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Efficacy of Botanicals for the Management of Root-Knot Nematode, *Meloidogyne incognita* in Chillies

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Abstract

Investigations were carried out to study the nematicidal potential of botanicals against Root-Knot Nematode, *Meloidogyne incognita* in Chilli. The highest reduction (81.87 per cent) in the population of infective juveniles was recorded in the treatment of carbofuran followed by *A. indica* (78.94), *O. sanctum* (74.73), and *C. gigantea* (74.26). The gall index ranged from 2 to 3 in treated plants whereas untreated plant shows 4 as gall index with more than 33 galls per plant. The number of fruits was maximum (4.75) in carbofuran treated plant followed by plants treated with *A. indica* (4.10), *O. sanctum* (4.0) and *C. gigantea* (3.75).

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Keywords

Chilli, Root knot nematode, Botanicals, Plant based Nematicide.

Introduction

Chilli (*Capsicum annum* L.) is considered as one of the most important commercial spice crops and is widely used universal spice, named as wonder spice. India is the world leader with a production of 13.76 million tons of chillies contributes 36 per cent to world's production followed by China, Thailand and Pakistan. Tamil Nadu is one of the major producers and consumers of chillies with a production of 29,390 tons from 44,610 ha contributing 3 per cent of total national production.

Root-knot nematodes belonging to the genus *Meloidogyne* are considered the most important group of plant-parasitic nematodes worldwide attacking nearly every crop. About 5 per cent of the total world crop yield is destroyed due to root knot nematodes (Sasser, 1987). Application of chemical nematicide is one of the most effective methods to manage the nematodes, but they having detrimental effect to both humans and the environment and are relatively unaffordable to the average small scale farmers (Washira *et al.,* 2009).

Therefore, there is a need to develop alternative method of control that are cheap, environmentally friendly and not harmful to humans. Botanical pesticides are often readily available, cheaper than the synthetic nematicides and their crude extracts and are easy to be prepared even by farmers. They reduce the chances of development of resistance or resurgence in pests. Thus, the present investigation was done to evaluate the nematicidal potential of botanical extracts *viz*., *Azadirachta indica Tephrosia purpurea, Acacia auriculiformis, Calotropis gigantea and Ocimum sanctum* on hatching of *Meloidogyne incognita* eggs, nematode infectivity and growth of chilli plants under pot culture.

Materials and Methods

Multiplication of Root knot nematodes, *Meloidogyne incognita*

The root knot nematode, *M. incognita* (Kofoid and White) Chitwood required for this study was maintained as pure culture on Chilli cv. PKM 1 raised in pots with sterilized pot mixture (2:1:1 sand, loamy soil and farmyard manure respectively) at Dr. M. S. Swaminathan Agricultural College and Research Institute, Eachangkottai, Thanjavur.

Preparation of aqueous extracts of botanicals

Healthy leaves of *A. indica, T. purpurea, A. auriculiformis, C.gigantea and O. sanctum* were used for aqueous extracts preparation. It was prepared by grinding 50 g of leaves with 200ml of distilled water.

To obtain a clear and transparent extract, the aqueous extract was filter through a muslin cloth and then centrifuged at 4000 rpm for 10 minutes. The supernatant solution was considered as stock solution and stored it in a refrigerator for laboratory studies. However, for pot culture experiments centrifugation was not done and filtrate from muslin cloth was used as such.

Chilli seedlings (PKM 1 variety) required for pot culture study was grown in protray filled with steam sterilized coir pith. Two weeks old seedlings were transplanted in 5 kg capacity pots filled with sterilized pot mixture of 1:1:2 proportions of sand, compost and red soil respectively.

The root knot nematode @ 1000 J2 / kg soil was inoculated two weeks after transplanting. The experiment was terminated at 90 days after transplanting.

Growth parameter such as shoot length (cm), root length (cm), shoot weight (g), root weight (g) and no. of fruit per plant were recorded.

T1 – 100 ml of aqueous extract of *C.gigantea*

T2 – 100 ml of aqueous extract of *O. sanctum*

T3 – 100 ml of aqueous extract of *A. indica*

T4 – Carbofuran 0.3 g/pot

T5 – Control

Estimation of final nematode population in soil and number of galls per root

Soil samples from the pots were collected in polythene bags and the final population of root-knot nematode was assessed by Cobb's sieving and decanting method (Cobb, 1918) followed by modified Baermann's funnel technique (Christie and Perry, 1951). The chilli plant were carefully dug out and rated for gall index using the scale of Taylor and Sasser (1978) under dissection microscope immediately after taking fresh root weight.

Statistical analysis

The data were analysed by ANOVA and least significant differences were calculated at p = 0.1.

