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Screening of Brassica germplasm against *Albugo candida* (White rust disease) on Brassica species (Rapeseed-mustard)

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Abstract: White rust distributed worldwide, caused by *Albugo candida* (Pers. Ex. Lev.) Kuntze. (*A. Cruciferarum* S. F. Gray) is one of the major disease responsible in reducing the yield of rapeseed-mustard. Among various management approaches use of resistant varities is consider best, as it is cost effective and environment friendly. However, till now only few resistant sources against the disease has been reported. Therefore, in the present investigation 70 rapeseed-mustard germplasm have been evaluated in field under epiphytotic conditions during 2011-12 and 2012-13 crop seasons. All the germplasms showed similar disease reaction after screening in both the years. Among 70 germplasm, seven germpalsms i.e. DLDC-1, DRMR-100, DRMR-312, EC-339000, GSL-1, NPJ-158 and RH-0644 were found free from the disease with 0% disease severity. These germplasms could be used in breeding programmes for the development of resistant genotypes having high yield potential.

Keywords: *Albugo candida*, Pathogen, Resistance, Rapeseed-mustard, Screening

INTRODUCTION

White rust disease is a major disease of Brassica species (Rapeseed-mustard) appears in different proportions on rapeseed-mustard crops in several localities throughout the world. (Saharan and verma, 1992). The disease has been recorded from more than eight countries of the world with a host range of more than 300 hosts (Meena, *et al*., 2014). White rust infection on plants resulted from two types 'local and systemic' (Verma and Petrie, 1980). In systemic infection disease appears as distortion, hypertrophy, hyperplasia and sterility of inflorescence. This phase of infection has been referred as the staghead (Maheshwari *et al*., 1985; Kolte, 1985 and Awasthi *et al.,* 1995).

White rust disease cause intensive yield losses. In India a yield loss of 17-32 percent in *B. juncea* and *B. rapa* (Bains and Jhooty, 1979) 23-55 per cent (Saharan *et al*. 1984), 31.5-37.2 per cent (Sing *et al*. 1990), 20-60 per cent (Bisht *et al*., 1994) and 17-34 per cent (Gupta *et al*., 2004) has been reported. Kolte *et al*. (1986) reported yield loss of 17-32 per cent in *B. juncea* in India, due to mixed infection of *A. candida* and *Hyaloperonospora brassicae*. Presently the growers are mainly dependent on chemical fungicides for the partial management of the disease which is not ecofriendly. To overcome these problems the only alternative method is to search out resistant sources from the available Brassica germplasm for the development of high yielding resistant varieties against the disease. Keeping above in view the present investigation was carried out for screening the Brassica germplasm against white rust disease.

MATERIALS AND METHODS

The experiment was conducted at Norman E. Borlaug Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, during rabi crop season of year 2011-12 and 2012-2013 for screening of white rust disease of rapeseed-mustard. Brassica germplasm supplied by DRMR, Sewar, Bharatpur, Rajasthan (Table 1). These germplasm of rapeseed mustard were used for determining their phenotypic disease reactions against white rust under artificially inoculated conditions for selection of resistant sources. Each entry was sown in two rows each of 3m length with two replications. Line to line distance was 30 cm, while plant to plant distance was 10-15 cm. PYS 6 was sown as a susceptible check after each entry. Each test entry and susceptible checks were artificially inoculated with white rust inoculum.

Methods of inoculation: Oosporic material i.e. staghead source of primary inoculum, collected from the previous year crop were grinded, mixed with the seeds before sowing and applied into the soil along with the seed at the time of sowing which served as source of primary inoculum in causing infection.

Fresh infected leaves contained white rust pustules which served as secondary source of inoculum were collected and made sporangial suspension in distilled water. Inoculum concentration was adjusted to 10^4

Table 1. Rapeseed-mustard germplasm supplied by DRMR, Sewar, Bharatpur (Rajasthan).

