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COMPARATIVE EFFICACY OF *GLOMUS FASCICULATUM*, *TRICHODERMA HARZIANUM*, CARBOFURAN AND CARBENDAZIM IN MANAGEMENT OF *MELOIDOGYNE INCOGNITA* AND *RHIZOCTONIA SOLANI* DISEASE COMPLEX ON BRINJAL

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ABSTRACT

Field experiment was conducted in a naturally root-knot nematode (*Meloidogyne incognita*) infested field. The results revealed that the treatment with *Trichoderma harzianum* @1.25 kg/ha and carbofuran @ 0.5 kg a.i/ha was found to be effective in increasing plant growth parameters and yield of brinjal. The treatment with carbofuran @ 1 kg a.i/ha was found to be best in suppressing the final nematode population in soil. Minimum disease incidence was recorded in treatment with carbofuran @ 0.5 kg a.i/ha + carbendazim @ 0.05%.

KEYWORDS: *Glomus fasciculatum*, *Meloidogyne incognita*, *Trichoderma harzianum*, management, brinjal.

INTRODUCTION

Brinjal is an important vegetables crops grown in India. Plants are rarely subjected to association of one potential pathogen. Brinjal is also susceptible to a number of disease causing pathogens among which *Rhizoctonia solani* is considered to be one of the important. The root-knot nematode, *Meloidogyne incognita* and *Rhizoctonia solani* are soil borne pathogens infecting a wide range of vegetable crops. Saikia and Bora (2008) found out that the maximum increase in yield of brinjal and maximum reduction in gall and egg masses were observed in treatment with VAM with half recommended dose of carbofuran @ 2 kg a.i/ha. Chakrabathy *et al.*, (2008) suggested that VAM helps in better uptake of phosphorus and other micro nutrients from the soil by the root which results in improved vigour and better growth of the plant. Bhagawati (2009) reported that seed treatment with *Ttrichoderma*

harzianum effectively manage the disease complex caused by *Meloidogyne incognita* and *Rhizoctonia solani* on okra and improve plant growth. Malhotra *et al.*, (2011) carried out under pot conditions to determine the effect of *Meloidogyne incognita* and *Rhizoctonia solani* on disease development and growth parameters in chilli. Vidyasagar *et al,*. (2012) carried out an experiment on glass house to investigate the interaction of *M.inocognita* and *R. solani* on tomato. Therefore disease management through ecofriendly biocontrol approaches using antagonist is becoming inevitable.

MATERIALS AND METHODS

A field trial was laid out in the Department of Nematology, A.A.U. infested with *Meloidogyne incognita* and *Rhizoctonia solani* during *rabi* season 2013.

The experiment was laid out in the field with a plot of 6 m². Initial nematode population of the field was recorded, carbofuran 3G was applied 5 days before transplanting. Three weeks old brinjal seedlings raised in sterilized soil were transplanted singly 2m x 3m with spacing 75 cm and 60 cm between rows and plants respectively.

Rhizoctonia solani was isolated from diseased French bean seedling showing typical symptoms of collar rot grown in Horticultural orchard of A.A.U. Jorhat by hyphal tip culture method and grown on Potato Dextrose Agar (PDA). The culture of the pathogen (*R. solani*) was maintained throughout the period of experimentation on PDA, periodically sub culturing on fresh media and stored at 4◦C. For soil inoculation, 15 days old culture of *R. solani* grown in MMSM (40 grams of maize meal was added to 960g of clean sand and were mixed thoroughly by pouring 200 ml of distilled water. The medium was then put into polypropylene bags of required size (20.5 x 26.0cm). The bags containing the medium were plugged with non absorbent cotton and autoclaved at 121◦C at 15 lb pressure for 30 minutes) were used. *R. solani* was inoculated at the rate of 1% w/w before sowing of seeds.

Pure culture of *Glomus fasciculatum* and *T. harzianum* was obtained from Department of Nematology, AAU, Jorhat. Infested soil of *G.fasciculatum* @ 25 g/m² containing an average of 600 spores were applied in the rows at the time of sowing in respective plots RBD, replicated three times. The plot with no treatment served as control. The different treatments : T_1= *Glomus fasciculatum* @ 600 spores/ sq.m, T_2 = *T.harzianum* @ 2.5 kg/ha, T_3 =Carbofuran @ 1 kg a.i/ha, T_4 = Carbendazim @ 0.1%, T_5 = *G. fasciculatum* @ 300 spores/m² + carbofuran @ 0.5 kg a.i/ha, T_6 = *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @

0.5 kg a.i/ha, T_7 = Carbofuran @ 0.5 kg a.i/ha+ carbendazim @ 0.05%, T_8 = Control (Nematode + Fungus). Observations were taken at full maturity. Ten plants from each plot were uprooted randomly and roots were washed carefully in tap water to remove adhering soil particles. Records of shoot length, fresh and dry weight of shoot and root, yield/plot, root knot index, disease incidence% and final nematode population were recorded.

