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Screening of mustard germplasms against *Alternaria* blight (*Alternaria brassicae* & *A. brassicicola*) in the Terai zone of West Bengal

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Abstract

Mustard [*Brasica juncea* (L.) Czern & Coss] belonging to the family Brassicaceae is the most important rabi oilseed crop suffering from different biotic and abiotic stresses. Among the biotic factors including *Alternaria* blight degrade seed quality as well as lowers its oil content. Use of resistant varieties is the best method owing to economic and environment friendly approach. Till now a few resistant varieties against the disease have been found. So, the present study was conducted during Rabi 2019-2020 and Rabi 2020-2021 at the Instructional farm of UBKV, Pundibari, Cooch Behar, West Bengal to screen the mustard germplasms against *Alternaria* leaf blight (*Alternaria brassicae* & *A. brassicicola*). The experiment was laid out in Randomised Block Design (RBD) using the 71 germplasms of mustard including check variety (B-9) collected from the Department of Genetics & Plant Breeding. All the germplasms were inoculated with local isolate of *Alternaria* obtained from the mustard field. Two years mean data of rabi 2019-20 & 2020-21 was pooled and the mean pooled data revealed that all the treatments were significantly superior over control check B-9 (PDI 67.82). Considering PDI, Pusa mustard-25(NPJ 112) showed lowest mean PDI (7.91) whereas Ganga showed highest PDI (54.69). Among the 71 germplasms 10 were found resistant, 32 found moderately resistant, 25 found susceptible and 4 found highly susceptible. The resistance germplasms will be used to develop superior cultivar (s) for managing *Alternaria* blight of mustard.

Keywords: Mustard, germplasms, *Alternaria* blight, PDI, resistance

Introduction

Mustard [*Brasica juncea* (L.) Czern & Coss] belonging to the family Brassicaceae (syn *Cruciferae*) is one of the major rabi oilseed crop in India (Verma *et al.*, 2025) [23]. It occupies first position in oilseed crops after groundnuts and contributes 33.24% of the total oilseed production (Anonymous, 2024) [5]. India is one of the leading countries with respect to production, consumption and import in vegetable oils. The crop accounted for 25 percent total area and 1/3 of total oil production. India ranked third after Canada and China in area and production (Shekhawat *et al.*, 2012; Saharan *et al.*, 2016) [18, 16]. In India area, production and productivity of mustard were 6.21 million hectares, 7.32 million tonnes and 1180kg/ha, respectively (Anonymous, 2014) [3] while those for the oilseeds in the country were 262.06 lakh hectares, 32.10 million tonnes, and 1225 kg/ha, respectively during 2016-17 (Anonymous, 2017-18) [4]. Rapeseed-mustard occupied an area of 9.18 million hectares with a production of 13.26 million tonnes and a mean productivity of 1444 kg/ha in the year 2023-24 (ICAR-DRMR, 2024). The estimated area, production and productivity of the crop in India during 2021-2022 were 9.168 million ha, 11.75 MT and 1178 kg/ha⁻¹, respectively (Ministry of Agriculture and Farmers Welfare, GoI (2022) [15]. The Area, production and productivity of mustard in India during 2021-22 was 9.168 million ha, 11.75 MT and 1178 kg/ha, respectively (Ministry of Agriculture and Farmers Welfare, GoI, 2022) [15]. The crop contributes nearly 30% of the total oilseed acreage and over 33% of the total oilseed production in the country. Rapeseed-Mustard crops in India are grown in diverse climatic conditions ranging from north-eastern/north-western hills to down south. The major mustard growing states in India are Uttar Pradesh, Punjab, Rajasthan, Madhya Pradesh, Bihar, Orissa, West Bengal and Assam.

Alternaria brassicae and *A. brassicola* causing Alternaria blight of mustard resulted yield losses (15%-71%) and reduction in oil content (14.6%-36%), respectively (Meena *et al.*, 2016) ^[13]. More than 30 diseases have been reported on *Brassica* in India among which Alternaria blight caused by *Alternaria brassicae* (Berk.) Sacc. is one of the most common and destructive diseases of mustard inflicting up to 30-40% yield loss. The estimated yield loss due to Alternaria blight in India ranged from 10-70% (Kumar, 1997) ^[11]. Yield losses due to this Alternaria blight under favourable environmental condition ranges from 10 to 70% (Singh *et al.*, 2020) ^[21, 22]. The yield losses were reported to the tune of 17-34% (Yadav and Gupta, 2011) ^[24]. The diseases are found regularly in moderate to severe form.

The susceptibility of crop plants including Indian mustard to various biotic, abiotic stresses, nutritional quality and low genetic diversity are the major limiting factors for its improvement (Srivastava *et al.*, 2023) ^[19].

