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ORGANIC MANAGEMENT OF CERCOSPORA LEAF SPOT OF BLACK GRAM *(CERCOSPORA CANESCENS)* BY USING PLANT LEAF EXTRACT, BIO-AGENTS AND MIX CROPPING

Mehjabi Hashmi, Pankaj Kumar Mehta, Shahnashi Hashmi*, Anshul Natani and Sachin Kumar Rathor
Institute of Agricultural Sciences, Department of Plant Pathology, Bundelkhand University, Jhansi284128, Uttar Pradesh, India
*Corresponding author E-Mail: shahnashi@gmail.com

ABSTRACT

Black gram (*Phaseolus mungo* L.), belongs to the family Leguminosae and sub family Papilionaceae. Pulses provide significant nutritional and health benefits, and are known to reduce several non-communicable diseases such as colon cancer and cardio- vascular diseases. cercospora leaf spot is a serious problem in all the areas having rice based cropping systems of the country. The preliminary signs and symptoms of the disease appear as water-soaked spot-on leaves. As spots end up older might also additionally coalesce together, inflicting enlarged dead area on the infected leaves. Cercospora leaf spot due to *Cercospora canescens* causes much damage to the production of black gram. The Datura leaf extract 10%, neem leaf extract 10%, chilly leaf extract 10 %, tobacco leaf extract 10 %, and bio- agents *viz. Trichoderma spp.* @ 10%, *Bacillus thuringiensis* @ 10% and *Bacillus subtilis* @ 10% were taken for their efficacy against the disease and yield parameters. All the treatment *viz.,* botanicals and bioagents were applied as foliar spray. In control plot only water spray was given. Seven days after spraying, Plant Disease severity was recorded in all the treatments.

After 1st spray minimum 18.25 per cent disease incidence was recorded in T_7 (*Trichoderma* spp. @ 10%), while in case of botanicals minimum 25.75 Per cent disease incidence was recorded in T_1 (neem leaf extract @ 10 %,). In case of T_9 (control plot) 33.33 per cent disease incidence was recorded.

After 2nd spray minimum 24.25 per cent disease incidence was recorded in T_7 (*Trichoderma* spp. @ 10%) followed by 29.25 in T_6 (of *Bacillus subtilis*), While in case of botanicals minimum 32.00 Per cent disease incidence was recorded in T_1 (neem leaf extract @ 10 %,).

Maximum 14.75 q/ha was recorded in T_7 (*Trichoderma* spp. @ 10%) followed by 13.25 q/ha in T_6 (*Bacillus subtilis*), 12.33 q/ha in T_5 (*Bacillus thuringiensis* @ 10%,). While in mix cropping (Urad+ Maize T_8) 9.75 q/ha was recorded. In case of T_9 (control plot) 9.00 q/ha was recorded. It is concluded that T7 – *Trichoderma* spp. @ 10% @14.75 q/ha found superior in all the parameters.

Keywords: Black gram, Cercospora canescens, Trichoderma spp., Bacillus subtilis and Bacillus thuringiensis

Introduction

The crop is generally grown during kharif as rainfed crop. It has the yield potential of 11 to 12 q ha-1 (Anonymus, 2019), as against the national average of 4.17 q ha^{-1}. Among pulses, Urd bean crop covers a total world area of 5 m ha with a total production of 3 m ton (John, 1991). Wheare as in India urdbean (*Phaseolus mungo* L.) production was 2.78 million tonnes from acreage of 4.63 million hectares with a productivity of 600 Kg/ha. (Agricultural Statistics Division, DES, MoAF&W, 2022). India is the largest producer and consumer of urdbean. The major black gram producing states in India are Madhya Pradesh, Uttar Pradesh, Punjab, Maharashtra, West Bengal, Andhra Pradesh, Orissa, Tamil Nadu and Karnataka. In the case of area, the share of Madhya Pradesh is

