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Inheritance of Stripe Rust Resistance in Intervarietal Crosses of *Triticum aestivum*

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ABSTRACT

With the view of determining the mode of inheritance of stripe rust resistance in some semi dwarf Mexican varieties and a tall Punjab strain which are extensively used in breeding programmes at Gurdaspur, these studies were made. Resistance in Kalyan Sona and Lerma Rojo was found to be dominant, whereas in WG. 142 and S 339 the character was found to be recessive. Resistance of Kalyan Sona and Lerma Rojo was conditioned by a single dominant gene. Resistance in WG. 142 and S 339 was found to be controlled by a recessive gene pair.

Kalyan Sona and Lerma Rojo were found to possess two nonallelic resistance genes each capable of conferring complete resistance.

INTRODUCTION

Epiphytotics of wheat rust recur year after year in the sub montane region of Punjab and cause large leakage in production. Depredations of epidemic are reflected on acre yields which are the lowest in this zone. Clouds of rust spores which over summer at various altitudes in the Himalayan ranges sweep down in early winter and infect the young seedlings. The cool humid weather conditions during the growing season of the crop are very congenial for the development and spread of the fungus. Out of the three kinds of rust, stripe rust caused by *Puccinia striiformis* (Chm.) is the most widespread and virulent. Breeding for stripe rust resistance to minimise the losses due to its infection, resulted in the evolution of some reputed commercial wheat varieties viz., C273, C286, C303 and C306 selected for resistance to stripe rust. These types, however, did not maintain their resistance for a long period. Breeding for resistance to this pathogen therefore, assumed special significance so that a good yield level could be maintained and stabilised in the sub montane zone.

Recently some dwarf lines were introduced from Mexico through the courtesy of Rockefeller Foundations. A number of them possessing high resistance to stripe rust have been employed as sources of resistance, in programme designed to evolve stripe rust resistance strains. As a result of this, valuable breeding material combining new and diverse resistance genes is built up. However, little is known as to the mode of inheritance of these resistance genes. In order to collect this information, crosses between the varieties possessing stripe rust resistance genes and susceptible commercial parents were studied under field

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conditions at Gurdaspur and the results are incorporated in this paper.

MATERIAL AND METHODS

Stripe rust resistant varieties of wheat (*Triticum aestivum* L.), Kalyan Sona, Lerma Rojo, S339 and WG 142 and commercial susceptible Punjab types C518, C273, C306 and C286 were used in the crosses made for stripe rust resistance studies. Briefly these varieties are described below.

1. Kalyan Sona: A double dwarf variety selected from the breeding material introduced from Mexico, resistant to stripe rust.
2. Lerma Rojo: Single dwarf type from Mexico, resistant to stripe rust.
3. S339: Double dwarf strain, introduced from Mexico, resistant to stripe rust.
4. WG 142: A tall Punjab strain combining stripe rust resistance of Trige Centeria.
5. C518: Tall lodging resistant Punjab variety, highly susceptible to stripe rust.
6. C273: Tall stiff straw high yielding Punjab variety, susceptible to stripe rust.
7. C306: Tall high yielding reputed Punjab variety, susceptible to stripe rust.
8. C286: Tall reputed high yielding Punjab strain susceptible to stripe rust.

(A) Mode of inheritance of resistance genes was determined from a study of F_1, F_2 and F_3 generations of the six intervarietal crosses of resistant parents with the susceptible commercial varieties. The crosses studied are given below.

1. C 273 x Kalyan Sona.
2. C 518 x Lerma Rojo.
3. C 518 x WG 142.
4. C 273 x S 339.
5. C 306 x S 339.
6. C 286 x S 339.

(B) The genetic relationship between two sources of resistance viz., Kalyan Sona and Lerma Rojo was determined from a study of F_1 and F_2 generations of the cross Kalyan Sona x Lerma Rojo.

The studies reported in this paper were conducted in the field during the years 1968 - 69 and 1969 - 70. The parents and the hybrid material were planted in paired rows with a distance of 23 cm between rows and 46 cm between pairs. Seed to seed distance in F_1 was kept 23 cm and 10 cm in the F_2 and F_3. The infector rows of Agra Local, a susceptible host material, were planted throughout, interspersing at regular intervals in between the rows of test material to ensure satisfactory spread of the fungus. Parent varieties were sown along with the crosses for comparison of reaction to the fungus.

The natural incidence of stripe rust during the years these studies were conducted was very high. Rust infection was further augmented by artificial inoculations of the material with mixture of races *19, 20, 31, A, D, E.* and *G.* of stripe rust (*Puccinia striiformis* (Schm.).

