Biological Forum – An International Journal **14(4): 1028-1031(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Screening of *Brassica juncea* against white rust in modified triple test cross mating design

Sunidhi Tiwari[1,*], Vedna Kumari[1], S. K. Gupta[2], Harpreet Singh[3], Rakesh Kumar[4] and Ashok Kumar[2]

[1]Department of Genetics & Plant Breeding, CSK HPKV Palampur (Himachal Pradesh), India.
[2]Division of Plant Breeding & Genetics, Sher-e-Kashmir University of Agricultural Sciences and Technology, FOA, Main Campus, Chatha, Jammu-180009 (J&K), India.
[3]Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana (Punjab), India.
[4]Department of Agriculture, Jagannath University, Jaipur (Rajasthan) India.

(Corresponding author: Sunidhi Tiwari)*
(Received 21 September 2022, Accepted 28 October, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Oilseed crops known to be the backbone of various agricultural economies from ancient times and play an important part in the agricultural industries as well as trade throughout the world. *Brassica juncea* (Indian mustard) belongs to family *Brassicaceae*, is a prominent oilseed crop cultivated globally. White rust is a devastating disease of oilseed Brassicas and it is desirable to find useful sources of host resistance in *B. juncea* as for control, breeding as well as selection for resistance is the most economical method of control. A study was carried out in the experimental field of CSKHPKV Palampur in the year during rabi 2019-2020 to 2020-2021 for generating the material by crossing of 12 lines with 3 testers (RCC-4 (P1, susceptible source), Donskaja IV (P2, resistant source) and their F1) to analyze in the randomized block design in the year 2021 to 2022. Screening of 12 lines with three testers and thirty-six crosses of *Brassica juncea* were done for their disease evaluation of White rust on leaf as well as pods. Out of 12 lines six genotypes were found moderately resistant and six were found susceptible. Among 36 crosses, 14 were found moderately resistant and 12 were found moderately susceptible and 10 were found susceptible to white rust.

Keywords: Oilseed, White rust, Destructive, Crosses, Resistant.

INTRODUCTION

In *Brassicaceae* family, a key agricultural genus is the *Brassica* genus comprises of the six most commonly known members in which three diploid species namely, *Brassica rapa* (A genome, *n*=10), *Brassica nigra* (B genome, *n*=8), and *Brassica oleracea* (C genome, *n*=9), and three allotetraploid species, *Brassica juncea* (AB genome, *n* =18), *Brassica napus* (AC genome, *n*=19), and *Brassica carinata* (BC genome, *n*=17). The 'Triangle of U' explained the genomic relationships among these six members (Wu *et al.,* 2022). Brassica can be consumed as a fodder, vegetable and for oil purpose (Tiwari *et al.,* 2021). *Brassica juncea* commonly known as Indian mustard with genome AABB and 2n=36 is one among the major oilseed crops and is cultivated globally in tropical as well as subtropical regions, also the Indian sub-continent. In India, it is a principle and the most important species in the group of rapeseed-mustard and holding more than 90% of its total acreage (Chand *et al.,* 2021; Yadava *et al.,* 2022).

The various usages of the rapeseed oil are such as in food products purposes and several other non-nutrition purposes such as in the lubricant especially, diesel fuel oils, greases (Tiwari *et al.,* 2022).

The major constraints of the low productivity of rapeseed-mustard is the various biotic as well as abiotic factors. Among the biotic factors, there are various diseases harm the Brassica crop such as *Alternaria* blight, downy mildew, white rust and Sclerotinia rot disease at many phases of plant development. The causal organism of white rust is the parasite *Albugo candida* which would turned into the most global and disastrous infection in India. The favorable weather conditions for the maximum disease incidence is the minimum temperature range up to 15-16ºC and maximum up to 28-29ºC and relative humidity more than 65 per cent disease (Sangeetha and Siddaramaiah 2007). All of the aerial plant parts described the manifestations of assault and results in the appearance of the conspicuous white pustules on the plant parts such as on the stems, leaves and inflorescence. This is the oomycetes pathogen which

