

## Effect of green manuring on *Globodera rostochiensis* and *Pratylenchus* spp. (Nematoda)

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**Abstract.** Concomitant effect of *Globodera rostochiensis* and *Pratylenchus* spp. on potato was investigated under glasshouse conditions. *G. rostochiensis* alone or with *Pratylenchus* spp. reduced significantly the weight and number of size 3 (>100 g) tubers. Experiments with various green manure crops showed that growing *Brassica nigra* L. and *Tagetes patula* L. prior to potato resulted in a decline of *G. rostochiensis* and *Pratylenchus* spp. population densities and a tuber yield increase compared to control. *Hordeum vulgare* L. increased the density of *Pratylenchus* spp. in soil.

**Key words:** Nematoda, population density, intercropping, green manure.

### INTRODUCTION

Nematodes are one of the major limiting factors for potato production in Bulgaria. Predominant nematode pests identified from the rhizosphere of potato are cyst nematodes (*Globodera* spp.), root lesion nematodes (*Pratylenchus* spp.), and stubby root nematodes (*Trichodorus* spp. and *Paratrichodorus* spp.) (Brown et al., 1980; Trifonova, 1998). *Globodera rostochiensis* and *Pratylenchus neglectus* or *P. penetrans* reduce the quality and yield of potato (Bernard & Laughlin, 1976; Stoyanov & Assenova, 1987; Olthof, 1990; Trifonova, 1995).

Nematode control for potato includes a combination of chemical and cultural practices to suppress nematode populations. Green manuring has been reported to be effective for the control of plant parasitic nematodes in some countries (Mojtahedi et al., 1991; Mahmood & Siddiqui, 1993; Siddiqui & Mahmood, 1993). Several plants have been found to contain nematotoxic principles and have been used to control plant nematodes (Sangwan et al., 1985; Pandely et al., 2001). Mustard (*Brassica juncea*), neem (*Azadirachta indica*), and castor-oil plant (*Ricinus communis*) have been reported to reduce nematode population densities

in potato (Akhtar & Alam, 1991). Incorporation of organic matter into the soil and intercropping are aimed at increasing crop production. Both practices have been used by farmers for many years. However, little is known about the use and effectiveness of green manure crops for controlling *G. rostochiensis* and *Pratylenchus* spp. in potato growing areas.

The objectives of this study were to evaluate the pathogenicity of *Pratylenchus* spp. alone and in combination with *G. rostochiensis* on potato and determine the efficacy of various green manure crops on potato yield in the presence of *G. rostochiensis* and *Pratylenchus* spp.

## MATERIALS AND METHODS

The experiments were conducted in a glasshouse. Pots (5 L) were filled with sterile soil. The population of *G. rostochiensis* was obtained from a field. Cysts were extracted by the wet-sieve decantation technique. Second-stage juveniles (L<sub>2</sub>) were obtained by exposing soaked cysts to potato root diffusate. The *Pratylenchus* population was collected from an infested barley field. Specimens for the inoculum were extracted from the soil by Cobb's sieve technique (Shepherd, 1970).

Single potato tubers (*Solanum tuberosum* cv. Focal) were planted in each pot. After a week, suspension of 10 000 L<sub>2</sub> *G. rostochiensis* or 10 000 *Pratylenchus* spp. or both was added to each pot. Uninoculated pots were used as controls. Regular cultural practices were followed. Three months after planting the tubers were harvested, weighed, and the yield data were recorded. Each treatment was replicated five times.

In a second experiment 200 g of freshly chopped leaves and roots of barley (*Hordeum vulgare* L.), mustard (*Brassica nigra* L.), pea (*Pisum arvense* L.), or marigold (*Tagetes patula* L.) was added to the pots as green manure. The control pots received no green manure. The pots were watered daily. Single potato tubers were planted in the pots and nematodes were added at a rate of 10 000 L<sub>2</sub> *G. rostochiensis* and 10 000 *Pratylenchus* spp. alone or combined per pot. All the treatments were replicated five times. The crops were harvested after three months. Nematodes were recovered from the soil samples by Cobb's method and wet-sieve decantation technique. The potato tubers were categorized by size (size 1 = <50 g, small; size 2 = 50–100 g, medium-sized; size 3 = >100 g, large). Data were compared by analysis of variance and Duncan's multiple range test.

