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STABILITY OF RUST RESISTANCE AND YIELD POTENTIAL OF SOME ICARDA BREAD WHEAT LINES IN PAKISTAN

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Thirty bread wheat lines resistant to Yellow rust (Yr) were selected after careful screening from two ICARDA nurseries during 1998 - 1999, Rabi season at Nuclear Institute for Food and Agriculture (NIFA), Tarnab, Peshawar under severe disease pressure. In the following crop cycle, these selections were again field evaluated for stability and effectiveness of Yr resistance at multilocations while their yield potential was ascertained at Tarnab in two different trials with Tatara as commercial check. Results revealed that uniformity was found in the potential behavior of 23 lines (77%) in both the cropping seasons against Yr. This included some high yielding (up to 7067 kg / ha) and low yielding lines (up to 4333 kg / ha) when compared with the check (6089 kg / ha). Yield potential of some high yielding lines with stable Yr resistance should be further evaluated over sites and seasons for wide adaptability, under national uniform testing in order to select and deploy future varieties to combat Yr for acquiring food security in Pakistan.

Key words: Yellow rust, Bread wheat, Yield potential.

Introduction

Large-scale cultivation of bread wheat varieties with genetic uniformity of rust resistance was one of the major causes of 1994 - 1995 Yr epidemic in northern Pakistan, where losses were up to 40% (Saari *et al* 1995). Inqilab-91 was swiftly spread throughout Pakistan after the defeat of Yellow rust resistance gene Yr 9 in Pirsabak - 85 and Pak - 81, which were extensively grown in the Northwest Frontier Province and barani areas of Punjab. At present, almost 80% of the area under wheat cultivation is occupied by this single variety, posing a high risk of crop loss due to change in races of Yr (Anonymous 2000). Therefore, a constant search for new and stable Yr resistance sources with high yield potential is imperative for the development of improved rust resistant cultivars. This paper reports two years results (1998 - 1999 and 1999 - 2000) of stability of Yr resistance in some selected wheat lines from ICARDA germplasm and their yield potential at Tarnab during 1999 - 2000.

Materials and Methods

Field experiments were conducted to select Yr resistant germplasm at NIFA during 1998 - 1999 from two ICARDA bread wheat nurseries, *viz*, Semi Arid Wheat Screening Nursery (SAWSN) and Wheat Observation Nursery for Drought (WON-D), which were composed of 174 and 91entries, respectively. In each nursery, every entry was planted in strips of small adjacent plots having 2 rows/plot of 2.5 m length and 0.3 m apart. A super susceptible wheat variety (Local White) was sown around each nursery as spreader and also to act as the adult plant susceptible check. Nurseries and spreader were inoculated two to three times in early March using prevailing Yr races obtained from CDRI, Murree. This was done after sunset using a turbo - air sprayer at growth stage 34 - 37 (Zadoks *et al* 1974). Rust severity and response data was recorded on flag leaves after flowering was almost complete and when Local White had severity more than 50%. Severity estimates were based on the Modified Cobb Scale (Paterson *et al* 1948), while host response to infection was scored according to (Singh 1993) and converted to Coefficient of Infection Scale developed by Stubbs *et al* (1986).

Stability of resistance in thirty Yr resistant sources selected during 1998 - 1999 were further filed and evaluated in the following crop cycle (1999 - 2000) at Rawalpindi, Islamabad, Chackwall, Nawshara and Peshawar in the CDRI National Wheat Disease Screening Nursery (NWDSN). Each entry was planted in a single 1m row, 0.3 m apart. Two rows of rust susceptible spreader consisting of Local White, Moroco and Sonora were planted around the nursery. In addition, a row of susceptible check (Local White) was also planted at the 5th and then every 25th subsequent row. Artificial rust inoculation and Yr data was recorded in the same way as mentioned above. Thirty selected lines were also evaluated for yield potential during 1999 - 2000 in two different trials of 15 selections each.

