



Efficacy of eco-friendly treatments on yield attributes in Indian mustard (*Brassica juncea* L.) against alternaria blight

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ARTICLE INFO	ABSTRACT
Received : 19 May 2022 Revised : 22 June 2022 Accepted : 31 July 2022 Available online: 15.01.2023 Key Words: Alternaria blight <i>Alternaria brassicae</i> bio-agents botanicals <i>Pseudomonas fluorescens</i> <i>Trichoderma viride</i>.	Indian Mustard that is emerged as the core oilseed crop is cultivated in the northern regions of India during <i>Rabi</i> season. Alternaria blight is one of the most destructive pathogens for Indian Mustard resulting in huge losses in quality and quantity of the produce. A research study was taken up to control the alternaria blight in Indian Mustard with selected eco-friendly treatments by monitoring disease intensity and yield attributes. It is noted that T₂ – <i>Trichoderma viride</i> has shown significant results on disease intensity and yield attributes, where disease intensity has significantly minimised in T₂ may be due to the mycoparasitic nature and ability to generate volatile and non-volatile compounds against pathogen with great anti-microbial activity. The results showed that maximum plant height (56.10 cm), test weight (4.11 g) and seed yield (1.21 t/ha) of Indian Mustard with minimum disease intensity (40.21 %) were recorded in the treatment T₂ and followed by T₆ – neem leaf extract @15% that has shown significant results on Alternaria blight.

Introduction

Indian Mustard that belongs to the Brassicaceae family is considered as the “Miracle for the Mankind” due to its wide gamut of benefits. It is also grown under wide agroclimatic conditions across the globe. Its oil is used as the main cooking medium in the northern regions of India which is irreplaceable by any other edible oil and the seeds are of high energy content, having 28-32% oil and relatively high protein content of 28-36% (Fahad, 2012). It also has a versatile use in the medical and tanning industry. Its oilcake is used as cattle feed. The sustainable cultivation of Rapeseed Indian Mustard is ravaged by several destructive fungal pathogens among which the diseases like downy mildew (*Peronospora parasitica*), Alternaria blight (*Alternaria brassicae*), white rust (*Albugo candida*) and powdery mildew (*Erysiphe polygoni*) are of major importance. Alternaria blight caused by *Alternaria brassicae* (Berk.) Sacc. and *Alternaria brassicicola* is one among the important diseases of

Indian Mustard with severe losses up to 70% in Rapeseed (*Brassica campestris*) (Kolte 2002); (Kolte *et al.*, 1987), which had reported from across the globe causing 10-70% yield losses in which 15 to 71% losses were reported from India (Kadian and Saharan, 1983; Ram and Chauhan, 1998) depending on the crop species, being high in *Brassica rapa* with 35-40% in Indian Mustard (Chattopadhyay, 2008). These fungal pathogens chase the crops in every stage of the crop growth ultimately resulting in huge losses in the quality of the produce. Several management strategies have merged in recent times which relied primarily on chemicals resulting in hazardous effects on mankind and the environment. Considering the above mentioned facts, a research study was planned to study the efficacy of selected eco-friendly treatments on Indian Mustard against Alternaria blight.

Material and Methods

The present study was conducted at Central Research Field of Naini Agricultural Institute, U.P. The study was conducted with selected treatments mentioned in (table 1) during *Rabi* season in 2021. The field was laid out in random block design with three replications (Fig 4). Infected plant parts with typical disease symptoms are fetched from standing field of Indian Mustard and brought to the laboratory for further studies. Identification of the pathogen based on characteristics was done through microscopic examination. Though, the damage due to *Alternaria brassicae* at initial stages may not be prominent but at later stages, the incidence of the disease becomes very high resulting in great losses. However, in severe cases, the plant may die Jay *et al.* (2019). Pre-post-harvest observations such as disease intensity (%), plant height (cm) at regular intervals, seed yield (t/ha) and test weight (1000 seeds) are recorded from randomly selected plants from each plot.

Table 1: Details of the selected eco-friendly treatments against *Alternaria brassicae*

Treatments	Mode of application
T ₁ Control	-
T ₂ <i>Trichoderma viride</i> @10g/kg	Seed treatment
T ₃ Nativo @0.05%	Foliar spray
T ₄ Garlic bulb extract @1%	Foliar spray
T ₅ <i>Pseudomonas fluorescens</i> @1%	Foliar spray
T ₆ Neem leaf extract @15%	Foliar spray

Preparation of botanical extracts

The fresh parts from healthy, disease plants were collected and carefully washed in clean water. Thus, obtained plant parts were grounded with the help of mortar and pestle by adding similar amount (100 ml) of sterile distilled water (1:1 w/v). This solution was boiled at 800°C for 10 minutes in hot water bath. Later, the grounded matter was filtered with the help of muslin cloth and followed by filtering with the help of Whatman No.1 filter paper. Thus, obtained plant extract was considered as 100%. Then the extract was diluted by adding required amounts of sterile distilled water as suggested by (Kavita and Dalbeer, 2013).

