Biological Control of White Grubs in Turf with Microsclerotial Granules

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Objectives:

1. *Determine relative susceptibility of three common grub species to the fungus*
2. *Compare several biopesticide formulations for control efficacy when applied under field conditions*
3. *Determine rates and timing of applications for optimal grub control under field conditions*

White grubs cause damage to turf grass by feeding on plant roots and may result in plant death. Control often relies on the application of chemical insecticides. As governments adopt new legislation restricting chemical insecticide applications, turfgrass managers face increasing constraints regarding the use of synthetic pesticides and find only a few non–chemical options available to control turfgrass pests. Fungal–based biological insecticides are commercially available for control of a wide range of insect pests including white grubs. Current commercial products commonly contain the infective spore (conidia) as the active agent, but are costly and may be ineffective when applied to control soil pests. We have already developed prototype liquid and granular formulations of Ma microsclerotia (capable of producing infective conidia after application to the field) to target soil–dwelling insects. This research evaluates the efficacy of these prototype formulations for control of white grubs evaluated under field application conditions.

Objective 1) Third instar and pupae of Japanese beetle were collected from the field in June, 2012. Grubs and pupae were exposed to Ma conidia using a dip assay with three dilutions ($7.0e^7$, $9.3e^6$, and $7.2e^5$ conidia/ml water) and an untreated control. Grubs and pupae (15 each/treatment) were dipped in the dilutions for five seconds, then place individually in 1 oz cups, and incubated in the dark at 25° C. Live and dead insects were counted after 7 days incubation.

Results. Mortality of Japanese beetle larvae and pupae exposed to varied concentrations of *Metarhizium* ranged from 40% control to 100% control *anisopliae* conidia (Table 1).

Table 1. The mortality of Japanese beetle larvae and pupae exposure to varied concentrations of *Metarhizium anisopliae* conidia.

Dilution, conidia/ml	% Mortality, Larvae	% Mortality, Pupae
0 (control)	20.0	13.3
7.2×10^5	53.3	40.0
9.3×10^6	100	46.6
7.0×10^7	73.3	80.0

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Objective 2) Formulation samples were applied to field sod plots at Purdue University. Five treatments (see table below) were applied in a randomized complete block design on two dates, August 2 and September 21. Plots had previously been infested with Japanese beetle adults to induce egg laying to increase grub density for treatment evaluation. Grub densities (number per sq ft) were determined for each treated plot in October, 2012.

Results. Application date influenced Japanese beetle larval densities following applications of three different formulations of *Metarhizium* fungus or Merit 240 SC (imidacloprid=chemical standard) in Kentucky bluegrass turf (Table 2). Control ranged from 38.6% to 69.3% for Japanese beetle larval populations assessed on October 8, 2012.

Objective 3) Liquid and granule treatments of Ma microsclerotia were applied to field plots consisting of 2ft x 2ft sod squares, located at NCAUR, Peoria, IL. Japanese beetle lures had been placed among the plots to attract a beetle infestation during the summer months. Treatments were applied at two rates (high and low) and on two dates, July 30, and September 12.

Results. These plots will be evaluated for larval density in October 2012.

Future expectations for this project include repetition of the field evaluations to verify these results for the first year´s field experiments. Additional efforts will be directed at conducting laboratory toxicological evaluations against additional white grub species and expanding on the results for Japanese beetle.

Summary Points

- Japanese beetle larvae and pupae are susceptible to infection by Ma conidia.
- Experimental formulations made with Ma microsclerotia provided near 50% control of Japanese beetle larvae, equal with an application of a commercial Ma formulation applied to turf in field plots.
- Control of white grubs with Ma was less than Merit chemical insecticide, which provided 90% control.
- The August application of treatments provided marginally better control of white grubs compared with the September application.

Table 2. Influence of application date on Japanese beetle larval densities following applications of three different formulations of *Metarhizium* fungus or Merit 240 SC (imidacloprid = chemical standard) in Kentucky bluegrass turf. Japanese beetle larval populations were assessed on October 8, 2012.

Treatment #	Product	Formulation	Application Date	JB/ft2 Mean(±SE)	% Control
1	Untreated		---	22.0±2.5 a	---
2	Ma Microsclerotia	GR	2–Aug	10.0±1.1 bc	54.5
3	Ma Microsclerotia	SC	2–Aug	8.5±1.6 bc	61.4
4	Met 52 MA Conidia	DP	2–Aug	6.8±1.3 cd	69.3
5	Merit	240 SC	2–Aug	1.3±0.5 d	94.3
6	Ma Microsclerotia	GR	21–Sep	11.5±3.2 bc	47.7
7	Ma Microsclerotia	SC	21–Sep	8.5±2.8 bc	61.4
8	Met 52 MA Conidia	DP	21–Sep	13.5±2.3 b	38.6
9	Merit	240 SC	21–Sep	2.3±0.5 d	89.8

*Japanese beetle larval densities followed by the same letter are not significantly different (α=0.05)

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