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Relationship of Yield and *Pratylenchus* spp. Population Densities in Superior and Russet Burbank Potato[1]

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Abstract: Number of *Pratylenchus* spp. (primarily *P. penetrans*) were recorded at planting in experimental potato plots over a 9-year period at one location on Prince Edward Island. Tuber yields of 'Superior' and 'Russet Burbank' potatoes in plots treated with aldicarb were compared with yields in adjacent untreated plots. There was a linear relationship between the number of root lesion nematodes at planting and tuber yield increases after treatment for Superior, but not for Russet Burbank ($P < 0.05$). When counts of root lesion nematodes were greater than 500/kg dry soil, however, the tuber yields of Russet Burbank increased in treated plots. Additional trials at other locations and the inclusion of other cultivars are needed to make numerical relationships of this type available to a nematode advisory service.
Key words: advisory service, potato, *Pratylenchus penetrans*, root lesion nematode, *Solanum tuberosum*, tuber yield.

Previous investigations on Prince Edward Island have shown that tuber yield improved when potato (*Solanum tuberosum* L.) fields with large populations of root lesion nematodes, *Pratylenchus penetrans* (Cobb) Filipjev and Sch. Stek., were treated with nematicides (6,7). Similar results on the pathogenicity of *P. penetrans* in potato have been demonstrated in Michigan (3,13) and Ontario (9,10).

The impact of *P. penetrans* on tuber yield appears to be related to the size of root lesion nematode populations at planting (6,7). The greatest increase in tuber yields from nematicide treatments in experimental plots on Prince Edward Island has been in 'Superior' potato. 'Russet Burbank' has also responded to nematicide applications, but usually to a lesser degree and not as consistently as Superior. Our objective was to examine the relationship between the Pi of *Pratylenchus* spp. (mostly *P. penetrans*) and corresponding tuber yield increases of Superior and Russet Burbank potato in response to aldicarb treatments.

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MATERIALS AND METHODS

The experiment was conducted in a 1-ha field. Soil type was a fine sandy loam (70% sand, 20% silt, 10% clay, 2.7% organic matter; pH 5.1–6.0). A weather station was located 2 km from the site. Respective 77-year averages (as of 1986) for May to September for rainfall were 77, 78, 79, 87, and 94 mm, and for air temperature were 9.2, 14.8, 18.9, 18.5, and 14.2 C.

Aldicarb was applied at planting in-furrow at 2.24 kg a.i./ha (20.5 g a.i./100 m) each year from 1978 to 1986. Untreated plots were established beside each treated plot. The location of these paired plots within the 1-ha field varied from year to year in a completely randomized design with at least four replicates. Small whole tubers of Superior or Russet Burbank were planted in late May or early June at 30-cm intervals in rows 6 m long and 0.9 m apart. There were four rows in each plot. Endosulfan as an emulsifiable concentrate at 0.6 kg a.i./ha and mancozeb as a wettable powder at 1.7 kg a.i./ha were applied as needed for insect and late blight control, respectively (1). Diquat as an aqueous concentrate at 0.6 kg a.i./ha was applied as a desiccant about 10 days before harvest. The center rows were harvested the first 2 weeks of October. Yield was based on tubers with no obvious defects and weighing at least

TABLE 1. *Pratylenchus* spp. at planting and corresponding tuber yield increases of potato after treatment with aldicarb.†