Morphology of pathogen

The mycelium of *Alternaria brassicae* is septate, brown to brownish-grey, and the conidiophores are

dark, septate and arise in fascicles, measuring about 14-74×4-8µm. Conidia are brownish-black, obclavate, borne singly in chains of 2-4, muriform with a long beak. Initially, symptoms were noticed as black spots with yellow hallow, later these enlarge and developed into prominent round spots with concentric rings giving a target board appearance (Fig 3). As the infestation increases, these spots coalesce to form large patches and cause blighting of leaves later defoliate Dharmendra *et al.* (2014). The beak of the pathogen is usually pale brown coloured, short, cylindrical and measures about 9-131µm in length and 3-8 microns in width (Fig 2).

Disease intensity (%)

Assessment of disease was done with the grading method following a grade chart of 0-9 (table 4). Disease intensity (%) is calculated by using the formula given by Wheeler (1969).

$$\text{Disease intensity} = \frac{\text{Sum of all disease rating}}{\text{Total number of rating} \times \text{Maximum disease grade}} \times 100$$

Its disease intensity (%) was recorded at 45, 60 and 75 days after the incidence of *Alternaria brassicae*.

Results and Discussion

Disease intensity (%)

The statistical analysis of the data exhibited (table 2 and figure 3) reveals that disease intensity was notably reduced in treatment T₂ – *Trichoderma viride* @10g/kg (40.21%) followed by T₆ – neem leaf extract @15% (42.58%), T₅ – *Pseudomonas fluorescens* @1% (44.83%) and T₄ – garlic bulb @1% (45.69%) as compared to treated check T₃ – Nativo @0.05% (38.61%) and untreated control T₁ – 48.50%. All the treatments were found to be significant over control but among the treatments, T₅ and T₄ are found to be non-significant to each other. The practice of bio-agents principally *Trichoderma* species has been stated as quite effective against a broad range of pathogens (Chattopadhyay *et al.*, 2002), predominantly as a seed treatment. Similar results with *Trichoderma viride* were reported by Yogita *et al.* (2017) as the most effective bio-agent in reducing the disease intensity. Hence, from the present study, the bio-agent *Trichoderma viride* has proved to be potential enough in restricting the pathogen growth and can

Table 2: Effect of treatments on disease intensity (%) and test weight (g)

Treatments	Disease intensity (%)			Test weight (1000 seeds) - g
	45 DAS	60 DAS	75 DAS	
T ₁ – Control	38.60	42.85	48.50	2.52
T ₂ – <i>Trichoderma viride</i> @10g/kg	31.83	36.76	40.21	4.11
T ₃ – Nativo @ 0.05%	29.30	34.52	38.61	4.33
T ₄ – Garlic bulb extract @1%	35.90	39.71	45.69	2.87
T ₅ – <i>Pseudomonas fluorescens</i> @1%	34.74	38.64	44.83	3.15
T ₆ – Neem leaf extract @15%	33.40	37.27	42.58	3.92
C.D @ (5%)	1.11	1.12	1.25	1.02
S.Em (±)	0.34	0.35	0.39	0.32

Table 3: Effect of treatments on plant height (cm) and seed yield (t/ha)

Treatments	Plant height (cm)			Seed yield (t/ha)
	45 DAS	60 DAS	75 DAS	
T ₁ – Control	38.26	43.75	51.05	0.62
T ₂ – <i>Trichoderma viride</i> @10g/kg	42.23	46.82	56.10	1.21
T ₃ – Nativo @0.05%	43.14	47.28	58.74	1.61
T ₄ – Garlic bulb extract @1%	38.82	44.10	52.45	0.92
T ₅ – <i>Pseudomonas fluorescens</i> @1%	39.22	44.91	53.95	1.09
T ₆ – Neem leaf extract @15%	40.44	46.12	55.24	1.11
C.D. @ (5%)	1.34	1.21	1.23	0.42
S.Em (±)	0.42	0.38	0.38	0.54

Table 4: Disease rating scale (Ram Singh Dhaliwal and Bahaderjeet Singh 2020)

Grade	Leaf area covered	Reaction
0	0	Immune
1	Small spots covering 1% or >1% leaf area	Highly resistant
3	Small spots (5mm) covering 1-10% leaf area	Resistant
5	Spots covering 11-25% of leaf area	Moderately resistant
7	Big patches covering 26-50% of leaf area	Moderately susceptible
9	Large spots covering <51% of leaf area	Highly susceptible

be used to manage the Alternaria leaf blight in mustard.

