



RESEARCH PAPER

Effects of bio consortium for the management of collar rot (*Sclerotium rolfsii*) disease of chickpea *in vivo* condition

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Abstract : A experiment was conducted in 2019-20 *Rabi* cropping season to obtain information on the incidence of chickpea diseases. The investigation was entitled effects of bio consortium for the management of collar rot (*sclerotiumrolfsii*) disease of chickpea *in vivo* condition was conducted, Department of Plant pathology JNKVV. The experiment was laid out in Completely Randomized Design (CRD) concept comprising nine treatment combinations with three replications in net house condition. **Effect of bio consortium against collar rot (*Sclerotiumrolfsii*) disease incidence on variety JG-12:** Among the treatments minimum germination per cent 76.67 per cent was observed in T₈. Maximum pre-emergence mortality 23.33 per cent was recorded in T₈. Maximum disease incidence of 24.48 and 22.77 per cent was observed in T₈ and minimum mortality 17.37% was recorded in T₆. **Effect of bio consortium on collar rot (*Sclerotiumrolfsii*) disease and phenotypic parameters on variety JG-12:** Among the treatments minimum germination per cent 78.60 per cent was observed in T₈. Maximum shoot height 24.33, 22.07, 20.07, 19.27, 16.37, 15.67, 14.23 and 13.30 cm were recorded in T₆. Maximum root height 10.37 was recorded in T₆. Maximum vigour index per cent of 3,274.21 was recorded in T₆. **Effect of bio consortium on collar rot (*Sclerotiumrolfsii*) disease incidence on variety JG-14:** Among the treatments minimum germination per cent 77.78 per cent was observed in T₈. Maximum pre-emergence mortality 22.22 per cent was recorded in T₈. Maximum disease incidence of 24.27 per cent was observed in T₈. minimum mortality 16.24 per cent was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*). **Effect of bio consortium on collar rot (*Sclerotiumrolfsii*) disease and phenotypic parameters on variety JG-14.** Among the treatments minimum germination percent 80.68 per cent was observed in T₈. Maximum shoot height 26.37 was recorded in T₆. Maximum root length 11.53, was recorded in T₆. Maximum vigour index percent of 3,658.07 was recorded in T₆.

Key Words : *Sclerotiumrolfsii*, Bio consortium, Management chickpea

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INTRODUCTION

Chickpea (*Cicerarietinum* L.) is a major legumes crop grown worldwide and ranks second in the global

farming. It belongs to the family Fabaceae, sub family Papilionaceae. Chickpea is a rich source of protein (20 to 25 %) and also enriches soil fertility by biological nitrogen fixation. In India, it is grown over an area 95.39

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lac hectares, with an annual production of 90.75 lac tone's and yield was 951kg/ha. However, the total area and production of chickpea in MP is 35.90 lac hectare and 45.95 lac tone's respectively, having productivity of 1056kg/ha (Anonyms, 2017). Chickpea collar rot is most serious and challenging disease which cause severe yield losses (upto 60-70%) under favorable conditions (Nene, 1984). *S. rolfsii* is soil borne pathogen and survives in soil for many years (Allce, 1984). The disease causes damage on root and stem of plant. The pathogen produces sclerotia which overwinter in soil and on plant debris besides it can survive in a long period causing disease in the following season (Punja, 1985). Drying of plants with foliage turned slightly yellow before death, scattered throughout the field is an indication of collar rot infection. The disease generally appears within two weeks of sowing and the younger plants collapse but older ones turn yellow and may dry without collapsing. The younger plants exhibit clear rotting at the collar region. The rotten portion is often covered with white mycelia strands of *S. rolfsii*. Thus, the control of the disease is very difficult. Various methods for controlling such disease have been investigated including the use of resistant varieties, chemical control, plant volatile compounds, plant extracts and biological control (Kumar and Tripathi, 1991; Dubey *et al.*, 2007 and El-Mougy *et al.*, 2007).

Management of plant disease through biological control has been considered as a viable alternative method as against the use of chemical pesticide and cultural practices. Different mode of action of bio control active micro-organism in controlling fungal plant disease include hyper-parasitism, predation, antibiosis, cross protection, competition for site and nutrient and induced resistance, the present investigation is mainly focused to sort out the most effective organic amendments and antagonists for management of collar rot (*Sclerotium rolfsii*) disease of chickpea.

