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OCCURRENCE AND CONTROL OF NEMATODES AFFECTING CARROT CROPS IN CYPRUS

by

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In Cyprus about 800 hectares of carrots are grown annually most of which are exported (99%) to the United Kingdom (Payiatas and Papachristodoulou, 1973). The crop is mainly grown in the Morphou and Lyssi areas where a large portion of the crop is usually discarded due to malformation of the tap roots.

Work in other countries on carrot nematodes has been limited. Jones (1950) was the first to describe *Heterodera carotae* Jones, a cyst nematode attacking carrot and wild carrot. In Italy, Lamberti (1971) reported that carrots attacked by *H. carotae* were unmarketable. In Germany damage to carrots from nematodes is chiefly inflicted by *Paratylenchus hamatus* Thorne *et* Allen, *Paratylenchus crenatus* Loof and *Tylenchorhynchus dubius* (Bütschli) Filipjev (Weischer, 1961). *Hemicycliophora typica* de Man is also a serious pest of carrots in Holland (*Oostenbrink*, 1960) and *Longidorus africanus* Merny is known to cause a « fangy » condition of carrots in California, similar to that on sugar beet (Thomason, personal communication).

Greco *et al.* (1974) and Lamberti *et al.* (1974) using the nematicides DD, Phenamiphos or Dazomet for the control of *H. carotae* obtained considerable yield increase of carrots with respect to the control. Walrave and Cannegieter (1958) and Philis (1974) used DD for the control of nematodes of this crop with very promising results.

The objective of the trials described here was to assess the oc-

currence of parasitic nematodes associated with carrot crops in Cyprus and to test the level of control obtained with various nematicides.

Materials and methods

Two trials were initiated in early 1973 at the two main carrot-growing areas of Cyprus (Lyssi and Katokopia) and continued in 1974. Another trial was also carried out during 1974 at Kondea, near Lyssi. The soil is a sandy loam at Lyssi and Kondea and a clay loam at Katokopia. A Randomised Complete Block experimental design with seven treatments and three replications of each was laid out at Lyssi and Katokopia (Table I) and with eight treatments and four replications of each at Kondea (Table II). Plot sizes were 3.6 x 5.4, 3.6 x 3.9, and 3.6 x 4.8 meters for the Lyssi, Katokopia and Kondea experiments, respectively.

Nematicides were applied two weeks before sowing with the carrot cultivar Chantenay. The granular compounds were broadcast incorporated in the soil with a rotavator to a depth of 15 cm; DD was injected in the soil with a hand injector at 30 x 30 cm spacing. Immediately after the application of the nematicides the plots were irrigated by sprinkler for a quarter of an hour to wet the top 2 cm of soil thoroughly.

A 250 g soil sample was taken from each plot immediately before treatments were applied, and thereafter sampling was undertaken monthly for nematode assessment. Nematodes were extracted by a modification of the sieving and Baermann funnel method.

At Lyssi, the crop was harvested in June, 1973 and May, 1974, and at Katokopia and Kondea in May. Yields were recorded from a 0.8 m^2 area in the centre of each plot. Nematode counts were statistically analysed after transformation using the formula $\sqrt{x+1}$. The data were analysed for significant differences using the Duncan's multiple range test.

Results and discussion

The predominant nematode species were *Paratylenchus neoamblycephalus* Geraert and *H. carotae* at Lyssi and *Pratylenchus thornei*

Table I - *Effect of nematicides on parasitic nematodes and yield of carrot at Lyssi and Katokopia.*

Treatments (1)	Rate/ha a. i.	Lyssi				Katokopia	
		1973		1974			
		Paraty-lenchus neoambly-cephalus (2)	Saleable yield (metric tons/ha)	*P. neo-ambly-cephalus* (3)	Saleable yield (metric tons/ha)	*Paraty-lenchus* sp. (4)	Saleable yield (metric tons/ha)
Dazomet	330.7 kg	187 e	4.1 e	39 d	43.9 a	16 d	4.8 c
Fensulfo-thion	18.7 »	968 d	41.0 b	107 d	42.0 ab	40 bcd	32.6 ab
DBCP	37.5 »	907 cd	24.8 c	479 bc	26.7 c	50 bc	41.7 a
Prophos	7.5 »	1712 c	38.5 b	345 c	48.7 a	48 bc	35.1 ab
Oxamyl	7.5 »	2385 b	30.7 c	605 b	40.3 abc	68 b	32.6 ab
DD	337.5 l	1232 cd	49.5 a	353 bc	44.4 a	22 cd	32.5 ab
Untreated	—	3563 a	13.2 d	1062 a	28.3 bc	334 a	26.3 b
C.V.		11.4%	22.5%	9.7%	19.7%	19.5%	3.3%

N. B. - Data followed on the columns by the same letters are not statistically different for P: 0.05.

(1) Applied in mid December, 1972.
(2) Mean population (January-May, 1973).
(3) Mean population (December 1973-April, 1974).
(4) Mean population (January-April, 1973).

