Phytoprotection

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Effet du nématode des lésions de racines (*Pratylenchus penetrans*) sur le pâturin annuel (*Poa annua*)

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Volume 89, numéro 1, avril 2008

URI : https://id.erudit.org/iderudit/000381ar
DOI : https://doi.org/10.7202/000381ar

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Éditeur(s)

Société de protection des plantes du Québec (SPPQ)

ISSN

0031-9511 (imprimé)
1710-1603 (numérique)

Découvrir la revue

Citer cet article

Bélair, G. & Simard, L. (2008). Effect of the root-lesion nematode (*Pratylenchus penetrans*) on annual bluegrass (*Poa annua*). *Phytoprotection*, *89*(1), 37–39. https://doi.org/10.7202/000381ar

Résumé de l'article

Cette étude a été menée afin d'évaluer l'effet de différentes densités de population du nématode des lésions de racines (*Pratylenchus penetrans*) sur la croissance du pâturin annuel (*Poa annua*) dans des conditions contrôlées. Dans deux expériences différentes, les nématodes ont été inoculés à des concentrations de 100, 500, 1000 ou 5000 nématodes 100 cm^{-3} de sol par pot ou par tube. Neuf sem après l'inoculation, les populations du *P. penetrans* dans les racines avaient augmenté de façon linéaire avec les concentrations initiales de nématodes dans les deux expériences. La croissance et la qualité du gazon étaient uniformes pour tous les traitements et il n'y avait aucune différence significative avec le témoin. Dans les conditions expérimentales présentes, *P. annua* s'est avéré une plante hôte tolérante au *P. penetrans*.

Effect of the root-lesion nematode (*Pratylenchus penetrans*) on annual bluegrass (*Poa annua*)

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Received 2008-04-26; accepted 2008-06-11

PHYTOPROTECTION 89 : 37-39

This study was undertaken to assess the effect of various population densities of the root-lesion nematode (*Pratylenchus penetrans*) on the growth of annual bluegrass (*Poa annua*) under controlled conditions. In two separate experiments, the nematodes were inoculated at concentrations of 100, 500, 1000 or 5000 nematodes 100 cm^{-3} soil per pot or per tube. Nine wk post-inoculation, root *P. penetrans* populations had increased linearly with initial nematode concentrations in both experiments. Growth and quality of turfgrass were uniform for all treatments, with no significant difference from the control. Under the current experimental conditions, *P. annua* was shown to be a tolerant host plant to *P. penetrans.*

Key words: annual bluegrass, golf course, *Poa annua*, *Pratylenchus penetrans*, root-lesion nematode, turfgrass.

[Effet du nématode des lésions de racines (*Pratylenchus penetrans*) sur le pâturin annuel (*Poa annua*)]

Cette étude a été menée afin d'évaluer l'effet de différentes densités de population du nématode des lésions de racines (*Pratylenchus penetrans*) sur la croissance du pâturin annuel (*Poa annua*) dans des conditions contrôlées. Dans deux expériences différentes, les nématodes ont été inoculés à des concentrations de 100, 500, 1000 ou 5000 nématodes 100 cm^{-3} de sol par pot ou par tube. Neuf sem après l'inoculation, les populations du *P. penetrans* dans les racines avaient augmenté de façon linéaire avec les concentrations initiales de nématodes dans les deux expériences. La croissance et la qualité du gazon étaient uniformes pour tous les traitements et il n'y avait aucune différence significative avec le témoin. Dans les conditions expérimentales présentes, *P. annua* s'est avéré une plante hôte tolérante au *P. penetrans*.

Mots clés : gazon, nématode des lésions de racines, pâturin annuel, *Poa annua*, *Pratylenchus penetrans*, terrain de golf.

The root-lesion nematode *Pratylenchus penetrans* (Cobb) Filipjev & Schuurmans-Stekhoven, an endoparasite, is highly damaging to numerous plants other than turfgrasses. In Canada, surveys of plant-parasitic nematodes have shown that root-lesion nematodes are commonly associated with turfgrass on golf courses (Fushtey and McElroy 1977; Simard *et al.* in press; Yu *et al.* 1998;). In Ontario, Yu *et al.* (1998) found four species of root-lesion nematodes, including *P. crenatus* Loof, *P. fallax* Seinhorst, *P. neglectus* (Rensch) Filipjev & Schuurmans-Stekhoven, and *P. thornei* Sher & Allen. A recent survey on 38 golf courses in Quebec and Ontario revealed the presence of *P. crenatus*, *P. penetrans* and *P. thornei* on greens, fairways and roughs (Simard *et al.* in press). Annual bluegrass (*Poa annua* L.) is a major turfgrass species on golf courses in Canada and the United States (Beard 2002; Royal Canadian Golf Association 2003). Currently, the pathogenicity of the root-lesion nematode to annual bluegrass is not well documented in the literature.

