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# Efficacy of Different Botanicals and Carbendazim in Managing Anthracnose (*Colletotrichum lindemuthianum*) in Green Gram (*Vigna radiata* L.)

**Yashika Srivastava [a++*], Sujeet Pandey [a++], Abhilasha. A. Lal [a#], Shubham Singh [a†] and Atul Suresh Bawane [a†]**

*[a] Department of Plant Pathology, Naini Agricultural Institute, (Formerly Allahabad Agricultural Institute), Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh, India.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

A field trial was conducted during the *Kharif* season of 2023 at the Central Research Field, Department of Plant Pathology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The objective was to evaluate the

[++] *M. Sc. Scholar;*
[#] *Professor;*
[†] *Ph. D. Scholar;*
**Corresponding author: Email: srivastavayashika28@gmail.com;*

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effectiveness of different botanicals in combination with 50 WP carbendazim against anthracnose disease caused by *Colletotrichum lindemuthianum* in green gram (*Vigna radiata* L.). Experimental results showed that all treatments significantly improved yield compared to the untreated control. The highest yield was recorded in $T_6$ comprising (Carbendazim alone as seed and foliar treatment) recorded 11.23 q/ha which was followed by $T_1$ (Carbendazim + Neem oil) to the tune of 9.23 q/ha and 8.73 q/ha. In control plot i.e ($T_0$) yielded the lowest at 6.03 q/ha. In terms of cost-benefit ratio (CBR), $T_6$ again showed the highest economic return (1:3.54), followed by $T_1$ (1:2.90), and $T_2$ (1:2.52). The control recorded a lower CBR of 1:2.02. The study highlights the potential of integrating botanicals like neem and eucalyptus oil with carbendazim for effective and economical management of anthracnose in green gram.

*Keywords: Anthracnose; botanicals; Colletotrichum lindemuthianum; cost benefit ratio fungicide; green gram; yield.*

## 1. INTRODUCTION

"Green gram (*Vigna radiata* L.) commonly known as mung bean, belonging to the family Fabaceae is an important pulse crop of India mainly cultivated in *Kharif* season. It has originated in South Mexico and Central America" (Vavilov, 1951). "The crop is one of the third most important pulse crop of India after chickpea and pigeon pea. It is quite versatile crop grown for seeds, green gram manure and forage and it also considered as "Golden Bean". It contains about 25 to 28% protein, 1 to 1.5% oil, 3.5 to 4.5% fiber, 62 to 65% carbohydrate" (Meena *et al*., 2017). "The crop is grown for its green pods whereas, dry seeds are used in various food preparations" (Kulkarni and Raja 2019). "This crop has become third most important food legume after soybean and peanut in production and is also the most utilized crop for direct consumption in the world. The average production of mung bean is globally split between India and Myanmar" (Nair *et al*., 2020).

"Mung bean production in India was 5.5 million hectares in 2022 and yield 3.17 million tonnes at a productivity of 570 kg/ha. The mung bean alone accounts for 10% of production and 16% of area for all pulses. The dominant contributors to mung bean cultivation in terms of area and production are Rajasthan (46% and 45% respectively), with Madhya Pradesh (9% and 14%), Maharashtra (9% and 8%), Karnataka (9% and 6%), Odisha (5% and 4%), Bihar (4% and 5%), Tamil Nadu (4% and 3%), Gujarat (3% and 4%), Andhra Pradesh (3% for both), and Telangana (2% for both) also playing significant roles, as stated in the Annual Report (2022-23) by AICRPR on *kharif* pulses" (ICAR- Indian Institute of Pulses Research, 2024).

"The crop suffers from many diseases caused by fungi, bacteria, viruses, nematodes and abiotic stresses" (Chaudhari & Gohel, 2016). "The first case of the anthracnose on green gram in India was discovered in 1951 in Jorhat, Assam" (Majid, 1953). "Generally powdery mildew, blight, root rot, anthracnose, leaf spot, rust, dry root rot, mung bean yellow mosaic disease, leaf crinkle disease, leaf curl, ascochyta leaf spot and bacterial blight diseases are found in green gram. Among these diseases Anthracnose (*Colletotrichum lindemuthianum*), is one of the most destructive disease" (Khaire & Hake, 2018). Anthracnose disease in green gram is caused by multiple species of the fungus *Colletotrichum* sp. and severity of disease depends on the weather conditions and reduces yield notably (Mandal *et al*., 2015). The average grain yield loss of 39.98% and stalk yield loss of 47.19% is due to anthracnose (Kulkarni & Raja, 2019). "The extent of yield loss caused by a disease is directly linked to its severity, and weather conditions. When pods are infected, the seeds are directly affected and which results is poor germination, potentially resulting in a complete loss of yield. The disease severity always depends on the weather conditions as the fungal pathogen is seed as well as soil-borne and omnipresent in nature" (Nandeesha *et al*., 2023).