S. N.	Name of germ-plasm	Brassica species	Collection from	S. N.	Name of germplasm	Brassica species	Collection from	S. N.	Name of germplasm	Brassica species	Collection from
1	DRMR-100	*B. carinata*	Bharatpur	26	RMT-08-2	*B. rapa*	Morena	51	PRE-2007-6	*B. juncea*	Pantnagar
2	DRMR-312	*B. carinata*	Bharatpur	27	RMM-09-10	*B. rapa*	Morena	52	EC-414324	*B. juncea*	Pantnagar
3	DRMR-11-10	*B. juncea*	Bharatpur	28	JMM-07-2	*B. juncea*	Morena	53	EC-339000	*B. napus*	Pantnagar
4	DRMR-11-11	*B. juncea*	Bharatpur	29	JMM-08-1	*B. juncea*	Morena	54	EC-414322	*B. juncea*	Pantnagar
5	DRMRIJ-11-275	*B. juncea*	Bharatpur	30	JMM-07-1	*B. juncea*	Morena	55	PRKS-28	*B. juncea*	Pantnagar
6	DRMRIJ-31	*B. juncea*	Bharatpur	31	JMT-08-13	*B. rapa*	Morena	56	SKM-815	*B. juncea*	SK Nagar
7	DRMR-261	*B. juncea*	Bharatpur	32	NPJ-164	*B. juncea*	New Delhi	57	SKM-B-817	*B. juncea*	SK Nagar
8	DRMR-11-08	*B. juncea*	Bharatpur	33	NPJ-165	*B. juncea*	New Delhi	58	TKM-10-2	*B. rapa*	Kanpur
9	DRMR-11-09	*B. juncea*	Bharatpur	34	NPJ-166	*B. juncea*	New Delhi	59	TK-17-14	*B. rapa*	Kanpur
10	DRMRIJ-11-287	*B. juncea*	Bharatpur	35	NPJ-167	*B. juncea*	New Delhi	60	ROHINI	*B. napus*	Kanpur
11	DRMRIJ-11-286	*B. juncea*	Bharatpur	36	NPJ-121	*B. juncea*	New Delhi	61	Varuna	*B. juncea*	Kanpur
12	NRCDR-705	*B. juncea*	Bharatpur	37	NPJ-127	*B. juncea*	New Delhi	62	RGN-282	*B. juncea*	Sriganganagar
13	RH-0834	*B. juncea*	Hisar	38	NPJ-158	*B. juncea*	New Delhi	63	Divya-33	*B. juncea*	Sriganganagar
14	RH-0904	*B. juncea*	Hisar	39	LES-42	*B. juncea*	New Delhi	64	NDRE-7	*B. juncea*	Faizabad
15	RH-0644	*B. juncea*	Hisar	40	LES-43	*B. juncea*	New Delhi	65	NDYR-32	*B. rapa*	Faizabad
16	RH-0704	*B. juncea*	Hisar	41	LET-36	*B. juncea*	New Delhi	66	GSL-1	*B. napus*	Ludhiana
17	RH-0735	*B. juncea*	Hisar	42	NPJ-140	*B. juncea*	New Delhi	67	CJ-37-61	*B. juncea*	Ludhiana
18	RH-0749	*B. juncea*	Hisar	43	NPJ-151	*B. juncea*	New Delhi	68	PBR-378	*B. juncea*	Bhathinda
19	RAUDL-9-32	*B. juncea*	Dholi	44	NPJ-152	*B. juncea*	New Delhi	69	PBR-375	*B. juncea*	Bhathinda
20	RAURD-09-212	*B. juncea*	Dholi	45	NPJ-157	*B. juncea*	New Delhi	70	YSB-9	*B. rapa*	Bawal
21	RAURDL-02-01	*B. juncea*	Dholi	46	DLDC-1	*B. carinata*	New delhi				
22	RM-WR-09-5	*B. juncea*	Morena	47	PAB-2005-16	*B. juncea*	Pantnagar				
23	JYM-11	*B. juncea*	Morena	48	PAB-2004-4	*B. juncea*	Pantnagar				
24	JMWR-08-3	*B. juncea*	Morena	49	PT-303	*B. rapa*	Pantnagar				
25	RMT-08-06	*B. rapa*	Morena	50	EC-414299	*B. rapa*	Pantnagar				

sporangia/ ml using haemocytometer. Prepared sporangial suspension of *A. candida* was sprayed directly to test plants at cotyledonary stage (2/3 leaf stage) and at initiation of flowering stage in the evening. Irrigation was done just after spraying and regular spraying of tab water as per requirement to maintain optimum RH and moisture for 3 days after inoculation. Crop after spraying was regularly watched for appearance of the disease. The observations on disease severity and disease reaction was recorded on the basis of all leaves on 10 plants selected randomly from each germplasm at maximum disease pressure i.e. at 75 DAS. using 0-9 rating scale (Table 2) as given in AICRP R&M (2010).

