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Management of anthracnose of dolichos bean caused by *Colletotrichum lindemuthianum*

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Abstract

Among the world's beans, the Dolichos bean is an important pulse cum vegetable crop. Dolichos bean has been affected by many foliar diseases and among them anthracnose caused by *Colletotrichum lindemuthianum* (Sacc. and Magn.) Scribner is the most devastating disease in India. In the present study of investigation, efficacy of various fungicides, bioagents and botanicals viz., propiconazole 0.1%, hexaconazole 0.1%, neem seed extract 5%, ginger rhizome extract 10%, *Trichoderma harzianum* 0.2%, *Trichoderma viride* 0.2% were evaluated.

After third spray significantly lowest percent disease incidence was recorded in the treatment of propiconazole 0.1% (23.60 PDI) and it was highly significant over all the treatments in reducing the disease incidence. The next promising treatment was hexaconazole 0.1% (27.40 PDI) and it was statistically significant among all the remaining treatments. The other effective treatment was neem seed extract @ 5% showing (30.00 PDI) followed by *Trichoderma harzianum* @ 0.2% (31.10 PDI) and these two treatments were at par with each other. In case of ginger rhizome extract @ 10% and *Trichoderma viride* @ 0.2% percent disease incidence were 38.00 and 36.27 percent respectively.

The highest percent disease incidence after third spray was noticed in control 57.60 PDI. All the treatments were statistically significant in reducing the disease intensity of *Colletotrichum lindemuthianum* of dolichos bean after 3rd spray. The lowest percent disease intensity was noticed in the treatment of propiconazole @ 0.1% recording (14.90 PDI). It was statistically significant over all treatments. The next promising treatment in reducing the disease was hexaconazole @ 0.1% exhibiting (17.00 PDI) which was statistically superior over remaining treatments. The other effective treatment was neem seed extract @ 5% showing (26.67 PDI). The next best treatments were *Trichoderma harzianum* @ 0.2% followed by *Trichoderma viride* @ 0.2% recording (27.62 PDI) and (29.73 PDI) respectively. The maximum percent disease intensity was observed in control (61.00 PDI).

Keywords: Anthracnose, *Colletotrichum*, bean, management

Introduction

Field bean (*Lablab purpureus* L.) belongs to the family Fabaceae and is commonly known as Hyacinth bean, Lablab bean, Egyptian bean, Bonavista vine, Australian pea, Indian bean, dolichos bean and poor man's bean. Dolichos is an important food source to people of all income categories, especially to the poor farmers as a source of dietary protein (Wortmann *et al.*, 1998) ^[11]. It is largely grown as a mixed crop with finger millet, groundnut and sorghum, under rainfed conditions and as a sole crop as well in irrigated conditions. Even though the area under this crop is increasing in the state, the productivity is considerably low (Rekha and Mallapur, 2007) ^[10]. The crop is affected by many diseases viz., anthracnose, Macrophomina dry root rot, ashy stem blight, bacterial leaf spot, powdery mildew, rust, ring spot virus, field bean yellow mosaic disease and root knot (Manjunath *et al.*, 2016) ^[8]. Among these, anthracnose caused by *Colletotrichum lindemuthianum* (Sacc. and Magnus) Briosi and Cavara is an important disease throughout the world and severe in tropical and subtropical regions (Corrales *et al.*, 1995) ^[3].

Anthracnose is challenging to manage since its causal agent, *C. lindemuthianum*, has a wide host range, is airborne and seed borne by nature, as well as having a lengthy life time in plant debris and seed. Realizing the importance of the field bean crop and widespread distribution of anthracnose disease, extent of losses caused by it, the present study was conducted to manage the disease effectively through different fungicides, botanicals and bioagents.

