

# Enhancing Biological Control of White Grubs by Native Parasitic Wasps on Golf Courses

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## Objectives:

1. Investigate the biology, behavior, and importance of native and introduced species of *Tiphia* wasps, the predominant parasitoids attacking white grubs on golf courses.
2. Determine the feasibility of enhancing *Tiphia* populations via habitat management, particularly through conservation or augmentation of wild flowers or other carbohydrate sources used by the adult wasps.

**Start Date:** 2000

**Project Duration:** 2 years

**Total Funding:** \$42,950

*Tiphia* wasps are the dominant group of parasitic insects that attack white grubs in the soil. During 2000, we determined that two species of *Tiphia* are common on golf courses in Kentucky. Adults of *Tiphia vernalis*, a species introduced for control of Japanese beetles, were active from May 4 to June 1. *Tiphia pygidialis*, a native species that attacks masked chafer grubs, were active from August 1 to September 14.

Weekly sampling of the natural grub population showed that both *Tiphia* species parasitized primarily third instars. Parasitism of masked chafers averaged 15% at two golf courses, but was as high as 37% at some sites.

Cues used by *Tiphia* to locate grubs below ground were examined by use of an "ant farm", positioned horizontally to allow observation of wasp behavior in the soil. Wasps were found to locate their victims by following species-specific scent trails left by the grub as it moves through the soil. They showed an even stronger response to frass from their host grubs.

Ovipositional behavior of each wasp species was characterized. Both *T. ver-*



Native wasps may provide a means of biological control for Japanese beetles.

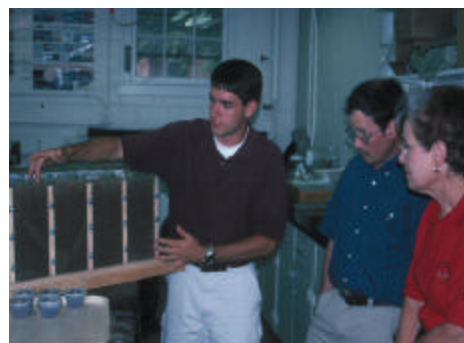
*nalis* and *T. pygidialis* deliver a paralyzing sting and then manipulate the body of the grub in preparation for oviposition. Then, the female scrapes the grub to thin the cuticle where the egg will be laid. *T. vernalis* lays its egg on the underside of the grub, whereas *T. pygidialis* lays its egg on the back of the host grub. Eggs hatch in 3 to 5 days. Larval development is completed in about 21 days, after which a cocoon is spun.

When offered Japanese beetle, masked chafer, or May beetle grubs, *T. vernalis* parasitized only Japanese beetles. *Tiphia pygidialis* were tested with the aforementioned grub species, plus two additional exotic species, European chafer and Oriental beetle. In general, only masked chafer grubs were attacked. In one case, however, *T. pygidialis* parasitized and completed larval development on a third-instar European chafer.

The relationship between the developing larval *Tiphia* and its host also was examined. Shortly after being parasitized, grubs quit feeding on grass roots and move down into the soil to depths as much as 20 cm.

We speculate that *Tiphia* wasps manipulate juvenile hormone levels in parasitized grubs, causing them to prematurely descend. Hemolymph was collected from normal and parasitized grubs to test this hypothesis. Our experiments show that once parasitized, grubs no longer contribute to turf damage.

Dilute sugar sprays were applied to small turf plots in an attempt to attract *Tiphia* wasps and increase parasitism of grubs. Although large numbers of wasps were attracted and observed feeding on the



A graduate student at University of Kentucky discusses methods used to understand how a parasitic wasp finds Japanese beetle grubs.

sprayed grass, no grubs were parasitized in sprayed plots. In adjacent, unsprayed turf, however, up to 37% of the grub population was parasitized. This indicates that sugar sprays applied near, but not directly on, grub-infested turf may increase the rate of parasitism.

Twenty species of flowering perennials were planted and monitored to determine if they attract *Tiphia* wasps. No wasps were found on these plantings. Since sugar water sprays did not attract any wasps when applied on surrounding turf, it is likely that no wasps were present at the study site. The wildflower test will be repeated elsewhere.

## Summary Points

- Information on *Tiphia* species behavior and life cycle was documented.
- Tiphia* were found to locate grubs by following species-specific scent trails left by grubs in soil, and respond to frass.
- One species of wasp attacks only one species of grub (species specific).
- Sugar sprays applied near grub infestations may increase the rate of *Tiphia* parasitism.
- Wildflowers have been unsuccessful attracting wasps.