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RELATIONSHIP BETWEEN INITIAL POPULATION DENSITIES OF *MELOIDOGYNE JAVANICA* AND YIELD OF SUNFLOWER IN MICROPLOTS

by
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Summary. The relationship between initial population densities (*Pi*) of *Meloidogyne javanica* and yield of sunflower was investigated in the field. Microplots were artificially infested with finely chopped nematode-infected tomato roots to give a range of initial population densities (*Pi*) of 0, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 eggs and juveniles of *M. javanica*/cm^3 soil. Tolerance limits (*T*) of 0.74, 0.45, 0.74 and 1.2 eggs and juveniles/cm^3 soil were calculated for height, dry top weight, seed yield and seed oil content, respectively. Minimum relative yields (*m*) of 0, 0, 0, and 0.7 were also calculated for height, dry top weight, seed yield and seed oil content, respectively. Maximum nematode reproduction rate (*Pf/Pi*) was 110.2 at lowest *Pi* and decreased with increasing nematode population density.

Sunflower (*Helianthus annuus* L.) is of world-wide importance mostly for oil production, occupying 18,070,000 ha surface with seed production of 20,937,000 t (F.A.O., 1994). The area and production of this crop has increased rapidly during the last decade in Italy and in 1993 there were 124,000 ha with 289,300 t seed production, respectively (ISTAT, 1994). Several nematodes attack sunflower but the most severe damage is caused by root-knot nematodes (*Meloidogyne* spp.). Rich and Green (1981) investigated the effect of *M. javanica* (Treub) Chitw. on the yield of sunflower in microplots but they did not find any reduction of seed yield. Therefore, a microplot experiment was undertaken to study the yield of sunflower in relation to different initial levels of an Italian population of *M. javanica*.

Materials and methods

One hundred and forty bottomless concrete tiles (30x30 cm cross section x 50 cm deep) were buried to 45 cm depth in the soil in a field near Bari; the tiles were contiguous along the rows and spaced 50 cm between the rows. They were filled to 5 cm from the top with 40 dm^3 sandy loam soil which had been treated four months earlier with 250 l/ha of 1,3 D.

An Italian population of *M. javanica* host race 1 (Di Vito and Cianciotta, 1991) was reared on tomato (*Lycopersicon esculentum* Mill.) cv Rutgers. Tomato roots infested with the nematode were carefully washed, finely chopped, thoroughly mixed and the number of eggs and juveniles in the egg masses on the roots were estimated by processing ten root samples of 10 g each with 1% aqueous solution of sodium hypochlorite (Hussey and Barker, 1973). Then the roots were thoroughly mixed with 100 kg of the fumigated soil and used as inoculum. Appropriate amounts of this inoculum and 10 g of a 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, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 eggs and/or juveniles of *M. javanica*/cm^3 soil. The microplots were arranged in a randomized block design with ten replicates.

Two seeds of the sunflower hybrid "Romsun HS 90" were sown in each microplot on 20 April, 1994 and thinned to one plant per each microplot ten days after emergence.

The normal procedures, such as irrigation, fertilization, and disease, pest and weed control, were practised.

The plants were harvested on 20 August. Plant height, top weight and seed yield were recorded. Seed oil content (% oil in the seeds) was also determinated by the following method: 30 g of seed per microplot were dried at 105° C for 48 hours and then 10 g were analysed for oil content by the nuclear magnetic resonance method (NMR) (Tiwari *et al.*, 1974) using a NMR mod. 10 Newport Analyser (Newport Instrument L.T.D.-UK).

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

Results and discussion

The Italian population of *M. javanica* host race 1 adversely affected the growth of sunflower. Symptoms (yellowish and stunting) of the nematode attack were clearly evident one week after plant emergence in pots infested with ≥ 256 eggs and juveniles/cm^3 soil. Many plants