Materials and Methods

The leaves and pods of dolichos bean having typical symptoms of anthracnose caused by *Colletotrichum lindemuthianum* were collected from the field of Plant Pathology, College of Agriculture (Dr. PDKV), Nagpur, Maharashtra and were brought to the laboratory and isolated. The collected anthracnose disease specimen was first microscopically examined for confirmation of fungus. After the confirmation of the fungal spores, isolation was by following tissue isolation by using PDA media. Koch's postulates were established to prove the pathogenicity of the

causal fungus. Pathogenicity of fungus was conducted under field condition by inoculating the healthy plants of dolichos bean with spore suspension of the fungus.

The observations of percent disease incidence and disease intensity were recorded after incidence of disease appear on the plant parts on randomly selected plants by using 0-9 scale given by Mayee and Dattar (1986)^[7]. Five plants per treatments per replication were selected randomly for observations. Three leaves (bottom, middle and top) were selected for observations and percent disease intensity was worked out after each spray.

Table 1: Scale of Anthracnose

Score	Description
0	No symptoms on leaves/ pods
1	Small, round brown spots covering 1% or less leaf/pod area
3	brown, sunken spots covering 1 to 10% of leaf/pods area
5	Brown, spots enlarging form circular spots covering 11 to 25% of leaf/pod area.
7	Circular, brown sunken spots, covering 26 to 50% leaf/ pod area
9	Circular to irregular, brown sunken spots covering 50% or more of leaf/ pod area

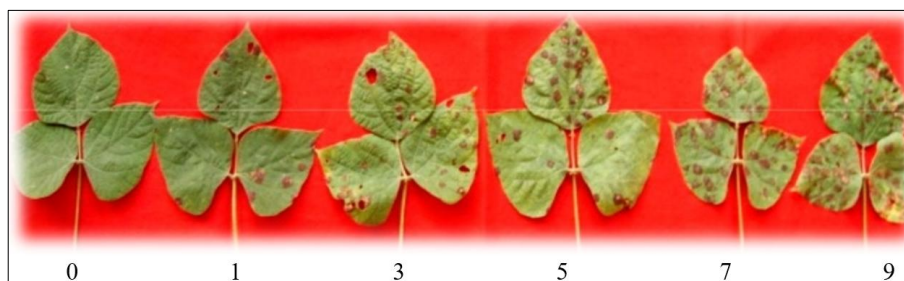


Plate 1: 0 to 9 Grade infection scale of *C. lindemuthianum*.

Percent disease incidence was calculated by following formula.

$$\text{PDI} = \frac{\text{No. of infected leaves/pods}}{\text{No. of infected leaves/pods examined}} \times 100$$

The percent disease intensity was calculated by following formula:

$$\text{PDI} = \frac{\text{Summation of all numerical ratings}}{\text{Total number of leaves observed} \times \text{Max grade}} \times 100$$

The percent disease control was calculated by following formula

$$\text{PDC} = \frac{\text{PDI in control} - \text{PDI in treatment}}{\text{PDI in control}} \times 100$$

The data obtained was statistically analyzed by using standard statistical methods (Gomez and Gomez, 1984)^[4].

Results and Discussion

Symptoms of anthracnose fungus

The early symptoms of infection usually appear on lower leaf surface along the veins which show brick red to purplish red discoloration. The typical symptoms of anthracnose disease first appeared as round to irregular shape small brown to black spots on leaves and petioles. These spots increase in size, these lesions enlarged, coalesced and formed large necrotic areas and forming irregular patches of dead tissue. The border of the spots was often tinged with red, while the central portion of the diseased spots on leaves became dry and papery in nature, detached and fell off to form a characteristic "shot hole" symptom. On petioles, typical lesions appeared as elongated brown to black lesions developed, which enlarged, coalesced all along the petioles and caused the sunken and blackish lesions.



Plate 2: Symptoms of anthracnose on leaves and pods

Isolation and identification of *C. lindemuthianum*

The pathogen causing anthracnose of dolichos bean was isolated from infected leaves of dolichos bean collected from field of Plant Pathology, College of Agriculture, Nagpur on potato dextrose agar medium (PDA) and later its pure culture accomplished. The culture of the pathogen was examined microscopically for morphological and culture characteristics. The fungus was identified as *Colletotrichum lindemuthianum* on the basis of their morphological character viz. hyphae, shape of spore produced and cultural characteristics viz. colour and type of colony.