Year	Nematodes (no./kg dry soil)‡	Yield increase (%)§ Superior Marketable	Superior Total	Russet Burbank Marketable	Russet Burbank Total
1980	500 (2.70)	0 (0)	0 (0)	0 (0)	0 (0)
1981	800 (2.90)	2 (8.1)	0 (0)	14 (22.0)	11 (19.4)
1982	1,100 (3.04)	12 (20.3)	18 (25.1)	6 (14.2)	9 (17.5)
1986	2,200 (3.34)	1 (5.7)	6 (14.2)	11 (19.4)	11 (19.4)
1979	2,500 (3.40)	8 (16.4)	8 (16.4)	13 (21.1)	13 (21.1)
1983	3,900 (3.59)	26 (30.7)	25 (30.0)	6 (14.2)	7 (15.3)
1978	6,000 (3.78)	34 (35.7)	47 (43.3)		
1985	9,000 (3.95)	30 (33.2)	38 (38.1)	22 (28.0)	25 (30.0)
1984	17,800 (4.25)	28 (32.0)	28 (32.0)	11 (19.4)	11 (19.4)

† Aldicarb applied at planting at 2.24 kg a.i./ha (20.5 g a.i./100 m).
‡ Geometric means with log means in parentheses. Based on at least 16 composite soil samples taken just before planting each year.
§ Based on 113–340 g for marketable and ≥ 113 g for total tuber yields; averages of at least four observations. Arcsine transformations in parentheses.

113 g. Marketable tubers were limited to the 113–340-g range.

The nematode Pi in soil was determined by removing 10 cores at 1-m intervals, 20 cm deep, from within the outside rows in each plot with a 2.5-cm-d soil probe. At least 16 composite samples were taken each year at planting. Each 10-core field sample was thoroughly mixed, and a 50-g subsample was removed and placed in a modified Baermann pan (12). After 7 days, nematodes that had emerged from soil were identified and counted. Soil was dried for 48 hours at 100 C, and counts for root lesion nematodes were expressed as the number of nematodes per kilogram of dry soil and transformed to logarithms for statistical computations. Yield increases in response to aldicarb treatments were expressed as percentages and analyzed statistically using the arcsine transformation to stabilize the variance. Yearly yield means were based on at least four replicates.

RESULTS

An examination of the nematode fauna at the experimental site revealed that most of the plant nematodes in soil, as well as in roots, were *Pratylenchus penetrans* (> 95%), with the remainder fitting the characteristics of *P. crenatus* Loof. A few *Tylenchorhynchus* spp. and *Tylenchus* spp. were recovered from soil, but these are not considered important pathogens of potatoes (4), nor were the populations large enough to warrant concern.

Large tuber yield increases for Superior were evident in 1978 and 1983–85 when nematode populations at planting were at least 3,900/kg dry soil (Table 1). The only obvious anomaly was in 1982 when a relatively low nematode Pi of 1,100/kg dry soil was associated with marketable and total tuber yield increases of 12% and 18%, respectively. The linear regression for percentage of tuber increases (angles) after treatment with levels of nematodes ($\log_{10}$ units) at planting show this relationship (Fig. 1). The significant slope coefficient and correlation coefficient ($P < 0.01$) indicate increasing marketable and total tuber yields with treatment for Superior over the range of nematode levels in this study.

Russet Burbank appeared to be less sensitive than Superior to nematode levels of 3,900/kg dry soil and above. Yield increase due to aldicarb treatment was similar for both cultivars when the nematode population levels were between 800 and 2,500/kg dry soil (Table 1). Marketable and total tuber yield increases for Russet Burbank ranged as high as 22% and 25%, respectively, when aldicarb was applied. It