"Considering, the emerging and devastating nature of the disease and economic loss of the crop, an attempt was made to evaluate the combined effect of fungicide, along with, botanicals for the control of this important disease in Prayagraj condition. Although chemicals are available for the management of *Colletotrichum* sp. a continuous inappropriate, non-discriminatory use of chemicals is known to causes undesirable effects. Such effect is residual toxicity in plants, resistance, environmental pollution and health hazards to

humans and animals. At present, the botanicals are gaining importance in plant disease management practices. These are cheaper than chemicals and safer means of disease management which reduce not only toxicity, hazards but also present ecofriendly approach in nature" (Singh *et al*., 2022).

## 2. MATERIALS & METHODS

The field experiment was carried out at the Central Research Field of the Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during *Kharif*, 2023. The seeds (local variety) were sown in August, 2023 maintaining a distance of 45 cm row to row and 10 cm plant to plant.

### 2.1 Treatment Details in Field Condition

**Spraying of essential oils:** Neem oil @2ml/lit, eucalyptus oil @ 2ml/lit, tea tree oil @ 2ml/lit, lavender oil@ 2ml/lit and thyme oil @ 2ml/lit water was mixed for foliar spray. For mixing oil and water, emulsifier (liquid soap) is used. These sprayed 3 times from 30, 45 and 60 DAS (Days After Sowing).

**Cost Benefit Ratio:** Gross returns were calculated by multiplying total yield with market price of the produce. Cost of cultivation and cost of treatments were deducted from the gross returns, to find out returns and cost benefit of ratio by following formula (Reddy & Reddi, 2004).

$$Cost\ Benefit\ Ratio = \frac{Net\ Return}{Total\ cost\ of\ cultivation}$$

**Table 1. Particulars of treatment**

| Treatments | Treatment Details |
|---|---|
| $T_0$ | Control |
| $T_1$ | Carbendazim [@ 2g/kg seed (S.T.)] + Neem oil [@2ml/lit (F.S.)] |
| $T_2$ | Carbendazim [@ 2g/kg seed (S.T.)] + Eucalyptus oil [@2ml/lit (F.S.)] |
| $T_3$ | Carbendazim [@ 2g/kg seed (S.T.)] + Tea tree oil [@2ml/lit (F.S.)] |
| $T_4$ | Carbendazim [@ 2g/kg seed (S.T.)] + Lavender oil [@2ml/lit (F.S.)] |
| $T_5$ | Carbendazim [@ 2g/kg seed (S.T.)] + Thyme oil [@2ml/lit (F.S.)] |
| $T_6$ | Carbendazim [@ 2g/kg seed (S.T.)] + [ Carbendazim @ 1g/lit (F.S.)] |

**S.T. = Seed Treament, *F.S. = Foliar Spray*

## 3. RESULT AND DISCUSSION

### 3.1 Effect of Treatments on Yield of Green Gram after Harvesting

The data presented in Table 2 and depicted in Fig. 1 revealed that, the yield (q/ha) of green gram significantly increased in the treatment $T_6$- Carbendazim (S.T) + Carbendazim (F.S.) with (11.23 q/ha), followed by $T_1$- Carbendazim + Neem oil (9.23 q/ha), $T_2$- Carbendazim + Eucalyptus oil (8.73 q/ha), $T_4$- Carbendazim + Lavender oil (8.31 q/ha), $T_3$- Carbendazim + Tea tree oil (8.06 q/ha) and $T_5$- Carbendazim + Thyme oil (7.99 q/ha) as compared to $T_0$- Control (6.03 q/ha). Comparing the treatments with CD value (0.61), all the treatments were statistically significant over ($T_0$) control.

In the present study, the maximum yield was observed in $T_1$- Carbendazim (S.T) + neem oil (F.S). The probable reason of increased yield might be attributed to the application of carbendazim and neem oil as a seed treatment and foliar spray. "Carbendazim being a systemic fungicide belonging to benzimidazoles group having single or multi- site mode of action against the pathogen" (Nandeesha *et al*., 2023). "Neem oil is usually used as an insecticide but also has fungicidal action. Although neem oil (or) water extracts of neem cake controls insects and pests, plant parasitic nematodes and soil borne pathogens. The foliar spray of neem oil was significantly effective to suppress the disease" (Bunker *et al*., 2019), Srilekha *et al*. (2020) and Modi and Tiwari (2020). "The most active component of neem oil is azadirachtin, followed by nimbidol, nimbin, sodium nimbinate, nimbidin, salannin and quercetin. Azadirachtin is a terpene limonoid present in seeds that has properties, which are both antifeedant and toxic to pathogens. Through antimicrobial activity, it inhibits microbial growth or potential to break the cell wall of pathogen" Kulkarni and Raja (2019) and Vijaykumar *et al*., (2022). Similar findings have been reported by Khan *et al*. (2005), Munjunath *et al*. (2016), Jagtap *et al*. (2013) and Singh *et al*. (2022).

