The TPW moth population recorded during the tomato-free period (dotted lines in Fig. 1) for the 1985-86 and 1986-87 seasons were about 1.5 and 3 times higher than the 1982-83 season, respectively. The presence of commercially grown tomatoes during the host-free period in the last two seasons probably contributed to those results. The tomato plant is the preferred host by TPW over other alternate hosts (Elmore & Howland 1943).

TPW moth activity recorded during the 1986-87 season was quite different from the others in this study. The high TPW catches that were recorded early in the season were mainly attributed to having a tomato crop year round. Although there was a population decline in early December, moth activity remained above 10 m/t/n throughout most of the growing season.

In order to reduce the potential adverse impact of tomato pinworm on future tomato production in Sinaloa, the following sanitation practices as proposed by Elmore & Howland (1943) should be implemented: 1) disk and plow under the crop residues promptly after harvesting of fields, 2) clean drainage ditches and irrigation canals where TPW alternate hosts grow, and 3) establish a tomato-free period during the summer.

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SUPPRESSION OF *DIAPREPES ABBREVIATUS* (COLEOPTERA: CURCULIONIDAE) ADULT EMERGENCE WITH SOIL APPLICATION OF ENTOMOPATHOGENIC NEMATODES (NEMATODA: RHABDITIDA)

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The sugarcane rootstalk borer weevil, *Diaprepes abbreviatus* (L.), is an important pest of sugarcane, citrus, and vegetable crops in the West Indies. It was first observed in central Florida in 1964 (Woodruff 1964) and is now found in the major citrus-producing areas of the state. Adults feed on new foliage and the larvae feed on roots causing damage that leads to host decline (Schroeder & Beavers 1977).

Entomopathogenic nematodes are promising biological control agents for a broad range of soil-inhabiting insects (Poinar 1971, Georgis & Poinar 1989). Beavers et al. (1982) isolated two species of entomopathogenic nematodes, *Steinernema carpocapsae* (Weiser) and *Heterorhabditis bacteriophora* Poinar, that were infectious to weevil larvae. Susceptibility of *D. abbreviatus* to the nematodes was further confirmed by Beavers (1984), Roman & Figueroa (1985), and Schroeder (1987).

This research was conducted in a weevil-infested citrus grove in Florida to evaluate efficacy of two species of entomopathogenic nematodes against late instar larvae. The grove, located near Lake Jem, Florida, consisted of 170 trees per ha (7.6 m between trees and rows), with an average tree height of 3.0 m. The grove was 12 years old. The soil type was an Astatula fine sand (thermic, coated typic quartzipsamments, 95% sand, less than 5% clay-silt). The grove was fertilized and treated with herbicide for weed control by a commercial management service, and had an endemic *D. abbreviatus* infestation.

Nematodes used were *S. carpocapsae* (All strain) and *H. bacteriophora* (HP-88) obtained from Biosys (Palo Alto, California), and *H. bacteriophora* (Florida strain) originally obtained from *D. abbreviatus* larvae collected from a citrus grove. *H. bacteriophora* (Florida strain) was identified by Dr. Poinar (University of California, Berkeley) and reared on wax moth larvae, *Galleria mellonella* (L.) (Dutky et al. 1964), for field release. In March, nematodes were sprayed on the surface of the soil on all sides of the trees in a band 1 m wide. The rate of application was 0, 100 and 500 nematodes per cm^2 applied in 1 liter per tree (5 & 25 million nematodes per tree). A starch polymer (Ag Sorbent Flakes, Super Absorbent Co., Lumberton, North Carolina) was used as a survival aid at 5 g per liter (Schroeder 1990). Nematode applications were timed to coincide with presence of late instar overwintering larvae (Schroeder 1987).

Adult emergence traps were used to evaluate treatment effects. The trap was a cone constructed of wire cloth (8 wires per 2.5 cm) 45 cm high, 1 m in diameter with a 1 liter plastic container on top to retain adult weevils. The trap was similar to the adult pecan weevil emergence trap (Raney & Eikenbary 1969). Traps were placed adjacent to the tree over major roots and observed twice weekly.

The field plot design was a randomized complete block. There were 10 trees per replicate, 1 trap per tree, and 4 replicates per treatment. Data were grouped by month. Untransformed data were subjected to two-way analysis of variance. Significant differences in treatment means were separated ($P < 0.05$) by Duncan's (1955) multiple range test.

The total number of weevils captured in the 200 traps from April through October was 568. There were 81, 82, 74, and 190 weevils collected from 40 traps for each treatment: *S. carpocapsae*, *H. bacteriophora* (HP-88), *H. bacteriophora* (Florida strain), all at the 5 million rate, and check, respectively. There were 141 adults collected from trees treated with *S. carpocapsae* at the 25 million rate. The reduction for all treatments compared with the check was 50%. Reduction for the 5 million rate for all species was 58%, and for the 25 million rate of *S. carporcapsae*, 26%.

Weevil emergence from trees treated with 5 million nematodes was significantly different ($P < 0.05$) compared with the check in May, June, and September (Table 1). Adult emergence from trees treated with 25 million nematodes was significantly different compared with the check in May and June. The number of weevils captured in 200 traps in October was 27, and there was no significant difference between treatments. The greatest effect of treatment was in May-June when adult emergence was reduced by 70%. There was no apparent difference in weevil control between *S. carpocapsae*, *H. bacteriophora* (HP-88), and *H. bacteriophora* (Florida strain) at 5 million nematodes per tree. When *S. carpocapsae* was applied at 25 million per tree in March (500 per cm^2), the effect of the nematodes was reduced. This was indicated by the increase in adult emergence in August and September compared with the 5 million rate. The re-

TABLE 1. CAPTURE OF ADULT *DIAPREPES ABBREVIATUS* IN 200 GROUND EMERGENCE TRAPS.

		Mean ± SEM adult weevils caught in 10 traps					
Nematode species	Rate	May	June	July	Aug	Sep	Oct
S. carpocapsae	$5x10^6$	7.0 ± 1.7b	3.3 ± 1.3b	3.5 ± 0.9a	3.0 ± 0.7b	0.3 ± 0.5b	1.8 ± 1.7a
S. carpocapsae	$25x10^6$	4.3 ± 1.2b	4.8 ± 1.3b	5.8 ± 1.4a	11.5 ± 4.3a	4.3 ± 4.0a	2.0 ± 2.2a
H. bacteriophora (HP-88 strain)	$5x10^6$	4.5 ± 1.2b	3.5 ± 1.0b	2.5 ± 1.3a	2.3 ± 0.9b	1.3 ± 1.0b	0.5 ± 0.6a
H. bacteriophora (Florida strain)	$5x10^6$	5.3 ± 1.8b	2.8 ± 1.4b	3.0 ± 0.4a	3.3 ± 1.9b	0.7 ± 1.0b	1.3 ± 1.5a
Check	0	15.3 ± 2.0a	9.5 ± 0.6a	4.8 ± 1.6a	5.3 ± 1.0ab	3.3 ± 1.7a	1.3 ± 1.0a

In columns, means followed by the same letter are not significantly different (P = 0.05; Duncan's (1955) new multiple range test).

duced effectiveness might have been caused by an increase in activity of nematophagous mites, Collembola, and other factors that affect nematode survival in soil as demonstrated by Epsky et al. (1988) and Ishibashi & Kondo (1986). Additional studies are underway to evaluate effect of rate on control of *D. abbreviatus* larvae in citrus groves. Use of the entomopathogenic nematode *S. carpocapsae* for control of root weevils in citrus offers an environmentally safe alternative to the use of insecticides.

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