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

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Objectives:

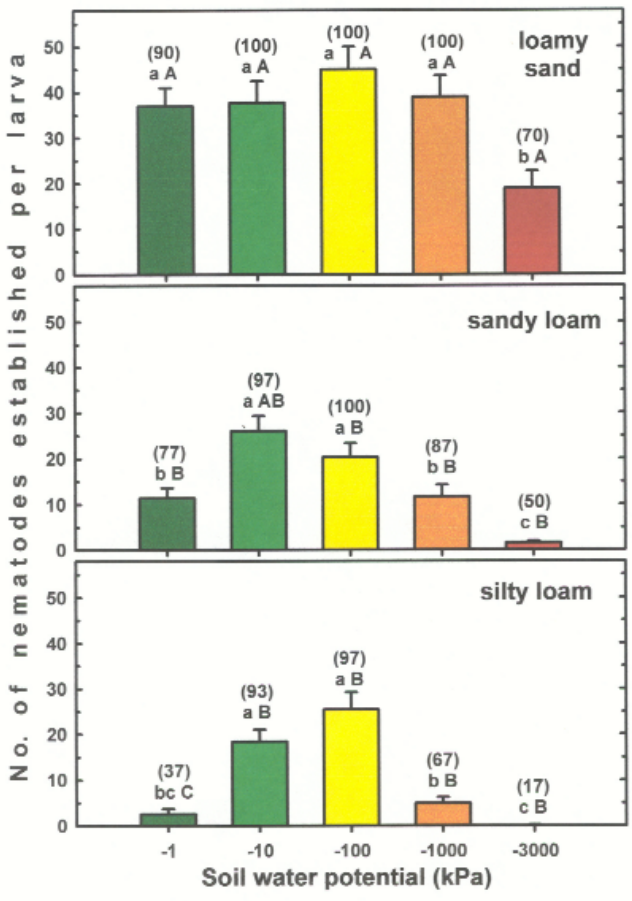
1. To improve predictability of *S. scarabaei* applications by determining the effect of soil moisture and soil type on the nematode's infectivity and persistence.
2. To determine the control potential of *S. scarabaei* against white grubs, especially with respect to low application rates and long-term control.

Start Date: 2003
Project Duration: three years
Total Funding: $29,208

Presently available entomopathogenic nematode species provide only limited control of most of the important white grub species. Our overall objective is to develop the recently discovered nematode *Steinernema scarabaei* as a novel biocontrol agent for white grub management.

Objective 1 is to improve predictability of *S. scarabaei* applications by determining the effect of soil moisture and soil type on the nematode's infectivity and persistence. The effect of six substrate types on *S. scarabaei* effectiveness was determined in laboratory and greenhouse experiments. Nematode infection and grub mortality tended to be the highest in a loamy sand, did not differ significantly among a sandy loam, a loam, and a silt loam, and tended to be the lowest in a highly acidic sand (pH 3.9) and a typical potting mix (69% organic matter).

The effect of soil moisture on *S. scarabaei* infectivity was studied in the laboratory in three selected soils. Moisture levels ranged from saturated to very dry (-1 to -3,000 kPa water potential) (gravimetric: loamy sand, 2.3-16%; sandy loam, 4.2-22%; silt loam, 6-30%).



Effect of different soil water potential (moisture levels) in loamy sand, sandy loam, and silt loam on Steinernema scarabaei *infectivity. (In parentheses above columns, percentage oriental beetle mortality).*

In loamy sand, there was no strong effect of soil moisture. Even at -3,000 kPa, 70% of the grubs were killed. In sandy loam and silt loam, the mortality and infectivity were highest at -10 and -100 kPa, lower at -1 and -1,000 kPa, and the lowest levels at -3,000 kPa. This effect was stronger in silt loam than in sandy loam.

Objective 2 is to determine the control potential of *S. scarabaei* against white grubs, especially with respect to low application rates and long-term control. Microplots (4' x 4'), enclosed by garden edging material, were seeded with oriental beetle 3rd instars (10 per ft^2) and treated with S. *scarabaei* (0, 0.125, 0.4, or 1.0 billion / A).

At 31 days after treatment (DAT), every larva recovered in the treated plots was infected by *S. scarabaei*. Based on previous experiments, such high efficacy can only have been achieved through additional grub infections caused by the *S. scarabaei* progeny emerged from the grubs killed by the applied nematodes.

This is supported by an increase in *S. scarabaei* densities in the soil samples between 0 and 31 DAT. The lack of increase at the highest *S. scarabaei* rate may be due to interference with high densities of other nematode species in the soil samples.

Steinernema scarabaei density did not decline during winter, but declined between April and August because no more oriental beetle larvae were left for nematode reproduction in spring. Nevertheless, *S. scarabaei* densities were high enough in August to cause infections in the new grub generation.

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* is highly effective in a range of typical turf soil types, but is probably most effective in lighter soils.