Management of diseases of mustard depends largely on chemical fungicides. These chemical fungicides are effective against the diseases of mustard but their excessive use caused environmental pollution, new resistant strain development of pathogen, and human health hazard. The indiscriminate use of agrochemicals including chemical fertilizers and pesticides resulted environmental pollution (Hermosa *et al.*, 2012) ^[7]. The environmental hazard caused by the chemicals changed human attitude towards the utilization of chemicals including fertilizers and pesticides for farming (Meena *et al.*, 2015) ^[12].

Materials and Methods

The experiment was conducted during Rabi 2020-21 and Rabi-2021-22 at Instructional Farm of Uttar Banga Krishi Vishwavidyalaya (UBKV), Pundibari, Cooch Behar. The experiment was laid out in Randomised Block Design (RBD) using the seventy-one (71) germplasms (treatments) with three replication including control check (B-9) collected from the Department of Genetics & Plant Breeding, UBKV. Seeds of each genotype were sown in the plot of size measuring 2 m x 2m and maintained spacing of 30 cm. (row to row) X 15 cm. (plant to plant) following scientific package and practices.

Visual estimation of these two diseases on all the 71-germplasm including check (B-9) was performed using 10 randomly selected and tagged plants from each germplasm for occurrence of disease symptoms and recording disease severity data at 7-days interval during the vegetative as well as true leaf stage, i.e., 45 days after sowing (DAS) under natural field conditions. 0-9 disease rating scale for calculating severity of Alternaria blight was used as stated in Table 1. (0-9 scale of AICRP on Rapeseed & Mustard, 2011) ^[2].

Table 1: Disease rating scale for Alternaria blight and White rust in rapeseed mustard on leaf.

Rating Scale	Leaf area covered (%)	Disease Reaction
0	0	Immune (I)
1	<5%	Highly Resistant (HR)
3	5-10%	Resistant (R)
5	11-25%	Moderately Resistant (MR)
7	26-50%	Susceptible (S)
9	>50%	Highly Susceptible (HS)

The percent Disease Index (PDI) was calculated using the following formula.

Percent Disease Index (PDI) = Sum of total numerical rating/Total no. of observation X 100/Max. grade

Results and Discussions

During rabi 2019-20 and rabi 2020-21, screening of 71 germplasm of mustard including check (B-9) was carried out against Alternaria leaf blight. Two years mean data of PDI of Alternaria blight of mustard was pooled to get pooled mean data. The pooled mean data exhibited that out of the 72 germplasm, none of the germplasms found immune (I) or highly resistant (HR) (Table 2; Table 3). Same results were found with study conducted by Yadav *et al.* (2014) ^[24] exhibited no immune or highly resistant response among the all 31 germplasms against the disease.

In present study, out of seventy one (71), ten (10) germplasms including Pusa mustard-25(NPJ 112), RNWR-09-3, DRMR-4001, GIRIRAJ, DRMR-15-47, DRMR-15-14, Divya-88, SKJM-05, RAURD-214 and RGIN-73 exhibited resistant (R) reaction against the disease and thirty two (32) germplasms viz. RW-4C-6-3(Sanjukta Asech), KMR-15-4, RRN-871, RGN-385, NPJ-195, Maya-C, SVJ-64, Sitara-Sreenagar, RH-0923, DRMR-15-16, NPJ-198, RGN-389, RGN-384, NPJ-200, DRMR-15-9, KMR-L-15-6, PRD-2013-9, DRMRIJ-15-66, RH-1368, RH-1325, RGN-386, PRD-2013-2, RH-749, RH-406, BPR-540-6, DRMR-IJ-31, NRCHB-101, DRMR-150-35, Pusa mustard27(EJ 17), CS 54, PHR 2 and RL 1359 found moderately resistant (MR). It was also found that 25 germplasms including B-58 (Seeta), RW351(Bhagarathi), RW-85-59(Sarna), NPJ-194, TM-276, Rohini (SC), PR-2012-9, RL-JEB-52, Kranti-NC, DRMRIJ-15-85, NPJ-196, RMM-09-10, JMM-927-RC, KM-126, SKM-1313, RB-77, KMR-53-3, RL-JEB-84, RGN-73-JC, RH-1209, PR-2012-12, NPJ-197, RB-81, Pusa mustard26(NPJ 113) and KRANTI showed susceptible (S) reaction and remaining 4 germplasms viz. B-9, Ganga, RH-1202 and DRMR-15-5 found highly susceptible (HS) against the disease (Table 2; Table 3).

