THE EFFECT OF *MELOIDOGYNE INCOGNITA* ON GROWTH OF SUNFLOWER IN POTS

by

N. SASANELLI and M. DI VITO

Summary. The effect of *Meloidogyne incognita* host race 1 on the growth of sunflower was investigated in a glasshouse experiment. Pots were infested with finely chopped nematode-infected tomato roots to give a range of population densities of 0, 0.062, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 eggs and juveniles/cm^3 soil. Tolerance limits (*T*) of 1.85, 2.37 and 2 eggs and juveniles of *M. incognita*/cm^3 soil were estimated for top weight, height and number of nodes of sunflower plants, respectively. Minimum relative yields (*m*) were 0.25, 0.3 and 0.5 for top weight, height and number of nodes of sunflower plants, respectively. The maximum rate of nematode reproduction on sunflower, about 81, occurred at the lowest initial population of the nematode.

Sunflower (*Helianthus annuus* L.) crop is of worldwide importance with 15,000,000 ha under cultivation yielding 21,000,000 t of seed. In Italy production of this crop has increased rapidly to 155,000 ha and 330,000 t during the last decade (FAO, 1989). Among several pests that attack sunflower in Italy, root-knot nematodes (*Meloidogyne* spp.) are the most common. However, information on the relationship between initial population density of *Meloidogyne incognita* (Kofoid *et* White) Chitw. and yield loss of sunflower is lacking. Therefore, a pot experiment was undertaken to ascertain the growth of sunflower at different infestation levels of an Italian population of *M. incognita*.

Materials and methods

The population of *M. incognita* host race 1 (Taylor and Sasser, 1978) was reared on tomato (*Lycopersicon esculentum* Mill.) cv. Rutgers. Tomato 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 10 g each with 1% aqueous solution of sodium hypochlorite (Hussey and Barker, 1973). The roots were then thoroughly mixed with 3 kg of steam sterilized sandy soil and used as inoculum. Appropriate amounts of this inoculum were thoroughly mixed with the steam sterilized sandy soil in each pot (750 cm^3 soil) to give population densities of 0, 0.062, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 eggs and juveniles of *M. incognita*/cm^3 soil. Two pregerminated seeds of sunflower cv. Romsun HS 301 were sown in each pot on 15 March 1990 and thinned to one plant per pot five days later. The pots were arranged in a randomized block design with 9 replicates on benches in a glasshouse at 26 °C ± 2.

The sunflower plants were harvested 45 days after sowing and the height, number of nodes and fresh and dry top weights were recorded. Final nematode soil density was determined by processing 500 cm^3 of soil per pot by a modified Coolen's method (Coolen, 1979; Di Vito *et al.*, 1985). The roots were processed in 1% aqueous solution of sodium hypochlorite (Hussey and Barker, 1973) to count eggs and juveniles.

Results

Meloidogyne incognita race 1 negatively affected the growth of sunflower plants. Symptoms (stunting) of the nematode attack were evident 15 days after sowing in pots infested with $\geqslant$ 128 eggs/cm^3 soil and 10 days later in pots infested with $\geqslant$ 32 eggs/cm^3 soil. Fresh and dry top weights, height and number of nodes of plants were greatly affected by *M. incognita*; and the data were consistent with the equation $y = m + (1 - m) \, z^{P-T}$ (Seinhorst, 1965; 1979), where *y* is the ratio between the yield (fresh and dry weight, height and number of nodes of plants) at *Pi* and that at $P \leqslant T$, *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 (Figs. 1, 2) gave tolerance limits of 1.85, 2.37 and 2 eggs/cm^3 soil for top fresh weight, height, and number of nodes of sunflower plants, respectively. The minimum relative yields (*m*), for the same parameters, were 0.25, 0.3 and 0.5 at $Pi \geqslant$ 128, 256 and 256 eggs/cm^3 soil, respectively (Figs. 1, 2). The value of the tolerance limit (*T*) and relative minimum yield (*m*) for the dry top weight of the plants were the same as for the fresh top weight.

The reproduction rate (*Pf/Pi*) of *M. incognita* race 1 was greater (80.7) at *Pi* = 0.062 and decreased with increasing *Pi* (Fig. 3). The equilibrium density of the nematode was estimated at 231.4 eggs and juveniles/cm³ soil (Fig. 3).

