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Reproduction du *Pratylenchus penetrans* sur différentes cultures de rotation au Québec

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Article abstract

The reproduction of the root-lesion nematode *Pratylenchus penetrans* was assessed on 12 rotation crops under greenhouse conditions. Brown mustard (*Brassica juncea*) was the best host and increased the initial population by 17.2 times. Soybean (*Glycine max*), Japanese millet (*Echinochloa frumentacea*), rape (*B. napus*), buckwheat (*Fagopyrum esculentum*), white mustard (*B. hirta*), and perennial ryegrass (*Lolium perenne*) were also very efficient in multiplying the nematode and were not significantly different from rye (*Secale cereale*), a standard host crop. Foxtail millet (*Setaria italica*), oats (*Avena sativa*), corn (*Zea mays*), and bromegrass (*Bromus inermis*) increased the initial population by 5.8, 5.7, 4.5, and 3.2 times respectively, but significantly less than rye. Forage pearl millet (*Pennisetum glaucum*) was the poorest host with a reproduction rate of 0.4. These results indicate that most commonly recommended rotation crops are suitable for the build up of *P. penetrans* populations in the soil with the exception of forage pearl millet. This annual crop has a great potential as a rotation crop for controlling the root-lesion nematode in Quebec.

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Reproduction of *Pratylenchus penetrans* on various rotation crops in Quebec

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[Reproduction du *Pratylenchus penetrans* sur différentes cultures de rotation au Québec]

La reproduction du nématode des lésions racinaires *Pratylenchus penetrans* a été évaluée en serre sur 12 cultures de rotation. La moutarde brune (*Brassica juncea*) a été la meilleure plante hôte et a augmenté de 17,2 fois la population initiale. Le soja (*Glycine max*), le millet japonais (*Echinochloa frumentacea*), le colza (*B. napus*), le sarrasin (*Fagopyrum esculentum*), la moutarde blanche (*B. hirta*), et le raygrass vivace (*Lolium perenne*) ont été également très efficaces à multiplier le nématode et n'étaient pas significativement différents du seigle (*Secale cereale*), une plante hôte standard favorable. Le millet d'Italie (*Setaria italica*), l'avoine (*Avena sativa*), le maïs (*Zea mays*), et le brome des prés (*Bromus inermis*) ont accru respectivement de 5,8, 5,7, 4,5 et 3,2 fois la population initiale mais de façon significativement moindre que le seigle. Le millet perlé fourrager (*Pennisetum*

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glaucum) a présenté le plus faible taux de multiplication, soit 0,4. Ces résultats nous indiquent que les cultures de rotation couramment recommandées sont favorables à l'accroissement des populations du *P. penetrans* dans le sol à l'exception du millet perlé fourrager. Cette culture annuelle a un bon potentiel comme culture de rotation dans la répression des populations du nématode des lésions racinaires au Québec.

The root-lesion nematode, *Pratylenchus penetrans* (Cobb) Filipjev and Schuurmans-Stekoven, is an endoparasitic nematode that reduces yield and quality in many crops including forages (Kimpinski *et al.* 1984; Thies *et al.*1995), vegetables (Olthof and Potter 1973), potato (*Solanum tuberosum* L.) (Olthof 1989), and tobacco (*Nicotiana tabacum* L.) (Jagdale *et al.* 2000). In Quebec, rye (*Secale cereale* L.) and oats (*Avena sativa* L.) are often grown in rotation with vegetables and tobacco. Unfortunately, they are good hosts of *P. penetrans,* which multiplies to high densities in their roots (Dunn and Mai 1973; Thies *et al.* 1995), thereby increasing initial nematode populations in the subsequent crop yr. Reduced yields in Quebec due to *P. penetrans* damage has increased reliance on broad-spectrum fumigants prior to both potato and tobacco planting. Safety and environmental issues, combined with the high cost of fumigation, emphasize the need for alternative root-lesion nematode management strategies. This experiment was designed to compare the reproduction of the root-lesion nematode on 12 crop species under greenhouse conditions.

The reproduction of the root-lesion nematode was tested on the following plants: common buckwheat (*Fagopyrum esculentum* Moench.), bromegrass (*Bromus inermis* Leyss cv. Carlton), perennial ryegrass (*Lolium perenne* L. cv. Aubade), brown mustard (*Brassica juncea* L.), white mustard (*B. hirta* Moench.), rape (*B. napus* L. cv. HL99), forage pearl millet (*Pennisetum glaucum* L. cv. CFPM101), foxtail millet (*Setaria italica* L. cv. Golden German), Japanese millet (*Echinochloa frumentacea* (Roxb.) Link.), corn (*Zea mays* L. cv. Pionneer 3893), soybean (*Glycine max* Merr. cv. Gaillard), oats (cv. Ultima), and rye (cv. Musketeer). Seeds were obtained from local seed suppliers except for forage pearl millet which was provided by Agriculture Environmental Renewal Canada, Nepean, Ontario.

Pratylenchus penetrans populations were collected from potato fields and reared on celery (*Apium graveolens* L.) plants in the greenhouse. After several mo, the inoculum was made by mixing the infested sandy soil (92% sand; 3% silt; 5% clay) from the rearing beds with a portion of the same soil (previously pasteurized) in order to provide 6200 nematodes per pot. Ten soil extractions were performed using the modified Baermann pan method (Townshend 1963) to estimate the initial numbers of nematodes present in soil.