Results and Discussion

Effect of botanicals on nematode infectivity and growth of chilli plants

Pot culture experiment was conducted to assess the effect of botanicals on nematode infectivity and growth of chilli cv. PKM 1. The results indicated that plant growth parameter was greater in plant treated with carbofuran. Similarly, the number of fruits was higher (4.75) in carbofuran treated plant followed by plants with *A. indica* (4.10), *O. sanctum* (4.0) and *C.gigantea* (3.75).

The highest reduction (81.87 per cent) in the population of infective juveniles was recorded in the treatment of carbofuran followed by *A. indica* (78.94), *O. sanctum* (74.73), and *C.gigantea* (74.26). In general all the treatments recorded reduced number of galls. The efficacy of treatments namely, *O. sanctum* and *C.gigantea* were on par with each other, accounting for 65.90 and 65.15 per cent reduction in number of galls compared to untreated control respectively. The gall index ranged from 2 to 3 in treated plants whereas untreated plants recorded 4 as gall index with more than 33 galls per plant (Table 1).

A number of wild plants growing throughout the world produce compounds having an immobilizing effect on *M. incognita*. These compounds are likely secondary metabolic products and while not involved in primary metabolism contribute to defense mechanism of plants. To assess the nematicidal properties of leaf extracts egg masses were transferred to *A. indica*, *T. purpurea, A. auriculiformis, C.gigantea, O. sanctum* and distilled water.

Table.1 Effect of different botanicals on nematode infectivity and growth of chilli plants

Treatments	Plant growth parameter					Nematode population		
	Shoot length (cm)	Root length (cm)	Shoot weight (g)	Root weight (g)	No. of fruits / plant	Juvenile population / 100 g soil	No. of galls / plant	Gall Index
Calotropis gigantea	52.02 (4.24)	22.55 (10.97)	15.15 (3.98)	8.42 (18.25)	3.75 (36.36)	11.00 (-74.26)	11.50 (-65.15)	3
Ocimum sanctum	54.42 (9.05)	24.95 (22.78)	15.82 (8.57)	8.55 (20.08)	4.00 (45.45)	10.80 (-74.73)	11.25 (-65.90)	3
Azadirachta indica	60.95 (22.14)	25.85 (27.21)	17.77 (21.96)	10.52 (47.75)	4.10 (49.09)	9.00 (-78.94)	8.75 (-73.48)	2
Carbofuran	62.12 (24.48)	27.32 (34.44)	18.77 (28.82)	11.75 (65.02)	4.75 (72.72)	7.75 (-81.87)	8.00 (-75.75)	2
Control	49.90	20.32	14.57	7.12	2.75	42.75	33.00	4
CD = 0.05	187.65	0.91	58.42	0.56	1.29	1.97	4.12	
SEd	88.03	0.43	27.41	0.26	0.60	0.92	1.93	

Figures in parentheses represent per cent increase or decrease over control.

Plate.1 Effect of different botanicals on nematode infectivity and growth of chilli plants under Pot culture study

Plate.2 Chilli Plants (PKM 1) treated with different botanical extracts

Enhanced inhibition of egg hatching was obtained in *A. indica* extract followed by *O. sanctum* and *C.gigantea* indicating that they possessed nematostatic properties, presence of toxic chemicals in the botanicals might have acted as prohibitors inhibiting emergence of juveniles (Sarosh and Hussain, 1986). The effect of different extracts on egg hatching could be due to the presence of tannins, alkaloids and flavonoids which have been reported to kill the nematodes.

The nematicidal effect of *O. sanctum* extract is attributed to their high contents of certain oxygenated compounds which are characterized by their lipophilic properties that enable them to dissolve the cytoplasmic membrane of nematode cells and their functional groups interfering with enzyme protein structure (Knoblock *et al.,* 1989).

Investigation on the effect of botanicals on infectivity of *M. incognita* on chilli variety PKM 1 pointed out that all the botanical extracts reduced the number of galls and nematode population in soil as compared to control (Table 1). But the synthetic nematicide carbofuran shows maximum suppression of nematode infectivity on plant and soil probably because the population was reduced to a very low density within a short period (Poornima and Vadivelu, 1993). Of the different botanicals, *A. indica* and *O. sanctum* proved to be most effective followed by *C.gigantea* which may be due to release of some nematoxins from additives (Tiyagi *et al.,* 1991).

Conclusion

Experimental results revealed that *A. indica*, *O. sanctum* and *C. gigantean* were highly effective in controlling *M. incognita* and possess nematicidal activity. Thus, the plant extracts can be used for the management of root knot nematodes in chilli and its application is expected to be cheap, easily available and eco-friendly.

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