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Management of Collar Rot Disease of Groundnut under Field condition

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ABSTRACT: Groundnut is a major oilseed and food crop in India and across the world. The groundnut crop is being affected by a variety of diseases. Among them collar rot is a serious pathogen that causes heavy losses in groundnut cultivation. Collar rot is a seed-borne disease that causes seed rotting and reduces germination. The current investigation concentrated mostly on collar rot management in the field. In field experiment conducted during *Rabi*, 2018-19, treatment T_5 (seed treatment with mancozeb at half recommended dose *i.e.*, 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. *i.e.*, GT2 in Talc formulation @ 4 g kg^{-1} seed) showed least per cent disease incidence at 7 DAS (3.47 %), 15 DAS (2.40 %), 30 DAS (1.76 %) and maximum germination per cent (92.17 %), shoot length (34.67 cm), root length (14.06 cm), fresh weight (376.45 g), dry weight (174.44 g) and yield (2522.22 kg ha^{-1}) among different treatments.

Keywords: Collar rot, Groundnut, mancozeb, seed treatment, *Trichoderma* spp., yield.

INTRODUCTION

In the world, groundnut is cultivated in more than 90 countries (Virmani and Singh 1985). Groundnut is a crop with high nutritive values, the kernels are a rich source of oil (43-55 %), protein (25-28 %) and carbohydrates (18 %) and well known for its ability to fix atmospheric nitrogen. It is known as ‘king of oilseeds (Aycock 1966). Almost 75 per cent of its production is used for oil extraction and the remaining is used for human consumption. It is cultivated on 30.19 M ha worldwide with a total production of 49.55 MMT and productivity of 1640 kg ha^{-1} (USDA, 2021). India holds first place in area and second place in the production of groundnut in the world. The total area of groundnut in India is 6.0 M ha with a production of 6.7 MMT and productivity of 1120 kg ha^{-1} (USDA, 2021). In Andhra Pradesh, it is cultivated in an area of 1.0 M ha with a production of 0.6 MT and 595 kg ha^{-1} productivity (Ministry of Agriculture and Farmers' Welfare, 2016-17).

Low productivity of groundnut is mainly because of the diseases caused by fungi, bacteria, viruses, nematodes, etc. which causes upto 70 per cent estimated yield loss (McDonald *et al.*, 1985; Lukose *et al*., 2008). Among all the diseases caused by groundnut, collar rot is one important disease because of its seed and soil borne nature. Collar rot caused by *Aspergillus* spp. (*A. niger*, *A. flavus* and *A. terreus*) is widespread in almost all groundnut growing states of India *viz.*, Andhra Pradesh, Tamil Nadu, Gujarat, Punjab, Uttar Pradesh, Maharashtra, Karnataka, Rajasthan and Orissa. Collar rot causes an average of 5-40 per cent yield loss (Bakhetia, 1983). Collar rot is very severe in sandy loam soil (Gibson, 1953) and occurs in two stages *viz.*, pre-emergence and post-emergence stages. In the pre-emergence stage, seed will rot in the soil due to a sooty black mass of spores that kill emerging hypocotyls (Jain and Nema, 1952). In the post-emergence stage, initially the cotyledons show circular light brown lesions and as they advance the stem or hypocotyl tissue becomes water-soaked and shows light brown discolouration (Chohan, 1965). Rotting of succulent hypocotyls will end up causing seedlings to collapse and die. It happens during the early stages of crop development and has a major effect on germination percentage. Growth parameters such as shoot length, root length, fresh weight, dry weight, and yield will be affected by infection. The effect of biocontrol agents with compatible fungicides is more effective than using either biocontrol agent or fungicide (Henis *et al.*, 1978; Sawant and Mukhopadhyay 1990; Subbaiah and Indra 2003; Veena 2012; Gangwar *et al*., 2014; Rohtas, 2016; Kumari and Singh, 2017; Aiswarya *et al*. (2022); Nath and Patel (2022). The present investigation emphasizes evaluating the efficacy of fungicide and potential bioagents alone or in combination under field conditions to find out the effective treatment for the management of collar rot of groundnut.

