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The Virulence Spectrum of Wheat Leaf Rust in Southern Punjab, Pakistan

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Abstract: 38 isogenic lines were studied for the presence of wheat leaf rust virulence during the years 1997-98 to 2001-2002 at Regional Agricultural Research Institute, Bahawalpur. Lr9, Lr19, Lr24, Lr25 and Lr36 were free of reaction whereas Lr3ka, Lr12, Lr13 and Lr17 exhibited resistant reaction. 18 lines (Lr1, Lr2a, Lr2c, Lr3, L3bg, Lr8, Lr10, Lr11, Lr14a, Lr14b, Lr16, Lr20, Lr21, Lr22b, Lr23, Lr26, Lr29 and Lr30) gave high population of virulence and exhibited 20S-100S reaction through out the study period. Lr18 and Lr34 gave improvement in reaction, which may be due to decline in their corresponding virulence. Lr34 is an adult plant resistant gene and can be exploited in combination with other genes. The high frequency of leaf rust virulence for Lr26 was recorded consistently during 4 year because the wheat varieties carrying Lr26 gene remained in the field covering vast area throughout the world. This gene in combination with other genes is effective against prevailing leaf rust pathogens in most of the cultivars in Pakistan.

Key Words: Wheat leaf rust virulence, resistance, Southern Punjab

Introuction

Leaf rust (***Puccinia recondita*** Rob. Ex. Desm. f. s***p. tritici*** Eriks. and E-Hennis) is worldwide in distribution and the most destructive foliar disease of the wheat crop. This disease can jeopardize wheat production especially in favourable conditions when it spreads fast and significantly reduces the yield (Hassan, 1979).

The loss in yield depends upon disease intensity and time of infection (Anonymous, 1993). Losses in grain yield in susceptible cultivars may exceed 50% in case of early onset of rust (Yaqoob, 1991). In Australia, Rees and Platz (1975) estimated crop losses upto 30% in susceptible varieties due to leaf rust. Meenakumari ***et al.*** (1992) evaluated 12 wheat varieties in India and recorded more than 60% losses in susceptible varieties.

Leaf rust pathogen is prolific in nature and possesses many physiological races (Johnston and Browder, 1966). These races vary in virulence and are capable of infecting different wheat cultivars. (Nayar ***et al.***, 1987). This ever changing nature of the pathogen has complicated the breeding for rust resistance. So far, 45 resistant genes have been identified (Roelfs ***et al.***, 1992). However, only 35 Lr genes have been well recognized (Browder, 1980). To identify the virulence in ***P. recondita***, monitoring is being done on the basis of their phenotypic expression with Lr genes in wheat line in wheat growing countries.

In present studies, the trap nursery was grown at Regional Agricultural Research Institute, Bahawalpur during 1997-98 to 2001-02 to ascertain the virulence pattern of wheat leaf rust in southern zone of the Punjab. The findings of such studies will provide the breeders early information about the behavior of Lr genes against existing leaf rust virulence patterns and timely warning for breeder to evolve new resistant varieties.

Materials and Methods

The studies were conducted in 5 consecutive years (1997-98 to 2001-02) with 38 isogenic lines provided by CIMMYT, Mexico. These lines carry leaf rust (Lr) resistance genes known as Lr differentials. The test entries of the trap nursery were planted in a single 2 m long and 30 cm apart row at Regional Agricultural Research Institute, Bahawalpur during mid November to mid December. Two rows of susceptible checks (Morocco and Local White) were also sown around the block to encourage maximum infection. These varieties are highly susceptible to all prevalent rust races and provide a substrate for rapid multiplication and distribution of rust inoculum.

The rust observations were recorded at 10-15 days interval starting from the appearance of rust upto the maturity of the crop. Regional Agricultural Research Institute, Bahawalpur is the site for breeding of wheat for southern zone of the Punjab and artificial inoculation is used to screen segregating generations. There is usually a high inoculum pressure at this station. The data of rust incidence was recorded following the method described by Peterson ***et al.*** (1948). The observations were compared among the years to find out the virulence patterns of rust races and their relative incidence.

Results and Discussion

A perusal of data shows the year-to-year fluctuation in relative leaf rust incidence level on Lr differentials (Table 1). Climatic conditions of the year 2001-02 did not favour the rust development as drought conditions prevailed and precipitation remained very low throughout the crop period. That's why most of the lines showed 0 reaction and only those entries exhibited traces (TR) reaction which were highly susceptible during 1997-98 to 2000-01. The genes Lr9, Lr19, Lr24, Lr25 and Lr36 were free of infection except Lr9 which gave resistant reaction (10R) during 1998-99 and Lr24 exhibited moderately resistant reaction (40MR) during 1999-2000.These results are in accordance with the findings of Chaudhry ***et al.*** (1995) who recorded the same observations during 1991-94 in the Punjab and Kaghan and reported that leaf rust resistant genes Lr9, Lr19, Lr24, Lr25 and Lr28 gave 0 reaction against all the prevailing rust races. It indicates their maintenance of resistance against all the prevailing rust virulences.