MATERIAL AND METHODS

The present investigation was conducted to check the efficacy of bio consortium and oil cake against *S. rolfsii* under in vivo conditions. The pathogen was isolated from infected gram seedlings by hyphal tip method of fungal isolation. Identification of *Sclerotium rolfsii* were done by morphological characters formed white mat of hyaline mycelium with formation of initially white sclerotia which later turned into brown hard structure. Sclerotia were black, varied from spherical to irregular

in shape and measured 80 to 85 µm in diameter. Pycnidial production was not observed in culture plates. Required bio-inoculants and oil cake *Trichoderma viride*, *Trichoderma hamatum*, *Trichoderma reesei* and *Pseudomonas fluorescens*, respectively were obtained from Microbes Research and Production Center, JNKVV Jabalpur (M.P.).

Roll-towel test :

A roll towel regularly used for seed vigour testing was used for testing bio efficacy of bio control agents. Healthy seeds were initially surface sterilized in sodium hypochlorite (1.05%) followed by three washing in sterile water and then inoculated with the bacterial isolate. After air-drying, the seeds were again dipped in mycelial suspension of *Sclerotium rolfsii* which was replicated in potato dextrose growth. Three replications of fifty seeds with the pathogen and two varieties, each were randomly counted and placed in coarse blotter paper sheets then covered with a moistened blotter paper and rolled. One twenty such rolls were kept on a blotter paper sheet and rolled as a single bundle following by incubating it in a growth chamber at 25°C temperature with 80 per cent relative humidity for 8 days. After incubation, germination percentage was noted along with root - shoot length and vigour index was calculated. Vigour index was calculated by multiplying per cent plant stand with some of shoot and root length (Rangeshwaran *et al.*, 2002).

Evaluation of bio consortium against *S. rolfsii* in vivo condition :

The tray experiment was conducted in poly-house condition. This experiment was planned in CRD with nine treatments and two varieties (JG-12 and JG-14) were used, so as to assess the efficacy of different bio consortium against *Sclerotium rolfsii*. A control was sown without any seed treatment.

Per cent disease incidence :

The incidence of collar rot in each treatment was recorded based on the germination at 28 days after sowing (DAS) using following formula. The observations were recorded based on seeds sown in each tray (Rao and Sitaramaih, 2000).

$$\text{Per cent disease incidence} = \frac{\text{No. of seedlings survived in normal tray} - \text{No. of seedlings survived in infected tray}}{\text{No. of germinated seedlings in normal tray}} \times 100$$

Observation recorded :*Effect of Bio consortium on growth parameters :*

Data on germination percentage was recorded after 10 days and at the time of maturity plant height (cm), dry weight and fresh weight (g plant-1) was calculated, the vigour index mass and vigour index percentage as follows the (Abdul Baki and Anderson 1973);

$$\text{Germination (\%)} = \frac{\text{Total no. of seed germination}}{\text{Total number of seed sown}} \times 100$$

$$\text{Vigour index (\%)} = \text{Germination \%} \times (\text{Root length} + \text{Shoot height})$$

Pre- and post-emergence mortality (%) :

Pre-emergence mortality was recorded immediate after complete emergence of the plants and post emergence mortality was recorded at 90 days after sowing. The pre and post-emergence mortality was calculated using the following formula:

$$\text{Pre-emergence mortality (\%)} = \frac{\text{No. of seed un-germinated}}{\text{No. of sown seed}} \times 100$$

$$\text{Post-emergence mortality (\%)} = \frac{\text{No. of seedling collapsed}}{\text{Total no. of seedling emerged}} \times 100$$

$$\text{Total mortality (\%)} = \text{Pre-emergence mortality (\%)} + \text{post-emergence mortality (\%)}$$

Root and shoot length :

The plants were carefully uprooted to measure root and shoot length using scale.