MATERIALS AND METHODS

Preparatory cultivation. The field experiment was laid out in split plot design by using three species of *Aspergillus* in sandy loam soil during *Rabi*, 2018-19 at Dryland farm, RARS, Tirupati Andhra Pradesh. Collar rot prone variety Narayani was used to test the bioefficacy of fungicides *i.e.*, mancozeb and potential bioagents by imposing different treatments. Nitrogen, phosphorus, and potassium dosages of 20-40-40 kg ha^{-1} (recommended) were administered in the form of urea, single super phosphate, and murate of potash, respectively. All groundnut packages of practices were followed (Vyavasaya Panchangam, published by Acharya N.G. Ranga Agricultural University, Hyderabad)

Preparation of sick plots. Most virulent isolates of pathogens *i.e.*, *A. niger*, *A. flavus* and *A. terreus* were selected by screening in pathogenicity test and then in poison food test. Then sick plots of *A. niger, A. flavus* and *A. terreus* were prepared by applying biomass of the infected plants. In addition to that the pathogen grown on sorghum seeds was applied to the soil @ 150 g/m^2 area (Elad *et al.*, 1981). Biomass with groundnut plant debris was evenly spread and incorporated into the soil by ploughing. The same area was used for conducting the field experiment.

Soil Application

Soil application with talc based formulation of potential bioagent *i.e.*, GT2 (have highest inhibition percentage *i.e.*, 88.64 % in dual culture) which is mass multiplied in FYM (2 kg formulation + 90 kg of FYM) one month before sowing.

Seed Treatment. Bioagents from three districts namely Chittoor *i.e.,* GT1 (85.17 %), Y.S.R. Kadapa *i.e.*, GT7 (84.20 %) and Anantapuramu *i.e.*, GT2 (88.64 %) exhibited the highest per cent inhibition among others in the dual culture method were selected as potential bioagents and talc formulations were prepared for seed treatment. Groundnut seeds were treated with talc-based formulation of potential *Trichoderma* spp. isolates *i.e.*, GT1, GT2 and GT7. Effective fungicide *i.e.*, mancozeb was selected by conducting poison food and compatibility studies. For treatment with fungicide, the groundnut seeds were treated with mancozeb@ 2.5 g kg^{-1} seed (recommended dose). GT2 exhibited the highest inhibition percentage among potential bioagents and was found compatible with mancozeb in compatibility test. So GT2 is used in combination with mancozeb in treatment T5.

Experimental details. The field experiment was laid out using split plot design using three species of *Aspergillus* (Table 1 and 2).

i. Design: Split plot design.
ii. Date of sowing: 08, December, 2018.
iii. Replication: 3.
iv. Variety: Narayani.
v. Plot size: 5 × 3 m (15 m^2).
vi. Spacing: 22.5 × 10 cm.

Observations recorded:

a) Per cent seedling germination.
b) Per cent disease incidence (PDI) at 7 DAS, 15 DAS and 30 DAS. PDI was calculated using formula

PDI = No. of plants infected/Total no. of plants × 100.

c) Shoot length, root length, fresh weight and dry weight.
d) The yield obtained from each plot was recorded after threshing.

Data were analysed using OPSTAT software.

Table 1: Details of treatments involved testing of potential bioagents and effective fungicide under field conditions during *Rabi*, 2018-19.

S. No.	Treatment number	Treatments
1.	T_1	Seed treatment with potential isolate of *Trichoderma* spp. from Chittoor *i.e.*, GT1 (Talc formulation) @ 8 g kg^{-1} seed.
2.	T_2	Seed treatment with potential isolate of *Trichoderma* spp. from Anantapururamu *i.e.*, GT2 (Talc formulation) @ 8 g kg^{-1} seed.
3.	T_3	Seed treatment with potential isolate of *Trichoderma* spp. from Y.S.R. Kadapa *i.e.*, GT7 (Talc formulation) @ 8 g kg^{-1} seed.
4.	T_4	Seed treatment with mancozeb at the recommended dose@ 2.5 g kg^{-1} seed
5.	T_5	Seed treatment with mancozeb at half recommended dose @ 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. *i.e.*, GT2 (Talc formulation) @ 4 g kg^{-1} seed.
6.	T_6	Soil application with potential bioagent *i.e.*, GT2 mass multiplied in FYM (2 kg formulation + 90 kg of FYM)
7.	T_7	Control

Table 2: Field layout of the experimental plot.

0.5m	An	Af	At	0.5m	1m	0.5m	Af	At	An	0.5m	1m	0.5m	At	Af	An	0.5m
BUND	T_3	T_7	T_6	BUND	SPACING	BUND	T_2	T_5	T_6	BUND	SPACING	BUND	T_1	T_6	T_4	BUND
	T_2	T_5	T_7				T_3	T_1	T_5				T_4	T_5	T_7	
	T_4	T_1	T_3				T_5	T_4	T_2				T_2	T_1	T_2	
	T_7	T_3	T_5				T_7	T_3	T_7				T_7	T_3	T_6	
	T_6	T_2	T_4				T_6	T_2	T_4				T_6	T_2	T_5	
	T_5	T_4	T_1				T_1	T_7	T_1				T_3	T_4	T_1	
	T_1	T_6	T_2				T_4	T_6	T_3				T_5	T_7	T_3	