RESULT AND DISCUSSION

The maximum shoot length, fresh and dry weight of shoot and root were observed in treatment with *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @ 0.5 kg a.i/ha followed by *G. fasciculatum* @ 300 spores/m² + carbofuran @ 0.5 kg a.i/ha (Table 1). With regards to dry weight of shoot, the treatment with *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @ 0.5 kg a.i/ha was found significantly superior over rest of the treatment. The treatment with *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @ 0.5 kg a.i/ha and by *G. fasciculatum* @ 300 spores/m² + carbofuran @ 0.5 kg a.i/ha were on par in respect of dry weight of root. Borah and Phukan (2004) reported that *G. fasciculatum* and carbofuran in combination significantly reduced the root knot index in brinjal and nematode population in soil. Weeder *et al.*(2008) reported that *Trichoderma* is highly rhizosphere competent i.e., able to colonize on roots.

Maximum yield was recorded in the treatment with *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @ 0.5 kg a.i/ha followed *G. fasciculatum* @ 300 spores/m² + carbofuran @ 0.5 kg a.i/ha (Table 1). Amongst the treatment, *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @ 0.5 kg a.i/ha was found effective in increasing the yield of brinjal (24.89%) over control. This may be due to the fact that *Trichoderma* colonized on the root structure of host plant attacking and killing soil borne pathogens before they could harm the plant. Then the plant were grown providing season-long protection, while sending messages through biochemical pathways to improve plant performances and yield.

All the treatment except carbendazim @ 0.1% brought about significant decrease in number of galls, eggmasses and final nematode population of soil was recorded in the treatment with carbofuran @ 1 kg a.i/ha followed by *G. fasciculatum* @ 300 spores/m² + carbofuran @ 0.5 kg a.i/ha. Considering the initial nematode population there was decrease of 68.98% in the treatment with carbofuran @ 1 kg a.i/ha followed by Carbofuran @ 0.5 kg a.i/ha+ carbendazim @ 0.05% (68.94%) over control. Borah and Phukan (2004) recorded that carbofuran @ 3 kg a.i/ha and *G. fasciculatum* + Carbofuran @ 1.5 kg a.i/ha in combinations significantly reduced the root knot index in brinjal and nematode population in soil. The

maximum reduction in disease incidence % was found in the treatment with Carbofuran @ 0.5 kg a.i/ha+ carbendazim @ 0.05 % (21.66%) followed by *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @ 0.5 kg a.i/ha (23.33%) and *G. fasciculatum* @ 300 spores/m² + carbofuran @ 0.5 kg a.i/ha (30.00%) (Table 2). Tripathi *et al.*, (2006) found that application of *T.harzianum* and *T.viride* significantly reduced the galls and nematode population and increased the growth of tomato plant when treated with different concentration of both the fungal extracts. Singh (2006) reported that both carbofuran and phorate @ 1.0 and 1.5 kg a.i/ha respectively was effective in control of the root knot nematode in cauliflower. Cauliflower gave 48% control and increased the yield upto 46%.

In the present study, the treatment with *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @ 0.5 kg a.i/ha followed *G. fasciculatum* @ 300 spores/m² + carbofuran @ 0.5 kg a.i/ha were found effective in increasing the shoot length, fresh and dry weight of shoot and root and yield of brinjal. While the treatment with *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @ 0.5 kg a.i/ha followed *G. fasciculatum* @ 300 spores/m² + carbofuran @ 0.5 kg a.i/ha were found effective in reducing galling and nematode population in soil and the treatment with Carbofuran @ 0.5 kg a.i/ha+ carbendazim @ 0.05 % (21.66%) followed by *T.harzianum* @ 1.25 kg a.i/ha + carbofuran @ 0.5 kg a.i/ha were effective in decreasing the disease incidence percentage.