Majority of the Lr genes were susceptible and exhibited 20S-100S leaf rust reaction during Ist four years of study. Eighteen (18) isogenic lines exhibited susceptible reaction. These include Lr1, Lr2a, Lr2c, Lr3, Lr3bg, Lr8, Lr10, Lr11, Lr14a, Lr14b, Lr16, Lr20, Lr21, Lr22b, Lr23, Lr26, Lr29 and Lr30. These Lr genes are ineffective worldwide and show susceptible reaction to most of the leaf rust races (Long ***et al.***, 1988; Perez and Roelfs, 1987 and Pretorious ***et al.***, 1987). Lr 11 is reported to have moderate to high frequency of virulence in Pakistan (Huerta-Espino, 1992). The high frequency of leaf rust virulence (20S-80S) for Lr26 was recorded consistently during 1997-98

Table 1: Reactions of near Isogenic Lines to *Puccinia Recondita* Rob.ex.desm. F. Sp. *Tritici* at Regional Agricultural Research Institute, Bahawalpur During 1997-98 to 2001-02

		Leaf rust virulence				
S. No.	Lr. Genes	1997-98	1998-99	1999-00	2000-01	2001-02
1	Lr-1	40MSS	20S	100S	60S	TRS
2	Lr-200	0	5RMR	60S	20MSS	0
3	Lr-2b	0	0	60MSS	20MSS	0
4	Lr-2c	40MSS	20S	60S	60S	Tr
5	Lr-3	60MSS	40S	100S	60S	0
6	Lr-3bg	40MSS	100S	80S	60S	0
7	Lr-3ka	10MR	10MR	20MR	20MRMS	TRS
8	Lr-8	40S	10R	20MS	60S	0
9	Lr-9	0	100S	0	0	0
10	Lr-10	80S	100S	40MSS	40MSS	0
11	Lr-11	40S	80R	80S	40S	0
12	Lr-12	0	5R	10R	10MRMS	0
13	Lr-13	Tr	80S	Tr	0	0
14	Lr-14a	60S	40S	20MSS	40S	Tr
15	Lr-14b	20S	10S	10RMR	80S	TRMR
16	Lr-15	0	80S	0	5MSS	Tr
17	Lr-16	80S	80S	20MSS	40MSS	0
18	Lr-17	5RMR	20MSS	TR	20MRMS	0
19	Lr-18	30S	60MSS	40RMR	20MRMS	TR
20	Lr-19	0	5MRMS	0	0	TR
21	Lr-20	10S	80S	20MSS	10S	-
22	Lr-21	10MRMS	40S	20MSS	10MRMS	-
23	Lr-22a	5RMR	40S	10R	0	-
24	Lr-22b	80S	100S	60S	80S	TMR
25	Lr-23	80S	100S	60S	60S	TMR
26	Lr-24	0	0	20MR	0	0
27	Lr-25	0	0	0	0	0
28	Lr-26	80S	80S	20S	40S	0
29	Lr-28	0	0	10MRMS	5MS	0
30	Lr-29	20S	40S	40MSS	40S	0
31	Lr-30	20S	80S	20MSS	40MSS	0
32	Lr-33	10MS	80S	40S	40MSS	0
33	Lr-34	30S	40S	60S	20MRMS	0
34	Lr-36	0	0	0	0	0
35	Lr-37	30S	60S	20MRMS	20MRMS	TR
36	Lr-13 (WL-711)	80S	30S	40S	30S	-
37	Lr-27+31	10S	10MS	20MS	10RMR	0
38	Lr-23+Gazaw	-	20S	20MS	5MSS	0

to 2000-01 in the present studies. Chaudhary ***et al.*** (1996) reported that wheat cultivars based on Lr26 resistance i.e. Pak-81, Pirsabak-85, Punjab-85 and Mehran-88 gave high leaf rust reaction (60-100 MSS) during 1994-95 at Bahawalpur, Khanewal and Faisalabad. Later on these varieties were withdrawn due to virulence against it. This gene in combination with other genes is

effective against prevailing leaf rust pathoypes in most of the varieties. Lr26 give immune reaction with avirulent pathotypes (Roelfs ***et al.***, 1992). The races carrying Lr26 virulence have established widely in the world (Khan ***et al.***, 2002). During 1999-2000 green house virulence analysis of the leaf rust diseased samples from Bahawalpur, Mardan and Pirsabak showed 10, 33 and 12% presence of virulence respectively for these genes (Anonymous, 2000). Lr3ka, Lr12, Lr14b, Lr22a and Lr34 were previously reported to be susceptible (Chaudhry ***et al.***, 1995) while in present studies these genes showed different type of reactions in different years. Lr3ka, Lr12, Lr13 and Lr17 remained resistant throughout the study period while Lr34 showed improvement in virulence.

Lr14b was susceptible during 1997-98, 1998-99 and 2000-01 while during 1999-2000 it gave resistant reaction (10RMR), which may be either the result of escape or due to change of varieties in the field. Lr13 is one of the most frequent Lr resistant genes present in the commercial varieties/lines of Pakistan and most of the varieties like Pak-81, Blue Silver, LU-26, Pari-73, Pavan-76 and Punjab-81 were withdrawn because of the prevailing virulence against this gene in the past. Virulence against this gene is still indicated by the reactions at different sites i.e. Peshawar, Pirsabak and Tarnab. Green house analysis of disease samples from these sites confirmed the presence of virulence (Anonymous, 2000).

Lr 15, Lr17, Lr19, Lr22a, Lr28 and Lr27+31 projected variable reaction. These reactions did not appear in some years, while in others these genes gave high to moderate virulence of rust. This occasional trapping of such type of genes indicates its presence and may cause problem if wheat varieties evolved and cultivated widely with these genes. However, these genes may be used in different combinations for lasting resistance e.g. Lr27+31 is postulated in our leading variety i.e. Inqlab-91 with Lr10. Lr18 and Lr34 gave improvement in rust reactions during the study period perhaps due to decline in their corresponding virulence. First 2 and 3 years these were susceptible and later on became resistant. Lr 18 is not postulated in Pakistani wheat, whereas, Lr34 is an adult plant resistant gene and can be exploited in combinations with other genes.

The breeders need to plan their breeding programme very judiciously for evolving varieties with different genetic background for resistance to leaf rust.

The results of present studies provide sufficient information for planning of wheat breeding for leaf rust resistance in terms of behavior of Lr genes to existing virulence pattern.

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