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Screening of Mustard Cultivars/ genotypes against systemic infection caused by *Albugo candida*(Pers. Ex. Lev.) Kuntz

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Abstract

Indian mustard is an important oil seed crop of India. Many factors are attributed to its low productivity. Among them White rust/white blister of mustard is most important. In the present study 47 genotypes were screened against white rust under natural conditions during the Rabi season 2020-21. The categorization of mustard cultivars have been carried out on the basis of percent stag head formation using a 0-9 scale. Out of 47 genotypes two (PM26 &ChhutkiSarsho) were found resistant, 12 (NRCHB101, JM3, Kalawati, Local2, DRMR1665, Farm Sona, Pusa Vijay, Karuna, Super Kala Sona, Super Maha Gold G9, Maya & RH406) were moderately resistant, 18 (Rohini, Mahiko, RGN73, Rohini, PM28, Gold Star, Local1, PM30, US126, Pusa Mahak, Pusa Tarak, Mustard2541, RVM3, Kaalia, PM0031, Radhika, Vasundhara & Basanti) were susceptible and 15 (Varuna, Divya203, NRCDR02, Kala sona, PM11, Pusa26, PBR210, YBH402, DRMRIJ31, DRMR150-35, Ganga, RH0119, Sej02, MS2, Pitambari) were found highly susceptible. None of the genotypes were found to be Immune or highly resistant.

Key Words: Indian mustard, genotypes, White rust, Stag head, Resistance

Introduction

Mustard (*Brassica juncea*L. Czern. &Coss.) is one of the importantRabi seasonoilseed crops of India which occupies a prominentplace, being next in importance to groundnut, both in area and production, containing 30 to 48 per cent oil. It fulfills the oil requirement of about 50 per cent population in the states of Madhya Pradesh, Rajasthan, Uttar Pradesh, Punjab, Bihar, Orissa, West Bengal and Assam. It is being grown around the globe for its oil, condiment along with for leafy vegetable in some parts of the world (Shyam *et. al*., 2020; Shyam *et. al*., 2021a.It is the most important oilseed crop of India having significant economic, nutritional, and industrial applications (Tripathi *et.al*., 2015; Thakur et al., 2020). It is the most significant and widely cultivated species of rapeseed mustard crops in India, accounting for 90% of the crop's area (9.168 million ha) and production (11.75 MT), with a productivity of 1178 kgha^{-1} in 2020–2021. The vulnerability of crop plants including Indian mustard to various biotic (Verma *et. al.,* 2021; abiotic stresses, nutritional quality (Shyam *et. al*., 2021b; Shyam *et. al.,* 2021c. White rust caused by *Albugo candida* (Pers. Ex. Lev.) Kuntz is an important disease of rapeseed,
(*Brassica campestris* L.) and mustard (*B. juncea*Coss.) in India. The pathogen produces two types of infections i.e. local and systemic. Local infection is characterized by the formation of raised creamy white sporangial pustules on the undersurface of leaves, on tender shoots and occasionally on green siliquae. The affected tissue turns necrotic and dies. Systemic infection is

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usually seen on young raceme and terminal leaves. The pathogen stimulates hypertrophy and hyperplasia resulting in abnormal swelling and malformation of the affected organ. Floral organs turn green, become greatly enlarged, distorted and seed formation is prevented.*Albugo candida* (*A. cruciferum*), the cause of white rust of mustard, occurs in all parts of the world where cruciferous crops are grown. A very little information on reactions of mustard cultivars to stag head formation is available in India. Therefore, present investigation was undertaken.

Materials and Methods

The Present investigation was undertaken on a total of 47 Indian mustard cultivars / genotypes (acquired from the Zonal Agricultural Research Station, Morena, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya (RVSKVV), Gwalior, M.P., India (AICRP on Rapeseed and Mustard). All the genotypes were grown in randomized block design with three replications in Rabi 2023 at the Agricultural Research farm, AKS University, Satna,(M. P.). Each cultivar / genotype was planted in a plot of one row of 2-meter length with an arrangement of 30 cm apart between rows and 15 cm plant to plant. The observation on incidence of white rust/ stag formation was monitored and documented. Observations on the occurrence of stag head for analyzing the percent disease index (PDI) were taken by counting all the 13 plants in each line of each block at 7-day intervals during the vegetative, true leaf stage and flowering stage i.e., 40 days after sowing (DAS) under natural field conditions. The disease incidence was recorded following a 0–9 scale as following Table 1.

Table 1: Disease rating scale for Stag head in mustard.

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

The Percent disease incidence of stag head formation was calculated by following formula:

$$\% \text{ Disease incidence} = \frac{\text{Total number of stag heads}}{\text{Total Number of Plants Observed}} \text{X100}$$

Results and Discussion

Staghead incidence

Incidence of Stag headswas recorded at one week before maturity of Indian mustard. The data revealed that all the genotypes were found to be infected from staghead incidence under field conditionsduring 2020-21. Out of the 47 Varieties/cultivars/genotypes screened,15 genotypes (Kala Sona, Pm211, Pusa 26, PBR210,YBH402, DRMRIJ31, DRMR150-35, Ganga, RH0119, Sej02, MS2 and Pitambari) were found highly susceptible with 100% staghead incidence

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followed by NRCDR2(62.5%), Divya (58.33%),Varuna(54.16%), 18 genotypes (Rohini, Mahiko, RGN73, Rohini, PM28, Gold Star, Local1, PM30, US126, Pusa Mahak, Pusa Tarak, Mustard2541, RVM3, Kaalia, PM0031, Radhika, Vasundhara & Basanti) were found to be susceptible and 12 genotypes (NRCHB101, JM3, Kalawati, Local2, DRMR1665 , Farm Sona, Pusa Vijay, Karuna, Super Kala Sona, Super Maha Gold G9, Maya & RH406) were found to be moderately resistant. Only two genotypes (PM26 &ChhutkiSarsho) were found to be resistant with 8.33% incidence. None of the cultivars /genotypes were found to be either Immune or highly resistant.

