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Bio-Management of Root-Knot Nematode, *Meloidogyne incognita* on Cowpea (*Vigna unguiculata* L.)

CP Nama and HK Sharma

Abstract
A pot culture experiment was conducted to study the effect of fungal and bacterial bio-agents *viz. Trichoderma harzianum*, *T. viride* and *Pseudomonas fluorescens* @ 5 g, 7.5 g and 10 g/kg seed against root-knot nematode, *M. incognita* infecting cowpea. Chemical check (carbosulfan 3% w/w) and untreated check were also maintained for comparison. The results of the present study revealed that the maximum shoot length, root length, shoot weight and root weight and minimum number of galls/plant, egg masses/plant, eggs/egg mass, nematode population/100cc and total nematode population were recorded with *T. harzianum* @ 10 g/kg seed followed by *T. viride* @ 10 g/kg seed and *P. fluorescens* @ 10 g/kg seed *T. harzianum* @ 10 g/kg seed over the control.

Keywords: Cowpea, *Trichoderma harzianum*, *T viride*, *Pseudomonas fluorescens*, *M incognita*

1. Introduction

The pulses form an integral part of the cropping system of farmers all over the country because these crops fit well in the crop rotation and occupy an important position in the human dietary, being a good source of vegetable protein (17-43%) and supplement to cereal based diet [10]. In addition to this, these crops play a vital role in increasing soil fertility by fixing atmospheric nitrogen through root nodules [15].

Cowpea (*Vigna unguiculata* L.) is one of the important *kharif* pulse grown in India [12]. Pulse crops have been the backbone of agricultural economy in India having a reasonably higher annual output. In India pulses are being cultivated in 25.51 million ha with the production of 17.29 million tonnes and the average production being 630 kg/ha during 2010-11 [2]. In Rajasthan cowpea is extensively grown in Ajmer, Bhilwara, Churu, Jaipur, Jhunjhunu, Nagaur, Pali, Sikar, Sirohi and Tonk district, with an area of about 1.05 lakh ha with 73.39 thousand tonnes production and average production being 697 kg/ha during 2011-12 [1].

The production of pulse crops unfortunately suffers from several constraints of which pest and disease are the most important once. Among pests, phytoparasitic nematodes have been recognized as one of the major constraint in pulse production [5]. The extent of losses due to nematodes especially in pulse crops is yet to be estimated properly but in cowpea production is estimated to cause annual yield losses of nearly 15% worldwide [14]. In India average loss caused by root-knot nematode on pulses may be 14.6% which could go as high as 50-80% in some crops [5]. In another study estimated 28.60 per cent losses due to root-knot nematode, *M. incognita* in cowpea [13].

There are number of practices for management of plant parasitic nematodes in which chemical nematicides is used against nematodes by farmer because it is effective, easy to apply, and show rapid effects. But on the other hand it may cause degradation in soil fertility, environmental pollution and also hazardous for animals and human being. That's why biological control are more promising management practice and also economically & ecofriendly. The present experiment was conducted to study the effect of fungal and bacterial bio-agents *viz. Trichoderma harzianum*, *T. viride* and *Pseudomonas fluorescens* @ 5 g, 7.5 g and 10 g/kg seed against root-knot nematode, *M. incognita* infecting cowpea.

2. Material and methods

The present 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 used as seed dressing each @ 5 g, 7.5 g and 10 g per kg seed with given sufficient moisture. Untreated and chemical checks (Carbosulfan 3% w/w) were 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. While harvesting, the care was taken to avoid losses of both roots and nematodes in adhering soil. Observation on various growth parameters *viz*. fresh root and shoot weights, shoot and root lengths were recorded without delay whereas for studying nematode infestation, the plant tissues were stained in 0.1% acid fuchsin in lacto phenol at 80 ºC for 2-3 minutes [11]. Then after gentle wash, roots were 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 100cc soil from each pot was processed by Cobb's sieving and decanting technique [7] followed by modified Baermann's funnel technique [6] for the estimation of nematode population in soil.

2. Result and discussion

Data presented in Table 1 revealed that all fungal and bacterial bio-agents applied significantly increased the plant growth and reduced nematode reproduction as compared to untreated check. The maximum shoot length (31.20 cm), root length (23.20 cm), shoot weight (19.60 g) and root weight (8.11 g) were recorded with *T. harzianum* @ 10 g/kg seed followed by *T. viride* @ 10 g/kg seed (30.50 cm, 22.90 cm, 19.20 g and 7.83 g) and *P. fluorescens* @ 10 g/kg seed (29.20 cm, 22.50 cm, 18.90 g and 7.61 g). However, maximum shoot length (34.80 cm), root length (25.02 cm), shoot weight (20.80 g) and root weight (8.33 g) were observed with seed dressing of carbosulfan 3% w/w while minimum shoot length (19.50 cm), root length (13.20 cm), shoot weight (12.13 g) and root weight (3.42 g) were observed with untreated check.

