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RUST RESISTANT DERIVATIVES OF CULTIVARS WL 711 AND C 306 OF WHEAT AND THEIR REACTION TO KARNAL BUNT

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ABSTRACT

Forty-two stripe and leaf rust resistant derivatives of cv. WL 711 and 28 of C 306 were evaluated in two yield trials during *rabi* 1990-1991. A number of lines with high rust resistance significantly outyielded the check varieties. Five derivatives of WL 711 and 21 of C 306 were completely free of rusts under field conditions and were significantly superior in grain yield. Among these derivatives, only WG 3964, WG 3965, WG 4033 and WG 4034 had low incidence of Karnal bunt. Other lines were highly susceptible to Karnal bunt.

Key words: *Triticum aestivum*, wheat, rust resistance, Karnal bunt.

WL 711 and C 306 are high yielding, widely adapted wheat (*Triticum aestivum* L.) cultivars recommended for irrigated timely sown and rainfed areas, respectively. WL 711 has consistently given significantly higher yield than other varieties in the All India Wheat Coordinated Trials. It was released for North-Western Plains Zone (NWPZ) in 1976, and is still a promising check for this zone. C 306 was released in 1965, for rainfed areas in the country and is still used as national check. However, both these agronomically superior genotypes have become highly susceptible to leaf rust (*Puccinia recondita* Rob. ex. Desm.). Therefore, a breeding programme was initiated to develop rust resistant derivatives of WL 711 and C 306 through backcross and pedigree methods.

MATERIALS AND METHODS

Wheat varieties CPAN 1922, 1951, 1959, 1962, 1973, 1992, 2010, Bobwhite, PBW 34 and 166, HW 109 and 547 and Girija, which have shown excellent field resistance to stripe and leaf rusts over years, were crossed with the varieties WL 711 and C 306. The F_1s were either backcrossed to WL 711 and C 306 or simply carried forward to F_2. In the segregating generations, promising plants resembling WL 711 and C 306 and having resistance to stripe and leaf rusts were selected. Agra Local, an infector, was sown interspersed and around the

plots. The crop was artificially inoculated with a mixture of predominant races of both the rusts obtained from IARI Regional Research Station, Flowerdale, Shimla, and multiplied in glasshouse. The promising lines were bulked in the F_5 or F_6 generations. The parentage of the derived lines is given in Table 1. Forty two derivatives of WL 711 along with WL 711 and HD 2329 were planted under irrigated, timely sown conditions. In the second

Table 1. Pedigree of different derivatives of wheat varieties WL 711 and C 306

Strain	Parentage
	WL 711 derived lines
WG 3960-3973	WL 711 x (CPAN 1874 x RUFF 'S')
WG 3974-3984	(WL 711 x BOW 'S') x 2 WL 711*
WG 3986-3988	(WL 711 x CPAN 1922) x 2 WL 711*
WG 3989-3997	(Wl 711 x CPAN 1973) x 2 WL 711*
WG 3998	(CPAN 1973 x WL 711) x WL 711
WG 3999	(CPAN 1992 x WL 711) x WL 711
WG 4000	(CPAN 1992 x WL 711) x CPAN 1992
WG 4001	(CPAN 2010 x WL 711) x CPAN 2010
WG 4002	(WL 711 x CPAN 1992) x 2 WL 711*
	C 306 derived lines
WG 4005-4006	[(EG 420 x C 306) x (CPAN 1973 x C 306)] x 2 C 306*
WG 4007	[(PBW 166 x C 306) x PBW 166] x 2 C 306*
WG 4008	[(Girija x C 306) x CPAN 1959] x 3 C 306*
WG 4016-4025	CPAN 1994 x C 306
WG 4026-4030	[(Girija x C 306) x CPAN 1922] x C 306
WG 4031-4034	[(Girija x C 306) x CPAN 1959] x C 306
WG 4035	[(HW 109 x C 306) x CPAN 1959] x C 306
WG 4036	[(CPAN 1951 x C 306) x (CPAN 1962 x PNC 306)]
WG 4037-38	(WG 357 x C 306) x CPAN 1959
WG 4039	(HW 547 x C 306) x C 306

*The numerals 2, 3 indicate two and three back crosses, respectively.

experiment, 28 derivatives of C 306 along with C 306 and PBW 175 as checks were grown under timely sown rainfed conditions at Gurdaspur during rabi 1990–91. Both experiments were laid out in randomized block design with four replications. The gross and net plot sizes were 1.38 x 6 m and 0.92 x 5 m, respectively.

