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THE EFFECT OF POPULATION DENSITIES OF *MELOIDOGYNE INCOGNITA* ON YIELD OF SUSCEPTIBLE AND RESISTANT TOMATO

by

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Summary. The relationship between initial population densities of *Meloidogyne incognita* race 1 and yield of susceptible and resistant tomato cultivars was investigated in the field. Microplots were infested with finely chopped nematode- infected pepper roots to give a range of population densities of 0, 0.031, 0.062, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64 or 128 eggs and juveniles/cm^3 soil. A tolerance limit (*T*) of 0.55 eggs and juveniles of *M. incognita*/cm^3 soil was calculated for both cultivars of tomato. A minimum relative yield (*m*) of 0 and 0.7 at initial population densities (*Pi*) $\geq$ 32 eggs and juveniles/cm^3 soil was also calculated for the susceptible and resistant tomato cultivar, respectively. Fruit size and marketable yield of tomato of the susceptible cultivar were negatively affected by the nematode infestation. Maximum nematode reproduction rate was 1,539 at the lowest *Pi* on the susceptible tomato but decreased with increasing nematode population density. Reproduction rate was lower than 1 at all initial population densities of *M. incognita* in microplots planted with the resistant tomato cultivar.

Yields of tomato (*Lycopersicon esculentum* Mill.) are greatly reduced by infestation of *Meloidogyne incognita* (Kofoid *et* White) Chitw., in southern Italy, especially in sandy soils (Di Vito, 1979). Investigations done under field condition in Apulia estimated a tolerance limit of 4 eggs/ml soil for a susceptible tomato cultivar and a minimum relative yield of 0 (Di Vito *et al.*, 1981). Similar results were obtained by Barker *et al.* (1976) in U.S.A. Further investigations under glasshouse condition in pots estabilished a tolerance limit of 3.3 eggs and juveniles of *M. incognita*/ml soil for the susceptible and resistant tomato cultivars and minimum relative yields (relative top weight of plant) of 0 and 0.77 for susceptible and resistant tomato cultivar, respectively (Di Vito and Ekanayake, 1983). However, these results were obtained by infesting microplots and pots with eggs and juveniles of *M. incognita* extracted by processing infested roots with Na0C1 solution (Hussey and Barker, 1973) and, therefore, the values of the tolerance limit and minimum relative yield were under estimated because the viability of the inoculum used was reduced by the effect of Na0C1 treatment in the extraction of process (Vrain, 1977; O'Bannon *et al.*, 1985; Di Vito *et al.*, 1986). Therefore, a field experiment was undertaken to study the effect of initial population density of *M. incognita* in relation to the yield of susceptible and resistant cultivars by inoculating the soil with nematode infested roots.

Materials and methods

One hundred and ninetysix bottomless concrete tiles (30 x 30 cm cross section x 50 cm deep) were plunged into the soil in a field at Bari. The tiles were contiguous along the row and spaced at 90 cm between the rows. They were filled with 40dm^3 of sandy soil (7% clay, 3.9% silt, 89.1% sand and 2.3% organic matter) which had been treated six months earlier with 200 1/ha of Telone. An Italian population of *M. incognita* race 1 (Taylor and Sasser, 1978) was reared on pepper (*Capsicum annuum* L.) cv. Yolo Wonder. Pepper roots infested by the nematode were finely chopped and the number of eggs and juveniles in the egg masses on the roots were estimated by processing ten root samples of 10g each with 1% aqueous solution of sodium hypochlorite (Hussey and Barker, 1973) then the roots were thoroughly mixed with 50kg of fumigated soil and used as inoculum. Appropriate amounts of the inoculum and 10g of fertilizer (12%N, 24%P and 12%K) were thoroughly mixed in a concrete mixer and incorporated into the soil of each microplot to give population densities of 0, 0.031, 0.062, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64 or 128 eggs and juveniles of *M. incognita*/cm^3 soil. Two lots of microplots, one for the susceptible cv. Ventura and the other for the resistant cv. DISA N (a new resistant tomato cultivar of the Istituto di Nematologia Agraria, Bari, Italy) were arranged in a randomized block design with seven replicates.

A two-month old seedling of either cv. Ventura or cv. DISA N was transplanted into each microplot on 10 May 1990. Appropriate experimental procedures in relation to usual practices for irrigation, fertilization, and disease, pest and weed control were followed.

Tomato fruits were harvested and weighed on 20 July and 3 August and fresh top weight of plants were also determined.

