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Eco Friendly Management of Anthracnose of Black Gram (*Vigna mungo* L.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted during the 2023 *Kharif* season at the Central Research Farm, Department of Plant Pathology, SHUATS, Prayagraj, U.P. to evaluate the efficacy of *Trichoderma harzianum* with botanicals against anthracnose disease in black gram under field conditions. There were seven treatments including control, *viz*., T_0 – Control, T_1 - *Trichoderma harzianum* @ 10g (S.T) + 10% (F.S), T_2 - *Trichoderma harzianum* @ 10g (S.T) + Datura leaf extract @ 10% (F.S), T_3 - *Trichoderma harzianum* @ 10g (S.T) + Neem leaf extract @ 10% (F.S), T_4 - *Trichoderma harzianum* @ 10g (S.T) + Onion bulb extract @ 10% (F.S), T_5 - *Trichoderma harzianum* @ 10g (S.T) + Garlic clove extract @ 10% (F.S) and T_6 - Hexaconazole @ 0.2g (S.T) + 0.2% (F.S). Among all the treatments, T_3 - *Trichoderma harzianum* @ 10g (S.T) + Neem leaf extract @ 10% (F.S) was

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found to be the significant against anthracnose. Minimum disease intensity (26.43%), maximum plant height (46.90 cm), maximum number of pods per plant (16.27 pods/plant), maximum yield (0.70 t/ha) and highest cost benefit ratio (1:2.13) was recorded in T_3 - *Trichoderma harzianum@* 10g (S.T) + Neem leaf extract @ 10% (F.S) as compared to treated check Hexaconazole and untreated check control.

Keywords: Black gram; botanicals, Colletotrichum lindimuthianum; foliar spray; kharif; seed treatment; Trichoderma harzianum.

1. INTRODUCTION

"Black gram [*Vigna mungo* (L.) Hepper] or Urad bean is one of the most important pulse crops in India. This legume originated in India, where it has been cultivated from ancient times and is one of the most highly priced legumes. The crop has inevitably marked itself as the most popular legume and can be most appropriately referred to as the King of legumes'' [1].

"Black gram can be grown in all seasons, *viz*., *Kharif*, *Rabi*, *Zaid* throughout India. India is largest producer as well as the consumer. The production of black gram is mostly confined to Asian countries, India being one of them. Major black gram growing states in India are Tamil Nadu, Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Telangana, Sikkim and Orrisa. The estimated production of black gram in India during 2021-2022 *Kharif* and *Rabi* season was 513 kg/ha and 866 kg/ha, respectively- and the total yield of black gram was 586 kg/ha" [2].

The Anthracnose of beans was discovered by Lindemuth at Bonn, Germany in 1875 and first described by Saccardo in 1878. In India, the black gram and green gram anthracnose was first reported from Jorhat of Assam state in 1951 [3]. In Uttar Pradesh, the black gram anthracnose was first reported in 1984 [4].

The disease has been reported from all major urd bean growing regions of India in mild to severe form and in tropical and subtropical areas it causes considerable damage by reducing seed quality and yield. The disease causes qualitative as well as quantitative losses. Losses in yield due to anthracnose have been estimated to be in the range of 24 to 67 percent [5]. In Uttar Pradesh the disease appears in the second or third week of June reaching at maximum during early August to mid-September causing maximum damage. In addition to common bean, the pathogen also attacks cowpea, mung bean, urd bean etc.

The management of seed-borne diseases is to eradicate or reduce the pathogen inoculum in the seed production field. Management strategies used to minimize seed-borne infection in the seed production field include host resistance, cultural, chemical and biological control methods [6].

2. MATERIALS AND METHODS

The present study was conducted at the experimental field of Department of Plant Pathology in Central Research Field, Sam Higginbottom University of Agriculture, Technology and Sciences, during the 2023 *Kharif* season. Field experiment was laid-out in Randomized block design with three replications. Black gram crop variety Shekar-3 (KU-309) was sown in last week of July with spacing of 30 cm and 10 cm between rows and plants, adopted in plot in plot size of 2x1m^2, respectively. Generally, anthracnose disease appeared at 34- 37 days after sowing. Observations on anthracnose disease intensity were recorded on randomly selected five plants of upper, middle and lower leaves from per plot. The formula for calculation of Disease intensity (%) and disease scale for anthracnose disease of black gram (0-5) was calculated according to the formula given by Rajkumar and Mukhopadhyay [7].

