**Original Research Article**

**Eco-friendly management of Anthracnose of black gram (*Vigna mungo* L.)**


## ABSTRACT

Black gram is the most important pulse crop grown in India. It belongs to family *Fabaceae*. The major losses of black gram due to anthracnose caused by *Colletotrichumlindemuthianum*is seed and soil borne disease. An experiment was conducted during the *kharif*season 2023 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. 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 found the most effective 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 maximum 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.



**Key words:** Black gram, Botanicals,*Colletotrichumlindimuthianum*, Foliar spray,*Kharif*, Seed treatment,*Trichoderma harzianum*.


## INTRODUCTION

Black gram [*Vigna mungo* (L.) Hepper] or Urad bean is one of the most important pulse crop in India. This legume originated in India, where it has been cultivated from ancient times and is one of the most highly priced legumes has inevitably marked itself as the most popular legume and can be most appropriately referred to as the "King of legumes**" (Modgil *et al.*, 2019)**.

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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 of India followed by Mynmar and Thailand. Major black gram growing states in India are Tamil Nadu, Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Telangana, Sikkim and Orrisa. As per the estimated production of pulses in 2021-22 as per the department of Agriculture and Farmers Welfare (DA and FW) is 26.96 million tonnes. The estimated production of black gram in India during *Kharif* and *Rabi* season in 2021-22 is 513 kg/ha, 866 kg/ha and the total yield of black gram is 586 kg/ha**(Department of Agriculture and Farmers Welfare, 2022).**

The Anthracnose of beans was discovered by Lindemuth at Bonn, Germany in 1875 and first described by Saccardo in 1878. In India, the blackgram and greengram anthracnose was first reported from Jorhat of Assam state in 1951 (**Majid, 1953**). In Uttar Pradesh, the blackgram anthracnose was first reported in 1984 **(Saxena, 1984).**

The disease has been reported from all major urdbean 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 **(Deeksha and Tripathi, 2002).** The disease appears in U. P. 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, mungbean, urdbean 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 **(Mohammed 2013).**

## 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 *Kharif*season of 2023. 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 the disease intensity (%) and disease scale for anthracnose disease of black gram (0-5) is given by **(Rajkumar and Mukhopadhyay, 1986).**

The disease severity of anthracnose was recorded after firstspray, 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 (1969).**

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

**0 1 2 3 4 5**

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

**Table1 .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 |

**Application of bioagent and botanicals**

*Trichodermaharzianum*are applied as a seed treatment for all treatments except treated checkHexaconazole and untreated check $T_0$- control. The main antagonistic activities of these

bio-agents were through, mycellial growth inhibition, toxic volatile metabolite production and inhibition of spore germination. The selected botanicals and bioagent are used as a foliar spray after the disease symptoms are apperead in the field. The selected treatments for foliar spray *Trichoderma harzianum*, Datura leaf extract, Neem leaf extract, Onion bulb extract and Garlic clove extract are showed promising results in the control of anthracnose. Mainly Neem leaf extract and Garlic clove extract are effectivelyreduced incidence ofanthracnose.

These bio-agents 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.

**Statical analysis**

The data obtained from the field experiment were statistically analysed by following the standard procedures **(Panse and Sukhatme, 1989).**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.

**RESULTS AND DISCUSSION**

A field study was carried out to assess on various aspects of anthracnose of black gram caused by *Colletotrichumlindimuthianum*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 no.2** to 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 the significant reduction in the disease intensity (%) at 45, 60, and 75 DAS was recorded in the treatments. The minimum disease intensity (%) of black gram was recorded in $T_3$- *Trichodermaharzianum* 10g/kg+Neem leaf extract @ 10%(7.86, 16.75, 25.62) followed by $T_5$- *Trichodermaharzianum* 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

in black gram were recorded $T_3$- *Trichodermaharzianum* 10g/kg+Neem leaf extract @ 10% (15.43, 38.26, 46.90) followed by $T_5$- *Trichodermaharzianum* 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 $T_3$- *Trichodermaharzianum* 10g/kg+Neem leaf extract @ 10% (16.26) followed by $T_5$-*Trichodermaharzianum* 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 $T_3$- *Trichodermaharzianum* 10g/kg+Neem leaf extract @ 10% (0.70 t/ha) followed by $T_5$- *Trichodermaharzianum* 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 $T_3$- *Trichodermaharzianum* 10g/kg+Neem leaf extract @ 10% was statistically found as most economic treatment as compared to other treatments and including $T_0$- untreated control.

**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 3nd 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 |
| $T_1$ | *Trichodermaharzianum* 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 |
| $T_2$ | *Trichodermaharzianum*+ 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* +Neemleaf 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 |
| $T_4$ | *Trichodermaharzianum*+ 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 |
| $T_5$ | *Trichodermaharzianum* + 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 (treatedcheck) 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 | _____ |

As per the present investigation showed the result, *Trichoderma harzianum* + Neem leaf extract found most effective against management of anthracnose in black gram. *Trichoderma* can produce harzianic acid, alamethicins, tricholin, peptaibols, antibiotics, 6-penthyl-α-pyrone, massoilactone, viridin, glioviridin, gliovirin, glisoprenins, heptelidic acid, pentylpyrone, gliotoxin, trichorzianines and oxazole which can increase growth of plants and induce resistance to disease. *Trichoderma* strains produced cell wall lytic enzymes and volatile and non-volatile toxic metabolites that impede colonization by antagonized microorganisms.*Trichoderma* has been found to be effective in plant growth characteristics and enhance biomass production. These fungi inhabit plant root and plant growth characteristics by increasing evolution and production of plants improved root growth and abiotic stress will enhance systemic resistance to diseases. *Trichoderma* species either added to the soil or applied as seed treatment, grow rapidly along with the developing root system as similar findings are found also in **(Rahman *et al.*, 2013), (Amin *et al.*, 2014), (Rahman *et al.*, 2018), (Modi and Tiwari, 2020)**and**(Laxmi *et al.*, 2023).**

These botanicals source of alternatives or complemental to synthetic fungicides in crop protection,*Azadirahctaindica*significantly toxic to *Colletotrichum*sp.Neem plants contain chemical compounds such as azadirachtin, nimbicidine and nimbin which are active triterpenoid compound having antimicrobial properties.This finding is most likely due to the active compounds found in neem leaves, including azadiractin, salanin and nimbin. Ingredients like 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**.** 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.*, 2013), (Trivedi *et al.*, 2013), (Satpathy and Beura 2021), (Prajapathi*et al.*, 2021), (Ganiyu*et al.*, 2018)**and**(Nishanthi*et al.*, 2020).**

## CONCLUSIONS

Based on the results obtained from present investigation it was found that *Trichoderma harzianum* @ 10g/kg (S.T) + Neem leaf extract @ 10% (F.S) proved to be most effective against anthracnose (*Colletotrichumlindimuthianum*) 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 to validate the findings.

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