Efficacy of bioagents against root-knot nematode, *Meloidogyne incognita* infecting cowpea, *Vigna unguiculata* L.

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ABSTRACT

A pot experiment under cage house condition was conducted at the Department of Nematology, RCA Udaipur in *kharif* 2012 to study the combined effect of *Trichoderma harzianum*, *T. viride* and *Pseudomonas fluorescens* @ 1.5 g/kg soil and @ 5 g/kg seed against root-knot nematode, *Meloidogyne incognita* infecting cowpea. The result revealed that *T. harzianum* @ 1.5 g/kg soil + *T. harzianum* @ 5 g/kg seed were found most effective in improving plant growth and reduction of nematode reproduction over control.

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INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is one of the important *kharif* pulses grown in India. It provides protein rich diet to human beings and nutritious fodder to livestock as it contains 21.6 to 30.6 per cent of calcium and high amount of iron (Mann, 1975). The production of pulse crops unfortunately suffers from several constraints of which pest and disease are the most important ones. Among pests, phytoparasitic nematodes have been recognized as one of the major constraints in pulse production. The extent of losses due to nematodes especially in pulse crops, is yet to be estimated properly but in cowpea production it is estimated to cause annual yield losses of nearly 15% worldwide (Sasser and Freckman, 1987). In India the average loss caused by root-knot nematode on pulses may be 14.6% which could go as high as 50-80% in some crops (Bhatti, 1992). Losses caused by root-knot nematode is estimated to be 28.60 per cent in cowpea (Reddy and Singh, 1981).

To manage nematode chemicals proved effective but their hazardous effects and non judicious use have enhanced the development of biological control strategies for management of plant parasitic nematodes with various types of antagonistic organisms (Jatala, 1986).

MATERIAL AND METHODS

The experiment was laid out in 6" earthen clay pots which contained 1kg infested soil with an initial inoculum level of 2 larvae per g of soil and replicated three times. Talc–based formulations of *T. viride*, *T. harzianum* and *P. fluorescens* were added to soil each @1.5g per kg soil and use as seed dressing each @ 5g per kg seed with given sufficient moisture. Untreated and chemical check (Carbofuran @ 2kg a.i./ha) was also maintained for comparison. After 10 days of germination one healthy plant in each pot was maintained and others were uprooted carefully. The pots were then watered regularly almost every day. At the expiry of 45 days of sowing observations were recorded. The plants were taken out from the pots carefully and the length and the weight of the shoot and the roots were recorded. The roots were gently washed in tap water and stained with hot 0.1% acid fuchsin in lacto phenol (McBeth *et al.*, 1941) and kept in clear lacto phenol for 24 hours. These roots

were then examined under the stereoscopic binocular microscope for counting the number of galls, number of egg masses per plant and number of eggs per egg mass. The soil, after removing the plant from each pot was mixed well and 100 cc soil from each pot was processed by Cobb's sieving and decanting technique (Cobb, 1918) followed by modified Baermann's funnel technique (Christie and Perry, 1951) for the estimation of nematode population in soil.

RESULTS AND DISCUSSIONS

Data presented in table revealed that all fungal and bacterial bioagents applied significantly increased the plant growth and reduced nematode reproduction as compared to untreated check. The maximum shoot length, root length, shoot weight and root weight were recorded with *T. harzianum* @ 1.5 g/kg soil + *T. harzianum* @ 5 g/kg seed followed by *T. harzianum* @ 1.5 g/kg soil + *T. viride* @ 5 g/kg seed and *T. harzianum* @ 1.5 g/kg soil + *P. fluorescens* @ 5 g/kg seed.

Table 1. Combined effect of bio-agents as soil and seed treatment on plant growth characters of cowpea.

Treatments	Plant growth characters			
	Shoot length (cm)	**Root length (cm)**	**Shoot weight (g)**	**Root weight (g)**
T_1=*T. viride* 1.5g/kg soil +*T. viride* 5g/kg seed	29.30	23.60	18.60	7.50
T_2=*T. viride*1.5g/kg soil + *T. harzianum* 5g/kg seed	30.20	23.80	18.80	7.62
T_3=*T. viride* 1.5g/kg soil + *P. fluorescens* 5g/kg seed	28.80	23.30	18.20	7.10
T_4=*T. harzianum* 1.5g/kg soil + *T. viride* 5g/kg seed	31.60	25.10	19.30	8.00
T_5=*T. harzianum* 1.5g/kg soil + *T. harzianum* 5g/kg seed	32.40	25.50	19.71	8.20
T_6= *T. harzianum* 1.5g/kg soil + *P. fluorescens* 5g/kg seed	31.00	24.90	19.00	7.80
T_7=*P. fluorescens* 1.5g/kg soil + *T. viride* 5g/kg seed	26.70	21.80	17.80	6.80
T_8=*P. fluorescens* 1.5g/kg soil + *T. harzianum* 5g/kg seed	27.40	22.30	18.10	6.90
T_9=*P. fluorescens* 1.5g/kg soil + *P. fluorescens* 5g/kg seed	26.30	21.70	17.50	6.60
T_{10}=Chemical check (Carbofuran 3G @ 2 kg a.i./ha)	35.50	27.20	21.70	8.60
T_{11}=Untreated check	19.41	13.10	12.00	3.10
SEm±	1.031	0.790	0.612	0.238
CD at 5%	3.025	2.316	1.796	0.697