The disease severity of anthracnose was recorded after first spray, fifteen days after second spray and fifteen days after third spray using 0- 5 rating scale and percent disease index (PDI) was calculated using the formula given by Wheeler [8].

$$Disease\ intensity\ (\%) = \frac{Sum\ of\ all\ disease\ rating}{Total\ number\ of\ ratings \times Maximum\ disease\ grade} \times 100$$

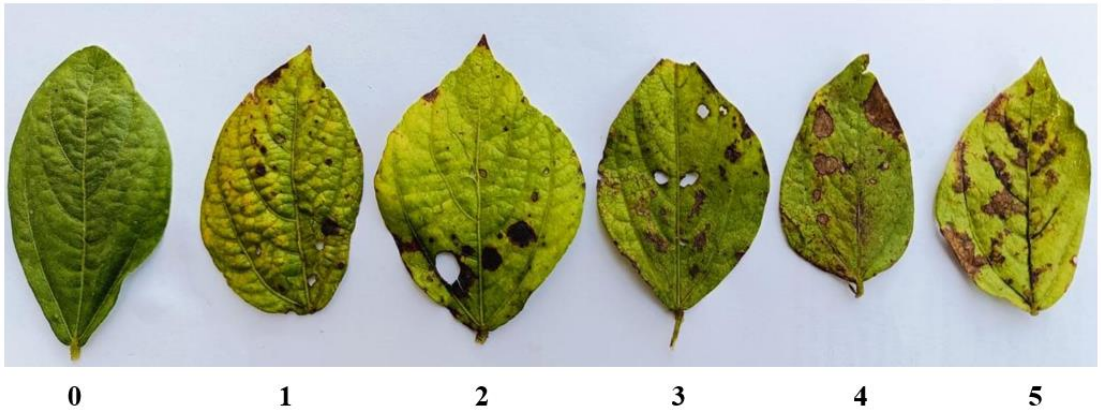

Fig. 1. Disease rating scale of Anthracnose disease in black gram

Table 1. Disease rating scale

Serial Number	Score / Grade	Description
1	0	No infection
2	1	1-5% leaf area covered
3	2	6-10% leaf areas covered
4	3	11-25% leaf areas covered
5	4	26-50% leaf areas covered
6	5	>50% leaf areas covered

2.1 Application of Bioagent and Botanicals

Trichoderma harzianum was applied as a seed treatment for all the treatments except treated check Hexaconazole and untreated check T_0-control. The main antagonistic activities of this bio-agent were through, mycelial growth inhibition, toxic volatile metabolite production and inhibition of spore germination [6]. The selected botanicals and bioagent was used as a foliar spray after the disease symptoms appeared in the field. The selected treatments for foliar spray *Trichoderma harzianum*, Datura leaf extract, Neem leaf extract, Onion bulb extract and Garlic clove extract have showed results in the management of anthracnose. Mainly Neem leaf extract and Garlic clove extract had significantly reduced incidence of anthracnose.

T. harzianum work by antagonizing the anthracnose-causing pathogens, boosting the plant's natural defence mechanisms, and enhancing soil microbial activity. Additionally, botanical extracts possess antifungal properties that directly combat anthracnose pathogens while promoting overall plant health.

2.2 Statistical Analysis

The data obtained from the field experiment were statistically analysed by following the standard procedures [9]. In the experiment Randomized Block Design (RBD) was adopted. The analysis of variance (ANOVA) technique was applied for drawing conclusion from data. The calculated values were compared the tabulated values at 5% level of probability for the appropriate degree of freedom.

