing dollar spot.

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Entomopathogenic Nematodes Control Annual Bluegrass Weevil

By Benjamin A. McGraw and Albrecht M. Koppenhöfer

Damage caused by larval feeding is most apparent on short turf.

The annual bluegrass weevil (*Listronotus maculicollis*, formerly *Hyperodes maculicollis*) (ABW) is a pest of golf course turf in the northeastern United States and eastern Canada. Damage caused by larval feeding is most apparent on short turf (<0.5"), and can be extensive in turf stands with high percentages of annual bluegrass (*Poa annua*). The predominant management strategy is to target overwintered adults as they appear on the playing surfaces in spring. If adult populations go uncontrolled, mated females will deposit eggs between the leaf sheaths of the turfgrass plant. Upon hatching, young larvae bore into the plant, and feed relatively protected from most chemical insecticides. Older larvae (3rd through 5th instars) emerge from the plant to feed externally on crown, and thus cause the most severe turf loss.

Due to the low tolerance for ABW damage to high-valued turf areas and the inability to effectively control the larva once inside the stem, superintendents may make several preventive chemical applications against emerging adults. However, the over-reliance on and overuse of insecticides, particularly of the pyrethroid class, has led to the development of pesticide-resistant populations on many golf courses. The reliance on preventive chemical insecticides and the possibility of the development of resistant populations has increased the need for less toxic and more sustainable approaches to controlling ABW.

We sought to determine if ABW populations are impacted by natural enemies (e.g.

pathogens, predators, parasites) residing in the golf course environment, and, if so, whether the natural enemies could be isolated and applied as biological control agents. In 2005, entomopathogenic nematodes (EPNs) were found infecting ABW larvae and pupae on several fairways in a statewide survey of New Jersey golf courses. EPNs are microscopic, insect-parasitic roundworms that have an infective juvenile (IJ) stage capable of locating and infecting soil-dwelling insects. Further studies conducted on three golf courses in New Jersey indicated that two species [*Steinernema carpocapsae* (Sc) and *Heterorhabditis bacteriophora* (Hb)] regularly infect ABW larvae in golf course fairways and can reduce a single weevil generation by up to 50 percent.

Two species of entomopathogenic nematodes infect annual bluegrass weevil larvae in fairways and can reduce a weevil generation by 50 percent.

PHOTOS COURTESY: BEN MCGRAW, PH.D.

The objective of this study was to determine if EPNs could be applied to turf to reduce ABW densities below damaging levels. We screened commercially available species in the laboratory against different ABW stages and followed these studies with multiple field trials to assess their efficacy under field conditions.

Laboratory screening

Five commercial EPN strains supplied by Becker Underwood (Sussex, UK) [Sc, *Steinernema kraussei* (Sk), *S. feltiae* (Sf), Hb and *Heterorhabditis megidis* (Hm)] and two native strains [Sc (PB) and Hb (PB), isolated from infected ABW larvae and pupae found in fairways] were tested in laboratory trials.

Adult susceptibility to EPNs was low to moderate (11–65 percent mortality) even under optimal laboratory conditions and at a high EPN rate. Therefore, EPNs do not show promise for the preventive control of ABW. However, larvae were moderately to highly susceptible to EPN infection, with fourth instars tending to be more susceptible than fifth instars. Despite high ABW densities in the laboratory trials (~80/ft^2), high control rates of fourth instars were observed for the commercial strains of Sf (89 percent) and Sc (81 percent) with somewhat lower rates for Sk (72 percent) and Hm (69 percent). Native and commercial nematode strains did not differ significantly in virulence to any ABW stage tested. These observations suggest that EPN field applications should be targeted against the early fourth instars to maximize control rates and minimize the potential for turf damage.

Field trials

Field trials were conducted in 5x6-foot (2.78-square-meter) plots on golf course fairways, arranged parallel to the edge of the rough-fairway border. Application times were based on peaks in larval densities estimated by weekly core sampling in adjacent plots and timed to target the larval population entering the soil (early peak in fourth instars). Nematodes, either reared in the laboratory (native strains) or formulated commercial product, were suspended in water and applied with watering cans followed by a rinse for a total of 0.125 in (3.1 mm) of irrigation.

