EFFECT OF *ROTYLENCHULUS RENIFORMIS* ON YIELD OF COWPEA IN POTS

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Summary. The relationship between a geometric series of ten initial densities (*Pi*) of *Rotylenchulus reniformis*, (mixtures of eggs, juveniles and immature females) from 0 to 64/cm^3 soil, and growth of cowpea (*Vigna unguiculata*) cv. Blackeye was investigated in two-litre clay pots. Fitting the Seinhorst model, $y = m + (1\text{-}m)z^{Pi-T}$, to average weight of seeds produced gave a tolerance limit (*T*) to the nematode of 0.12 eggs, juveniles and immature females/cm^3 soil. Minimum relative yields (*m*) for weight of seeds produced was 0.65 at $Pi \geq 16$ nematodes/cm^3. The maximum rate of nematode reproduction was 32.2-fold and occurred at the lowest initial population density. The highest final population density (*Pf*) of the nematode was 10.3 eggs + juveniles + immature females and eggs/cm^3 soil and occurred at *Pi* = 1 juvenile + young female/cm^3 soil.

Many studies have been conducted to estimate the economic impact of *Rotylenchulus reniformis* Linford *et* Oliveira on various crops. In these studies, nematode damage has been observed at initial population levels ranging from 0.1 to 5 nematodes/cm^3 soil (Gaur and Perry, 1991; Robinson *et al.*, 1997). Chickpea (*Cicer arietinum* L.), pigeonpea [*Cajanus cajan* (L.) Mill.], soybean [*Glycine max* (L.) Merr.] and many *Phaseolus* species are the leguminous crops most adversely affected by *R. reniformis* (Sikora and Greco, 1990). Cowpea [*Vigna unguiculata* (L.) Walp.] is a good host for the reniform nematode in several parts of the world, including Venezuela (Crozzoli, 2002). Damage to cowpea is particularly serious in India, where the use of nematode resistant varieties is recommended to minimize nematode damage (Gupta and Yadav, 1980; Khan and Husain, 1988, 1998). However, little information exists on yield suppression of cowpea caused by increasing densities of *R. reniformis*. Therefore, an experiment was conducted to relate population densities of *R. reniformis* with yield of cowpea in pots.

MATERIALS AND METHODS

The experiment was conducted in a screen-house in Maracay, Aragua State, Venezuela. A Venezuelan population of *R. reniformis* was obtained from pigeon pea and maintained on cowpea cv. Bayo. The inoculum for the experiment was collected by macerating infected cowpea roots in water with a blender, for 120 seconds. Nematode motile stages and eggs were recovered by sieving the suspension through 1.4-mm-pore, 45-μm-pore and 10-μm-pore sieves. Pre-germinated seeds of cowpea cv. Blackeye were planted singly in 17-cm-diameter plastic pots containing 2,000 cm^3 of steam-pasteurized soil (sand 60.8%, silt 34%, clay 5.2%, organic matter 6.8%, pH 7.2). Three days later, the soil was infested with initial population densities (*Pi*) of 0, 0.25, 0.5, 1, 2, 4, 8, 16, 32 or 64 eggs + juveniles + young females/cm^3 of soil. The nematodes were introduced into the soil by pouring an aqueous suspension of inoculum into five holes, 4 cm deep, around the seedling in each pot. The treatments were randomised in six replicates on a screen-house bench. Plants were fertilized with 200 ml/pot of a nutrient solution (2 g/l 15-15-15, NPK) every 15 days. The pots were irrigated as required. Ambient temperature during the experiment was in the range 24-28 °C.

Plants were harvested 70 days after inoculation. Seeds from plants in each pot were removed from the desiccated pods and their weight recorded. To determine the final nematode density (*Pf*), motile nematodes and eggs were extracted from the root systems by maceration and sieving as described above. Eggs were collected from a 10-μm-pore sieve nested with a 45-μm-pore sieve onto. Soil nematode densities were assessed by soil elutriation (s'Jacob and Van Bezooijen, 1971). The *Pf* value was calculated as the total of nematode motile stages and eggs from soil and roots.

A curve was fitted to the relationship between cowpea seed weights and nematode density by visually comparison with graphs previously generated to the equation $y = m + (1\text{-}m)z^{Pi-T}$, proposed by Seinhorst (1965, 1986). In this equation, *y* is the relative yield (the ratio between the average of the growth parameter considered at *Pi* and that at $Pi \leq T$), *m* is the minimum relative yield (the value of *y* at the largest *Pi*), *Pi* is the nematode populations density at sowing, *T* is the tolerance limit (the magnitude of *Pi* above which yield reduction begins to occur), and *z* is a constant <1 with $z^T = 1.05$.

RESULTS AND DISCUSSION

The tolerance limit (*T*) of cowpea cv. Blackeye in terms of seed weight to *R. reniformis* was 0.12 eggs + juveniles + young females/cm^3 soil (Fig. 1). Maximum yield suppression (*m*) was 35% and occurred at $Pi \geq 16$ eggs + juveniles + young females/cm^3 soil (Fig. 1).

Nematode reproduction was observed at all initial population levels and was greater at smaller than at larger values of *Pi*. The maximum rate of nematode population increase was 32.2-fold and occurred at the lowest initial population density ($Pi = 0.25$ eggs + juveniles + young females/cm^3 soil) (Table I). The highest final population density (*Pf*) of the nematode was 10.3 eggs + juveniles + immature females and eggs/cm^3 soil and occurred at $Pi = 1$ eggs + juveniles + young females/cm^3 soil.

