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CONTROL OF THE CITRUS NEMATODE *TYLENCHULUS SEMIPENETRANS* IN ESTABLISHED GRAPEFRUIT ORCHARDS OF CYPRUS

by
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Summary. Trials in Cyprus for controlling the citrus nematode, *Tylenchulus semipenetrans* Cobb, in established grapefruit orchards resulted in effective nematode control and increase of yields. In the case of early harvest, the nematicides fenamiphos and aldicarb increased yields significantly, as a mean of five years, by 74.2% and up to 53.2%, respectively, while when the crop was harvested only once, in winter, prophos increased yields significantly over the entire experimental season by 20.5%, compared to the untreated. The use of liquid nematicides through irrigation for controlling the nematode proved very effective while it was evident that yield losses were more pronounced in sandy than in clayey soils.

In Cyprus, there are about 7,450 hectares of land planted with citrus of which 21% are planted with grapefruits (*Citrus paradisi* Macf.) with a value of production reaching CY £ 5.7 million or 30% of the total value of citrus. A large proportion of the crop is exported thus making a substantial contribution to the island's economy. Previous studies (Philis, 1989) have shown that the citrus nematode, *Tylenchulus semipenetrans* Cobb, can cause damage to citrus trees, heavy infestations causing symptoms of poor growth, die-back of twigs and reduced fruit size.

Several nematicides were investigated for the control of the nematode in relation to crop production and the results are reported here.

Materials and methods

Experiments were undertaken on farms at Alaminos and Fassouri, both situated on the south coast of the island. At both farms the trees were cv Marsh, grafted on sour orange (*Citrus aurantium* L.), and were ten and 18 years, respectively. Nematicides were applied in spring, at the frequency shown in Table I and the dosage in Table II. Immediately after application, granular nematicides were incorporated into the soil to a depth of 7-10 cm. Nematicides in liquid form were applied through a sprinkler using the "Dosatron" injector; care was taken to avoid leaching of nematicides beyond the root zone. Soil type of Alaminos was classified as sandy loam, containing 60% sand, 25% silt and 18% clay while at Fassouri it contained 25% sand, 26% silt and 49% clay.

At both experimental sites, there were four treatments including the controls, each treatment consisting of three trees, replicated four and three times for the Alaminos and Fassouri trials, respectively. Nematode counts were made twice per year, in spring and autumn. Nematode populations were assessed from one soil sample taken from each tree at 8-15 cm depth. Second stage juveniles (J2) and males were extracted from 250 g of soil by a modified

TABLE I - *Frequency of nematicide application for the two trials.*

	Alaminos					Fassouri				
Treatments	1984	1985	1986	1987	1988	1987	1988	1989	1990	1991
A. Fenamiphos EC	+	–	–	–	+					
B. Prophos EC						+	–	–	+	–
C. Prophos G						+	–	+	–	+
D. Aldicarb G	+	+	+	+	+					
E. Aldicarb G	+	–	+	–	+	+	–	+	–	+
F. Control	–	–	–	–	–	–	–	–	–	–

+: Treatment applied; -: Treatment not applied.

