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Effect of plant root extracts to control root-knot nematode (*Meloidogyne* spp.) of soybean (*Glycine max*)

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ABSTRACT

Chemical control of plant-parasitic nematodes, essentially, involves the use of synthetic nematicides. However, apart from its very high cost, increased concern for the environment has necessitated a reduction in the amount of nematicide used for nematode control. Additionally, there has been an increase in the intensity of search for other efficient, ecologically sound and safe control methods. *Meloidogyne* spp. (Kofoid and White) Chitwood, eggs were exposed to concentrations of root extracts of Siam weed [*Chromolaena odorata* (L.) King and Robinson], Neem (*Azadirachta indica* A. Jass), Castor bean (*Ricinus communis* L.) and Lemon grass (*Cymbopogon citratrus* (DC.) Stapf). One hundred percent concentration of root extracts of Siam weed and Neem exhibited 100% inhibition of egg hatch and larval mortality. While 100% concentration of root extracts of Castor bean and Lemon grass exhibited 93 and 95% inhibition of egg hatch and 62.1 and 75% larval mortality respectively. Egg inhibition and larval mortality decreased with an increase in the dilution of all the extracts. Similarly with an increase in exposure time, juvenile mortality was also increased. Significant differences were also observed in the concentrations of the root extracts in respect of the two parameters.

Key words: Edible soybean, larval mortality, *Meloidogyne* spp., root extracts

INTRODUCTION

Among various pests and diseases, which damage crops, plant-parasitic nematodes present a formidable pest problem for different crops. Most species attack and feed on plant roots and underground plant parts. Root-knot nematode (*Meloidogyne* spp.), is an important pest of vegetables. Its approximate distribution in agricultural soils of India is 75% among *Meloidogyne* species. It attacks almost all the cultivated plants and can cause high losses. Initially, very few pests and diseases were found on edible soybean (*Glycine max* (L.) Merr.) in India. As cultivation expanded and became more intensive, pest and disease problems increased in incidence and severity (Akem 1991 and Akem et *al*., 1992). Nematodes did not initially constitute a serious problem on edible soybean, although some important nematode species were found attacking the crop (Caveness 1967 and Ogunfowora et *al*., 1983). With more intensive cultivation of edible soybean in areas that are frequently used in growing other vegetables, damage from root-knot nematode to edible soybean is increasing. Greenhouse studies confirmed this (Afolami 1999 and Atungwu 2001).

Indiscriminate use of synthetic pesticides for controlling nematodes is likely to give rise to phytotoxicity, environmental pollution and nematode resistance. Unsafe use of pesticides may result in poisoning of humans is a problem especially in developing countries (Yudelman et *al*., 1998 and Conway 1995). Toxicity of root extracts of different plants against nematodes has been reported by many researchers (Onifade et *al*., 1994 and Hackney, et *al*., 1975). In view of damage potential of these tiny hidden enemies of crop plants, an urgent need was felt for initiating coordinated efforts at national level pertaining to nematode distribution, assessment of crop losses and for developing nematode management technologies. The present research was undertaken to evaluate plant root extracts to control root-knot nematode on edible soybean.

MATERIALS AND METHODS

Preparation of extracts

Twenty-five gram of thoroughly washed and chopped roots of Siam weeds *Chromolaena odorata* (L.) King and Robinson), Neem (*Azadirachta indica* A. Jass), Castor bean (*Ricinus communis* L.) and Lemon grass (*Cymbopogon* citratrus (DC.) Stapf) were ground separately in an electric grinder in 100 mL of distilled water. These were then centrifuged and filtered through Whatman No. 1 Filter Paper (Whatman, Bristol, UK) and constituted the undiluted (100%) treatment. This extract was diluted 5, 10 and 20 times with distilled water.

Extraction of juveniles

Root-knot nematode was identified on the basis of perineal pattern Eisenback *et al*. It was maintained on the edible soybean cv. TGX 1485-1D and the second juveniles were extracted from roots using the tray method of Whitehead and Hemming.

Extraction of eggs

Egg masses collected from edible soybean roots were vigorously shaken with 200ml of 5.2% sodium hypochlorite in stopper flasks for 2 min. Eggs were washed by rinsing with tap water through a 75 µm sieves, collected on a 26 µm sieve and transferred into distilled water forming egg suspension.

Effect of root extract on egg hatching

A small drop of eggs suspended in distilled water was placed in Petri dishes and eggs counted under a stereo microscope. Ten milliliter of the undiluted and each dilution of root extract of each plant were added. Petri dishes containing distilled water served as controls. Each treatment was replicated four times. The Petri dishes were incubated at room temperature. Hatching was observed after 7 days and the percentage inhibition calculated as follow.