A 2 kg soil sample, the composite of 20 cores, was collected with a soil sampler from each microplot after the last harvest. Soil samples 500cm^3 each, were then processed by Coolen's modified method (Coolen, 1979; Di Vito *et al.*, 1985) to estimate the final population density and to determine the reproduction rate of the nematode.

Results and discussion

Symptoms (stunting) of *M. incognita* attack on susceptible tomato cv. Ventura were evident by 18 May in the microplots infested with 128 eggs/cm^3 soil and at the beginning of June in those containing $\geq$ 8 eggs/cm^3 soil. All plants in the microplots at Pi = 128 eggs/cm^3 soil were dead by 11 June and six on 20 June in those infected by 64 eggs/cm^3 soil. The microplots planted with the resistant tomato cv. DISA N showed negligibile reduction of growth even at large inoculum levels. The time required for flowering and fruiting were not noticeably affected by the nematodes. However, susceptible plants in heavily infested microplots flowered poorly and produced small and unmarketable fruits. Yield and top fresh weight of the plants were greatly affected by *M. incognita*, mostly with the susceptible cv. Ventura. Data were consistent with the equation $y = m + (1 - m)z^{P-T}$ (Seinhorst, 1965), where y is the ratio between the yield at Pi and that at $P \leq T$, m the minimum relative yield (y at very large Pi), z a constant < 1 with $z^{-T} = 1.05$, T the tolerance limit (Pi at which no yield is lost), and P initial population density. Fitting the data to the above equation (Fig. 1) gave a tolerance limit (T) of 0.55 eggs and juveniles/cm^3 soil for both cultivars

