

# 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

**B**iological insecticides and natural enemy conservation can reduce the need for chemical inputs on golf courses. This work is the first survey of white grubs and their natural enemies on golf courses in the transitional climactic zone, and the first anywhere for masked chafers (*Cyclocephala spp.*), the most important native grub pests. We seek new pathogens having promise as bio-insecticides and to clarify how site characteristics might be altered to enhance natural suppression of grub populations.

Grub survey kits were sent to 34 golf superintendents throughout Kentucky in late summer asking them to collect 30 grubs and a soil sample from their worst non-treated grub site. Samples were returned via overnight mail. Six additional Lexington-area golf courses were intensively sampled in late August, mid-September, and early October to track natural enemy incidence over time.

Grubs were identified, incubated for 30 days, and dissected to assess mortality from bacterial, fungal, or protozoan pathogens. Masked chafers (MC) and Japanese beetles (JB) accounted for 64 and 30%, respectively, of grubs sent in by superintendents. MC also predominated on Lexington courses. Grub populations declined from about 18 per 0.1 m<sup>2</sup> in late August to about 5 per 0.1 m<sup>2</sup> in October and 2 per 0.1 m<sup>2</sup> the following spring owing to natural mortality agents. *Tiphia* wasps, *Metarhizium* fungus, *Serratia* (amber disease) and *Paenibacillus* (milky disease) bacteria, and entomopathogenic



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nematodes (EPN) infected 2, 5, 8, 20, and 18% of the MC grubs, and 0, 3, 5, 12, and 19% of the JB grubs sent in by superintendents.

*Ovavesicula*, a protozoan that causes debilitating disease in adult JB, was uncommon in KY, but gregarines (*Stichospora*) infected 26% of JB grubs in the spring. The latter two pathogens were absent or uncommon in MC grubs. Additional *Stichospora*-infected grubs were reared to determine their fate which has not previously been studied. Such grubs emerged as adults although their maturation was slightly delayed. Eighty EPN strains, 40 each from MC and JB grubs, are being processed for PCR identification.

Replicated stands of irrigated turfs used in fairways or roughs of transition zone golf courses were sampled for grub species preference and incidence of parasitoids and pathogens. Plots maintained at fairway height (5/8") consisted of creeping bentgrass (CB), perennial ryegrass (PR), zoysiagrass (Z), and bermudagrass (B). Plots at rough height (2.5 in)

consisted of turf-type tall fescue (TF), Kentucky bluegrass (KB), PR, or a TF/KB mix. Of the fairway-height grasses, Z and B had the highest incidence of MC grubs. MC predominated in CB, whereas JB favored PR. JB populations were highest in rough-height grasses, outnumbering MC 2-4 fold. Skunk damage was greatest in CB and PR at fairway height. There was little skunk digging in fairway-height Z or B, or in rough-height grasses. Parasitism by *Tiphia* occurred in all grasses but was greatest in zoysiagrass.

Grub collection kits were sent to cooperators in 22 states to survey natural enemy load in JB populations throughout the species range in the USA. Collected grubs are being analyzed for pathogens to test whether impact of particular agents is associated with how long JB has been established in a given area.

## Summary Points

- Grub species and associated pathogens and parasitoids were surveyed on 27 Kentucky golf courses, the first such study in the transitional climactic zone. Masked chafers and Japanese beetle grubs accounted for about 66 and 30% of the grub infestations, respectively. Insect-pathogenic nematodes, *Tiphia* wasps, milky disease, and other pathogens account for moderate to high natural mortality at some sites.
- Nematodes isolated from MC and JB grubs are currently being identified.
- Turfgrass species and mowing height influence incidence of grubs and natural enemies.
- Pathogens of JB grubs are being surveyed across the eastern and central United States to determine if natural enemy load can predict area-wide cycles of decline of grub populations.