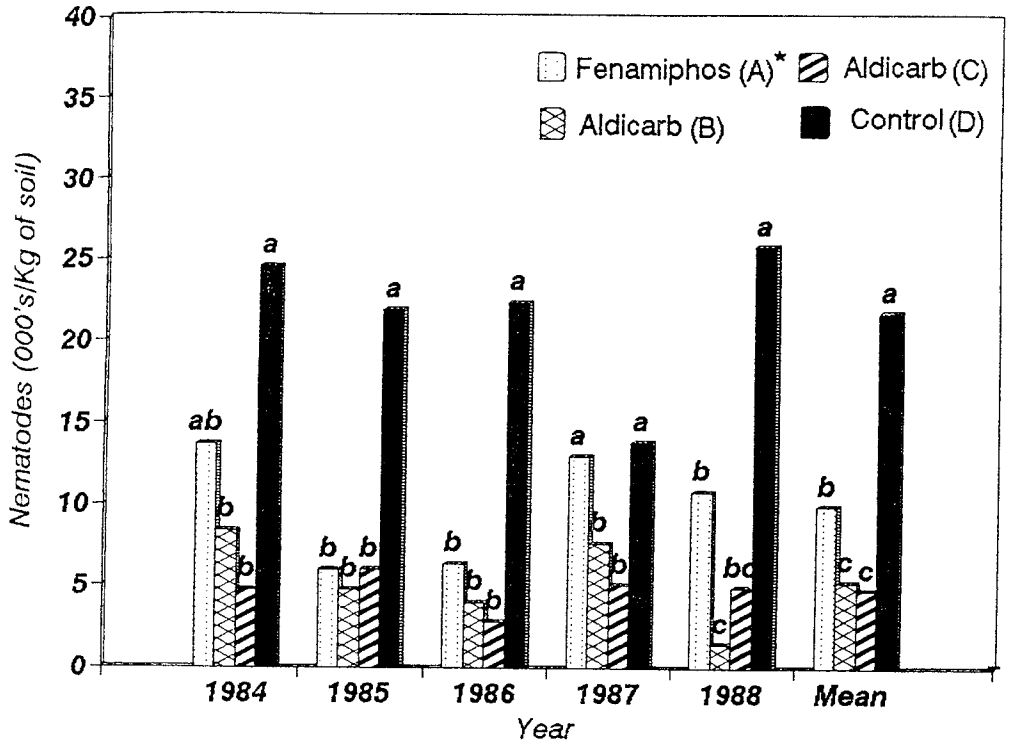


Fig. 1 - Effect of nematicides on the citrus nematode at Alaminos (1984-1988).

TABLE II - *Effect of nematicides on grapefruit yield at Alaminos and Fassouri.*

Alaminos														
Treatments	Rate of application (g a.i./m²)	Yield (Tons/ha)												
		1984		1985		1986		1987		1988		Mean	
		Early	Total	Early	Total	Early	Total	Early	Total	Early	Total	Early	Total
A. Fenamiphos EC	4	6.9a	25.5a	7.5a	13.5a	3.3a	19.8a	15.6a	20.1a	20.7a	44.7a	10.8a	24.7a
B. Aldicarb 15%G	3	6.9a	22.8a	6.6a	9.9a	1.5bc	20.4a	14.4a	18.9a	18.3a	43.2a	9.5a	23.0a
C. Aldicarb 15%G	3	6.0a	21.9a	5.7a	12.3a	1.8b	20.4a	12.9a	16.2a	17.4a	40.2a	8.7a	22.2a
D. Control	–	2.4b	22.2a	4.8a	8.4a	0.9bc	18.0a	11.1a	15.3a	11.7a	37.2a	6.2b	20.2a

Fassouri						
Treatments	Rate of application (g a.i./m²)	Yield (Tons/ha)				
		1987	1988	1989	1991	Mean
A. Prophos EC	2.8	92.4a	71.4ab	107.1a	69.3a	85.1a
B. Prophos 10%G	2.8	81.0ab	62.4bc	93.3ab	65.7ab	75.6bc
C. Aldicarb 15%G	3.0	84.6ab	74.4a	99.0ab	60.9ab	79.7ab
D. Control	–	79.8b	58.8c	87.0b	56.7b	70.6c

In column averages sharing the same letter, do not differ significantly (P = 0.05).