Effect of root extracts on larval mortality

Ten milliliter of the undiluted and each dilution of root extract of each plant were separately poured into Petri dishes and 1ml of suspensions containing 20 freshly hatched juveniles were added to each Petri dish. All treatments were replicated four times. The Petri dishes were incubated at room temperature. Percent mortality was calculated after 12, 24 and 48 h. All the data collected were analyzed using analysis of variance and means separated with the Duncan Multiple Range Test (Gomez et *al*., 1984).

RESULTS AND DISCUSSION

Egg hatch

Table shows the effect of concentration of extracts of plants on number of eggs and percentage hatch inhibition indicated that one hundred percent concentration of root extracts of Siam weed and Neem gave the maximum inhibition of egg hatching (100%) followed by Lemon grass and Castor bean with 95 and 93.2% inhibition, respectively. Other dilutions viz. 20, 10 and 5%, though significant, were less effective as compared to 100% concentration. It is evident that as extract was diluted; toxicity was decreased resulting in correspondent decrease in inhibition and minimum inhibition was observed in distilled water (0% concentration). The inhibitory effect of the extracts might be due to the chemicals present in the extracts that possess ovicidal and larvicidal properties.

These chemicals either affected the embryonic development or killed the eggs or even dissolved the egg masses. It has been reported (Adegbite 2003, Goswami et *al*., 1986 and Hackney et *al*., 1975) that extracts contained alkaloids, flavonoids, saponins, amides including benzamide and ketones that singly and in combination inhibited hatching.

Larval mortality

Table shows the effects of larval mortality over time due to the concentration of extracts of roots of the test plants. The root extracts of test plants were effective in causing larval mortality; 100% concentration of extracts being more efficacious and show high significant difference than other concentrations. 100% concentration extracts of Siam weed and Neem showed 100% mortality even after 12 h of exposure time. While 100% concentration of Lemon grass and Castor bean showed 75 and 62.1% mortality after 12 h of exposure time. The juvenile mortality increased with increase in exposure time. The

mortality was found to differ significantly between different concentrations of extracts of the tested plants at all the three intervals tried (12, 24 and 48hrs.). As the exposure period increased mortality increased to 87.5 and 75.6%, respectively in Lemon grass and Castor bean at 100% concentration of the root extracts.

CONCLUSIONS

It has been concluded from present research that certain plant extracts are a source of cheap and effective nematicides of root knot nematodes. The root extracts of Neem, Siam weed, Lemon grass and Castor bean were found to have nematicidal properties. This finding is important from the point of view of controlling root-knot nematodes affecting edible soybean without the use of nematicides in view of the environmental pollution likely to cause. The future looks bright for identifying new classes of pesticides from natural plants to replace the synthetic dangerous and expensive chemicals used at present. The cooperation of nematologists, breeders, chemists, ecologists and others in the field of agriculture is necessary to achieve maximum progress in this important field of research.

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Table 1. Effects of concentration of plant root extracts on egg hatch, and exposure time on larval mortality on *Meloidogyne* spp.

		Egg hatch		**Larval mortality (%) after**		
Plant	**Concentration**	No of eggs[y] (%)[y]	Hatch inhibition after 7 days	12h[y]	24h[y]	48h[y]
C. odorata	100	27.5a	100.0a	100.0a	100.0a	100.0a
	20	20.3b	92.5b	91.0b	98.8a	97.0a
	10	20.0b	72.8c	14.6c	35.9b	56.7b
	5	17.2c	72.6c	5.0d	7.8c	15.9c
	0	22.7b	19.2d	0.0e	2.5d	2.5d
A. indica	100	22.20a	100.0a	100.0a	100.0a	100.0a
	20	18.8a	88.7b	81.0b	89.0b	90.0b
	10	15.5b	67.8c	12.3c	27.9c	45.9c
	5	14.5b	66.8c	1.7d	6.8d	14.6d
	0	14.2b	16.3d	0.0d	0.0e	0.0e
R. communis	100	18.9a	94.2a	62.1a	68.3a	75.6a
	20	21.7a	76.9b	21.1b	27.9b	38.9b
	10	21.6a	58.5c	14.2c	23.6c	26.8c
	5	20.6a	44.7d	6.7d	9.0d	12.3d
	0	14.1b	14.1e	0.0e	1.7e	1.7e
C. citratrus	100	24.4a	96.2a	75.0a	77.6a	87.5a
	20	17.8b	76.1b	17.1b	26.8b	50.0b
	10	12.5c	65.7c	14.1c	13.5c	24.7c
	5	12.8c	52.8d	3.3d	6.7d	13.5d
	0	22.1a	14.8e	0.0d	0.0e	0.0e