



# Effect of Certain Fungicides and *Trichoderma* Spp. on the Growth Parameter, Yield Attributes and Yield Affected by Powdery Mildew of Green Gram (*Vigna radiata* L.)

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## ABSTRACT

Powdery mildew is an important foliar disease of green gram caused by *Erysiphe polygoni* DC. in India. An experiment was carried out to evaluate the efficacy of fungicides (Propiconazole, Carbendazim, Wettable sulphur, Mancozeb) and bio-agents (*Trichoderma viride*, *T. harzianum*,) against powdery mildew of green gram in the Central Experimental Field, Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the *kharif* season 2018-19. The experiment was laid out in randomized block design (RBD) with seven treatments and each replicated thrice. In a field assay, maximum plant height (71.11) cm was observed in *Trichoderma viride* as foliar spray followed by *Trichoderma harzianum*, Carbendazim, Wettable sulphur, Propiconazole and Mancozeb. The experiment revealed that, among the treatments Carbendazim, as foliar spray was most effective with maximum length of pods (7.27) cm and weight of pods (5.6) g followed by Wettable sulphur, Propiconazole, Mancozeb, *Trichoderma harzianum* and *Trichoderma viride*. Maximum yield was recorded with Carbendazim (10.15) q/ha, as foliar spray followed by Wettable sulphur (9.76) q/ha, Propiconazole (9.22) q/ha, Mancozeb (8.60) q/ha, *Trichoderma harzianum* (7.88) q/ha and *Trichoderma viride* (7.22) q/ha.

**Key words:** Bio-agents, *Erysiphe polygoni*, Fungicides, Green gram, Powdery mildew.

## INTRODUCTION

Green gram (*Vigna radiata* L.), commonly known as mung bean is one of the important pulse crop in India. It is an ancient and well known leguminous crop of Asia (Mehandri *et al.*, 2019). [*Vigna radiata* (L.) Wilczek] is a short duration legume crop cultivated primarily for their dry seeds (Singh *et al.*, 2014). Green gram belongs to the family Leguminosae. It is an erect, herbaceous annual plant which is highly branched and is about 60 to 76 cm tall (Oplinger *et al.*, 1990). It is quite versatile crop grown for seeds, green manure and forage and it is also considered as "Golden Bean" because of its nutritional values and suitability for increasing the fertility of the soil, by the way of addition of nitrogen to the soil (Pratap *et al.*, 2013).

Green gram is a protein rich staple food and contains about 25.0 to 28.0 per cent protein, 1.0 to 1.5 per cent oil, 3.5 to 4.5 per cent fibre, 4.5 to 5.5 per cent ash and 62.0 to 65.0 per cent carbohydrate on a dry weight basis (Itoh *et al.*, 2006). It is particularly rich in high amounts of thiamine, niacin and ascorbic acid (Nair *et al.*, 2019).

Green gram production is continuously challenged by biotic and abiotic stresses that take a heavy toll of the crop; diseases cause an estimated yield loss of 20 to 30 per cent (Singh, 1995; Nair *et al.*, 2019), poor crop management practices and non-availability of quality seeds of improved varieties to farmers (Chauhan *et al.*, 2010; Pratap *et al.*, 2019a). Green gram suffers from many diseases caused by fungi, bacteria, viruses, nematodes. In green gram,

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considerable losses in the production occur as a result of Alternaria leaf spot (*Alternaria alternata*), powdery mildew (*Erysiphe polygoni*), anthracnose (*Colletotrichum lindemuthianum*), Cercospora leaf spot (*Cercospora canescens*), bacterial blight (*Xanthomonas phaseoli*), rust (*Uromyces appendiculatus*), leaf crinkle and yellow mosaic virus (Singh *et al.*, 2000; Pandey *et al.*, 2018). Among these, powdery mildew is a serious problem in all the areas having rice based cropping systems of the country (Abbaiah, 1993; Meena *et al.*, 2016). Powdery mildew occurs under cool temperature (22°C to 30°C) and is favoured by cloudy

