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EFFECT OF *GLOBODERA ROSTOCHIENSIS* ON THE YIELD OF POTATO IN VENEZUELA

by
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Summary. The relationship between initial densities (*Pi*) of *Globodera rostochiensis* pathotype Ro2 and yield of the susceptible potato cultivar Andinita was investigated in 30 dm^3 microplots at Cubiro, Lara State. *Pi* used were 0, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64, 128 or 256 eggs/cm^3 soil. Yield response to *Pi* fitted the model $y=m+(1-m)z^{Pi-T}$; in which y is the relative yield, m is the minimum relative yield and T is the tolerance limit. A tolerance limit of the potato cultivar Andinita to *G. rostochiensis* of 1.5 eggs/cm^3 soil was derived with the model. Maximum yield suppression was 73% and occurred at Pi=256 eggs/cm^3 soil. Maximum nematode reproduction was 20-fold and occurred at Pi=0.25 eggs/cm^3 soil. Nematode equilibrium density was 40 eggs/cm^3 soil.

The potato cyst nematode, *Globodera rostochiensis* is found in most of the potato growing regions of the world (Turner and Evans, 1998). In Venezuela the nematode is distributed in the Andean and Lara States (Greco and Crozzoli, 1995), but information on yield of potato in those areas as affected by a range of population densities of this cyst nematode is lacking. Therefore, an investigation was conducted in microplots to determine the effect of increasing densities of a population of *G. rostochiensis* from the Lara State on the growth of potato and on the dynamics of the nematode.

Materials and methods

The experiment was conducted in Agua Negra (1200 m asl), near Cubiro (Lara State). One hundred and four microplots made of transparent plastic tubes, 30 cm diam. x 42.5 cm deep, were buried into the soil leaving a rim of 5 cm exposed. Each microplot was filled with 30 dm^3 of soil (sand 54.1%, silt 25.6%, clay 20.3%, organic matter 5.4%, pH 4.8). Nematodes (*G. rostochiensis* Woll.) were obtained from field infested soil. This soil was mixed and the nematode populations densities estimated. Then appropriate amounts of it were thoroughly mixed with that of each microplot to obtain population densities of 0, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64, 128 and 256 eggs/cm^3 soil. Microplots were arranged according to a randomised block design comprising eight replicates per nematode density. One potato tuber (*Solanum tuberosum* L.) (cv. Andinita) was planted in each microplot on 29 November 1997. The microplots received routine cultural practices and plant heights were recorded every 20 days. The tuber yield in each microplot was weighed at harvest on 10 March 1998. A 1.5-2 dm^3 soil sample, composed of 10 cores, was collected from each microplot soon

