



Evaluation and validation of disease management module for Alternaria Blight in Mustard

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ABSTRACT

Leaf blight of mustard is one of the major constraints for its successful cultivation and may be attributed to cause substantially high yield losses. Integrated Disease Management (IDM) practices, found suitable against Alternaria blight, developed and evaluated elsewhere, are here by tested and validated as IDM module with slight modifications as per local requirements. This is basically to demonstrate the benefit of good available technology to farmers as on farm trials (OFT). The comparative efficacy of four different treatments were incredibly convincing for the farmers. It was realized that all three modules were significantly superior over prevailing farmers' practice. Overall, seed treatment with aqueous garlic bulb extract @ 5% (w/v) along with one spray of aqueous garlic bulb extract @5% (w/v) at 45 DAS followed by one foliar spray of Mancozeb-75% WP @ 2.5g/l at 75 DAS (T₄) found most effective in reducing disease incidence consecutively for three years and average reduction in disease severity of 71.90%. Besides, reduction in disease severity significant increase in yield and yield attributing characters could be observed using this treatment. The average yield increase of 37.30% could be recorded with maximum B:C of 2.56. In this way, treatment improved production and other yield parameters without imposing any drastic input burden to farmers, as evidenced by cost and benefit estimates. Therefore, it can be concluded that T₄ can be considered for improved sustainable package of practice for Alternaria blight management of Mustard.

Introduction

Oilseed constitutes the second largest agricultural commodity in India after cereals accounting for nearly 4 per cent of gross national product and 14 per cent of the gross cropped area (Rathur *et al.*, 2021). Despite the fact that India is one of the leading oilseeds producing countries in the world, we are unable to fulfill the edible oil requirements for our own country. Among the oilseeds, mustard is an important oilseed crop of India next to ground nut in terms of both area and production. India is one of the largest producers of rapeseed – mustard in the world and comprised of 17.3 per cent and 10.3 percent of total area and production,

respectively during 2017-18 (FAOSTAT, 2018). However, the average productivity remained 1511 kg/ha during 2018-19 which is far below the world average productivity of 1979 kg/ha. The total area of mustard cultivation in the country is 6.12 million hectares with production of around 9.26 million tonnes (Chauhan *et al.*, 2020). Madhya Pradesh, being a leading state of mustard production in India after Rajasthan, Gujarat and West Bengal, encompasses nearly 11.76% to the total mustard production in the country (Sharma *et al.*, 2019). In Madhya Pradesh, rape seed and mustard are grown in an area of 0.78 million hectare, with total

production of 0.75 million tonnes and the average productivity of 1305 kg/ ha (Directorate of Economics and Statistics, 2019). The actual yield potential of mustard is still not achieved by the farmers because of incidence of different diseases and pest. Among the different diseases, Alternaria blight of Mustard caused by caused by *Alternaria brassicae* (Berk) Sacc. and *A. brassicicola* (Schw.) have been accounted from all the continents of the world (Meena *et al.*, 2010). It is one of the chief diseases of Brassica and causes 10-70 yield losses depending upon the severity of disease in different parts of northern India (Kumar and Kolte, 2001).

To combat the losses due to Alternaria blight in standing crop, use of chemical fungicides is the only option among the growers. However, chemicals fail to control the disease at several occasions because of prevailing of several environmental factors like rain fall, temperature coinciding with stage of crop and amount of inoculum. Further, unscrupulous use of pesticides is imposing serious health risks and environmental hazards. In this way, the need of the hour is to envisage alternatives of chemical fungicides for eco-friendly management of Alternaria blight. In the recent era, biological control has provided prolific achievements in plant disease management in modern agriculture leading to low level of environmental vulnerability. Besides phytoextracts, different biocontrol agents have also been used to manage different plant diseases (Srivastava *et al.*, 2009; Kumar *et al.*, 2009). However, there is still inconsistency in their performance because of their living nature and exposure to different biotic and abiotic factors in soil and/or environment. Therefore, use of phytoextracts could be a better choice in integration of need based chemical use for plant disease management. Owing to high economic value of Mustard and extensive damage caused by Alternaria blight in Madhya Pradesh, the present study, was conducted to find out the suitable Integrated Disease Management (IDM) module comprising of botanicals in integration of judicious use of chemicals and other means mitigate the disease incidence in an economically viable and sustainable manner which would also reduce the quantum of toxicants used per season in addition to disease management.

