RESEARCH NOTES

Journal of Nematology 16(4):393–395. 1984.

Influence of *Nacobbus aberrans* Densities on Growth of Sugarbeet and Kochia in Pots[1]

R. N. Inserra,[2] M. di Vito,[3] and H. Ferris[4]

Key words: false root-knot nematode, *Beta vulgaris*, *Kochia scoparia*, modeling, tolerance, reproduction.

Among the physiological races of *Nacobbus aberrans* Thorne and Allen, only the "sugarbeet" race is present in the United States (5). This race reproduces on kochia (*Kochia scoparia* (L.) Schrad.), tomato (*Lycopersicon esculentum* Mill.), and sugarbeet (*Beta vulgaris* L.) but not on pepper (*Capsicum annuum* L.) and potato (*Solanum tuberosum* L. and *S. tuberosum* subsp. *andigena* Jus. and Buk.) (5). Kochia is an annual weed in cultivated and waste lands of the northern central and western United States. Suppression of sugarbeet plant weight ranged from 75 to 27%, compared with noninoculated controls, 30 and 60 days after single inoculations with 12 *N. aberrans* "subarbeet" race second-stage juveniles (J2)/cm^3 soil (6). Damage to pepper and tomato seedlings grown in soil infested with increasing densities (from 0.125 to 12 eggs/cm^3 soil) of another race of *N. aberrans* was reported in Mexico (8,9). However, little information exists on yield suppression of sugarbeet and other hosts caused by increasing densities of *N. aberrans*. The "sugarbeet" race of *N. aberrans* may limit the growth of kochia and act as a biological antagonist of this weed in infested fields.

Two greenhouse experiments were conducted to examine the relation between *N. aberrans* population densities and growth of sugarbeet and kochia in pots.

Nacobbus aberrans "sugarbeet" race was obtained from kochia collected in Nebraska and maintained on sugarbeet 'Tasco AH14.' Inoculum for experiments was collected by incubating egg masses at 25 ± 3 C on 75-μm-pore microsieves. One pregerminated sugarbeet Tasco AH14 seed was planted in individual 6-cm-d plastic pots containing 400 cm^3 methyl bromide fumigated sandy loam (72% sand, 18% silt, 10% clay). Three days later, soil was infested with a geometric series of 0, 0.25, 0.5, . . . , 64 J2/cm^3 soil initial population (Pi). The nematodes were introduced into the soil by pouring an aqueous suspension of inoculum into five holes, each 8 cm deep, around the pregerminated seed in each pot. Treatments were randomized in five replicates on a greenhouse bench. Greenhouse temperature was maintained at 25 ± 3 C with 19 hours light supplemented with high output fluorescent lamps. Plants were harvested 65 days after inoculation. Total fresh weight (top and root), fresh top, and storage root weights were recorded. To determine the final nematode density (Pf), eggs were recovered from roots by an NaOCl method (4) and J2 were extracted from soil by the Cobb sieve and decanting method (1). The Pf value was calculated as the total of J2 from soil and eggs from roots.

In a second experiment, pregerminated seeds of kochia were inoculated with a geometric series of 0, 0.25, . . . , 16 J2 of *N. aberrans*/cm^3 soil. Treatments in this trial were randomized in four replicates, and plants were grown in a greenhouse as previously described. Plants were harvested 65 days after soil infestation, and fresh top weight and Pf determined with the same procedures used in the sugarbeet experiment.

Sugarbeet plant response to the Pi was fitted to the model $y = m + (1 - m)z^{P-T}$

Received for publication 23 March 1984.

[1] Journal paper No. 2960.

[2] Nematologist, Plant Science Department, Crops Research Laboratory, Utah State University, UMC-63, Logan, UT 84322.

[3] Nematologist, Istituto Nematologia Agraria CNR, 70126 Bari, Italy.

[4] Nematologist, Department of Nematology, University of California, Riverside, CA 92521.

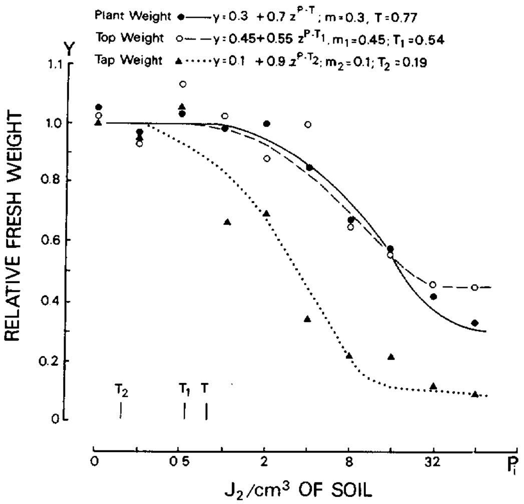

FIG. 1. Relationship between the initial soil density (Pi) of *Nacobbus aberrans* "sugarbeet" race and the relative fresh weight of plant (top and root), top, and storage root of sugarbeet ('Tasco AH14') 65 days after planting in infested soil.