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These were laid out at NIFA in a Randomized Complete Block (RCB) design with three replications, with Tatara as check. Each entry was planted on 4.8 m^2 plot with 4 rows, 4 m long and 0.3 m apart. Both trials were sown on October 10, 1999 with seed rate of 100 kg / ha. Recommended doses of fertilizer were applied and normal agronomic practices were carried out during the growing season. Each entry was harvested at maturity and threshed separately to determine grain yield/plot, which was converted to kg/ha and analyzed statistically according to Gomez and Gomez (1984).

Results and Discussion

Recorded data with brief description are given below:

Stability of Yr resistance. Response of thirty ICARDA bread wheat lines along with susceptible check (Local White) to Yr during two crop cycles in Pakistan is presented in Table 1. During 1998-1999, 27 lines were found to be resistant, while the remaining three displayed moderate susceptibility to Yr. Coefficients of infection for these two classes were < 3 and < 9, respectively. Coefficients of infection values < 3 indicated

Table 1
Yellow rust response of some ICARDA bread wheat lines during two crop cycles in Pakistan

S.No.	Wheat Lines	Nursery number	Coefficient of infection (1998 - 1999)[a]	Average coefficient of infection (1999 - 2000)[b]	Terminal reaction [c]
1	BWL - 2001	SAWSN - 15	< 3	< 3	5MRMS
2	BWL - 2002	SAWSN - 18	< 3	< 3	TRMR
3	BWL - 2003	SAWSN - 23	< 3	< 3	TS
4	BWL - 2004	SAWSN - 25	< 5	< 3	TMSS
5	BWL - 2005	SAWSN - 29	< 5	< 3	TRMR
6	BWL - 2006	SAWSN - 62	< 3	< 5	20MSS
7	BWL - 2007	SAWSN - 64	< 3	< 3	TR
8	BWL - 2008	SAWSN - 72	< 9	< 3	5MRMS
9	BWL - 2009	SAWSN - 119	< 3	< 3	TS
10	BWL - 2010	SAWSN - 124	< 3	< 3	TR
11	BWL - 2011	SAWSN - 135	< 3	< 3	TR
12	BWL - 2012	SAWSN - 136	< 3	< 3	TR
13	BWL - 2013	SAWSN - 144	< 3	< 3	TMS
14	BWL - 2014	SAWSN - 157	< 3	< 5	20MS
15	BWL - 2015	SAWSN - 165	< 3	< 3	5MSS
16	Local White	Check	100	60	60S
17	BWL - 2016	WON-D - 1	< 3	< 8	40MSS
18	BWL - 2017	WON-D - 2	< 3	< 3	TR
19	BWL - 2018	WON-D - 9	< 3	< 3	TR
20	BWL - 2019	WON-D - 10	< 3	> 10	40S
21	BWL - 2020	WON-D - 11	< 3	< 3	TMSS
22	BWL - 2021	WON-D - 15	< 3	< 3	10S
23	BWL - 2022	WON-D - 19	< 3	< 3	TR
24	BWL - 2023	WON-D - 39	< 3	< 3	TR
25	BWL - 2024	WON-D - 43	< 3	< 3	TR
26	BWL - 2025	WON-D - 48	< 3	< 3	TR
27	BWL - 2026	WON-D - 64	< 3	< 3	TR
28	BWL - 2027	WON-D - 81	< 3	< 3	TMR
29	BWL - 2028	WON-D - 82	< 3	< 3	TR
30	BWL - 2029	WON-D - 87	< 3	< 3	TR
31	BWL - 2030	WON-D - 89	< 3	< 3	TR
32	Local White	Check	60	60	60S

[a], Based on NIFA Yr data; [b], Means of Coefficients of Infection values computed for five locations of Yr data in Pakistan; [c], Maximum Potential reaction during 1999 - 2000.

