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

T. Mekete¹, W. Mandefro¹ and N. Greco²

¹ EARO, National Plant Protection Research Center, P.O. Box 37, Ambo, Ethiopia
² C.N.R., Istituto per la Protezione delle Pianta, Sezione di Bari, Via G. Amendola 165/A, 70126 Bari, Italy

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 cm³ soil in pots and inoculated with initial population levels (P_i) of 0, 1, 2, 4, 8 or 16 second stage juveniles/cm³ 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 (r² = 0.96) and pepper (r² = 0.94) and tolerance limits (T) of 0.28 and 0.36 juveniles/cm³ 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 Seinhorst’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 cm³ 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/cm³ 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)z²T (Seinhorst, 1965, 1986) was fitted to the data. In this model y is the relative yield (the ratio between the yield at a given P_i and the average yield at P = T), m is the minimum relative yield (the value of y at very large P_i), P (P_i) is the nematode population density at transplanting, and z is a constant < 1 with 1/z²T = 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) difference due to inoculum level. Also, the fresh weight data fitted Seinhorst’s model (Figs 1 and 2) with r² 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/cm³ soil with an estimated minimum yield (m) of 0.4 at 32 nematode juveniles/cm³ soil. The minimum yield of pepper was the same as that of tomato but the tolerance limit was larger, 0.36 juvenile/cm³ 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/cm³ 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 cm³ 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/cm³ soil and one of 0.55 egg and juvenile/cm³ 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.

LITERATURE CITED
