RELATIONSHIP BETWEEN INITIAL POPULATION DENSITIES OF *MELOIDOGYNE JAVANICA* AND DAMAGE TO PEPPER AND TOMATO IN ETHIOPIA

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Summary. Pot experiments were conducted in glasshouse to ascertain the damage potential of an Ethiopian population of *Meloidogyne javanica* on tomato and pepper. Tomato cv. Marglobe and pepper cv. Marekofana seedlings were planted in 500 cm^3 soil in pots and inoculated with initial population levels (*Pi*) of 0, 1, 2, 4, 8 or 16 second stage juveniles/cm^3 soil according to a completely randomized design. Nematode population densities were negatively correlated with tomato and pepper growth while root galling increased with the increase of the inoculum level of the nematode. Seinhorst's model fitted the data for tomato (r^2 = 0.96) and pepper (r^2 = 0.94) and tolerance limits (*T*) of 0.28 and 0.36 juveniles/cm^3 soil, respectively, were estimated. The minimum yield (*m*) was 0.4 for both plant species.

In Ethiopia, vegetable crops are widely cultivated in both the rainy and dry seasons, on farms that range in size from small to large. Tomato, pepper, and shallot/onion predominate and represent the most profitable crops on small-scale farms (Lemma *et al.*, 1992). Unfortunately, root-knot nematodes (*Meloidogyne incognita, M. javanica and M. ethiopica*) are widespread in the country and often dramatically reduce the yield of these vegetables (Mandefro and Mekete, 2002). Nevertheless, no information was available on the effect of Ethiopian populations of these nematodes on the growth of the major tomato and pepper cultivars. Therefore, two experiments were undertaken to ascertain the damage potential of increasing population densities of *M. javanica* on the growth of the mentioned crops and the suitability of the Senhorst's model (Seinhorst, 1965, 1986) to fit the data.

MATERIALS AND METHODS

Two nematode populations were obtained from infected tomato [(*Lycopersicon esculentum* (L.) Karsten *et* Farw] and pepper (*Capsicum annuum* L.) plants from Ziway, Ethiopia. They were identified as *M. javanica* (Treub) Chitw. on the basis of perineal pattern observations. The nematodes were maintained separately on susceptible tomato 'Rutgers' in the greenhouse at the National Plant Protection Research Center, Ambo, Ethiopia.

To obtain a pure population, a single egg mass was isolated from each nematode population and increased on susceptible tomato 'Rutgers' by making successive re-inoculations. When sufficient well-infested tomato roots were available, these were gently washed in tap water and put on Baermann funnels to collect second stage juveniles emerging from egg masses. Juveniles were collected after seven days and checked for their viability before use.

Plastic pots of 500 cm^3 were filled with a mixture of sterilized soil, sand and organic matter, in the ratios 2:1:1 respectively. Pots were arranged according to a completely randomised design, comprising eight replicates, on benches in a glasshouse maintained at 25-30 °C. A one-month-old seedling of either tomato (cv. Marglobe) or pepper (cv. Marekofana) was transplanted into each pot (both of these cultivars are widely grown) . The nematode population densities tested were 0, 1, 2, 4, 8 and 16 second stage juveniles/cm^3 of soil. The nematodes were added in four 3-cm-deep holes made around the seedlings and the pots were lightly watered. Pots were subsequently watered daily in the morning.

After 60 days, plants were uprooted, fresh shoot weights were recorded and root-knot index was rated according to a 0-5 scale. In this scale 0 = no galls, 1= 1-10% of the root system galled, 2 = 11-35% of the root system galled, 3 = 36-65% of the root system galled, 4 = 66-90% of the root system galled, and 5 = 91-100% of the root system galled (Mekete, 2000). A statistical analysis was done to assess the degree of correlation between root galling index and inoculum levels.

To relate nematode densities and plant growth, Seinhorst's model $y = m + (1 - m)z^{P-T}$ (Seinhorst, 1965, 1986) was fitted to the data. In this model y is the relative yield (the ratio between the yield at a given Pi and the average yield at $Pi \leq T$) , with $y = 1$ at $P \leq T$), m is the minimum relative yield (the value of y at very large Pi), P (= Pi) is the nematode population density at transplanting, and z is a constant < 1 with $z^{-T} = 1.05$.

RESULTS AND DISCUSSION

The growth of both tomato and pepper was negatively affected by *M. javanica*. Analysis of variance for the