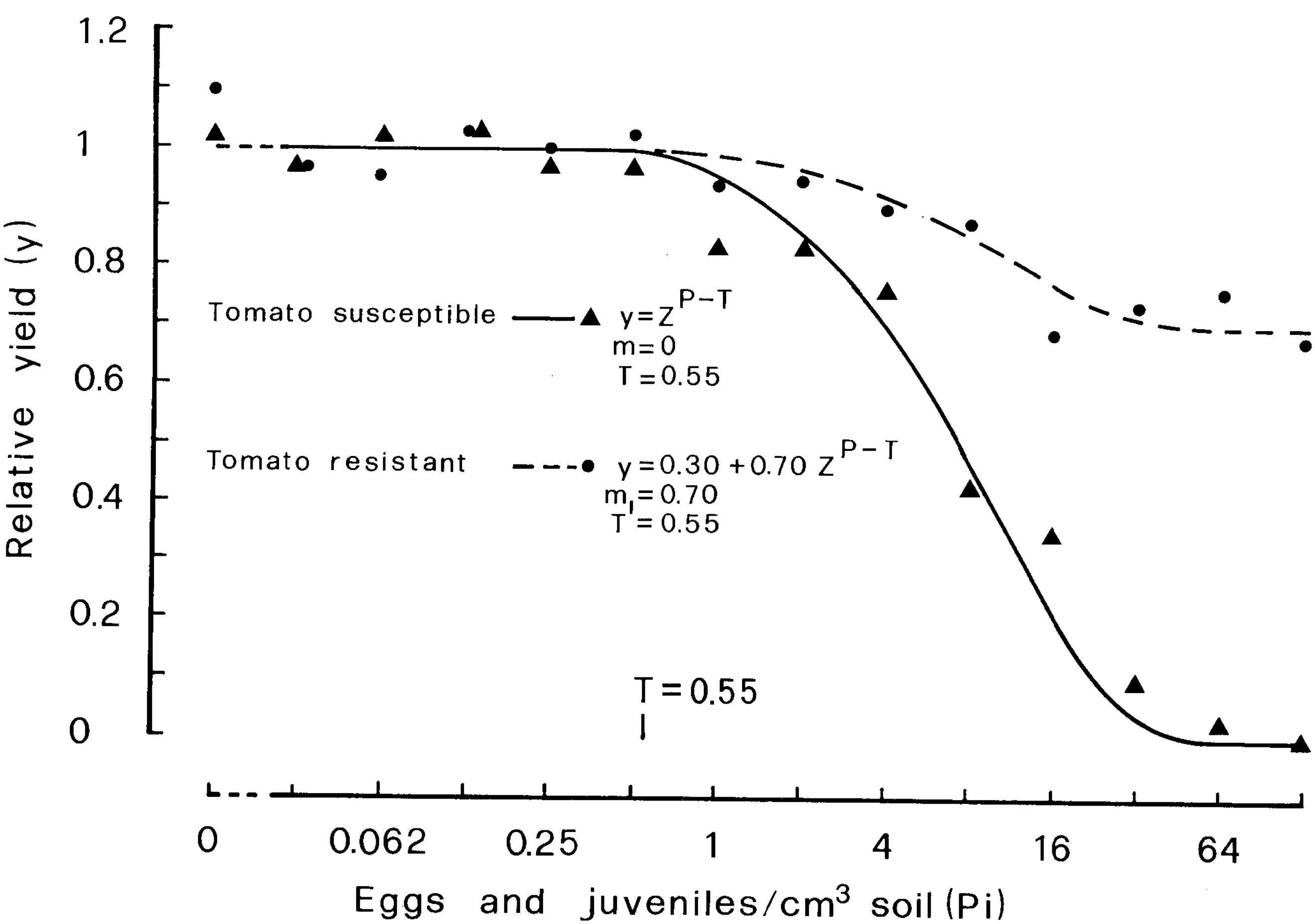

Fig. 1 - Relationship between initial population density (Pi) of *Meloidogyne incognita* race 1 and relative yield (y) of susceptible (cv. Ventura) and resistant tomato (cv. DISA N).

and minimum relative yield (*m*) of 0 and 0.7 at $Pi \geq 32$ eggs and juveniles/cm^3 soil for susceptible and resistant tomato, respectively. The same value of tolerance limit (*T*) and relative minimum yield (*m*) were also obtained for the fresh top weight of plants. The fruit size of the susceptible tomato cv. Ventura was significantly affected ($P \leq 0.01$) by the nematode infestation and was 40 and 10g at lowest and largest *Pi*, respectively (Fig. 2). Also the percentage of marketable yield of susceptible tomato was significantly influenced ($P \leq 0.01$) by initial population density (*Pi*) of *M. incognita* and was about 90% at the lowest *Pi* and smaller at increasing *Pi* and around 20% at $Pi = 64$ eggs and juveniles/cm^3 soil (Fig. 2).

The fruit size and marketable yield of the resistant cv. DISA N were not affected at all initial population densities of the nematode.

The final population densities (*Pf*) of *M. incognita* increased at *Pi* between 0.031 and 32 eggs and juveniles/cm^3 soil and decreased at $Pi \geq 64$ eggs/cm^3 soil in microplots planted with susceptible tomato (Tab. I) and was very low in all microplots planted with the resistant cultivar.

The reproduction rate (*Pf/Pi*) of *M. incognita* race 1 was higher at $Pi \leq 0.25$ (from 1,138 to 1,539) and ≥ 1 at $Pi \geq 0.031$ and ≤ 32 in microplots planted with the susceptible tomato cultivar and was ≤ 1 in microplots at $Pi \geq 64$ and all microplots transplanted with the resistant tomato cv DISA N (Tab. I). The equilibrium density of *M. incognita* is around 64 eggs and juveniles/cm^3 of the initial population density (Tab. I).

Investigation on the pathogenicity of *M. incognita* race 1 confirmed the destructive effect of this nematode on tomato. The tolerance limit of susceptible and resistant tomato cultivars was 0.55 eggs and juveniles/cm^3 soil and relative minimum yields were 0 and 0.7 at $Pi \geq 32$ eggs/cm^3 soil, respectively. The value of the tolerance limit was 7 times lower than that found in previous experiments (Di Vito *et al.*, 1981; Di Vito and Ekanayake, 1983). The discrepancy in this value was due to the type of inoculum used; in fact when the eggs and juveniles of *Meloidogyne* spp. are extracted by Na0C1 method the viability of the inoculum is reduced by at least 60-80% of that without treatment (Di Vito *et al.*, 1986). The values of minimum relative yields of susceptible and resistant cultivar were 0 and 0.7, respectively, and were the same as that found in pots experiments (Di Vito and Ekanayake, 1983) but these values were found at a lower *Pi* of *M. incognita*.