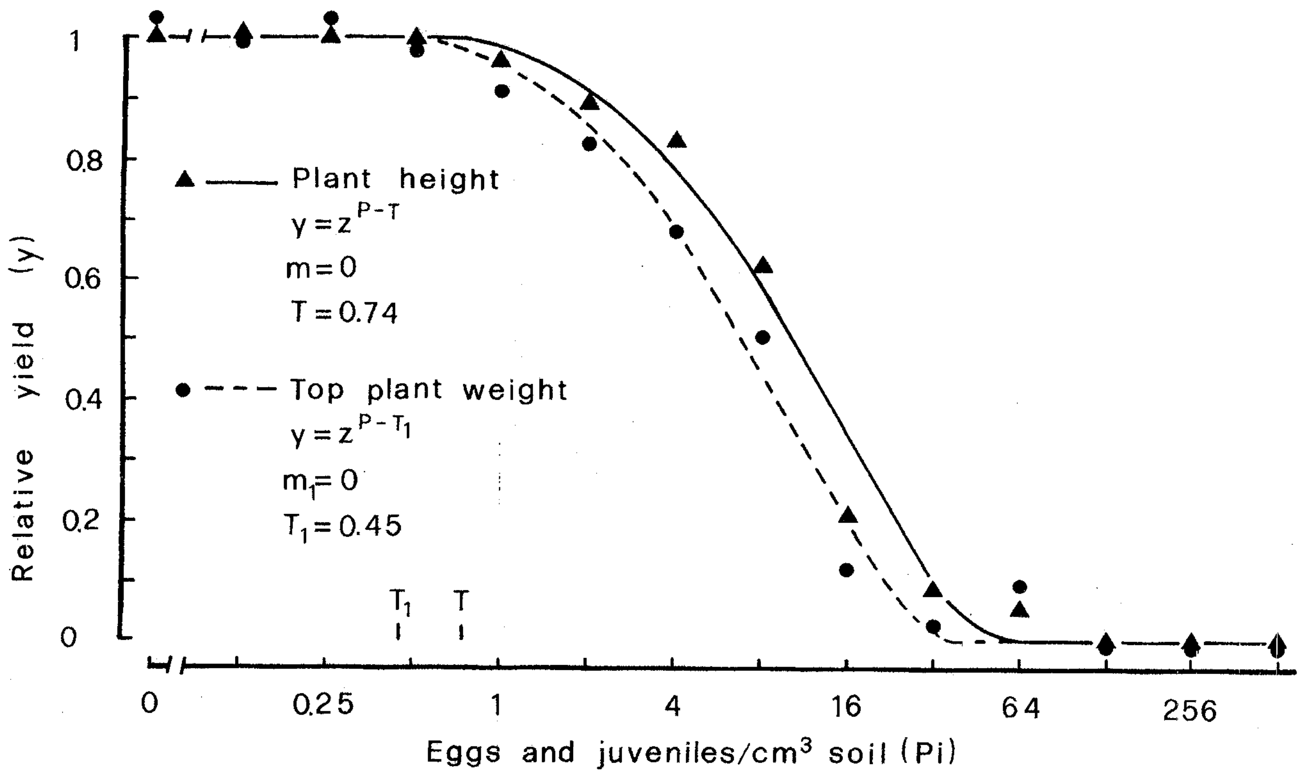

Fig. 1 - Relationship between initial population densities (Pi) of *Meloidogyne javanica* host race 1 and relative height and top weight of plants of the hybrid "Romsun HS 90" of sunflower grown in microplots.