weather. Powdery mildew is easily recognized due to white, powdery growth of the fungus on infected portions of the plant host. The powdery appearance results from the superficial growth of the fungus as a thread-like stands (hyphae) over the plant surface and the production of chains of spores (conidia). The fungus is an obligate parasite that requires living hosts to complete their life cycle. Powdery mildew is one of the economically important diseases in green gram which occur at later stages of crop growth. Venkata Rao (1997) observed that 40 and 50 days old green gram plants were highly susceptible to powdery mildew. The yield losses of powdery mildew in green gram are reported to be 20-40% and it may be extend up to 100% when it occurs at the seedling stage in different regions of India (Khajudparn *et al.*, 2007, Pandey *et al.*, 2018; Nair *et al.* 2019).

Very limited information is available on the biological methods to manage mungbean foliar diseases including powdery mildews, *Cercospora* leaf spot and anthracnose (Pandey *et al.*, 2018). So in this context, the prime objective of this research article is to observe and record the effect of certain test fungicides and *Trichoderma* spp. on the plant height, pod length, pod weight and seed yield of green gram affected by powdery mildew disease which clear cut from the title of manuscript.

## MATERIALS AND METHODS

The field experiment was conducted at Central Research Farm, Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh during the *kharif* season of 2018-2019. The trial was laid in randomized block design (RBD) with seven treatments including untreated control and each replicated thrice. Green gram crop variety pant moong-1 was sown in last week of July with a spacing of 45 cm and 10 cm between rows and plants, adopted in plot size of 2 × 1 m<sup>2</sup>, respectively. During experimental period average temperature (maximum and minimum) and Relative Humidity (maximum and minimum) were 35 and 21; 95.23 and 40.14, respectively.

## Disease intensity

Disease intensity (%) =

$$\frac{\text{Sum of all disease rating}}{\text{Total number of leaves} \times \text{maximum grade}} \times 100$$

Observations on powdery mildew disease intensity were recorded on randomly selected plants from the bottom, middle and top leaves (Wheeler, 1969). The powdery mildew disease was graded on the basis of disease intensity observed on leaves by applying 0-9 disease rating scale developed by Mayee and Datar (1986) as described below (Table 1):

**Table 1:** Disease rating scale.

Grade	Per cent disease severity with description
0	No symptoms on leaves.
1	Small powdery spots on leaves covering 1-3% or less leaf area.
3	Powdery lesions on leaves small, scattered, covering 1-10% of leaf area.
5	Powdery lesions bigger, covering 11-25% of leaf area.
7	Powdery patches bigger coalescing covering 26-50% of leaf area.
9	Powdery growth covering 51% or more of leaf area, white coating on petioles, flowers and pods resulting in its shedding, reduced pod set.

Fungicides were evaluated mostly in the field trials foliar sprays (Table 2). Most of these studies assessed fungicide efficacies in reducing disease incidence and/or severity and yield benefit; however missed the economic analyses of the fungicide applications, which is critical component to recommend for farmers.

## Spraying of fungicides

The experimental plot was regularly visited for observing appearance of the disease. The disease was noticed after 35-40 days of sowing and observation were recorded. Two sprays of fungicides were given at 10 days interval.

## Preparation of fungicidal spray suspension

The fungicidal spray solution of desired concentration as per treatment was freshly prepared every time at the site of

**Table 2:** Effect of different treatments on the plant growth, yield attributes and yield of green gram (*Vigna radiata* L.) influence by powdery mildew.