The root-lesion nematode is able to reproduce on various crops, including perennial ryegrass (*Lolium perenne* L.) (Bélair *et al.* 2002). Troll and Rohde (1966) reported the capability of this nematode to infect turfgrass species such as annual ryegrass (*Lolium multiflorum* Lam.), creeping red fescue (*Festuca rubra* L.) and Kentucky bluegrass (*Poa pratensis* L.). However, Townshend *et al.* (1973) showed that several cultivars of Kentucky bluegrass are not favourable to the reproduction of the root-lesion nematode. Consequently, Townshend *et al.* (1984) proposed that Kentucky bluegrass could be used as a cover crop to control root-lesion nematode populations in orchards. Yu *et al.* (1998) suggested that bluegrass turf species probably repress the development of lesion nematodes and can eventually eliminate them on golf courses.

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This study was undertaken to assess the effect of various population densities of the root-lesion nematode on the growth of annual bluegrass under controlled conditions. In 2004, two growth chamber trials were carried out in the research facilities of Agriculture and Agri-Food Canada, Horticulture Research and Development Centre, in St-Jean-sur-Richelieu, Quebec. Both experiments were conducted with annual bluegrass collected on a golf course located in the Montreal area (45°23'N; 73°21'W) using a golf course hole cutter (10.8 cm diam, 7.7 cm deep). Annual bluegrass cores were cut to standardize core depth to around 2.5 cm in order to remove most of the golf course soil and preserve the integrity of the root system. Turfgrass cores were subsequently placed into pots (11 cm diam, 9.5 cm deep) filled with a 4:1 (v:v) mix of pasteurized sand and peat. A second experiment was performed using growth tubes (Tube RLC-7, 3.8 cm diam, 14 cm deep, Stuewe and Sons Inc., Corvallis, OR) containing the same sand:peat mix. Annual bluegrass tillers were then separated from a single core and transplanted individually in the tubes. In both experiments, annual bluegrass was grown for 1 wk prior to nematode inoculation. Annual bluegrass was evenly watered as needed and fertilized once per wk, with (20-20-20) (N-P_2O_5-K_2O) + micronutrients, at N rate of 300 µg L^{-1}. The plants were maintained in a growth chamber at 20 ± 2°C and a 12-h photoperiod during the study.

The experimental design was a randomized complete block design with six treatments in both experiments, and each treatment was replicated 6 or 20 times for pots and tubes, respectively. Two treatments were included as controls: water only (spray volume of 75 mL per pot and 15 mL per tube), and oxamyl, a systemic nematicide formulated as Vydate® L, at 0.2 g a.i. m^{-2} per application (spray volume of 5 mL per pot and 1.6 mL per tube). For the nematicide treatment, one application was made concurrently with the other treatments, and one more application was made 3 wk after nematode inoculation. The nematodes used in both trials were obtained from a pure culture of *P. penetrans* reared on tobacco cv. Delgold at 25°C in the greenhouse. The nematodes were inoculated at concentrations of 100, 500, 1000 or 5000 nematodes 100 cm^{-3} soil using 75 mL per pot and 15 mL per tube water suspension. After 9 wk, the number of nematodes in the roots was recorded. The entire root system from each container was washed under running tap water, weighed, and placed in a misting chamber for a 2-wk extraction period at 22°C (Seinhorst 1950). Nematodes were counted using a stereomicroscope and expressed as numbers per pot or tube. Mowed clipping dry weight (Pot: wk 1 to 9; Tube: wk 5, 8 and 9) and visual assessment of turfgrass quality (Pot: wk 1 to 9; Tube: wk 2 to 9) were also evaluated weekly. Visual quality, including ratings for colour, density and uniformity of turfgrass in tubes or pots, was evaluated using a scale of 1 to 9, where 1 = dead turfgrass, 9 = best visual quality, and 6 = lowest acceptable quality rating. Analyses of variance followed by a protected LSD ($P = 0.05$) were performed to compare treatments for nematode counts, mowed clipping dry weight, and visual rating of quality (SAS Institute Inc. 1999). Results of both experiments showed that annual bluegrass is a host conducive to the development of the root-lesion nematode (Table 1). Nine wk post-inoculation, root *P. penetrans* populations had increased linearly with initial nematode concentrations in both experiments (Pot: $F = 4.40$, $P < 0.01$; Tube: $F = 27.82$, $P < 0.0001$) (Table 1). In the presence of 1000 and 5000 nematodes 100 cm^{-3} soil, the quality

Table 1. Effect of inoculation rate (per 100 cm³ soil) on *Pratylenchus penetrans* populations and on dry weight of clippings and visual ratings of *Poa annua* in two experiments