Plant height (cm):

The statistical data presented (table 3) reveal that maximum plant height (cm) observed in treatment T₂ – *Trichoderma viride* @10g/kg (56.10 cm) followed by T₆ – neem leaf extract @15% (55.24 cm), T₅ – *Pseudomonas fluorescens* @1% (53.95 cm) and T₄ – garlic bulb extract @1% (52.45 cm) as compared to treated check T₃ – Nativo @0.05% (58.74 cm) and untreated control T₁ – 51.05 cm. All

treatments were found to be significant over control and among the treatments, T₆ and T₂ are found non-significant to each other. The results obtained from the present study could be correlated with the studies made by Rini and Sulochana (2006) who evaluated the efficacy of bio-control agents against Alternaria blight when applied alone or in combination. The height of the plant increased greatly in *Trichoderma viride*, may be due to the inhibitory effect of bioagents related to the bio-control agent's hyper parasitism/mycoparasitism feature.

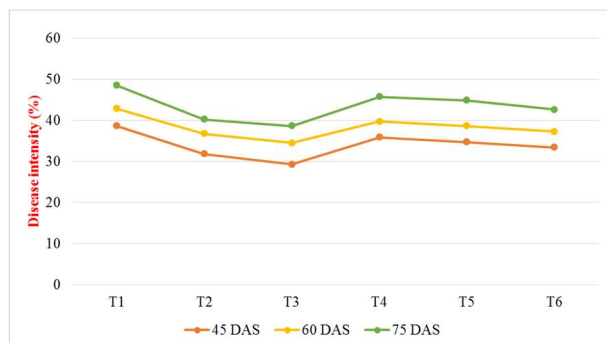


Figure 1: Effect of different treatments on disease intensity (%) of Indian Mustard



Figure 2: Pure culture and microscopic view of *Alternaria brassicae*



Figure 3: Symptoms caused by the pathogen



Figure 4: Experimental trial of Indian Mustard

Seed yield (t/ha):

The analysed data depicted in the table 3 discloses that seed yield considerably increased in treatment *Trichoderma viride* @10g/kg (1.21) followed by T₆ – neem leaf extract @15% (1.11), T₅ – *Pseudomonas fluorescens* @1% (1.09) and T₄ – garlic bulb extract @1% (0.92) as compared to treated check T₃ – Nativio @0.05% (1.61) and untreated control T₁ – 0.62. All treatments found to be merely equal to control but the treatments (T₁ and T₄), (T₄, T₅, T₆ and T₂), (T₅, T₆ and T₂), (T₆ and T₂) and (T₂ and T₃) are found non-significant among themselves.

Test weight (g):

The analysed data and presented in the (table 2) explain that test weight considerably increased in treatment T₂ – *Trichoderma viride* @10g/kg @ (4.11) followed by T₆ – neem leaf extract @15% (3.92), T₅ – *Pseudomonas fluorescens* @1% (3.15) and T₄ – garlic bulb extract @1% (2.87) as compared to treated check T₃ – Nativio @0.05% (4.33) and untreated control T₁ – 2.52. All the treatments were found to be significant over control and the treatments (T₁, T₂ and T₃), (T₄ and T₅), (T₅, T₆ and T₂), (T₆, T₂ and T₃) and (T₂ and T₃) were found not significant themselves.

Similar discoveries were also reported by Yogita *et al.* (2017) *Trichoderma viride* was proven as the most effective bio-agent recorded maximum yield (t/ha). *T. Viride* seems to possess an antagonistic effect on fungal plant pathogens due to its parasitic nature, competition for space, nutritional supply and antagonistic chemical produced. It has been involved in the production of antibiotics like Trichodermin, extracellular enzymes such as chitinase, cellulase and unsaturated monobasic acids like dermadine and peptides that can harm the plant pathogens Mamgain *et al.* (2013) and Rehman *et al.* (2013).

