Nematol. medit. (1977), 5: 39-44.

Agricultural Research Institute - Nicosia, Cyprus

RESISTANCE OF TOMATO VARIETIES TO THE ROOT-KNOT NEMATODE *MELOIDOGYNE JAVANICA* IN CYPRUS

by

J. PHILIS and N. VAKIS

The root-knot nematode, *Meloidogyne javanica* (Treub) Chitwood, causes economic losses to many vegetable crops. It is a serious pest of tomatoes in Cyprus (Taylor, 1965) where the crop provides an annual income to farmers of about £ 1.9 million. (Anon., 1973). Chemical control of the nematode in Cyprus has proved successful (Philis, 1974). Nevertheless, the use of high yielding root-knot resistant tomato cultivars could provide a useful additional method of combating losses, especially in fields with severe root-knot nematode infestations. This paper describes work undertaken to select high yielding cultivars resistant to *M. javanica.*

Taylor (1967) expressed plant resistance to nematode attack on the basis of ability of the parasite to reproduce. Dropkin (1969) reported that resistance to *Meloidogyne* broke down in some plants when the temperature had risen above 28° C, suggesting that such changes presumably occur under natural conditions if plants are exposed to prolonged hot weather, while Peacock (1959) reported that resistant varieties can also be attacked but at a lower degree than susceptible ones. Southey (1965) reported that estimates of resistance cannot be based on degree of galling alone without reference to the reproduction rate of the parasite.

Materials and methods

Initial tests were made in 1972 at Famagusta in nematode infested fields using eight tomato cultivars, namely: Calmart, 70T82 (72T24),

Atkinson, Nemared, Marmar, Martarum, VFN-8 and Pearson. In the following year, three selections which showed resistance, VFN-8, 70T82 and Calmart, were further tested in fumigated and non-fumigated soil. EDB was injected at the rate of 84 l a.i./ha at a depth of 15 cm and 30 cm square spacing, two weeks prior to planting; a small amount of water was sprinkled on the soil after fumigation to form a seal.

In 1975, seedlings of the cultivars VFN-8, 70T82 and of the new introduction 72T51 were tested at Paphos, Pareklishia and Ormidhia, three widely separated tomato growing areas. The susceptible cultivar Pearson was included in the trials as a control.

In the trials, tomato seedlings were planted in May and spaced 60 cm in rows 120 cm apart. In trials at Famagusta, in 1972 and 1973, root galling was recorded 120 days after planting. In the 1975 trials root galling was estimated at 120, 112 and 122 days respectively at Paphos, Pareklishia and Ormidhia, and samples of roots for nematode counts at 120, 93 and 94 days respectively. All cultural operations were carried out as per standard practice.

Extraction of larvae: Second-stage larvae were extracted from 250 g of soil taken at the depth of 0-15 cm prior to fumigation or planting and at completion of harvesting using a combination of sieving and funnel methods.

Root-galling: At the end of the growing season several plants selected at random were carefully uprooted and the extent of root galling estimated according to the scale: 1) no galling, 2) trace to light, 3) light to moderate, 4) moderate to heavy, 5) heavy to severe.

Counts of adult females and galls: A sample of 1g of feeder roots was cut into small pieces and immersed for 4 minutes in warm 0.05% lactophenol acid fuchsin solution. The stained roots were then washed and cleared by immersion in lactophenol for 48 hours. A stereoscopic microscope was used to record fully grown females, with or without egg masses. The number of galls was also counted.

Fruit yields: crops were harvested once or twice per week and marketable yields fruit quality and other relevant data noted.

Results and discussion

All the cultivars tested, except Pearson, largely prevented nematode reproduction. However, many second stage larvae were found

embedded in the roots of resistant cultivars one month after planting but their development to adults was much delayed and many probably failed to complete development (Table I). Prior to planting there was a low population level of larval nematodes in the soil and this did not correlate with root gallin (Table II), but there was some correlation of root galling in Pearson with the numbers of larvae in the soil at full plant growth.

