

LEAF RUST DEVELOPMENT IN VARIOUS CULTIVARS OF WHEAT CARRYING DIFFERENT KNOWN GENES FOR RESISTANCE

A.A. HAKRO, M. ASLAM AND A.K. KHANZADA

*Crop Diseases Research Institute,
Pakistan Agricultural Research Council, Karachi-75270, Pakistan.*

Abstract

Wheat cultivars Punjab 76 (Lr1), Chenab 70 (Lr13), Khyber 79 (Lr13), ZA-77 (Lr1 + 13), Faisalabad 83 (Lr + 13), Lyallpur 73 (Lr1 + 13), Pari-73 (Lr1 + 13), Sandal (Lr1 + 13), Sindh 81 (Lr1 + 13), Yecora (Lr1 + 13), Zamindar (Lr1 + 13), Zarghoon (Lr1), Arz (Lr3 + 13), Barani 83 (Lr3 + 13), Punjab 81 (Lr13 +) and Morocco (without gene) for leaf rust resistance were included in the test. The plants 45 days after planting were inoculated through spraying with aqueous suspension of uredospores of *Puccinia recondita*. Leaf rust epidemic was first observed early in February on Morocco which does not carry any known gene for resistance. The start of the disease on the cultivars carrying one or other gene (s) for resistance were delayed by one to three weeks. Similarly the rate of development of the disease per unit time was also slower on cultivars carrying a gene for resistance than on the one without any known gene for resistance.

Introduction

Leaf rust disease of wheat caused by *Puccinia recondita* Rob. Ex Desm. f.sp. *tritici* is one of the most important maladies affecting the crop since it not only causes appreciable losses in yield *per se* but also reduces grain quality to a considerable extent. It is cosmopolitan in nature and encountered almost throughout the world. According to most conservative estimates an epidemic of mild severity of this disease which occurred in Pakistan during the 1977-78 crop season caused a loss of 10% to the country's wheat production (Hassan *et al.*, 1979). Breeding for resistance provides the only economical and efficient means of managing the disease in the field. Kirste (1958) experimentally demonstrated that when late blight was severe at Celle in Germany, use of resistance delayed the start of the epidemic. Based on this and similar other data Vander Planck (1968) argued that while the use of monogenic "Vertical resistance" delayed the start of the epidemic, presence of the polygenic "horizontal resistance" in a cultivar slowed the progress of the epidemic. Aslam (1972) indicated that delay in the onset of the epiphytotic was proportional to the amount of resistance present in the host population. Hussain *et al.*, (1988), Khanzada (1989), and Hamid (1988) postulated the presence of a number of genes for leaf rust resistance in Pakistani wheats. The effect of these genes on rust development was studied under field conditions in cultivars possessing them.

Materials and Methods

Wheat cultivars Punjab 76 (Lr1), Chenab 70 (Lr13), Khyber 79 (Lr13), ZA-77 (Lr1 + 13), Faisalabad 83 (Lr1 + 13), Lyallpur 73 (Lr1 + 13), Pari-73 (Lr1 + 13), Sandal (Lr1 + 13), Sindh 81 (Lr1 + 13), Yecora (Lr1 + 13), Zamindar (Lr1 + 13), Zarghoon (Lr1), Arz (Lr3 + 13), Barani 83 (Lr3 + 13), Punjab 81 (Lr13 +), and Morocco which does not carry any known gene for resistance were included in the test. Each cultivar

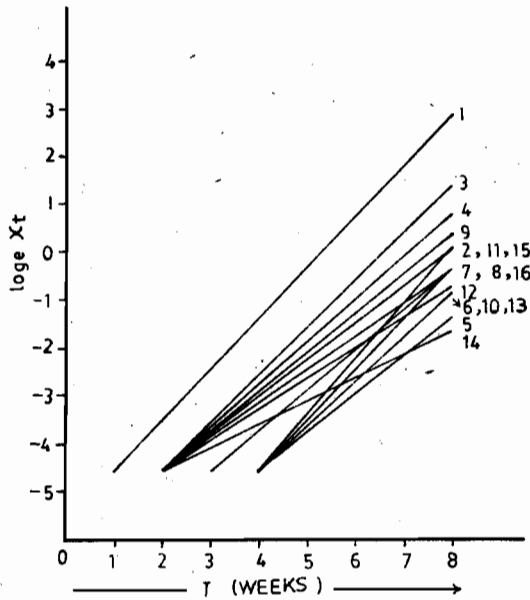


Fig.1. Progress of the leaf rust epidemic on test lines plotted on log linear scale.

was planted in 2x2m plots. The trial with three replications was laid out in randomized complete block design.

The plants were inoculated through spraying with an aqueous suspension of uredospores of *P. recondita* 45 days after planting. The inoculum besides carrying high pathogenicity against all genes included in the test also possessed virulence against (Lr1,3,10,11,13,15,17,20,23 and 30).

Data on disease severity (Table 1) according to the modified Cobb's Scale was collected at weekly intervals starting with the first appearance of the disease. The relative rate (r_1) of disease development on each cultivar was calculated using the methods of Vander Planck (1963). The progress of the epidemic on test lines was plotted on a log-linear scale (Fig.1).

