Integrating Natural Enemies, Cultural Control, and Plant Resistance for Sustainable Management of Insect Pests on Golf Courses

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Objectives:

1. *Evaluate the role of ants as beneficial predators in golf turf: determine the predominant species inhabiting golf courses; and develop tactics for managing mound-building pest ants on putting greens with reduced environmental risk or impact on beneficial species.*
2. *Investigate synergism between endophyte-enhanced, resistant turfgrasses and bio-rational insecticides for improved management of white grubs and black cutworms.*
3. *Examine the main and interacting effects of cultural practices (mowing height, irrigation, and N fertilization) on nutritional and defensive characteristics of creeping bentgrass on relative susceptibility to white grubs and black cutworms.*

Ants are important predators on eggs and larvae of cutworms, grubs, and other pests, but on golf courses, these positive aspects must be weighed against the fact that some ant species build mounds on putting greens and tees. Surveys of ants inhabiting golf courses revealed that virtually all nuisance ant problems on putting greens and tees involve one species, *Lasius neoniger*. Surface insecticides usually won't eliminate these ants because the treatments fail to reach the ground-nesting queen. Our research showed that two commercially available baits containing either avermectin (Advance® Granular Carpenter Ant Bait; WhitMire Micro-Gen, Inc.) or hydramethylnon (Maxforce® granular ant bait; Clorox, Inc.) are effective for spot-treating ants in high-profile situations. Minimum effective rates were investigated. In another test, fipronil (Chipco Choice®, Rhone-Poulenc, Inc.), a novel phenyl pyrazole, was effective for season-long suppression of *Lasius* nests and mounds on putting greens. Registration of fipronil for general ant control on golf courses is expected in 2000.

Other field experiments demonstrated that *Lasius neoniger* and other ant species are important in suppressing eggs and larvae of other insect pests. Populations of caterpillars (sod webworms and cutworms) were higher on golf tees where ants were eliminated than where ants were abundant. Thus, it may be beneficial to conserve turf ant populations except on putting greens where the mounds are intolerable. *Lasius* ants cultivate and tend certain root-feeding aphids from which the ants obtain sugary honeydew as food. Root aphids, which appear to cause no damage, were present under all cool-season grasses. The aphids are abundant in fairways and roughs, but apparently are unable to survive in sand-based putting greens and tees. Maintaining access to aphids in close, irrigated rough may be one reason why *Lasius* ant nests are so abundant around the edges of greens and tees. Controlling root aphids may be one means of discouraging buildup of mound-building ants.

Two other studies related to Objective 1 were initiated in 1999. The first involves research on *Tiphia* wasps, which are important native parasites of white grubs. We have begun to characterize the wasps' seasonal life cycle, food plants used as nectar sources by the adults, and means by which populations of these beneficial insects can be augmented on golf courses, e.g., through planting of preferred wildflowers. We also are investigating cues by which the wasps locate grub victims underground. The second study involves evaluation of potential impact of turf insecticides on native pollinators. We found that imidacloprid (Merit®), applied as it would be for grub control, had no adverse effect on native bumblebees foraging on patches of flowering white clover in treated turf.

Our second objective concerns whether use of endophytic grasses in combination with microbial-based insecticides can provide enhanced levels of insect control. We sought to determine if the sublethal stress endured by insect pests feeding on endophytic grass might enhance the activity of microbial controls. Dose-mortality studies with *Bacillus thuringiensis* and spinosad (Conserve®) revealed no such interactions against black cutworms. Spinosad was effective, even at 0.25 label rate, and *B. thuringiensis* was ineffective, regardless of endophyte level of the grass. Similarly, feeding on roots of endophytic grass did not affect susceptibility of Japanese beetle grubs to milky disease bacteria, *Bacillus popilliae.*

Work conducted for Objective 3 in 1999 focused on potential interactions between plant growth regulators (PGR's) and insects attacking creeping bentgrass. We speculated that physiological or nutritional effects of the PGR's might alter the attractiveness or suitability of the turfgrass as food for plant-feeding insects. Large plots of fairway-height creeping bentgrass were maintained under monthly applications of Scott's Turf Enhancer® 2 SC (paclobutrazol), Primo® liquid (trinexapac-ethyl), or as untreated controls. The turf was challenged with cutworms and white grubs, and natural population densities of insect pests also were monitored. Our data suggest that use of paclobutrazol or trinexapac-ethyl on creeping bentgrass will neither increase nor decrease insect populations in the treated