3. RESULTS

A field study was carried out to assess on various aspects of anthracnose of black gram caused by *Colletotrichum lindimuthianum* with reference to evaluation of disease intensity (%), plant height (cm), number of pods, seed yield (t/ha) and cost benefit ratio of the treatments.

The results of the field experiment presented in Table 2 clearly indicate that the disease intensity was significantly low in all the treated plots compared to the untreated control plot after three sprays. Disease intensity was recorded three times at 45, 60 and 75 DAS. The first spray of treatments was applied at 40 days after sowing and second spray was applied at 55 days after sowing and third spray was applied at 70 days after sowing. Among the treatments, significant reduction in the disease intensity (%) at 45, 60, and 75 DAS was recorded in the treatment, T_3-*Trichoderma harzianum* 10g/kg + Neem leaf extract @ 10%. The minimum disease intensity

Table 2. Effect of selected treatments on per cent disease intensity of anthracnose and growth parameters of black gram at different time intervals

Treatment no	Treatments	Per cent disease intensity (%)				Plant height (cm)				No. of pods per plant	Yield (q/ha)	C:B ratio
		45 DAS (After 1st spray)	60 DAS (After 2nd spray)	75 DAS (After 3rd spray)	Mean	30 DAS	60 DAS	90 DAS	Mean			
T_0	Untreated control	16.34	29.58	43.22	29.72	11.86	29.70	36.93	26.04	9.20	0.45	1: 1.40
T_1	*Trichoderma harzianum* 10g/kg (S.T) + 10% (F.S)	13.80	26.46	35.28	25.18	11.80	34.53	40.66	29.54	13.00	0.57	1: 1.73
T_2	*Trichoderma harzianum* + Datura leaf extract 10g/kg (S.T) + 10% (F.S)	14.51	27.22	38.55	26.76	12.20	31.80	39.86	28.07	11.73	0.52	1: 1.57
T_3	*Trichoderma harzianum* + Neem leaf extract 10g/kg (S.T) + 10% (F.S)	7.86	16.75	25.62	16.74	11.60	38.26	46.90	33.53	16.26	0.70	1:2.13
T_4	*Trichoderma harzianum* + Onion bulb extract 10g/kg (S.T) + 10% (F.S)	14.15	26.83	37.93	26.31	11.26	32.00	40.36	28.57	11.86	0.54	1:1.63
T_5	*Trichoderma harzianum* + Garlic clove extract 10g/kg (S.T) + 10% (F.S)	9.25	20.11	29.35	19.66	12.13	36.66	43.13	31.50	14.53	0.65	1:1.75
T_6	Hexaconazole (treated check) 0.2g/kg (S.T) + 0.2% (F.S)	5.68	14.49	22.58	14.39	12.06	40.56	47.80	34.82	18.40	0.79	1:2.22
S. Em (±)		0.18	0.17	0.24	_____	0.11	0.16	0.18	_____	0.13	0.01	_____
C.D (5%)		0.57	0.52	0.73	_____	0.36	0.49	0.56	_____	0.43	0.04	_____

(%) of black gram was recorded in T_3- *Trichoderma harzianum* 10g/kg + Neem leaf extract @ 10% (7.86, 16.75, 25.62) followed by T_5- *Trichoderma harzianum* 10g/kg + Garlic clove extract @ 10% (9.25, 20.11, 29.35) as compared to the other treatments including T_0- untreated control. The maximum plant height was recorded T_3- *Trichoderma harzianum* 10g/kg + Neem leaf extract @ 10% (15.43, 38.26, 46.90) followed by T_5- *Trichoderma harzianum* 10g/kg + Garlic clove extract @ 10% (14.70, 36.66, 43.13) as compared to the other treatments including T_0- untreated control. The maximum number of pods per plant was recorded in T_3- *Trichoderma harzianum* 10g/kg + Neem leaf extract @ 10% (16.26) followed by T_5- *Trichoderma harzianum* 10g/kg + Garlic clove extract @ 10% (14.53) as compared to the other treatments including T_0- untreated control. The significant increase in yield was recorded in T_3- *Trichoderma harzianum* 10g/kg + Neem leaf extract @ 10% (0.70 t/ha) followed by T_5- *Trichoderma harzianum* 10g/kg + Garlic clove extract @ 10% (0.65 t/ha) as compared to the other treatments including T_0- untreated control. And cost benefit ratio T_3- *Trichoderma harzianum* 10g/kg + Neem leaf extract @ 10% was statistically found as most economic treatment as compared to other treatments and including T_0- untreated control.

