Natural Enemies and Site Characteristics Affecting Distribution and Abundance of Native and Invasive White Grubs on Golf Courses

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Objectives:

1. Determine identity and incidence of microbial pathogens and parasitoids of Japanese beetle and masked chafer grubs on golf courses across Kentucky, the first such study in the transitional turfgrass zone. Quantify site characteristics associated with particular grub species and natural enemy incidence.
2. Evaluate how grass species, mowing height, and golf course pesticides affect incidence of pathogen infection and parasitism of naturally occurring white grubs in the field and if impact of naturally-occurring pathogens can be enhanced.
3. Test the hypothesis that natural enemy load on Japanese beetle grub populations on golf courses is greater in geographical regions where populations have stabilized than in regions into which the pest has more recently spread.

Start Date: 2007
Project Duration: three years
Total Funding: $60,000

Use of biological insecticides and conservation of natural enemies can reduce the need for chemical inputs on golf courses. This new project is the first systematic survey of white grubs and their natural enemies on golf courses in the transitional climatic zone. We seek new pathogens having potential as bio-insecticides, and to clarify how site characteristics and management practices might be altered to enhance natural enemy impact on masked chafer and Japanese beetle grubs. Such knowledge will help superintendents to conserve and possibly enhance natural enemies for more sustainable golf turf.

Grub survey kits were sent to 34 golf superintendents in throughout Kentucky in late summer 2007. Superintendents were asked to collect 30 grubs and a soil sample from their worst non-treated grub site and to complete a brief survey concerning site characteristics and recent history of grubs and insecticide usage at their course. Samples were returned to us via pre-paid overnight mail.

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Six additional golf courses were intensively sampled (25 grubs from each of three sites per course) on each of three dates (late August, mid-September, and early October) to track mortality from natural enemies over time. Grubs were identified, examined for parasitoids, and incubated in soil for 30 days at 30°C. Grubs will be dissected during the winter months to assess mortality from bacterial, fungal, or protozoan pathogens.

The 2007 samples confirm that masked chafers (*Cyclocephala spp.*) are the most destructive species on Kentucky golf courses representing 85% of grubs sent in by superintendents. On some courses, however, Japanese beetle grubs predominate. *Tiphia pygidialis*, a parasitic wasp, killed 30% of the masked chafer grubs at some courses. Incidence of milky disease, nematodes, *Serratia* bacteria, fungal infection, and other pathogens is being assessed and samples of pathogens are being saved for testing as potential new biological control agents.

Experiments in 2007 examined the reasons why Japanese beetle grubs rarely damage sand-based greens. Egg-laying response and grub survival was compared in turf in creeping bentgrass sand- or soil-based greens, or maintained at fairway height. Although survival and weight gain of implanted grubs was similar in each type of grass, adults laid few eggs in sand-based greens suggesting that sand topdressing warrants study as a possible grub management tactic.

Replicated stands of turfgrasses used in fairways or roughs of transition zone golf courses were established in spring 2007 to assess grub species preferences and how grass type affects the impact of parasitoids and pathogens on grub populations. Fairway plots consist of creeping bentgrass, perennial ryegrass (PR), zoysiagrass, and bermudagrass mowed at 5/8" (1.6 cm). Rough plots of turf-type tall fescue (TF), Kentucky bluegrass (KB), perennial ryegrass, or a TF/KB mix are mowed at 2.5" (6.4 cm). Endemic and seeded grub populations will be sampled for incidence natural mortality agents in 2008 and 2009.

Experiments to enhance infectivity of endemic or augmented milky disease bacteria are underway. We believe that chitinase, an enzyme that causes ulcers in the gut lining, can facilitate penetration of ingested spores to the body cavity where they induce lethal infection. Milky spore powder we are preparing from diseased masked chafer grubs will be formulated with barley flour, which contains five chitinase proteins, to study effects on LC_{50}. If chitinase synergizes infectivity, we will collaborate with R. Palli (University of Kentucky) to express the chitinase gene in the milky spore bacteria.

Summary Points

- Microbial pathogens and parasitoids of white grubs are being surveyed on 40 Kentucky golf courses, the first such study in the transitional climatic zone.
- Masked chafers, the predominant grub species in Kentucky, suffer high mortality from *Tiphia* wasps, milky disease, and other pathogens at some sites.
- New grub pathogens with potential as bio-insecticides may be discovered.
- Influence of site characteristics and management practices on incidence of grubs and natural enemies is being studied to help superintendents practice conservation biological control.