Conserve Beneficial Insects on Your Golf Course

Natural enemies buffer turf against pest outbreaks.

by DANIEL A. POTTER

GOLF COURSE superintendents are constantly alert for insect pests, but it is doubtful that they think as often about the many beneficial insects and other small creatures inhabiting their turf. Some, such as tiny springtails and soil mites, aid in the breakdown of grass clippings and other plant litter, thus aiding nutrient recycling. Earthworms admittedly are a nuisance when they deposit their castings (soil and excrement) on closely mowed playing surfaces, but those sins must be weighed against the benefits they provide by aerifying and enriching the soil, enhancing water infiltration, and breaking down thatch (1).

Healthy turf also is hunting ground to diverse natural enemies such as predatory insects and spiders, as well as tiny wasps or flies that parasitize other insects. These so-called parasitoids lay eggs, *Alien*-style, in caterpillars or grubs, and the victim is then devoured by the developing parasitoid larva. Our long-term research has repeatedly shown the importance of natural enemies in buffering turf against pest outbreaks (2).

Golf courses also are frequented by honeybees and native pollinators, such as bumblebees, that forage on flowering weeds (e.g., white clover) in roughs and out-of-play areas. Habitat fragmentation, pesticide poisonings, diseases, and parasites such as tracheal mites are causing bees and other pollinators to disappear at alarming rates. This has prompted the U.S. Department of Agriculture to release warnings of an impending pollination crisis.

Honeybees, an introduced species, have been particularly hard hit. This decline places a greater importance on native pollinators. Golf courses can help to sustain insect pollinator populations by providing suitable habitat and nectar sources that may be deficient in surrounding subdivisions and urban areas.

After more than 22 years of studying turf insects, it is apparent to me that conserving beneficial species is among the keys to sustainable resource management for golf courses. This article summarizes some of our more recent USGA-funded research to evaluate the role of beneficial insects on golf courses and to develop tactics that allow superintendents to control pests without eliminating beneficial and non-target species.

Turfgrass Ants: Nuisance or Benefit?

Ants, which occur by the billions in roughs and elsewhere on golf courses, are voracious predators of the eggs and larvae of cutworms, grubs, and other turfgrass pests. These benefits, of course, must be weighed against the nuisance factor when ants build nests and mounds on putting greens and tees. We surveyed nuisance ants on golf courses in Kentucky and found that virtually all of the mounding problems involve just one species, *Lasius neoniger.* This same ant is found on golf courses throughout much of the United States.

Like all ants, *Lasius* is a social insect. Nests, consisting of shallow, interconnected chambers, occur in the upper 12 inches of soil. Each colony may contain hundreds of sterile female workers, but only one reproductive queen. A small mound of excavated soil particles tops each passage to the surface. The queen ant, with her eggs and larvae, remains underground and is fed and looked after by the workers.

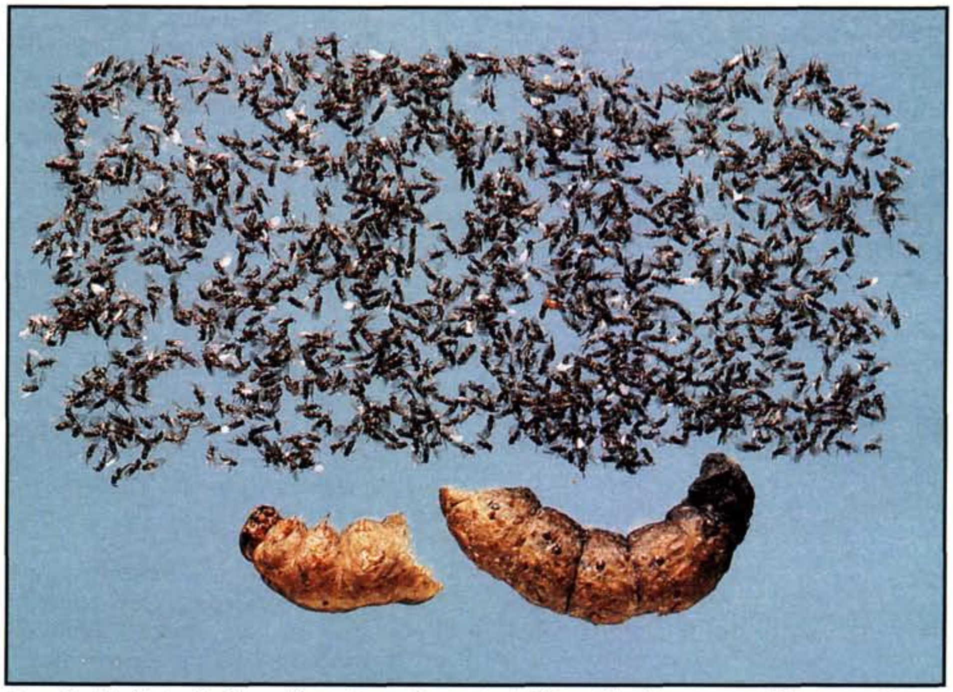
Turf-infesting ants are tough to control because conventional insecticides kill only a portion of surface-foraging workers, but usually fail to eliminate the queen. Thus, colonies may rebound soon after treatment. We tested a different approach: use of baits such as those used by pest control operators to eliminate ants from homes. Such baits contain a delayed-action insecticide formulated on sugary or protein-based food substances that attract the foraging ants. The workers carry the bait down into the nest and feed it to the queen and her brood. Once the queen is eliminated, the colony dies out and the mounds are not rebuilt.

