

# 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 pathogens and parasitoids of Japanese beetle (JB) and masked chafer (MC) grubs on golf courses across Kentucky, the first such study in the transitional turfgrass zone.
2. Quantify site characteristics associated with particular grub species and natural enemies and prospect for potential new bio-control agents.
3. Evaluate how grass species and mowing height affect the susceptibility of white grubs to natural enemies in the field.
4. Test if a lag in buildup of natural enemies explains why Japanese beetle grub populations tend to reach outbreak densities on golf courses as the pest expands into new geographical regions and then stabilize over time.

**Start Date:** 2007

**Project Duration:** three years

**Total Funding:** \$60,000

Biological insecticides and natural enemy conservation can reduce the need for chemical inputs on golf courses. 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. Six additional 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 and Japanese beetles accounted for 64 and 30%, respectively, of grubs sent in by superintendents. Masked chafers also predominated on Lexington courses. Grub populations declined from about 18 m<sup>-2</sup> in late August to about 5 m<sup>-2</sup> in October and 2 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 nematodes infected 2, 5, 8, 20, and 18% of the masked chafers grubs, and 0, 3, 5, 12, and 19% of the Japanese beetle grubs sent in by superintendents, but much higher mortality from particular agents was seen on some courses. *Ovavesicula*, a protozoan that reduces egg production by adult Japanese beetle,

was uncommon in KY, but gregarines (*Stichtospora*) infected 26% of Japanese beetle grubs in the spring. The latter two pathogens were absent or uncommon in masked chafer grubs.

Replicated stands of irrigated turfgrasses used in fairways or roughs of transition zone golf courses were sampled for grub species preference and incidence of parasitoids and pathogens. Of the fairway-height grasses, zoysiagrass and bermudagrass had the highest incidence of masked chafer grubs. Masked chafers predominated in creeping bentgrass, whereas Japanese beetles favored perennial ryegrass. Japanese beetle populations were highest in rough-height grasses, outnumbering masked chafers 2-4 fold.

Two years of rating skunk damage showed greatest foraging in creeping bentgrass and perennial ryegrass at fairway height. There was little to no skunk activity in fairway-height zoysiagrass or bermudagrass, or in rough-height grasses. Milky disease was the most common pathogen of masked chafers, present in both fairway and rough cut grass (rates to 24% and 20% for fairway zoysiagrass and rough-cut Kentucky bluegrass, respectively).

*Tiphia pygidialis* parasitism on masked chafer grubs occurred in all grasses but was greatest in zoysiagrass. *Tiphia vernalis* parasitism on Japanese beetle grubs occurred in all grasses except bermudagrass, however at rates lower than *T. pygidialis* on masked chafer.



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## Summary Points

- Masked chafers and Japanese beetles accounted for about 66 and 30% of the grub infestations, respectively, on surveyed Kentucky golf courses. *Tiphia* wasps, milky disease, and other pathogens accounted for moderate to high natural mortality at some sites. Nematodes isolated from masked chafer and Japanese beetle grubs, and a protozoan pathogen (*Stichospora sp.*), are being evaluated as potential bio-insecticides.
- Turfgrass species and mowing height affected the species makeup of grubs and natural enemies. Skunk foraging damage was greatest in cool-season grasses at fairway height and least in warm-season grasses despite the presence of grubs.
- Japanese beetle grubs surveyed across the eastern and central United States showed a trend for higher pathogen loads in eastern states with longer history of infestation than in central or Midwestern states.