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Screening of different *Brassica* germplasm against White Rust Resistance

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ABSTRACT: There is various diseases reported in rapeseed-mustard but white rust is one of the most important disease which is caused by *Albugo candida*. In India white rust causes a yield loss of 17-34 per cent. The present investigation was undertaken to study the different *Brassica* genotypes for white rust resistance in a group of 37 varieties/genotypes of *Brassica juncea, Brassica napus, Brassica rapa* (Toria). To exploit disease resistance genotypes for hybridization programme postulated on the basis of Disease severity score may be successful in the genotypes found from both irrigated and rainfed environment conditions. The lines shows Resistant to Moderately Resistant from both environment in experiment can be used as white rust resistant source for further breeding programme. On the basis of Disease severity score in case of *B. juncea* JD-6, *B. napus* CNH-11-2, GSH-1699, GSC-101, and in case of *B. rapa* (Toria) Tapeshwari were found more Resistant from both irrigated and rainfed environment conditions.

Keywords: Indian mustard, Rainfed, White rust &Yield.

INTRODUCTION

In India, rapeseed-mustard is the second most important oilseed crop after groundnut and shares about 28.6% of the Indian oilseed economy. *Brassica juncea* contributes more than 80% to the total rapeseed-mustard production in the country and is an important component in the oilseed sector (Vinu *et al*., 2013). Rapeseed and mustard are the major rabi oil seed crops of India. India produced 10.1 million tons of rapeseed and mustard in year 2020-21. The area under rapeseed and mustard in India is 6.7 million hectares, with a productivity of 1511 kg/ha during 2020-21. In the state of Jammu & Kashmir the area under rapeseed - mustard is 51870 ha with production of 59600 MT and 1149 kg per productivity during 2018-19. There is various diseases reported in rapeseed-mustard but white rust is one of the most important disease which is caused by *Albugo candida*. In India white rust causes a yield loss of 17-34 per cent (Yadava *et al.*, 2014). The disease is characterized by both local and systemic symptom expression. Local infection appears as white or creamy yellow pustules or "blisters" on leaves and stem. Systemic infection results in abnormal growth and distortion of inflorescence and sterility of flowers, commonly called stag head formed as a result of hypertrophy and hyperplasia. The epidemic development of white rust caused by *A. candida* is dependent upon many factors, viz. aggressiveness of race, amount of available initial inoculum, time of first appearance of the disease and prevailing weather conditions. *A. candida* isolates from different *Brassica* species/cultivar or from different geographical regions may be different in their incubation period, latent period and production of sporangia and zoospores, pustule size, shape and texture and aggressiveness (Gupta and Saharan, 2002; Patni *et al.*, 2005; Mishra *et al.*, 2009). Pathogen (*Albugo candida*) produces white or creamy pustules on both cotyledons, true leaves and pods which reduces the photosynthetic capacity of plants and affects yield and normal plant development. Disease on the foliage affects and downgrades the leaves for sale and its human consumption as a vegetable. Disease levels on leaves through inoculum density affect the disease severity on cotyledon, leaves and siliqua. A lesion on foliage causes extensive distortion, hypertrophy, hyperplasia and sterility of inflorescences generally called "systemic infection". The systemic infection phase increases fruit shattering and hence reduces yield of mustard. Disease assessment keys based on the host area affected have been prepared for many diseases. Charts for rating the different growth stages of rapeseed mustard are available.

MATERIAL AND METHODS

Thirty seven diverse strain/varieties of *B. juncea*, *B. napus*, and *B. rapa* (Toria) were grown during *rabi* season of 2019-2020 in a randomized block design with 3 replications. The field experiment was done in two locations (irrigated and rainfed) *i.e*. Division of Plant Breeding and Genetics, SKUAST-J, F.O.A. Chatha, Jammu and Advanced centre for rainfed agriculture (ACRA), Dhiansar, Jammu for diseases severity of three species of *Brassica* was recorded in natural environment from both locations.

White rust disease severity at leaf stages. Average disease severity on true leaves due to white rust was taken at 75 and 90 days for leaf and staghead but in case of toria it was taken at 35 and 55 days after sowing for leaf and staghead by using 0-9 disease rating scale as follows:

The leaves of five plants were randomly collected from each treatment and rated as per the above rating scale and disease severity was calculated separately from each treatment. The formula given by Wheeler (1969) was used to calculate the (%) diseases severity as follows:

$$\text{Diseases severity (\%)} = \frac{\text{Sum of all numerical ratings}}{\text{No. of leaves examined} \times \text{Maximum grade of scale}} \times 100$$