Morphological characters of pathogen

The fungus produces acervuli which is saucer shape fruiting body. The morphological characteristics of the spore of *Colletotrichum lindemuthianum* were recorded from the culture. The conidia were hyaline, unicellular, falcate or lunette (sickle shape) or cylindrical or more or less guttulate, mitigate or with apex prolonged into the simple cellular appendage, produced from phialides (indigenous cells) eteroblastically. The length of conidia ranged between 10.5-22.5 μm and breadth of 3.5-4.5 μm . The fungus produced brownish white, uniform, circular, fluffy growth in center with concentric rings and appressed growth at periphery on potato dextrose agar was observed.



Plate 3: Isolation of *Colletotrichum lindemuthianum*

Pathogenicity

Pathogenicity test was performed to confirm the pathogen i.e. behaviour of *Colletotrichum lindemuthianum* was carried out under pot culture by using the spray inoculation method with conidia suspension (8×10^5 conidia/ml). It was observed that the symptoms appeared after 15 days of inoculation, which were similar to the anthracnose caused by *Colletotrichum lindemuthianum*. The pathogen was reisolated from the infected leaf tissues on PDA medium. The microscopic characters of reisolated fungus were same as recorded in the parent culture of the test fungus and colony characteristics of both the culture were same. This proved the Koch's postulates and pathogenicity of the isolated fungus which proved that *Colletotrichum lindemuthianum* is causal organism of anthracnose disease of dolichos bean.



Plate 4: Pathogenicity test of *C. lindemuthianum*

Percent disease incidence

The data presented in the table No. 2 revealed that, after first spray, all the treatments were significantly effective in showing the less incidence of anthracnose caused by *Colletotrichum lindemuthianum* of dolichos bean. The

significantly less percent disease incidence was recorded in the treatment of propiconazole 0.1% (28.20 PDI) and it was highly significant over all the treatments in reducing the disease incidence. The next promising treatment was hexaconazole 0.1% (30.30 PDI) and it was statistically significant among all the remaining treatments. The other effective treatment was neem seed extract showing (34.30 PDI) followed by *Trichoderma harzianum* (34.60 PDI) and these two treatments were at par with each other. The highest disease incidence was recorded in control (45.00 PDI).

After second spray, significantly less percent disease incidence was recorded in the treatment of propiconazole 0.1% (26.00 PDI) and it was highly significant over all the treatments in reducing the disease incidence. The next promising treatment was hexaconazole 0.1% (29.00 PDI) and it was statistically significant among all the remaining treatments. The other effective treatment was neem seed extract @ 5% showing (31.00 PDI) followed by *Trichoderma harzianum* @ 0.2% (31.40 PDI) and these two treatments were at par with each other. The highest disease incidence after second spray was recorded in control (49.00 PDI).

After third spray, significantly less percent disease incidence was recorded in the treatment of propiconazole 0.1% (23.60 PDI) and it was highly significant over all the treatments in reducing the disease incidence. The next promising treatment was hexaconazole 0.1% (27.40 PDI) and it was statistically significant among all the remaining treatments. The other effective treatment was neem seed extract @ 5% showing (30.00 PDI) followed by *Trichoderma harzianum* @ 0.2% (31.10 PDI) and these two treatments were at par with each other. In case of *Trichoderma viride* @ 0.2% and ginger rhizome extract @ 10% recording 36.27 and 38.00 percent disease incidence respectively. The highest percent disease incidence was recorded in control (57.60 PDI).

