Sustainable White Grub Management with Steinernema scarabaei*: a New Highly White Grub-pathogentic and -specific Nematode*

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Objectives:

1. To develop and implement the use of *S. scarabaei* as a novel biological method for sustainable white grub management with particular interest to low application rates and long-term control.

Start Date: 2003
Project Duration: one-year extension
Total Funding: $9,996

Presently available species of entomopathogenic nematodes provide only limited control of most of the important white grub species. The recently discovered *Steinernema scarabaei* has exceptionally high virulence against a wide range of white grub species and is effective and persists very well in wide range of soil types and soil moisture levels. While previous studies have shown the exceptional efficacy of *S. scarabaei* as a curative control agent, this study addresses its potential for long-term suppression of white grubs with special interest to low application rates.

Microplots (4' x 4') in 3- to 5-year-old Kentucky bluegrass stands were enclosed by garden edging material, seeded with oriental beetle, *Anomala orientalis*, late second and early third instars (10 per ft²) and treated with *S. scarabaei* in mid-September. Grub and nematode populations were determined periodically by going through cup cutter cores and baiting soil samples with wax moth larvae. Three experiments are being conducted that were started in mid-September of 2002, 2003, and 2004.

Our field studies show that *S. scarabaei* reproduces very well in oriental beetle larvae and that the progeny emerging from the larvae infected by the applied

White grub infected with Steinernema scarabaei

Rate	Months after *S. scarabaei* application							
(× billion/acre)	1(Oct)	8(May)	13(Oct)	20(May)	25(Oct)	32(May)	37(Oct)	4(May)
0.16-1.0	86-100	96-100	62-92	67-94	0-94	63-100	0-64	0-100
0.04-0.1	50-79	86-100	76-79	94-95	33-50	67-83	---	---
0.024	9	89	41	100	8	100	---	---

Table 1. *Suppression (% compared to non-treated control) of oriental beetle larval populations after* Steinernema scarabaei *application averaged across ranges of application rates across three experiments.*

S. scarabaei provides additional control starting about three weeks after application. As a result, rates as low as 0.16 billion *S. scarabaei* per acre (b/a) (standard nematode rate is 1-2 b/a) have provided excellent control (86-100%) of oriental beetle larvae at one month after application (Table 1). Even at rates as low 0.04 b/a, it has provided at least 50% control. Lower rates seem to insufficient to provide short-term white grub suppression.

Due to its excellent reproduction in the infected white grubs, *S. scarabaei* is able to overwinter at numbers sufficiently high to resume infecting white grubs in spring when soil temperatures reach about 60°F. Consequently, all application rates, even those that did not provide sufficient control in early fall, provide 89-100% control by late May before the white grubs pupate.

Laboratory experiments have shown that *S. scarabaei* does not infect prepupae, pupae, and adults of various white grubs species. While small larvae, especially first instars, may be infected, they do not allow for significant *S. scarabaei* reproduction. Laboratory experiments have also indicated that *S. scarabaei* poorly infects and reproduces in other common turfgrass insects such as larvae of cutworms, armyworms, sod webworms, or billbugs. Consequently, *S. scarabaei* populations have to persist from about early June trough mid-August as infective juveniles in the soil without the possibility of significant reproduction in hosts.

While our observations indicate that *S. scarabaei* populations dramatically decline from late May until mid-August, apparently enough infective juveniles survive through the hot and hostless summer months to start infecting larvae of the next white grub generation. As a result, most of our treatments have provided significant (62-92%) control of oriental beetle larvae in October of the year following their application (Table 1). As in the first year, control rates further increased (67-100%) in the following spring (20 months after application).

S. scarabaei continues to persist in the experimental plots even four years after application and also continues to provide significant oriental beetle suppression in some treatments, but the effect becomes more patchy and less reliable over time. However, even in individual 4' x 4' plots, white grub densities rarely exceeded five larvae per ft². Once current problems with mass production of *S. scarabaei* can be overcome, this biological control agent could be released periodically (e.g., every two to four years) in areas with recurrent grub infestations to provide long-term suppression.

Summary Points

- *S. scarabaei* is highly effective as a curative white grub control.
- Due to multiplication in infected grubs, even very low *S. scarabaei* rates can provide very high control rates within one month.
- The best long-term effect of *S. scarabaei* is expected with low rates that allow some grubs to survive until spring allowing *S. scarabaei* an additional reproduction round before summer.
- *S. scarabaei* can provide reliable white grub control for at least two years after application and persists for at least four years in treated areas.