causes reduction up to 50 to 89.8 per cent in seed yield and also decrease the photosynthetic capacity of plants and ultimately affect normal plant development. This disease first affects the foliage and then downgrades the leaves and makes it unsuitable for the intake of human consumption as vegetable. Further this disease also affects the cotyledon, leaves and siliqua by the inoculum density present on leaves and formation of lesion would lead to hypertrophy, sterility of inflorescences, hyperplasia called as "systemic infection" and it results in the shattering of fruits and yield reduction of mustard (Rai and Sharma 2022). Many of the released cultivars are defenceless for this disease (Dahiya *et al.,* 2019) and due to its devastating nature of the disease, it is needed to screen the cultivars for identification of resistant varieties to overcome from problem.

MATERIALS AND METHODS

The experiment was carried out in the experimental field of Department of Genetics and Plant Breeding, CSKHPKV Palampur. The experimental material composed of 12 parents and 3 testers and 36 hybrids. Two diverse genotypes RCC-4 (P1) and Donskaja IV(P2) and their F1 were used as testers. Evaluation of these genotypes was done in RBD (Randomized block design) with three replications. The crosses were attempted as per the modified triple test cross (TTC) design. The experimental plot of each treatment consisted of one row of 1.5m length. The row to row and plant to plant spacings were maintained at 30cm and 15cm, respectively. Recommended packages of practices were followed to raise the environment. Screening of all the genotypes for reaction to white rust were done was done under the natural epiphytotic field conditions on scale 0-9 given by Conn *et al.* (1990) and with the help of visual examinations, data was taken for recording the disease severity on the leaves as well as on the pods after almost 100 days of sowing on the ten leaves and pods sampled randomly out of each plot. The formula for calculating the disease severity under natural epiphytotic conditions given below:

$$\text{Average severity score} = \frac{(N-1\times 0)+(N-2\times 1)+(N-3\times 3)+(N-4\times 5)+(N-5\times 7)+(N-6\times 9)}{\text{Number of leaf samples}}$$

Table 1: Disease score, disease severity percentage and corresponding reaction to white rust in Indian mustard.

Disease score	Disease severity (%) and symptoms	Disease reaction
0	No infection on either leaf surface	Immune
1-2	Up to 5% leaf area covered with small pinpoint to larger brown necrotic flecks under inoculation point	Highly resistant (HR)
3-4	> 5%-10% leaf area covered with very sparse sporulation, one to few pustules on lower surface and no of pustules on upper surface	Resistant (R)
5-6	11%-25% leaf area covered with few to many scattered pustules with good sporulation on lower surface and none to few pustules on upper surface	Moderately resistant (MR)
7-8	26%-50% leaf area covered with many pustules with abundant sporulation on lower surface with none to few pustules on upper surface	Susceptible (S)
9	> 50% leaf area covered with many large coalescing pustules on lower surface with few to many pustules on upper surface of the cotyledon	Highly susceptible (HS)

RESULTS AND DISCUSSION

The response of genotypes for white rust scores are presented in Table 2. Out of three testers, one tester RCC-4 (P1) were found susceptible to white rust and the second tester Donskaja-IV (P2) shows no infection and considered as immune against white rust. The genotype Donskaja-IV has proved to a resistant source for white rust and also act as a donor parent for the white rust with locus AcB1-A5.1. The resulted F1 acted as a third tester were found resistant.

Out of 12 lines namely, RSPR-69, Urvashi, DMR-J-31, Pusa Karishma, RSPR-03, Kranti found to be moderately resistant for the white rust and none of the parent found moderately susceptible and genotypes PusaTarak, DRMR-2017, RL-1359, Pusamehak, TM-172 were found susceptible.

