Relative Susceptibility of Selected Cultivars of Potato to Pratylenchus penetrans[1]

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Abstract: Pratylenchus penetrans suppressed the tuber yields of potato cultivars 'Katahdin', 'Kennebec', and 'Superior', but did not affect yields of 'Russet Burbank'. In comparison with noninfested controls, all initial nematode densities (P_i) of *P. penetrans* (P_i = 38, 81, 164, 211/100 cm³ of soil) suppressed yields of Superior; a moderate P_i (81/100 cm³ soil) suppressed yields of Kennebec; and on Katahdin, a moderate P_i enhanced yields, but higher P_i's caused a marked loss. In general, yields were related to the tolerance of the cultivars to nematode colonization. Highest nematode densities were found in the roots of Russet Burbank; the next highest, in succeeding order, were found in roots of Kennebec, Katahdin, and Superior. Symptoms of nematode invasion were confined to losses of tuber yield and root weight. *Key Words:* root-lesion nematode, *Solanum tuberosum,* tolerance.

The root-lesion nematode *Pratylenchus penetrans* (Cobb) Filip. and Schuur.-Stekh. is a damaging parasite of potato (*Solanum tuberosum* L.). Dickerson et al. (3) showed that this nematode was pathogenic to potato and suppressed yields. Hastings and Bosher (5) reported an average growth inhibition of 59.6% for potato seedlings infected with this pest. Oostenbrink demonstrated that *P. penetrans* caused losses in tuber yields of 20-50% (12) and in total plant weight of 50% (13).

The initial population density (P_i) of a plant-parasitic nematode generally is a useful parameter for estimating yield losses. Oostenbrink (14) demonstrated a negative linear regression between P_i of *P. penetrans* and yield of potato tubers. Olthof et al. (9) and Olthof and Potter (11) showed that initial densities of *P. penetrans* were related to yield losses in potato and other crops. Only a single cultivar was used in each of these studies.

The objective of our study was to determine the effects of P_i of *P. penetrans* on yields of selected potato cultivars.

MATERIALS AND METHODS

Microplots similar to those described by Olthof and Potter (10) were used to investigate the effects of different initial population densities (P_i) of *P. penetrans* on the growth and yield of four potato cultivars. Cylindrical clay drainage tiles 20 x 30 cm were covered at one end with 1.19-mm mesh nylon screen and placed screen-down in a 25-cm deep hole. Microplot sites were centered at 0.9-m intervals. Nematode-infested soil containing 0, 38, 81, 164, or 211 *P. penetrans*/100 cm³ of soil was prepared by mixing steam-sterilized, sandy clay loam

Received for publication 25 August 1975.
[1] Michigan Agricultural Experiment Station Journal Article No. 7362. Portion of an M.S. thesis submitted to Michigan State University by the senior author. Research supported in part by the Michigan Potato Industry Commission.
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We would like to thank John F. Davenport for his aid throughout the course of this study.

greenhouse soil with infested soil in which Navy bean, *Phaseolus vulgaris* L., had previously been grown, and placed into tiles located at the Michigan State University Entomology Experiment Farm. Potato cvs. 'Katahdin', 'Kennebec', 'Russet Burbank', and 'Superior' were planted singly in tiles with five plants/treatment-variety combination and arranged in a completely randomized design. Superior and Russet Burbank were planted as whole seed to a depth of 6 cm; cut seed were used for the other cultivars. Fertilizer treatments were not applied to the microplots. All plants were sprayed once in midsummer with azinphosmethyl to control aphids and leafhoppers.

Microplots of each cultivar were harvested when plants of a given cultivar exhibited signs of dieback. Superior, Kennebec, Katahdin, and Russet Burbank were harvested 116, 122, 133, and 147 days after planting, respectively. Foliage, roots, and tubers were weighed separately.

Bioassays to determine P_i's at the time of planting were prepared by planting four 15-cm diam pots from each infestation level with Navy beans. After 30 days, the roots of each plant were removed, rinsed free of soil, cut into 1-cm lengths, and placed in a mist chamber (15). To facilitate nematode extraction, roots were sprayed with a solution of 50 μg/ml dihydrostreptomycin sulfate + 10 μg/ml ethoxyethyl mercuric chloride (2) for 45 sec every 20 min for 5 days. The numbers of nematodes recovered from each root system were considered to be the total number present in the bioassay soil, and these numbers were converted to a basis of number/100 cm^3 of soil. A small sample of roots, stained with an acid fuchsin-ethanol-acetic acid solution (7) and destained with chloral hydrate, from each root system showed few eggs or larvae. Soil from bioassay pots contained few nematodes after the 30-day growth period.

After harvesting, final population densities (P_f) of *P. penetrans* in 2-g root samples were determined for each plant by using the mist chamber technique. Soil removed from tiles and checked by a sugar flotation-centrifugation method had relatively small numbers of nematodes.

RESULTS AND DISCUSSION

The initial population density of *P. penetrans* influenced tuber growth of four cultivars (Fig. 1). Yield losses of Superior were 20-30% at all P_i's, whereas Russet Burbank yields were less affected by low densities. In comparison to the controls, yield of Katahdin was enhanced at a P_i of 81/100 cm^3 of soil, but higher P_i's caused marked losses. Enhanced root growth has been reported for crops infected with *Meloidogyne* spp. (6) and for *Dioscorea rotundata* Poir infected with *Pratylenchus coffeae* (Zimm.) Filip. & Schuur.-Stekh. (1). In our study, moderate nematode densities may have stimulated root proliferation and increased tuber growth. Losses in tuber growth of Kennebec were apparent at and above P_i's of 81/100 cm^3 of soil.