In 2006, high levels of ABW control (63–94 percent) were observed with rates of 1 billion IJs/acre (standard EPN field rates) to moderate ABW infestations (~ 25/ft^2). Sf provided the greatest control (94 percent) but was not statistically different from the other treatments (Figure 1).

The 2007 field trials included an additional commercial strain (Hb) and two application rates (1 and 0.5 billion IJs/ac) for each species. Trials were conducted on fairways where the larval densities in the untreated control plots (>65 larvae per square foot) exceeded commonly accepted thresholds for damage (>40 larvae per square foot). Though higher EPN application rates led to greater control

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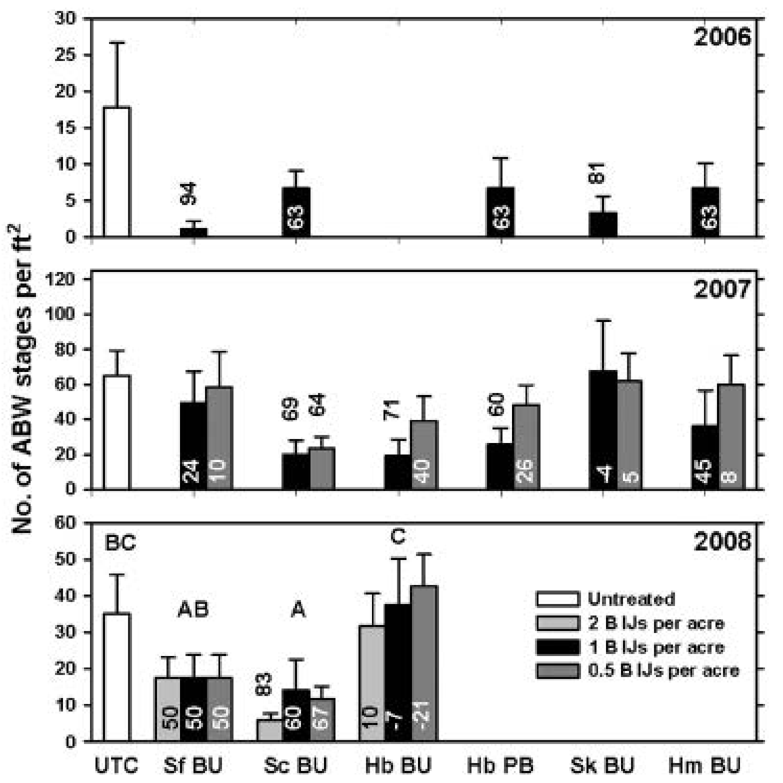
FIGURE 1: EPN IMPACT ON ABW DENSITIES



Effect of EPN species/strain and application rate on ABW densities. Numbers above or within columns indicate percent reduction relative to the density in the untreated control. Letters above columns (2008) indicate significant differences (Tukey's pairwise comparison test,* P<0.05*) between EPN species when all rates were combined.

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in most instances, control was more variable (0–71 percent) than in 2006, and likely attributable to higher ABW densities. Between the two application rates, Sc provided the most consistent control (64–69 percent).

In 2008, the previous top-performing species (Sf, Sc and Hb) were tested at three application rates (2, 1 and 0.5 billion IJs per acre) to intermediate ABW densities (~ 35-40 ABW/ft^2). Sc provided the highest and most consistent control (60–83 percent), however, without clear dose effect and not significantly better than Sf.

Conclusions

Our findings in laboratory bioassays and evidenced in select field trials suggest that ABW larvae are very susceptible to several commercially available EPNs and that curative control of ABW with EPNs may be feasible.

Our results indicate that Sc and Sf could provide control comparable to chemical insecticides (>80 percent) when applied at standard rates (1 billion IJs per acre) to moderate larval densities. Although each species demonstrated the capability of high control in the field, the range of control (Sf = 10–94 percent; Sc = 60–83 percent) is currently far too variable for reliable use on valuable turf. Additionally, we observed a significant decrease in susceptibility between fourth- and fifth-instar ABW larvae in laboratory bioassays, which may indicate that the application of nematodes must be precisely timed to achieve high levels of control. Future studies will investigate the role that pest density and application timing have on control levels to reduce the variability in control.

