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Observed and Hypothetical Leaf Rust Progress Curves of Some Genotypes of Wheat

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Summary. The hypothetical leaf rust progress curves of 15 genotypes of wheat were generated by integrating the components of slow rusting resistance determined in the glasshouse. The area under the disease progress curve (AUDPC) from the hypothetical and observed leaf rust progress curves were compared. It was found that the hypothetical AUDPC values of all the genotypes studied were smaller than their respective observed AUDPC values. Possible causes for the discrepancies in the observed and hypothetical values are discussed.

Key words: Wheat – Leaf rust – Resistance

Introduction

Cereal rusts are polycyclic diseases and therefore it is difficult to predict the effect of a component or a set of components of host resistance estimated in monocyclic-infection experiments conducted in the glasshouse. This is because the various components are quantitative in nature and interact together in determining the progress of an epidemic. This difficulty in directly extending glasshouse data to field performance of slow leaf rusting wheat cultivars was recognized by Shaner and Hess (1978) who developed a set of equations to generate leaf rust progress curves from the components of slow rusting resistance estimated in the glasshouse. Using these equations the hypothetical leaf rust progress curves of 15 genotypes of wheat are generated and compared with the observed leaf rust progress curves in the field. The results are reported here.

Material and Methods

The components of slow rusting resistance required to generate disease progress curves using the equations of Shaner and Hess (1978) were estimated in the glasshouse on seedlings during the period December, 1978 to March, 1979. The host genotypes consisted of five wheat varieties/cultures: 'Kharchia Local', 'Lal Bahadur' (both fast-rusters), HD 2009, 'Sonalika' and L 1435/14581 8156 (all slow-rusters), and their 10 hybrids, obtained by crossing them in all possible combinations excluding reciprocals. A single race, 77A, of *Puccinia recondita f.* sp. *tritici*, which was fully virulent on all the wheat genotypes, was used in the study. All the genotypes were sown in the field in a single randomized block design on November 30, 1978. The spreader rows were inoculated on December 30, 31, 1978 and January 1, and 2, 1979. For generating leaf rust progress curves January 15, 1979 was taken as day zero (since all the uredia generally appear by 13th day after inoculation). Since the component v, the proportion of spores that land on a potential infection site and give rise to uredium, was not determined experimentally, the value obtained by Shaner et al. (1978), i.e. v = 0.12, was used and was assumed to be the same for all genotypes. The number of uredia appearing each day (N_i), the number of daily infections (Y_i) and the proportion of leaf tissue that was infected through $(i-1)^{th}$ day ($A_i - 1$), were calculated according to Shaner and Hess (1978). The disease severity (Y_i) was calculated using the formula:

$$Y_i = \frac{a \times \sum_{J=0}^{i} N_i}{\alpha}$$

(where N_i, a and α are as described by Shaner and Hess 1978). The epidemic was simulated on a leaf blade area of 10^4 mm^2 with 10 initial infections because when these values were used the observed and hypothetical disease progress curves of 'Kharchia Local' were almost identical. The observed and hypothetical areas under disease progress curve (AUDPC) were calculated using the formula of Shaner and Finney (1977). The closeness of agreement between the observed and expected values was tested by calculating the correlation coefficient between them. The disease severity and AUDPC were obtained by using the B 4700 computer.

Results and Discussion

The observed and hypothetical leaf rust progress curves of different genotypes of wheat are given in Figures 1 to 6. The hypothetical AUDPC values of the different geno-