**Table 2. Effect of treatments on yield of green gram**

| Treatments | Treatment details | Yield (q/ha.)* |
|---|---|---|
| $T_0$ | Control | 6.03$^{e}$ |
| $T_1$ | Carbendazim + Neem oil | 9.23$^{b}$ |
| $T_2$ | Carbendazim + Eucalyptus oil | 8.73$^{bc}$ |
| $T_3$ | Carbendazim + Tea tree oil | 8.06$^{d}$ |
| $T_4$ | Carbendazim + Lavender oil | 8.31$^{cd}$ |
| $T_5$ | Carbendazim + Thyme oil | 7.99$^{d}$ |
| $T_6$ | Carbendazim (S.T) + Carbendazim (F.S.) | 11.23$^{a}$ |
| | C.D. (0.05) | 0.61 |
| | S.Ed. (±) | 0.23 |

**Mean of three replications.*

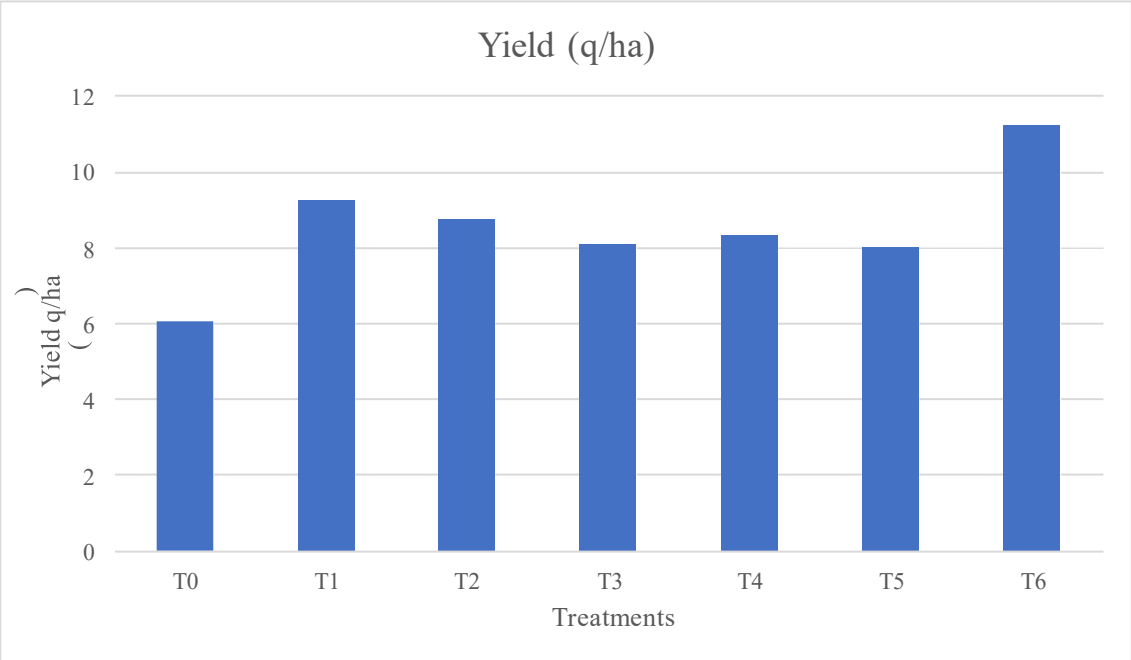


**Fig. 1. Effect of treatments on yield (q/ha) of green gram**

## 3.2 Economics of Treatments

The data presented in Table 3. and depicted in Fig. 2 revealed that the C:B significantly increased in the treatment $T_6$- Carbendazim (S.T) + Carbendazim (F.S.) (1:3.54), followed by $T_1$- Carbendazim + Neem oil (1:2.90), $T_2$- Carbendazim + Eucalyptus oil (1:2.52), $T_4$- Carbendazim + Lavender oil (1:2.37), $T_3$- Carbendazim + Tea tree oil (1:2.21) and $T_5$- Carbendazim + Thyme oil (1:2.04) as compared to $T_0$- Control (1:2.02).