Table I - *Reproduction of Meloidogyne javanica on four tomato cultivars. (1975 Experiments).*

Station	Cultivar	Galls/g of root				Adult females/gall			
		Months after planting							
		1	2	3	4	1	2	3	4
Paphos	VFN-8	0.0	0.0	2.5	13.2	0.0	0.0	1.0	3.7
	70T82	0.0	0.0	2.0	2.5	0.0	0.0	1.0	1.0
	72T51	0.0	0.0	0.2	0.5	0.0	0.0	1.0	1.0
	Pearson	6.8	32.0	37.0	41.5	1.4	1.7	2.7	3.3
Pareklishia	VFN-8	0.0	0.0	0.0	—	0.0	0.0	0.0	—
	70T82	0.0	0.0	0.0	—	0.0	0.0	0.0	—
	72T51	0.0	0.0	0.0	—	0.0	0.0	0.0	—
	Pearson	0.0	8.3	28.0	—	0.0	1.6	2.2	—
Ormidhia	VFN-8	0.0	0.0	0.0	—	0.0	0.0	0.0	—
	70T82	0 0	0 0	0.0	—	0.0	0.0	0.0	—
	72T51	0.0	0.0	0 0	—	0.0	0.0	0.0	—
	Pearson	0.2	8.0	10.2	—	1.0	3.4	3.5	—

Soil fumigation increased yields of resistant cultivars, but the largest difference between yields from fumigated and non-fumigated soils was obtained with the susceptible cultivar Pearson (Table III). The yield performance of VFN-8 in non-fumigated soil compared favourably with that of Pearson in fumigated soil. In non-fumigated soil a Paphos and Pareklishia VFN-8 yielded 26.7 and 65.8 per cent respectively more than Pearson (Table II) and at Famagusta in 1972

Table II - *Resistance and yield of four tomato cultivars tested against the root-knot nematode,* M. javanica. *(1975 Experiments).*

Location	Cultivar	Yield[1] Tons/ha	Mean root-knot index[2]	Larvae 250 g soil[3]	Galls/g root[3]	Adult females/ gall[3]	Adult females/g of root[3,4]
Paphos	VFN-8	45.5 a	1.5	410 b	13.2	3.7	48.8 b
	70T82	40.3 b	1.1	220 bc	2.5	1.0	2.5 c
	72T51	37.8 bc	1.1	140 c	0.5	1.0	0.5 c
	Pearson	35.9 c	4.2	2000 a	41.5	3.3	136.9 a
C.V.		6.4%		18.8%			1.0%
Pareklishia	VFN-8	61.0 a	1.0	213 b	0 0	0.0	0.0
	70T82	36.4 c	1.0	180 b	0.0	0.0	0.0
	72T51	42.9 b	1.0	200 b	0.0	0.0	0.0
	Pearson	36.8 c	3.0	767 a	28.0	2.2	61.6
C.V.		9.2%		15.3%			
Ormidhia	VFN-8		1.0	95 b	0.0	0.0	0.0
	70T82	N.A	1.0	95 b	0.0	0.0	0.0
	72T51		1.0	105 b	0.0	0.0	0.0
	Pearson		3.2	946 a	10.2	3.5	35.7
C.V.				24.3%			

[1] Mean of four, three and four replications for Paphos, Pareklishia and Ormidhia trials, respectively.

[2] Average of 3 plants, based on a scale from 1 (no galling) to 5 (severe galling). Sampled 120, 112 and 122 days after planting for Paphos, Pareklishia and Ormidhia, respectively.

[3] Examined at 120, 93 and 94 days after planting for Paphos, Pareklishia and Ormidhia, respectively.

[4] Analysis based on $\sqrt{n + 0.5}$ transformation.

Numbers in a column followed by the same letter are not significantly different at the 5% level (Duncan Multiple Range Test).