The result is in accordance with previous findings in mustard (Ali *et al.*, 2016) ^[1]. The symptom of the disease first found on the lower leaves during November December and reached at its peak towards the upper leaves. The reaction of different germplasms of mustard against the disease varied significantly. The severity of the disease is extremely influenced by the environmental factors. Out of the 71, ten (10) germplasms found resistant to the disease which agreed the findings of Chakrabarty *et al.* (2018) ^[6], Singh *et al.* (2018) ^[20], Singh *et al.* (2020) ^[21, 22] and Muhammad *et al.* (2022) ^[14]. Host resistance is most important aspect of integrated disease management. It was found that resistance of plant against the disease is mediated by several factors including leaf enzymes such as polyphenol oxidase, peroxidase, and catalase involved in phenolic pathway; high content of sugar in leaf, and presence of wax material on the leaf surface preventing germination of conidia and germ tube as wax act as hydrophobic coating against adhesion of water-borne inoculum (Meena *et al.* 2016) ^[13]. Therefore, it is very important to give emphasis on these parameters in order to get resistant genotype of mustard against Alternaria blight.

Table 2: Reaction of different mustard germplasms against *Alternaria* blight

Sr. No.	Germplasms	PDI			Reaction
		Rabi 2019-20	Rabi 2020-21	Pooled	
1	B-58 (Seeta)	27.98	26.58	27.28	S
2	RW351 (Bhagarathi)	29.1	27.64	28.37	S
3	RW-85-59 (Sarna)	26.33	25.01	25.67	S
4	RW-4C-6-3 (Sanjukta Asech)	24.95	23.7	24.32	MR
5	NPJ-194	29.04	27.59	28.32	S
6	TM-276	41.38	39.31	40.35	S
7	Rohini (SC)	26.98	25.63	26.31	S
8	KMR-15-4	12.35	11.73	12.04	MR
9	PR-2012-9	42.35	40.24	41.29	S
10	Divya-88	9.98	9.48	9.73	R
11	RL-JEB-52	27.89	26.49	27.19	S
12	Kranti-NC	31.17	29.61	30.39	S
13	DRMRIJ-15-85	31.88	30.28	31.08	S
14	RH-1202	54.31	51.6	52.96	HS
15	NPJ-196	35.62	33.84	34.73	S
16	RMM-09-10	27.28	25.92	26.6	S
17	JMM-927-RC	41.63	39.54	40.58	S
18	RRN-871	20.89	19.85	20.37	MR
19	KM-126	30.72	29.18	29.95	S
20	SKM-1313	28.11	26.7	27.4	S
21	RB-77	31.66	30.07	30.86	S
22	DRMR-15-5	54.17	51.47	52.82	HS
23	KMR-53-3	33.00	31.35	32.18	S
24	RL-JEB-84	28.12	26.71	27.41	S
25	Ganga	56.09	53.29	54.69	HS
26	RGN-73-JC	45.56	43.28	44.42	S
27	RH-1209	29.27	27.8	28.54	S
28	PR-2012-12	30.78	29.24	30.01	S
29	RGN-385	23.89	22.69	23.29	MR
30	NPJ-195	22.81	21.67	22.24	MR
31	Maya-C	23.72	22.54	23.13	MR
32	SKJM-05	9.99	9.49	9.74	R
33	SVJ-64	15.14	14.39	14.76	MR
34	Sitara-Sreenagar	24.05	22.85	23.45	MR
35	RH-0923	12.95	12.3	12.63	MR
36	DRMR-15-16	24.31	23.1	23.71	MR
37	NPJ-198	22.00	20.9	21.45	MR
38	DRMR-15-47	9.97	9.48	9.72	R
39	RGN-389	23.97	22.77	23.37	MR
40	RAURD-214	10	9.5	9.75	R
41	DRMR-15-14	9.98	9.49	9.73	R
42	DRMR-4001	9.44	8.97	9.21	R
43	RGN-384	14.12	13.41	13.77	MR
44	NPJ-197	30.94	29.39	30.17	S
45	RB-81	48.08	45.67	46.88	S
46	NPJ-200	24.34	23.12	23.73	MR
47	DRMR-15-9	22.76	21.62	22.19	MR
48	KMR-L-15-6	15.75	14.96	15.35	MR
49	PRD-2013-9	24.09	22.88	23.48	MR
50	DRMRIJ-15-66	23.95	22.75	23.35	MR
51	RH-1368	23.45	22.28	22.87	MR
52	RH-1325	23.99	22.79	23.39	MR
53	RGN-386	24.09	22.89	23.49	MR
54	RNWR-09-3	8.26	7.84	8.05	R
55	PRD-2013-2	24.01	22.81	23.41	MR
56	RH-749	23.7	22.52	23.11	MR
57	GIRIRAJ	9.87	9.37	9.62	R
58	RH-406	22.69	21.55	22.12	MR
59	BPR-540-6	21.33	20.27	20.8	MR
60	RGIN-73	9.99	9.49	9.74	R
61	DRMR-IJ-31	20.67	19.63	20.15	MR
62	NRCBH-101	23	21.85	22.42	MR
63	DRMR-150-35	23.98	22.78	23.38	MR
64	Pusa mustard-25 (NPJ 112)	8.11	7.71	7.91	R
65	Pusa mustard 26 (NPJ 113)	32.12	30.51	31.32	S
66	Pusa mustard 27 (EJ 17)	23.12	21.96	22.54	MR
67	CS 54	23.92	22.72	23.32	MR
68	PHR 2	24.08	22.88	23.48	MR
69	RL 1359	23.98	22.78	23.38	MR
70	KRANTI	30.95	29.4	30.17	S
71	B-9 (check)	69.56	66.08	67.82	HS
C.D.		0.695	0.660	0.677	
SE(m)		0.229	0.217	0.223	
C.V.		1.545	1.545	1.545	