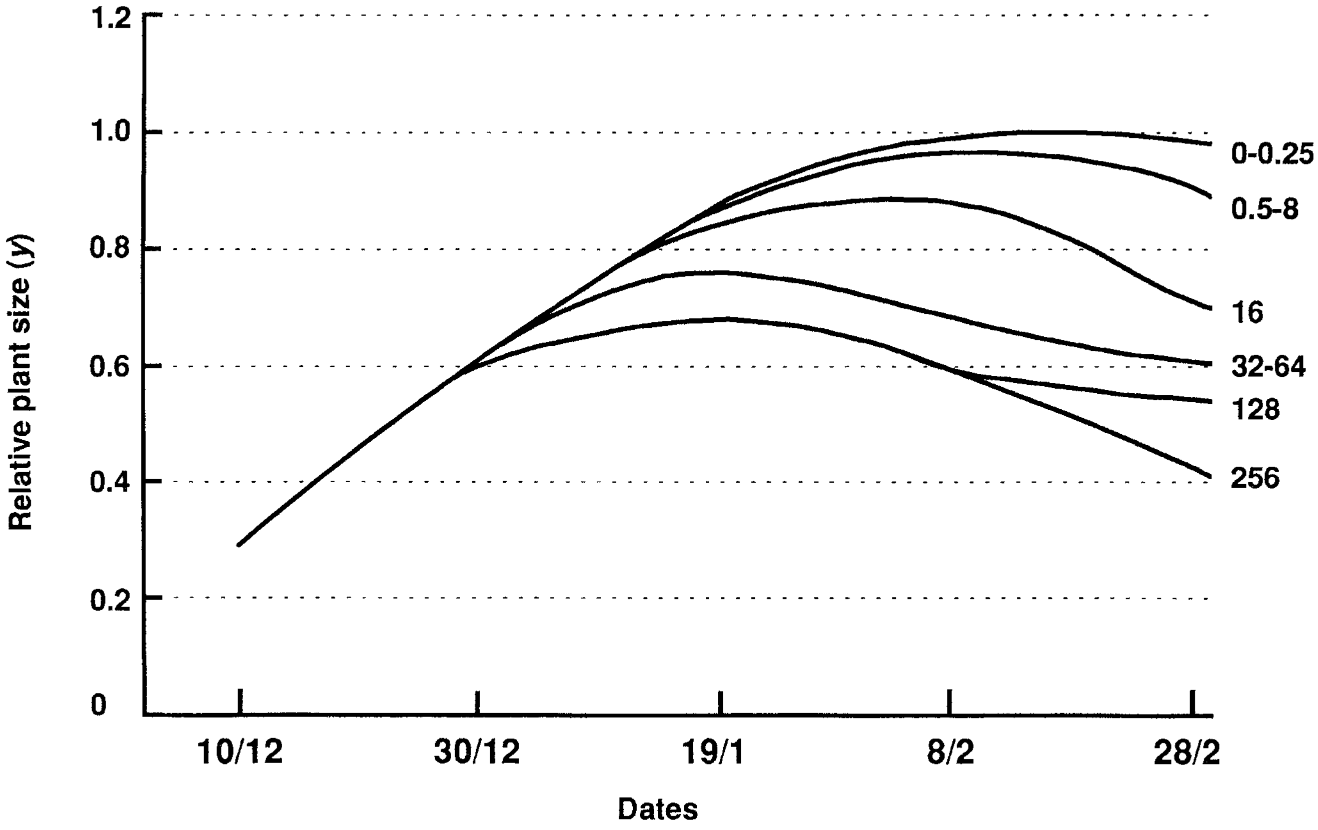

Fig. 1 - Growth curves of potato cv. Andinita sown in microplots, derived from relative plant heights from 10 December 1997 until 28 February 1998, as affected by a range of initial population densities of *Globodera rostochiensis* (expressed in eggs/cm^3 of soil at the end of each curve).

after crop harvest. The soil was air dried and the cysts were extracted from a 200 cm^3 sub-sample per pot using a Fenwick can. Cysts were then crushed and their eggs counted to determine final population densities of the nematode (s'Jacob and van Bezooijen, 1971).

Data on plant height were used to construct growth curves of the potato as affected by different population densities of the nematode. In these curves each point is the rate between the average plant height of potato at given nematode densities, as measured at different observation dates, and the average plant height at harvest of potato in pots not exposed to the nematode.

Data on tuber yield were fitted by Seinhorst's model (Seinhorst, 1965; 1986) $y = m+(1-m)z^{Pi-T}$ (equation 1) where y=the relative yield (the ratio between the yield at a given Pi and that at $Pi \leq T$), with $y=1$ for $Pi \leq T$, m=the minimum relative yield (y at very large Pi), Pi=population density of the nematode at sowing (in eggs/cm^3 soil), T=the tolerance limit (Pi above which yield loss occurs) and z=a constant with $z^{-T}=1.05$.

Data on egg populations at harvest (Pf) were fitted by Seinhorst's nematode population model (Seinhorst 1970; 1982), $Pf= axy(-{}^{e}\log q)^{-1}(1-qPi)+(1-x)Pi+sx(1-y)Pi$ (equation 2), in which a= maximum reproduction rate of the nematode; x=the proportion of nematode eggs that would hatch in the presence of a host assuming that it was not damaged by the nematode, $y=y$ from equation 1, s=the proportion of eggs that did not hatch in the absence of a host, $Pi=Pi$ in equation 1, and q=a constant <1.

Results and discussion

Inoculum levels did not influence plant emergence. However, symptoms of nematode infection (stunting and yellowing) appeared earlier in microplots with larger population densities. Growth curves based on plant height indicated that as early as 30 December, plant growth was suppressed in microplots infested with≥32 eggs/cm³ soil (Fig. 1). Twenty days later growth suppression was also obvious in microplots with 16 eggs/cm³ soil, but it was minimal up to the time of harvest of tubers in microplots with smaller population densities. Generally the growth reduction of potato plants was obvious 40-50 days after plant emergence only in microplots with≥32 eggs/cm³ soil. Thus, farmers are probably unaware of yield losses of potato that occur in most of the infested fields. The leaf symptoms associated with nematode attack, which appear late in the season, are commonly attributed to environmental stresses. Yellowing and senescence of plants in mid-season can also be misinterpreted as being a normal characteristic of an early maturing potato cultivar. Therefore, the best way to predict yield losses associated with *G. rostochiensis* is by determining the nematode population density in the soil before planting, rather than by visual observation of leaf symptoms and plant growth (Greco and Moreno, 1992).