Table III - *Resistance and yield of tomato cultivars tested against the root-knot nematode,* M. javanica. *(1972 and 1973 Experiments at Famagusta).*

Cultivar	1972		1973			
			Non-fumigated soil		Fumigated soil	
	Yield Tons/ha[1]	Mean root-knot index[3]	Yield Tons/ha[2]	Mean root-knot index	Yield Tons/ha[2]	Mean root-knot index[3]
Atkinson	47.8 bc	1.0	—	—	—	—
Nemared	85.3 a	1.3	—	—	—	—
Calmart	40.7 c	1.0	17.1 c	1.4	22.5 bc	1.0
70T82	58.7 bc	1.0	34.5 abc	1.1	40.6 ab	1.0
Marmar	66.2 b	1.0	—	—	—	—
Martarum	62.7 b	1.0	—	—	—	—
VFN-8	65.2 b	1.0	39.2 ab	1.1	47.3 a	1.0
Pearson	56.0 bc	2.0	18.1 bc	4.7	43.8 a	2.2
C.V.	22%		33%		33%	

[1] Mean of four replicates.
[2] Mean of three replicates.
[3] Average of 3 plants.
For scale see Table II.

the difference was 16.4 per cent, although not statistically significant (Table III). The cultivars 70T82 and 72T51 outyielded Pearson, but not VFN-8, in non-fumigated soils (Table II). Atkinson, Nemared, Calmart, Marmar and Martarum while showing some level of resistance to root-knot nematode were not included in the 1975 trials because their horticultural characteristics under local conditions did not compare favourably with those of the other resistant cultivars.

The invasion by the nematode of the roots of VFN-8, 70T82 and 72T51 at Paphos in the 1975 experiment may have been related to the prolonged exposure of the plants to hot weather (Dropkin, 1969). Air temperature was often above 28° C for prolonged periods during the 120 days of the experiment and very often reached 35° C. Similarly at Famagusta, high temperatures may have resulted in the slight galling on the roots of Nemared, 70T82, Calmart and VFN-8 (Table III).

The effect of high temperatures could be minimised by planting about mid-April.

The results of the various experiments demonstrated the resistance of the cultivars VFN-8, 70T82 and 72T51 to the root-knot nematode, *M. javanica*. Each of the cultivars produced fruit of commercially acceptable quality and yields were comparable with those of Pearson grown in fumigated soil. All cultivars produced fruit resistant to cracking.

SUMMARY

Trials carried out in Cyprus have shown that the tomato varieties VFN-8, 70T82 and 72T51 are resistant to the nematode *Meloidogyne javanica* and produce a good crop under conditions prevailing on the islands. Nematode reproduction on these varieties, however, is not fully prevented.

RIASSUNTO

Resistenza di varietà di Pomodoro al nematode galligeno Meloidogyne javanica *a Cipro.*

Prove condotte a Cipro hanno mostrato che le varietà di Pomodoro VFN-8, 70T82 e 72T51 sono resistenti a *Meloidogyne javanica* (Treub) Chitwood e danno buone produzioni nelle condizioni locali. Tuttavia, la riproduzione del nematode galligeno sulle radici di queste varietà non è del tutto inibita.

LITERATURE CITED

ANONYMUS, 1973. Agricultural Survey. Statistics and Research Department. Ministry of Finance, Republic of Cyprus, 36 p.

DROPKIN V. H., 1969. The necrotic reaction of tomatoes and other hosts resistant to *Meloidogyne*: Reversal by temperature. *Phytopathology, 59*: 1632-1637.

PEACOCK F. C., 1959. The development of a technique for studying the host-parasite relationship of the root-knot nematode *Meloidogyne incognita* under controlled conditions. *Nematologica, 4*: 43-55.

PHILIS J., 1974. Chemical control of the root-knot nematode *Meloidogyne javanica* Treub on tomato. Technical paper 4, Agricultural Research Institute, Nicosia, Cyprus, 9 p.

SOUTHEY J. F., 1965. Plant Nematology. Technical Bulletin 7, HMSO London, 282 p.

TAYLOR A. L., 1965. Final report. United Nations Special Fund. Agricultural Research Institute, Ministry of Agriculture and Natural Resources, 37 p.

TAYLOR A. L., 1967. Introduction to research on Plant Nematology. FAO Rome, 133 p.

Accepted for publication on 21 December 1976.