Out of 36 crosses, RSPR69 × Donskaja IV, Urvashi × F1, Urvashi × Donskaja-IV, DRMR-J-31 × RCC-4, DRMR-J-31 × F1, DRMR-J-31 × Donskaja-IV, Pusa Tarak × F1, Pusa Tarak × Donskaja-IV, Pusa Karishma × F1, Pusa Karishma × Donskaja-IV, RSPR-03 × F1, RSPR-03 × Donskaja-IV, Kranti × F1, Kranti × Donskaja-IV were found moderately resistant to white rust and RSPR69 × F1, Urvashi × RCC4, DRMR 2017 × F1, DRMR 2017 × Donskaja-IV, RSPR-03 × RCC4, RL-1359 × F1, RL1359 × Donskaja-IV, Pusa Mehak × F1, Pusa Mehak × Donskaja-IV, Varuna × Donskaja-IV, Pusa Bold × F1, Pusa Bold × Donskaja-IV were found moderately susceptible and RSPR-69 × RCC-4, PusaTarak × RCC-4, DRMR 2017 × RCC4, RL-1359 × RCC-4, Pusa Mehak × RCC-4, Kranti × RCC4, Varuna × RCC-4, Varuna × F1, Pusa Bold × RCC-4 were found susceptible. None of the genotype in parents as well as crosses found highly susceptible to white rust (Table 2). These results are in agreement with Awasthi *et al.* (2012); Bisht *et al*. (2016); Yadav *et al.* (2018). Li *et al*. (2007) evaluated *Brassica juncea* genotypes for white rust and resulted in the moderately to susceptible reaction in most of the genotypes.

