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SOURCES OF RESISTANCE TO INDIAN PATHOTYPES OF STEM AND LEAF RUSTS IN BREAD WHEAT

S.V. Sai Prasad[1], D.K. Verma[1], A. Divya[1], Jang Bahadur Singh[1], K. Kaushal[1], T.L. Prakasha[1], V.G. Dubey[1], A.N. Mishra[1], A.K. Sharma[2], M.S. Saharan[2] and Indu Sharma[2]

[1]IARI Regional Station, Indore [2]DWR, Karnal

Wheat is a major cereal crop in India with annual production of more than 90 million tons from an area of around 26 million hectares. Stem rust caused by *Puccinia graminis* f. sp. *tritici* and leaf rust caused by *P. triticina* are amongst the most serious diseases affecting wheat cultivation. Changing virulence pattern due to continued evolution of new pathotypes through migration, mutation, recombination and selection has thrown perpetual challenge to breed resistant varieties. Indian bread wheat germplasm showed more susceptibility to stem rust pathotypes belonging to race 40-group and leaf rust pathotypes of race 77- and 104-groups (1). Developing cultivars with long lasting resistance depends on availability of confirmed sources of resistance. Broadening of genetic base for resistance is necessary in order to minimize the losses caused by these pathogens. Hence, an effort was made to identify bread wheat genotypes showing resistance to important rust pathotypes across different locations.

Table-1 : Durum genotypes with their parentage

S. No.	Genotype	Parentage
1	HI 1567	HI 1136/HW 3024
2	HI 1568	355 M088/Milan/HW 2045//WR 329
3	HI 1569	Raj3777/WLT-277//HW2045
4	HI 1571	Raj3777/WLT-277//HW2045
5	HI 1572	SKAUZ*2/FCT

Responses of bread wheat genotypes to stem and leaf rusts tested at multi-locations were analysed to identify resistant genotypes. Responses recorded in different plant pathological screening nurseries like Plant

Table-2 : Adult-plant responses of bread wheat genotypes to mixtures of important pathotypes of stem and leaf rusts

Genotype	Year of testing	Trial	Stem		Leaf				Postulated genes
			South		South		North		
			HS	ACI	HS	ACI	HS	ACI	
HI 1567	2007 – 08	NIVT 2	20S	5.3	10MS	2.1	20MS	3.0	-
	2009 – 10	AVT I	10S	2.3	10MS	2.4	TS	0.2	
	2010 – 11	EPPSN	5MR	0.6	20S	5.0	0	0.7	
	2011 -12	MDSN	5S	3.0	5MR	0.7	TR	0.1	
HI 1568	2007 – 08	NIVT 2	40S	11.0	5MS	1.1	30S	5.2	-
	2009 – 10	AVT I	10S	2.0	5S	1.5	30S	7.0	
	2010 – 11	EPPSN	10MR	2.3	10MS	2.6	10MR	0.0	
	2011 -12	MDSN	5S	3.3	TMR	0.1	0	0	
HI 1569	2007 – 08	NIVT 2	20S	5.5	10MS	1.7	TS	0.2	-
	2009 – 10	AVT I	20MS	5.4	5S	1.0	TR	0.1	
xtx180	2010 – 11	EPPSN	10S	3.5	10MS	2.0	TMS	0.2	
	2011 -12	MDSN	5S	3.3	5MR	1.0	0	0	
HI 1571	2008 – 09	NIVT 3	40MR	4.7	5S	1.2	TR	0.0	***Sr2+; Yr2+***
	2009 – 10	AVT I	20S	3.7	10MS	1.4	10MS	1.6	
	2010 - 11	AVT II	20MR	3.6	20S	2.6	10MS	1.4	
	2011-12	EPPSN	10S	2.5	5MR	0.5	TMS	0.2	
	2012-13	MDSN	5S	1.67	20MR	2.73	0	0	
HI 1572	2008 – 09	NIVT 5A	20S	4.7	10MS	1.8	TR	0	***Sr31+; Lr26+; Yr9+***
	2009 – 10	AVT I	10S	2.1	15S	3.7	40S*	8.2	
	2010 - 11	AVT II	5S	2.2	20MS	5.0	5S	1.5	
	2011-12	EPPSN	5S	1.3	5MR	1.0	0	0	
	2012-13	MDSN	5S	3.3	10S	3.47	0	0	

HS = Highest Disease Score (Terminal severity), ACI = Average Coefficient of Infection

Table-3 : Adult-plant responses of bread wheat genotypes to specific pathotypes of stem and leaf rusts.