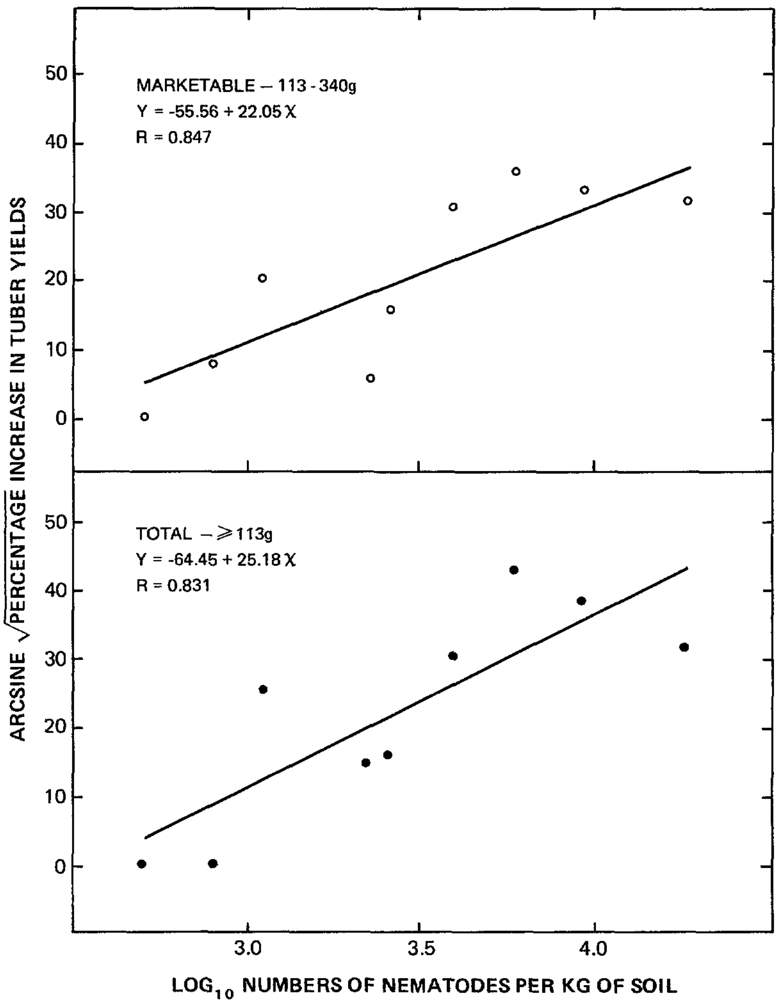

FIG. 1. Relationship between percentage (arcsine) increase in tuber yields of Superior potato after treatment with aldicarb at 2.24 kg a.i./ha (20.5 g a.i./100 m) and log numbers of root lesion nematodes in soil at planting.

cannot be stated, however, that tuber yield increases were associated with nematode population levels, since the linear relationship between the two variables was not significant ($P > 0.05$).

DISCUSSION

The majority of soil samples from fields on Prince Edward Island have contained populations of root lesion nematodes falling within the range shown in Table 1. Therefore, the expected after-treatment yield gain in Superior potato can be estimated from the straight-line relationship in Figure 1, when information is available on the size of populations of *Pratylenchus* spp. at planting. It is possible that a curvilinear relationship may be more appropriate when nematode populations are large, but from a practical standpoint the relationship is linear. Ferris (5) stated that any error incurred by the assumption of linearity is minimal relative to the inherent variability of nematode field data.

We have no explanation for the anomaly in 1982 when a relatively low nematode Pi was associated with yield increases. Endosulfan was applied as needed and insect populations were very low in all plots. Weather data indicated that precipitation and temperature in 1982 for the May to September growing season did not differ significantly from the 77-year average.

One of the major difficulties facing a nematode advisory service is that plant damage caused by nematodes can be greatly influenced by other factors such as weather, other pathogens and pests, and soil type (2). In addition, it should be stressed that determination of nematode levels is imprecise; the sampling scheme in this study provided estimates only to within about 50% of the true population mean (11). More information at other locations with varying soil and weather conditions, other potato cultivars, different crop rotations, and additional knowledge of winter survival of nematodes should alleviate some of the variability in estimation. Another difficulty for an advisory service in the Maritime region of Canada is the lack of time to collect samples in the spring and to return information to growers before planting. A previous study, however, has indicated that populations of *P. penetrans* on Prince Edward Island decreased over winter by 40–60% (8). Data on winter survival of root lesion nematodes together with the results of this study could be used in predicting whether nematicide treatments would be of economic value to a grower.

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