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CONCOMITANT INTERACTION OF *MELOIDOGYNE CHITWOODI* AND *PRATYLENCHUS NEGLECTUS* IN A POTATO CROPPING SYSTEM

by
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Summary. Concomitant interaction of *Meloidogyne chitwoodi* and *Pratylenchus neglectus* was investigated on potato cv. Russet Burbank under glass house, microplot and field conditions. *M. chitwoodi* alone or with *P. neglectus* significantly reduced size 1 and size 3 tubers respectively. Green manure crops of oil radish, barley, velvetbean and buckwheat prior to potato resulted in decline of *M. chitwoodi* and *P. neglectus* population densities and tuber yield increase compared to fallow. Maximum yield followed barley while minimum soil and root population of both nematode species was in velvetbean plots. Application of prophos along with green manure significantly increased the tuber yield and grade 1 and 2 tubers as compared to fallow. Among all, buckwheat as a preceding crop increased the above parameters more than the other green crops.

Nematodes are one of the major limiting factors for potato production in Idaho. Predominant nematode pests identified from the rhizosphere of potato are root knot nematodes (*Meloidogyne* spp.), root lesion nematodes (*Pratylenchus* spp.) and stubby root nematode (*Trichodorus* and *Paratrichodorus* spp.) (Hafez and Thornton, 1992). *Meloidogyne chitwoodi* reduces the quality and yield of potato and *Pratylenchus neglectus* causes yield reduction (Hafez *et al.*, 1999). Nematode management for potato includes a combination of chemical and cultural practices to maintain nematode populations below the economic threshold level and thereby reducing yield loss and quality damage (Mojtahedi *et al.*, 1993; Santo, 1994; Al-Rehiayani *et al.*, 1999). However, little is known about the use and effectiveness of green manure crops for management of *M. chitwoodi* and *P. neglectus* in Idaho potato rotation systems. The objectives of this study were to: 1) evaluate the pathogenicity of *P. neglectus* alone and in combination with *M. chitwoodi* on potato; 2) determine the efficacy of green manure crops with or without prophos, on potato yield in the presence of *M. chitwoodi* and *P. neglectus*.

Materials and methods

An experiment was conducted in a glasshouse in 6 l pots filled with a sterile soil mixture. Single potato tubers (*Solanum tuberosum* L.) cv. Russet Burbank were planted in each pot and suspension of 20,000 J2 *M. chitwoodi* Golden, O'Bannon, Santo *et* Finley or 10,000 *P. neglectus* (Rensch) Filipjev *et* Schuurmans Stekhoven alone or together were added. Regular cultural practices were followed. Five months after planting the crop was harvested, tubers were weighed and yield data were recorded. The experimental design was a completely randomized block with four treatments of five replications each.

In a second experiment silt-loam soil was fumigated with metham sodium at 469 l/ha before incorporating fresh, glasshouse-grown green manures. Each experimental unit consisted of a 16 l microplot receiving the moisture adjusted equivalent of 228 g fresh barley (*Hordeum vulgare* L.), velvetbean [*Mucuna deeringianum* (Bort) Merr.], buckwheat (*Fagopyrum esculentum* L.) or oil radish (*Raphanus sativus* L.) green manures. Fallow (control) microplots received no green manure. Single potato tubers, average weight 60 g were planted in the microplots and nematodes were added at the rate of 10,000 *P. neglectus* or 20,000 J2 *M. chitwoodi*, alone or combined, per microplot. The experimental design was a randomized complete block with four replications. Microplots were harvested after four months and soil, roots and tubers separated. Nematodes were recovered from soil sample by Cobb's method and from roots by mistifier technique. Potato tubers were categorized by size and % of infected tubers were calculated.

A field experiment was conducted in a *M. chitwoodi* infected field to determine the effects of green manure and prophos on tuber yield, grade distribution and nematode infection. The experiment was laid out in a randomized block design with four treatments each of four replications. Three green manure crops *viz.*, oil radish, buckwheat and rapeseed (*Brassica napus* L.) were planted in the autumn with fallow treatment as a control. Two months after planting, the field was ploughed to incorporate the green manure crops. Prophos 6 EC, was applied at 18.8 l c.p./ha to all treatments and the potato seed tubers cv. Russet Burbank were planted in rows three feet apart. Weeding and other normal cultural practices were followed. Five months after planting the crop tubers were hand-harvested from 15 feet of the middle two rows of each plot and weighed. The tubers were graded and evaluated for nematode infection. Data were analyzed as a split-split plot factorial and means separated by FLSD.

Results and discussion

M. chitwoodi alone or concomitantly with *P. neglectus* significantly reduced the size 3 tubers as compared to control plots (Table I) under glasshouse conditions. *M. chitwoodi* alone reduced size 1 tubers as compared to uninoculated control. However, either one did not influence yield of size 2 tuber. But Olthof (1990) reported that in one experiment Pi of 186 *P. neglectus*/kg soil suppressed the marketable and total number of tubers by 19 and 25%, respectively. In another study Kimpinski and McRae (1988) found that there was a linear relationship between the number of root lesion nematodes at planting and tuber yield increases after aldicarb treatment for cv. Superior, but not for cv. Russet Burbank.

