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 grupbs on golf courses.
2. Determine the feasibility of enhancing *Tiphia* populations via habitat management, particularly through conservation or augmentation of wildflowers or other carbohydrate sources used by the adult wasps.

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Tiphia wasps are the dominant group of parasitic insects that attack white grubs in the soil. We found that two species, *Tiphia vernalis* and *Tiphia pygidialis*, are abundant on golf courses in Kentucky. Adults of *T. vernalis*, a species introduced for control of Japanese beetles, were active from the first week of May through the second week of June. *Tiphia pygidialis*, a native species that attacks masked chafer grubs, were active from early August until early October.

Weekly sampling of the natural grub population showed that both *Tiphia* species parasitized primarily third instars. Parasitism of masked chafers averaged 15 to 20% at several golf courses, but was as high as 62% in localized areas of high grub density. Wasps were found to locate their victims by following species-specific scent trails left by the grub as it moves through the soil. Wasps showed an even stronger response to frass from their host grubs.

Both *T. vernalis* 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. Eggs hatch in three to five days. Larval development is completed in about 21 days, after which a cocoon is spun.

Tiphia wasp preparing to lay an egg on a masked chafer grub.

Wasps were found to be host specific, attacking only certain species of grubs. 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 green June beetle, two exotic species, European chafer and Oriental beetle and a California chafer species, *Cyclocephala pasadenae*, which is not encountered by *T. pygidialis* in Kentucky. In general, only masked chafer grubs, including the California species, were attacked.

Shortly after being parasitized, grubs quit feeding on grass roots and move down into the soil to depths as much as 20 cm (7.8 in.). It was determined that both venom from the wasp's sting and constant feeding by the larval *Tiphia* are responsible for the change in grub movement patterns. Hemolymph was collected from parasitized and non-parasitized grubs. 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 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.

Student spraying foliage of trees with sugar water to attract *Tiphia* wasps.

Fall and spring blooming perennial flower gardens were planted and monitored to determine if flowers can be used to attract and retain *Tiphia* wasps in an area. Few *T. vernalis* were found on any of the spring-blooming flowers and no *T. pygidialis* were attracted to the fall-blooming species. Sugar water sprays applied near these gardens attracted large numbers of wasps, suggesting that, contrary to anecdotal USDA reports, *Tiphia* wasps do not commonly use flowers as a food source.

Summary Points

- Flight periods of *Tiphia* species attacking Japanese beetle and masked chafer grubs were determined.
- Grub parasitism rates on golf courses ranged from 15-22%.
- Range of grub species parasitized by each *Tiphia* species was determined.
- Once parasitized, grubs quit feeding on grass roots and move deeper into the soil.
- Wildflower plantings were not effective for attracting *Tiphia*, but the wasps could be attracted to an area with sugar water sprays.