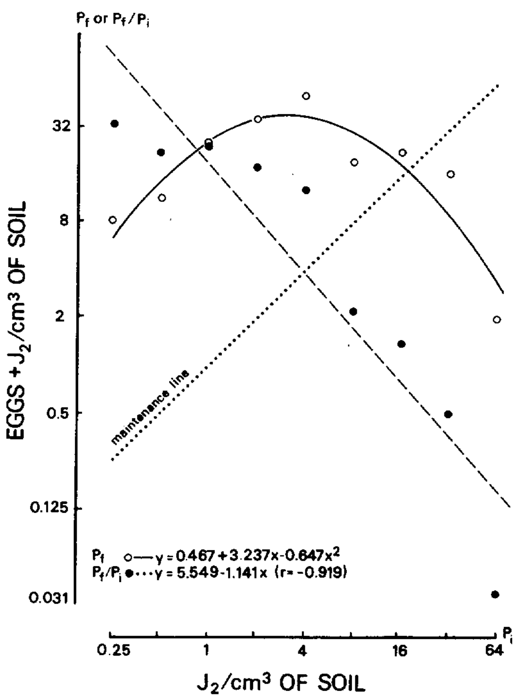

FIG. 2. Relationship between initial (Pi) and final (Pf) soil density and between initial density (Pi) and ratio Pf/Pi of *Nacobbus aberrans* "sugarbeet" race on sugarbeet ('Tasco AH14') 65 days after planting in infested soil. Both x and y are expressed on a $\log_2$ basis.

for $P > T$ and $y = 1$ for $P < T$ (where y = relative yield, m = relative minimum yield, $z < 1$, P = initial nematode density, $z^{-T} = 1.05$, and T = tolerance limit) (7). Tolerance limits to *N. aberrans* "sugarbeet" race were 0.77, 0.54, and 0.19 J2/cm^3 soil for the fresh plant (top and root), top, and storage root weights, respectively (Fig. 1). Maximum growth suppression was 90% for storage root, 70% for plant, and 55% for top weights (Fig. 1). The estimates of minimum yields (m) and tolerance limits (T) were confirmed by analyzing the data with a computer algorithm (2). Previous tests also indicated that growth suppression of sugarbeet storage root caused by *N. aberrans* was greater than suppression of total plant and top (6).

Nematode reproduction occurred at all Pi and was higher at low than at the largest Pi (Fig. 2). Largest Pf occurred at Pi of

TABLE 1. Effects of initial soil density (Pi) of *Nacobbus aberrans* on final soil density (Pf) of the nematode, growth of kochia, and numbers of root galls on kochia and sugarbeet after 65 days.

Pi (J2/cm^3 soil)	Pf (eggs + J2/cm^3 soil)	Pf/Pi	Kochia fresh top weight (g)†	Numbers of galls/plant†	
				Kochia	Sugarbeet
0.00			1.10 a		
0.25	0.00	0.00	0.95 a	0.25** a	19 a
0.5	0.41	0.82	0.99 a	0.50** a	25 a
1.0	0.08	0.08	1.06 a	0.25** a	34 a
2.0	<0.01	<0.01	0.99 a	0.50** a	70 b
4.0	1.29	0.32	0.86 a	1.75** b	68 b
8.0	0.42	0.03	0.98 a	1.00** ab	72 b
16.0	0.00	0.00	0.92 a	0.50** a	56 b

† Values are mean of four replicates. Column means followed by common letters are not different according to Duncan's multiple-range test ($P = 0.05$).

** Indicates lower ($P = 0.01$) gall numbers on kochia roots compared to sugarbeet roots according to the Student's t test.

four J2/cm^3 soil (Fig. 2). The maximum rate of nematode population increase on sugarbeet, about 32-fold, occurred at Pi = 0.25 J2/cm^3 soil. This increase was less than the maximum increase of about 140-fold reported for *Heterodera schachtii* Schmidt on sugarbeet in pots at the same Pi (3), confirming that *N. aberrans* develops more slowly than *H. schachtii* and has lower fecundity, as observed previously (6). The lowest Pi (0.25 J2/cm^3 soil) produced the largest Pf/Pi (Fig. 2). A negative linear correlation described the relationship between Pi and Pf/Pi (Fig. 2).

No suppression of kochia plant growth was observed at any Pi (Table 1). Sixty-five days after soil infestation, the Pf were lower than Pi (Table 1). Fewer ($P = 0.01$) galls were induced by *N. aberrans* on kochia than on sugarbeet roots at the same Pi (Table 1). All kochia plants bloomed and produced seeds regardless of nematode infection.

Our findings suggested that sugarbeet suffered more damage than the weed kochia from *N. aberrans* infections. Kochia appeared to be a less favorable host and more tolerant to *N. aberrans* than sugarbeet. Kochia plants were not damaged by the highest Pi used in these experiments, and such densities generally do not occur under natural conditions. However, this weed should be considered a means of maintaining *N. aberrans* in infested soils. Nematode-infected kochia plants in ditch canals may lead to contamination of the drainage water with this nematode and its consequent dissemination.

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