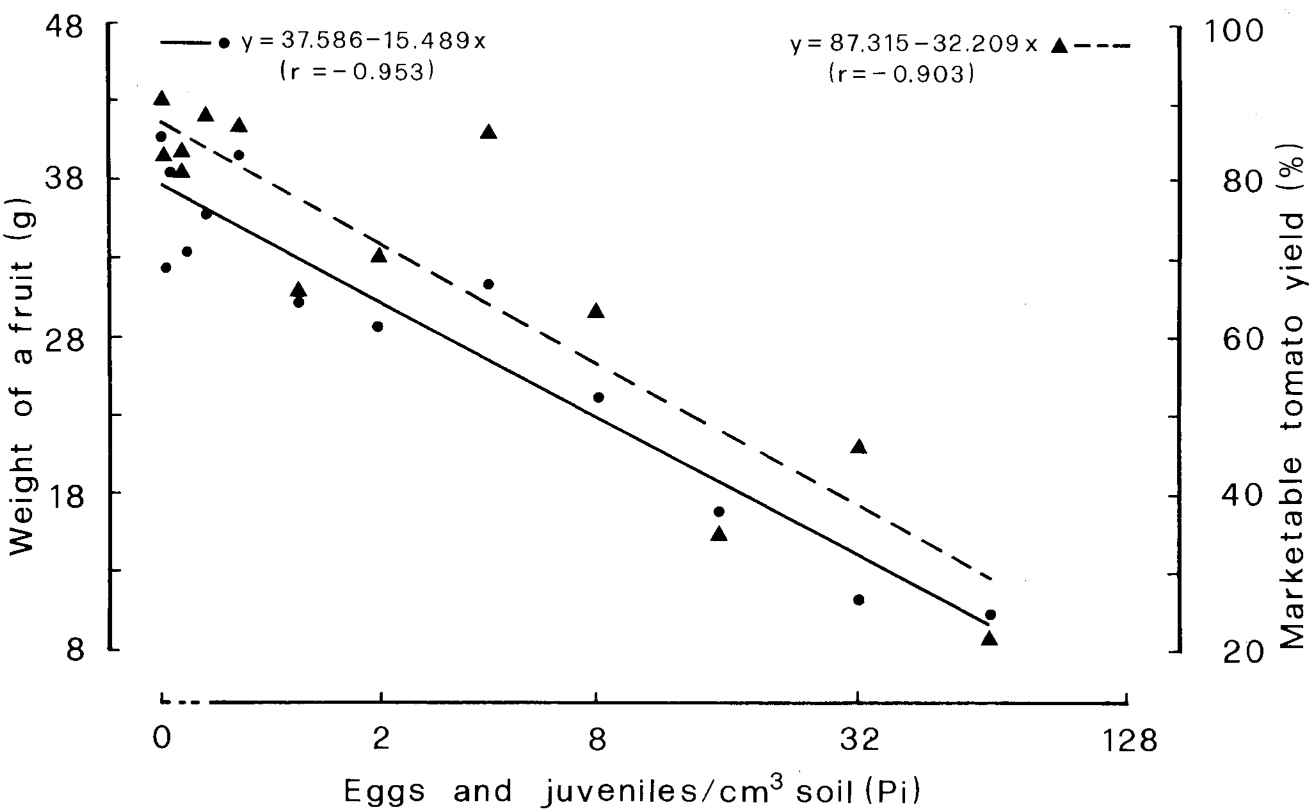

Fig. 2 - Relationship between initial population density [log(*Pi* + 1)] of *Meloidogyne incognita* race 1 and weight of a fruit and percentage of marketable yield of susceptible tomato (cv. Ventura).

The initial population density of *M. incognita* negatively also effected the quality of yield of the susceptible tomato, e.g. the size of tomato fruit. This parameter of the tomato is important when the production is for peeled tomato factories.

The decline of nematode populations in microplots with a large inoculum and planted with cv. Ventura may have been due to lack of food because of the poor or lack of growth of the plants following nematode attack. In the microplots planted with cv. DISA N, most of the juveniles which had penetrated the roots were unable to complete their development, therefore, nematode numbers declined (Tab. I).

TABLE I - *Relationship between initial (Pi) and final (Pf) population and reproduction rate (Pf/Pi) of* Meloidogyne incognita race *1 on susceptible (cv. Ventura) and resistant (cv. DISA N) tomato.*

Eggs and juveniles/cm³ soil			Reproduction rate (Pf/Pi)	
Pi	Pf			
	Ventura	DISA N	Ventura	DISA N
0.031	44.4	0.02	1,432	0.64
0.062	83.6	0	1,338	0
0.125	192.4	0	1,539	0
0.25	284.4	0	1,138	0
0.5	253.2	0.5	506	1
1	231.1	0.5	231	0.5
2	275.6	1.2	138	0.6
4	328.1	1.2	83	0.3
8	228.0	0.4	28.5	0.05
16	137.6	0.4	8.6	0.025
32	91.1	1.2	2.8	0.037
64	61.8	0.1	0.9	0.001
128	64.2	0.4	0.5	0.003

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