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads :

Effect of bio consortium against collar rot (*Sclerotium rolfsii*) disease incidence on variety JG-12*Germination percentage:*

Among the treatments minimum germination per cent 76.67 per cent was observed in T₈ (*T. viride*+*T. harzianum*+*T. aureoviride*+*Pseudomonas fluorescens*) followed by 77.78 per cent in T₄ (*T. harzianum* + *T. aureoviride*) and highest germination 91.11 per cent was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Pre-emergence mortality:

All the treatment has significantly reduced the pre-emergence mortality as compared to control. Maximum pre-emergence mortality 23.33 per cent was recorded in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) followed by 22.22 per cent in T₄ (*T. harzianum* + *T. aureoviride*). Minimum pre-emergence mortality 8.89 per cent was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Post-emergence mortality :

Maximum disease incidence of 24.48 and 22.77 per cent was observed in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) and T₄ (*T. harzianum* + *T. aureoviride*), respectively. Minimum disease incidence of 8.48 per cent was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Total mortality (%) :

Maximum mortality of 47.81 per cent was observed

Table 1: Effect of bio consortium against collar rot (*Sclerotium rolfsii*) disease incidence on variety JG-12

Sr. No.	Combination	Germination	Pre emergence mortality	Post emergence mortality	Total mortality
T ₁	<i>Trichoderma viride</i> + <i>Trichoderma harzianum</i>	87.78	12.22	13.96	26.18
T ₂	<i>T. viride</i> + <i>T. aureoviride</i>	80.00	20.00	20.74	40.74
T ₃	<i>T. viride</i> + <i>Pseudomonas fluorescens</i>	86.67	13.33	15.50	28.83
T ₄	<i>T. harzianum</i> + <i>T. aureoviride</i>	77.78	22.22	22.77	44.99
T ₅	<i>T. harzianum</i> + <i>Pseudomonas fluorescens</i>	81.11	18.89	20.50	39.39
T ₆	<i>T. viride</i> + <i>T. harzianum</i> + <i>P. fluorescens</i>	91.11	8.89	8.48	17.37
T ₇	<i>T. viride</i> + <i>T. harzianum</i> + <i>T. aureoviride</i>	84.44	15.56	20.92	36.48
T ₈	<i>T. viride</i> + <i>T. harzianum</i> + <i>T. aureoviride</i> + <i>Pseudomonas fluorescens</i>	76.67	23.33	24.48	47.81
T ₉	Control	62.22	36.67	53.51	90.17
	S.E. ±	1.92	1.99	2.83	2.93
	C.D. (P=0.05)	5.76	5.97	8.48	8.77

in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) and minimum mortality 17.37% was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Effect of bio consortium on collar rot (*Sclerotiumrolfsii*) disease and phenotypic parameters on variety JG-12 :

Germination percentage :

Among the treatments minimum germination percent 78.60 per cent was observed in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) followed by 79.77 per cent in T₄ (*T. harzianum* + *T. aureoviride*) and highest germination 94.40 per cent was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Plants height (Shoot and Root):

Maximum shoot height 24.33, 22.07, 20.07, 19.27, 16.37, 15.67, 14.23 and 13.30 cm were recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*), T₁ (*Trichoderma viride* + *Trichoderma harzianum*), T₃ (*T. viride* + *Pseudomonas fluorescens*), T₇ (*T. viride* + *T. harzianum* + *T. aureoviride*), T₅ (*T. harzianum* + *Pseudomonas fluorescens*), T₂ (*T. viride* + *T. aureoviride*), T₄ (*T. harzianum* + *T. aureoviride*), T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*), respectively.

Maximum root height 10.37, 10.27, 10.00, 9.60, 9.40, 9.10, 8.36 and 8.03 cm were recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*), T₁ (*Trichoderma viride* + *Trichoderma harzianum*), T₃ (*T. viride* + *Pseudomonas fluorescens*), T₇ (*T. viride* + *T.*

harzianum + *T. aureoviride*), T₅ (*T. harzianum* + *Pseudomonas fluorescens*), T₂ (*T. viride* + *T. aureoviride*), T₄ (*T. harzianum* + *T. aureoviride*) and T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*), respectively.

Vigour index :

Maximum vigour index per cent of 3,274.21 and 2,906.31 was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*) and T₁ (*Trichoderma viride* + *Trichoderma harzianum*). Minimum vigour index per cent of 1,676.34 and 1,794.34 were observed in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) and T₄ (*T. harzianum* + *T. aureoviride*), respectively.

Effect of bio consortium on collar rot (*Sclerotiumrolfsii*) disease incidence on variety JG-14.