Material and Methods

Field Experiment

A field experiment was conducted during Rabi season for three consecutive years 2016-17, 2017-18 and 2018-19 at 15 farmers' fields of Gopalpur, and Chorgahi villages of Sidhi District by Krishi Vigyan Kendra (KVK), Sidhi (MP) with an aim to find out the effective IDM treatments for the management of Alternaria blight of mustard under the On Farm Trial (OFT) programme of KVK. The trials were laid out in randomized block design having four treatments (Table 1) including control (farmers practice) maintaining five replications. The experimental field was laid down by applying recommended standard agronomical practices for mustard crop (Singh *et al.*, 2019). To exclude the effect of cultivar variability, highly susceptible mustard variety Varuna was chosen for all locations. A 25 m² plot was prepared with planting of mustard at 45 x 15 cm during last week of October every year. 100 g fresh bulbs of garlic were crushed in 100 ml of sterilized distilled water to prepare 1 per cent w/v aqueous extract. Prepared extract was then filtered through double layer muslin cloth. The filtrate, thus obtained was considered as 100% plant extract. The observations of Alternaria blight severity on leaves were recorded 40 days after sowing (DAS) and up to one week before harvesting at an interval of 15 days.

The percent infection was measured on the basis of number of leaves infected per ten plants and disease severity was recorded on leaves and siliqua at each 15 days interval following 0-5 scale (Sharma and Kolte, 1994).

Where,

0 = No visible symptoms of Alternaria blight;

1 = 1-10% leaf area blighted;

2 = 10-25% leaf area blighted;

3 = 26-50% leaf area blighted;

4 = 51-75% leaf area blighted and

5 = 76-100% leaf area blighted.

The disease severity was recorded on randomly selected plants in each treatment and replications and per cent disease index was calculated. Further, reduction in disease severity was also calculated over control plants according to following formula given by Nene, 1972.

Percent Disease Index = (Sum of all numerical ratings / Total no. of leaves observed x maximum rating) x100

Reduction in disease incidence (%) = $\{(Disease\ severity\ in\ untreated\ plots - Disease\ severity\ in\ treated\ plot) / Disease\ severity\ in\ untreated\ plots\} \times 100$

Economics of Integrated Alternaria Blight Management

Further, grain yield of each treatment was recorded from whole population separately in all the five replications. The yield was calculated by cumulating the successive plucking from respective field and computing to kilogram per hectare. The number of siliquae per plant, number of seeds per siliqua and weight of 1000 grains (test weight) were also recorded in all the treatments. The data were tabulated, pooled and ranked on the basis of their yield and yield component performance. The benefit cost ratio (B:C) of different modules was calculated by estimating different costs of cultivation and return from yield after converting them to one hectare land. The gross income from mustard of all treatments was calculated on the basis of minimum support price (MSP) of crop of respective year.

Table 1: Details of treatments for management of Alternaria blight in Mustard.

Treatment no.	Treatment details
T ₁	Control (Water spray)
T ₂	Seed treatment with aqueous garlic bulb extract @ 5% (w/v)
T ₃	T ₂ + Two foliar sprays of aqueous garlic bulb extract @5% (w/v) at 45 and 75 DAS
T ₄	Seed treatment with aqueous garlic bulb extract @ 5% (w/v) + One spray of aqueous garlic bulb extract @5% (w/v) at 45 DAS + One foliar spray of Mancozeb-75% WP @ 2.5g/l at 75 DAS

Results and Discussion

The impact of four different integrated disease management treatments on severity of Alternaria blight in mustard was recorded. Results presented in Table 2 clearly indicated that the Alternaria blight incidence was significantly reduced in all the treatments. The minimum disease severity of Alternaria blight was recorded in treatment T₄ consistently in during all the years and the minimum mean disease severity of 10.40% was recorded in T₄. In control, maximum mean disease severity of 36.60% was recorded and in this way seed treatment with aqueous garlic bulb extract @ 1% (w/v) along with its one spray at 45 DAS and one foliar spray of mancozeb-75% WP @ 2.5g/l at 75 DAS maximum reduced the Alternaria blight and maximum mean reduction in disease severity of 71.90% was recorded.