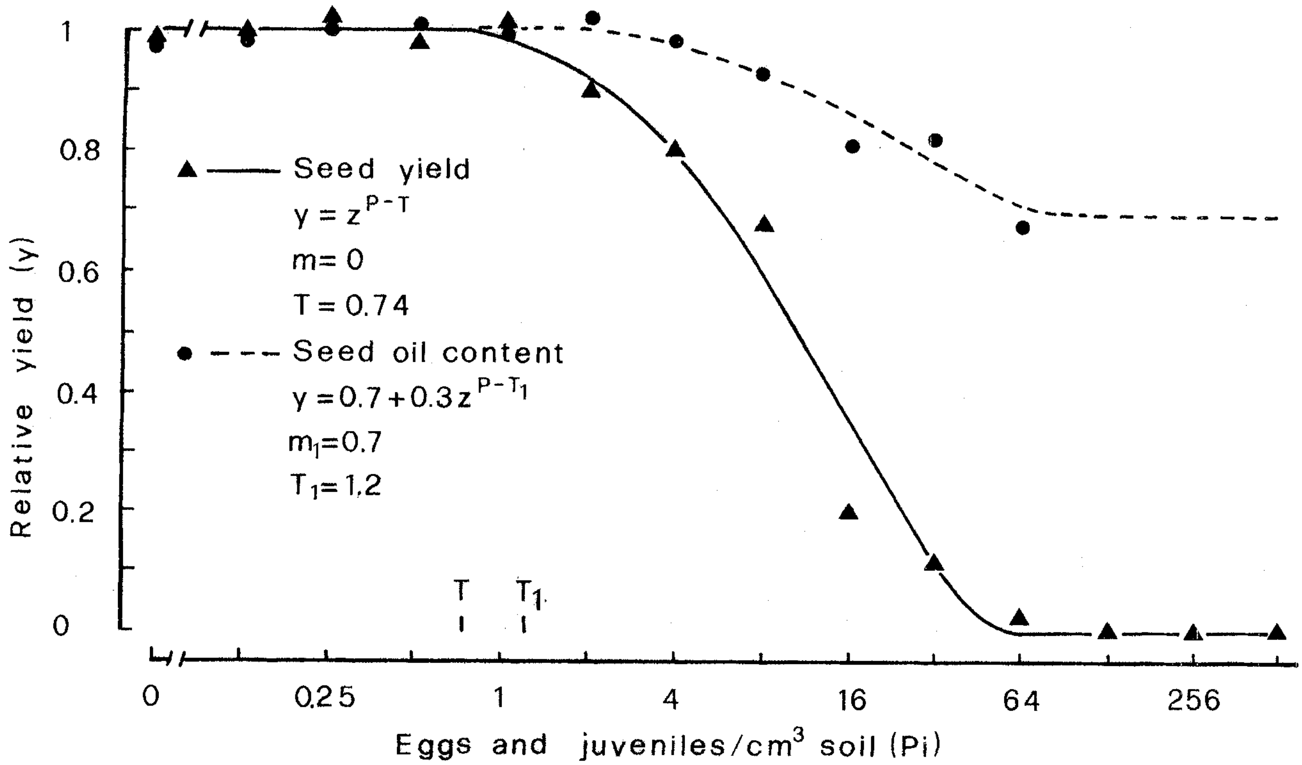

Fig. 2 - Relationship between initial population densities (*Pi*) of *M. javanica* host race 1 and relative seed yield and seed oil content of the hybrid "Romsun HS 90" of sunflower grown in microplots.

died after one more week. Yellowing and stunting were also evident two weeks later in microplots infested with more than 16 eggs and juveniles/cm^3 soil; the inoculum level did not affect the time of germination or number of germinated seeds. Height, dry top weight of the plants and seed yield and seed oil content were greatly affected by *M. javanica.* Data were consistent with the Seinhorst's model $y=m + (1-m)z^{P-T}$ (Seinhorst, 1965; 1979), where y is the relative yield, 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* above which yield is lost), and P initial population density of the nematode. Fitting the data to this model gave tolerance limits (T) of 0.74, 0.45, 0.74 and 1.2 eggs and juveniles/cm^3 soil for height, dry top weight, seed yield and percentage of seed oil content, respectively (Figs. 1 and 2). The minimum relative yields (m) were: 0 for height of plants at $Pi \geq 64$ eggs and juveniles/cm^3 soil; 0 for dry top weight of plants at Pi ≥ 32; 0 for seed yield at Pi ≥ 64; and 0.7 for seed oil content at Pi ≥ 64 (Figs. 1 and 2).

Positive final population densities (*Pf*) of *M. javanica* were recorded at *Pi*s between 0.125 and 16 eggs and juveniles/cm^3 soil (Table I) and increasingly negative ones in microplots infested with $Pi \geq 32$ eggs and juveniles/cm^3 soil.

The highest reproduction rate (*Pf/Pi*) was recorded at $Pi = 1$ eggs and juveniles/cm^3 (Table I) and at $Pi \geq 32$ reproduction was negligible.

This experiment confirmed the high susceptibility of sunflower to *M. javanica.* The seed yield and seed oil content of sunflower were decreased by nematode infestation. These two parameters have a tolerance limit of about one egg and juveniles of *M. javanica*/cm^3 soil which is in contrast to the results obtained by Rich and

TABLE I - *Relationship between initial (Pi) and final (Pf) population densities and reproduction rate (Pf/Pi) of* Meloidogyne javanica *race 1 on the hybrid sunflower "Ronsum HS 90" grown in microplots.*

Eggs and juveniles/cm³ soil		Reproduction rate (*Pf/Pi*)
Pi	*Pf*	
0.125	7.3	58.4
0.25	9.0	36.0
0.5	45.2	90.4
1	110.2	110.2
2	118.6	55.1
4	186.1	46.5
8	181.7	22.7
16	31.3	1.9
32	13.6	0.4
64	3.1	0.05
128	1.7	0.01
256	1.6	0.006
512	2.0	0.004

Green (1981) who did not notice any effect of this nematode on sunflower. Most probably the inoculum densities used by Rich and Green were too low (0.05, 0.25 and 1.25 eggs and juveniles of the nematode/cm^3 soil) and may be lower than the tolerance limit. Type of inoculum, nematode population and plant cultivar are also important factors to cause differences in the results.

However, *M. javanica* must be considered a major pest of sunflower and tolerance limit of the crop to the nematode must be taken in the consideration when planting in infested soil.

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