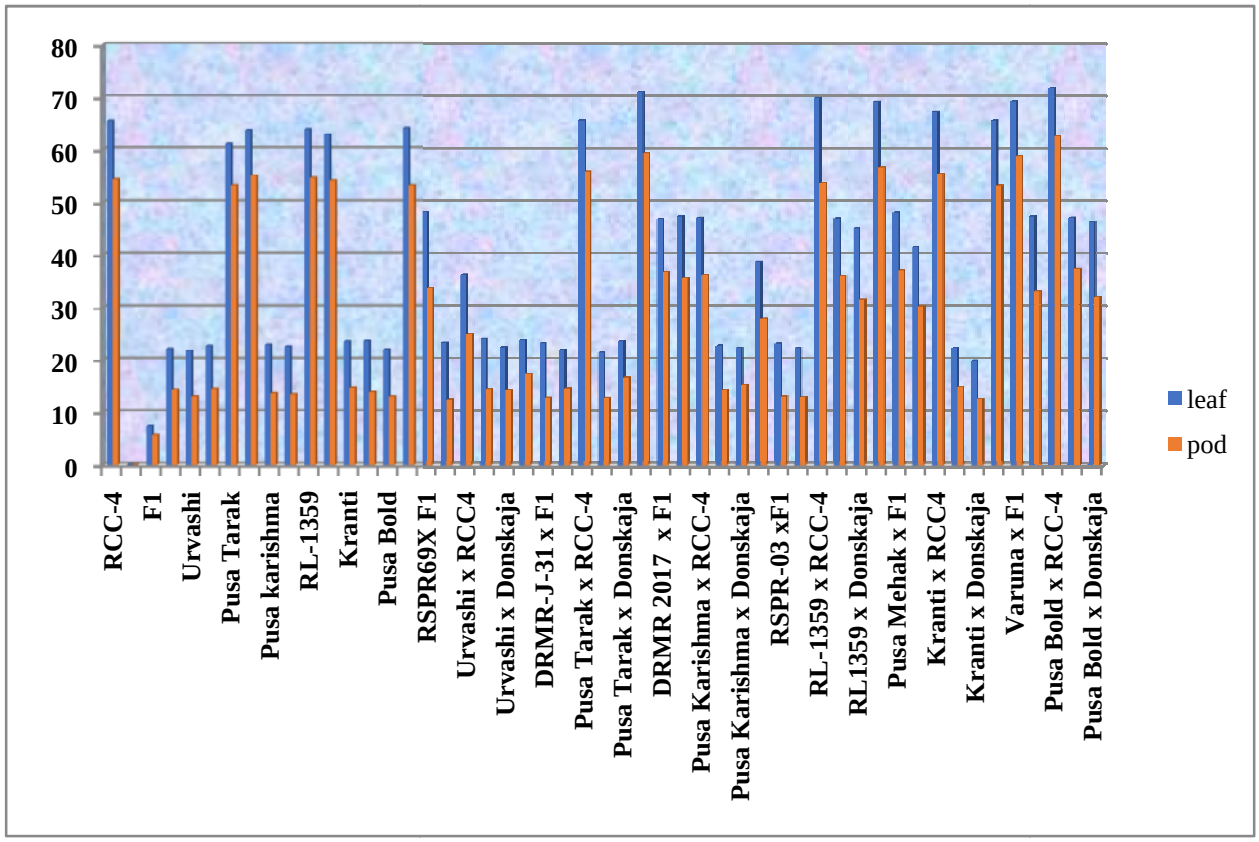

Fig. 1.

Table 2.

	Genotypes	Leaf (TDI)	Pod (TDI)	Reaction		Genotypes	Leaf (TDI)	Pod (TDI)	Reaction
1.	RCC-4	65.63	54.43	S	27.	PusaTarak × Donskaja-IV	23.67	16.7	MR
2.	Donskaja IV	0	0	R	28.	DRMR 2017 × RCC4	71.17	59.48	S
3.	RCC-4 × Donskaja IV (F1)	7.4	5.63	R	29.	DRMR 2017 × F1	46.93	36.82	MS
4.	RSPR-69	22.2	14.43	MR	30.	DRMR 2017 × Donskaja	47.43	35.67	MS
5.	Urvashi	21.76	13.03	MR	31.	Pusa Karishma × RCC-4	47.16	36.27	MR
6.	DMR-J-31	22.7	14.6	MR	32.	Pusa Karishma × F1	22.8	14.36	MR
7.	PusaTarak	53.4	61.33	S	33.	Pusa Karishma × Donskaja IV	22.35	15.28	MR
8.	DRMR 2017	63.79	55.14	S	34.	RSPR-03 × RCC4	38.8	27.96	MS
9.	Pusa Karishma	22.9	13.57	MR	35.	RSPR-03 × F1	23.2	13.12	MR
10.	RSPR-03	22.6	13.42	MR	36.	RSPR-03 × Donskaja IV	22.33	13	MR
11.	RL-1359	63.97	54.67	S	37.	RL-1359 × RCC-4	70.03	53.8	S
12.	Pusa Mehak	62.97	54.2	S	38.	RL-1359 × F1	47.03	36.07	MS
13.	Kranti	23.47	14.77	MR	39.	RL1359 × Donskaja	45.19	31.57	MS
14.	Varuna	23.55	13.78	S	40.	Pusa Mehak × RCC-4	69.3	56.76	S
15.	Pusa Bold	22.08	13.02	S	41.	Pusa Mehak × F1	48.17	37.13	MS
16.	RSPR-69 × RCC-4	64.2	53.4	S	42.	Pusa Mehak × Donskaja	41.61	30.27	MS
17.	RSPR69 × F1	48.3	33.77	MS	43.	Kranti × RCC4	67.35	55.47	S
18.	RSPR69 × Donskaja IV	23.37	12.5	MR	44.	Kranti × F1	22.35	14.9	MR
19.	Urvashi × RCC4	36.33	25	MS	45.	Kranti × Donskaja	19.9	12.63	MR
20.	Urvashi × F1	24.1	14.51	MR	46.	Varuna × RCC-4	65.7	53.3	S
21.	Urvashi × Donskaja IV	22.44	14.28	MR	47.	Varuna × F1	69.4	58.93	S
22.	DRMR-J-31 × RCC-4	23.86	17.43	MR	48.	Varuna × Donskaja	47.43	33.17	MS
23.	DRMR-J-31 × F1	23.24	12.88	MR	49.	Pusa Bold × RCC-4	71.91	62.76	S
24.	DRMR-J-31 × Donskaja	21.93	14.63	MR	50.	Pusa Bold × F1	47.17	37.46	MS
25.	PusaTarak × RCC-4	65.73	55.97	S	51.	Pusa Bold × Donskaja	46.4	32.07	MS
26.	PusaTarak × F1	21.52	12.87	MR					