highest (24 %), followed by Uttar Pradesh (10 %) and Maharashtra (7%) during 2020-21. In black gram, considerable losses in the production occur as a result of cercospora leaf spot (*Cercospora canescens*), anthracnose (*Colletotrichum lindemuthianum*), powdery mildew (Erysiphe polygoni), bacterial blight (*Xanthomonas phaseoli*), rust (*Uromyces appendiculatus)*, leaf crinkle and yellow mosaic virus. Among these, cercospora leaf spot is a serious problem in all the areas having rice based cropping systems of the country. Heavy infections of *Cercospora* spp. can cause premature defoliation of the black gram plant and inhibited the pod formation of the crop. Due to infection, no of grain less in per pod and the grain size also smaller as compare to healthy pod. Grain yield losses have been reported up to 23% due to cercospora leaf spot in Urdbean. Maximum loss of 61% was observed in case of grain yield (Iqbal *et al*., 1995). The disease starts appearing about 30 days after sowing (Grewal *et al*., 1980). For management of cercospora leaf spot in Urd bean, many practices viz., chemical method, organic amendments, and biological control have been reported. Biological control of cercospora leaf spot is regarded as an important component of integrated disease management system and it acts as an alternative to various chemical pesticides due to their self-sustaining action. Eco-friendly control like use of bio-agents and botanicals against plant diseases is however, a current technique to plant diseases management and it has drawn the unique attention of the plant pathologist everywhere in the world. Most of the bio-agents are cost effective and do not have dangerous outcomes on people and useful soil micro-organisms. Keeping the above facts in view the present investigations deal with organic management by using plant leaf extracts, bio-agents and mix cropping (Urad+ Maize).

Materials and Methods

A virulent isolate of *Cercospora canescens* isolate from cercospora leaf spot infested black gram plants was used in the present studies. Biocontrol agents viz., *Trichoderma* spp. *Bacillus subtilis* and *Bacillus thuringiensis* obtained from the Department of Plant Pathology of the University. The field experiments were carried out in the premises of Organic Research Farm, Department of Plant Pathology, Institute of Agricultural Science, situated in the main campus of the Bundelkhand University, Jhansi (U.P.) during kharif 2023.

Management of leaf spot of black Gram:

The present investigations were carried out during Kharif season 2023 at organic Research Farm of Bundelkhand University, Jhansi, Uttar Pradesh. The effectiveness of tobacco leaf extract 10%, neem leaf extract 10%, chilly extract 10 %, and bio-agents *viz,. Bacillus thuringiensis* @ 10%, *Bacillus subtilis* @ 10 % and *Trichoderma* spp. @ 10 % were taken. All the treatment *viz.,* botanicals and bioagents were applied as foliar spray. In control plot only water spray was given. Seven days after spraying, Plant Disease severity was recorded in all the treatments. All recommended agronomical practices were followed. The details of experiments as follows-

Experimental Details:

Design	:	Randomized Block Design
Plot size	:	3×3 M^2
Replication	:	3
Treatments	:	9
Spacing	:	30× 10 cm
Variety	:	HD-2255

Treatment Details:

1. T1-Foliar application of Neem leaf extract @10 %
2. T2-Foliar application of Datura leaf extract @ 10 % concentration
3. T3-Foliar application of chilly leaf extract @ 10 % concentration.
4. T4-Foliar application of tobacco extract@ 10 %
5. T5-Foliar application of *Bacillus thuringiensis* @ 10 % concentration
6. T6-Foliar application of *Bacillus subtilis* @ 10 % concentration
7. T7-Foliar application of *Trichoderma* spp. @ 10 % concentration
8. T8-Foliar application of Mix cropping (Urad+ Maize) @ 10 % concentration
9. To-Control

Plant Disease severity was observed by following scale

Table 1 : Leaf spot disease rating scale (1-9 points)

Grade/scale	Description	Disease severity (%)
1	No disease	0
2	Lesions present largely on lower leaves, no defoliation	1-5
3	Lesions largely on lower leaves, very few on middle leaves, defoliation of some lower leaflet evident	6-10
4	Lesions on lower and middle leaves but severe on lower leaves, defoliation of some lower leaflet evident.	11-20
5	Lesions present on all lower and middle leaves, over 50% defoliation of lower leaves.	21-30
5	Severe lesions on lower and middle leaves, lesions present but less severe on top leaves, extensive defoliation of some middle leaflet evident.	31-40
7	Lesions in all leave but less severe on top leaves, defoliation of all lower and some middle leave.	41-60
8	Defoliation of all lower and middle leaves, severe lesions on top leaves, some defoliation of top leaves evident.	61-80
9	Almost all leaves defoliated leaving bare stems; some leaflet may remain, but show severe leaf spots.	81-100

Observation Recorded:

Plant Disease incidence was recorded using following formula

$$PDI = \frac{\text{Number of diseased leaves/ treatment}}{\text{Total number of leaves/ treatment}} \times 100$$

Statistical analysis of data:

The data of the experiments conducted in the fields were subjected to statistical analysis. The data were transformed whenever required. The critical differences were worked out at 0.05 per cent probability level to find out the difference between the treatments.