Table 2. Rating (0-9) scale for measuring disease severity and disease reaction (AICRP R&M, 2010).

Rating score	Leaf area covered (%)	Disease reaction
0	No symptoms	Immune
1	< 5	Highly resistant
3	6-10	Resistant
5	11-25	Moderately Resistant
7	26-50	Susceptible
9	< 50	Highly susceptible

RESULTS AND DISCUSSION

In the present investigation, out of seventy germplasm (70) seven germplasm i.e. DLDC-1, DRMR-100, DRMR-312, EC-339000, GSL-1, NPJ-158 and RH-0644 showed immune reaction i.e. free from the disease. EC-414299, PT-303, TK-17-14, YSB-9 and DRMRIJ-11-287 were moderately resistant with a disease severity of 11.11-16.67 per cent, RMM-09-10, RMT-08-06, RMT-08-2, TKM 10-2, Divya-33, DRMRIJ-11-286, JMM-07-1, DRMR-261, JMT-08-13, NPJ-121, NPJ-127, NRCDR-705 and PAB-2005-16 were susceptible with a disease severity 26-50 per cent while, DRMR-11-10, DRMR-11-11, DRMRIJ-11-275, DRMRIJ-31, CJ-37-61, DRMR-11-08, DRMR-11-09, EC-414322, EC-414324, JMM 07-2, JMM-08-1, JMWR-08-3, LES-42, LES-43, LET-36, NDRE-7, NDYR-32, NPJ-140, NPJ-151, NPJ-152, NPJ-157, NPJ-164, NPJ-165, NPJ-166, NPJ-167, PAB-2004-4, PBR-375, PRE-2007-6, PRKS-28, RAUDL-9-32, RAURD-09-212, RAURDL-02-01, RGN-282, RH-0704, RH-0735, RH-0749, RH-0834, RH-0904, RM-WR-09-5, ROHINI, SKM-815, SKM-B-817 and Varuna were found highly susceptible with more than 50 per cent against white rust (Table 3). Yadav *et al.* (1999). evaluated 74 Indian mustard (*Brassica juncea*) germplasm lines for resistance against white rust diseases. None of the genotype was found resistant Li *et al*. (2007)**.** Screened 44 *B. juncea* genotypes, *viz*. 22 from India, 12 from Australia, and 10 from China, Out of 40 genotypes, 04 Chinese genotypes (CBJ-001, CBJ-002, CBJ-003, CBJ-004) and 01 Australian genotype (JR049) consistently showed high resistance to *A. candida*. Li *et al*. (2008). who screened 44 *B. juncea* genotypes among them CBJ-001, CBJ-003 and CBJ-004 showed highly resistance against *A. candida.* Meena *et al*. (2011) reported PBC 9221, and EC 414299 brassica lines as resistant to white rust. DRMR (2011) reported EC414291, EC 414293, MCB1, DRMR 243, DRMR 261, DRMR 270, NRCDR 705, JMWR 945-2-2-75 Kr, EC 399313, JYM 11 and NDWR 5-1 as resistant lines to white rust. In earlier studies different workers evaluated different Brassica germplasms and reported few germplasms as a resistant source. However, in the present investigation Brassica lines tasted were different from earliar workers. In the present studies few lines were found free from the disease, however some lines were found moderately resistant.

Conclusion

In this study, seventy germplasms of *B. carinata*, *B. napus*, *B. juncea*, and *B. rapa* were screened out against white rust disease. Among these DLDC-1, DRMR-100 & DRMR-312 (*B.carinata*); EC-339000 & GSL-1 (*B. napus*); NPJ-158 & RH- 0644 (*B. juncea*) were free from the disease with 0% disease severity. The NPJ-158 and RH-0644 (*B.juncea*) lines could be best exploited as a source of resistance in breeding programme for the development of high yielding varities against white rust disease.