A damage threshold (*T*) of potato to *G. rostochiensis* of 1.5 eggs/cm³ soil was derived from fitting tuber yields to the Seinhorst model (Fig. 2). At population densities greater than *T*, yield was greatly suppressed by the nematode and

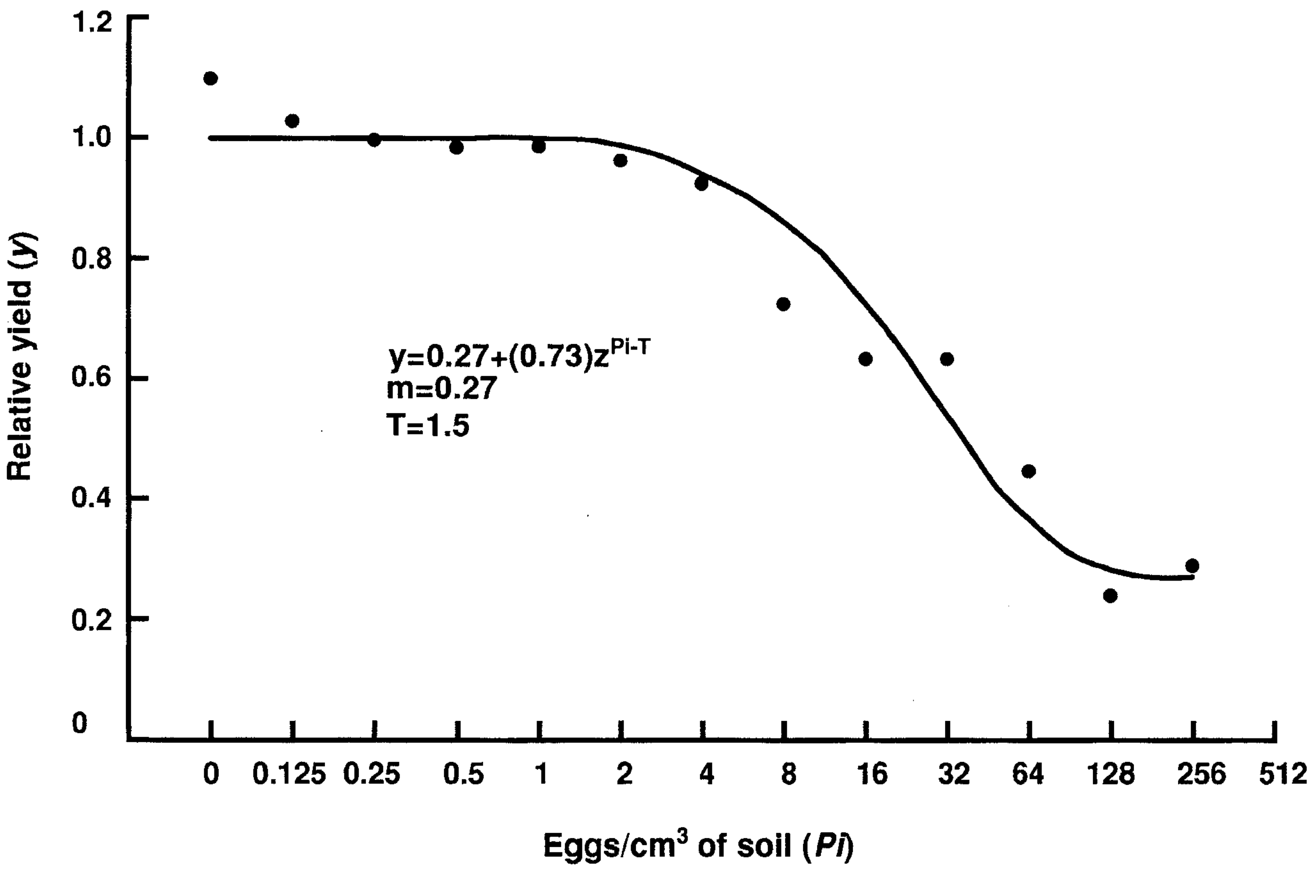

Fig. 2 - Effect of initial population density (*Pi*) of *G. rostochiensis* on relative tuber yield (*y*) of potato cv. Andinita.

reductions in yield of 30, 50 and 73% occurred in microplots infested with 16, 32 and 256 eggs/cm^3 soil, respectively (Fig. 2). The lowest relative yield was 0.27 for tuber weight and occurred in microplots infested with≥256 eggs/cm^3 soil.

Nematode populations densities increased only in microplots with *Pi*≥32 eggs/cm^3 soil. At larger *Pi* only a small proportion of nematodes reproduced, while most of the *Pf* seems to originate from *Pi* which appears as a constant proportion<1. In fact this was 0.6 at *Pi*=64, stet 0.5 at Pi=128 and Pi=256 eggs/cm^3 soil. This is probably due to the great growth reduction caused by *Pi*≥64 eggs/cm^3 soil which provided sufficient food for only a small proportion of the nematodes. The maximum reproduction rate of the nematode was 20-fold and occurred at *Pi*=0.25 eggs/cm^3 soil, while the equilibrium density was 40 eggs/cm^3 soil (Fig. 3).