Results and Discussion

Management of the disease:

Effect of different treatments on Cercospora leaf spot after 1st *spray*

All the tested bioagents, and botanicals significantly reduced the disease incidence and increase the crop yield as compare the control. Data given in Table no. 1 and fig. no. 1 that maximum 25.70 per cent disease incidence was recorded in *Trichoderma* spp. (T_7) followed by 25.70 in control plot before the treatment application.

After 1st spray minimum 18.25 per cent disease incidence was recorded in T_7 (*Trichoderma* spp. @ 10%) followed by 20.25 in T_6 (*Bacillus subtilis*), 23.33 in T_5 (*Bacillus thuringiensis* @ 10%,). While in case of botanicals minimum 25.75 Per cent disease incidence was recorded in T_1 (neem leaf extract @ 10 %,) followed by 26.85 in T_2 (Datura leaf extract @ 10 %). In case of T_3 (chilly leaf extract 10%) 27.33 per cent disease incidence was recorded. While in mix cropping (Urad+ Maize T_8) 29.75 % disease incidence was recorded. In case of T_9 (control plot) 33.33 per cent disease incidence was recorded after 1st spray of the bioagents and botanicals.

Effect of different treatments on leaf spot 2nd spray after 15 Days of first spray:

Minimum 24.25 per cent disease incidence was recorded in T_7 (*Trichoderma* spp. @ 10%) followed by 29.25 in T_6 (of *Bacillus subtilis*), 31.75 in T_5 (*Bacillus thuringiensis* @ 10%,). While in case of botanicals minimum 32.00 Per cent disease incidence was recorded in T_1 (neem leaf extract @ 10 %,) followed by 32.25 in T_2 (Datura leaf extract @ 10 %). In case of T_3 (chilly leaf extract 10%) 32.33 per cent disease incidence was recorded. While in mix cropping (Urad+ Maize T_8) 38.33 % disease incidence was recorded. In case of T_9 (control plot) 40.33 per cent disease incidence was recorded after 2nd spray of the bioagents and botanicals.

Effect of different treatment on crop yield

Maximum 14.75 q/ha was recorded in T_7 (*Trichoderma* spp. @ 10%) followed by 13.25 q/ha in T_6 (*Bacillus subtilis*), 12.33 q/ha in T_5 (*Bacillus thuringiensis* @ 10%,). While in case of botanicals

maximum 11.25 q/ha was recorded in T_1 (neem leaf extract @ 10 %,) followed by 10.75 q/ha in T_2 (Datura leaf extract @ 10 %). In case of T_3 (chilly leaf extract 10%) 10.00 q/ha was recorded. While in mix cropping (Urad+ Maize T_8) 9.75 q/ha was recorded. In case of T_9 (control plot) 9.00 q/ha was recorded.

The effectiveness of Neem extract in the field was investigated and reported on against *C. canescens* by Karthikeyan *et al*. (2007). Similarly, Neem extract proved successful in combating *C. canescens* of mung bean, according to Kausal *et al*. (2008). These experiments, conducted in vitro and in vivo against *C. canescens*, indicated that Neem extract was efficient in decreasing radial growth and disease incidence responsible for mung bean leaf spot. In the common of cases, bio-agents have been applied to soil or seeds to suppress soil-borne pathogens and lower disease incidence through hyper, antibiosis, and competition (Pandey *et al*., 2009, Yadav *et al*., 2005)

Naresh Kumar *et al.* (2022) investigated the effectiveness of plant extracts such as Neem leaf extract, Dhatura leaf extract, garlic clove extract, Arjun leaf extract, Aswagandha leaf extract, and Alovera leaf extract @10% against *Cercospora canescens*. Moreover, in-situ (field) tests using a randomized block design with six treatments and three replications were conducted. Neem leaf extract was found to be the most effective treatment, with the lowest disease intensity (25.69%), highest number of pods produced per plant, highest pod weight (g), and highest yield (q/ha), followed by extracts from Arjun leaf, Alovera leaf, Aswagandha leaf, Dhatura leaf, and garlic cloves. Cercospora leaf spot is one of the diseases that is known to contract. Cercospora leaf spot seriously impairs mung bean productivity.