White rust diseases severity at staghead stage: Total racemes of five staghead affected plants and number of racemes showing staghead symptoms per plant were counted and staghead severity was calculated as per formula given by Wheeler (1969):

$$\text{Staghead severity (\%)} = \frac{\text{Number of racemes showing staghead/plant}}{\text{Total number of racemes/plant}} \times 100$$

Scale (0-9) for rating of entries for reaction of white rust:

Rating score	Leaf area covered by the pustules (%)	Reaction
0	No pustules	Immune
1	Less than 5% area covered by pustule	Highly resistant
3	5-10% leaf area covered by pustule	Resistant
5	11-25% leaf area covered by pustule	Moderately resistant
7	26-50% leaf area covered by pustule	Moderately susceptible
9	More than 50% leaf area covered by pustule	Susceptible

RESULTS AND DISCUSSION

White rust symptoms for *Brassica* species at leaf and staghead stage were given in Fig. 1, and 2 respectively. To screen *Brassica* plants right from seedling stage to maturity against white rust disease caused by pathogen *Albugo candida*, the actual photograph based on 0-9 rating scale was conceptualized. The rating scale was developed from original field photographs with all above ground parts of infected plant *viz.* staghead (Fig. 2) and leaves. Disease assessment key was illustrated with the following percent of severity: 0(No pustules), 1(Less than 5% leaf area covered by pustules), 3(5-10% leaf area covered by pustules), 5(11-25% leaf area covered by pustules), 7 (26-50% leaf area covered by pustules) and 9 (26-50% leaf area covered by pustules). The similar findings was reported by Bisht *et al.*, (2016) conducted study of seventy germplasms of *B. carinata*, *B. napus*, *B. juncea*, and *B. rapa*the germplasms were screened out against white rust disease.

Fig. 1. Leaves of *Brassica* species infected by pustules of white rust disease caused by *A. candida*

Fig. 2. Staghead of *Brassica* species infected by pustules of white rust disease caused by *A. candida*.

White rust disease severity under irrigated and rainfed condition (E^1 and E^2): Under irrigated condition, the percent of disease severity of white rust on leaves of different genotypes of *Brassica juncea*, *Brassica napus* and *Brassica rapa* (Toria) was recorded at two stages of plant growth *i.e.* 75 DAS and 90 DAS but in case of toria it was recorded at 35 DAS and 55 DAS. In case of mustard, at 75 DAS, the maximum white rust severity for leaves was recorded in genotypes of RH-0923 (54.4%) and Kranti (56%) and minimum severity (leaf) was found in Giriraj (31.5%). At 90 DAS maximum white rust severity for staghead was recorded in NRCDR-2 (24.42%) and Giriraj (15.24%) while as zero severity score for staghead was found in RSPR-01, RSPR-69, SKJM-5, JD-6, RH-1209, RB-50 and Kranti. Under rainfed condition, in case of mustard, at 75 DAS, the maximum disease severity for leaves was recorded in genotypes of JM-12-6 (41.47%) while as minimum severity for leaves was found in RSPR-01 (22.72%). At 90 DAS, the maximum disease severity for staghead was observed in genotypes of NRCDR-2 (19.22%) while as zero severity score for staghead was found in RSPR-01, RSPR-03, RSPR-69, SKJM-5, JD-6, RH-1209, RB-50 and Kranti.

In case of gobhi sarson, after 75 days of sowing the maximum white rust severity for leaves was observed in genotypes of RSPN-28 (15.63%) and AKGS-1 (15.61%) while as minimum disease severity for leaves was found in GSH-1699 (4.82%). On the other hand, after 90 days of sowing, the maximum diseases severity for staghead was found in RSPN-25 (3.31%) while as zero disease severity score for staghead was found in RSPN-29, CNH-11-2, AKGS-1, JGS-12-3, GSH-1699, GSC-101, GSC-21, EC552608 and HNS-1102. Under rainfed condition, the maximum diseases severity for leaves was recorded in the genotypes of RSPN-28 (11.64%) while as zero severity for leaves was found in GSH-1699 (2.03%) these observations were recorded after 75 DAS and at 90 DAS the maximum diseases severity for staghead was observed in HNS-1102 (2.60%) while as zero severity score for staghead was found in RSPN-25, DGS-1, RSPN-28, CNH-11-2, GSH-1699, GSC-101, GSC-6, GSC-21 and EC552608.