Germination percentage :

Among the treatments minimum germination per cent 77.78 per cent was observed in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) followed by 78.89 per cent in T₄ (*T. harzianum* + *T. aureoviride*) and highest germination 92.22 per cent was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Pre-emergence mortality :

Maximum pre-emergence mortality 22.22 per cent was recorded in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) followed by 21.11 in T₄ (*T. harzianum* + *T. aureoviride*) and Minimum pre-emergence mortality 7.78 per cent was

Table 2: Effect of bio consortium on collar rot (*Sclerotiumrolfsii*) disease and phenotypic parameters on variety JG-12

Sr. No.	Combination	Germination	Shoot length	Root length	Vigour index
T ₁	<i>Trichoderma viride</i> + <i>Trichoderma harzianum</i>	89.85	22.07	10.27	2,906.31
T ₂	<i>T. viride</i> + <i>T. aureoviride</i>	80.00	15.17	9.10	1,941.33
T ₃	<i>T. viride</i> + <i>Pseudomonas fluorescens</i>	88.67	20.07	10.00	2,666.47
T ₄	<i>T. harzianum</i> + <i>T. aureoviride</i>	79.77	14.23	8.27	1,794.34
T ₅	<i>T. harzianum</i> + <i>Pseudomonas fluorescens</i>	83.50	16.37	9.40	2,151.22
T ₆	<i>T. viride</i> + <i>T. harzianum</i> + <i>P. fluorescens</i>	94.40	24.33	10.37	3,274.21
T ₇	<i>T. viride</i> + <i>T. harzianum</i> + <i>T. aureoviride</i>	85.54	19.27	9.60	2,469.57
T ₈	<i>T. viride</i> + <i>T. harzianum</i> + <i>T. aureoviride</i> + <i>Pseudomonas fluorescens</i>	78.60	13.30	8.03	1,676.34
T ₉	Control	70.32	10.67	6.43	1,202.93
	S.E. ±	1.02	0.45	0.16	45.07
	C.D. (P=0.05)	3.05	1.33	0.48	134.96

recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Post-emergence mortality :

Disease intensity, at flowering stage, among treatment varied from 8.47 to 24.27 as compared to control post-emergence mortality was 50.79 per cent. Maximum disease incidence of 24.27 and 22.49 per cent was observed in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) and T₄ (*T. harzianum* + *T. aureoviride*), respectively. Minimum disease incidence of 8.47 was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Total mortality (%) :

Total mortality per cent among treatment ranges

from 16.24 to 46.49 per cent as compared to control 85.24 per cent. Maximum mortality of 46.49 per cent was observed in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) and minimum mortality 16.24 per cent was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Effect of bio consortium on collar rot (*Sclerotium rolfsii*) disease and phenotypic parameters on variety JG-14:

Germination percentage :

Among the treatments minimum germination per cent 80.68 per cent was observed in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas*

Table 3: Effect of bio consortium on collar rot (*Sclerotium rolfsii*) disease incidence on variety JG-14

Sr. No.	Combination	Germination	Pre emergence mortality	Post emergence mortality	Total mortality
T ₁	<i>Trichodermaviride</i> + <i>Trichodermaharzianum</i>	88.89	11.11	12.49	23.60
T ₂	<i>T. viride</i> + <i>T. aureoviride</i>	81.11	18.89	19.17	38.06
T ₃	<i>T. viride</i> + <i>Pseudomonas fluorescens</i>	87.78	12.22	15.19	27.42
T ₄	<i>T. harzianum</i> + <i>T. aureoviride</i>	78.89	21.11	22.49	43.60
T ₅	<i>T. harzianum</i> + <i>Pseudomonas fluorescens</i>	83.33	16.67	18.69	35.35
T ₆	<i>T. viride</i> + <i>T. harzianum</i> + <i>P. fluorescens</i>	92.22	7.78	8.47	16.24
T ₇	<i>T. viride</i> + <i>T. harzianum</i> + <i>T. aureoviride</i>	85.56	14.44	15.54	29.99
T ₈	<i>T. viride</i> + <i>T. harzianum</i> + <i>T. aureoviride</i> + <i>Pseudomonas fluorescens</i>	77.78	22.22	24.27	46.49
T ₉	Control	65.56	34.44	50.79	85.24
	S.E.±	1.77	2.32	2.60	2.36
	C.D. (P=0.05)	5.32	6.12	5.50	7.06