Discussion

The results of our experiment demonstrate that *M. incognita* can severely affect the growth of sunflower, whereas in Florida, Rich and Green (1981) found that *M. javanica* did not. Although root-knot nematode species may differ in their pathogenicity, we consider that this apparent discrepancy may be due to the density and type of inoculum used. In Florida the nematodes used were obtained by the sodium hypochlorite method (Hussey and Barker, 1973). Previous pathogenicity tests (O'Bannon *et al.*, 1965; Vrain, 1977; Di Vito *et al.*, 1986) have demonstrated that the use of eggs and juveniles of *M. incognita* from dissolved egg masses is much less suitable than entire egg masses. Moreover, the nematode densities used in Florida (5, 25 and 125 eggs and juveniles/100 cm³ soil) were rather low and probably close to the tolerance limit of sunflower to the nematode and were, therefore, not potentially capable of causing any yield loss.

Our findings indicate that sunflower plants can be severely damaged if grown in root-knot nematode infested soils, particularly in sandy soil which are conducive to nematode infection. However, damage by *M. incognita* could be reduced by sowing as early as possible, when soil temperatures are still relatively low, and therefore unfavorable for nematode reproduction.
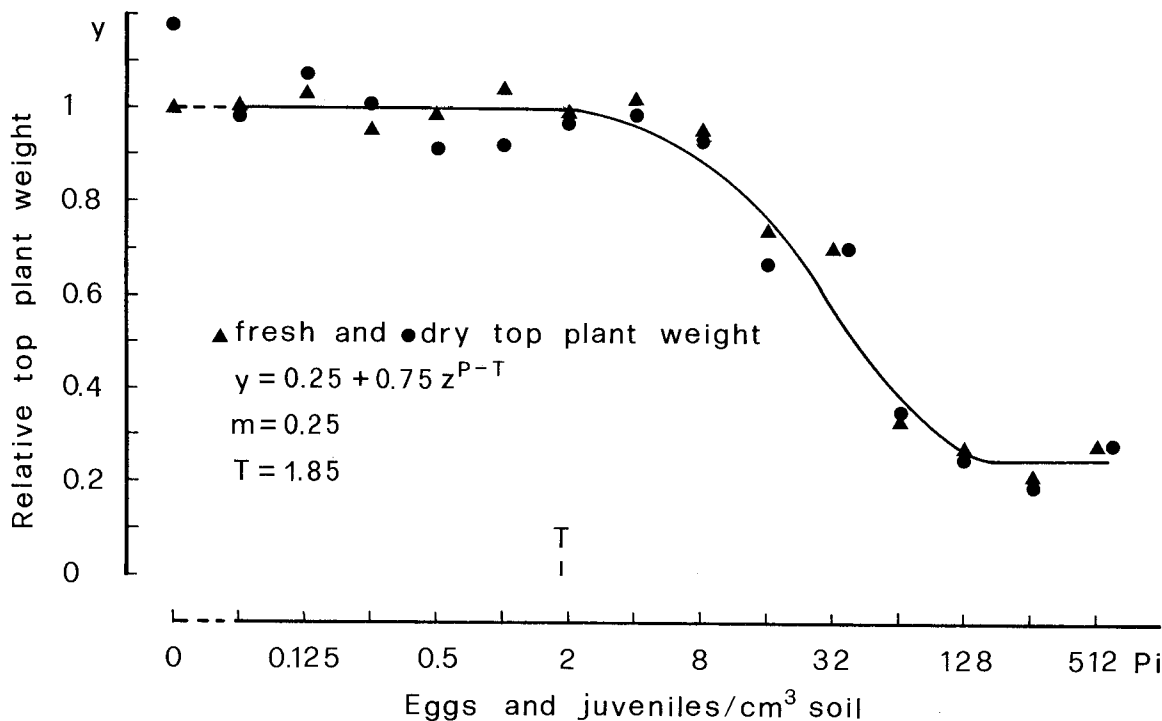
Fig. 1 - Relationship between initial population density (*Pi*) of *Meloidogyne incognita* host race 1 and relative fresh and dry top weight of sunflower (cv. Romsun HS 301) grown (for 45 days) in pots in a glasshouse.
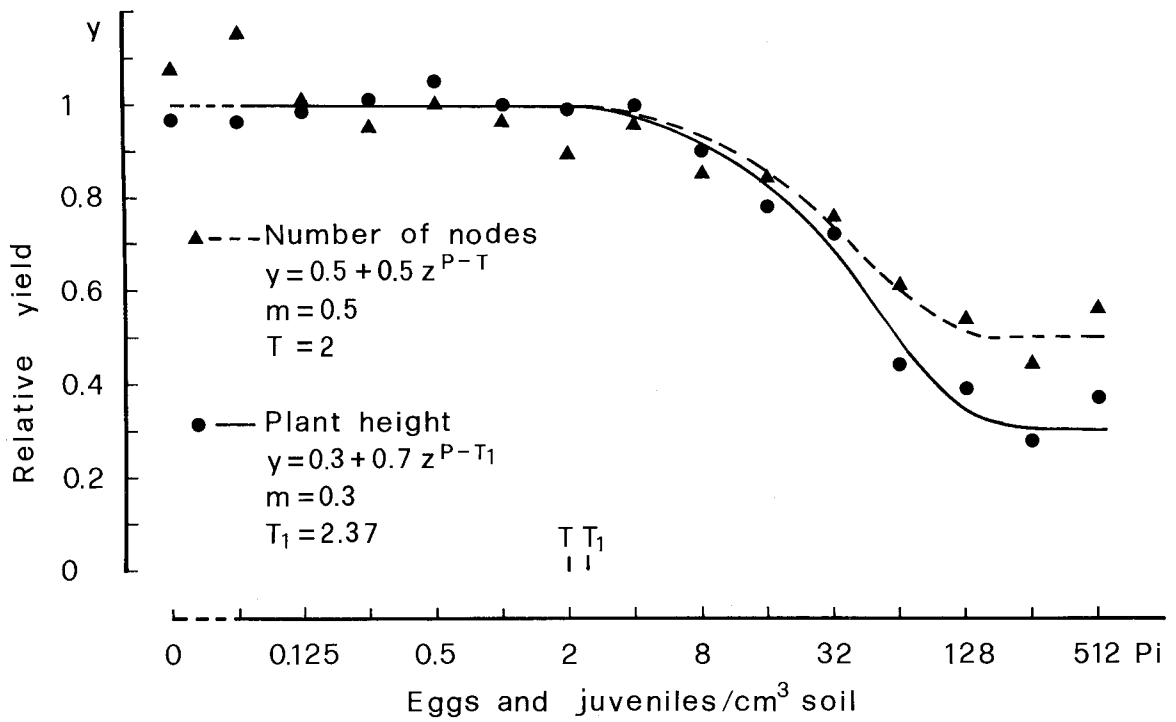
Fig. 2 - Relationship between initial population density (*Pi*) of *Meloidogyne incognita* host race 1 and relative height and number of nodes of sunflower (cv. Romsun HS 301) grown (for 45 days) in pots in a glasshouse.
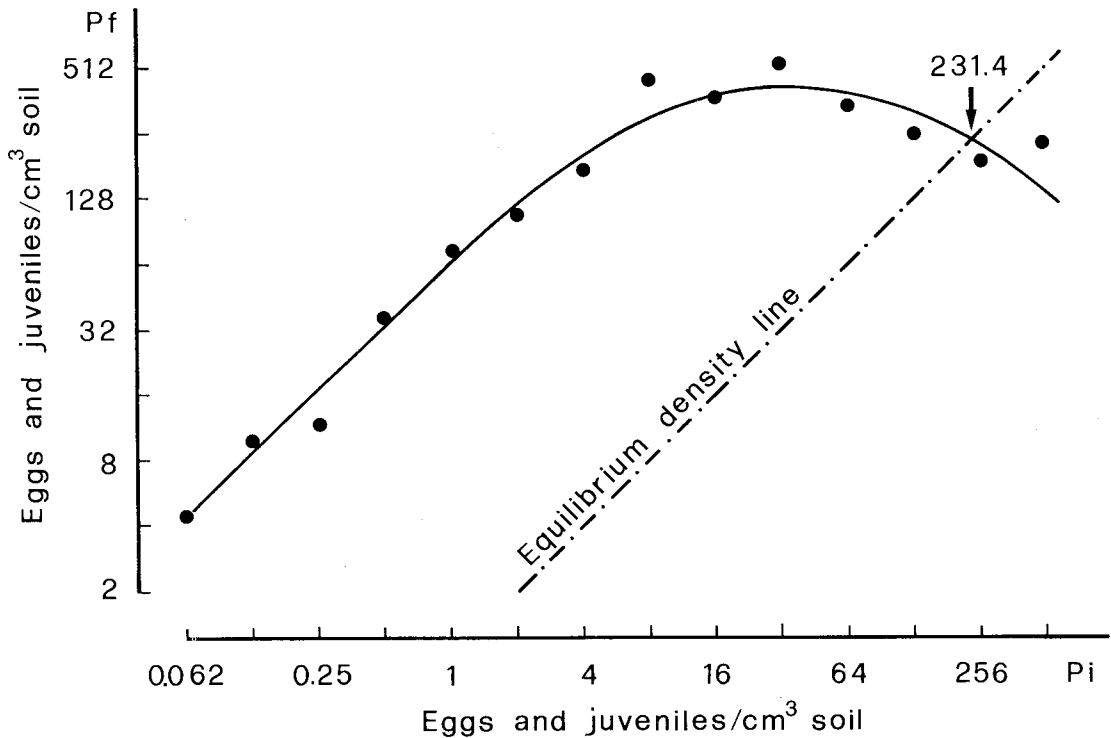