In the case of toria, the maximum disease severity after 35 DAS for leaves was recorded in the genotypes of PTC-2010-2 (38.10%) while as minimum disease severity for leaves was found in Tapeshwari (11.43%). The second recording of disease severity for staghead was done after 55DAS from which the maximum disease severity was observed in the genotype of PTC-2010-2 (12.10%) while as zero severity score for staghead was found in PT-2012-2, RSPT-6, KBS-3, RMT-10-9, Tapeshwari, RSPT-2 and PT-303. Under rainfed condition, at 35 DAS the maximum disease severity for leaves was recorded in the genotypes of PTC-2010-2 (33.13%) while as minimum severity for leaves was found in Tapeshwari (9.21%). At 55 DAS the maximum diseases severity for leaves was observed in the genotypes of TH-1401 (8.14%) while as zero severity score was found in Bhawani, PT-2012-5, RSPT-6, KBS-3, RMT-10-9, Tapeshwari, RSPT-2 and PT-303. The other finding was done by Abhishek *et al.*, (2017) he concluded that out of 30 genotypes of rapeseed- mustard were tested, none was found free to this disease. Some showed moderate resistance but remaining genotypes were found as moderately susceptible, susceptible and highly susceptible against white blister.

Diseases severity reaction under irrigated condition (E^1) and rainfed (E^2) condition. All the 37 genotypes of *Brassica juncea, Brassica napus* and *Brassica rapa* (Toria) were categorized into different classes of disease reaction *i.e.* Highly resistant (5%), Resistant (5-10%), Moderately resistant (11-25%), Suceptible (26-50%) and Highly susceptible (more than 50%) according to the (0-9) diseases rating scale.

Under irrigated condition, in case of *Brassica juncea*NRCHB-101, NRCDR-2, RSPR-01, RSPR-03, RSPR-69, SKJM-5, JD-6, RH-1209, Giriraj, RB-50 and JM-12-6 were categorized into susceptible group with 26-50% of diseases severity and in case of highly susceptible Kranti and RH-0923 are involved with more than 50% diseases reaction. Under rainfed condition, RSPR-01, JD-6 was categorized into moderately resistant reaction with 11-25% of diseases reaction, on the other hand NRCHB-101, RSPR-03, RSPR-69, SKJM-5, RH-0923, RH-1209, Giriraj, RB-50, JM-12-6 and Kranti were categorized into susceptible reaction (26-50%).

In case of *Brassica napus*, under irrigated condition, CNH-11-2, GSH-1699 and GSC-101 were categorized into resistant group with 5-10% of disease reaction and RSPN-29, RSPN-25, DGS-1, RSPN-28, AKGS-1, JSC-12-30, GSC-6, GSC-21, EC552608 and HNS-1102 genotypes were found moderately resistant (11-25%). Under rainfed condition, CNH-11-2, GSH-1699, GSC-101, GSC-6, GSC-21 and EC552608 genotypes were found highly resistant with 5% of diseases reaction and RSPN-25, DGS-1, RSPN-29 and JGS-12-3 were found resistant (5-10%) and on the other hand RSPN-28, AKGS-1 and HNS-1102 were found moderately resistant genotypes with 11-25% diseases reaction.

In case of *Brassica rapa* (Toria), Bhawani, PT-2012-5, RSPT-6, Tapeshwari, TH-1401, PT-303 were found in moderately resistant reaction with 11-25% diseases severity and PTC-2010-2, BAUT-09, KBS-3, RMT-10-9 genotypes were found susceptible (26-50%) under irrigated condition. Under rainfed condition, Tapeshwari was found resistant genotype and Bhawani, PT-2012-5, RSPT-6, BAUT-09, KBS-3, RMT-10-9, RSPT-2, TH-1401, PTC-2010-2 and PT-303 were found moderately resistant. The white rust accessions were also tested by Yadav *et al.* (2017) they screened 2000 Indian mustard accessions against white rust and phenotypic evaluation of resistant accessions to assess the nature and magnitude of genetic diversity including their agronomic potential was carried out at three locations which showed the pathogenic variability under different locations.

Table 1: Disease severity score of different genotypes of *Brassica* species in irrigated condition (E^1).

Reaction	Species	Genotypes
HR (Highly Resistant, 5%)	*B. juncea*	-
	B. napus	-
	B. rapa (Toria)	-
R (Resistant, 5-10%)	*B. juncea*	
	B. napus	- CNH-11-2, GSH-1699, GSC-101
	B. rapa (Toria)	-
MR (Moderately Resistant, 11-25%)	*B. juncea*	-
	B. napus	RSPN-29, RSPN-25, DGS-1, RSPN-28, AKGS-1, JSC-12-3, GSC-6, GSC-21, EC552608, HNS-1102
	B. rapa (Toria)	Bhawani, PT-2012-5, RSPT-6, Tapeshwari, RSPT-2, TH-1401, PT-303
S (Susceptible, 26-50%)	*B. juncea*	NRCHB-101, NRCDR-2, RSPR-01, RSPR-03, RSPR-69, SKJM-5, JD-6, RH-1209, Giriraj, RB-50, JM-12-6
	B. napus	-
	B. rapa (Toria)	PTC-2010-2, BAUT-09, KBS-3, RMT-10-9
HS (Highly Susceptible, more than 50%)	*B. juncea*	RH-0923, Kranti
	B. napus	-
	B. rapa (Toria)	-

Table 2: Disease severity score of different genotypes of *Brassica* species in rainfed condition (E^2).

