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Research Article

BIOMANAGEMENT OF ROOT-KNOT AND RENIFORM NEMATODES ON OKRA

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ABSTRACT

Seed dressing with culture filtrate of *Paecilomyces lilacinus* resulted in a significant control of root-knot nematodes, *Meloidogyne incognita* and reniform nematode, *Rotylenchulus reniformis* singly or concomitantly, with a corresponding increase in plant growth, length and weight of plants and number of pods, chlorophyll content of leaves, water absorption capacity of roots of okra (*Abelmoschus esculentus*). In another experiment soil application with oil cake of neem (*Azadirachta indica*) showed significant suppression of the nematodes, both singly as well as concomitantly, with the consequent improvement in different growth parameters of the plants as above. A combination of seed dressing treatment with culture filtrate of *P. lilacinus* and soil amendment with neem cake gave synergistic effect with respect to nematode management and improvement in plant growth parameters.

Keywords: *Meloidogyne incognita, Rotylenchulus reniformis, Paecilomyces lilacinus,* Neem cake, *Abelmoschus esculentus*.

INTRODUCTION

Okra (*Abelmoschus esculentus* (L) Moench) has hold a key rank in vegetables. In India okra is a most prominent vegetable crop cultivated for its fresh soft green fruit during rainy and summer season. It is mainly grown for its young fruits consumed as vegetable which are rich in iron, carbohydrates, proteins minerals and vitamins. Some pathogens include fungi, bacteria, viruses and nematodes, which are independent to each other and are capable of producing diseases in okra. Since a large number of fungi occur naturally in the soil, they might be expected to exert an influence on other soil micro-organisms including nematodes. Culture filtrates of several soil borne fungi are known to exhibit nematicidal action besides inhibiting larval emergence of plant parasitic nematodes[1, 2 3]. This has opened a new field for further exploration of nematode pathogenic fungi to be used as successful biological agents. In the present study, the efficacy of the culture filtrates of fungus *Paecilomyces lilacinus* (Thom.). Samson was tested against *Meloidogyne incognita* and *Rotylenchulus reniformis* attacking on okra.

MATERIAL AND METHODS

Paecilomyces lilacinus was cultured in Richards's liquid medium. Mycelial mats of 15-day-old culture were removed and the liquid medium was filtered through a Whatman No. 1 filter paper. Culture filtrate was centrifuged at 6000 rpm for 15 min and used undiluted 's' for seed dressing. Seeds of the okra cv. Pusa sawani were thoroughly mixed with the culture filtrate to give a uniform and smooth coating over the seeds. The treated seeds were then spread in an enamel tray and allowed to dry in shade before sowing. The treated seeds were sown in earthen pots containing sterilized oil manure mixture separately.

Another experiment on the above lines was also established by using organic amendments. In this experiment manure, however, was not mixed with soil. The pots were treated with the oil-seed cakes of neem/margosa (*Azadirachta indica* A. Juss.) at the rate of 1.0 g N/kg soil. The pots were watered after treatment to ensure proper decomposition of the soil amendments and after a week, four surface sterilized seeds of okra were sown in each of the pots separately. Untreated pots served as control. Each treatment including controls were replicated six times. The pots were then placed on a green house bench in a randomized block. After emergence thinning was done to keep only one plant per pot. The plants were inoculated with 5000 2nd stage juveniles of *Meloidogyne incognita* or immature females of *Rotylenchulus reniformis* separately and concomitantly. Weeding and watering were done as and when required. The experiments were terminated three months after inoculation. The plants were uprooted, and the roots were thoroughly washed with running water. The water absorption capability of roots was determined by the method described by Alam[4]. The chlorophyll content of leaves was determined by the method described by Hiscox and Israelstam.[5]

The degree of root-knot infection was assessed by counting the root galls per root system. In the case of soil population of the reniform nematode, soil from each treatment was processed after the termination of the experiment using Cobb's sieving and decanting and the modified Baermann funnel techniques.[6] Statistical analysis of the data for critical difference (C.D.) at p = 0.05 and p = 0.01 levels was done as per procedure described by Pansey and Sukhatme.[7]