Treatments	Conc. (%)	Plant height (cm)	Length of pods (cm)	Weight of pods (g)	Seed yield (q/ha)
T <sub>0</sub> - Control	-	60.94	5.27	3.04	5.20
T <sub>1</sub> - Propiconazole	0.1%	65.69	7.00	4.51	9.22
T <sub>2</sub> - Carbendazim	0.1%	66.50	7.27	5.06	10.15
T <sub>3</sub> - Wettable sulphur	0.3%	66.02	7.13	4.99	9.76
T <sub>4</sub> - Mancozeb	0.25%	64.79	6.60	4.25	8.60
T <sub>5</sub> - <i>Trichoderma viride</i>	0.1%	71.11	6.20	3.72	7.22
T <sub>6</sub> - <i>Trichoderma harzianum</i>	0.1%	69.41	6.53	3.96	7.88
F- test	-	S	S	S	S
S. Ed. (±)	-	1.60	0.34	0.30	0.20
C. D. (P = 0.05)	-	3.48	0.74	0.65	0.43

experimentation just before spraying operations. The quantity of spray materials required for average of crop was gradually increased as the crop advanced in age. The spray solution of desired concentration was prepared by adoption of the following formula (Singh *et al.*, 2009).

$$N = \frac{T \times P}{a.i.}$$

Where

N = Quantity of a formulated pesticide required.

T = Total spray fluid required.

P = Percentage strength required.

a.i. = Given percentage strength of a formulated pesticides.

#### Preparation of *Trichoderma* spp. suspension

Talcum based formulation of *Trichoderma viride* and *T. harzianum*, manufactured by Yash Biotech Pvt. Ltd., Prayagraj were used for field experiment. Before applying the talcum based formulation of *Trichoderma viride* in the field the c.f.u (Colony forming unit) were checked in the laboratory. Foliar spray of *Trichoderma viride* was given at 10 days interval @ 10 g/l of water (Deore and Sawant, 2000).

#### Statistical analysis

The data were subjected to statistical analysis of variance after using suitable transformations. The test was used to determine the significant difference. The statistical analysis of randomized block design was carried out as per the procedure given by Fisher and Yates (1968) and the analysis of variance (ANOVA) was done. After, threshing and winnowing seed weight of each replication in kilogram was recorded and yield per hectare was computed by using net plot yield data and it was then converted to quintals per hectare.

## RESULTS AND DISCUSSION

The results and discussion of the experiment conducted on various aspects of powdery mildew of green gram caused by *Erysiphe polygoni* D.C. with reference to evaluation of plant height (cm), pod length (cm), pod weight (g) and seed yield (q/ha) affected by some fungicides and *Trichoderma* spp. are presented here under.

The result presented in below table revealed that all the treatments were statistically significant and increased plant height as compared to control. The maximum plant height (71.11) cm was recorded in T<sub>5</sub>- *Trichoderma viride* @ 0.1% followed by T<sub>6</sub>- *Trichoderma harzianum* @ 0.1% (69.41) cm, T<sub>2</sub>- carbendazim @ 0.1% (66.50) cm, T<sub>3</sub>- wettable sulphur @ 0.3% (66.02) cm, T<sub>1</sub>- propiconazole @ 0.1% (65.69) cm, T<sub>4</sub>- mancozeb @ 0.25% (64.79) cm and T<sub>0</sub>- control (60.94) cm. Among the treatments most effective was T<sub>5</sub>- *Trichoderma viride* @ 0.1% (71.11) cm.

Maximum plant height was observed in *Trichoderma viride* because inhibition of fungal growth due to secretion of extracellular cell degrading enzymes such as chitinase B-1, 3-glucanase, cellulose and lectin, which may have helped myco parasites in the colonization of their host. The inhibition of pathogen may also be attributed to the

production of secondary metabolites by antagonists such as glioviridin, viridian and gliotoxin (Kalmesh and Gurjar, 2002). *Trichoderma* spp. was reported to produce metabolites which inhibit the spore germination of number of fungi (Dennis and Webster 1971a; Dennis and Webster 1971b; Sokita *et al.*, 1981; Biswas *et al.*, 2000). Martinez (1999) reported that cellulose produced by *Trichoderma harzianum* induced systemic acquired resistance in melon plants against powdery mildew.