4. DISCUSSION

In the present investigation, *Trichoderma harzianum* + Neem leaf extract found most effective against management of anthracnose in black gram. *Trichoderma* strains produced cell wall lytic enzymes and volatile and non-volatile toxic metabolites that impede colonization by antagonized microorganisms [10]. *Trichoderma* can produce harzianic acid, alamethicins, tricholin, peptaibols, antibiotics, 6-penthyl-α-pyrone, massoilactone, viridin, glioviridin, gliovirin, glisoprenins, heptelidic acid, pentyl pyrone, gliotoxin, trichorzianines and oxazole which can increase growth of plants and induce resistance to disease [11]. *Trichoderma* has been found to be effective in plant growth characteristics and enhance biomass production. *Trichoderma* species either added to the soil or applied as seed treatment, grow rapidly along with the developing root system [12]. Similar findings are reported by Modi and Tiwari [13]; Sushmitha and Zacharia [14]; Laxmi *et al.* [15] and Nezu *et al.* [16].

These botanicals source of alternatives or complemental to synthetic fungicides in crop protection, *Azadirachta indica* significantly toxic to *Colletotrichum* sp. Neem plants contain chemical compounds such as azadirachtin, nimbicidine and nimbin which are active triterpenoid compound having antimicrobial properties [17]. This finding is most likely due to the active compounds found in neem leaves, including azadirachtin, salanin, nimbin, nimbidin, and limonoids which cause the pathogens cell to rupture, restrict the activity of certain enzymes that are found in proliferating fungi and ultimately cause the fungi to die. Neem leaf extract have shown good fungicidal potential against may foliar pathogens of different crops as ecofriendly fungicide [18]. Due to rising environmental concerns, plant extracts are now being used to manage plant diseases instead of synthetic fungicides. Natural fungicides from botanicals decompose quickly, lowering environmental risk. Plants may manufacture secondary metabolites of phenols, flavonoids, and coumarins, which are known to be natural fungicides and similar findings are found also in Obi *et al.* [19]; Prajapathi *et al.* [20]; Ganiyu *et al.* [21] and Nishanthi *et al.* [22].

