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MANAGEMENT OF ANTHRACNOSE OF FIELD BEAN CAUSED BY *COLLETOTRICHUM LINDEMUTHIANUM* THROUGH DIFFERENT FUNGICIDES AND BIOAGENTS

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ABSTRACT

Field bean does not show its full production potential due to several biotic and abiotic stresses. Its productivity is affected by many pathogens among which, *Colletotrichum lindemuthianum*, the causative agent of anthracnose is responsible for yield loss. A field experiment was conducted to study the effectiveness of different systemic, contact, combi fungicides and bio against *Colletotrichum lindemuthianum*. The investigation was carried out in Randomized Complete Block design with nine treatments and replicated thrice. T_5- a combination of seed treatment with *T. viride* @ 5g $Kg^{-1}$of seeds followed by two foliar sprays of metiram 55% + pyraclostrobin 5% WG (Cabrio top) @ 0.2% was found to be the best with lowest mean disease severity of 21.66 per cent and highest yield (9.94 q/ha) over the untreated control (53.33 % and 7.72 q/ha). Next best was observed in T_6- (seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays of cymoxanil 8% + mancozeb 64% WP (curzate) @ 0.2%) with 26.66 per cent disease severity and yield (9.78 q/ha). However, highest benefit cost ratio of 1.74 was recorded in T_3 seed treatment with *T. viride* @ 5g $Kg^{-1}$of seeds followed by two foliar sprays of hexaconazole 5% EC @ 0.1 per cent, followed by T_4- seed treatment with *T. viride* @ 5g $Kg^{-1}$of seeds followed by two foliar sprays of carbendazim 50 % WP @ 0.1 with benefit to cost ratio of 1.70.

Key words : Fungicides, Bioagents, Field evaluation, Field bean.

Introduction

Field bean (*Lablab purpureus* L.) belongs to the family *Fabaceae* and commonly known as Hyacinth bean, Lablab bean, Egyptian bean, Bonavista vine, Australian pea, Indian bean, dolichos bean and poor man's bean. Dolichos is derived from the Greek word meaning long or elongated. Field bean is generally considered to be originated in South-east Asia. It 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). India is the leading producer of field bean in the world with cultivated area of 0.085 million hectares and production of 0.030 million tones with productivity of 236 Kg/ha. Karnataka state alone contributes about 90 per cent both in terms of area and production of field bean in India with an area of 0.38 lakh hectares with production of 0.29 lakh tonnes and productivity of 649 kg/ha (Anonymous, 2019). 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).

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, 2012). 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).

Field bean anthracnose caused by *C. lindemuthianum* is one of the most important seed borne diseases of field bean in the world (Amin *et al*., 2014). It affects all plant parts *viz*., stem, pods and seeds. The disease has been identified in entire bean growing areas of the country, where moist and cool weather prevails during the growth season. The first indications of an infection are patches of reddish-purple discoloration along the veins on the underside of the leaves. Similar symptoms on the upper surface of leaves will manifest as the disease advances. Pod and stem lesions are more distinctly defined than leaf lesions; they are elevated, dark brown or reddish-brown, slightly depressed and grey or brown in color. Seeds infected with pods suffer direct harm, which lowers their ability to germinate and can even lead to a total loss of production. These infected seeds may act as primary source of inoculum for the next season (Manjunath *et al*., 2012).

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 wide spread distribution of anthracnose disease, extent of losses caused by it, the present study was conducted to manage the disease effectively through different fungicides and bioagents.

Materials and Methods

Description of the study Area

The field experiment was conducted during late *kharif* 2020, at College of Sericulture, Chintamani, which is located at 13° 40 North latitude and 78° 06 East longitude and has an elevation of 865 m above mean sea level in the eastern dry zone of Karnataka. The texture of the soil at the experimental site was red sandy clay loam.