These results provide useful information on the impact of *G. rostochiensis* on the yield of potato in Lara State. The tolerance limit, minimum yield and nematode equilibrium density are similar to those reported in central Chile in summer potatoes (Greco and Moreno, 1992), in Italy (Greco *et al.*, 1982) and in The Netherlands (Seinhorst, 1982). However, in this experiment the reproduction rate of the nematode (20 fold) was much less than that reported in Italy (58-65 fold) (Greco *et al.*, 1982) and in the spring potato in Chile (39 fold) (Greco and Moreno, 1992) but larger than that occurring on crops harvested from early to late winter (8-9 fold) in Chile. Differences in environmental conditions, length of the potato growth cycle

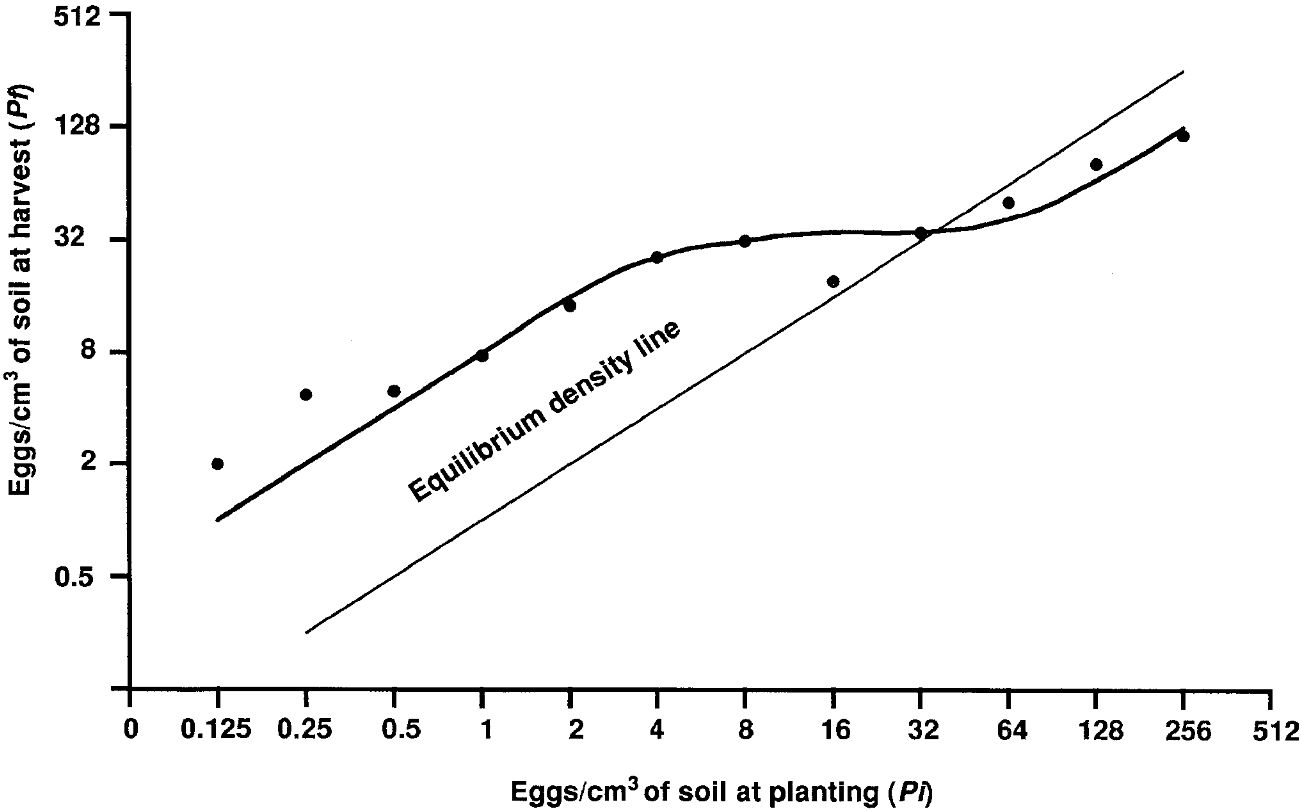

Fig. 3 - Relationship between at planting (*Pi*) and at harvest (*Pf*) population densities of *G. rostochiensis* on potato cv. Andinita in microplots in Lara State.

and different cultivars may account for differences in the reproduction rates of the nematode. Whether these differences in the reproduction rate of the nematode would affect the length of the crop rotation required to reduce the population of *G. rostochiensis* to levels not damaging to potato in Venezuela is not known. Therefore, it is necessary to complement these studies with others to ascertain the decline of the nematode population in the absence of the host plant in that country.

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