The probable reason for the increment in cost benefit ratio was minimum disease intensity and maximum healthier plants with maximum yield which was attributed by the application of carbendazim and neem oil as a seed treatment and foliar spray. This resulted in significant increase in cost benefit ratio.

The increase in use of toxic chemicals to control the pest and diseases of crop endangered the environment and reduce bio diversity as well as health of consumers. Organic amendment produced volatile and non-volatile substances during their decomposition and also stimulate resident and introduced antagonists. Crops cultivated with organic manures are not only free from harmful chemicals; apart from supplying plant nutrients, they improve soil physical and microbial properties and eliminate pollution of underground water.

**Table 3. Effect of treatments on cost benefit ratio**

| Treatment | Treatment details | Yield (q/ha) | Gross return (₹/ha) | Total cost of cultivation (₹/ha) | Net return (₹/ha) | Cost benefit ratio |
|---|---|---|---|---|---|---|
| **$T_0$** | Control | 6.03 | 51,255 | 25,290 | 33,615 | 1:2.02 |
| **$T_1$** | Carbendazim @ 2g/kg seed (S.T) + Neem oil @ 2ml/l (F.S) | 9.23 | 78,455 | 27,030 | 51,425 | **1:2.90** |
| **$T_2$** | Carbendazim @ 2g/kg seed (S.T) + Eucalyptus oil @ 2ml/l (F.S) | 8.73 | 74,205 | 29,394 | 44,811 | 1:2.52 |
| **$T_3$** | Carbendazim @ 2g/kg seed (S.T) + Tea Tree oil @ 2ml/l (F.S) | 8.06 | 68,510 | 30,914 | 37,596 | 1:2.21 |
| **$T_4$** | Carbendazim @ 2g/kg seed (S.T) + Lavender oil @ 2ml/l (F.S) | 8.31 | 70,635 | 29,812 | 40,823 | 1:2.37 |
| **$T_5$** | Carbendazim @ 2g/kg seed (S.T) + Thyme oil @ 2ml/l (F.S) | 7.99 | 67,915 | 33,157 | 34,758 | 1:2.04 |
| **$T_6$** | Carbendazim 50 WP @ 2g/kg seed (S.T) + @ 1g/l (F.S) | 11.23 | 95,455 | 26,934 | 68,521 | 1:3.54 |

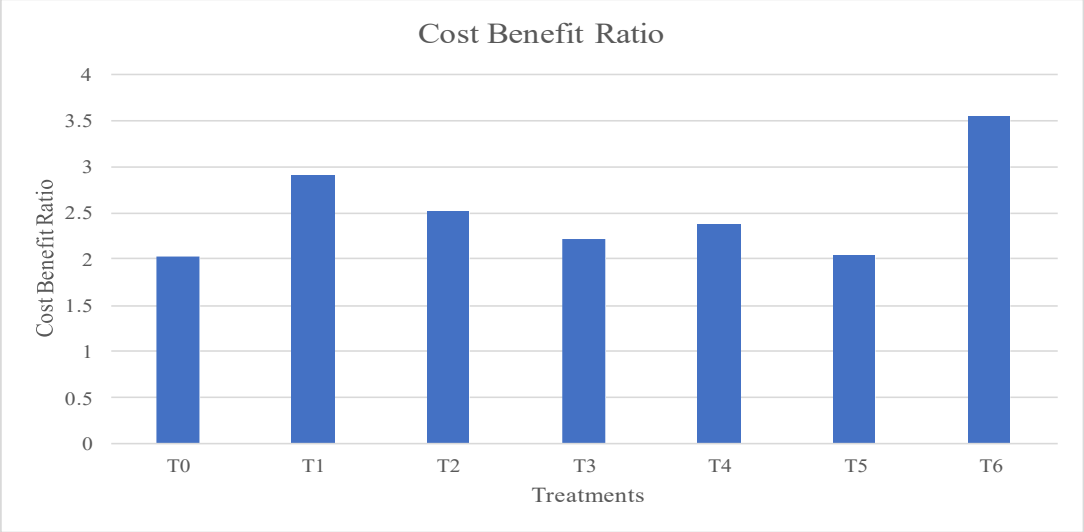


**Fig. 2. Effect of treatments on cost benefit ratio**

## 4. CONCLUSIONS

From the present study, it can be concluded that the seed treatment with carbendazim @ 2g/kg and foliar spray of neem oil @ 2ml/l was most effective on anthracnose of green gram caused by *Colletotrichum lindemuthianum*, recorded maximum yield (q/ha) and cost benefit ratio. However present study was limited to one crop season (*Kharif*, 2023) under the climatic conditions of Prayagraj, Uttar Pradesh, India. Therefore, for validation of the results more such trials should be carried out in future for further recommendations.

