Indian J. Genet., **51** (1): 37–41 (1991)

DIVERSITY FOR RESISTANCE AGAINST STRIPE AND LEAF RUST IN SOME CULTIVARS OF WHEAT

S. K. SHARMA, H. S. DHALIWAL, A. S. RANDHAWA AND P. S. BAGGA

Punjab Agricultural University, Regional Research Station, Gurdaspur 143521

(Received: August 22, 1989; accepted: November 25, 1989)

ABSTRACT

The diversity for resistance against stripe and leaf rusts was studied in four resistant exotic wheats, CPAN 1922, CPAN 1973, CPAN 1992 and CPAN 2037. The varieties were crossed among themselves and with WL 711, a highly susceptible variety to both rusts. Incidence of rust was recorded on parents, F_1, F_2 and backcross generations. All the resistant CPAN entries exhibited the presence of identical genes for resistance to stripe and leaf rust. The resistance against leaf rust was caused by a single dominant gene, while the stripe rust resistance was found to be controlled by two dominant genes.

Key words: Wheat, stripe rust, leaf rust, resistance, genetic diversity, inheritance.

Breeding for disease resistance involves identification of stable sources of resistance and their utilization in crop improvement. The resistant genetic stocks may have different or identical gene(s). Limited genetic diversity among resistant stocks may unnecessarily increase the breeding material, while the varieties developed would have narrow genetic base and higher vulnerability to diseases. It is, therefore, necessary to characterize the resistance genes for their genetic diversity. Some wheat introductions from CIMMYT, viz. CPAN 1922, CPAN 1973, CPAN 1992 and CPAN 2037, have shown field resistance to stripe and leaf rusts over years of their testing under artificial epiphytotics at Gurdaspur. These genetic stocks are being used in the breeding programme. The present study is, therefore, an attempt to understand the genetic control and diversity for rust resistance among these stocks.

MATERIALS AND METHODS

Each stripe and leaf rust resistant wheat (*Triticum aestivum*) stock (CPAN 1922, CPAN 1973, CPAN 1992 and CPAN 2037) was crossed with cv. WL 711 in 1985-86. The cv. WL 711 is highly susceptible to the important races of stripe and leaf rusts. Crosses were also made among the resistant stocks. During 1987- 88, one row of each parent and F_1, 15 rows of F_2, and 9 rows of each backcross (BC_1 and BC_2) of each of the ten crosses were grown at the Regional Research Station, Gurdaspur. The row length was 2.25 m with 30 cm and 15 cm spacings between rows and plants within a row, respectively. The rust spreader row containing a mixture of highly susceptible varieties, Agra Local, Kharchia and Lal Bahadur was planted in the border as well as in the different paths in the experiment. The material was inoculated in the field with a mixture of predominant races of both rusts obtained from IARI Regional Research Station, Flowerdale, Shimla, and multiplied in glasshouse at Gurdaspur. Rust reactions were recorded as per standard method on the basis of the disease intensity and type of pustules. All MS and S plants were grouped together as susceptible and the rest as resistant.

RESULTS AND DISCUSSION

The pedigree of all the five parents are given in Table 1. The stripe rust reaction of the parents, F_1, F_2 and backcrosses is given in Table 2. The F_1 in all the crosses were resistant, indicating that stripe rust resistance was dominant. The F_2 segregation of these crosses showed a good fit to 15 R : 1 S ratio. In all the backcrosses with WL 711, the ratio of 3 R : 1S was observed. This means that stripe rust resistance of CPAN 1922, CPAN 1973, CPAN 1992 and CPAN 2037 is governed by two dominant genes. These resistant cultivars, when crossed among themselves, gave F_1, F_2 and back crosses resistant to stripe rust.

Data on leaf rust reaction of the parents and different generations are summarised in Table 3. The rust reaction of different F_1s of the crosses of resistant stocks with WL 711 confirmed dominance of leaf rust resistance. The F_2 of these four crosses had a good fit to 3R : 1 S segregation ratio. In the backcrosses with WL 711, a good fit to 1:1 ratio was obtained. The leaf rust resistance of the resistant stocks is, therefore, controlled by a single dominant gene. Randhawa et al. [1] also reported one dominant gene for leaf rust resistance in CPAN 1973 from crosses with two highly susceptible varieties to leaf rust. These resistant cultivars, crossed among themselves, produced resistant F_1 hybrids, F_2 plants and backcrosses without segregation.