The experiment was conducted in a randomized complete block design with ten replications. The greenhouse conditions were 23-25°C with a photoperiod of 16 h light and 8 h dark, and 70% relative humidity. Plastic containers (15.24 cm diam and 1.5 L volume) were used for all crops. The seeding rate was adapted to each crop, using a standard field plant density. The three different seeding rates were: one seed per container for corn, soybean, and rape; three seeds per container for buckwheat, brown mustard, white mustard, foxtail millet, Japanese millet, forage pearl millet, oats, and rye; and ten seeds per container for bromegrass and perennial ryegrass. All crop species were harvested after 11 wk of growth.

Soil and root samples from each crop were collected to determine the number of the root-lesion nematodes in each. Soil nematode density was estimated by processing two subsamples of 50 cm^3 for each plot by the Baerman pan method. Roots were washed and two subsamples per plot were placed in a misting chamber for 2 wk at 22°C.

After the nematode extraction, roots were oven-dried (65°C) for 2 d and weighed. Nematodes were counted using a stereo-microscope and expressed as numbers per kg of soil and as numbers per g of dry root weight. For each crop, a reproduction factor (Pf/Pi) was calculated, where Pf = total number of nematodes per pot at harvest (soil and root) and Pi = initial number of nematodes in soil per pot.

Nematode counts were transformed using ($\log_{10}[x+2]$) before statistical analysis. Data were analyzed by the analysis of variance and general linear model (GLM) procedures (SAS Institute Inc. 1988). Waller's test was used to compare treatments when the analysis of variance showed significant differences among means ($P \leq 0.05$).

The highest nematode counts were recorded on brown mustard; this crop increased 17.2 times the initial *P. penetrans* population, a rate of increase that was significantly ($P \leq 0.05$) higher than that observed on rye, our standard favorable host crop (Table 1). Soybean, Japanese millet, rape, buckwheat, white mustard, and perennial ryegrass were also very efficient in increasing lesion nematode numbers, and multiplication rates on these crops were not significantly different from rye. Foxtail millet, oats, corn, and bromegrass increased nematode numbers by 5.8, 5.7, 4.5, and 3.2 times respectively, rates that were significantly lower than rye. Forage pearl millet was the poorest host of *P. penetrans* in either soil or roots, with a reproduction factor nearly 10 times lower than on bromegrass. In Ontario, Jagdale *et al.* (2000) reported *P. penetrans* suppression by pearl millet in infested tobacco fields. Thies *et al.* (1995) observed low *P. penetrans* numbers in pearl millet roots. Bromegrass was also a poor host of the root-lesion nematode but to a lesser extent than the forage millet. Kimpinski *et al.* (1984) reported bromegrass to be a poor host of *P. penetrans* in Prince Edward Island.

These results are quite consistent with the literature. MacDonald and Mai (1963) have reported that root-lesion nematode multiplied well on soybean and rape. Rye and oats, which are usually used as rotation crops, are known to be

Table 1. Reproduction of *Pratylenchus penetrans* on selected rotation crops in Quebec

	Numbers of *P. Penetrans*[a,b]		Reproduction factor
Crops	kg^{-1} soil	g^{-1} dry root	(Pf/Pi)[b,c]
Brown mustard	73000 a	18118 bc	17.2 a
Soybean	33720 c	51757 a	9.6 b
Japanese millet	13990 de	6923 efg	9.5 b
Rape	49378 b	4969 fghi	9.3 b
Rye	35384 c	1480 hi	9.0 bc
Buckwheat	48520 b	2355 ghi	8.8 bc
White mustard	43511 bc	10667 de	8.7 bc
Perennial ryegrass	12576 defg	6060 efgh	8.4 bc
Foxtail millet	17140 gh	21898 b	5.8 de
Oats	19690 d	10993 de	5.7 de
Corn	6860 ef	15725 cd	4.5 ef
Bromegrass	6758 ef	6614 efgh	3.2 f
Pearl millet	1276 f	333 i	0.4 g

[a] Data are arithmetic means of ten replicates.
[b] In the same column, values followed by the same letter are not significantly different ($P \leq 0.05$), as determined by Waller's test.
[c] Pf = Total number of nematodes per pot (soil and root) after 11 weeks of growth; Pi = Initial number of nematodes in soil per pot.

good hosts of the root-lesion nematode (Thies *et al.* 1995; Florini and Loria 1990). Therefore, an interesting management approach would be to use forage pearl millet as a rotation crop instead of the usual cereals that can increase nematode pressure on subsequent crops due to their good host status. In addition, many common weeds contain lesion nematodes (Townshend and Davidson 1960) and their presence would tend to negate the beneficial effects of a rotation crop which by itself was a poor host. To control *P. penetrans* using a resistant crop, it will be necessary to find a plant species that is a poor host or nonhost and also to maintain weed-free conditions for the entire growing season.

The results obtained in this study indicate that most of the commonly recommended rotation crops are suitable for the build-up of *P. penetrans* populations in the soil with the exception of forage pearl millet. This crop has stimulated great interest as a potentiel rotation crop for controlling *P. penetrans* populations in various crops in Quebec. Field trials are currently under way to assess the impact of this crop on the development of *P. penetrans* populations and its effect on yields of the subsequent crops, such as potato and tobacco.

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