Where in, An= *Aspergillus niger*; Af= *Aspergillus flavus*; At= *Aspergillus terreus.*

RESULTS AND DISCUSSION

Germination percentage: Among the different treatments imposed, in T_5 (seed treatment with mancozeb at half recommended dose *i.e.*, 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. *i.e.*, GT2 in Talc formulation @ 4 g kg^{-1} seed) significantly higher germination percentage *i.e.*, 92.17 per cent was recorded followed by T_4 (seed treatment with mancozeb at recommended dose *i.e.*, 2.5 g kg^{-1} seed) *i.e.*, 87.87 per cent and lowest (63.07 %) was observed in T7 (control). From Table 3 it is revealed that among the three species of *Aspergillus*, *A. terreus* highly effected the germination percentage followed by *A. flavus* and least effected by *A. niger*.

Table 3: Effect of treatments on germination percentage of groundnut seeds under field conditions during *Rabi,* 2018-19.

Treatments	*A. niger*	*A. flavus*	*A. terreus*	Mean B
T_1	87.12 (69.00)	86.36 (68.48)	85.60 (67.76)	86.36^{bc}(68.41)
T_2	87.12(68.95)	85.60 (67.69)	85.60 (67.69)	86.11^{bcd} (68.11)
T_3	81.05 (64.18)	78.78 (62.56)	78.03 (62.03)	79.29^{e}(62.92)
T_4	89.39 (70.98)	87.87 (69.61)	86.36 (68.30)	87.87^{b}(69.63)
T_5	92.42 (74.16)	92.42 (74.03)	91.66 (73.22)	92.17^{a}(73.80)
T_6	86.63 (68.53)	85.60 (67.69)	83.33 (65.89)	85.19^{cd}(67.37)
T_7	66.66(54.72)	61.36 (51.55)	61.18 (51.45)	63.07^{f}(52.57)
Mean A	84.34^{a}(67.22)	82.57^{b}(65.94)	81.68^{c}(65.19)	
Factors	**C.D(P=0.05)**	**SE(d)**	**SE(m)**	
Factor (A)	1.03 (0.91)	0.3 (0.3)	0.2 (0.22)	
Factor (B)	2.07(1.70)	1.01(0.83)	0.72 (0.59)	
Factor (B) at same level of A	N/A	1.76 (1.44)	0.68 (0.59)	
Factor (A) at same level of B	N/A	1.67 (1.37)	1.18 (0.97)	

*Figures in parenthesis are angular transformed values

Per cent disease incidence at 7 DAS, 15 DAS and 30DAS: At 7 DAS, the lowest disease incidence (3.47 %) was noted in the T_5 (seed treatment with mancozeb at half recommended dose *i.e.*, 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. *i.e.*, GT2 in Talc formulation @ 4 g kg^{-1} seed) followed by T_4 (seed treatment with mancozeb at recommended dose *i.e.*, 2.5 g kg^{-1} seed) *i.e.*, 4.37 per cent and highest (27.87 %) was observed in T_7 (control). All the treatments significantly differed among themselves (Table 4).

Table 4: Effect of treatments on per cent disease incidence at 7 DAS under field conditions during *Rabi,* 2018-19.

Treatments	*A. niger*	*A. flavus*	*A. terreus*	Mean B
T_1	14.37^{c} (22.26)	10.40^{c} (18.81)	6.00^{bc}(14.17)	10.26^{c} (18.41)
T_2	7.70^{e} (16.10)	8.67^{e} (17.11)	5.67^{cd}(13.77)	7.34^{e} (15.66)
T_3	17.97^{b} (25.07)	14.03^{b} (21.99)	5.40^{cde} (13.43)	12.47^{b} (20.16)
T_4	3.50^{f} (10.76)	5.47^{f} (13.52)	4.13^{f}(11.73)	4.37^{f} (12.00)
T_5	2.20^{g} (8.52)	4.57^{g} (12.33)	3.63^{f}(10.98)	3.47^{g} (10.61)
T_6	12.23^{d} (20.46)	9.53^{d} (17.98)	6.13^{b} (14.33)	9.30^{d} (17.59)
T_7	32.70^{a} (34.86)	28.10^{a} (31.99)	22.80^{a} 28.51)	27.87^{a} (31.79)
Mean A	12.95^{a} (19.72)	11.54^{b} (19.10)	7.68^{c}(15.27)	
Factors	**C.D(P=0.05)**	**SE(d)**	**SE(m)**	
Factor (A)	0.46 (0.34)	0.16 (0.12)	0.11 (0.09)	
Factor (B)	0.44 (0.36)	0.22 (0.18)	0.15 (0.13)	
Factor (B) at same level of A	0.82 (0.67)	0.38 (0.31)	0.30 (0.23)	
Factor (A) at same level of B	0.84 (0.67)	0.39 (0.31)	0.27 (0.22)	