Experimental Materials used

Susceptible field bean variety HA-3 was used under rain fed conditions with a spacing of 30×45 cm to evaluate the efficacy of different fungicides and bioagents against anthracnose of field bean. In accordance with the different treatments the seeds were treated with captan @ 3g/kg of seeds, some seeds are treated with *T. viride*. @ 5g/kg of seeds and *P. fluorescence* @ 5g/kg of seeds. Among the different contact, systemic, combi fungicides, fungal and bacterial bio agents tested *in vitro*, the fungicides and the bioagents with best results were selected for evaluation under field conditions for the management of the disease.

Evaluation of fungicides and bioagents in field condition

The experiment was laid out in Randomized Complete Block Design (RCBD) with nine treatments that were reproduced three times (Table 1). After initiation of

Table 1 : Treatment details of field experiment.

Treatment	Treatment details
T_1	Seed treatment with *T. viride* at 5g/kg of seeds followed by foliar applications of copper oxy chloride @ 3g/l twice at 15 days interval.
T_2	Seed treatment with *T. viride* at 5g/kg of seeds followed by foliar applications of mancozeb @ 2g/l twice at 15 days interval.
T_3	Seed treatment with *T. viride* at 5g/kg of seeds followed by foliar applications of hexaconazole @ 1mL/l twice at 15 days interval.
T_4	Seed treatment with *T. viride* at 5g/kg of seeds followed by foliar applications of carbendazim @ 1mL/l twice at 15 days interval.
T_5	Seed treatment with *T. viride* at 5g/kg of seeds followed by foliar applications of cabrio top @ 2g/l twice at 15 days interval.
T_6	Seed treatment with *T. viride* at 5g/kg of seeds followed by foliar applications of curzate @ 2g/l twice at 15 days interval.
T_7	Seed treatment with *T. viride* at 5g/kg of seeds followed by two foliar applications of *Trichoderma viride* at 10 mL/l twice at 15 days interval.
T_8	Seed treatment with *T. viride* at 5g/kg of seeds followed by foliar applications of *Pseudomonas fluorescence* at 10 mL/l twice at 15 days interval.
T_9	Untreated control

disease, the plants were sprayed with different doses of two best contact, systemic and combi fungicides each, fungal and bacterial bioagents. Two sprays were given at 15 days interval. The plants in each plot were scored for disease severity on five point scale as given by Mayee and Datar (1986), then the data was converted into per cent disease index (PDI) according to the formula given by Wheeler (1969). The other observations of yield parameters *viz.*, seed yield and straw yield was recorded, further per cent yield increase over control was estimated for each treatment. Each treatment was harvested separately and yield per plot was recorded further economics of each treatment was worked by cost benefit ratio. The economic analysis of the experiment was done by taking into consideration of market prices prevailing during 2021 for the produce and cost of treatment.

Statistical analysis

Randomly selected five plants were assessed individually from each treatment and the results were analysed statistically. The per cent disease index (PDI) was calculated using formula given by Wheeler. Before analysis, the data on per cent anthracnose severity was subjected to angular transformation as advocated by Fisher and Yates (1963).

Results and Discussion

The experiment on disease management of anthracnose of field bean using different contact, systemic, combi fungicides, fungal and bacterial bioagent was conducted during late *kharif* 2020. The results are presented in Table 2 and Fig. 1.