## RESULTS AND DISCUSSION

Treatment with *G. rostochiensis* alone or concomitantly with *Pratylenchus* spp. reduced significantly the weight and number of size 3 tubers and suppressed the potato yield as compared to control (Table 1). Also *Pratylenchus* spp. alone

**Table 1.** Effect of *Globodera rostochiensis* and *Pratylenchus* spp. on mean potato weight and size distribution

Nematode	Tuber weight, g	Mean number per pot		
		<50 g	50–100 g	>100 g
<i>Pratylenchus</i> spp.	517.8b	3.6c	3.2d	0.96ab
<i>G. rostochiensis</i>	298.8a	1.8a	2.8c	1.20b
<i>Pratylenchus</i> spp. + <i>G. rostochiensis</i>	304.8a	2.0ab	1.8a	0.80a
Control	912.8c	2.2b	2.2b	7.40c
<i>F</i>	96.02	8.89	8.59	249
SE	41.58	0.387	0.299	0.288

Means in columns followed by the same letters are not significantly different according to Duncan's multiple range test (for  $P = 0.05$ ).

suppressed size 3 tubers as compared to uninoculated control. Olthof (1990) reported that *Pratylenchus neglectus* suppresses the total number of tubers by 25%. Kimpinski & McRae (1988) found a linear relationship between the number of root lesion nematodes at planting and tuber yield increases after aldicarb treatment.

In our study green manure treatments influenced significantly tuber weight and size distribution (Table 2). The total yield of tubers from all green manure treatments was significantly higher than control. The yields from the mustard, marigold, and pea treatments were significantly higher than from barley treatments. The number of size 1 and 2 tubers was the smallest from the marigold treatments.

**Table 2.** Efficacy of green manures on potato tuber yields and size distribution in the presence of *Globodera rostochiensis* and *Pratylenchus* spp.

Treatment	Tuber weight, g	Number per pot		
		<50 g	50–100 g	>100 g
Mustard	746.6c	3.2d	2.0b	6.6e
Marigold	740.0c	0.8b	1.8ab	5.4d
Barley	718.2b	1.6c	2.8c	2.8b
Pea	742.0c	0.0a	3.4d	4.4c
Control	400.2a	3.8e	1.6a	0.8a
<i>F</i>	133	38.1	9.23	44.7
SE	18.459	0.336	0.352	0.479

Means in columns followed by the same letters are not significantly different according to Duncan's multiple range test (for  $P = 0.05$ ).

Significantly more size 3 tubers (the largest category) than control were produced in all green manure treatments. These results clearly indicate that higher potato yields with more large tubers may be obtained by using green manures as a cultural practice.

Among all green manure crops studied the largest populations of *Pratylenchus* spp. in the soil were recorded in the case of barley (Table 3). Marigold treatment reduced significantly soil populations of *Pratylenchus* spp. *G. rostochiensis* populations were smaller than control in the soil from all green manure treatments. The highest decrease was observed in pots treated with mustard. However, marigold, barley, and pea also supported significantly lower populations than control. The largest reduction in nematode multiplication for *G. rostochiensis* (79.7%) occurred in the mustard and for *Pratylenchus* spp. in the marigold (43.7%) treatment.

The finding that green manuring with mustard is more effective against *G. rostochiensis* than marigold, pea, or barley treatments is in agreement with the results of Akhtar & Alam (1991), who reported reduction in nematode numbers due to mustard (*Br. juncea*) grown along with potato.

The nematicidal or nematostatic effect of marigold is associated with its high content of  $\alpha$ -terthienyl (Uhlenbroek & Bijloo, 1958). These results are in agreement with those of Sasanelli & D'Addabbo (1992, 1993) and Hachney & Dickerson (1975), who reported nematotoxic properties of *Tagetes* spp.

It would be useful to ascertain whether the cultivation of these plants for short periods or their application as green manure could be beneficial for the control of nematodes in the field.

**Table 3.** Efficacy of various green manures in controlling the population of *Globodera rostochiensis* and *Pratylenchus* spp.

Treatment	<i>G. rostochiensis</i>		<i>Pratylenchus</i> spp.	
	No. in 200 g soil	Reduction in comparison with control, %	No. in 200 g soil	Reduction in comparison with control, %
Mustard	52.2a	79.7	159.8c	4.3
Marigold	155.6b	39.5	93.6a	43.7
Barley	165.0b	35.6	316.8d	–90
Pea	162.4b	36.8	142.0b	14.5
Control	256.4c	–	166.8c	–
<i>F</i>	90		189.9	
SE	10.78		8.67	

Means in columns followed by the same letters are not significantly different according to Duncan's multiple range test (for  $P = 0.05$ ).

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## Haljasväetise toime koldsele kartuli-kiduussile (*Globodera rostochiensis*) ja niiduingerjatele (*Pratylenchus* spp.) (Nematoda)

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Kasvuhoone vegetatsioonikatsetes selgitati koldse kartuli-kiduussi ja niiduingerjate koosmõju kartulile (*Solanum tuberosum* cv. Focal). Kiduussid eraldi ja

koos niiduingerjatega vähendasid suurte (üle 100 g) mugulate saaki. Haljasväetisena kasutatud must kapsasrohi (must sinep *Brassica nigra* L.) ja peiulill (*Tagetes patula* L.) vähendasid tunduvalt mõlema nematoodi arvukust. Sellega kaasnes saagikuse tõus. Koldse kartuli-kiduussi arvukus vähenes ka odra toimel, kuid niiduingerjate asurkonna tihedus mullas suurenes odra toimel oluliselt.