We tested a number of baits containing the active ingredients abamectin, fipronil, hydramethylnon, or spinosad in "taste tests" to determine palatability to *Lasius*, and then in field tests on golf courses. Several of the baits were effective. One in particular, Maxforce® granular ant bait containing hydramethylnon, seems to be well suited for use on closely mowed turf. Sprinkling a small amount around the mounds generally eliminated a colony within a few days. While not cost-effective for broadcasting, the bait method is practical for spot-treating putting greens and tees. Labeling for Maxforce permits its use on golf courses, including putting greens, except in California. Golf course superintendents may wish to experiment with this approach. The bait method is selective and nonhazardous to beneficial insects and wildlife.

We also found that broadcast applications of fipronil (the active ingredient in Chipco Choice) can provide season-long suppression of *Lasius* ants. Fipronil is effective at very low use rates, and it seems to have little impact on earthworms and predatory insects other than ants. The manufacturer has submitted a registration request for granular fipronil for ant control on golf courses. If granted, this will provide a powerful option for selective control of mound-building ants on greens and tees. It might be counterproductive, however, to treat fairways and roughs for *Lasius* because of the ants' importance in biological control of turfgrass pests.

We also documented a remarkable mutualism between *Lasius* ants and subterranean root aphids. The ants tend and protect the aphids, carrying them about in their mandibles and stroking them to obtain their sugary honeydew (a carbohydrate-rich, liquid fecal product), much as a farmer tends dairy cattle. These root aphids, which apparently do not harm the grass, are abundant in native soil surrounding putting greens, but apparently absent from sand-based greens. Perhaps the workers' "sweet tooth" (i.e., access to aphids) is why ant nests on putting greens often encroach from the edge. Possibly managing the aphids would help to suppress the ants. Despite its being so abundant on golf courses, ours is the first record of this aphid species, *Geoica setulosa*, from the eastern United States. With USDA collaborators, we are publishing the first descriptions, illustrations, and keys to this species – a case of golf courses enhancing knowledge of biodiversity!

Superintendents should bear in mind that "nuisance" ants such as *Lasius* are beneficial in fairways and roughs because they prey upon other pests. Several studies have shown how important this benefit can be. For example, we allowed black cutworm moths to lay eggs on turf cores, implanted the cores into fairways and roughs of two golf courses, and watched and videotaped the eggs' fate over the next 24 hours. Ants consumed up to 85% of the eggs in untreated roughs in a single night. In treated fairways where the ants were suppressed, much higher numbers of cutworm eggs survived to hatch.



Parasitoids that attack pest insects are important allies of turf managers. Tiny parasitic wasps killed and emerged from a black cutworm. Each of the more than 1,500 female wasps that emerged from this larva will seek out and parasitize additional cutworms.

Tiphia *wasps lay eggs on root-feeding white grubs; the wasp larva then feeds on the victim, killing it within a few weeks.*

Target-Selective Insecticides

The 1990s saw dramatic change in the types of insecticides used on golf courses. Traditional organophosphates (OPs) and carbamates were supplanted, in large part, by newer chemistry with more target-selective activity. Pyrethroids (e.g., bifenthrin, cyfluthrin, deltamethrin, lambdacyhalothrin, permethrin) and spinosad (Conserve®) came into use against surface-feeding pests, whereas two relatively persistent compounds, imidacloprid (Merit,® a chloronicotinyl) and halofenozide (MACH2,® a molt-accelerating compound), now dominate the grub control market. Fipronil (Chipco Choice®) provided a new option for mole cricket control.

