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CONTROL OF POTATO CYST NEMATODE *GLOBODERA ROSTOCHIENSIS* WITH SOME PLANT EXTRACTSAND NEEM PRODUCTS

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Abstract

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An experiment was conducted under glass-house conditions to test the effects of five plants products in the form of drenches on the growth of potato and population density of potato cyst nematode *Globodera rostochiensis*. All the tested formulations improved plant growth, yield and suppressed the nematode multiplication. Neem oil+extract of *Nicotiana tabacum* 0.5% or *Veratrum album* 1.0% were the most effective in reducing the disease incidence (77.7 – 77.8%), followed by neem Azal 0.3% (66.6%) and neem oil 0.3% (50.0%). None of the formulations was phytotoxic even at the tested concentration.

Key words: drench application, population density, potato cyst nematode, *Globodera rostochiensis*

Introduction

The potato cyst nematode *Globodera rostochiensis* (Woll.) is the major pests for the potato cultivars in Bulgaria, causing up to 80% loss of yield (Trifonova, 1995; 2000). Soil treatment with nematocides has been an established practice for the control of cyst-forming nematodes of the genus *Globodera*, though it is very expensive for the farming community. In recent years we have been observing an increasing trend to use alternative methods of pest control based on replacing chemicals pesticides by natural compounds. Biological strategies depended of the use of organic amendments (Kantharaju and Reddy, 2001), antagonistic plants (Franco et al., 1999) and bio-control agents (Mani et al., 1998). Among the numerous ingredients of plants studies during the last 20 years, extracts and compounds from the neem tree (*Azadirachta indica*) have attracted the special interest of entomologists all over the world. In recent years some marketable, neem-based products have been developed. Investigations on extracts from neem and neem products have revealed that some of them are effective against insects and nematodes (Kumar and Khanna, 2006; Mojumder, 1995; Sharma, 2000).

According Akhtar and Mahmood (1993) bare-root dip treatment with neem oil effective reducing population density of *Meloidogyne incognita* on tomato.

Therefore, investigations were undertaken to test the nematocidal potential of neem based products and extracts of *Nicotiana tabacum* and *Veratrum album* for control of *Globodera rostochiensis*.

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Materials and Methods

The experiments were conducted in the glasshouse at a mean temperature of 21°C ± 2°C and were terminated after 12 weeks or after completion of the nematodes life-cycle.

Nematode

The population of *Globodera rostochiensis* was obtained from soil samples collected from heavily infested potato fields in Smolyan region. The cysts of the nematode were produced on susceptible potato cultivars *S. tuberosum* cv. Focal in glasshouse. They were extracted from the soil by wet-sieve technique (Southey, 1986).

Plant products

The three commercial formulation: two of neem (*Azadirachta indica* A. Juss.) - neem Azal 0.3% and neem oil 0.3%; one of soya oil 0.3%; plant extracts of *Nicotiana tabacum* L. and neem oil 0.5% and *Veratrum album* L. and neem oil 1.0% was tested. They were added into the soil as a drench in the rate of 50 ml/pot. The commercial formulations were obtained from the National Service for Plant Protection – Sofia. The plant extracts were prepared by the method of Atanasov and Stojanova (1997) in the Department of Biological and Integrated Plant Protection – Kostinbrod.

Treatments

The treatments were made in a glasshouse at 20-22° C and 13 h day length. The 12 cm diameter pots were filled with 600 g of autoclaved soil. Seed tubers cv. Nadejda was used in the all tests. Each plant was inoculated with 50 viable cysts put in muslin bags around the root. Each treatment was replicated five times.

The final nematode density was determined after 12 weeks by the wet-sieve decantation technique (Southey, 1986). The number of cysts/pot, reproduction index (R = pf/pi), plant parameters and yield of potato tubers were recorded.

The data were subjected to factorial analysis of variance and treatments were compared using Duncan `s multiple range test (Steel and Torrie, 1980).

Results and Discussion

Growth characters

The soil application of the plant products significantly improved plant growth and increased the yield of potatoes from 0.6% to 13.2%, compared with the untreated-inoculated plants (N) (Table 1). The best results were obtained in the case of neem oil+*Nicotiana tabacum* extract: 24.4 cm total weight of shoot, and 59.9 cm total plant length. Infection by *G. rostochiensis* caused significantly decrease in the weight of potato compared to the uninoculated control (C). Data showed that the total plant length of inoculated-treated with soya oil + *V. album* extract plants were not significantly different from the untreated-inoculated plants ($P \leq 0.05$).

The greatest increase in the yield occurred with oxamyl treatment (16.8%), followed by neem oil+*Nicotiana tabacum* extract (13.2%), neem oil+*V. album* extract (11.5%), and neem oil (0.9%), compared with inoculated untreated plants (N). Infection by the nematode caused 99.7% decline in the yield.