Treatment	Clipping weight[a,b] (g)	*P. penetrans*/ pot or tube[a,c]	Visual rating[a,d]		
			Colour	Density	Uniformity
Experiment 1: Pot					
Water	0.97 (0.27)	< 1 b[e]	8.5 (0.3)	8.7 (0.3)	8.6 (0.4)
Nematicide	1.04 (0.28)	0 b	8.5 (0.4)	8.7 (0.3)	8.5 (0.4)
100 *P. penetrans*	1.03 (0.26)	9 (4) b	8.6 (0.3)	8.7 (0.2)	8.7 (0.2)
500 *P. penetrans*	0.96 (0.27)	102 (26) b	8.5 (0.3)	8.7 (0.3)	8.6 (0.3)
1000 *P. penetrans*	0.96 (0.25)	385 (66) b	8.5 (0.3)	8.6 (0.3)	8.0 (0.4)
5000 *P. penetrans*	1.00 (0.28)	1426 (661) a	8.5 (0.3)	8.5 (0.2)	8.0 (0.3)
Experiment 2: Tube					
Water	0.32 (0.12)	< 1 d	8.5 (0.2)	7.8 (0.4)	NR[e]
Nematicide	0.34 (0.12)	0 d	8.4 (0.2)	7.7 (0.3)	NR
100 *P. penetrans*	0.32 (0.13)	125 (60) cd	8.2 (0.2)	7.4 (0.4)	NR
500 *P. penetrans*	0.32 (0.13)	569 (60) c	8.3 (0.2)	7.5 (0.5)	NR
1000 *P. penetrans*	0.31 (0.12)	1310 (221) b	8.1 (0.2)	7.3 (0.4)	NR
5000 *P. penetrans*	0.28 (0.12)	2602 (427) a	7.8 (0.2)	7.0 (0.4)	NR

[a] Data are means (± SE). Within a column, means followed by the same letter are not significantly different as determined by LSD test at $P = 0.05$. The absence of letters in a column indicates that there were no significant differences.
[b] Means of dry clipping collected after each turfgrass mowing (pot = 9 times; tube = 3 times).
[c] Means of 6 replicates (pot) and 20 replicates (tube) after 9 wk.
[d] Means of 9 visual ratings (including colour, density and uniformity) for pots, and 8 (colour) and 4 (density) visual ratings for tubes.
[e] No uniformity rating for tubes.

of annual bluegrass was slightly reduced in tubes, and a significant reduction in top growth was recorded 5 wk after plant establishment in tubes ($F = 2.53$, $P < 0.05$). In pots, a similar effect from the highest nematode concentration was observed on the quality of annual bluegrass, with a significant reduction in top growth during the first ($F = 2.96$, $P < 0.05$) and second ($F = 2.77$, $P < 0.05$) wk after inoculation. However, 9 wk after transplanting, growth and quality of turfgrass were uniform for all treatments, with no significant difference from the controls. The similarity between the nematicide and water control treatments indicates that nearly zero nematodes were introduced on the planting material and that the observed population build-up in the inoculated treatments is due to nematode inoculation only.

Damage thresholds are extremely complex and difficult to establish because they vary with the type of soil, the season, the growth stage and vigour of the plant, and cultural practices. Moreover, nematodes nearly always live in communities made up of more than one species. Surveys performed on golf courses in Quebec and Ontario revealed the exact same situation in turfgrass (Simard *et al.* in press; Yu *et al.* 1998), so that one or several species present may be contributing to the damage.

Typically, nematodes are associated with a disease complex in which significant turfgrass injury is the result of a combination of stresses such as diseases, environmental stress, and/or parasitic nematodes (Beard 2002). Nematode lesions can be enlarged by fungi and bacteria that invade and multiply in the wounds (Powell 1971; Taheri *et al.* 1994). In Canada, wheat root rot was significantly more severe when *P. neglectus* occurred together with the fungus *Rhizoctonia solani* kühn (Benedict and Mountain 1956). Physiological changes occurring in plants infected with nematodes can enhance their susceptibility to attacks by fungi, whether pathogenic or non-pathogenic (Powell 1971). In Germany, Kemper (1966) observed severe root-lesion nematode damage on wheat in a sandy soil exhibiting a low pH. Usually, thresholds are lower in sandy soils than in heavy-textured soils that are more fertile and moisture-retentive. As with other plants, turfgrasses are more tolerant of a given nematode population level during favourable growth periods in spring and fall than during summer when grass is exposed to numerous physical stresses (Smiley *et al.* 2005). Shallow-rooted grass plants tend to be less tolerant than deeper-rooted plants. Damage threshold levels are considerably higher on grass that is well fertilized and watered, such as in the current study, than on grass that is under nutrient and/or moisture stress. Close mowing practices place severe physiological stress on turfgrass, thus substantially lowering threshold levels (Smiley *et al.* 2005). Further investigation is needed to establish the damage thresholds of *P. penetrans* on turfgrass species under different soil and environmental conditions, and also to determine the effect of *P. penetrans* on disease development under various turfgrass management programs in Canada.

ACKNOWLEDGEMENTS

The authors thank Dr. Julie Dionne, Royal Canadian Golf Association, for her collaboration in this research project, and Nathalie Dauphinais, Yvon Fournier and Marie-Ève Gosselin for their dedicated technical assistance. This research was conducted through a collaborative research agreement between the Ontario Golf Superintendents' Association and the Matching Investment Initiative program of Agriculture and Agri-Food Canada.

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