INFLUENCE OF *MELOIDOGYNE JAVANICA* ON GROWTH OF OLIVE CUTTINGS IN POTS

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RESUMEN

Sasanelli, N., D'Addabbo T., and R. M. Lemos. 2002. Influencia de *Meloidogyne javanica* sobre el crecimiento de plantas de olivo propagadas por estacas y cultivadas en potes. Nematrópica 32:59-63.

El efecto de incrementos de densidades de poblaciones (0, 0.0625, 0.125, 0.25, . . . 256 huevos y juveniles/cm^3 de suelo) de *Meloidogyne javanica* sobre el crecimiento del patron de olivo DA 12 I y el cultivar FS 17 se evaluó en condiciones de invernadero. Plantas de 10 meses de edad provenientes de estacas se transplantaron en potes de arcilla de 600 cm^3 de capacidad, los cuales contenían suelos infectados con diferentes densidades del inoculum. La presencia del nematodo redujo la longitud y número de nudos de los brotes de ambas selecciones de olivo. Los límites de tolerancia estimado para los tres parámetros de crecimiento fueron 0.49 huevos y juveniles/cm^3 de suelo para el patron DA 12 I y 0.61 (longitud de brotes y número de nudos) y 0.90 (diámetro del brote) huevos y juveniles/cm^3 de suelo para el cultivar FS 17. Las densidades de equilibrium de los nematodos fueron 17.2 y 14.5 huevos y juveniles/cm^3 de suelo para DA 12 I y FS 17, respectivamente. Los resultados de estos experimentos indican que el daño causado por el nematodo agallador de las raíces es un factor limitante para la producción de material de propagación de olivo de buena calidad en viveros carentes de buenas prácticas fitosanitarias.

Palabras claves: Limite de tolerancia, *Meloidogyne javanica*, nematodo nodulador de raices, patron, *Olea europaea*, olivo, patogenicidad.

One of the principal means by which plant parasitic nematodes of perennial crops and fruit trees are disseminated over great distances is by infected or contaminated propagative rootstocks. The majority of root-knot nematode (*Meloidogyne* spp.) infections on fruit tree plantations originate from unsanitized propagative material produced in uncertified nurseries (Lehman, 1994). Olive trees (*Olea europaea* L.) are damaged by root-knot nematodes (Inserra *et al.*, 1981; Lamberti and Baines, 1969; Abrantes *et al.*, 1992) and especially by *M. javanica* (Treub) Chitwood, which causes severe growth reduction of olive seedlings (Sasanelli *et al.*, 1997). The olive industry in the Mediterranean area has not implemented a rigorous nematode certification program for commercial olive tree nurseries, where unsanitary conditions often exist. Major nematode pests of olive trees have been detected for many years in propagative olive plant material in Italy and Spain, which are the leading olive-producing countries in the Mediterranean Basin (Vovlas *et al.*, 1975; Inserra and Vovlas, 1981; Castillo *et al.*, 1999). Olive propagative material is produced in clean media from tissue culture, cuttings, and seeds. However, this propagative material may become contaminated in the nurseries when it is transferred to soil media. Young olive plants grown in pots in nurseries are often damaged by root-knot nematodes. This damage is often overlooked by nurserymen and confused with nutrient deficiencies and other causes. In order to make olive tree nurserymen better aware of the damage that root-knot nematode infections can cause to young olive trees in the nursery, an experiment was conducted to determine the quantitative relationship between root-knot nema-

tode population densities in the soil and the consequent growth reduction of olive seedlings. The results of this experiment are reported in this publication.

Two olive selections were used for this test: the olive rootstock DA12-I, which is commonly used by the Italian olive tree industry, and the self-rooted selection FS 17, a good cultivar for production of olives with high oil content. Ten-month-old self rooted olive cuttings (Fontanazza, 1993) of the two olive selections were then individually transplanted in 600 cm^3 clay pots filled with steam sterilized sandy soil (pH 7.2; sand > 99%; silt < 1%; clay < 1% and organic matter = 0.75%). The root-knot nematode used was a population of *M. javanica* parasitizing tomato and olive trees in eastern Apulia, Italy. This population was cultured on tomato (*Lycopersicon esculentum* Mill.) cv. Rutgers for two months in a glasshouse at 25 ± 2°C. Nematode-infected tomato roots, with large egg masses, were finely chopped and the number of eggs and juveniles/g of roots was estimated by processing 10 root samples of 5 g each with 1% aqueous solution of sodium hypochlorite (Hussey and Barker, 1973). The roots were then thoroughly mixed with 4 Kg of steam sterilized sandy soil and the soil mixture used as inoculum. Appropriate amounts of the nematode inoculum were added to the soil of each pot and thoroughly mixed, to give a range of increasing population densities of 0, 0.0625, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64, 128 to 256 eggs and juveniles/cm^3 soil. The pots were arranged on benches in a glasshouse at 25 ± 2°C in a randomized block design with 10 replicates of each population density. Plants were pruned to leave only the main shoot, and shoot length, diameter at the insertion with the stem, and number of nodes were recorded.