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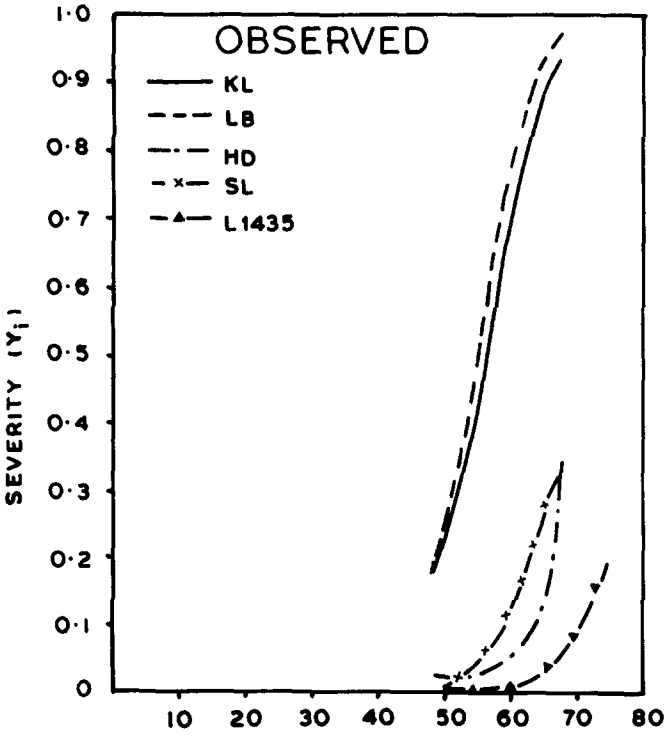

Fig. 1.

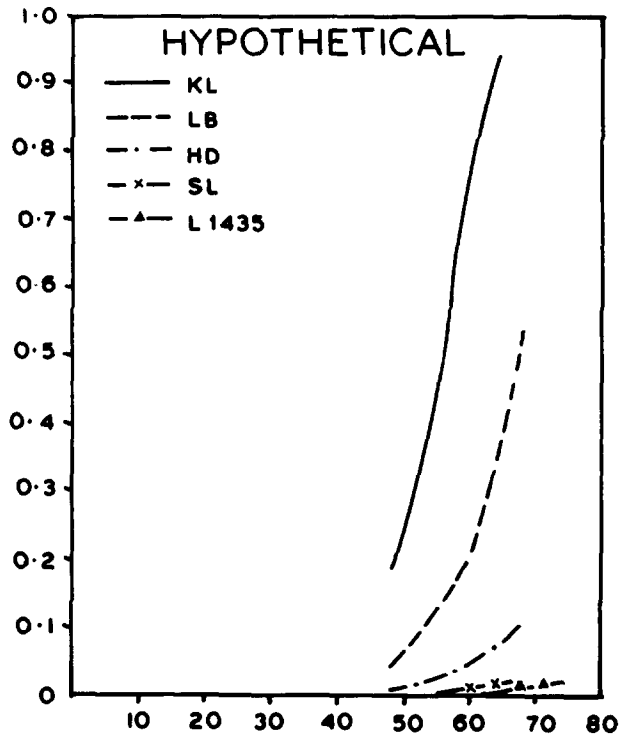

Fig. 2.

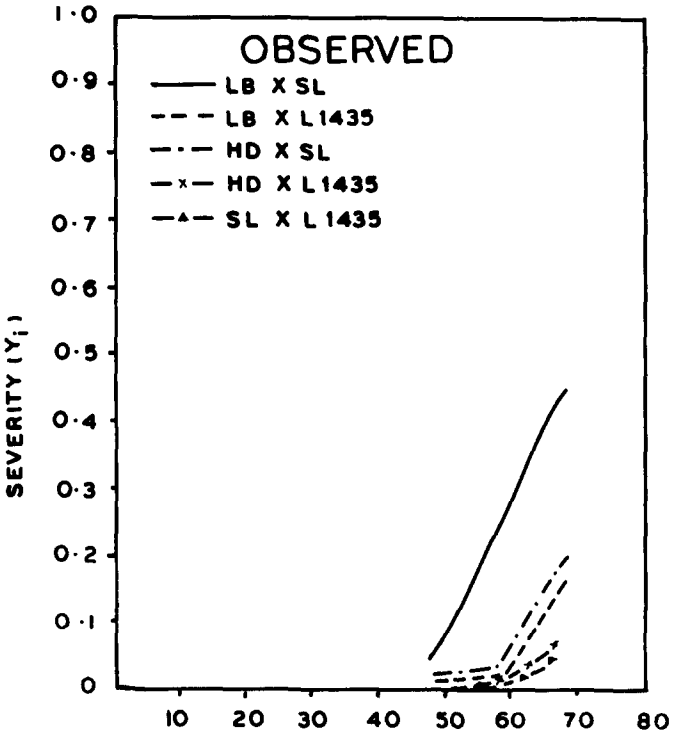

Fig. 3.