*Figures in parenthesis are angular transformed values

At 15 DAS, minimum PDI (2.40 %) was noted in T_5 (seed treatment with mancozeb at half recommended dose *i.e.*, 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. *i.e.*, GT2 in Talc formulation @ 4 g kg^{-1} seed) followed by T_4 (seed treatment with mancozeb at recommended dose *i.e.*, 2.5 g kg^{-1} seed) *i.e.*, 3.88 per cent. The highest (25.02 %) was observed in T_7 (control). All treatments significantly differed among themselves **(**Table 5).

Among the treatments at 30 DAS, T_5 (seed treatment with mancozeb at half recommended dose *i.e.*, 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. *i.e.*, GT2 in Talc formulation @ 4 g kg^{-1} seed) showed the least PDI (1.76 %) followed by T_4 (seed treatment with mancozeb at recommended dose *i.e.*, 2.5 g kg^{-1} seed) *i.e.*, 2.94 per cent and highest (19.50 %) was observed with T_7 (control). All treatments significantly differed. All the treatments were effectively controlled *A. terreus* (0.00 PDI) followed by *A. Flavus* (8.84 PDI) and *A. niger* (10.96 PDI) (Table 6).

Table 5: Effect of treatments on per cent disease incidence at 15 DAS under field conditions during *Rabi*, 2018-19.

Treatments	*A. niger*	*A. flavus*	*A. terreus*	Mean B
T_1	16.10^c(23.65)	8.97^c(17.42)	2.23^b(8.59)	9.10^c(16.55)
T_2	8.63^d(17.08)	7.40^d (15.78)	1.23^c(6.37)	5.76^e(13.08)
T_3	19.40^b(26.12)	12.37^b (20.58)	2.60^b(9.21)	11.46^b(18.64)
T_4	7.67^e(16.06)	3.97^e (11.48)	0.00^d(0.00)	3.88^f (9.18)
T_5	3.41^f(10.62)	3.80^e (11.24)	0.00^d(0.00)	2.40^g (7.29)
T_6	8.27^d(16.70)	8.63^c (17.08)	2.13^b(8.40)	6.34^d(14.06)
T_7	37.10^a(37.51)	30.47^a (33.49)	7.50^a(15.88)	25.02^a(28.96)
Mean A	14.37^a(21.11)	10.80^b(18.15)	2.24^c(6.92)	
Factors	**C.D(P=0.05)**	**SE(d)**	**SE(m)**	
Factor (A)	0.47 (0.54)	0.17 (0.19)	0.12 (0.13)	
Factor (B)	0.46 (0.43)	0.23 (0.21)	0.16(0.15)	
Factor (B) at same level of A	0.85 (0.82)	0.39 (0.37)	0.31(0.35)	
Factor (A) at same level of B	0.87 (0.87)	0.40 (0.39)	0.28 (0.27)	

*Figures in parenthesis are angular transformed values

Table 6: Effect of treatments on per cent disease incidence at 30 DAS under field conditions during *Rabi*, 2018-19.

Treatments	*A. niger*	*A. flavus*	*A. terreus*	Mean B
T_1	12.30^c (20.52)	7.80^c(16.21)	0.00^a(0.00)	6.70^c (12.24)
T_2	6.33^d (14.57)	5.37^d(13.39)	0.00^a(0.00)	3.90^d (9.32)
T_3	14.63^b (22.48)	9.77^b(18.20)	0.00^a(0.00)	8.13^b (13.56)
T_4	5.30^e (13.30)	3.53^e(10.83)	0.00^a(0.00)	2.94^f (8.04)
T_5	2.83^g(9.69)	2.43^f (8.96)	0.00^a(0.00)	1.76^g (6.22)
T_6	4.50^f (12.24)	5.30^d(13.30)	0.00^a(0.00)	3.27^e (8.51)
T_7	30.83^a (33.72)	27.67^a(31.72)	0.00^a(0.00)	19.50^a (21.81)
Mean A	10.96^a (18.07)	8.84^b(16.09)	0.00^c(0.00)	
Factors	**C.D.**	**SE(d)**	**SE(m)**	
Factor (A)	0.42 (0.37)	0.15 (0.13)	0.11 (0.00)	
Factor (B)	0.32 (0.26)	0.16 (0.13)	0.11(0.09)	
Factor (B) at same level of A	0.62 (0.54)	0.27 (0.22)	0.28(0.24)	
Factor (A) at same level of B	0.66 (0.54)	0.29 (0.24)	0.21 (0.17)	