Table 2: Effect of different treatments on leaf spot after 1st spray, 2nd spray and on crop yield

Treatments	Treatments details	Doses	PDI before spray	7 days After 1st spray	% control	7 days After 2nd spray	% control	Yield q/ha.	% Yield increased
T1	Foliar application of neem leaf extract	10 %	20.80	25.75	22.74	32.00	20.65	11.25	25.00
T2	Foliar application of Datura leaf extract	10 %	23.80	26.85	19.44	32.25	20.03	10.75	19.44
T3	Foliar application of chilly leaf extract	10 %	24.80	27.33	18.00	32.33	19.38	10.00	11.11
T4	Foliar application of tobacco extract	10 %	23.90	27.80	16.65	32.80	18.67	10.25	13.88
T5	Foliar application of *Bacillus thuringiensis*	10 %	25.10	23.33	30.00	31.75	21.27	12.33	37.00
T6	Foliar application of *Bacillus subtilis*	10 %	18.80	20.25	39.24	29.25	27.47	13.25	47.22
T7	Foliar application of *Trichoderma* spp.	10%	25.70	18.25	45.24	24.25	39.78	14.75	63.88
T8	Mix cropping (Urad+ Maize)		24.33	29.75	10.74	38.33	4.95	9.75	8.33
T0	Control	-	25.70	33.33	-	40.33	-	9.00	
CD@ 0.5% level				2.64		2.64		2.12	
Sem				0.92		1.13		0.36	

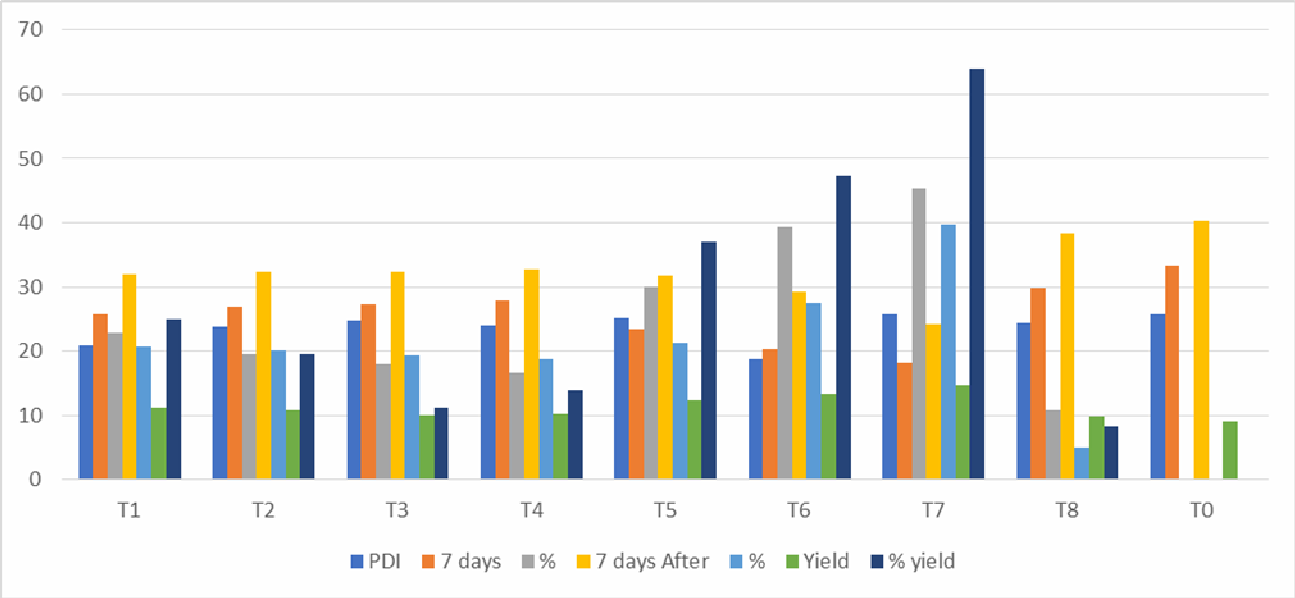

Fig.1: Effect of different treatments on leaf spot after 1st spray, 2nd spray and on crop yield

Conclusion

On the basis of present investigation, it may be concluded that the use these treatments as a foliar application, may be recommended for the management of *Cercospora canescens* and all the tested bioagents and botanicals are significantly increased the crop yield as compare to the untreated control.

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