The experiment was terminated 180 days after transplanting, when plants were uprooted. The percentage increase of main shoot length, diameter, and number of nodes was calculated with respect to their initial values at transplanting, to assess the effect of *M. javanica* on plant growth. Final nematode soil density in each pot was determined by processing 500 cm^3 soil by the Coolen's method (Coolen, 1979). *Meloidogyne javanica* density in roots was assessed by cutting up each root system into small pieces and further comminuting them in a blender, containing 1% aqueous solution of NaOCl for three periods of 20 sec (Marull and Pinochet, 1991). The water suspension was then sieved on a 250 µm pore sieve over a 5 µm pore sieve. Nematodes and root debris gathered on the 5 µm pore sieve were separated by centrifuging at 2,000 rpm for five min in a magnesium sulphate solution of 1.16 specific gravity. Eggs and juveniles in the water suspension were counted and final nematode population density (*Pf*) in each pot was determined by summing nematodes recovered from soil and roots.

Both olive selections were severely affected by the attack of *M. javanica*. Olive roots infected with the nematode were deformed by spheroidal or elongate galls, located at the root apex and along the root axis (Fig. 1). The effect of the nematode on the olive plants (yellowing and poor growth) became evident at population densities of 0.49 and 0.61 eggs and juveniles/cm^3 soil for DA 12 I and FS 17, respectively.

Data from the experiment were fitted by trial and error to the Seinhorst's equation (1965; 1979)

$$y = m + (1- m) z^{(P- T)} \qquad \text{(i)}$$

where y (relative plant growth) is the ratio between the values of plant growth parameters (percentage increase of shoot length, diameter and number of nodes) at a given

Fig. 1. Roots of olive cv. FS 17 infected by *Meloidogyne javanica*.

P and that at $P \leq T$, m = the minimum relative plant growth (y at very large P), z = a constant < 1, with $z^{-T} = 1.05$, P = initial population density, and T = the tolerance limit (P value below which no plant growth reduction is expected).

For DA 12 I a tolerance limit (T) of 0.49 eggs and juveniles/cm^3 soil was found for percentage increase of shoot length, diameter and number of nodes, whereas the minimum relative plant growth values (m) were 0.5 for the per cent increase of shoot length and number of nodes, and 0.6 for the percent increase of shoot diameter (Fig. 2A).

Tolerance limits for the cultivar FS 17 were 0.61 eggs and juveniles/cm^3 soil for percentage increase of shoot length and number of nodes and 0.90 eggs and juveniles/cm^3 soil for the per cent increase of shoot diameter. Values of m were 0.55 and 0.6 respectively (Fig. 2B).

Data for the relationship between initial (Pi) and final (Pf) *M. javanica* density (Fig. 3) agree with the Seinhorst's (1986) equation (9):

$$Pf = ay(-^e\log q)^{-1}\,(1-q^{Pi}) + s(1-x)Pi \quad \text{(ii)}$$

in which Pf and Pi are as above; a = maximum multiplication rate; q = a constant < 1; y = the ratio between the root weight at a given Pi and that in the absence of the nematode; s = the proportion of the eggs that do not hatch in the absence of the host roots and x = the proportion of eggs that hatch in the presence of host roots. The final population of *M. javanica* fits to the equation (ii) if it is assumed that $s = 0.1$ and $x = 1$. The maximum reproduction rates (Pf/Pi) were 285 and 103, for DA 12 I