The maximum pod length (7.27) cm was recorded in T<sub>2</sub>- carbendazim @ 0.1% followed by T<sub>3</sub>- wettable sulphur @ 0.3% (7.13) cm, T<sub>1</sub>- propiconazole @ 0.1% (7.0) cm, T<sub>4</sub>- mancozeb @ 0.25% (6.60) cm, T<sub>6</sub>- *Trichoderma harzianum* @ 0.1% (6.53) cm, T<sub>5</sub>- *Trichoderma viride* @ 0.1% (6.20) cm and T<sub>0</sub>- control (5.27) cm. Among the treatments most effective was T<sub>2</sub>- carbendazim @ 0.1% (7.27) cm.

The result presented in above table revealed that all the treatments were statistically significant and increased pod weight as compared to control. The maximum pod weight (5.06) g was recorded in T<sub>2</sub>- carbendazim @ 0.1% followed by T<sub>3</sub>- wettable sulphur @ 0.3% (4.99) g, T<sub>1</sub>- propiconazole @ 0.1% (4.51) g, T<sub>4</sub>- mancozeb @ 0.25% (4.25) g, T<sub>6</sub>- *Trichoderma harzianum* @ 0.1% (3.96) g, T<sub>5</sub>- *Trichoderma viride* @ 0.1% (3.72) g and T<sub>0</sub>- control (3.04) g. Among the treatments most effective was T<sub>2</sub>- carbendazim @ 0.1% (5.06) g.

The result presented in above table revealed that all the treatments were statistically significant and increased yield (q/ha) as compared to control. The maximum yield (10.15) q/ha was recorded in T<sub>2</sub>- carbendazim @ 0.1% followed by T<sub>3</sub>- wettable sulphur @ 0.3% (9.76) q/ha, T<sub>1</sub>- propiconazole @ 0.1% (9.22) q/ha, T<sub>4</sub>- mancozeb @ 0.25% (8.60) q/ha, T<sub>6</sub>- *Trichoderma harzianum* @ 0.1% (7.88) q/ha, T<sub>5</sub>- *Trichoderma viride* @ 0.1% (7.22) q/ha and T<sub>0</sub>- control (5.20) q/ha. Among the treatments most effective was T<sub>2</sub>- carbendazim @ 0.1% (10.15) q/ha.

Results showed that the highest yield was recorded in T<sub>2</sub>-carbendazim (10.15) q/ha, followed by T<sub>3</sub>-wettable sulphur (9.76) q/ha. The inhibition of *Erysiphe polygoni* by carbendazim is because, the chemical fungicides has a direct anti-microbial effect and is involved in cross-linking in cell walls, induction of gene expression, hypersensitive cell death, phytoalexin production and induced systemic resistance (Apel and Hirt, 2004). This result is also supported by the earlier findings (Meena *et al.* 2016; Hiremath and Lal, 2018). In contrast, dinocap (QIL) and tridemorph (amines groups) were also too much effective against powdery mildew (Pandey *et al.*, 2018). Yadav *et al.* (2017) reported that *T. viride*, *T. harzianum* and *Pseudomonas fluorescens* were effective to reduce powdery mildew of mungbean (~80-84% reduction).

## CONCLUSION

Application of synthetic fungicides is a common practice to control fungal diseases of mungbean and growers also integrate other cultural methods with chemical sprays.

Efficacies of several fungicides were evaluated in fields and controlled environments at universities and research institutions, however, there is a knowledge gap regarding how much of these evaluated fungicides are currently used by mungbean growers. In addition, additional research are required for fungicide efficacy trials including rotating and tank mixing with different modes of actions, different rates as well as volume of water for spray coverage. Attention should also be given to develop and evaluate new generation fungicides. Therefore, future research is recommended for in vitro fungicide sensitivity test using large numbers of pathogen isolates from diverse areas. Regarding biological control, it was concluded that they were more effective in reducing diseases in controlled environments than in fields.

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