*Figures in parenthesis are angular transformed values

Shoot length and root length: When the interaction effects were observed, among the treatments maximum shoot and root length were recorded in T_5 (seed treatment with effective fungicide at half recommended dose *i.e.*, 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. in Talc formulation @ 4 g kg^{-1} seed) against *A. niger* (31.67 cm and 13.67 cm), *A. flavus* (34.00 cm and 14.00 cm) and *A. terreus* (38.33 cm and 14.50 cm) followed by T_4 (seed treatment with effective fungicide at recommended dose *i.e.*, 2.5 g kg^{-1} seed) against *A. niger* (31.00 cm and 11.33 cm), *A. flavus* (32.67 cm and 12.17 cm) and *A. terreus* (36.67 cm and 12.33 cm). Minimum shoot and root length were observed in inoculated control T_7 against *A. niger* (10.67 cm and 3.33 cm), *A. flavus* (15.00 cm and 5.00 cm) and *A. terreus* (22.67 cm and 6.67 cm).Among the three species of *Aspergillus*, *A. niger* more effected the shoot and root length followed by *A. flavus* and less effected by *A. terreus* (Table 7 and 8).

Table 7: Effect of treatments on shoot length (cm) under field conditions during *Rabi*, 2018-19.

Treatments	*A.niger*	*A. flavus*	*A. terreus*	Mean B
T_1	24.00^c	27.67^c	32.00^d	27.89^d
T_2	29.00^b	30.33^b	34.67^{bc}	31.33^c
T_3	21.33^d	25.00^d	29.33^e	25.22^e
T_4	31.00^{ab}	32.67^a	36.67^{ab}	33.44^b
T_5	31.67^a	34.00^a	38.33^a	34.67^a
T_6	24.33^c	27.67^c	34.33^c	28.78^d
T_7	10.67^e	15.00^e	22.67^f	16.11^f
Mean A	24.57^a	27.48^b	32.57^c	
Factors	**C.D(P=0.05)**	**SE(d)**	**SE(m)**	
Factor (A)	1.15	0.40	0.29	
Factor (B)	1.13	0.55	0.39	
Factor (B) at same level of A	2.08	0.96	0.75	
Factor (A) at same level of B	2.12	0.97	0.69	

Table 8: Effect of treatments on root length (cm) under field conditions during *Rabi*, 2018-19.

Treatments	*A. niger*	*A. flavus*	*A. terreus*	Mean B
T_1	7.00^{e}	8.17^{de}	8.17^{de}	7.78^{e}
T_2	9.67^{c}	10.33^{c}	10.67^{c}	10.22^{c}
T_3	6.33^{e}	7.67^{e}	8.00^{e}	7.33^{f}
T_4	11.33^{b}	12.17^{b}	12.33^{b}	11.94^{b}
T_5	13.67^{a}	14.00^{a}	14.50^{a}	14.06^{a}
T_6	8.00^{d}	8.67^{d}	8.83^{d}	8.50^{d}
T_7	3.33^{f}	5.00^{f}	6.67^{f}	5.00^{g}
Mean A	8.48^{b}	9.43^{a}	9.88^{a}	
Factors	**C.D(P=0.05)**	**SE(d)**	**SE(m)**	
Factor (A)	0.45	0.16	0.11	
Factor (B)	0.43	0.21	0.15	
Factor (B) at same level of A	0.80	0.37	0.29	
Factor (A) at same level of B	0.82	0.38	0.27	

Fresh weight and dry weight: When the interaction effects were observed, among the treatments significantly highest fresh and dry weight were observed in T_5 (seed treatment with effective fungicide at half recommended dose *i.e.*, 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. in Talc formulation @ 4 g kg^{-1} seed) against *A. niger* (366.00 g and 160.00 g), *A. flavus* (371.67 g and 173.33 g) and *A. terreus* (391.67 g and 190.00 g) followed by T_4 against *A. niger* (295.00 g and 123.33 g), *A. flavus* (340.00 g and 126.67 g) and *A. terreus* (363.33 g and 143.67 g). Significantly lower fresh and dry weight were recorded in inoculated control T_7 against *A. niger* (71.00 g and 38.00 g), *A. flavus* (85.67 g and 46.67 g) and *A. terreus* (131.67 g and 73.00 g). Among the three species of *Aspergillus*, *A. terreus* less effected the fresh and dry weight followed by *A. flavus* and more effected by *A. niger* (Table 9 and 10).

Table 9: Effect of treatments on fresh weight (g) under field conditions during *Rabi*, 2018-19.

