Investigation on the potential use of fungicides against *Alternaria*blight ofIndian mustard under *in vivo*

Abstract

The effectiveness of seven fungitoxicants, namely mancozeb (0.2%), azoxystrobin (0.05%),propiconazole (0.05%), difenconazole (0.05%), thiram, propineb and hexaconazole (0.05%), was evaluated as a single spray at 45 DAS and in combination with mancozeb at 45 DAS before spraying the other four fungicides separately at 60 DAS in field settings for two years in a row, during the rabi seasons of 2020–21 and 2021-22. The amount of efficacy varied across the treatments, but the spraying of several fungitoxicants alone as a single spray treatment or each fungicide in succession with mancozeb (0.2%) considerably reduced the Alternaria blight disease over control. Lower Alternaria blight severity and highest yield of 1676.17 kg/ha has generally been reported when two fungicide combinations, such as mancozeb at 45 DAS and the azoxystrobinfungicides at 60 DAS, are sprayed and highest and lowest siliqua infection was observed in propineb and mancozeb+difenoconazoletreatments respectively.

Keywords- disease severity, efficacy, fungicides and rapeseed-mustard

Comment [RbD1]: Some numerical data presented in the abstract could benefit from additional context or explanation to aid comprehension. Provide a brief interpretation or significance for key numerical results to enhance understanding.

Comment [RbD2]: The beginning of words should be written in capital letters.

Introduction

Oilseed crops are significant to India's agricultural economy. Seed Brassicas, also known rapeseed-mustard categorized as Brassicaceae. In terms of acreage and production, oilseed brassicas rank third globally after soybean and palm, and they are the second most significant oil seed crop in India, behind groundnut (Kumar and Chopra, 2014). Indian mustard is one of the most significant varieties of rapeseed mustard, accounting for around 85% of the entire amount produced in India (Kumar and Chauhan, 2005). The main states in India where mustard is grown are Punjab, Gujarat, UP, Haryana, Rajasthan, and Madhya Pradesh. It is also grown in a few non-traditional South Indian regions, such as Andrapradesh, Tamilnadu, and Karnataka. With 6.412 million hectares of land, India contributes 6.33 million tonnes of rapeseed and mustard to global production (Anonymous, 2017–18). Of all the oilseed crops

grown in Rajasthan, rapeseed-mustard holds a prominent place. Rajasthan leads the nation in terms of both rapeseed-mustard production and area. The districts of Alwar, Bharatpur, Jaipur, Dholpur, Sawaimadhopur, Sriganganagar, Jhunjhunu, and Sikar are where the mustard crop is primarily grown in Rajasthan. With a production of 3.588 million tonnes, it covers 2.379 million hectares (Anonymous, 2018–19). The disease known as Alternaria blight manifests itself as symptoms on the leaves and stems of mature plants and seedlings, as well as in ripening siliquae.

In both vegetable and oleiferous Brassicas, dark patches on the leaves and siliquae lower photosynthetic capacity and promote immature ripening, which results in less high-quality seed production (Kumar et al., 2014). In the Jhansi region of India, mustard leaf blight was a common occurrence, with disease intensities ranging from 23.9 to 62.0 percent, according to Chadar et al. (2016).

MATERIALS AND METHODS

Seven fungitoxicants*viz.*, mancozeb (0.2%), azoxystrobin(0.05%), propiconazole (0.05%),difenconazole (0.05%), thiram, propineb andhexaconazole (0.05%)was evaluated against the disease Alternaria blight was sprayed alone at 45 DAS and in conjunction with mancozeb at 45 DAS. The remaining eleven fungicides were sprayed separately at 60 DAS under field circumstances for two years in a row, during the rabi seasons of 2020 and 2021–22. In both seasons, the highly susceptible mustard variety "Varuna" was sown in the first week of November to guarantee that the leaf and blooming stage corresponded with the time when disease development was at its peak. The experiment was conducted under field settings in 5m×3 m plot utilizing randomized block design with three replications. As a check and control, plots were sprayed with ordinary water.