Dr. Ben McGraw is an assistant professor in the Department of Golf and Plant Sciences at the State University of New York (SUNY) at Delhi, NY. Dr. Albrecht Koppenhöfer is a professor and turfgrass extension specialist in the Department of Entomology at Rutgers University in New Brunswick, NJ. Reach McGraw at mcgrawba@delhi.edu.

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McGraw, B.A. and A.M. Koppenhöfer. 2008. Evaluation of two endemic and five commercial entomopathogenic nematode species (Rhabditida: Heterorhabditidae and Steinernematidae) against annual bluegrass weevil (Coleoptera: Curculionidae) larvae and adults. *Biological Control* 46: 467-475.

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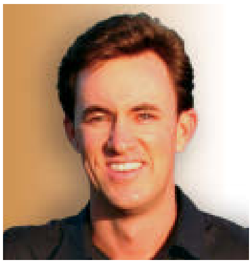
The Bunkers Down Under

WHEN ASKED HOW THEY GET AWAY WITH SO RARELY RAKING SAND OR LEAVING FACES BARE, THEY MERELY SHRUGGED.



BY GEOFF SHACKELFORD

Fortune took me to Australia last month for the Presidents Cup and a chance to finally see golf as they do it Down Under. And I bring you good news.

Australian golfers have many of the same peccadillos as American golfers: They like rough, trees, expensive clubhouse re-dos and for their courses to punish every bad shot without concern for playability. But that's about where the similarities end.

Because even with their affinity for difficulty and manly shot values, Aussie golfers are light years ahead of American golfers when it comes to common sense bunker maintenance. Whether by fortune or accident, they do not treat the bunker as an almightly cathedral requiring perfect sand, constant grooming and video-game aesthetics.

Now, some who watched the Presidents Cup or the Australian Open might quibble with this assertion, citing the tightly clipped edges of bunkers cutting right into greens and giving Aussie golf a distinct flair. However, with an arid climate and overall mentality of not making grass so green, their turf grows slower, making the lip maintenance a minor issue. Especially since crews have so much time freed up from the daily, almost neurotic sand primping demanded by Americans.

First of all, there's the way they rake sand. The floors are raked almost daily at most of the better clubs, every few days at the public courses. Not much different than us, right?

Think again. With sand-based golf at most places, the bunker floors are shaped out of native soil and packed in nicely. No liners and minimal drainage. So even though bunker faces are steep, there is no obsession with stacking the bunker walls with two to three inches of sand to hide the native soil, even though aesthetically this look sticks out and to some of us weirdos, adds a roughness and patina to the bunkering that is… beautiful. Instead, the area raked regularly in bunkers is perhaps 50 percent of the total bunker square footage, with only occasional touch-ups of the faces and that's usually done with a broom.

I was there during their springtime and got to see 20 courses, including several after heavy rains. In America, the horror of washed out faces and uneven lies has golfers expecting maintenance staffers to be out after the final drop has fallen from the sky to cover up the horrors of erosion and rain no matter how absurd it may seem for bunkers to be perfect so soon after a weather event.

Several Aussie superintendents were nice enough to discuss their practices and when asked how they get away with so rarely raking sand or leaving faces with nothing more than a dusting of the tan stuff, they merely shrugged.

When I probed a bit more, they didn't throw their American colleagues under the bus or even question why we do things the way we do. But instead, they just said this is what golfers in Australia know and most are just fine with a rustic approach to bunkers. In fact, they insist on the face maintenance because with so little sand, balls nearly always finish in the bottom of bunkers on the flatter floors. And I've yet to meet a golfer who longs for buried lies in bunker faces, American or otherwise.

Re-educating the American golfing public to understand just how much expense and manpower is wasted on bunker maintenance is probably impossible at this point, but if we could just get one major championship or high profile event to show the earth can revolve on its axis with only a dusting of sand on faces and merely raking a portion of bunker floors, we could be just like the Aussies. And that would be a very good thing.

Reach Shack, Golfdom's contributing editor, at geoffshack@me.com. Check out his blog – now a part of the Golf Digest family – at www.geoffshackelford.com.

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