Treatments	*A. niger*	*A. flavus*	*A. terreus*	Mean B
T_1	133.67^{e}	176.00^{d}	187.67^{e}	165.78^{e}
T_2	206.67^{c}	243.33^{c}	261.67^{c}	237.22^{c}
T_3	106.33^{f}	145.00^{e}	247.33^{c}	166.22^{e}
T_4	295.00^{b}	340.00^{b}	363.33^{b}	332.78^{b}
T_5	366.00^{a}	371.67^{a}	391.67^{a}	376.45^{a}
T_6	161.67^{d}	180.00^{d}	205.00^{d}	182.22^{d}
T_7	71.00^{g}	85.67^{f}	131.67^{f}	96.11^{f}
Mean A	191.48^{c}	220.24^{b}	255.48^{a}	
Factors	**C.D(P=0.05)**	**SE(d)**	**SE(m)**	
Factor (A)	3.70	1.30	0.92	
Factor (B)	8.24	4.05	2.86	
Factor (B) at same level of A	14.49	7.01	2.43	
Factor (A) at same level of B	13.68	6.62	4.68	

Table 10: Effect of treatments on dry weight (g) under field conditions during *Rabi*, 2018-19.

Treatments	*A.niger*	*A. flavus*	*A. terreus*	Mean B
T_1	72.67^{d}	95.00^{c}	100.00^{d}	89.22^{de}
T_2	105.00^{c}	123.00^{b}	127.33^{c}	118.44^{c}
T_3	47.00^{e}	78.33^{d}	123.33^{c}	82.89^{e}
T_4	123.33^{b}	126.67^{b}	143.67^{b}	131.22^{b}
T_5	160.00^{a}	173.33^{a}	190.00^{a}	174.44^{a}
T_6	86.00^{d}	88.33^{cd}	105.00^{d}	93.11^{d}
T_7	38.00^{e}	46.67^{e}	73.00^{e}	52.56^{f}
Mean A	90.29^{c}	104.48^{b}	123.19^{a}	
Factors	**C.D(P=0.05)**	**SE(d)**	**SE(m)**	
Factor (A)	2.29	0.80	0.57	
Factor (B)	7.87	3.86	2.73	
Factor (B) at same level of A	13.71	6.69	1.50	
Factor (A) at same level of B	12.80	6.25	4.42	

Pod yield: When the interaction effects were observed, among the treatments significantly higher yield was recorded in T_5 against *A. niger* (2466.67 kg ha^{-1}), *A. flavus* (2511.11 kg ha^{-1}) and *A. terreus* (2588.89 kg ha^{-1}) followed by T_4 against *A. niger* (1955.55 kg ha^{-1}), *A. flavus* (2311.11 kg ha^{-1}) and *A. terreus* (2400.00 kg ha^{-1}). Significantly lower yield was recorded in inoculated control against *A. niger* (244.45 kg ha^{-1}), *A. flavus* (444.45 kg ha^{-1}) and *A. terreus* (1166.67 kg ha^{-1}). Among the three species of *Aspergillus*, *A. terreus* less effected the yield followed by *A. flavus* and most effected by *A. niger* (Table 11, Plate 1)

Table 11: Effect of treatments on yield (kg ha^{-1}) under field conditions during *Rabi,* 2018-19.

Treatments	*A. niger*	*A. flavus*	*A. terreus*	Mean B
T_1	1,222.22^{d}	1,622.22^{cd}	1,628.89^{d}	1,491.11^{e}
T_2	1,444.44^{c}	1,711.11^{c}	1,813.33^{c}	1,656.30^{c}
T_3	1,044.45^{e}	1,288.89^{e}	1,377.78^{e}	1,237.04^{f}
T_4	1,955.55^{b}	2,311.11^{b}	2,400.00^{b}	2,222.22^{b}
T_5	2,466.67^{a}	2,511.11^{a}	2,588.89^{a}	2,522.22^{a}
T_6	1,266.67^{d}	1,666.67^{cd}	1,744.45^{c}	1,559.26^{d}
T_7	244.45^{f}	444.45^{f}	1,166.67^{f}	618.52^{g}
Mean A	1,377.78^{c}	1,650.79^{b}	1,817.14^{a}	
Factors	**C.D(P=0.05)**	**SE(d)**	**SE(m)**	
Factor (A)	35.22	12.36	8.74	
Factor (B)	59.72	29.33	20.74	
Factor (B) at same level of A	106.10	50.79	23.11	
Factor (A) at same level of B	101.56	48.62	34.38	