S (Susceptible), HS (Highly susceptible), R (Resistant), HR (Highly Resistant), MR (Moderately Resistant)

Table 3: Categorizations of reactions of mustard germplasms against *Alternaria* leaf blight.

Severity (%) Category	Disease Reaction	Number of Genotypes	Name of Genotypes
0	Immune (I)	0	-
<5	Highly Resistant (HR)	0	-
5.0-10.0	Resistant(R)	10	Pusa mustard-25(NPJ 112), RNWR-09-3, DRMR-4001, GIRIRAJ, DRMR-15-47, DRMR-15-14, Divya-88, SKJM-05, RAURD-214, RGIN-73
10.1-25.0	Moderately Resistant (MR)	32	RW-4C-6-3 (Sanjukta Asech), KMR-15-4, RRN-871, RGN-385, NPJ-195, Maya-C, SVJ-64, Sitara-Sreenagar, RH-0923, DRMR-15-16, NPJ-198, RGN-389, RGN-384, NPJ-200, DRMR-15-9, KMR-L-15-6, PRD-2013-9, DRMRIJ-15-66, RH-1368, RH-1325, RGN-386, PRD-2013-2, RH-749, RH-406, BPR-540-6, DRMR-IJ-31, NRCHB-101, DRMR-150-35, Pusa mustard27(EJ 17), CS 54, PHR 2, RL 1359
25.1-50.0	Susceptible(S)	25	B-58 (Seeta), RW351 (Bhagarathi), RW-85-59 (Sarna), NPJ-194, TM-276, Rohini (SC) PR-2012-9, RL-JEB-52, Kranti-NC, DRMRIJ-15-85, NPJ-196, RMM-09-10, JMM-927-RC, KM-126, SKM-1313, RB-77, KMR-53-3, RL-JEB-84, RGN-73-JC, RH-1209, PR-2012-12, NPJ-197, RB-81, Pusa mustard 26 (NPJ 113), KRANTI
>50.1	Highly Susceptible (HS)	4	B-9 (check), Ganga, RH-1202, DRMR-15-5

Conclusion

All the germplasms showed varying degree of resistance or susceptibility against *Alternaria* leaf blight. It was found that all the treatments were significantly superior over check B-9 (PDI 67.82). Considering PDI, Pusa mustard-25 (NPJ 112) showed lowest mean PDI (7.91) whereas Ganga showed highest PDI (54.69). Management through resistance is considered as the best strategy. Due to the unavailability of resistance sources, control of *Alternaria* blight disease becomes difficult and requires frequent fungicidal spray. The regular appearance of this disease with no apparent resistance among the related varieties of Indian mustard warrants immediate attention for the control of the disease.

It has been found that germplasms of mustard possessed resistant to moderately resistant reaction in field screening against both *Alternaria* blight. This is possible that the identified resistant genotypes of mustard could be used in further breeding programme in order to develop resistant cultivar for commercially cultivating in the farmer's field. Hence, it is necessary to have donor parents with high degree of resistance against *Alternaria* blight and white rust.

Future Scope

To achieve the goal, it is necessary to conduct controlled laboratory tests on large number of mustard genotypes for the disease. It is also necessary to confirm resistance in glasshouse under controlled artificial inoculation and employ disease resistant gene-linked molecular markers followed by testing under field conditions because often disease escaped and plant exhibited resistant reactions. In order to suppress resistance in the disease resistance host, pathogen require more virulent genes. Therefore, more resistance gene of the host will prevent the evolution of new races of the pathogen.

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