Table 1. Effect of bio agents and chemicals alone and in combinations on the growth parameters and yield of brinjal (Mean of 3 replications)

Treatments	Shoot length (cm)	Fresh weight of shoot (g)	Dry weight of shoot (g)	Fresh weight of root (g)	Dry weight of root (g)	Yield		% increased over control
						Per plot (kg)	q/ha	
Glomus fasciculatum @ 600 spores/sq.m.	62.12^{cd}	143.73^{e}	45.67^{de}	21.95^{cd}	8.44^{d}	12.27	204.45^{c}	4.24
T. harzianum @ 2.5 kg/ha	65.83^{bc}	160.72^{c}	51.28^{c}	26.83^{b}	11.58^{b}	13.45	223.61^{b}	14.27
Carbofuran @ 1 kg a.i/ha	59.07^{de}	127.52^{f}	42.85^{e}	16.43^{ef}	6.49^{ef}	12.07	201.27^{c}	2.54
Carbendazim @ 0.1%	61.11^{cd}	143.61^{e}	45.15^{de}	19.64^{de}	7.17^{e}	12.20	204.44^{c}	3.65
G. fasciculatum @ 300 spores/m^2 + Carbofuran @ 0.5 kg a.i/ha	70.17^{ab}	172.08^{b}	57.44^{b}	27.55^{ab}	13.79^{a}	14.12	235.39^{a}	19.96
T. harzianum @ 1.25 kg/ha + Carbofuran @ 0.5 kg a.i/ha	72.50^{a}	182.68^{a}	61.38^{a}	30.76^{a}	14.32^{a}	14.70	245.00^{a}	24.89
Carbofuran @ 0.5 kg a.i/ha + Carbendazim @ 0.5%	64.95^{bc}	153.05^{d}	46.95^{d}	24.07^{bc}	10.33^{c}	12.44	207.22^{c}	5.69
T_8 : Control	55.20^{e}	123.29^{g}	27.79^{f}	15.23^{f}	5.67^{f}	11.77	196.11^{c}	
S.Ed.±	1.70	1.21	1.30	1.67	0.55		4.64	
$CD_{0.05}$	3.57	2.50	2.76	3.55	1.17		9.83	

Means followed by the same letter in the superscript(s) are not significantly different.

Table 2. Effect of bio agents and chemicals alone and in combinations on host infection, nematode multiplication and disease incidence on brinjal (Mean of 3 replications)

Treatments	No. of galls	No. of eggmasses	Final nematode population/ 250 cc soil	% decreased over control	% increase/ decrease over INP	Disease incidence (%)
Glomus fasciculatum @ 600 spores/sq.m.	85.80 (9.29)^{c}	68.70 (8.32)^{bc}	166.45 (12.53)^{d}	58.19	-35.98	30.00 (32.21)^{b}
T. harzianum @ 2.5 kg/ha	82.37 (9.10)^{d}	67.47 (8.24)^{c}	153.53 (12.41)^{d}	61.34	-40.95	28.33 (32.16)
Carbofuran @ 1 kg a.i/ha	44.07 (6.68)^{g}	58.30 (7.67)^{e}	123.18 (11.12)^{f}	68.98	-52.62	33.33 (35.26)^{b}

Carbendazim @ 0.1%	95.79 (9.81)^{b}	70.83 (8.43)^{ab}	388.55 (19.72)^{b}	2.16	+49.44	26.67 (31.09)^{b}
G. fasciculatum @ 300 spores/m^2 + Carbofuran @ 0.5 kg a.i/ha	72.33 (8.53)^{f}	61.17 (7.85)^{d}	123.65 (11.14)^{f}	66.27	-52.44	25.00 (30.60)^{b}
T. harzianum @ 1.25 kg/ha + Carbofuran @ 0.5 kg a.i/ha	77.63 (8.84)^{e}	63.00 (7.97)^{d}	133.94 (11.59)^{e}	65.54	-48.48	23.33 (28.33)^{b}
Carbofuran @ 0.5 kg a.i/ha + Carbendazim @ 0.5%	81.87 (9.07)^{d}	66.03 (8.19)^{c}	136.87 (11.72)^{e}	68.94	-47.37	21.66 (27.74)^{b}
T_8 : Control	98.59 (9.95)^{a}	72.40 (8.54)^{a}	397.14 (19.94)^{a}		+52.74	51.67 (45.96)^{a}
S.Ed.±	0.06	0.08	0.08			0.71
$CD_{0.05}$	0.13	0.17	0.18			1.52

(+) = Increase; (-) = Decrease; INP = Initial Nematode Population

Initial nematode population 260/250 ml of soil

Values of number of galls, eggmasses and final nematode population within parentheses are square root ($\sqrt{x + 0.5}$) transformed data

Values of disease incidence percentage are angular transformed values

Means followed by the same letter in the superscript(s) are not significantly different

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