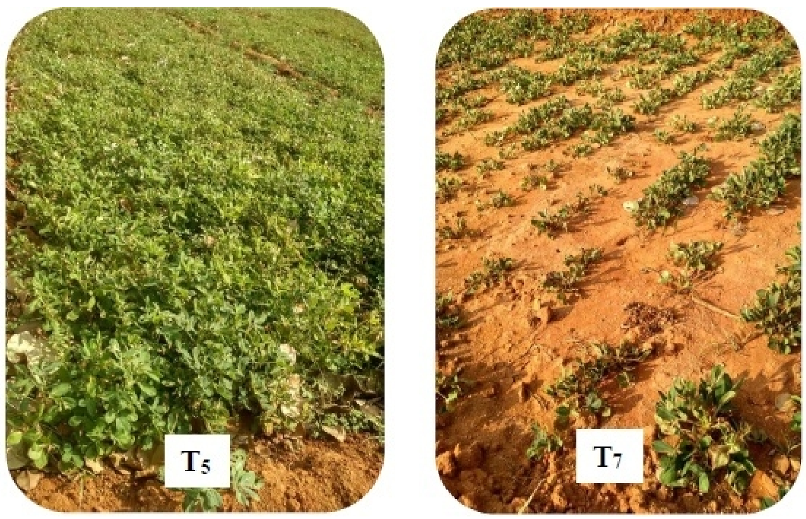

Plate 1. Field view of T_5 (seed treatment with mancozeb at half recommended dose @ 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. *i.e*., GT2 in Talc formulation @ 4 g kg^{-1} seed) and T_7 (Control).

Thus overall, the efficacy of treatment T5 (seed treatment with mancozeb at half recommended dose *i.e*., 1.25 g kg^{-1} seed + potential isolate of *Trichoderma* spp. *i.e*., GT2 in Talc formulation @ 4 g kg^{-1} seed) was found to be superior which recorded highest germination per cent (*A. niger*-92.42 %, *A. flavus*-92.42 % and *A. terreus*-91.66 %), least per cent disease incidence at 7 DAS (*A. niger*-2.20 %, *A. flavus*-4.57 % and *A. terreus*-3.63 %), at 15 DAS (*A. niger*-3.41 %, *A. flavus*-3.80 % and *A. terreus*-7.50 %), at 30 DAS (*A. niger*-2.83 %, *A. flavus*-2.43 % and *A. terreus*-0.00 %), maximum shoot length (*A. niger*-31.67 cm, *A. flavus*-34.00 cm and *A. terreus*-38.33 cm), maximum root length (*A. niger*-13.67 cm, *A. flavus*-14.00 cm and *A. terreus*-14.50 cm), highest fresh weight (*A. niger*-366.00 g, *A. flavus*-371.67 g and *A. terreus*-391.67 g), highest dry weight (*A. niger*-160.00 g, *A. flavus*-173.33 g and *A. terreus*-190.00 g) and more yield (*A. niger*-2466.67 kg ha^{-1}, *A. flavus*-2511.11 kg ha^{-1} and *A. terreus*-2588.89 kg ha^{-1}) when compared to other treatments.

The present findings are supported by several workers according to them the integration of biocontrol agents with compatible fungicides gave higher disease control in several crops than obtained by either biocontrol agent or fungicide (Henis *et al.*, 1978;Sawantand Mukhopadhyay, 1990; Subbaiah and Indra, 2003; Veena, 2012; Nandeesha, 2013; Gangwar *et al*., 2014; Rohtas, 2016; Kumari and Singh 2017). According to Lora and Begum's research (2019); Mancozeb and Carbendazim are effective against collar rot infection. Whereas, Devi and Prasad (2009) observed that collar rot incidence was significantly reduced (66.70 %) with seed treatments of *T. viride* and captan, followed by seed treatment with *T. viride*(72.30 %) and captan (74.30 %) when compared to control (98.30 %). Seed treatment with *T. viride* increased germination percentage, dry matter production and pod yield. According to Aiswarya *et al*. (2022); Nath and Patel (2022), seed treatment with a biocontrol agent followed by fungicide provides the best disease control, which was also corroborated to our research finding.

CONCLUSION AND FUTURE SCOPE

The current research concludes that groundnut collar rot disease is complicated in nature owing to the connection of many soil-borne pathogens, and that there is a need for the combination of cultural, biological, and chemical strategies in plant disease management. Integration of bioagents and fungicides in field experiments and groundnut collar rot disease control assessment in farmer fields can be undertaken in the future.

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Conflict of Interest. None.

REFERENCES

Aiswarya, N., Bhattiprolu, S. L., Reddy, K. B., & Rao, G. R. (2022). Efficacy of Fungicides and Bio-control Agents against *Aspergillus flavus*. *Biological Forum – An International Journal, 14*(2): 698-703.

Aycock, R. (1966). Stem rots and other diseases caused by *Sclerotiumrolfsii, North Carolina, Agricultural Experiment Station Technical Bulletin,* no. 174, p 202.