Note: Data are average value of three replications.

However, maximum shoot length, root length, shoot weight and root weight were observed with soil application of carbofuran 3G @ 2 kg a.i./ha while minimum shoot length, root

length, shoot weight and root weight were observed with untreated check.

The minimum number of galls/plant, egg masses /plant, eggs/egg mass, nematode population/100cc and total nematode population were observed with *T. harzianum* @ 1.5 g/kg soil + *T. harzianum* @ 5 g/kg seed followed by *T. harzianum* @ 1.5 g/kg soil + *T. viride* @ 5 g/kg seed (27.90, 16.90, 105.20, 123 and 1929) and *T. harzianum* @ 1.5 g/kg soil + *P. fluorescens* @ 5 g/kg seed. However, minimum number of galls, egg masses/plant, eggs/egg mass, nematode population/100cc and total nematode population were observed with soil application of carbofuran 3G @ 2 kg a.i./ha while maximum galls/plant, egg masses/plant, eggs/egg mass, nematode population/100cc and total nematode population were observed with untreated check 48.20, 34.40, 207.92, 363 and 7562 respectively.

Table 2. Combined effect of bio-agents against root-knot nematode, *M. incognita* as soil and seed treatment on cowpea.

Treatments	Nematode reproduction				
	No. of galls/ plant	No. of egg masses / plant	No. of eggs / egg mass	Nematode population / 100cc soil	Total population
T_1=*T. viride* 1.5g/kg soil +*T. viride* 5g/kg seed	33.80	23.00	116.90	162	2884
T_2=*T. viride*1.5g/kg soil + *T. harzianum* 5g/kg seed	31.50	20.70	112.40	146	2504
T_3=*T. viride* 1.5g/kg soil + *P. fluorescens* 5g/kg seed	35.10	25.30	119.30	176	3229
T_4=*T. harzianum* 1.5g/kg soil + *T. viride* 5g/kg seed	27.90	16.90	105.20	123	1929
T_5=*T. harzianum* 1.5g/kg soil + *T. harzianum* 5g/kg seed	25.40	15.30	98.70	110	1646
T_6= *T. harzianum* 1.5g/kg soil + *P. fluorescens* 5g/kg seed	29.20	18.10	108.30	139	2128
T_7=*P. fluorescens* 1.5g/kg soil + *T. viride* 5g/kg seed	38.30	27.53	126.70	209	3732
T_8=*P. fluorescens* 1.5g/kg soil + *T. harzianum* 5g/kg seed	36.02	26.20	122.00	196	3428
T_9=*P. fluorescens* 1.5g/kg soil + *P. fluorescens* 5g/kg seed	39.60	29.10	129.80	221	4038
T_{10}=Chemical check (Carbofuran 3G @ 2 kg a.i./ha)	22.80	12.10	80.00	88	1079
T_{11}=Untreated check	48.20	34.40	207.92	363	7562
SEm±	1.097	0.821	3.901	6.354	124.099
CD at 5%	3.216	2.408	11.442	18.637	363.971

Note: (i) Data are average value of three replications (ii) Initial inoculums level 2 juvenile / g soil.

These findings are in agreement with the results of Pandey and Kalra (2003) who evaluated the efficacy of various organic materials (neem compound, *Mentha distillate*, *Murraya koengii* distillate, *Artemisia annua marc* and vermicompost) and biological control agents (*Glomus aggregatum* and *T. harzianum*) alone or in combinations for the management of *M. incognita* on *Withania somnifera*. The

highest root-knot suppression was noticed in vermicompost and *T. harzianum* combination over *Mentha* distillate and *G. aggregatum*. Islam *et al*. (2005) tested the efficacy of three antagonistic fungi, *T. harzianum* isolates (GT1, TV1 and W120) and two organic soil amendments (poultry refuse and mustard oil cake) against root-knot nematode disease (*Meloidogyne* spp.) of tomato. Results showed that combined application of poultry refuse and *T. harzianum* (PR+GT1, PR+TV1 and PR+W120) gave higher disease reduction and increased plant growth.

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