Table 1. Parentage of wheat cultivars

Cultivar	Parentage
CPAN 1922	Ore Fl_2 158-Fdl xCOC75
CPAN 1973	(GLL x Cuc "S") x (KVZ x SX)
CPAN 1992 (Bobwhite "S")	(Au x Kal-Bb) x Wop "S"
CPAN 2037	Samine (D630) Nai-Weiqqui RM x Cno^2-ChrL 932-OL-11AP-OAP
WL 711	(S 308 x Chris) x Kalyan Sona

Therefore, it can be concluded that CPAN 1922, CPAN 1973, CPAN 1992 and CPAN 2037 possess two dominant genes for stripe rust resistance and one dominant gene for leaf rust resistance. Lack of segregation in different generations of resistant x resistant crosses confirms that all the four CIMMYT introductions have the same genes for stripe and leaf rust resistance.

Table 2. Incidence of stripe rust on parents, F_1, F_2 and backcross generations

Parent/generation	Resistant plants	Susceptible plants	Mode of segregation R : S	χ^2 value
Parents:				
CPAN 1922	15	0		
CPAN 1973	12	0		
CPAN 1992	14	0		
CPAN 2037	14	0		
WL 711	0	14		
F_1:				
CPAN 1922 x WL 711	14	0		
CPAN 1973 x WL 711	13	0		
CPAN 1992 x WL 711	15	0		
CPAN 2037 x WL 711	14	0		
F_2:				
CPAN 1922 x WL 711	156	15	15:1	1.85
CPAN 1973 x WL 711	183	10	15:1	0.37
CPAN 1992 x WL 711	169	9	15:1	0.42
CPAN 2037 x WL 711	98	6	15:1	0.04
Backcrosses:				
(CPAN 1922 x WL 711) x WL 711	84	30	3:1	0.11
(CPAN 1973 x WL 711) x WL 711	80	22	3:1	0.64
(CPAN 1992 x WL 711) x WL 711	92	22	3:1	1.97
(CPAN 2037 x WL 711) x WL 711	66	27	3:1	0.80

One of the parents of CPAN 1973 has cv. Kavkaz (Table 1), which carries 1 BL/ 1 RS translocation [2,3]. CPAN 1992 (Bobwhite) had the cv. Aurore in its pedigree, again having 1 BL/1 RS translocation. The 1 BL/1 RS translocation is known to carry Yr 9 and Lr 26 genes [4]. Therefore, CPAN 1922, CPAN 1973, CPAN 1992 and CPAN 2037 seem to carry Yr 9 and Lr 26 genes for stripe and leaf rust resistance, respectively. The second gene for stripe rust resistance is yet to be identified. It will be worthwhile to use anyone of these resistant stocks in wheat breeding.

The genetic study has revealed lack of diversity for resistance in the resistant stocks. This necessitates screening of different wheat germplasms, breeding materials and nurseries to identify diverse genes for resistance so as to utilize them successfully for breeding rust resistant varieties. Additional variability for resistance to rusts and other diseases should

Table 3. Incidence of leaf rust on parents, F_1, F_2 and backcross generations

Parent/generation	Resistant plants	Susceptible plants	Mode of segregation R:S	χ^2 value
Parents:				
CPAN 1922	15	0		
CPAN 1973	12	0		
CPAN 1992	14	0		
CPAN 2037	14	0		
WL 711	0	14		
F_1:				
CPAN 1922 x WL 711	14	0		
CPAN 1973 x WL 711	13	0		
CPAN 1992 x WL 711	15	0		
CPAN 2037 x Wl 711	14	0		
F_2:				
CPAN 1922 x WL 711	125	46	3:1	0.33
CPAN 1973 x WL 711	140	53	3:1	0.62
CPAN 1992 x WL 711	128	50	3:1	0.91
CPAN 2037 x WL 711	74	30	3:1	0.82
Backcrosses:				
(CPAN 1922 x WL 711) x WL 711	50	64	1:1	1.72
(CPAN 1973 x WL 711) x WL 711	48	54	1:1	0.36
(CPAN 1992 x WL 711) x WL 711	51	63	1:1	1.26
(CPAN 2037 x WL 711) x WL 711	48	45	1:1	0.10

also be introduced from allied species and genera of wheat. The 1 BL/1 RS translocation has already shown excellent stable resistance against rusts and powdery mildew both in India and other parts of the world [5].

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