Field evaluation of treatments

The data presented in the table No. 3 indicated that, all the treatments were statistically significant in reducing the disease intensity of *Colletotrichum lindemuthianum* of dolichos bean after first spray. The lowest percent disease intensity was noticed in the treatment of propiconazole @ 0.1% recording (23.47 PDI) which was statistically significant over all treatments. The next promising treatment in reducing the disease was hexaconazole @ 0.1% exhibiting (25.16 PDI) which was statistically superior over remaining treatments. The other effective treatment was neem seed extract @ 5% showing (30.00 PDI). The next best treatments were *Trichoderma harzianum* @ @ 0.2% recording (31.00 PDI) followed by *Trichoderma viride* @0.2% and Ginger rhizome extract @ 10% recording (34.16 PDI) and (34.87 PDI) respectively and both these treatments were at par with each other. The maximum percent disease intensity was observed in control (49.50 PDI). The percent disease control was recorded in the range of 17.62 to 52.38 percent, the highest PDC was noticed in the treatment of propiconazole @ 0.1% followed by hexaconazole @ 0.1% recording (52.38 PDC) and (49.17 PDC) respectively. The lowest PDC was noticed in the treatment of ginger rhizome extract @ 10% recording (17.62 PDC).

After second spray, all the treatments were statistically significant in reducing the disease intensity of *Colletotrichum lindemuthianum* of dolichos bean. The lowest percent disease intensity was noticed in the treatment of propiconazole @ 0.1% recording (21.00 PDI) which was statistically significant over all treatments. The next promising treatment in reducing the disease was hexaconazole @ 0.1% exhibiting (23.02 PDI) which was statistically superior over remaining treatments. The other effective treatment was neem seed extract @ 5% showing (28.00 PDI). The next best treatments were *Trichoderma harzianum* @ 0.2% and *Trichoderma viride* @ 0.2% recording (30.19 PDI) and (31.23 PDI) respectively and both these treatments were at par with each other. The maximum percent disease intensity was observed in control (51.33 PDI). The percent disease control was recorded in the range of 37.21% to 59.08%. The highest PDC was noticed in the treatment of propiconazole @ 0.1% followed by hexaconazole @ 0.1% recording (59.08 PDC) and (55.15 PDC) respectively. The lowest PDC was noticed in the treatment of ginger rhizome extract @ 10% recording (37.21 PDC).

All the treatments were found statistically significant in reducing the disease intensity of *Colletotrichum lindemuthianum* of dolichos bean after third spray. The lowest percent disease intensity was noticed in the treatment of propiconazole @ 0.1% recording (14.90 PDI) which was statistically significant over all treatments. The next promising treatment in reducing the disease was hexaconazole @ 0.1% exhibiting (17.00 PDI) which was

statistically superior over remaining treatments. The other effective treatment was neem seed extract @ 5% showing (26.67 PDI). The next best treatments were *Trichoderma harzianum* @ 0.2% followed by *Trichoderma viride* @ 0.2% recording (27.62 PDI) and (29.73 PDI) respectively. The maximum percent disease intensity was observed in control (61.00 PDI). The percent disease control was recorded in the range of 49.72% to 75.57%. The highest PDC was noticed in the treatment of propiconazole @ 0.1% followed by hexaconazole @ 0.1% recording (75.57 PDC) and (72.13 PDC) respectively. The lowest PDC was noticed in the treatment of ginger rhizome extract @ 10% recording (49.72 PDC).

Similar finding was reported by Magar (2014) reported that after three sprayings with propiconazole recorded least disease intensity 31.81, 28.88 and 25.92%, respectively, which were at par with tebuconazole recorded 34.81, 33.32 and 28.88% followed by hexaconazole recorded percent disease intensity 39.25, 37.77 and 33.32%, respectively and among the bioagents tested seed treatment of *T. viride* + spraying of *T. viride* recorded 49.62, 46.66 and 43.70% disease intensity respectively which was at par with *P. fluroscens* i.e. 54.08, 51.10 and 48.14% after all the three sprayings. While botanical Neem oil was found effective than both the bioagents which recorded 44.19% disease intensity with 22.14% disease control over untreated control. Also, the results are consistent with those of Poddar *et al.*, (2010) ^[9], Khalequzzaman (2015) ^[5], Anjali *et al.*, (2024) ^[1] and Arpitha *et al.*, (2025) ^[2]

Table 2: Effect of fungicides, bioagents and botanicals on percent disease incidence of *C. lindemuthianum* of dolichos bean.