Treatments

T1: Single spray of mancozeb 75% WP (0.2%)

T2: Single spray of azoxystrobin 23% SC (0.05%)

T3: mancozeb 75% WP (0.2%) folowed by azoxystrobin 23% SC (0.05%)

T4: Single spray of propiconazole 25% EC (0.05%)

T5: Single spray of hexaconazole 5% EC (0.05%)

T6: Single spray of difenconazole 25% EC (0.05%)

T7: mancozeb 75% WP (0.2%) followed by propiconazole25% EC (0.05%)

T8: mancozeb 75% WP (0.2%) followed by difenconazole25% EC (0.05%)

T9: mancozeb 75% WP (0.2%) followed by hexaconazole 5%EC (0.05%)

T10: Propineb

T11: Thiram

T12: Water spray (control)

Observation on Alternaria leaf blight severity (%) wasrecorded at 90-100 days after sowing and Alternaria podblight severity (%) at 15 days before harvest. The diseaseseverity was calculated by using 0-6 disease rating scale(Conn *et al.*, 1990). The percent disease severity was calculated by usingfollowing formula:

$$\text{Per cent disease severity} = \frac{\text{Sum of all numerical ratings}}{\text{No. of leaves examined x maximum grade}} \text{ x } 100$$

Seed yield (kg/ha): The crop was harvested at maturity and threshed each treatment plot seperately and individual plot yield was recorded. The idividual plot yield was then converted to yield per hectre.

1000 seed wt (g): A lot of seeds was drawn at random from each treatment replication wise. 1000 seeds were counted from each sample, weighed separately and expressed in grams.

Oil content (%): Oil content(%) were determined by using the nuclear magnetic resonance (NMR).

Results and Discussion

The effectiveness of seven fungitoxicants, namely mancozeb (75% WP; 0.2%), azoxystrobin (23% SC; 0.05%), propiconazole (25% EC; 0.05%), difenconazole (25% EC); thuram, propineb, and hexaconazole (5% EC; 0.05%), against Alternaria blight disease was evaluated as a single spray at 45 DAS, in combination with mancozeb at 45 DAS, and then for two consecutive years during Rabi 2020–21 and 2021–22. The combined data, which is shown in Table 1, showed that the Alternaria blight disease was considerably reduced when various fungitoxicants were sprayed alone as a single spray treatment or when each fungicide was sprayed consecutively with mancozeb 75% WP (0.2%). Nevertheless, the degree of efficacy differed among the treatments.

When two fungicide combinations are sprayed, such as mancozeb at 45 DAS and the azoxystrobin fungicides at 60 DAS, the results are typically lower severity of Alternaria blight and highest yield of 1676.17 kg/ha. Propineb and mancozeb+difenoconazole treatments showed the lowest and highest levels of siliqua infection, respectively. Comparing all single spray treatments to combinations of two fungicides spray, such as mancozeb at 45

DAS and the other four fungicides at 60 DAS, has generally resulted in lower Alternaria blight severity. The best results were obtained when using foliar spray with mancozeb 75% WP (0.2%) at 45 DAS and hexaconazole 5% EC (0.05%) at 60 DAS to limit the severity of Alternaria leaf blight (ALB) up to 78.0 percent and Alternaria pod blight (APB) up to 56.5 percentand increased seed yield upto 29.9 percent as compared to untreated control. The second most promising treatment, however, was foliar spraying mancozeb at 75% WP (0.2%) and then diffenconazole at 25% EC (0.05%). This combination reduced ALB severity to 71.6 percent and increased APB severity to 51.5 percent, while also increasing seed yield by 29.4% relative to the control.
None of the single spray treatment of fungicides was found superior over the combination sprays treatment against Alternaria blight disease.

Hexaconazole spray was determined to be the most effective single spray therapy in reducing the severity of ALB (59.3%) and APB (32.7%) compared to the control, which had a higher seed production (20.3%). Plots sprayed with propiconazole (0.05%) at 45 DAS recorded the greatest 1000 seed weight of 4.0 g, while the lowest was in treatment of azoxystrobin 23% SC (0.05%), or 3.5 g. However, no significant differences were found between the treatments for oil content or 1000 seed weight. The plots treated with hexaconazole as a single spray or in conjunction with mancozeb had the highest percentage of oil content (39.6%) (Table 1). Singh et al. (2008) and Chattopadhyay et al. (2003) have evaluated the effectiveness of seven fungicides against Alternaria leaf blight disease under field conditions.