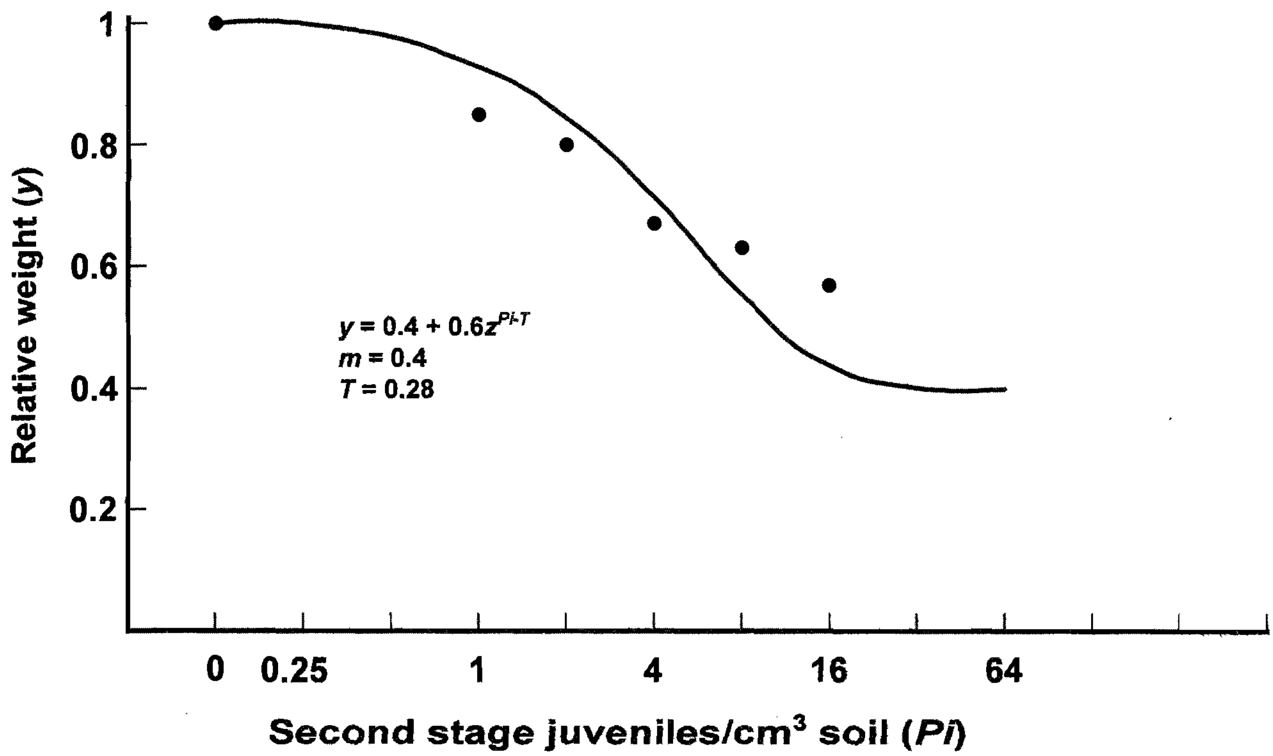

Fig. 1. Relationship between initial population densities of *Meloidogyne javanica* and fresh weight of tomato.

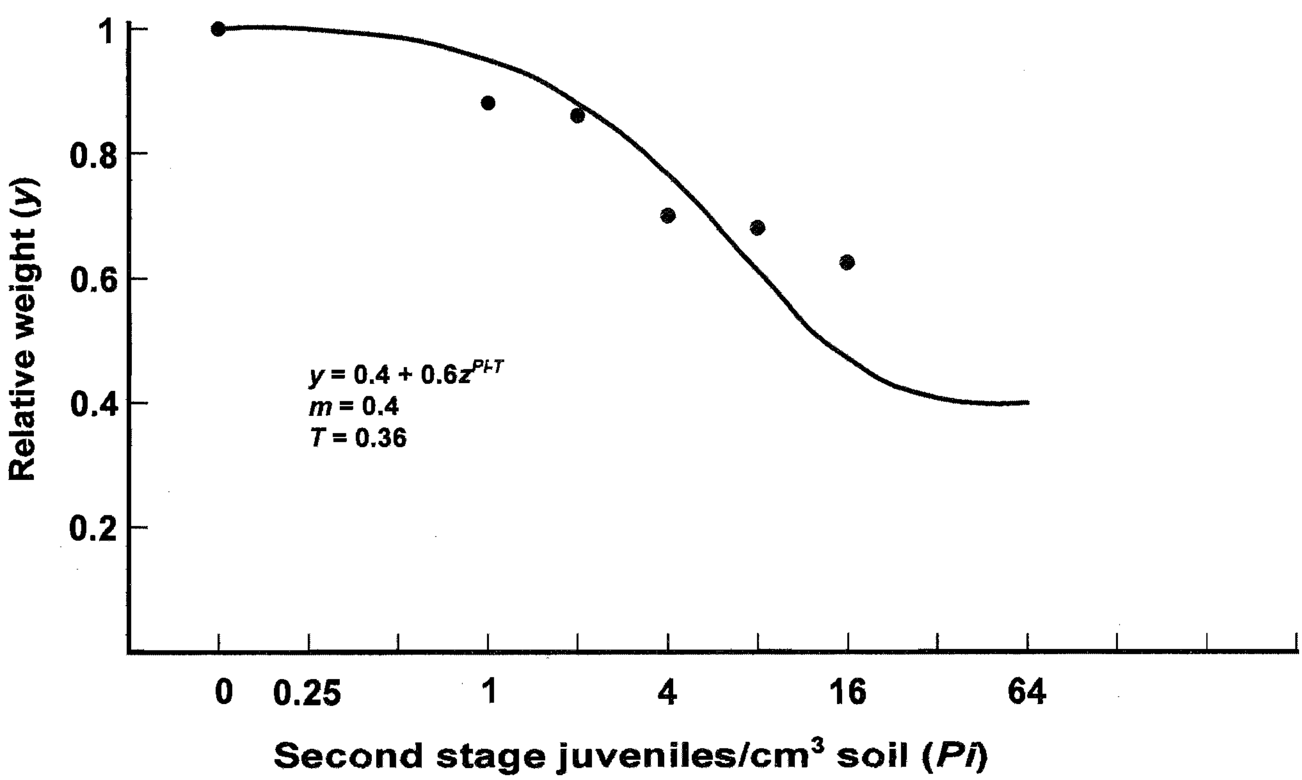

Fig. 2. Relationship between initial population densities of *M. javanica* and fresh weight of pepper.