Table 4: Effect of bio consortium on collar rot (*Sclerotium rolfsii*) disease and phenotypic parameters on variety JG-14

Sr. No.	Combination	Germination	Shoot length	Root length	Vigour index
T ₁	<i>Trichodermaviride</i> + <i>Trichodermaharzianum</i>	92.85	24.90	10.73	3,309.11
T ₂	<i>T. viride</i> + <i>T. aureoviride</i>	84.45	16.37	9.20	2,159.88
T ₃	<i>T. viride</i> + <i>Pseudomonas fluorescens</i>	90.70	22.77	10.23	2,993.02
T ₄	<i>T. harzianum</i> + <i>T. aureoviride</i>	82.55	15.17	8.63	2419.17
T ₅	<i>T. harzianum</i> + <i>Pseudomonas fluorescens</i>	87.76	18.10	9.47	2,463.27
T ₆	<i>T. viride</i> + <i>T. harzianum</i> + <i>P. fluorescens</i>	96.52	26.37	11.53	3,658.07
T ₇	<i>T. viride</i> + <i>T. harzianum</i> + <i>T. aureoviride</i>	89.35	21.10	9.67	2749.31
T ₈	<i>T. viride</i> + <i>T. harzianum</i> + <i>T. aureoviride</i> + <i>Pseudomonas fluorescens</i>	80.68	15.20	8.27	1,893.21
T ₉	Control	77.60	12.57	6.77	1,500.40
	S.E. ±	0.67	0.41	0.35	57.44
	C.D. (P=0.05)	2.02	1.24	1.04	171.98

fluorescens) followed by 82.55 per cent in T₄ (*T. harzianum* + *T. aureoviride*) and highest germination 96.52 per cent was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*).

Plant height (Shoot and Root) :

Maximum shoot height 26.37, 24.90, 22.77, 21.10, 18.10, 14.37, 16.17 and 15.20 cm were recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*), T₁ (*Trichoderma viride* + *Trichoderma harzianum*), T₃ (*T. viride* + *Pseudomonas fluorescens*), T₇ (*T. viride* + *T. harzianum* + *T. aureoviride*), T₅ (*T. harzianum* + *Pseudomonas fluorescens*), T₂ (*T. viride* + *T. aureoviride*), T₄ (*T. harzianum* + *T. aureoviride*) and T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*), respectively.

Maximum root length 11.53, 10.73, 10.23, 9.67, 9.47, 9.20, 8.63 and 8.27 cm were recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*), T₁ (*Trichoderma viride* + *Trichoderma harzianum*), T₃ (*T. viride* + *Pseudomonas fluorescens*), T₇ (*T. viride* + *T. harzianum* + *T. aureoviride*), T₅ (*T. harzianum* + *Pseudomonas fluorescens*), T₂ (*T. viride* + *T. aureoviride*), T₄ (*T. harzianum* + *T. aureoviride*) and T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*), respectively.

Vigour index :

Maximum vigour index per cent of 3,658.07 and 3,309.11 was recorded in T₆ (*T. viride* + *T. harzianum* + *P. fluorescens*) and T₁ (*Trichoderma viride* + *Trichoderma harzianum*). Minimum vigour index per cent of 1,893.21 and 2419.17 were observed in T₈ (*T. viride* + *T. harzianum* + *T. aureoviride* + *Pseudomonas fluorescens*) and T₄ (*T. harzianum* + *T. aureoviride*), respectively.

In dual culture test, each of all tested fungal and bacterial consortium limited the growth of the pathogen and overgrew the pathogen colony when compared to the control. In consortium treatment, maximum percent inhibition of *Sclerotium rolfsii* was observed in *T. viride* + *T. harzianum* + *P. fluorescens* (65.74) similarly result reported by Singh *et al.* (2013) in which combination of *Trichoderma* spp. and *Pseudomonas* spp. to assess the synergistic effect of compatible isolates for plant growth promotion and management of *S. rolfsii*.

Conclusion:

– The pathogen was identified as *Sclerotium rolfsii* on the basis of cultural and morphological characters.

– In consortium treatment, maximum inhibition of *Sclerotium rolfsii* was observed in *T. viride* + *T. harzianum* + *P. fluorescens*.

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