The data presented in the table indicated that all the treatments imposed were significantly superior over the untreated control (53.33%) in reducing the anthracnose severity and increasing the yield of field beans during kharif 2020 crop season. Among the nine treatments, T_5- a combination of seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays of metiram 55 % + pyraclostrobin 5% WG (Cabrio top) @ 0.2% was found to be the best with lowest mean disease severity of 21.66 with highest yield of 9.94 q ha^{-1} over the untreated control followed by T_6- (seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays of cymoxanil 8 % + mancozeb 64% WP (Curzate) @ 0.2%) with 26.66 per cent disease severity and yield of 9.78 q ha^{-1} and T_3- (seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays of hexaconazole 5% EC @ 0.1%) with disease intensity of 27.22 per cent and seed yield of 9.58 q ha^{-1}. T_2- seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays mancozeb 75% WP @ 0.2% of and T_1- seed treatment with *T. viride* @ 5g Kg^{-1}of seeds followed by two foliar sprays of copper oxy chloride 50% WP @ 0.3% were effective in controlling the disease with 32.77, 36.66 per cent disease severity with 9.25, 9.10 q ha^{-1}, respectively. Moderate control was observed in T_7- (seed treatment with *T. viride* @ 5g Kg^{-1}of seeds followed by two foliar sprays of *T. viride*) and T_8-(seed treatment with *T. viride* @ 5g Kg^{-1}of seeds followed by two foliar sprays of *P. fluorescence*) with per cent disease severity of 35.00, 38.89 per cent and yield of 8.84, 8.61 q ha^{-1} respectively over control. All treatments significantly reduced the disease severity. However, metiram 55% + pyraclostrobin 5 % WG (Cabrio top) @ 0.2% was found to be best with 59.38 per cent decrease in disease intensity and 28.76 per cent increase in yield over control followed by cymoxanil 8 % + mancozeb 64% WP (Curzate) @ 0.2%, hexaconazole 5% EC and carbendazim 50% WP with 50.01, 48.96, 42.72 per cent decrease over control and with 26.68, 24.09, 23.45 per cent increase in seed yield over control respectively. The results here are consistent with those of Padder *et al.* (2010) and Khalequzzaman (2015) .

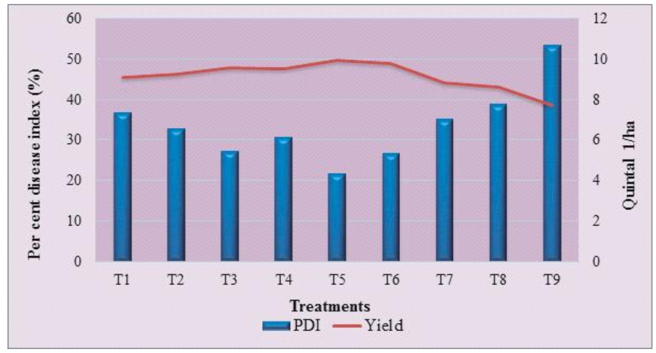

Fig. 1 : Management of field bean anthracnose under field condition during *kharif* 2020.

Benefit cost ratio

Economics of the disease management trial was worked out by considering the total cost of cultivation of the crop, cost of treatments and gross returns. The highest benefit cost ratio of 1.74 was recorded in T_3 seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays of hexaconazole 5% EC @ 0.1 per cent. Next in the order was T_4- seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays of carbendazim 50% WP @ 0.1% followed by T_2- seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays mancozeb 75 % WP @ 0.2 % with benefit cost ratio of 1.70 and 1.63, respectively. Next in the order was metiram 55% + pyraclostrobin 5% WG (Cabrio top) with benefit cost ratio of 1.61 followed by cymoxanil 8% + mancozeb 64% WP (Curzate) with

Table 2 : Management of anthracnose of field bean caused by *C. lindemuthianum* using different fungicides and bio agents during *kharif* 2020 under field conditions.