Data presented in Table 2 showed that the minimum number of galls/plant (29.32), egg masses /plant (16.33), eggs/egg mass (100.67), nematode population/100cc (114) and total nematode population (1787) observed with *T. harzianum* @ 10 g/kg seed followed by *T. viride* @ 10 g/kg seed (30.91, 18.00, 108.00, 142 and 2116) and *P. fluorescens* @ 10 g/kg seed (32.03, 20.33, 112.67, 150 and 2473). However, minimum number of galls (20.43), egg masses/plant (11.67 eggs/egg mass (81.00), nematode population/100cc (84) and total nematode population (1050) observed with seed dressing of carbosulfan 3% w/w while maximum galls/plant, egg masses/plant, eggs/egg mass, nematode population/100cc and total nematode population were observed with untreated check 49.08, 35.33, 205.33, 360 and 7664 respectively.

Table 1: Effect of bio-agents at three different doses as seed treatment on plant growth characters cowpea

Treatments		Plant growth characters			
		Shoot length (cm)	Root length (cm)	Shoot weight (g)	Root weight (g)
T. viride 5g/kg seed	T_1	25.90	21.50	17.00	6.50
T. viride 7.5g/kg seed	T_2	28.30	22.10	18.20	6.82
T. viride 10g/kg seed	T_3	30.50	22.90	19.20	7.83
T. harzianum 5g/kg seed	T_4	26.40	21.70	17.30	6.63
T. harzianum 7.5g/kg seed	T_5	28.90	22.40	18.50	7.32
*T. harzianum*10g/kg seed	T_6	31.20	23.20	19.60	8.11
P. fluorescens 5g/kg seed	T_7	25.10	21.20	16.80	6.41
P. fluorescens 7.5g/kg seed	T_8	27.50	21.80	17.70	6.72
P. fluorescens 10g/kg seed	T_9	29.20	22.50	18.90	7.61
Chemical check (Carbosulfan 3% w/w)	T_{10}	34.80	25.02	20.80	8.33
Untreated check	T_{11}	19.50	13.20	12.13	3.42
SEm±		1.036	0.760	0.631	0.215
CD (P=0.05)		3.038	2.228	1.851	0.632

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

Table 2: Effect of bio-agents against root-knot nematode, *M. incognita* at three different doses as 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. viride 5g/kg seed	T_1	37.12	29.33	130.67	230	4100
T. viride 7.5g/kg seed	T_2	34.68	24.00	119.00	183	3074
T. viride 10g/kg seed	T_3	30.91	18.00	108.00	142	2116
T. harzianum 5g/kg seed	T_4	35.93	27.67	127.33	206	3765
T. harzianum 7.5g/kg seed	T_5	31.51	22.67	116.33	153	2822
*T. harzianum*10g/kg seed	T_6	29.32	16.33	100.67	114	1787
P. fluorescens 5g/kg seed	T_7	40.71	31.00	133.33	243	4417
P. fluorescens 7.5g/kg seed	T_8	36.53	26.00	124.00	199	3459
P. fluorescens 10g/kg seed	T_9	32.03	20.33	112.67	150	2473
Chemical check(Carbosulfan 3% w/w)	T_{10}	20.43	11.67	81.00	84	1050
Untreated check	T_{11}	49.08	35.33	205.33	360	7664
SEm±		1.366	0.893	3.159	8.297	101.557
CD (P=0.05)		4.006	2.618	9.266	24.334	297.856

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 powder formulation of *T. harzianum* as seed treatment for the management of root-knot and root rot disease complex, caused by the root-knot nematode *M. javanica* and the fungus *R. solani*, on soybean plants under greenhouse conditions. Number of galls, root galling, egg masses and disease severity were reduced sharply on plants treated with *T. harzianum* as seed treatment, compared with the non-treated plants [9]. Similarly, significant increased the plant growth and reduced final nematode population, treated with *T. harzianum* and *P. fluorescens* over streptocycline [3]. *T. harzianum* and *P. fluorescens* as seed treatment to manage the disease complex caused by *M. incognita* and *R. solani* on. Both the bio-agents were found to be significantly effective in reducing the damage and increasing the growth parameters of okra as compared to the treatment inoculated with *M. incognita* and *R. solani* [4]. *T. viride*, *T. harzianum* and *P. fluorescens* each @ 10 g/kg seed increased the growth parameters of okra plants and root-knot nematode populations were reduced in all the treatments compared to inoculated control. Against root-knot nematode, *M. incognita* [8].

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