Table II - *Effect of nematicides on* Pratylenchus thornei *and yield of carrot, at Kondea.*

Treatments (1)	Rate/ha a.i. (kg)	Nematode population (2)	Saleable yield (metric tons/ha)
Dazomet	294.0	57 d	21.9 d
Fensulfothion	15.0	58 d	35.7 abc
Phenamiphos	7.5	69 c	39.0 ab
DBCP	30.0	82 b	26.7 cd
Di-Trapex(R)	31.0	77 bc	39.9 ab
Prophos	6.0	71 bc	31.8 bc
Neosar(R)	75.0	71 c	42.3 a
Untreated	—	150 a	26.1 cd
C.V.		4.0%	26.6%

N. B. - Data followed on the columns by the same letters are not statistically different for P: 0.05.

(1) Applied in mid November, 1973.
(2) Mean population (December 1973-April, 1974).

Sher *et* Allen at Kondea. *P. neoamblycephalus* was found in great numbers at Lyssi. At Katokopia, however, *Paratylenchus* sp. was found in low numbers, probably due to the heavier type of soil. At Lyssi, *H. carotae* larvae were extracted from soil when the plants were at an early stage of growth but no larvae were found later in the experiment.

Nematode-infested fields had a sparse and stunted plant growth (Fig. 1) and the main root of young plants had an abundance of lateral roots. There was considerable malformation of the carrot roots in the untreated plots, being very pronounced at Lyssi and Kondea. There was also some malformation in the treated plots but to a much lesser extent.

Fig. 1 - Effect of DD on carrots attacked by *P. neoamblycephalus* and *H. carotae*. Left: Untreated. Right: Treated.

All nematicides at the rates used decreased nematode populations. At Lyssi, the effectiveness of the nematicides in controlling the nematodes and increasing yields lasted for the consecutive carrot-growing seasons. Dazomet, however, although very effective in con-

trolling the nematodes was phytotoxic although this did not persist into the second season. In 1973, the nematicides Fensulfothion, Prophos and DD increased yields of marketable carrots about threefold, but in 1974, Prophos and DD gave yield increases of only x 1.5 (Table I). At Katokopia, DBCP (dibromochloropropane) increased yiedls by 58% (Table I) but in 1974 there was no effect of treatments on yield, most probably due to inability of *Paratylenchus* sp. to reproduce to economically damaging levels. At Kondea, most of the nematicidal treatments resulted in increased yields, but only the Neosar was significantly affected from the untreated control (Table II).

These observations indicate that nematodes present a more serious problem to carrots at Lyssi, where the soils are light textured and there is more frequent growing of carrots than at Katokopia. The use of nematicides is, however, an economical way of overcoming the problem. For example, treatment for one hectare is about £ 40 for Prophos, but assuming the effect of treatment carried over into the second season, the cost is much less than the revenue obtained from increased yields of carrots.

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SUMMARY

Trials were carried out in 1973 and 1974 at Lyssi and Katokopia, Cyprus, for the control of parasitic nematodes attacking carrots. The nematicides DD, DBCP, Di-trapex(R), fensulfothion, phenamiphos, prophos, Neosar(R) and oxamyl, applied prior to sowing of carrots controlled the nematodes and increased marketable yields. Dazomet applied at 330.7 kg/ha was phytotoxic in the first year but in the second year crop yields were considerably increased. Nematode damage was more pronounced in the light soils of Lyssi area than the heavy soils of Katokopia and involved the nematodes *Paratylenchus neoamblycephalus* Geraert, *Heterodera carotae* Jones and *Pratylenchus thornei* Sher *et* Allen.

RIASSUNTO

Nematodi parassiti della Carota a Cipro e relativa lotta.

Nel 1973 e 1974 sono state condotte, a Lyssi e Katocopia (Cipro) delle prove di lotta contro i nematodi parassiti della Carota. I nematocidi D-D, DBCP, Di-Trapex, Fensulfotion, Fenamifos, Profos, Neosar ed Oxamyl, somministrati prima della semina, hanno ridotto le cariche nematologiche ed aumentato le produzioni. Il Dazomet, alla dose di 330,7 kg/ha di principio attivo è risultato fitotossico il primo anno, ma al secondo anno dalla sua somministrazione ha aumentato considerevolmente le produzioni. I nematodi, *Paratylenchus neoamblycephalus* Geraert, *Heterodera carotae* Jones e *Pratylenchus thornei* Sher *et* Allen hanno danneggiato la Carota più nei terreni sciolti di Lyssi che in quelli argillosi di Katocopia.

RÉSUMÉ

Nématodes parasites des carottes dans l'Ile de Chypre et lutte relative.

Des essais de lutte chimique contre les nématodes qui attaquent les carottes, conduits à Lyssi et Katocopia (île de Chypre), montrent que les nématicides D-D, DBCP, Di-Trapex(R), Fensulfothion, Phenamiphos, Prophos, Neosar(R) et Oxamyl, avant le semis des carottes, ont contrôlé les nématodes et par voie de conséquence la récolte commercialisable a été augmentée. Le Dazomet, à la dose de 330,7 kg/ha de M.A., malgré sa phytotoxicité la première année de la fumigation a accru significativement la récolte la deuxième année. Le dommage par *Paratylenchus neoamblycephalus* Geraert, *Heterodera carotae* Jones et *Pratylenchus thornei* Sher *et* Allen était plus grand en sol léger de Lyssi qu'en sol lourd de Katocopia.

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