Genotypes	Year of testing	Trial	Stem rust	Leaf rust						
			40A	117-6			77-5		104-2	
			Indore	Pune	Indore	Pune	Delhi	Ludhiana	Delhi	Ludhiana
HI 1567	2009 – 10	AVT I	5MR	10MR	TR	TR	5R	-	TR	-
HI 1568			5MR	10MR	TMR	TR	5MR	-	TR	-
HI 1569			5R	20MR	TR	5MR	5R	-	10R	-
HI 1571	2009 – 10	AVT I	5MR	5MR	TR	5MR	5R	-	TR	-
	2010 - 11	AVT II	5MR	5MR	5MR	0	TR	0	TR	0
HI 1572	2009 – 10	AVT I	5MR	10MR	0	10MR	5R	-	5R	-
	2010 - 11	AVT II	TR	5MR	5MR	TR	TR	0	5MR	20S

Table-4 : Seedling responses of bread wheat genotypes to individual pathotypes of stem and leaf rusts.

Genotypes	Year	Stem rust pathotypes																				
		40A	117-6	184-1	15-2	21A-2	117 a-1	117-3	40A	42B	11A	40-2	295	40-1	24a	184	15-1	34-1	117-1	117-2	11	122
HI 1567	2009-10	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
HI 1568		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
HI 1569		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
HI 1571	2009-10	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	2010-11	R	R	R	-	R	NG	R	R	R	R	R	R	R	R	-	-	R	R	NG	R	-
HI 1572	2009-10	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	2010-11	R	R	R	-	R	R	R	R	R	R	R	R	R	R	-	-	R	R	R	R	-
		Leaf rust pathotypes																				
		11	12-2	12-3	12-5	12-7	12-9	77	77-1	77-2	77-5	77-7	77-8	77-10	77-11	77A-1	104-2	104-3	104-4	104 B	106	107-1	108-1	162-1
HI 1567	09-10	R	R	R	R	R	-	R	R	R	R	R	MS	R	-	R	R	-	-	R	R	R	R	R
HI 1568		R	R	R	R	R	-	R	R	R	R	R	R	R	-	R	R	-	-	R	R	R	R	R
HI 1569		R	R	R	R	R	-	R	R	R	R	R	R	R	-	R	R	-	-	R	R	R	R	R
HI 1571	09-10	R	R	R	R	R	-	R	R	R	R	R	R	R	-	R	R	-	-	R	R	R	R	R
	10-11	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
HI 1572	09-10	R	R	R	S	S	-	R	S	R	S	S	R	MR	-	R	R	-	-	R	R	R	R	R
	10-11	R	R	R	R	R	S	R	S	R	S	R	R	R	R	R	S	S	S	R	R	R	R	Mix

Pathological Screening Nursery (PPSN), Elite PPSN and Multiple Disease Screening Nursery (MDSN) from 2007 to 2013 (2) were analysed. The genotypes with maximum average co-efficient of rust infection up to 15.0 for a minimum of four years were classified as `resistant'. Responses of the genotypes to specific pathotypes of stem and leaf rust at both seedling and adult-plant stages were also analysed.

Five bread wheat genotypes out of those developed at IARI-RS, Indore *viz*., HI 1567, HI 1568, HI 1569, HI 1571 and HI 1572 (Table-1) were identified to be resistant to stem and leaf rusts in multi-location testing (Table-2). Rust resistance genes like *Sr2*+, *Yr2*+ (HI 1571) and *Sr31+; Lr26+; Yr9+* (HI1572) were postulated in these genotypes (Table-2). All of them were found to be resistant to all the pathotypes at seedling stage except HI 1567, which showed an MS (moderately susceptible) reaction to leaf rust pathotype 77-8 (Table-4). However, all the genotypes showed effective adult-plant resistance against most prevalent and virulent pathotypes of stem and leaf rusts including 40A of stem rust and 77-5 of leaf rust (Table-3). Hence, they can be used as potential resistance donors to breed varieties against these virulent pathotypes. Moreover, HI 1571 and HI 1572 were found to carry non-race specific, non-hypersensitive adult-plant resistance gene *Lr34* (3), which has a history of proven durability. Several of them were found resistant to other diseases like powdery mildew (HI 1567, HI 1572, HI 1569, HI 1568) and flag smut (HI 1567 and HI 1568). Having promoted to Advanced Varietal Trials, these genotypes have good yield potential and other desired agronomic traits too. Hence, these genotypes can be used as potential sources of resistance to stem and leaf rusts along with powdery mildew and flag smut for developing disease resistant high yielding wheat varieties.

CONCLUSION

Wheat is the leading cereal grain produced and consumed in the world. Stem rust (*Puccinia graminis* f. sp. tritici) and leaf rust (*P. triticina*) are amongst the most serious diseases affecting wheat cultivation. Field responses against stem and leaf rusts recorded from 2007-2013 during multi-location testing in coordinated trials were analysed to identify wheat genotypes with combined resistance to both the rusts. The genotypes with average co-efficient of infection up to 15.0 during two years of evaluation in PPSN were further tested in Elite PPSN and MDSN which maintained their resistance through to mixtures of important pathotypes of stem and leaf rusts are being reported in the present short communication. Five bread wheat genotypes out of those developed at IARI-RS, Indore *viz*., HI 1567, HI 1568, HI 1569, HI 1571 and HI 1572 and showed resistance. Thus, these genotypes offer effective sources of resistance to stem and leaf rusts for developing new varieties resistant to both the rusts.

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