USE OF THE NEMATODE STEINERNEMA CARPOCAPSAE FOR CONTROL OF THE RED IMPORTED FIRE ANT (HYMENOPTERA: FORMICIDAE)

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The red imported fire ant, Solenopsis invicta Buren, is a major medical and agricultural pest that infests much of the Southern United States. Initial efforts to develop control strategies for this species focused on chemical toxicants (Williams et al. 1980). Within the last decade, research has included insect growth regulators (Banks et al. 1988) and biological control agents (Vander Meer 1988).

The entomopathogenic nematode, Steinernema (=Neoaplectana) carpopcapsae (Weiser), represents a biological agent that has produced economic control of other soil-dwelling insects such as white grubs and mole crickets (Poinar 1979, Gaugler 1981, Bradford et al. 1988, Hudson et al. 1988) suggesting a potential for use against the fire ant. Fire ants are known to be susceptible to infection by S. carpopcapsae. In laboratory tests Poole (1976) found 100% susceptibility of reproductive and brood to S. carpopcapsae (DD-136). Quattlebaum (1980) achieved 22.4 to 96.8% control of active fire mounds after pressure injection of S. carpopcapsae (DD-136) at various concentrations.

The efficacy of S. carpopcapsae infective juveniles (All strain) in controlling S. invicta was investigated at several locations in North Central Texas during the summer of 1988. S. carpopcapsae treatments were compared with amidoxydrazone (Amdro) treatments and controls to determine if nematode treatments were effective in reducing mound density or reducing the number of life stages within treated mounds.

Turf irrigation and no immediate prior treatment were requirements for selection of trial sites (Gray & Johnson 1983). Sites included a water reclamation facility, an electric plant, a municipal park, a golf course, a junior college and the University of North Texas campus.

Commercial packaging of infective juveniles of S. carpopcapsae were obtained from Biosys (Palo Alto, California). Selected packages were rehydrated and examined for nematode viability before application.

Active mounds at each trial site were located and marked. A block design was used with control blocks separating the treatments. Each replicate consisted of 4-8 naturally clumped mounds. A minimum of 60 mounds were used per trial (12 trials) and there were 3-4 blocks per treatment at each trial. A total of 235 mounds were treated with nematodes, 246 with amidoxydrazone and 245 were untreated controls.
At each trial site, nematodes were mixed with tap water to a concentration of 2 million/3.8 liter (1 gallon). The concentration was applied to selected mounds as a drench with a sprinkler can. Amidinohydrazone was applied per label directions (5 tablespoons/mound).

Mounds were assessed at weeks 1, 3 and 6 for worker response to external disturbance. They were assessed as active (1 = >12 workers responding) or inactive (0 = ≤12 workers responding). Nematode treated mounds that were still active at week 3 were retreated.

Satellite mounds found within 1 foot of treated mounds were considered inclusive of the original mound. In some instances (at least once per trial) active mounds that had not been previously marked were found outside the treatment blocks. They were not included in the assessment for activity.

After the final assessment for activity (week 6), randomly selected mounds (n = 164) were sampled with an 8.25 cm (inside diameter) pipe to a depth of 10 cm at the center of each mound. In the laboratory, samples were washed through a series of sieves (150 μm smallest mesh opening) to separate life stages. The presence of queens and eggs, the number of alates, workers, larvae and pupae were recorded for each sample. Samples of workers collected from each trial site were sent to the University of Texas Breckenridge Field Laboratory for species verification.

Mean activity levels per mound were evaluated by analysis of variance, followed by Duncan’s multiple range test (1955). Control achieved was calculated using Abbott’s formula (1925). The mean number of individuals in each life stage was evaluated by multivariate analysis of variance, followed by Duncan’s multiple range test of those life stages significant to the model.

Mean activity levels at week 6 were 0.425 ± 0.178 (nematode), 0.478 ± 0.167 (Amdro) and 0.794 ± 0.159 (control). These means were found to be significantly different by analysis of variance (F = 16.98, df = 2, p < 0.0001). However, Duncan’s multiple range test did not separate the mean activity levels of the two treatment groups at the 0.05 level. The use of Abbott’s formula, based on 0.794 activity of control mounds, resulted in an estimate of 47% control for nematode treatment, compared to 39% control achieved by amidinohydrazone.

The mean number of individuals/mound sampled was different between treatments and control (F = 8.93, df = 2, p = 0.0008). The mean number of individuals were 412.9 ± 257.2 (control), 113.4 ± 133.6 nematode and 160.5 ± 143.6 (Amdro). Of the life stages counted (alates, workers, larva and pupae, Table 1), only the mean number of workers were found to be significantly different between treatment and control mounds (F = 3.06, p = 0.001). Generally the two treatments reduced all life stages below levels found in controls. Duncan’s multiple range test did not separate the treatment groups, which would indicate a similar reduction of life stages by the nematode and amidinohydrazone treatments.

The trials indicated treatment of fire ants with S. carpocapsae at a concentration of 2 million/3.8 liter (1 gallon) achieved control comparable with amidinohydrazone over a 6 week period. More studies are needed to assess the potential use of S. carpocapsae in an integrated pest management program.

**TABLE 1. Total and Mean Number of Life Stages Counted (All Trials).**

<table>
<thead>
<tr>
<th></th>
<th>Larva</th>
<th>Pupae</th>
<th>Workers</th>
<th>Alates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>847 (70.6)</td>
<td>187 (15.6)</td>
<td>3066 (320.7)</td>
<td>24 (2.0)</td>
</tr>
<tr>
<td>Nematode</td>
<td>393 (32.8)</td>
<td>36 (3.0)</td>
<td>1473 (122.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Amdro</td>
<td>107 (8.9)</td>
<td>17 (1.4)</td>
<td>1211 (100.9)</td>
<td>3 (.25)</td>
</tr>
</tbody>
</table>
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REFERENCES CITED


TOMATO PINWORM (LEPIDOPTERA: GELECHIIDAE):
AN INCREASING PEST ON TOMATOES IN SINALOA, MEXICO

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The tomato pinworm (TPW), Keiferia lycopersicella Walsingham has become the most important key pest affecting tomatoes grown in Sinaloa, Mexico, surpassing the tomato fruitworm, Heliotis zea (Boddie), the tobacco budworm, Heliothis virescens (Fabricius), and the beet armyworm, Spodoptera exigua (Hübner) in importance in the state (Anonymous 1983). This has been especially true for the last two growing seasons