They discovered that the best method for managing Alternaria blight disease was to apply a foliar spray containing iprodione twice at 45 and 60 days after sowing. This was followed by mancozeb (Table 2). Singh and Singh (2007), however, discovered that Blitox-50 and Bavistin were more successful in lessening the severity of the disease than foliar spray containing mancozeb. The least successful treatment for lowering the severity of the illness was Cuman L. The severity of Alternaria blight disease was reduced from 57.3 to 41.4 percent with two foliar sprays of Ridomil MZ applied 60 and 80 days after sowing. The yield increased from 1052 kg/ha (control) to 1842 kg/ha (Yadav, 2003).

Conclusion

The investigation's findings, in summary, showed that the foliar spray containing mancozeb at 45 DAS and hexaconazole at 60 DAS was the most successful in reducing the severity of

Alternaria leaf and pod blight and boosted seed output compared to the untreated control. It might be evaluated as preventative sprays on farmer's fields in mustard, allowing a recommendation to be made about the pathogen's control.

Table 1- Evaluation of fungicides for management of Alternaria blight disease of mustard under field conditions *rabi*2020-21 and 2021-22

	DISEASE SEVERITY			SILIQUA INFECTION			NO.OF SPOTS		
	2020	**2021-22**	**Pooled**	**2020**	**2021-22**	**Pooled**	**2020**	**2021-22**	**Pooled**
T1	17.67	20.83	19.25	16.54	17.54	17.04	6.31	7.62	6.965
T2	22.62	27.85	25.235	26.01	28.31	27.16	6.75	7.65	7.2
T3	13.67	13.9	13.785	10.62	5.71	8.16	4.21	5.36	4.785
T4	20.59	24.02	22.305	17.69	19.64	18.66	9.56	10.41	9.985
T5	28.82	31.44	30.13	26.77	28.74	27.75	8.06	9.26	8.66
T6	14.77	18.37	16.57	11.29	12.79	12.04	5.76	6.88	6.32
T7	23.7	25.28	24.49	30.55	34.69	32.61	7.52	8.44	7.98
T8	33.67	34.04	33.855	67.46	63.83	65.64	11.26	12.31	11.785
T9	18.58	21.33	19.955	12.91	12.24	12.57	4.95	5.64	5.295
T10	35.35	38.49	36.92	70.84	68.85	69.84	9.1	10.68	9.89
T11	53.87	57.59	55.73	71.04	69.35	70.19	11.8	12.86	12.33
T12	20.59	22.32	21.455	14.07	16.1	15.08	4.24	6.86	5.55
Sowing	0.21	0.12	0.18	0.14	0.08	0.23	0.24	0.2	0.23
Variety	0.18	0.05	0.16	0.12	0.07	0.20	0.21	0.17	0.16
Sowing x variety	0.37	0.36	0.33	0.25	0.14	0.40	0.422	0.34	0.24

Table 2- Pooled data showcasing management of Alternaria blight of mustard by yield and number of pods

	Number of pods	Yield kg/ha

	2020	2021-22	Pooled	2020	2021-22	Pooled
T1	122.73	91.37	107.05	1653.33	1426.67	1540
T2	88.37	84.83	86.6	1545	1409	1477
T3	127.75	117.15	122.45	1717.67	1634.67	1676.17
T4	112.95	97.78	105.365	1736	1480.67	1608.335
T5	102.13	99	100.565	1565.33	1447	1506.165
T6	143.03	136.23	139.63	1901.67	1747.67	1824.67
T7	105.13	102.83	103.98	1411	1302	1356.5
T8	63.73	63.42	63.575	1253.33	949	1101.165
T9	116.77	112.69	114.73	1282.33	1373.67	1328
T10	93.89	91.82	92.855	955.33	802	878.665
T11	95.08	99.87	97.475	756.33	577	666.665
T12	122.85	112.17	117.51	927.33	886.33	906.83
Sowing	13.02	6.68	6.71	19.69	15.38	12.8
Variety	11.23	5.59	5.81	17.05	12.32	11.09
Sowing x variety	21.23	9.18	11.63	34.1	23.64	22.18

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Comment [RbD3]: References are old, it is better to use new references.

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