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 at relatively high rates. As governments adopt new legislation restricting chemical insecticide applications, turfgrass managers face increasing constraints for pest control and have only a few non–chemical options available to control insect pests. Biological insecticides of Metarhizium (Ma) fungus are commercially available for control 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. As an alternative, liquid and granular formulations of Ma made with microsclerotia (capable of producing infective conidia after application to the field) may be better suited 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: Grubs of the Japanese beetle were collected from the field in October, 2012. Grubs were exposed to Ma conidia (commercial Met 52 EC, Novozyme) and granules made with microsclerotia (experimental formulation) applied to potting soil in 1 oz plastic cups for a dosage/response assay. Four fungal rates used ranged from 1.75 x 106 to 2.2 x 108 conidia/cup, plus an untreated control. Grubs (30 / treatment dosage) were incubated in the dark at 25o C. Live and dead insects were counted after 14 days incubation.

Results: The mortalities (Table 1) indicate that the LC_{50} for these large grubs would be near 4 x 107 conidia per cup. Calculating this value to field rates would be equivalent to about 6 x 1013 conidia per acre. This rate within the range of suggested field applications of 1.1 x 1014 conidia per acre (Met 52 EC label rate for turf).

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. Plots had previously been infested with Japanese beetle adults to induce egg laying to increase grub density for treatment evaluation. Two applications of fungal treatments were applied to each plot, August 8 and September 17, 2013 and compared with a single application of Dylox 9.3 G applied on August 8. Grub densities (number per sq ft) were determined for each treated plot in September 26, 2013.

Results: While all treatments resulted in significant reductions in Japanese beetle larval densities, there was no statically significant difference in the level of control provided by any of the Metarhizium formulations (Table 2). However, all Metarhizium formulations provided

Table 1. Mortality (%) of Japanese beetle grubs exposed to varied concentrations of *Metarhizium anisopliae*.

Conidia/cup	Met 52 EC	Microsclerotia Granules
0 (control)	3.3	23.3
1.75×10^6	23.3	13.3
8.75×10^6	26.3	26.6
4.38×10^7	46.6	70.0
2.19×10^8	76.7	76.7

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Table 2. Japanese beetle (Popillia japonica Newman) larval density (±SE) and percent control in plots of Kentucky bluegrass turf treated with four different formulations of the entomophagus fungus Metarhizium anisopliae or the chemical insecticide Dylox 9.3G (trichlorfon). Plots were located at Purdue University in West Lafayette, IN and were evaluated on September 26, 2013.

Treatment	Rate ($g/1000ft^2$)	Application Date	JB Larvae/ft^2	% Control
Untreated	---		16.25±2.78 a	0.0
Met 52 EC	200	8 Aug and 17 Sep	5.00±3.00 b	69.2
Met 52 G	200	8 Aug and 17 Sep	3.50±2.53 b	78.5
Microsclerotia EC	1800	8 Aug and 17 Sep	7.25±3.30 b	55.4
Microsclerotia G	800	8 Aug and 17 Sep	6.00±2.04 b	63.1
Dylox 9.3G	602	8 Aug	0.50±0.50 b	96.9

*Numbers followed by the same letter are not statistically different at α=0.05

levels of control that were statistically similar to that of the chemical standard Dylox 9.3G.

Objective 3: Treatments of Ma were applied to field plots consisting of 2ft x 2ft sod squares, located at NCAUR, Peoria, IL. Plots had previously been infested with Japanese beetle adults to induce egg laying to increase grub density for treatment evaluation. Fungal treatments were applied at rates identical to those in Objective 2.

Results: These plots are currently being evaluated to determine grub densities. Evaluations were delayed due to the federal government furlough.

Future expectations for this project include repetition of the field evaluations to verify results for 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. Also, additional laboratory evaluations will evaluate the ability of microsclerotia to produce infective conidia when exposed to adverse conditions such as summer temperatures expected in the turf environment.

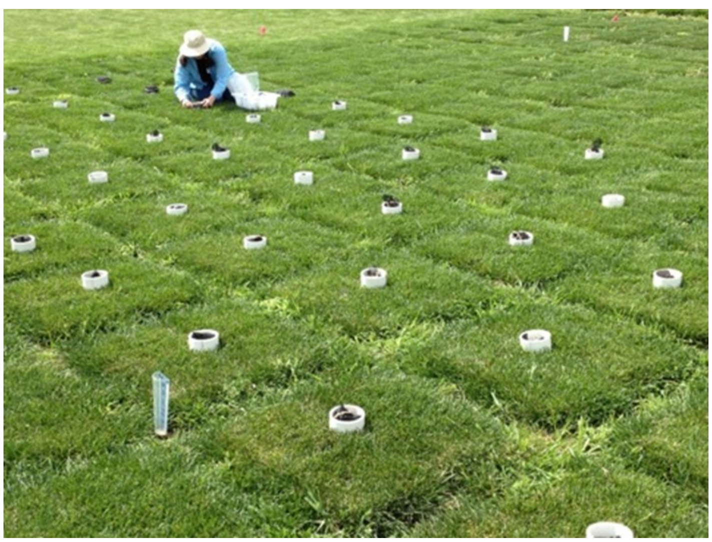

Figure 1. Infesting turf plots with adult Japanese beetles to assure high grub densities for evaluations of biological insecticide treatments. (USDA-ARS-NCAUR, Peoria, IL)

Summary Points

- The LC_{50} needed to kill large Japanese beetle larvae in the laboratory supports field application rates on commercial labels and currently used in field experiments.
- Experimental formulations made with Ma microsclerotia provided similar levels of control for Japanese beetle larvae when compared with applications of commercial Ma formulations applied to turf in field plots.
- Control of white grubs with Ma treatments (commercial and experimental) were not significantly different from Dylox insecticide.
- The double application of treatments provided similar control of white grubs when compared with results from single applications from the 2012 field season.

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