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Table 1. Screening of *Brassica* germplasm for white rust disease resistance.

Rating scale (0-9)			Disease reaction of white rust on the basis of disease severity		
Per-cent intensity	**Reaction**	**Germplasm**	**No. of Germplasm**	**%Disease severity**	**Disease* reaction**
0%	Immune	07	DLDC-1	0.00	Immune
			DRMR-100	0.00	Immune
			DRMR-312	0.00	Immune
			EC-339000	0.00	Immune
			GSL-1	0.00	Immune
			NPJ-158	0.00	Immune
			RH-0644	0.00	Immune
>5%	Highly resistant	00	Nil	-	-
5-10%	Resistant	00	Nil	-	-
11-25%	Moderately Resistant	05	EC-414299	16.67	Moderately resistant
			PT-303	16.67	Moderately resistant
			TK-17-14	16.67	Moderately resistant
			YSB-9	16.67	Moderately resistant
			DRMRIJ-11-287	11.11	Moderately resistant
26-50%	Susceptible	14	RMM-09-10	50.00	Susceptible
			RMT-08-06	38.89	Susceptible
			RMT-08-2	38.89	Susceptible
			TKM-10-2	47.22	Susceptible
			Divya-33	47.22	Susceptible
			DRMRIJ-11-286	50.00	Susceptible
			JMM-07-1	50.00	Susceptible
			DRMR-261	44.44	Susceptible
			JMT-08-13	36.11	Susceptible
			NPJ-121	50.00	Susceptible
			NPJ-127	50.00	Susceptible
			NRCDR-705	47.22	Susceptible
			PAB-2005-16	44.44	Susceptible
			PBR-378	44.44	Susceptible
<50%	Highly Susceptible	44	DRMR-11-10	66.66	Highly susceptible
			DRMR-11-11	72.22	Highly susceptible
			DRMRIJ-11-275	77.77	Highly susceptible
			DRMRIJ-31	77.77	Highly susceptible
			CJ-37-61	61.11	Highly susceptible
			DRMR-11-08	72.22	Highly susceptible
			DRMR-11-09	58.33	Highly susceptible
			EC-414322	61.11	Highly susceptible
			EC-414324	61.11	Highly susceptible
			JMM-07-2	61.11	Highly susceptible
			JMM-08-1	77.77	Highly susceptible
			JMWR-08-3	55.55	Highly susceptible
			JYM-11	66.66	Highly susceptible
			LES-42	58.33	Highly susceptible
			LES-43	58.33	Highly susceptible
			LET-36	69.44	Highly susceptible
			NDRE-7	58.33	Highly susceptible
			NDYR-32	72.22	Highly susceptible
			NPJ-140	74.99	Highly susceptible
			NPJ-151	77.77	Highly susceptible
			NPJ-152	80.55	Highly susceptible
			NPJ-157	69.44	Highly susceptible
			NPJ-164	77.77	Highly susceptible
			NPJ-165	77.77	Highly susceptible
			NPJ-166	72.22	Highly susceptible
			NPJ-167	74.99	Highly susceptible
			PAB-2004-4	61.11	Highly susceptible
			PBR-375	58.33	Highly susceptible
			PRE-2007-6	66.66	Highly susceptible
			PRKS-28	72.22	Highly susceptible
			RAUDL-9-32	61.11	Highly susceptible
			RAURD-09-212	77.77	Highly susceptible
			RAURDL-02-01	69.44	Highly susceptible
			RGN-282	66.66	Highly susceptible
			RH-0704	63.88	Highly susceptible
			RH-0735	77.77	Highly susceptible
			RH-0749	55.55	Highly susceptible
			RH-0834	61.11	Highly susceptible
			RH-0904	77.77	Highly susceptible
			RM-WR-09-5	66.66	Highly susceptible
			ROHINI	61.11	Highly susceptible
			SKM-815	55.55	Highly susceptible
			SKM-B-817	55.55	Highly susceptible
			Varuna	77.77	Highly susceptible

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