The severity and spread of *A. candida* is influenced by several variables; including the virulence of a race, quantity of inoculum, the timing of disease onset and local climate. The first Type is a localized infection of the white rust disease on leaves, while the second type is a systemic infection on inflorescence causing hypertrophiedinflorescence. A systemic infection causes inflorescence growth, distortion and floral sterility which are frequently referred to as a "stag head" shape created by hypertrophy and hyperplasia. In the present investigation among all the genotypes screened against white rust (stag head) only two genotypes showed resistant reaction against the disease. The results are in accordance with Lakra and Saharan (1989); Gairola and Tewari (2017). However, Yadav and Singh (1999) screened 74 Indian mustard (*B. juncea*) germplasm lines for a resistance against white rust disease and none of the genotype was found to be resistant. Awasthi *et al.* (2012) reported that almost all the important varieties of *B. juncea*being grown in India were susceptible to white rustScreened 75 genotypes and reported only three resistant and 26 were moderately resistant, rest of them were susceptible or highly susceptible. The broad variety in how different genotypes react to pathogens in terms of susceptibility to disease may be caused by the varied expression of resistance gene(s) and genetic background of genotypes that influences genotypepathogen interaction (Singh *et al*., 2021). The dynamics of host-pathogen interaction are greatly influenced by both macro and micro environment, which in turn has an impact on the severity of the disease .

Table 2: Genotypic response against white rust in a set of Indian mustard genotypes

S. No.	Genotypes	Stag head %		S.No.	Genotypes	Stag head %	
		PDI	Reaction			PDI	Reaction
1	PM26	8.33	R	26	RH0119	100	HS
2	PM30	45.83	S	27	Sej02	100	HS
3	US126	45.83	S	28	MS2	100	HS
4	Kala Sona	100	HS	29	RVM3	37.50	S
5	PM211	100	HS	30	PM0031	37.50	S
6	Mahiko	37.50	S	31	Pusa Vijay	16.67	MR
7	Pusa26	100	HS	32	Kaalia	33.33	S
8	Mutard2541	50	S	33	Radhika	37.50	S
9	PBR210	100	HS	34	Vasundhara	37.50	S
10	NRCHB101	25	MR	35	Basanti	45.83	S
11	Gold Star	28.83	S	36	Pitambari	100	HS
12	YBH402	100	HS	37	Divya203	58.33	S
13	Local01	29.17	S	38	Kalawati	25	MR

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14	DRMRIJ31	100	HS	39	Karuna	16.67	MR
15	DRMR150-35	100	HS	40	Varuna	54.16	HS
16	NRCDR2	62.50	HS	41	RGN73	29.16	S
17	ChhutkiSarsho	08.33	R	42	Super Kala Sona	16.67	MR
18	JM3	25.00	MR	43	Local2	25.00	MR
19	Pusa Mahak	45.83	S	44	Farm Sona	20.83	MR
20	Pusa Tarak	45.83	S	45	Super Maha Gold G9	16.67	MR
21	Krishna Gold	100	HS	46	DRMR1665	25.00	MR
22	Rohini	37.50	S	47	RH406	12.50	MR
23	PM28	37.50	S				
24	Maya	12.50	MR				
25	Ganga	100	HS				

Table 3: Categorization of Mustard genotypes on the basis of reaction against White rust stag head formation

Category of Severity (%)	Disease Reaction	No. of Genotypes	Genotypes
0	Immune (I)	NIL	NIL
<5	Highly Resistant (HR)	NIL	NIL
5.1-10	Resistant (R)	02	PM26, ChhutkiSarsho
10.1-25	Moderately Resistant(MR)	12	NRCHB101, JM3, Kalawati, Local2, DRMR1665, Farm Sona, Pusa Vijay, Karuna, Super Kala Sona, Super Maha Gold G9, Maya, RH406
25.1-50	Susceptible (S)	18	Rohini,Mahiko, RGN73,Rohini, PM28,Gold Star, Local1, PM30, US126, Pusa Mahak, Pusa Tarak, Mustard2541, RVM3, Kaalia, PM0031, Radhika, Vasundhara, Basanti,
>50	Highly Susceptible (HS)	15	Varuna, Divya203,NRCDR02, Kala sona, PM11, Pusa26, PBR210, YBH402, DRMRIJ31, DRMR150-35, Ganga, RH0119, Sej02, MS2, Pitambari,

Conclusion

It has been determined that thecultivar /genotypes/ germplasm lines of Indian mustard exhibited resistant to moderately resistant responses in field screening trial against systemic infection of white rust-stag disease. None of the genotypes were found immune to disease. Stag head infection was highly influenced by time of sowing and climatic conditions. Late sown genotypes when combined with conducive climatic conditions were more prone to stag head formation. Genotypes showed resistant reaction under such conducive conditions can be use in future breeding programs to develop resistant commercial cultivars, it is crucial to identify a variety of resistance genes in any crop species.

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Fig. 1. White rust/white blister symptoms on the mustard leaves: White cottony pustules on the lower surface left), Chlorotic spots on the upper leaves right)

Fig. 2. Systemic symptoms: stag head (white arrows) on the inflorescenceleft), inflorescence of whole plant converted in stag head right)

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Conflict of Interest: Authors have declared that no competing interests exist.

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