Fig. 3 - Relationship between initial (*Pi*) and final (*Pf*) population density of *Meloidogyne incognita* host race 1 on sunflower (cv. Romsun HS 301) grown (for 45 days) in pots in a glasshouse.

Literature cited

COOLEN W. A., 1979. Methods for the extraction of *Meloidogyne* spp. and other nematodes from roots and soil. *In*: Root-Knot Nematodes (*Meloidogyne* species) Systematics, Biology and Control. (F. Lamberti and C. E. Taylor eds), Academic Press, London, pp. 317-329.

DI VITO M., GRECO N. and CARELLA A., 1985. Population densities of *Meloidogyne incognita* and yield of *Capsicum annuum*. *J. Nematol.*, *17*: 45-49.

DI VITO M., GRECO N. and CARELLA A., 1986. Effect of *Meloidogyne incognita* and importance of the inoculum on the yield of eggplant. *J. Nematol.*, *18*: 487-490.

FAO, 1989. *Production Yearbook*, *43*: 160.

HUSSEY R. H. and BARKER K. R., 1973. A comparison of methods of collecting inocula of *Meloidogyne* spp. including a new technique. *Pl. Dis. Reptr.*, *57*: 1025-1028.

O'BANNON J. H., BOGE W. L. and PEADEN R. N., 1985. A comparison of NaOCl or water extraction on development and survival of *Meloidogyne chitwoodi* and *M. hapla* eggs at four temperatures (Abstr.). *J. Nematol.*, *17*: 508.

RICH J. R. and GREEN V. E., 1981. Influence of *Meloidogyne javanica* on growth and yield of oilseed sunflower. *Nematropica*, *11*: 11-16.

SEINHORST J. W., 1965. The relationship between nematode density and damage to plants. *Nematologica*, *11*: 137-154.

SEINHORST J. W., 1979. Nematode and growth of plants: formulation of the nematode-plant system. *In*: Root-knot Nematodes (*Meloidogyne* species) Systematic, Biology and Control. (F. Lamberti and C. E. Taylor, eds), Academic Press, London, pp. 231-256.

TAYLOR A. L. and SASSER J. N., 1978. Biology, Identification and Control of Root-knot Nematodes (*Meloidogyne* species), North Carolina State University Graphic, Raleigh NC (U.S.A.), pp. 111.

VRAIN T. C., 1977. A technique for collection of larvae of *Meloidogyne spp.* and a comparison of eggs and larvae as inocula. *J. Nematol.*, *9*: 249-251.