Final root weight of Kennebec and Superior was suppressed (Table 1), but that of Katahdin and Russet Burbank was not significantly affected. Stunting of roots was primarily attributable to the absence of many of the finer lateral roots (Fig. 2). There was no observable root necrosis, as is usually reported for diseases caused by this nematode (8), nor were there any effects on top growth.

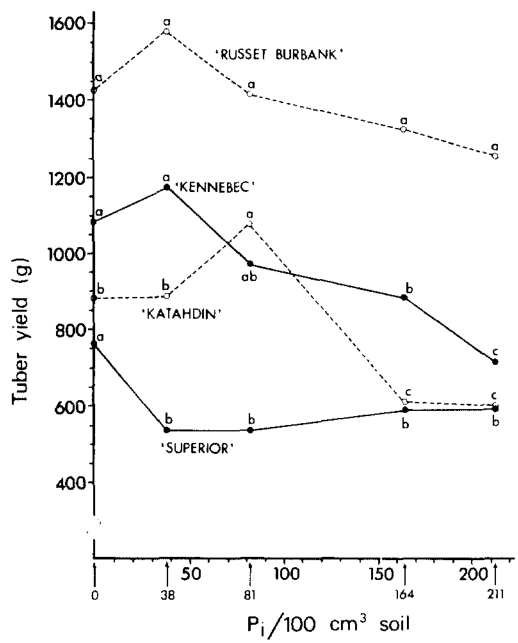

FIG. 1. Effects of initial population level (P_i) of *Pratylenchus penetrans* on the tuber yield of selected potato cultivars. Points on the same line with common letters not significantly different, according to Duncan's Multiple Range Test (P = 0.05).

TABLE 1. Effects of initial population density (P_i) of *Pratylenchus penetrans* on root growth of selected potato cultivars.

P_i/100 cm³ soil	Fresh root weight (g)[z]			
	Katahdin	Kennebec	R. Burbank	Superior
0	11.2 a	29.8 a	8.2 a	12.6 a
38	6.6 a	16.2 b	7.4 a	6.6 b
81	9.8 a	16.4 b	8.0 a	5.8 b
164	8.2 a	12.4 b	5.8 a	5.2 b
211	8.8 a	12.0 b	7.0 a	5.8 b

[z]Numbers are the means of root systems of five plants. Column means followed by common letters not significantly different, according to Duncan's Multiple Range Test (P = 0.05).

Final nematode densities in roots of harvested plants (Table 2) could not be correlated either with initial densities or tuber weights. However, severity of losses in these cultivars may be related to plant susceptibility and P_i. The lowest P_i caused losses in Superior, the cultivar with the lowest final population density (P_f). Conversely, Russet Burbank supported the highest populations with no significant loss in yield. Thus the ability of these infected cultivars to produce acceptable yields is related to plant tolerance, rather than resistance, to *P. penetrans.*

Although variations in P_f for each cultivar were too great for a numerical estimation of equilibrium densities, relative tolerances of these cultivars to infection can be assigned: Russet Burbank is the most tolerant; Kennebec, Katahdin, and Superior follow in decending order of tolerance. The data indicate that Katahdin may support a higher density of *P. penetrans* than previously reported (4).

These results are comparable to those of Olthof and Potter (11), who used the cultivar 'Sebago'. They found an equilibrium

FIG. 2. Effects of initial population level (P_i) of *Pratylenchus penetrans* on the growth of Kennebec potato root systems. (Left to right, P_i = 0, 81, 211 nematodes/100 cm³ of soil; scale = 37.5 cm.).

TABLE 2. Effects of selected potato cultivars on the final population density (P_f) of *Pratylenchus penetrans* in microplots.

P_i/100 cm^3 soil	P_f/g fresh root (in thousands)[a]			
	Katahdin	Kennebec	R. Burbank	Superior
38	2.5 ab y	2.5 ab y	5.8 a x	1.9 b z
81	2.0 bc y	1.8 bc y	2.7 c x	0.9 c z
164	2.7 a y	3.4 a x	4.0 b x	2.9 a y
211	1.5 c y	1.2 c yz	2.2 c x	0.9 c z
Mean	2.2	2.2	3.7	1.7

[a]Numbers are the means of roots of five plants. Column means followed by common letters a, b, or c, and row means followed by common letters x, y, or z not significantly different, according to Duncan's Multiple Range Test ($P = 0.05$).

density of 1200-1300/g root, with yield losses occurring at a P_i of 67/100 g of soil. Thus, Sebago's tolerance to *P. penetrans* is low, only slightly better than that of Superior.

Information on the relative tolerance of potato cultivars to *P. penetrans* and other nematode pests should prove to be useful in areas where such problems exist. By combining this knowledge with an estimation of costs for control and other peripheral operations, growers should be able to choose cultivars both for yield potential and sensitivity to nematode infection. Field trials are an obvious future step in the evaluation of cultivar tolerance to *P. penetrans.*

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