Table 2
Yield potential of Yr resistant lines selected from ICARDA germplasm in two experiments at NIFA during 1999 - 2000 rabi season

S.No.	Wheat lines	Grain yield (kg / ha)	Increase decrease over check (%)
		EXPERIMENT 1	
1	BWL - 2001	4889	(-) 17.91
2	BWL - 2002	5289	(-) 11.19
3	BWL - 2003	5422	(-) 8.96
4	BWL - 2004	5889	(-) 1.12
5	BWL - 2005	6444	(+) 8.19
6	BWL - 2006	6133	(+) 2.97
7	BWL - 2007	4333	(-) 27.24
8	BWL - 2008	6022	(+) 1.10
9	BWL - 2009	7067	(+) 18.53
10	BWL - 2010	5644	(-) 5.23
11	BWL - 2011	5222	(-) 12.32
12	BWL - 2012	5222	(-) 12.32
13	BWL - 2013	5600	(-) 5.97
14	BWL - 2014	5667	(-) 4.85
15	BWL - 2015	5444	(-) 8.59
16	Tatara	5956	-
	LSD (0.05)	1424.12	
		EXPERIMENT 2	
17	BWL - 2016	5778	(-) 7.13
18	BWL - 2017	5556	(-) 10.70
19	BWL - 2018	5111	(-) 17.85
20	BWL - 2019	5556	(-) 10.70
21	BWL - 2020	6267	(+) 0.72
22	BWL - 2021	5378	(-) 13.56
23	BWL - 2022	5333	(-) 14.28
24	BWL - 2023	6444	(+) 3.56
25	BWL - 2024	6178	(-) 0.70
26	BWL - 2025	4978	(-) 19.99
27	BWL - 2026	5200	(-) 16.42
28	BWL - 2027	5511	(-) 11.42
29	BWL - 2028	6444	(+) 3.56
30	BWL - 2029	5556	(-) 10.70
31	BWL - 2030	5333	(-) 14.28
32	Tatara	6222	-
	LSD (0.05)	1467.99	

that the genotypes possess adequate resistance, while < 10 showed partial susceptibility according to Saari and Wilcoxson (1974). In the multilocation screening which was carried out in the following season (1999 - 2000), number of resistant wheat lines was reduced to 26, three expressed moderate susceptibility, and for one genotype rust developed in an out of control fashion with ACI > 10, demonstrating high susceptibility. Inconsistency was recorded in the Coefficients of Infection values of seven genotypes in both years. During the 1998-1999 season, three lines (BWL - 2004, BWL - 2005 and BWL - 2008) had < 9 Coefficient of Infection which were reduced to < 3 in the following year. Similarly, Coefficients of Infection of four lines (BWL - 2006, BWL - 2014, BWL - 2016 and BWL - 2019) were < 3 in 1998 - 1999, but higher during 1999 - 2000, varying between < 5 to > 10. Based on the inconsistent performance of these seven genotypes to Yr, it was concluded that variability in the environment might be responsible, but this needs further study.

Out of the 30 selected genotypes, 23 were found stable for Yr resistance and produced similar resistant (ACI < 3) behavior in the multilocation screening when compared with their original response recorded during 1998 - 1999 (Table 1). In addition, the terminal Yr reaction of these 23 genotypes was desirable because rust severity was negligible to maximum of 5%,while the highest infection type was MR to MS. Furthermore, these results showed that the selection efficiency for rust resistant sources remained about 77%.

Assessment of yield potential. Yield potential of 30 Yr resistant wheat lines evaluated at Tarnab in two trials during 1999 - 2000 are presented along with commercial check (Tatara) in Table 2. Variability in yield potential was observed, but statistically no significant difference was found among the lines when compared with checks in their respective trials. However, seven lines (BWL - 2005, BWL - 2006, BWL - 2008, BWL - 2009, BWL - 2020, BWL - 2023 and BWL - 2028) produced up to 19% more grain yield than the commercial check. Twenty-three lines had lower yield than the check.

Out of the 23 Yr stable lines, only four (BWL - 2009, BWL - 2020, BWL - 2023 and BWL - 2028) produced higher grain yield than Tatara, which ranged from 45 - 1104 kg / ha (Table 2). Further evaluation of this material under national uniform testing for wide adaptability may result in to one or more Yr resistant cultivars. In addition, very useful material was found in this study although low yielding showed stability of resistance to Yr over sites/seasons and can be used as candidate sources of resistance by wheat breeding programs in Pakistan.

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