This was followed by treatment T₃, where seed treatment and two foliar sprays (45 and 75 DAS) of aqueous garlic bulb extract @ 1% (w/v) were imposed, mean disease severity and its reduction of 15.30% and 48.56 % respectively were recorded. However, seed treatment of aqueous garlic bulb extract @ 1% (w/v) resulted in minimum reduction in mean disease severity of 43.50%. The results, so obtained indicated that although individual treatments showed significant effect in disease management, but when integrated together in a suitable manner along with practicing spray schedule at an early stage of disease occurrence, provided augmented results in disease management. The performance of Garlic aqueous extract had been studied by earlier workers viz. Singh *et al.*, (2016), Mahapatra and Das (2013), Meena *et al.*, 2008 and Rajendra & Lalu, 2006 who also observed

Table 2: Effect of integrated management practices on Alternaria blight severity

Treatments	Disease severity (%)				Reduction in Disease severity (%)			
	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean
T ₁	37.00	37.08	35.83	36.60	0.00	0.00	0.00	0.00
T ₂	18.50	19.66	23.83	20.70	50.00	46.97	33.49	43.50
T ₃	14.00	13.41	18.43	15.30	62.16	63.83	48.56	58.20
T ₄	9.25	10.16	11.47	10.40	75.00	72.59	67.98	71.90
CD at 5%	2.56	2.14	2.46	2.39	-	-	-	-
CV	10.48	8.61	8.85	9.31	-	-	-	-

Table 3: Effect of integrated management practices on yield attributing characters in mustard

Treatments	No. of siliquae/ plant				Increase in no. of siliquae / plant (%)				No. of seed / siliqua				Increase in no. of seed/ siliqua (%)			
	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean
T ₁	74.16	73.66	74.66	74.16	0.00	0.00	0.00	0.00	13.75	13.10	13.25	13.37	0.00	0.00	0.00	0.00
T ₂	82.66	82.00	82.33	82.33	11.46	11.32	10.27 _{ss}	11.02	14.8	14.00	14.0	14.27	07.63	06.87	07.63	7.38
T ₃	90.33	88.66	89.33	89.44	21.80	20.36	19.64	20.6	14.85	14.10	14.20	14.38	08.00	07.63	08.00	7.88
T ₄	96.33	93.16	95.33	94.94	29.89	26.47	27.69	28.02	15.0	14.30	14.50	14.60	09.09	09.16	09.43	9.23
CD at 5%	7.30	8.94	6.65	7.63	-	-	-	-	1.68	1.59	1.58	1.62	-	-	-	-
CV	6.82	8.38	6.20	7.13	-	-	-	-	9.57	8.89	8.73	9.06	-	-	-	-

Table 4: Effect of integrated management practices on test weight and yield of mustard

Treatments	Test weight (g.)				Increase in Test weight (%)				Yield (qt./ ha)				Increase in Yield (%)			
	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean
T ₁	3.76	3.78	3.79	3.78	0.00	0.00	0.00	0.00	10.16	10.76	10.38	10.43	0.00	0.00	0.00	0.00
T ₂	3.85	3.88	3.90	3.88	02.66	2.64	02.90	2.73	12.50	12.81	12.58	12.63	23.08	19.05	21.19	21.10
T ₃	4.01	4.02	4.05	4.03	06.93	06.34	06.06	6.44	13.66	13.63	13.59	13.63	34.43	26.67	30.92	30.70
T ₄	4.05	4.11	4.10	4.09	07.71	08.73	8.17	8.20	14.51	14.16	14.26	14.31	42.81	31.59	37.37	37.30
CD at 5%	0.3	0.35	0.32	0.32	-	-	-	-	1.41	1.14	1.04	1.20	-	-	-	-
CV	6.19	7.08	6.49	6.59	-	-	-	-	8.98	7.14	6.26	7.46	-	-	-	-

Table 5: Economic of different IDM modules for management of Alternaria blight in Mustard