In microplot studies, green manure treatments significantly influenced tuber weight and size distribution (Table II). Total yield of tubers from all green manure treatments was significantly higher than from fallow. Yield from the barley treatments was significantly higher than from buckwheat and yields from oil radish and velvetbean were intermediate. In addition, the number of size 1 tubers, the smallest category, was significantly less from the barley, radish and buckwheat treatments than from fallow and velvetbean. Kimpinski *et al.* (1992) also found

TABLE I - *Concomitant interaction of* Meloidogyne chitwoodi *and* Pratylenchus penetrans *on potato under glass house conditions*

Nematodes(s)	Tuber wt.	Size 1+	Size 2	Size 3
	g	—no./microplot—		
None	1734NS	18.2 b	7.0NS	5.4 a
P. neglectus	1803	18.7 b	7.9	5.2 ab
P. neglectus+ *M. chitwoodi*	1703	18.3 b	7.0	4.7 ab
M. chitwoodi	1562	24.6 a	6.0	4.8 b

Means in a column followed by different letters are significantly different.
NS = not significant. +Size 1 = <50 g; Size 2 = 50 to 100 g; and Size 3 = >100 g.

TABLE II - *Efficacy of green manure on potato tuber yields and weight distribution in the presence of* M. chitwoodi *and* P. neglectus *under microplot conditions.*

Treatment	Tuber wt.	Size 1+	Size 2	Size 3
	g	—no./microplot—		
Barley	2005 a	17.6 b	6.5NS	6.6 a
Oil radish	1814 ab	17.9 b	7.6	5.4 ab
Velvetbean	1779 ab	24.7 a	7.5	4.4 b
Buckwheat	1614 b	16.4 b	6.7	5.1 b
Fallow (none)	1290 c	23.2 a	6.5	2.5 c

Means in a column followed by different letters are significantly different.
NS = not significant. +Size 1 = <50 g; Size 2 = 50 to 100 g; and Size 3 = >100 g.

TABLE III - *Efficacy of green manure on the population of* M. chitwoodi *and* P. neglectus *under microplot conditions.*

Treatment	M. chitwoodi		P. neglectus	
	500 cm^3 soil	g root	500 cm^3 soil	g root
Barley	7421 ab	5238 ab	493 ab	953 a
Oil radish	4554 bc	2762 b	1049 a	765 ab
Velvetbean	4033 c	3210 b	299 b	561 b
Buckwheat	5326 abc	3369 b	363 ab	346 b
Fallow (none)	8494 a	6893 a	506 ab	736 ab

Means in a column followed by different letters are significantly different.

TABLE IV - *Potato tuber yield, grade distribution and percent infected tubers from plots with and without green manure incorporation and with and without prophos application in a field infested with* M. chitwoodi.

Soil Treatment	Tuber Yield (kg/ha)	Grade Distribution		Infected %
		Grade 1 and 2	Cull tubers	
Without prophos:				
Buckwheat	47.4 ab*	35.1 a	12.3 bc	50.8 a
Rapeseed	46.5 ab	33.5 ab	13.0 bc	46.8 a
Oil radish	45.3 bc	32.7 abc	12.7 bc	34.7 bc
Fallow	43.1 bc	28.9 bc	14.2 ab	35.2 cd
With prophos:				
Buckwheat	50.4 a	35.1 a	15.8 a	37.7 ab
Rapeseed	45.4 bc	30.9 abc	14.5 ab	49.2 ab
Oil radish	43.5 bc	32.6 abc	10.8 c	35.0 cd
Fallow	40.7 c	28.5 c	12.2 bc	30.5 d

*Means within a column followed by the same letter are not significantly different ($\alpha = 0.05$).

that potato tuber yield was higher in the cropping sequences that began with barley. All green manure treatments produced significantly more size 3 tubers, the largest category, than fallow. These results clearly indicate that higher yields of potato tubers with more large tubers and fewer culls may be obtained when utilizing green manures as a cultural practice.

Among all crops barley recorded highest population of *P. neglectus* in the root. Kimpinski *et al.* (1992) reported that lesion nematode population was largest in barley roots when barley followed potato.

M. chitwoodi populations were lower at harvest in roots and soil from the green manure treatments (Table III). However, highest decrease was observed in microplots planted with barley. O'Bannon *et al.* (1982) also found that barley is a good host for *M. chitwoodi* and Ferris *et al.* (1994) reported that barley was a maintenance host, supporting the *M. chitwoodi* population at its current level without substantial increase or decline. Radish, velvetbean and buckwheat supported significantly lower root populations than fallow. *P. neglectus* populations were less affected than *M. chitwoodi.*

Application of prophos along with green manure significantly increased the tuber yield and grade 1 and 2 tubers as compared to fallow (Table IV). Buckwheat as a preceding crop increased tuber yield, grade distribution and per cent infected tubers. However, the yields increase in the plots, as compared to fallow, with-

out prophos is not significantly different. Reports indicated that application of prophos either alone or along with 1,3 dichloropropene reduced the percent infection by *M. chitwoodi*. Percent reduction of infested tuber was not significant with or without addition of prophos, in contrast to Radewald *et al.* (1975) results.

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