S.N.	Treatment	Conc.%	After 1 st spray	After 2 nd spray	After 3 rd spray
1	Hexaconazole	0.1	30.30 *(33.41)	29.00 (32.58)	27.40 (31.56)
2	Propiconazole	0.1	28.20 (32.02)	26.00 (30.65)	23.60 (29.06)
3	Neem seed extract	5	34.30 (35.84)	31.00 (33.83)	30.00 (33.21)
4	Ginger rhizome extract	10	40.00 (39.23)	39.14 (38.72)	38.00 (38.05)
5	<i>Trichoderma viride</i>	0.2	37.00 (37.46)	36.00 (36.86)	36.27 (37.03)
6	<i>Trichoderma harzianum</i>	0.2	34.60 (36.03)	31.40 (34.08)	30.10 (33.27)
7	Control	-	45.00 (42.13)	49.00 (44.42)	57.60 (51.35)
'F' test			Sig.	Sig.	Sig.
SE _± (m)			0.18	0.47	0.41
CD P=0.05			0.87	1.43	1.27

*Figures in the parentheses are arcsine value

Table 3: Field evaluation of different fungicides, bioagents and botanicals on percent disease intensity of anthracnose of dolichos bean caused by *Colletotrichum lindemuthianum*.

S.N.	Treatment details	Conc. (%)	After 1 st spraying		After 2 nd spraying		After 3 rd spraying	
			PDI	PDC	PDI	PDC	PDI	PDC
1	Hexaconazole	0.1	25.16 *(30.10)	49.17	23.02 *(28.67)	55.15	17.00 *(24.35)	72.13
2	Propiconazole	0.1	23.47 (28.97)	52.38	21.00 (27.27)	59.08	14.90 (22.70)	75.57
3	Neem seed extract	5	30.00 (33.21)	39.39	28.00 (31.94)	45.45	26.67 (30.09)	56.27
4	Ginger rhizome extract	10	34.87 (36.19)	17.62	32.23 (34.59)	37.21	30.67 (33.62)	49.72
5	<i>Trichoderma viride</i>	0.2	34.16 (35.76)	30.98	31.23 (33.97)	39.15	29.73 (33.04)	51.26
6	<i>Trichoderma harzianum</i>	0.2	31.00 (35.10)	37.37	30.19 (33.32)	41.18	27.62 (31.70)	54.72
7	Control	-	49.50 (44.71)	-	51.33 (45.76)	-	61.00 (51.35)	
'F' test			Sig.		Sig.		Sig.	
SE $\pm$ (m)			0.25		0.55		0.74	
CD P = 0.05			0.78		1.70		1.61	

*Figures in the parentheses are arcsine value.

PDI= Percent disease incidence

PDC= Percent disease control

Conclusions

Among the bean crops dolichos bean is the most important bean crop grown throughout the world. In terms of area cultivated and production, it is annual crop with more economical in cultivation and gives maximum income to the farmer. Dolichos bean suffers from many diseases. Among them anthracnose caused by *Colletotrichum lindemuthianum* is major destructive disease. It appears almost every year in varying intensity leading to greater yield losses. Most of the bean varieties were reported susceptible to this disease. Therefore, it was necessary to obtain the information on disease initiation, symptoms and management by using different fungicides, bioagents and botanicals. The treatment of propiconazole @ 0.1% was statistically significant over all treatments in reducing disease. The next promising treatment was hexaconazole @ 0.1% which was statistically superior over remaining treatments in reducing disease. The other effective treatments were neem seed extract @ 5% followed by *Trichoderma harzianum* @ 0.2%.

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