Results and Discussion

The start of the epidemic was first observed on 5th February on Morocco which does not carry any known gene for resistance (Table 1). On the otherhand the start of the epidphytotic on the cultivars carrying one or the other gene (s) for resistance appear to have been delayed by one to three weeks. Since high pathogenicity at the loci corresponding to the genes for resistance carried by the cultivars included in these studies was present in the inoculum and is also available in nature, the apparent delay in the onset of disease could probably be due to the presence of hitherto unresolved gene (s) or due to the complimentary effect of genes conditioning resistance at the adult plant stage.

Table 1. Leaf rust development in various cultivars of wheat carrying different known genes for resistance.

S.No.	Variety	Lr gene	5/2	11/2	17/2	24/2	2/3	10/3	17/3	24/3	r1/wk
1.	Morocco	None	Ts	5s	10s	20s	50s	70s	90s	95s	1.08
2.	Punjab 76	Lr1	0	Ts	2s	5s	10s	20s	30s	50s	0.77
3.	Chenab 70	Lr13	0	2s	5s	10s	20s	50s	70s	80s	0.88
4.	Khyber 79	Lr13	0	Ts	2s	5s	15s	30s	50s	70s	0.91
5.	ZA-77	Lr1,13	0	0	0	Tms	Tms	5ms	10ms	20ms	0.80
6.	Faisalabad 83	Lr1,13	0	0	0	Tms	5ms	10ms	20ms	30ms	0.94
7.	Lyallpur-73	Lr1,13	0	0	0	Tms	5ms	10ms	20ms	40ms	0.05
8.	Pari-73	Lr1,13	0	Ts	Ts	5s	10s	20s	30s	40s	0.70
9.	Sandal	Lr1,13	0	Ts	2s	5s	10s	20s	30s	30s	0.82
10.	Sindh 81	Lr1,13	0	0	0	Ts	5s	10s	20s	30s	0.94
11.	Yecora	Lr1,13	0	0	Ts	5s	10s	20s	40s	50s	0.92
12.	Zamindar	Lr1,13	0	Tms	2ms	5ms	5ms	10ms	20ms	20ms	0.64
13.	Zarghoon	Lr1+	0	0	0	Tms	5ms	10ms	20ms	30ms	0.94
14.	Barani 83	Lr3,13	0	Tms	2ms	5ms	5ms	5ms	10ms	10ms	0.48
15.	Punjab 81	Lr13+	0	Tms	2ms	5ms	10ms	20ms	40ms	50ms	0.77
16.	Arz	Lr3,13	0	0	Tms	2ms	5ms	10ms	20ms	40ms	0.84

The highest relative rate (r_1) of disease progress, 1.08 wk⁻¹, was observed on variety Morocco and the lowest r_1 of 0.48 wk⁻¹ was recorded for cv. Barani 83 carrying both Lr3 & 13. This can easily be seen from the slope of lines in Fig.1. Because of the small differences in the r_1 of disease development for different cultivars overlaps occur in lines showing progress of the epidemic in various cultivars. This is indicated by numeral relating to cultivars in Table 1 against each line. Although most of the other varieties included in the test also carry both these resistance yet rust developed on these varieties at significantly different rates. According to McIntosh (personal communication) Lr13 is a complex locus which in addition to the major gene also carries a number of other minor genes which compliment the resistance conditioned by this locus. Aslam, Barney, and Munir (in press) have experimentally demonstrated differences in latent period between varieties carrying Lr13. According to them these differences are due to the presence or otherwise of one or more of the genes complimenting Lr13. Thus the rate of rust development on a variety may be proportional to the compliment of these supporting genes present at the locus.

References

- Aslam, M. 1972. *Aggressiveness in Puccinia recondita Rob. ex. Desm. f. sp. tritici*. I. Concepts and terminology. II. Predominance of one culture over another in composites. III. Components of aggressiveness. Ph.D. Dissertation. Kansas State. Univ.
- Aslam, M., K.Burney and A. Munir. 1992. Preliminary evidence for specificity between factors controlling latent period in wheat cultivars and brown rust isolates. *Pak. J. Bot.*, 24: 183-186.

- Hamid, S.J. 1988. Genetics and Breeding for rust resistance in wheat. Visiting scholar report. PBI, Castle Hill, Sydney.
- Hassan, S.F., M. Hussain and S.A. Rizvi. 1979. *Proceeding National Farmers and Wheat Research Production*, Islamabad. August, 6-9, pp.231-234.
- Hussain, M., A.A. Hakro, M. Aslam and E. Gordon-Werner. 1988. Postulated genes for rust resistance in Pakistani wheats. *Cereal Rust Conference, Vienna, Austria*. September 5-9, pp.137-139.
- Khazada, A.K. 1989. Genetics and Breeding for rust resistance in wheat. Visiting scholar report. PBI, Castle Hill, Sydney.
- Kirste, 1958. Ergebnisse von Krautfäule-Spritzversuchen. *Kartoffelbau*, 9: 114-115.
- Vander Planck, J.E. 1963. *Plant disease epidemics and their control*. Academic Press.
- Vander Planck, J.E. 1968. *Plant disease resistance*. Academic Press.

(Received for Publication 15 July 1992)