Conclusion

The results revealed that minimum disease intensity with maximum plant height (cm), test weight (g) and seed yield (t/ha) are observed in treatment T₂ – *Trichoderma viride* @10g/kg. In a view to cutdown the indiscriminate use of the chemical fungicides and their uncertainties on the environment and mankind, such an attempt was made to evaluate the efficacy of the bio-control agents and botanicals on

the *Alternaria* blight of rapeseed. Thus, it is evident from the present study that the application of bio-control agents and botanicals is more efficient in defeating pathogen growth and it is eco-friendly to utilise. These can provide a way better and effective management practice for the pathogen. However, further freedom is there for more research trials for better results in a broader view.

References

- Chattopadhyay, C. (2008). Management of diseases of Rapeseed-Mustard with special reference to Indian conditions. In: Sustainable Production of Oilseeds: Rapeseed Mustard technology. Agrotech Publication Academy, Udaipur, pp. 364-38.
- Chattopadhyay, C., Singh, F., Singh, B. & Gupta, Ajit. (2002). Yield losses in Indian mustard due to white rust and effect of some cultural practices on *Alternaria* blight and white rust severity, *Brassica*, 4, 18-24.
- Dharmendra, K., Neelam, M., Yashwant, K.B., Ajay, K., Kamallesh, K., Kalpana, S., Gireesh, C., Chandra, K.K., Sushil, K.S., Raj, K.M. & Adesh, K. (2014). *Alternaria* blight of oilseed brassicas: A comprehensive review, *African of Microbiology Research*, 8(30), 2816-2829.
- Fahad, M.AI-Jassas & Mohammed. S. AI-Jasser. (2012). Chemical composition and fatty acid content of some spices and herbs under Saudi Arabia conditions. *The Scientific World Journal*, Volume, Article ID 859892, 1-5.
- Jay, K.Y., Singh, H.K., Singh, S.K., Kavita. & Shubham, S. (2019). Efficacy of plant extracts against *Alternaria brassicae* under *in vitro* condition, *Journal of Pharmacognosy and Phytochemistry*, 8(1), 528-532.
- Kadian, A.K. & Saharan, G.S. (1983). Incidence of *Alternaria* blight of mustard, Cabbage and Cauliflower in the Aligarh district, *Chemical and Environmental Research*, 7, 111-116.
- Kavita & Dalbeer. (2013). Efficacy of different botanicals against *Alternaria brassicae* in *in-vitro* conditions, *International Journal of Science and Research*, 4(8), 791 - 793.
- Kolte, S.J. (2002). Diseases and their management in Oilseed crops, new paradigm in oilseeds and oils: research and development needs (Mangala Rai, Harvir Singh, D. M. Hegde ed.), *Indian Society of Oilseeds Research, Hyderabad*, 244-252.
- Kolte, S. J., Awasthi, R.P. & Vishwanath. (1987). Assessment of yield losses due to *Alternaria* blight in Rapeseed and Mustard, *Indian Phytopathology*, 40, 209-211.
- Mamgain, A., Roychowdhury, R. & Tah, J. (2013). *Alternaria* pathogenicity and its strategic controls, *Research journal of Tropical Agriculture*, 1, 01-09.
- Ram Singh Dhaliwal and Bhahderjeet Singh. (2020). Effect of weather parameters and date of sowing on intensity of *Alternaria* blight of rapeseed mustard, *Indian Phytopathology*, 73(2), 85-95.
- Ram, R. S. and Chauhan V.B. (1998). Assessment of yield loss due to *Alternaria* leaf spot in various cultivars of Mustard and Rapeseed, *Journal of Mycopathology Research*, 36(2), 109-111.
- Rehman, S.U., Lawrence, R., Kumar, E.J. & Zaffar, A.B. (2013). Comparative efficacy of *Trichoderma viride*, *T. harzianum* and carbendazim against *Alternaria* blight disease of cauliflower, *Journal of Bio-pesticides*, 4(1), 35-37.
- Rini, C.R. & Sulochana, K.K. (2006). Management of seedling rot of chilli (*Capsium annum* L.) using *Trichoderma Spp.* and fluorescent *Pseudomonads Pseudomonas fluorescens*, *Journal of Tropical Agriculture*, 44, 79-82.
- Wheeler, B.E.J. (1969). An Introduction to plant disease. John Wiley Sons Limited London, P. 301.
- Yogita, T., Sunil, Z. & Brijesh, S.C. (2017). Efficacy of bio-agents and plant extracts against *Alternaria* leaf blight of Mustard (*Brassica juncea* L.), *European Journal of Biotechnology and Bioscience*, 5(4), 29-35.

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