Treatment	Treatment details	Per cent disease index (PDI)	Per cent decrease in disease severity over control	Seed yield (q ha^{-1})	Per cent increase in seed yield over control	B:C ratio
T_1	ST with *T. viride* @ 5g Kg^{-1} of seeds + two sprays of copper oxy chloride @ 3g L^{-1}	36.66 (37.158)	31.26	9.10	17.88	1.51
T_2	ST with *T. viride* @ 5g Kg^{-1} of seeds + two sprays of mancozeb @ 2g L^{-1}	32.77 (34.700)	38.55	9.25	19.82	1.63
T_3	ST with *T. viride* @ 5g Kg^{-1} of seeds + two sprays of hexaconazole @ 1mL L^{-1}	27.22 (31.171)	48.96	9.58	24.09	1.74
T_4	ST with *T. viride* @ 5g Kg^{-1} of seeds + two sprays of carbendazim@1g L^{-1}	30.55 (33.476)	42.72	9.53	23.45	1.70
T_5	ST with *T. viride* @ 5g Kg^{-1} of seeds + two sprays of metiram + pyraclostrobin @ 2g L^{-1}	21.66 (27.165)	59.38	9.94	28.76	1.61
T_6	ST with *T. viride* @ 5g Kg^{-1} of seeds + two sprays of cymoxanil + mancozeb @ 2g L^{-1}	26.66 (30.765)	50.01	9.78	26.68	1.59
T_7	ST with *T. viride* @ 5g Kg^{-1} of seeds + two sprays of *Trichoderma viride* at 10 mL L^{-1}	35.00 (36.061)	34.37	8.84	14.51	1.36
T_8	ST with *T. viride* @ 5g Kg^{-1} of seeds + two sprays of *Pseudomonas fluorescence* at 10 mLL^{-1}	38.89 (38.403)	27.08	8.61	11.53	1.30
T_9	Untreated control	53.33 (46.941)	-	7.72	-	1.24
S. Em ±		**1.424**		**0.429**		
CD (5%)		**4.157**		**1.253**		

*ST: Seed treatment.

Table 3 : Cost economics of field management on anthracnose of field bean caused by *C. lindemuthianum.*

S. no.	Treatments	Cost of cultivation (Rs. ha^{-1})	Treatment cost (Rs. ha^{-1})	Total cost of cultivation (Rs. ha^{-1})	Seed yield (q ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
1	T_1	34400	1815	36215	9.10	91000	54785	1.51
2	T_2	34400	835	35235	9.25	92500	57265	1.63
3	T_3	34400	565	34965	9.58	95800	60835	1.74
4	T_4	34400	895	35295	9.53	95300	60005	1.70
5	T_5	34400	3615	38015	9.94	99400	61385	1.61
6	T_6	34400	3355	37755	9.78	97800	60045	1.59
7	T_7	34400	3015	37415	8.84	88400	50985	1.36
8	T_8	34400	3015	37415	8.61	86100	48685	1.30
9	T_9	34400	-	34400	7.72	77200	42800	1.24

benefit cost ratio 1.59 over untreated control (1.24). Copper oxy chloride 50% WP recorded the benefit cost ratio of 1.51. Comparatively less B:C ratio was observed in *T. viride* and *P. fluorescence* with 1.36 and 1.30, respectively (Table 3).

The data presented in Table 3 depicted that the treatment of seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays of hexaconazole 5% EC was found to be most effective with maximum benefit cost ration of 1.74 and the treatment of seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays of *P. fluorescence* @ 10 mLL^{-1} was found to be least effective treatment with benefit cost ratio of 1.30.

Conclusion

From the present investigation, it can be concluded that the significant variation exists within the treatments in disease control and yield. As far as disease control and yields are considered, combi fungicides performed better as compared to other contact and systemic fungicides. From the practical point of view, the chemical, which gives the maximum returns is more important rather than the control of the disease. So, calculation of benefit: cost ratio gives an information on whether the technology could be adopted in the farmers' fields or not. Hence, benefit: cost ratio is an important parameter for recommendation of any treatment for successful control of plant disease. From a pragmatic perspective, managing the disease is less crucial than finding the chemical that yields the highest returns. Therefore, calculating the benefit-to-cost ratio provides insight into whether farmers could implement the technology on their fields. Hence, the benefit-to-cost ratio is a crucial factor to consider while recommending a chemical for plant diseases that can be effectively controlled. In the present study, the treatment containing seed treatment with *T. viride* @ 5g Kg^{-1} of seeds followed by two foliar sprays of *P. fluorescence* @ 10 mLL^{-1} was found to be least effective treatment with benefit cost ratio of 1.30.

Declaration

The authors declare no conflict of interest.

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