On maturity, data were recorded for grain yield per plot and analysed by the standard statistical method. Rust reactions were recorded as per standard method [1, 2] noting the intensity and type of pustules. Karnal bunt (*Neovossia indica* (Mitra) Mundkur) appeared in epidemic form, therefore, its incidence was recorded on a pooled sample of 2000 grains per line.

RESULTS AND DISCUSSION

WL 711 and C 306 derivatives showing significantly higher grain yield than checks are listed in Table 2. WG 3996, WG 4000, WG 3990, WG 3964, WG 3999, WG 4001, WG 4002, WG 3995,WG 3965 and WG 3981, in order of their ranking, gave significantly higher yield than WL 711 and HD 2329. Their grain yield ranged from 46.7 to 50.0 q/ha against 42.1 and 42.4 q/ha of WL 711 and HD 2329, respectively. At present, HD 2329 is the predominant variety and the highest yielding check in NWPZ. The other derivatives of WL 711 were either statistically at par or numerically superior to WL 711 and HD 2329. All the 42 derived lines were superior to WL 711 and HD 2329 in their leaf rust resistance. Three lines showed disease intensity of 20S-30S, 13 showed disease reaction tS-10S, and 26 were completely free of leaf rust.

Table 2. Grain yield of rust resistant lines derived from crosses with wheat varieties WL 711 and C 306

Category	Total selections	Grai yield (q/ha)
Derivatives of WL 711		
Statistically superior to check	10	46.7–50.0
Statistically at par	32	38.0–46.2
Derivatives of C 306		
Statistically superior to check	25	21.7–40.5
Statistically at par	3	17.9–21.0

Among C 306 derivatives WG 4031, WG 4034 and WG 4039 recorded significantly higher yield of 40.5, 36.9 and 35.6 q/ha in comparison to 30.4 and 16.3 q/ha of PBW 175 and C 306, respectively. Cultivar PBW 175 is the best drought tolerant wheat variety for the entire NWPZ. All other lines from this programme, except WG 4028, WG 4035 and WG 4036, also gave significantly higher yield over C 306. The derivatives of C 306 exhibited excellent leaf rust resistance and seven lines had disease incidence of tS-10S. The lines developed in these two breeding programmes were free from stripe rust.

Karnal bunt reaction of the rust resistant parents used was not known when the crossing programme was undertaken. Most of the high yielding rust resistant selections mentioned in the text had higher Karnal bunt susceptibility than WL 711 and C 306. Twenty-six derivatives of WL 711 and 18 of C 306 showed Karnal bunt incidence higher than the checks. However, a few high yielding rust resistant derivatives like WG 3964 (48.9 q/ha), WG 3965 (46.7 q/ha) and WG 4033 (27.5 q/ha) and WG 4034 (36.9 q/ha) of WL 711 and C 306, respectively recorded low infection of Karnal bunt also (Table 3). These may be used as

parents having resistance to both rusts and Karnal bunt. The derivatives WG 3964 and WG 3965 originated from the cross WL 711 x (CPAN 1874 x RUFF's') while WG 4033 and WG 4034 also had the same parentage [(Girija x C 306) x CPAN 1959] x C 306. There is likelihood of still developing more high yielding and rusts and Karnal bunt tolerant versions of WL 711 and C 306 from these two crosses.

Table 3. Grain yield and leaf rust reaction of derivatives of wheat varieties WL 711 and C 306 with low incidence of Karnal bunt

Variety and derivatives	Grain yield (q/ha)	Leaf rust reaction	Incidence of karnal bunt (%)
Derivatives of WL 711			
WG 3964	48.9	0	2.4
WG 3965	46.7	tR	1.2
WL 711 (ch)	42.1	80S	8.8
HD 2329 (ch)	42.4	40S	9.1
$LSD_{0.05}$	4.3	—	—
Derivatives of C 306			
WG 4033	27.5	10S	3.2
WG 4034	36.9	tS	3.5
C 306 (ch)	16.3	60S	11.1
PBW 175 (ch)	30.4	0	1.4
$LSD_{0.05}$	5.0	—	—

Further, there is a need to develop wheat stocks having multiple disease resistance against rusts, smuts and bunts etc. This will be difficult till rust resistant stocks with major genes for Karnal bunt resistance become available. Recently, monosomic addition lines for chromosome 3 D and 6 D of *Aegilops squarrosa* (DD) accession No. 3754 in *T. durum* cv. PBW 114 were found highly resistant to Karnal bunt when compared with PBW 114 [3]. The wild progenitors of cultivated wheats may, therefore, possess such karnal bunt resistant genes.

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