5. CONCLUSIONS

Based on the results from present investigation it was found that *Trichoderma harzianum* @ 10g/kg (S.T) + Neem leaf extract @ 10% (F.S) was most significant against anthracnose (*Colletotrichum lindimuthianum*) of black gram (*Vigna mungo* L.) under field conditions. The studies revealed that, minimum disease intensity (%), maximum plant height (cm), maximum number of pods (pods/plant), maximum yield (t/ha) and cost benefit ratio were recorded in *Trichoderma harzianum* @ 10g/kg (S.T) + Neem leaf extract @ 10% (F.S). The present investigation was limited to one crop season (July, 2023 – October, 2023) under Prayagraj agro-climatic conditions, therefore, to substantiate the present results more such trials are required in future.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Modgil R, Kaundal S, Sandal A. Bio-chemical and functional characteristics of black gram (*Vigna mungo*) cultivars grown in Himachal Pradesh, India. International Journal of Current Microbiology and Applied Sciences. 2019;8(4):2319-7706.
2. Department of Agriculture and Farmers Welfare; 2022. Available:https://enads.dacent.nic.in.
3. Majid S. Annals report of department of agriculture, Assam for year ending 31st March 1950. The Grow More Food Campaign. 1953;11(2):107-110.
4. Saxena RM, Gupta JS. Field survey for suspected seed transmitted disease of mung bean and urd bean in Uttar Pradesh. Indian Phytopathology. 1984;34(3):340-345.
5. Deeksha J, Tripathi HS. Cultural, biological and chemical control of anthracnose of urd bean. Journal of Mycology and Plant Pathology. 2002;32(1):52-55.
6. Mohammed A. An overview of distribution, biology and the management of common bean anthracnose. Journal of Plant Pathology and Microbiology. 2013;4(8):1-6.
7. Rajkumar, Mukhopadhyay AN. Field evaluation of urd bean germplasm lines against Colletotrichum capsici. Indian Journal of Mycology and Plant Pathology. 1986;17:66.
8. Wheeler BEJ. An introduction to plant diseases. John Wiley and Sons Limited. 1969;301.
9. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: Indian Council of Agricultural Research. 1989;355.
10. Rahman MA, Razvy MA, Alam MF. Antagonistic activities of Trichoderma strains against chili anthracnose pathogen. International Journal of Microbiology and Mycology. 2013;1(1):7-22.
11. Rahman MA, Ansari TH, Alam MF, Moni JR, Ahmed M. Efficacy of Trichoderma against Colletotrichum capsici causing fruit rot due to anthracnose of chilli (*Capsicum annum* L.). A Scientific Journal of Krishi Foundation. 2018;16(2):75-87.
12. Amin M, Teshele J, Tesfay M. Evaluation of bio-agents as seed treatment against *Colletotrichum lindemuthianum*, in haricot bean anthracnose under field condition. Research in Plant Sciences. 2014;2(1):22-26.
13. Modi M, Tiwari S. Eco-friendly management of anthracnose disease of cowpea (*Vigna unguiculata*) Sacc. and Magn. International Journal of Current Microbiology and Applied Sciences. 2020;9(2):2720-2725.
14. Sushmitha, B. and Zacharia, S. (2021). Efficacy of bio-agents and botanical extracts against anthracnose (*Colletotrichum lindemuthianum*) of black gram (*Vigna mungo* L.). International Journal of Current Microbiology and Applied Sciences. 10(05): 672- 679.
15. Lakshmi PHP, Simon S, Lal AA. Comparative effect of bioagents and microalgae against anthracnose (Colletotrichum capsici) disease of chilli (*Capsicum annum* L.). International Journal of Environment and Climate Change. 2023;13(08):521- 525.
16. Nezu NJ, Islam S, Hasan Md S, Islam ATMS,Hasan Md M. Eco-friendly management of anthracnose of chilli using formulated Trichoderma and indigenous medicinal plant. Ecology Journal. 2023; 5(1):73-79.
17. Satpathy MR, Beura SK. Evaluation of plant extracts for the management of cowpea anthracnose disease caused by *Colletotrichum lindemuthianum*. Journal of Current Opinion in Crop Science. 2021;2(3):379-383.
18. Trivedi A, Sharma SK, Hussain T, Sharma SK, Gupta PK. Application of biodynamic preparation, bio control agent and botanicals for organic management of virus and leaf spots of black gram (*Vigna mungo* L. Hepper). Academia Journal of Agricultural Research. 2013; 1(4):060-064.
19. Obi VI, Barriuso-Vargas JJ. Effect of some botanicals on *Colletotrichum destructivum* of cowpea. Annals of Plant Protection Sciences. 2013;7(37):4576- 4581.
20. Prajapati MK, Rawat S, Kumar J, Borpatragohain B, Rai A. Evaluation of botanicals against the Colletotrichum

capsici causing anthracnose of chilli (*Capsicum annum* L.) under lab and field condition. The Pharma Innovation Journal. 2021;10(2):602-607.

21. Ganiyu SA, Popoola AR, Yussuf TF, Owolade OF, Gbolade JO. Management of anthracnose disease of cow pea with three plant leaf extracts for enhanced grain yield in Abeokuta, Nigeria. Nigerian Agricultural Journal. 2018;49(2):1-7.
22. Nishanthi P, Gobika R, Charumathi M, Suji HA, Raj TS. Management of *Colletotrichum capsici* (SYD.) Butler and Bisby causing fruit rot of chilli using fermented leaf extracts. Plant Archives. 2020;20(1):2509-2514.

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