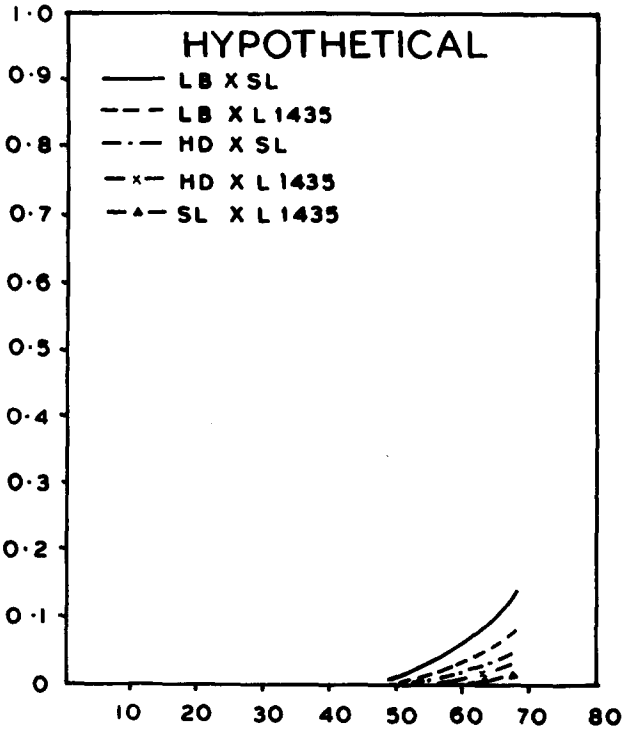

Fig. 4.

Figs. 1-6. Observed and hypothetical leaf rust progress curves of different wheat genotypes

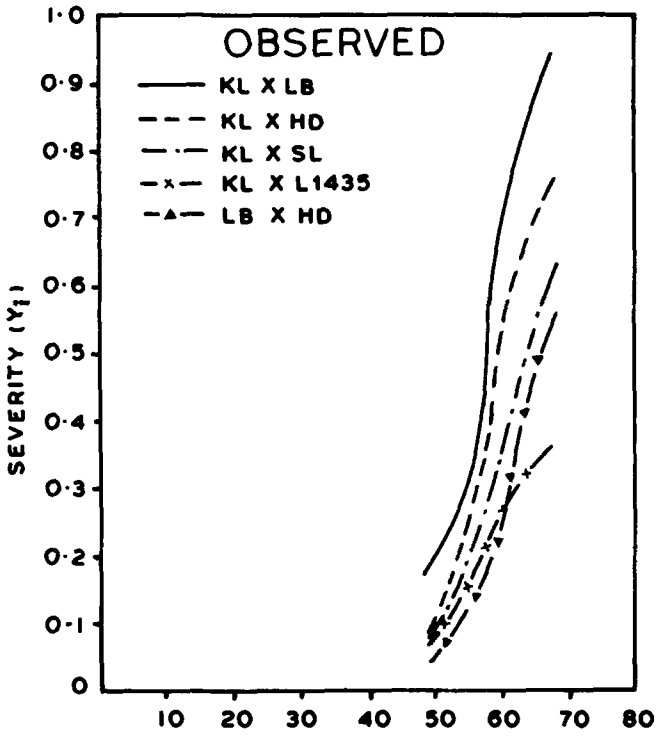

Fig. 5.