Population density

Different treatments significantly reduced the incidence of potato cyst nematode on potato plants. In all treatments population density of *G. rostochiensis* drastically declined compared with control (N). The highest reproduction rate of *G. rostochiensis* was registered in the infected-untreated plants (R = 3.6) (Figure 1). The greatest decrease in the number of newly formed cyst occurred in the oxamyl application (R = 0.4). Among all treatments, oxamyl gave the maximum reduction in population density (86.0% over control). The number of females was significantly reduced in the presence of the neem products (50.0% - 77.8%). Maximum reduction in reproduction

Table 1

Effect of soil application of plant products on the growth and yield of potato in soil infected with *Globodera rostochiensis*

Treatments	Plant weight			Plant length, cm			Yield, g	Increase, %
	shoot	root	total	shoot	root	total		
Neem Azal 0.3%	20.4	1.40	21.7*	43.2	9.5*	72.7*	32.2	6.6
Neem oil +N. tab.	22.4	2.1	24.4*	49.2	10.7	59.9*	34.2	13.2
Neem oil + V. album	22.3	2.3	24.3*	47.3	9.3	56.0*	33.7	11.5
Neem oil 0.3%	18.5	1.2	19.7*	40.2	8.2	48.4*	30.5	0.9
Soya oil 0.3%	14.1	0.7	14.8*	30.2	5.4	35.6*	30.4	0.6
Soya oil + N. tab.	16.2	1.1	17.2*	37.3	7.3	44.6*	31.3	3.6
Soya oil + V. album	15.3	0.9	16.2*	34.2	6.2	40.5ns	30.7	1.6
Control	24.1	2.3	26.3*	50.1	10.3	60.1*	101.2	23.5
Nematode	10.2	0.9	11.1	33.2	7.2	40.4	30.2	
Oxamyl 1.5 mg/g siol	22.2	2.2	24.3*	50.2	9.8	60.0*	35.3	16.8
Se			0.36			0.44	0.23	
Sd			0.54			1.11	0.44	

* - Significant differences from the control (N) at P 0.05

index was observed in the treatments with neem oil+extracts of *N. tabacum/ V. album* (R = 0.8), followed by neem Azal (R = 1.2)) and neem oil (R = 1.8) treatments. These data are similar to those reported by Kumar and Khanna (2006) to the root-knot nematode *Meloidogyne incognita* on tomato. The treatments with soya oil had lest effect on the population density of the nematode. The reproductive rate of *G. rostochiensis* in these treatments was decreased by 22.2%.

All treatments reduced population density of the potato cyst nematode and increased the tuber yield. Results indicated that neem-based treatments improved plant status, exerted significant control of the nematode density. Integration of neem oil and extracts of *N. tabacum/V. album* showed the greatest nematicidal effect against the cyst nematode.

It is known that *A. indica* produce limonoids (azadirachtin, nimbidin, phenolics, aldehydes etc) different from those found in other plants (Hasan and Khan, 2004; Khan, 1976; Mojumder, 1995; Kumar and Khanna, 2006). According Akhtar and Alam (1991), Upadhyay et al. (2003), Khurma and Singh (1997) the seed and leave extracts of neem (*Azadirachta indica* A. Juss) caused 100% juvenile mortality of the root-knot nematodes and some free-living nematodes on the potato.

Nicotiana tabacum L. and *Veratrum album* L. contain active substances – the alkaloids, nicotin, protovetrin, ervin etc. (Asenov and Nicolov, 1988). These alkaloids act at direct contact cause death of the insects (Atanasov et al., 2005). Our data show a possible antagonistic effect of the plant extracts of *N. tabacum L.* and *V. album L.* There are two possibilities for effect of the alkaloids on the cyst - through the neck or directly through the hitting covering of the cysts. It is well known that the biologically active substances quickly decompose and are influenced by environmental factors, such as soil, temperature and moisture. This fact and our study results let us to conclude that to have good effect in the management of the control of potato nematode it is necessary for the plant extract to be applied in the time of hatching of the juveniles. The results agree with data obtained *in vitro* by

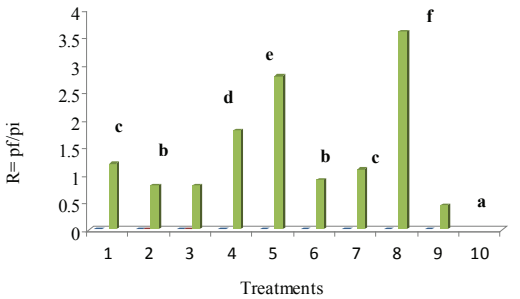

Fig. 1. Effects of soil application of plant products on the reproduction rate of *G. rostochiensis*:

1 = neem Azal 0.3%; 2 = neem oil+*N. tabacum* 0.5%; 3 = neem oil+*V. album* 1%; 4 = neem oil 0.3%; 5 = soya oil 0.3%; 6 = soya oil+*N. tabacum* 0.5%; 7 = soya oil+*V. album* 1%; 8 = nematode; 9 = oxamyl 1.5 mg/g soil; R = pf/pi – final/initial nematode density. Columns with the same letters are not significantly different ($P \leq 0.05$) according to Duncan`s Multiple Range Test

Trifonova and Atanasov (2009) for juveniles of *G. rostochiensis*.

Our results suggest that application of the tested products can provide effective control of potato cyst nematode and use an alternative method of plant disease control.

Conclusions

The results obtained from research on the application of plant products on the plant growth and yield of potatoes infected by *G. rostochiensis* allow us to make the following conclusions:

All treatments improved the plant growth and yield of potatoes.

The neem-based products – neem oil 0.5% and neem-Azal 0.3% caused significant inhibitory effect on the multiplication of *G. rostochiensis*. They decreased reproduction rate to 66.6%.

The best reduction in the population density was obtained in the application of neem oil+ plant extracts of *Nicotiana tabacum* 0.5%/*Veratrum album* 1.0% treatments - 77.7 - 77.8%.

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