RESULTS

It is clear from the results presented in Tables 1 and 2, that when chickpea and pigeon pea plants were inoculated with 5000 specimens per plant of the root-knot nematode, *Meloidogyne incognita* and the reniform nematode, *Rotylenchulus reniformis* singly or concomitantly, there was significant reduction in different growth parameters (length and weight of plants), chlorophyll content of leaves, water absorption capacity of roots

and root nodule index, more being in concomitant inoculations. However, the reduction due to concomitant inoculation was relatively less than the sum total of the reductions caused by either of them singly at the same inoculum level. Similar effects of test nematodes were also noted in plants raised from culture-filtrate of *Paecilomyces* treated seeds but to a lesser extent. These reductions in different parameters due to the test nematodes were also found to have positive correlation with root-gall development (in *M. incognita* - inoculated plant) and nematode multiplication (in *R. reniformis* - inoculated plants), thus, indicating an inhibitory effect of culture filtrate root dressing on the nematodes. It was also observed that both the nematodes were mutually inhibitory in concomitant inoculations.

The culture filtrate of the *Paecilomyces lilacinus* was found to be highly effective in reducing the damage caused by either of them *M. incognita* and *R. reniformis* and did not have significant effect on the plant growth. The number of galls and multiplication rate of *R. reniformis* was reduced in plants raised from *P. lilacinus* treated seeds. Damage caused by both the nematodes was further reduced when organic amendments were also added along with culture filtrate of *P. lilacinus*. The overall growth of plants was comparatively improved in presence of neem cake.

Table 1: Effect of seed dressing with culture filtrate of fungus, *Paecilomyces lilacinus* on nematode population, root-knot development, root nodulation and plant growth of okra (*Abelmoschus esculentus*).

Treatment *Paecilomyces lilacinus*			Length (cm)		Fresh weight (g)		Dry weight Ig)		No. of Pod/s Plant	Chlorophyll content (mg/g) Total (a+b)	No. of root galls/ plant	No. of R. reniformis/ pot	Water absorbed/ plant (g/day)
	Mel	Rot	Shoot + Root	% reduction	Shoot + Root	% reduction	Shoot + Root	% reduction					
Untreated	-	-	64.0	-	62.0	-	14.0	-	28	2.50	-	-	37.5
	5000	-	39.0	39.06	27.0	56.45	5.2	62.85	13	1.72	168	-	20.2
	-	5000	41.5	35.15	29.0	53.22	5.8	58.57	15	1.83	-	22266	23.6
	5000	5000	29.0	54.68	16.0	74.19	2.5	82.14	11	1.38	110	13708	18.5
Treated	-	-	66.5	-	64.5	-	16.1	-	28	2.73	-	-	40.5
	5000	-	42.0	36.84	30.0	53.90	6.8	57.76	16	1.95	148	-	22.5
	-	5000	44.0	33.83	32.2	50.07	7.7	52.17	19	2.03	-	20358	25.4
	5000	5000	32.0	51.87	19.0	70.54	3.6	77.63	14	1.60	93	12964	18.5
C.D. (p = 0.05)			4.27		3.95		2.19		1.49	0.41			2.54
C.D. (p = 0.01)			5.91		5.47		3.04		2.07	0.57			3.52

Mel = *Meloidogyne incognita* J_2. Rot = *Rotylenchulus reniformis*.

Table 2: Effect of seed dressing with culture filtrate of fungus, *Paecilomyces lilacinus* on nematode population, root-knot development, root nodulation and plant growth of okra (*Abelmoschus esculentus*) in presence of neem cake.