Treatments	Cost of cultivation (Rs./ha)				Gross return (Rs./ ha)				Net return (Rs./ ha)				B:C Ratio			
	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean	2016-17	2017-18	2018-19	Mean
T ₁	19452.5	20105	20226	19927.83	37592	43040	43596	41409.33	18139.5	22935	23370	21481.5	1.93	2.14	2.15	2.07
T ₂	20594	21219.5	21329	21047.5	46250	51240	52836	50108.67	25656	30020.5	31507	29061.17	2.24	2.41	2.47	2.37
T ₃	21008	21633.5	21740	21460.5	50542	54440	56952	53978	29534	32806.5	35212	32517.5	2.4	2.51	2.61	2.51
T ₄	21984.5	22001.5	2298.5	22061.5	53687	56640	59892	56739.67	31702.5	34638.5	37693.5	34678.17	2.44	2.57	2.69	2.56

disease management effects of Garlic bulb extract in mustard crop for *Alternaria* blight. The findings of present investigations are in tune to their results. Latif *et al.*, 2006 also reported the efficacy of garlic extract in controlling the seed-borne fungi from mustard. In another study by Meena *et al.*, 2011, the results pertaining to use of garlic extract along with mancozeb/ cow urine revealed the lowest leaf blight severity on leaf (33.1%) and pod (26.3%) of mustard when garlic extract was used along with mancozeb. However, when garlic extract was used along with cow urine respectively 34.4% and 27.3% disease severity was recorded on leaves and pods by Meena *et al.*, 2011.

Yield attributing factors like number of siliquae/plants, numbers of seeds/ siliqua were also recorded highest in treatment T₄ in all the three years and mean number of siliquae/plants of 94.94 could be recorded with an increase of 28.02% over control. The maximum average no. of seed/siliqua of 14.60 with an increase of 9.23% were recorded in treatment T₄. This was followed by treatment T₃ where increase in mean number of siliquae/plants and no. of seed/siliqua of respectively 20.6% and 7.88% could be recorded over control (table 3). Another observations regarding, test weight (weight of 1000 grains) also recorded maximum in treatment T₄ followed by treatment T₃ in all the three years. Overall, 8.20% and 6.44% increase in test weight could be recorded in treatment T₄ and T₃ respectively over control. With respect to yield enhancement, the maximum mean yield increase of 37.37% was recorded in T₄ over control. However, in T₂ and T₃ mean yield increase of respectively 21.19% and 30.92% was recorded (table 4). The similar findings have been reported by Meena *et al.*, (2011) who reported maximum grain yield (2052 kg/ha) of Mustard using two foliar sprays of mancozeb @ 0.25% at 45 and 75 days after sowing which was significantly at par with two spray of garlic bulb extract (2006 kg/ha). The findings of Mahapatra and Das (2016) are also in accordance with our recent observations where they stated that the treatment having seed soaking with salicylic acid (10⁻³ M) along with one spraying of Mancozeb (0.3%) at 45 days after sowing and spraying of garlic bulb extract (5%) at 75 DAS

gave maximum yield as well as maximum profit with minimum disease severity under gangetic alluvial zones of West Bengal. In a similar study by Kumar *et al.*, 2019 using garlic extract in combination with bio-control agent *Trichoderma*, effective management of *Alternaria* blight of mustard has been reported. They not only identified the disease management activity by garlic extract but also reported significant yield enhancement (more than 40%) over control. The results of present study are in agreement to their findings.

The economics was also calculated after the experimentation based on the expenditure incurred for different treatments under trial. The income data from the yield of mustard are presented in table 5. While comparing the economics of all the treatments, maximum net returns was obtained from treatment T₄ in all the three years with an average net return of Rs. 34678.17 per hectare which is significantly higher than the usual practice done by the farmers of the area (Rs. 21481.50 per hectare). This led to highest B:C ratio of 2.56 in treatment T₄ compared to 2.07 in control. Similar trends of cost benefit ratio in *Alternaria* blight management in mustard using garlic extract were found by Kumar *et al.*, 2019 who recorded it as 1:4.003 while using 1% w/v garlic bulb extract.

Conclusion

Therefore, looking to the disease control potential, grain yield gain, and maximum protection due to disease losses, net return and favorable benefit cost ratio as well as sustainability, the seed treatment with aqueous garlic bulb extract @ 5% (w/v) along with its one spray 45 DAS followed by one foliar spray of mancozeb-75% WP @ 2.5g/l at 75 DAS can be used and recommended for the management of *Alternaria* blight of mustard.

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Conflict of interest

The authors declare that they have no conflict of interest.

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