effect of *M. javanica* on fresh weight of both crop plants showed significant (P = 0.05) differense due to inoculum level. Also, the fresh weight data fitted Seinhorst's model (Figs 1 and 2) with r^2 values of 0.96 and 0.94, respectively. According to this model the tolerance limit (*T*) of tomato to the nematode was of 0.28 second stage juvenile/cm^3 soil with an estimated minimum yield (*m*) of 0.4 at 32 nematode juveniles/cm^3 soil. The minimum yield of pepper was the same as that of tomato but the tolerance limit was larger, 0.36 juvenile/cm^3 soil, indicating that this plant species is slightly less susceptible than tomato to the Ethiopian population of *M. javanica*.

Root galling severity increased with the increase of inoculum level of *M. javanica* on both tomato and pepper (Figs 3 and 4), thus confirming the high damage potential of the nematode and its reproduction capacity on both crop plants. However, root galling was more severe on tomato than on pepper as the maximum index rates at *Pi* = 16 juveniles/cm^3 soil were 4.5 and 4, respectively.

Damage caused by low population densities of *M. javanica* has also been observed by other authors on different crop plants. Barker *et al.* (1985) reported damages by *M. javanica* to peach, soybean and tobacco at *Pi* as low as 50-100, 30-100 and 90-100 eggs and juveniles/100 cm^3 soil, respectively. Less than 0.2 juvenile/100 gram of soil were considered as the tolerance limit to *M. javanica* of both susceptible and resistant tomato (Barker and Olthof, 1976). Similar results were obtained by other authors with *M. incognita*. Di Vito *et al.* (1985, 1991) reported a tolerance limit of pepper to this root-knot nematode of 0.16 egg and juvenile/cm^3 soil and one of 0.55 egg and juvenile/cm^3 soil for susceptible and resistant tomato cultivars. However, the minimum yield observed by these authors (0 for tomato and 0.2 for pepper) were lower than those in our experiments. Differences in root-knot nematode species and population, pot and microplot size, plant species and cultivar, the way of collecting and using the inoculum, and environmental conditions may account for differences in tolerance limits and minimum yields observed by independent investigators. In any case, tolerance limits were rather low and at a level difficult to define. Nevertheless, we feel that our results can be useful to advisory services for the management of *M. javanica* on vegetable crops in Ethiopia.

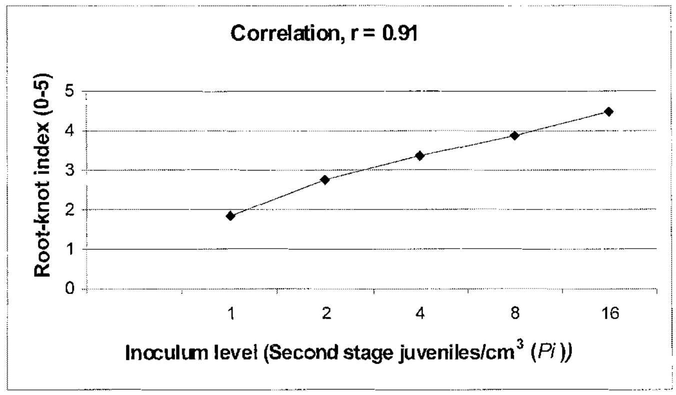

Fig. 3. Correlation between inoculum level of *M. javanica* and galling index of tomato roots.

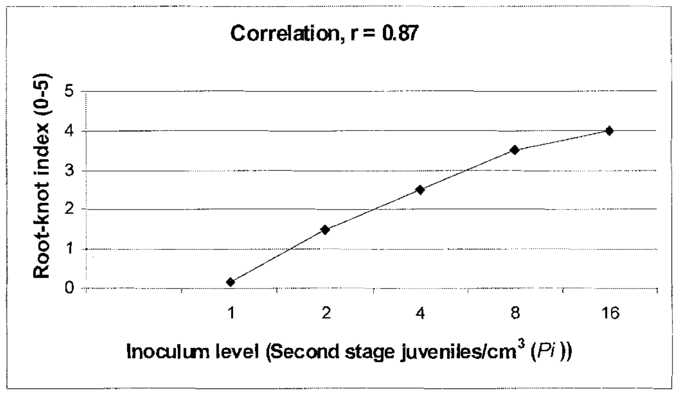

Fig. 4. Correlation between inoculum level of *M. javanica* and galling index of pepper roots.

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