Treatment *Paecilomyces lilacinus*			Length (cm)		Fresh weight (g)		Dry weight Ig)		No. of Pod/s Plant	Chlorophyll content (mg/g) Total (a+b)	No. of root galls/ plant	No. of R. reniformis/ pot	Water absorbed/ plant
	Mel	Rot	Shoot + Root	% reduction	Shoot + Root	% reduction	Shoot + Root	% reduction					
Untreated	-	-	68.5	-	66.3	-	15.5	-	30	2.60	-	-	42.0
	5000	-	43.5	36.49	30.3	54.29	6.7	56.77	15	1.84	157	-	23.5
	-	5000	45.7	33.28	33.2	49.92	7.2	53.54	17	1.95	-	21510	25.5
	5000	5000	33.8	50.65	18.2	72.54	3.6	76.77	13	1.50	102	12802	20.5
Treated	-	-	70.1	-	68.9	-	17.7	-	32	2.80	-	-	45.2
	5000	-	46.6	33.52	33.2	51.81	8.2	53.67	17	2.00	141	-	25.5
	-	5000	48.8	30.38	36.9	46.44	9.2	48.02	19	2.15	-	19672	28.0
	5000	5000	36.5	47.93	22.1	67.92	5.3	70.05	15	1.75	88	11925	23.0
C.D. (p = 0.05)			4.47		4.26		2.39		1.50	0.46			2.55
C.D. (p = 0.01)			6.18		5.90		3.31		2.10	0.63			3.53

Mel = *Meloidogyne incognita* J_2. Rot = *Rotylenchulus reniformis*.

DISCUSSION

Efficiency of the fungus, *P. lilacinus* as bio-control agent of nematodes has been tested in many countries with fruitful results. In India, work with *P. lilacinus* is meager and literature available on the effect of *P. lilacinus* on *M. incognita* and *R. reniformis* is very scanty. A successful bio-control agent must be capable adapting to or tolerating varying environmental conditions. It should be capable of affecting a diverse number of nematode species and must not be pathogenic to plants, human and other animals. Keeping the above points in view, it is necessary to test the potentially effective nematode control under varying climatic conditions with different types of nematode species and on different crops. In the present study, the efficacy of culture filtrate of the fungus *P. lilacinus* was tested against *M. incognita* and *R. reniformis* singly and concomitantly attacking on okra. It was found from the results that culture filtrate of *P. lilacinus* was not pathogenic to the test plants (Tables 1 and 2). However, it was highly effective in reducing plant damage caused by test nematodes. P. lilacinus was found to be more effective against root-knot than the reniform nematode. This could be due to the fact that these nematodes have differential pathological/ ecological behaviour with different morphology and biology. Adverse effect of the culture filtrates of several fungi on hatching and survival of plant parasitic nematodes [8, 9,10]. Nematicidal action of culture filtrates against plant parasitic nematodes may be attributed to the production of certain toxic metabolites by fungi. *P. lilacinus* culture filtrate, in the present study, also showed nematicidal action. The fungus is known to produce certain toxic metabolites and/or enzymes, like β(1-3) gluconase, chitinase, leucostatin lilacin[11, 12, 13, 14]. Thus, this presence in the

fungal filtrate may be responsible for deleterious effect on nematode.

When culture filtrate of *P. lilacinus* was used along with neem cake the level of nematode control increased. It is understandable because both the components of the integrated nematode control strategy are known to be highly effective against plant-parasitic nematodes[15, 16, 17, 18, 19]. The application of oil seed cake provide more and more inducing substrate (nitrate) for enzyme (nitrate reductase) to accelerate its activity, which results ultimately in increased metabolic activity of plant then plant growth. *P. lilacinus* being an opportunistic fungus is capable of not only colonizing and destroying reproductive organs of females, eggs and cysts of nematodes but is also a good competitor of soil microbes growing easily on organic substances in absence of its natural host (e.g. nematodes). Thus, it may will have first multiplied on organic substrate before attacking the nematodes.

CONSLUSION

A combination of seed dressing treatment with culture filtrate of *P. lilacinus* and soil amendment with neem cake gave synergistic effect with respect to nematode management and improvement in plant growth parameters.

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