CONCLUSION

In this study, 12 lines, three testers of *Brassica juncea* and 36 crosses were screened for reaction to white rust under natural epiphytotic field conditions on 0-9 scale given by Conn *et al.* (1990) and observations on disease severity were recorded on the basis of visual observations. Out of 12 lines six genotypes were found moderately resistant and six were found susceptible. Among 36 crosses, 14 were found moderately resistant and 12 were found moderately susceptible and 10 were found susceptible to white rust.

Acknowledgement. Authors are highly obliged to Division of Plant Breeding and genetics, FAO (Faculty of Agriculture), SKUAST Jammu for providing the seed material for the current experiment.

Conflict of Interest. None.

REFERENCES

Awasthi, R. P., Nashaat, I., Kolte, S. J., Tewari, A. K., Meena, P. D. and Bhatt, R. (2012). Screening of putative resistant sources against Indian and exotic isolates of *Albugo candida* inciting white rust in rapeseed-mustard. *Journal of Oilseed Brassica*, *1*(1), 27-37.

Bisht, K. S., Tewari, A. K., Upadhyay, 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.

Chand, S., Patidar, O. P., Chaudhary, R., Saroj, R., Chandra, K. and Meena, V. K. (2021). "Rapeseed-mustard breeding in India: Scenario, achievements and research needs," in Brassica breeding and biotechnology. (London, UK: Intech Open).

Conn, K. L., Tewari, J. P. and Awasthi, R. P. (1990). A disease assessment key for *Alternaria* black spot in rapeseed and mustard. *Canadian Plant Disease Survey*, *70*, 19-22.

Dahiya, N., Rashmi and Pant, U. (2019). Inheritance of white rust in newly developed resistant line of *Brassica juncea* from local germplasm. *International Journal of Chemical Studies*, *7*(2), 677-679.

Rai, S. K. and Sharma, A. (2022). Screening of different Brassica germplasm against White Rust Resistance. *Biological Forum – An International Journal*, *14*(2a), 155-159.

Tiwari, S., Gupta, S. K., Rai, S. K., Upadhyay, R. G., Kaur, J. and Jameel, F. (2021). Fatty acid profiling in gobhi sarson (*Brassica napus*). *Environment Conservation Journal*, *22*(3), 409-414.

Tiwari, S., Gupta, S. K., Singh, H., Yadav, O. P. and Pandey M. K. (2022). Screening of Brassica Genotypes against Alternaria Blight under Northern Indian Shivalik Hill conditions. *Biological Forum – An International Journal*, *14*(3), 1659-1662.

Wu, J., Lang, L., Lin, R., Cai, X., Zhang, L., Guo, X., Wang, T., Chen, H. and Wang, X. (2022). Investigation of *Brassica* and its relative genomes in the post-genomics era. *Horticulture Research*, *9*.

Yadav, R., Singh, P., Sandhu, P. S., Pant, U., Avtar, R. and Radhamani, J. (2018). Identification and evaluation of Indian mustard genotypes for white rust resistance and agronomic performance. *Indian Journal of Genetics and plant breeding*, *78*(1), 81-89.

Yadava, D. K., Yadav, R., Vishwakarma, H., Yadav, S., Saini, N. and Vasudev, S. (2022). Genetic diversity characterization and population structure in *Brassica juncea*. The *Brassica juncea* genome, compendium of plant genomes. Eds. T. Mohapatra and C. Kole (Switzerland: Springer), 73–84.

How to cite this article: Sunidhi Tiwari, Vedna Kumari, S. K. Gupta, Harpreet Singh, Rakesh Kumar and Ashok Kumar (2022). Screening of *Brassica juncea* against white rust in modified triple test cross mating design. *Biological Forum – An International Journal*, *14*(4): 1028-1031.