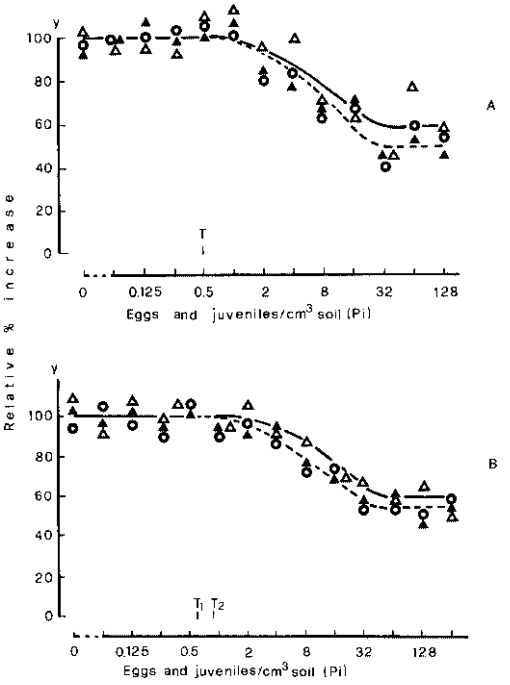

Fig. 2. Relationship between initial population density of *Meloidogyne javanica* and relative percentage growth increase of the olive rootstock DA 12 I (A) and cultivar FS 17 (B).

A) **o** = % increase of shoot length; ▲ = % increase of node number,
$y = 0.5 + 0.5 \times 0.905^{(P-T)}$, $T = 0.49$ eggs and juveniles/cm^3 soil;
Δ = % increase of shoot diameter, $y = 0.6 + 0.4 \times 0.905^{(P-T)}$, $T = 0.49$ eggs and juveniles/cm^3 soil;

B) **o** = % increase of shoot length; ▲ = % increase of node number,
$y = 0.55 + 0.45 \times 0.923^{(P-T)}$, $T = 0.61$ eggs and juveniles/cm^3 soil;
Δ = % increase of shoot diameter, $y = 0.6 + 0.4 \times 0.948^{(P-T)}$, $T = 0.91$ eggs and juveniles/cm^3 soil.

(Pi = 0.125 eggs and juveniles/cm^3 soil) and FS 17 (Pi = 0.0625 eggs and juveniles/cm^3 soil), respectively. Nematode reproduction rate decreased as Pi increased. An equilibrium density of the nematode of 17.2 (DA 12 I) and 14.5 (FS 17) eggs and juveniles/cm^3 soil was also estimated (Fig. 3A, B).

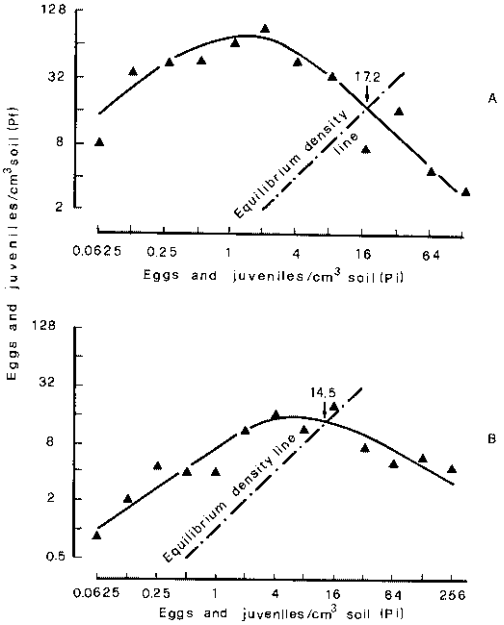

Fig. 3. Relationship between initial (*Pi*) and final (*Pf*) population density of *Meloidogyne javanica* on olive rootstock DA 12 I (A) and cultivar FS 17 (B).

This study confirmed the susceptibility of DA 12 I and FS 17 to *M. javanica* already observed in previous screening trials (Sasanelli *et al.*, 1997). The low tolerance limits found for the tested olive germplasm indicates that growth of young olive plant can be strongly suppressed in the presence of the nematode.

Values of T and m from the experiments may be useful for a quick estimation of possible plant growth reduction with the help of the Tables of Nematode-Pathogenicity (Sasanelli, 1994).

In conclusion, our data show that the adoption of good sanitation practices in olive tree nurseries is imperative to obtain good quality propagative material which is expected by national and international olive tree industries. The use of resistant olive rootstocks or cultivars may minimize the incidence of nematode infections in the nurseries, but may cause selection of

root-knot nematode populations capable of circumventing resistance if the plants are grown in conditions of poor sanitation.

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