The results of this experiment confirm the ability of the reniform nematode to damage cowpea. In a pot experiment, Gupta and Yadav (1980) reported 42 and 51% suppression of the fresh shoot and root weights, respectively, at a *Pi* of 2 juveniles/cm^3 of soil. This same initial population level induced 20% yield losses in our experiment (Fig. 1). However, in plot experiments conducted in south Florida, similar initial reniform nematode population densities caused only 5% yield losses to snap beans. At 9 *R. reniformis*/cm^3 of soil, which was the largest population level occurring in the Florida field, snap bean damage did not exceed 25% (McSorley, 1980; McSorley *et al.*, 1981; Robinson *et al.*, 1997).

The different effect of the reniform nematode observed on the yield of cowpea to that on snap bean that we observed in these experiments was probably due to different experimental procedures. However, damage levels measured in pots can differ from those observed under field conditions, because in field plantings many factors present in the soil can increase or suppress nematode damage.

It is worthy mentioning that the maximum yield suppression measured in our experiment (35%) was greater than that (20%) caused in a similar experiment by the southern root-knot nematodes (*Meloidogyne incognita*) on the same cowpea cv. Blackeye, which is resistant to the southern root-knot nematode (Crozzoli, *et al.*, 1999). However, in field observations conducted in Florida, high population levels of the reniform nematode were less destructive to snap bean than were root-knot nematodes (*Meloidogyne* spp.) (McSorley, 1980; McSorley *et al.*, 1981). The crop losses (20%) observed in our pot experiment at 2 reniform nematodes/cm^3 of soil, a population level commonly found under field conditions in Venezuela, have potential to have an adverse economic impact on cowpea growers in the country. However, the damage level observed in our pot experiment needs to be verified by additional experiments under microplots and field conditions.

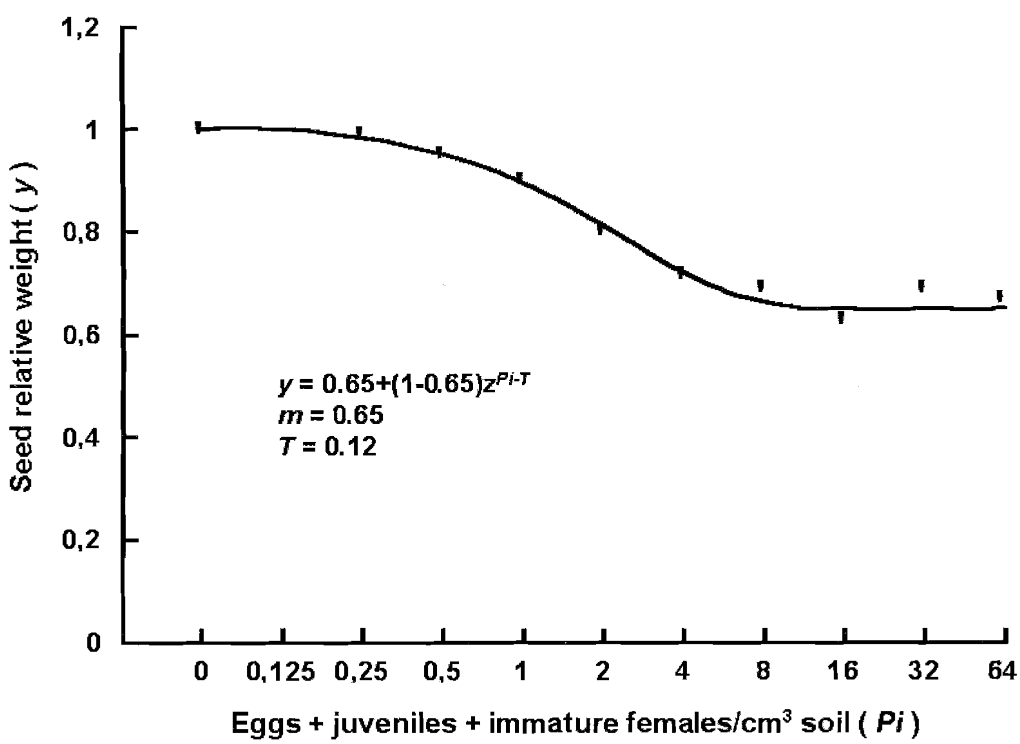

Fig. 1. Relationship between initial population density (*Pi*) of *Rotylenchulus reniformis* and relative seed weight of cowpea cv. Blackeye (*y*), 70 days after sowing.

Table I. Effect of initial population densities (*Pi*) of *Rotylenchulus reniformis* on final population densities (*Pf*) of the nematode on cowpea plants grown in plastic pots, 70 days after sowing.

Eggs+juveniles+ immature females/cm^3 soil before sowing (*Pi*)	Eggs+juveniles+ immature females/total roots at harvest	Juveniles+ immature females/ 2000 cm^3 soil	Total nematode stages/pot at harvest (*Pf*)	*Pf/Pi*
0.25	1,300	14,190	15,490	32.2
0.5	1,280	14,800	16,080	16.1
1	1,440	19,100	20,540	10.3
2	1,360	13,340	14,700	3.7
4	1,100	11,580	12,680	1.6
8	660	8,020	8,680	0.5
16	680	7,200	7,880	0.3
32	100	8,140	8,240	0.1
64	60	6,980	7,040	0.06

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