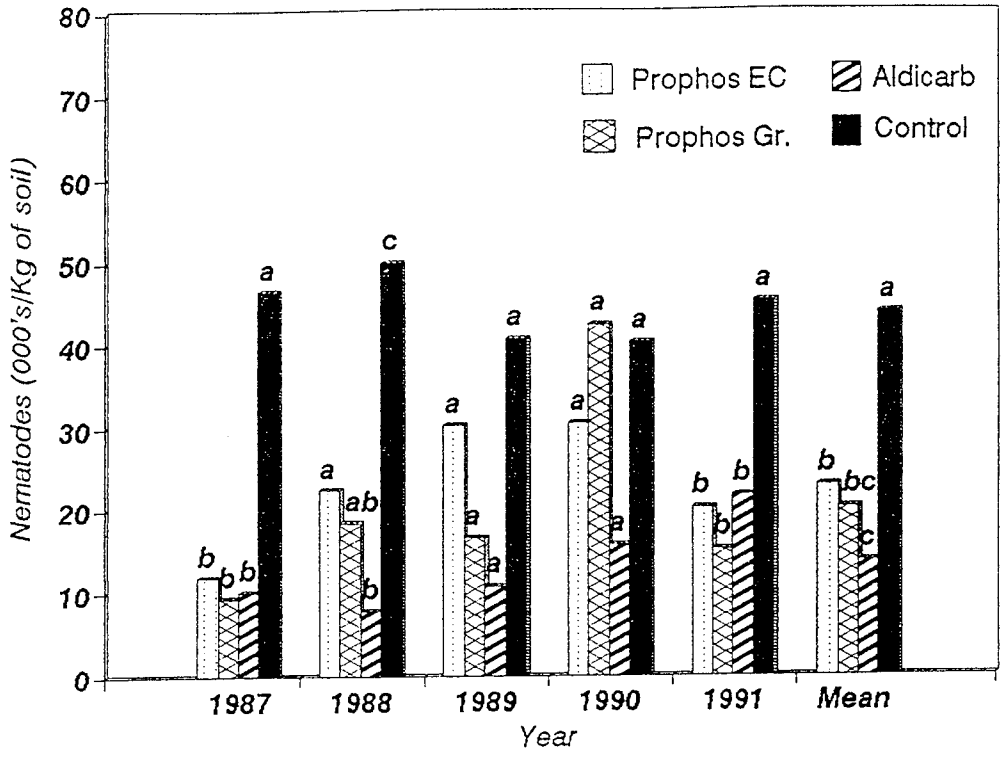
Baermann Funnel method (Philis, 1988). Yield data were collected for five years at Alaminos and four years at Fassouri. Harvesting at Alaminos was performed twice a year, i.e. in mid-October and late December while at Fassouri the crop was picked only once, in winter.

Results and discussion

At both trial sites, effective nematode control was achieved with all nematicides and yields were considerably increased. At Alaminos, aldicarb significantly reduced the nematode population in all years by an average of 76% compared with the untreated (Fig. 1). However, there was no significant difference in nematode control between aldicarb applied each year and every other year, suggesting that yearly use is not necessary. Fenamiphos also significantly reduced the nematode population in the soil during the 5-year experimental period by an average of 54.2%, it's nematicidal activity lasting for three years. At Fassouri, prophos in both liquid and gramular formulations and aldicarb significantly reduced the population of the nematode in most cases reaching as an average of five years, 47.5%, 53.7% and 69.8%, respectively, compared to the untreated (Fig. 2).

At Alaminos, fenamiphos significantly increased the early crop throughout the period of the experiment by an average of 74.2%. Aldicarb, applied annually and every other year, significantly increased marketable yields by 53.2% and 40.3%, respectively, compared with untreated trees (Table II). However, total yields were not significantly affected by the treatments, although numerically increased from 9.9% to 22.3%. This was, evidently, due to harvesting of the early crop. At Fassouri, liquid prophos and aldicarb increased yields significantly over the untreated by 20.5% and 12.9%, respectively, over the four harvesting seasons; prophos, in the granular form, increased the yield numerically by 7.1%. In most years liquid prophos gave better yields than the other treatments (Table II). Due to error we were not able to harvest during 1990.

At Fassouri, the overall nematicidal effect of liquid prophos applied every three years, was similar to that of the yearly application of the granular formulation. The trials also indicated that yield losses caused by the citrus nematode do not always correlate with the nematode populations in the soil and may by influenced by other factors,



Columns sharing the same letter within the same year do not differ significantly (P = 0.05).
* See Table I for explanations.

Fig. 2 - Effect of nematicides on the citrus nematode at Fassouri (1987-1991).

the most important being soil type. At Alaminos, although nematode populations in the soil were half of those at Fassouri, yield response after treatment was much better, indicating that damage to citrus is more pronounced in light soils, as at Alaminos, than in heavy soils. Severity of damage by the nematode in sandy soils is also probably enhanced by adverse soil factors, nutritional deficiencies possibly resulting from rapid leaching or absence of endomycorrhizal fungi (Inserra *et al.*, 1979).

The overall low yields at Alaminos were mainly related to the young age of the trees and serious water shortage, especially during the establishment of the orchard. At Fassouri, because of the older and larger trees, as well as availability of irrigation water, yields were three times more than at Alaminos. The annual cost of nematicides ranged between U.S. $ 100-180 per hectare. Therefore, the relatively high income from grapefruits easily out-weighs the cost of nematicides.

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