Effects of *Heterodera fici* on the Growth of Commercial Fig Seedings in Pots

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Journal of Nematology 14(3):416-418. 1982.

The fig cyst nematode, *Heterodera fici* Kirjanova, is worldwide in distribution (2). In infested soil the nematode damage to fig (*Ficus carica* L.) is more evident in the seedling stage than on adult trees. Growth suppression of nematode infected ornamental fig (*F. elastica* Roxb.) seedlings compared to noninoculated controls was observed in glasshouse experiment (1). But no information is available on the effect of increasing nematode densities on the growth of commercial fig plants. This report attempts to fill this void. In several nurseries the commercial fig rootstocks are obtained by seeds as described in this experiment.

The experiment was made using clay pots containing 700 cm³ of steam pasteurized sandy loam soil. Cysts were extracted with a Fenwick can from soil of a heavily infested fig orchard at Barile (Potenza), Italy. The extracted cysts were incorporated into 2 liters of the pasteurized soil, and cysts and eggs in a 200-cm³ aliquot of soil were extracted (6) and their number determined (9). Portions of the remaining 1,800 cm³ of infested soil were mixed with the uninfested soil to obtain a range of initial population densities (P_i) of eggs and second-stage juveniles in a geometric progression.

Three pregerminated commercial fig seeds were planted in clay pots containing 700 cm³ of infested soil. Ten unseeded pots containing the fig orchard soil and infested with 10 eggs plus second-stage juveniles/cm³ of soil were included in the experiment

Received for publication 8 September 1981.

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to calculate the natural population decrease in the absence of the host plant. Pots were randomized on a glasshouse bench and plants were grown at 20–25 C. Each treatment (nematode density) was replicated 10 times. Twenty days after sowing, the plants were thinned to one seedling per pot. Plants were harvested 104 days after sowing, and fresh top weights were recorded. Terminal nematode population densities (P_f) were determined 40 days after harvesting the plant tops thus allowing a greater number of nematode females to become cysts. The soil from each pot was mixed thoroughly and the cysts extracted (6) and counted, and numbers of eggs plus second-stage juveniles were determined.

The relation between the fresh top weight of the fig seedlings and the number of nematodes at sowing is shown in Fig. 1. Fitting a curve according to the equation $y = m + (1\text{-}m)\ z^{\ P\text{-}T}$ (equation i) for $P \geq T$ and $y = 1$ for $P \leq T$ (the most probable relation between initial nematode density P and final relative plant weight y; [3,7,8]) with $z^{-T} = 1.05$ and m, the minimum yield $= 0$ (y for $P \geq 64$) suggests a value of tolerance limit $T = 0.15$ eggs and second-stage juveniles/cm³ soil (Fig. 1). Slightly smaller or larger values are about equally probable. Also m could have been slightly larger than 0, if the dying of the plants at the large initial nematode densities was due to Seinhorst's "second merchanism of growth reduction" (8). Three plants died at 8 nematodes/cm³, 6 at 16 nematodes, 9 at 32 nematodes, and all 10 at 64 nematodes and larger initial densities.

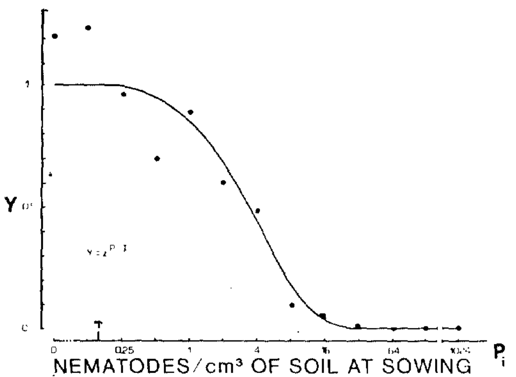

Fig. 1. Relation between initial population density (P_i) of *Heterodera fici* and fresh weight of the tops of commercial fig plants (y).

Figure 2 indicates the relation between the final (P_f) and the initial (P_i) nematode population densities. A curve according to the equation $P_f = [a\ x\ y\ (1 - a^{P}{}_{i}) \ / - lnq] + (1 - x + Sx - Sxy)\ P_i$ (eq. ii) was fitted to the observation (4,5). In equation ii, P_i and P_f are initial and final nematode population densities; a = maximum rate of multiplication; q = *a constant* < 1; x = the proportion of eggs that hatch in the presence of the host; S = the proportion of eggs which does not hatch in absence of the host; and y = relative yield. The first part of the curve (Fig. 2) suggests an a (maximum rate of multiplication) value of 12. The multiplication rates at high densities averaged about 0.91; at low initial densities they averaged about 9.

At the initial densities (P_i) from 16 to 1,024 the relative yield was 0 according to Fig. 1. Even if there had been some initial root growth, nematode multiplication would have contributed very little to the final population at $P_i \geq 32$. Fitting a curve according to $P_f = a(1\text{-}q^{P}{}_{i})/\text{-}lnq$ to observed $P_f\ /\ y$ (nematode density in the portion of the soil containing roots) at $P_i \leq 4$ nematodes/cm³ soil suggests a maximum P_f in soil with roots of 21 nematodes/cm³, therefore, an average of 1 nematodes/cm³ if 5% of the soil contained nematodes. The average ratioP_f/P_i at initial densities ≥ 32 nematodes/cm³, 0.91, is therefore a measure of the survival in the absence of host roots, which, however, it might underestimate

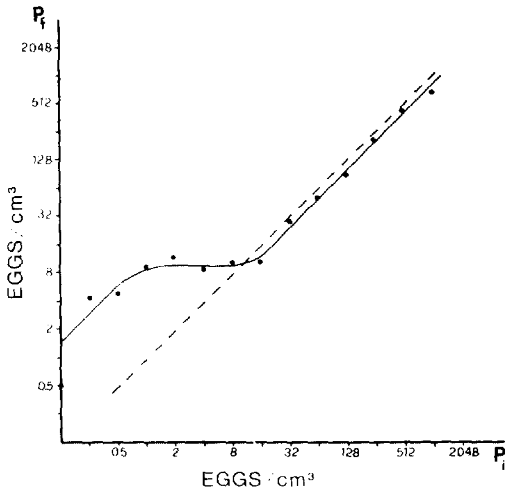

Fig. 2. Relation between initial (P_i) and final (P_f) population of *Heterodera fici*.

slightly. Some hatching induced by host roots shortly after the beginning of the experiment may have occured. This survival was 0.96 in pots with infested soil but without roots. The two figures are not significantly different.

The data do not allow estimation of x. To calculate a curve for the relation between P_f and P_i at P > 16 nematodes/cm^3 soil x can be assumed to be unity. This reduces the second term of the right hand part of equation ii to $S(1\text{-}y)P_i$.

The *H. fici* densities determined in field samples are smaller than real densities because eggs in eggs sacs are usually ignored. Also in this experiment this portion of eggs was not taken in account. Therefore advice on control should be based on a smaller value of T than that derived from the result of the pot experiment.

The very low value of minimum yield, m = 0, depends upon the very small seedlings used in the experiment. Braasch (1) reports that in ornamental fig the *H. fici* damage was higher in small seedlings than in older plants. The value of m will undoubtedly increase with the plant age (7).

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