Using target-selective insecticides is another means for integrating chemical and biological control in a more sustainable way. But are the newer insecticides really less toxic to beneficial species? To find out, we evaluated their potential impact on predatory insects, earthworms, and pollinators such as bumblebees that forage in weedy turf.

In a two-year field study, Kentucky bluegrass plots were treated with imidacloprid (Merit®) or halofenozide (MACH2®) in late May or June, followed by irrigation as is recommended for grub control. Other plots were treated with bendiocarb (Turcam), a broad-spectrum carbamate, or left untreated for comparison. We monitored the insecticides' impact on predator populations using pitfall traps, and also sampled earthworms and other beneficial soil fauna.

Every few weeks the plots were implanted with lab-reared eggs, larvae, or pupae of black cutworms, or eggs of Japanese beetles, and predation rates were determined. We wanted to see if any of the insecticides affected natural enemies enough to reduce predation on these pests. Finally, efficacy against the targeted pests was evaluated by sampling white grub populations in late summer. Other tests were done to compare the hazard to predators of irrigated versus non-irrigated spray residues.

We also have been evaluating potential hazards of insecticides to pollinators. Turf plots with flowering white clover were treated with preventive grub insecticides, with or without watering in, or with short-residual surface insecticides. Bumblebee hives were confined on the turf in large, screened cages after the residues had dried. The bees were allowed to forage for several weeks, and the hives then were sacrificed to evaluate hive health.

To determine if exposure to insecticide-treated plots disrupts bee behavior, foraging activity of workers, as well as their defensive response were evaluated. In one test, a researcher wearing a bee suit entered each cage and disturbed the hive by striking it with a stick in a consistent manner. The number of bees that issued forth to try to sting the intruder, and the speed of that response, were recorded. We also monitored native bumblebees' response to open turf plots with white clover to determine if bees avoid insecticide-treated areas.

New Chemistry is Promising

Halofenozide (MACH2®) had no measurable adverse effects on earthworms and other beneficial soil organisms, predators, or bumblebees in our tests. Nevertheless, our applications in late May provided excellent (>90%) residual control of Japanese beetle and masked chafer grubs. This demonstrates the product's selective toxicity to pest species, mainly white grubs and caterpillars.

Imidacloprid (Merit®) also gave excellent (>90%) residual control of white grubs. Granular or liquid applications followed by irrigation had relatively low impact on earthworms and predators, and no measurable adverse effects on bumblebees. Although imidacloprid is systemic, our results suggest that it is not translocated into pollen or nectar, or at least not at levels that are harmful to bees.

In contrast, exposure to non-irrigated imidacloprid spray residues resulted in paralysis, impaired walking, and other neurotoxic effects in predatory beetles, as well as decline of bumblebee colonies that were confined on treated plots. It is important to note that these adverse effects were substantially reduced or eliminated with timely post-treatment irrigation.

Broad-spectrum carbamates and OPs, by comparison, can have severe impact on beneficial species. Bendiocarb, for example, reduced earthworm populations by >90%, and it also caused high acute mortality of predators regardless of whether they were hit by spray droplets, crawled over dry residues, or consumed insecticide-contaminated food. Exposure to non-irrigated residues of bendiocarb or chlorpyrifos caused severe decline of bumblebee colonies foraging on flowering white clover that had been sprayed along with the grass.

Preserve Beneficial Organisms

Our studies indicate that the new, target-selective turf insecticides generally are compatible with conservation of beneficial invertebrates. Halofenozide and spinosad (Conserve®), in particular, seem to pose little or no hazard to earthworms, predators, parasitoids, or pollinators. Imidacloprid caused some suppression of earthworms, at least in our tests, but the reductions were short-lived and much less severe than those caused by bendiocarb, carbaryl, or certain organophosphates (e.g., ethoprop, fonofos).

Imidacloprid also seems to be compatible with predators and pollinators so long as the residues are watered in. Carbamates, organophosphates, and pyrethroids can adversely affect pollinators if residues are present on flowering weeds such as clover or dandelions. Mowing flower heads before treatment, using granular formulations, post-treatment irrigation, chemical weed control, or avoiding insecticide sprays when weeds are in bloom can reduce such hazards.

Literature Cited

1. Potter, D. A. 1991. Earthworms, thatch, and pesticides. *USGA Green Section Record.* 29(5):6-8.

2. Potter, D. A. 1992. Natural enemies reduce pest populations in turf. *USGA Green Section Record.* 30(6):6-10.

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Mound-building ants may warrant management on putting greens, but their predatory habits make them allies in suppressing other pests in fairways and roughs.