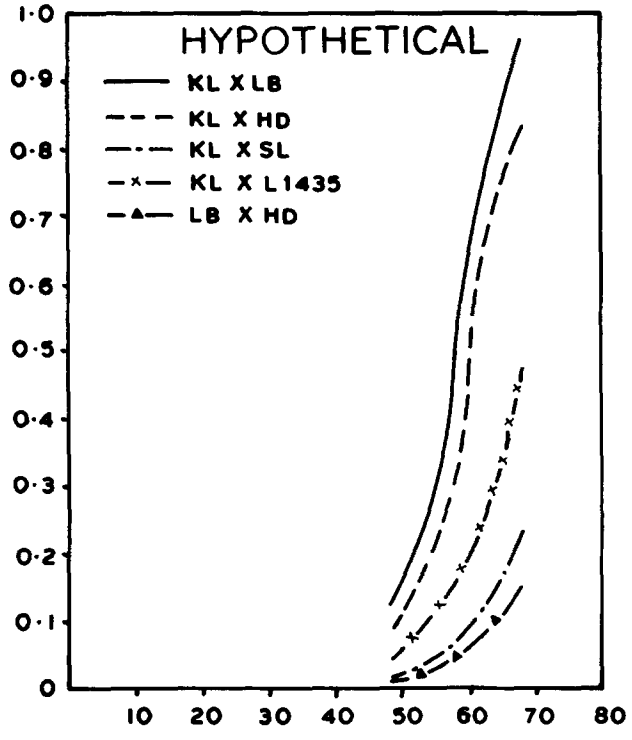

Fig. 6.

types studied were either close to or smaller than their respective observed AUDPC values (Table 1). It was particularly interesting to find that the hypothetical AUDPC values of all the genotypes except 'Kharchia Local' (which was used as a standard for generating leaf rust progress curves) were smaller than their respective observed AUDPC values. This may be due to the well known fact that the slow rusting abilities of cultivars are generally underestimated in small experimental plots where the test cultivars are continuously exposed to heavy spore showers from the susceptible plants of spreader rows. The deviations may also be due to one or more components of host resistance not considered in this study. One of these components may be infectibility (v) which was assumed to be the same for all the genotypes. This did not seem to be an unrealistic assumption in view of the fact that only very small differences among the cultivars were observed in this respect by Shaner and Hess (1978). Another component may be infectious period which was arbitrarily taken as 20 days for all the genotypes studied. Infectious period is somewhat difficult to estimate accurately. Moreover, infectious period determined in the glasshouse may not be representative for field conditions. According to Van der Plank (1968) infectious period is of minor importance in case of cereal rusts. The deviations between observed and hypothetical AUDPC values might have also been due to the fact that the equations do not account for changes in host resistance due to plant maturity or due to variations in weather (Shaner and Hess 1978).

Table 1. Observed and hypothetical areas under disease progress curves of different wheat genotypes

Variety/ Cross	Area under disease progress curve Observed	Hypothetical
'Kharchia Local' (KL)	11.58	12.29
'Lal Bahadur' (LB)	12.43	4.67
HD-2009 (HD)	2.30	0.99
'Sonalika' (SL)	2.51	0.22
L-1435	1.71	0.34
KL X LB	11.27	10.61
KL X HD	8.21	7.94
KL X SL	6.52	2.01
KL X L-1435	4.30	4.15
LB X SL	4.74	1.21
LB X L-1435	1.12	0.75
HD X SL	1.36	0.40
HD X L-1435	0.58	0.27
L-1435 X SL	0.49	0.15

Correlation between observed and hypothetical values = 0.8535 (significant at 1%)

The observed AUDPC values of a majority of the genotypes studied were fairly close to their respective hypothetical AUDPC as is evident from the significant correlation coefficient of 0.8535. Therefore, it can be concluded that it should be possible, using equations of Shaner and

Hess (1978), to predict slow rusting resistance of the cultivars fairly accurately.

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