Reaction	Species	Genotypes
HR (Highly Resistant, 5%)	*B. juncea*	-
	B. napus	CNH-11-2, GSH-1699, GSC-101, GSC-6 , GSC-21, EC552608
	B. rapa (Toria)	-
R (Resistant, 5-10%)	*B. juncea*	-
	B. napus	RSPN-25, DGS-1, RSPN-29, JGS-12-3
	B. rapa (Toria)	Tapeshwari
MR (Moderately Resistant, 11-25%)	*B. juncea*	RSPR-01, JD-6
	B. napus	RSPN-28, AKGS-1, HNS-1102
	B. rapa (Toria)	Bhawani, PT-2012-5, RSPT-6, BAUT-09, KBS-3, RMT-10-9, RSPT-2, TH-1401, PTC-2010-2, PT-303
S (Susceptible, 26-50%)	*B. juncea*	NRCHB-101, RSPR-03, RSPR-69, SKJM-5, RH-0923, RH-1209, Giriraj, RB-50, JM-12-6, Kranti
	B. napus	-
	B. rapa (Toria)	-
HS (Highly Susceptible, more than 50%)	*B. juncea*	-
	B. napus	-
	B. rapa (Toria)	-

CONCLUSIONS

To exploit disease resistance genotypes for hybridization programme postulated on the basis of Disease severity score may be successful found from both irrigated and rainfed environment conditions. The lines shows Resistant to Moderately Resistant from both environment in experiment can be used as white rust resistant source for further breeding programme. On the basis of Disease severity score in case of *B. juncea* JD-6, *B. napus* CNH-11-2, GSH-1699, GSC-101, and in case of *B. rapa* (Toria) Tapeshwari were found more Resistantfrom both irrigated and rainfed environment conditions. These genotypes can be utilized for future White rust resistance mustard breeding programme.

FUTURE SCOPE

The screening of the aforementioned genotypes against thewhite rust disease gives us information about the quality of resistance genes, which in turn can be utilized to breed resistant cultivars and will also be helpful in determining nature of resistance in varieties. The lines identified from experiment may act as a useful genetic resources for improvement of *Brassica* species and resistant accessions can serve as a rich gene pool for rapeseed-mustard breeding programms.

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Conflict of interest. None

REFERENCES

Bisht, K. S., Tewari, A. K. and Upadhaya, P. (2016). Screening of *Brassica* germplasm against *Albugo candida* (white rust disease) on *Brassica* species (rapeseed-mustard). *Journal of Applied and Natural Science, 8*(2): 658-662.

Gupta, K. and Saharan, G. S. (2002). Identification of pathotype of *Albugo candida* with stable characteristic symptoms on Indian mustard. *Journal of Mycology and Plant Pathology*, *32*: 46-51.

Mishra, K. K., Kolte, S. J., Nashaat, N. I. and Awasthi, R. P. (2009). Pathological and biochemical changes in *Brassica juncea* (mustard) infected with *Albugo candida* (white rust). *Plant Pathology*, *58*: 80–86.

Patni, C. S., Singh, A. and Awasthi, R. P. (2005). Variability in *Albugo candida* causing white rust disease of rapeseed-mustard. *Journal of Research and Education*, *4*: 20-24.

Vinu, V., Singh, N., Vasudev, S., Yadava, D. K., Kumar, S., Naresh, S., Bhat, S. R. and Prabhu, K. V. (2013). Assessment of genetic diversity in *Brassica juncea* (*Brassicaceae*) genotypes using phenotypic differences and SSR markers. *International Journal of Tropical Biology*, *61*(4): 1919-1934.

Wheeler, B. E. J. (1969). An introduction to plant diseases. *John Wiley and Sons Limited*: 301.

Yadava, R. B., Kumar, A., Kumar, A. and Verma, S. K. (2014). Screening of rapeseed-mustard cultivars/lines for resistance against alternaria blight. *Indian Journal of Science Research*, *5*(1): 89-91.

Yadav, R., Nanjundan, J., Sandhu, P. S. and Jalli, R. (2017). Identification and evaluation of Indian mustard genotypes for white rust resistance and agronomic performances. *Indian Journal of Genetics and Plant Breeding*, *78*(1): 81-89.

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