Bakhetia, D. R. C. (1983). Control of white grub (*Holotrichia consenguinea*) and collar rot (*Aspergillus niger*) of groundnut sown in different dates in Punjab. *Indian Journal of Agricultural Sciences, 53*(9), 846-850.

Chohan, J. S. (1965). Collar rot of groundnut caused by *A. niger* Van Tieghem and *Aspergillus pulverulunus* (Mc Alpine) Thom. in the Punjab. *Journal of Research, Panjab Agricultural University, 2*(1), 25-33.

Devi, M. C., & Prasad, R. D. (2009). Biointensive management of collar rot of groundnut caused by *Aspergillus niger*. *Journal of Biological Control*, *23*(1), 21-24.

Elad, Y., Hadar, Y., Hadar, E., Chet, I., & Henis, Y. (1981). Biological control of *Rhizoctonia solani* by *Trichoderma harzianum* in carnation. *Plant Disease*, *65,* 675-677.

Gangwar, R. K., Rathore, S. S., & Sharma R. K. (2014). Integrated management of collar rot disease of groundnut. *Pestology, 38*(1), 63-66.

Gibson, I.A.S. (1953). Crown rot a seedling disease of groundnut caused by *A. niger*. Anomalour effect of orange mercurial seed dressings. *Transactions of the British Mycological Society*, *36*, 324-334.

Henis, Y., Ghaffar, A., & Baker, R. (1978). Integrated control of *Rhizoctonia solani* damping-off of radish: Effect of successive plantings, PCNB, and *Trichoderma harzianum* on pathogen and disease. *Phytopathology*, *68*, 900-907.

Jain, A. C., & Nema, K.G. (1952). *Aspergillus* blight of groundnut seedling. *Science and Culture*, *17*, 348-349.

Kumari, M., & Singh, M. (2017). Bio-intensive Management of collar rot disease of groundnut (*Arachis hypogaea* L.) caused by *Aspergillus niger*. *International Journal of Chemical Studies*, *5*(4), 80-82.

Lora, S., & Begum, T. (2019). Managing of Collar Rot Disease in Groundnut (*Arachis hypogaea* L.) by few Chemicals. *International Journal of Scientific Research in Biological Sciences, 6*, 3.

Lukose C. M., Moradia, A. M., & Kunadia. B. A. (2008). Diseases of groundnut in Gujarat and their management. Published Research Scientist (Groundnut). Main Oilseeds Research Station. Junagadh Agricultural University, Junagadh, pp 1–16.

McDonald, D., Subrahmanyam, P., Gibbons, R. W., & Smith, D. H. (1985). Early and late leaf spots of groundnut. *ICRISAT Information Bulletin*, no. 21.

Ministry of Agriculture and Farmers' Welfare, 2016-2017.

Nandeesha, B. S., Kumar, R., & Reddy, N. P. E. (2013). Evaluation of different fungicides and their compatibility with *Trichoderma* spp. for the management of *Aspergillus niger*, incitant of collar rot of groundnut. *Asian Journal of Biological and Life Sciences*, *2*(1), 59-63.

Nath, K., & Patel, V. P. (2022). Evaluation of different fungicides and bio-agents to minimize the collar rot disease of groundnut caused by *Aspergillus niger* Van Tiegham. *International Journal of Tropical Agriculture*, *40*(1-2), 159-165.

Rohtas, R., Saharan, H. S., & Rathi, A. S. (2016). Management of collar rot of groundnut with bio-agent, botanicals and chemicals. *Biosciences Biotechnology Research Asia*, *3*, 1657-1663.

Sawant, I., & Mukhopadhyay, A. N. (1990). Integration of metalaxyl with *Trichoderma harzianum* for the control of *Pythium* damping off in sugar beet. *Phytopathology*, *43*, 535-541.

Subbiah, G., & Indra, N. (2003). Management of seed and collar rots caused by *Aspergillus niger* Van Tiegham in groundnut (*Arachis hypogaea* L.) by biocontrol method.*Madras Agriculture Journal, 90*(4), 292-297.

USDA, (2021). World Agricultural Production.

Veena, G. A. (2012). Studies on integrated management of *Rhizoctoniabataticola* (Taub.) Butler causing dry root rot of chickpea. *M.Sc. (Ag.) Thesis* submitted to Acharya N G Ranga Agricultural University, Rajendranagar, Hyderabad.

Virmani, S. M., & Singh, P. (1985). Agroclimatological characteristics of the groundnut-growing regions in the semi–arid tropics. In: Agro meteorology of groundnut. Proceeding of the International Symposium held at the ICRISAT Sahenlian Center, Niamey, Niger.

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