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Author(s) hereby declare 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 this manuscript.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

Bunker, R. N., Tanwar, N. S. and Aggarwal, S. K. (2019). Management of sorghum anthracnose caused by *Colletotrichum graminicola* (Ces.) Wilson. *International Journal of Current Microbiology and Applied Sciences.* 8(10): 1365-1371

Chaudhari, K. A. and Gohel, N. M. (2016). Management of anthracnose disease of mung bean through new fungicidal formulations. *Journal of Pure and Applied Microbiology*.10(1): 691-696.

Chaudhary, R. S., Simon, S. and Bana, R. S. (2017). Efficacy of plant extracts against anthracnose (*Colletotrichum lindemuthianum*) of green gram (*Vigna radiata* L.). *International Journal of Chemical Studies*. 5(4): 769-772.

ICAR-Indian Institute of Pulses Research (2024): https://iipr.icar.gov.in/mungbean/.

Jagtap, G. P., Gavate, D. S. and Dey, U. (2013). Management of *Colletotrichum truncatum* causing anthracnose/ pod blight of soybean by fungicides. *Indian Phytopath*ology. 66(2): 177-181.

Khaire, P. B. and Hake, L. G. (2018). Disease management of *Kharif* green gram and black gram. *Popular Kheti*. 6(2): 96-103.

Khan, A. A., Khan, R. U., Singh, R., (2005). Management of *Cercospora* leaf spot and anthracnose diseases of mungbean by fungicides. *Annals of Plant Protection Sciences*. 13(2), 465-529.

Kulkarni, S. and Raja (2019). Evaluation of botanicals and bioagents against

*Colletotrichum truncatum* (SCHW.) Andrus and Moore, causing anthracnose of green gram. *Journal of Pharmacognosy and Phytochemistry*. 8(2): 2370-2373.

Majid, S. (1953). Annals report of department of agriculture, Assam for the year ending 31st March, 1950. Part EL The grow more food campaign. *Agricultural and Food Sciences*. 2: 112.

Mandal, R. and Singh, N., Singh, N. and Mehta, S. K. and Khirbat, S. K., (2015). Influence of environmental conditions on the incidence of anthracnose of mungbean. *Annals of Agri Bio Research*. 20(2): 184-187.

Meena, I. R., Simon, S. and Lal, A. A. (2017). Eco-friendly management of anthracnose (*Colletotrichum truncatum*) of green gram (*Vigna radiata* L.). *Annals of Plant Protection Sciences*. 25(2): 362-364.

Modi, M. and Tiwari, S. (2020). Eco-friendly management of anthracnose disease of cowpea (*Vigna unguiculata*) Sacc. and Magn. *International Journal of Current Microbiology and Applied Sciences.* 9(2): 2720-2725.

Nair, R. M., Pandey, A. K., War, A. R., Hanumantharao, B., Shwe, T., Alam, A. K. M. M., Pratap, A., Malik, S. R., Karimi, R., Mbeyagala, E. K., Douglas, C. A., Rane, J. and Schafleitner, R. (2020). Biotic and abiotic constraints in mung bean production-progress in genetic improvement*. Frontiers in Plant Science*. 10:1340.

Nandeesha, C. V., Akbari, L. F., Jaiswal, A., Harsha, B. R., Patil, B., Bhaliya, C. M., Kumar, N., Singh, T. and Jain, S. (2023). Control efficacy and yield response of different fungicides evaluated against. *Crop Protection*. 174: 1-8.

Reddy, T. Y. and Reddi, G. H. S. (2004). Principles of Agronomy (2nd edition), *Kalyani Publishers*. Ludhiana. pp. 72.

Singh, S., Prasad, D. and Singh, V. P. (2022). Evaluation of fungicides and genotypes against anthracnose disease of mung bean caused by *Colletotrichum lindemuthianum* .

Srilekha, V., Simon, S. and Zacharia, S. (2020). Effect of green manure and neem oil on anthracnose disease of chilli (*Capsicum annum* L.). *International Journal of Current Microbiology and Applied Sciences*. 9(12): 2329-2336.

Vavilov, N. (1951). The origin, variation, immunity and breeding of cultivated plants. *Chronica Botanica*. 13: 364.

Vijaykumar, K. N., Kulkarni, S., Patil, P. V., Kambrekar, D. N. and Shashidhar, T. R. (2022). Eco-friendly management of purple blotch of garlic caused by *Alternaria porri* (Ellis) Ciferri. *Biological Forum - An International Journal*. 14(2): 1406-1412.

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