Parent varieties, Kalyan Sona, Lerma Rojo, S 339 and WG 142 were observed to be resistant and C 518, C 273, C 306 and C 286 uniformly susceptible.

In all these cases random samples of the segregating generations were employed for inheritance studies.

RESULTS

Six crosses, viz., C 273 x Kalyan Sona, C 518 x Lerma Rojo, C 273 x S 339, C 306 x S 339, C 518 x WG 142 and C 286 x S 339 were studied for field resistance to stripe rust. The data on the F_1, F_2 and F_3 generations are summarized in Table I.

Table I. Inheritance of field reaction to stripe rust

Cross	Resistant	Heterozygous	Susceptible	χ^2	P value	Mode of inheritance
C 273 x Kalyan Sona						
F_1	10	—	—	—	—	—
F_2	276	—	94	0.0324	0.95-0.50	3R: 1S
F_3	57	130	65	0.7619	0.95-0.50	1R:Seg.:1S
C 518 x Lerma Rojo						
F_1	12	—	—	—	—	—
F_2	280	—	86	0.4408	0.95-0.50	3R : 1S
F_3	51	98	61	1.8894	0.50-0.20	1R: 2Seg.: 1S
C 273 x S 339						
F_1	—	—	11	—	—	—
F_2	75	—	235	0.1075	0.95-0.50	3S : 1R
F_3	45	113	52	1.6857	0.50-0.20	1 S: 2Seg.: 1R
C 306 x S 339						
F_1	—	—	19	—	—	—
F_2	110	—	360	0.6383	0.50-0.20	3S : 1R
F_3	94	210	86	2.5743	0.50-0.20	1 S : 2Seg.: 1R
C 518 x WG 142						
F_1	—	—	9	—	—	—
F_2	62	—	178	0.0888	0.95-0.50	3S : 1R
F_3	25	54	31	0.6910	0.95-0.50	1 S : 2Seg.: 1R
C 286 x S 339						
F_1	—	—	8	—	—	—
F_2	65	—	205	0.1233	0.95-0.50	3S : 1R
F_3	49	115	56	0.8997	0.95-0.50	1 R : 2Seg. : 1S

It is evident from Table I that in crosses where Kalyan Sona and Lerma Rojo are involved as one of the parents, the resistant type of reaction was dominant and the mode of segregation in F_2 and F_3 of both the crosses confirmed the operation of one pair of dominant genes controlling resistance to stripe rust.

In crosses C 273 x S 339, C 306 x S 339, C 518 x WG 142 and C 286 x S 339 susceptible type of reaction was

dominant and pattern of segregation in F_2 and F_3 suggested that in varieties S 339 and WG 142 the resistance to stripe rust was controlled by a recessive gene pair.

(B) Genetic relationship between two sources of resistance viz., Kalyan Sona and Lerma Rojo was also studied and the data on F_1 and F_2 generations of this cross is presented in Table II.

Table 2. Field reaction of F_1 and F_2 generations of cross Kalyan Sona x Lerma Rojo to stripe rust

Cross	Resistant	Hetero-zygous	Susce-ptible	X^2	P value	Mode of inheritance
Kalyan Sona x Lerma Rojo						
F_1	8	–	–	–	–	–
F_2	471	–	29	0.1520	.95-.50	15R : 1S

From Table 2 it appears that resistant type of reaction was dominant. The mode of segregation in F_2 reveals that the resistance genes in Kalyan Sona and Lerma Rojo are separate.

DISCUSSION

These studies were taken up with the object of finding the genetic nature of stripe rust resistance of the varieties Kalyan Sona, Lerma Rojo and S 339 and a tall Punjab strain WG 142, which are being used extensively in breeding programmes at Gurdaspur. The inheritance studied revealed that resistance of Kalyan Sona and Lerma Rojo was conditioned by a single dominant gene while resistance of S 339 and WG 142 was contributed by a recessive gene pair. Dominance of resistance was also reported by number of workers viz., Pal (1951), Pal *et al.* (1956), Ghosh *et al.* (1958) and Bhullar *et al.* (1967). Similarly susceptibility was found to be dominant by Biffen (1905), Favert and Vallega (1953), Bahal and Kohli (1960), Bakshi and Sawhney (1965) and several other workers.

Study of the cross Kalyan Sona x Lerma Rojo made with the view of determining the genetic relationship between the two sources of resistance showed that Kalyan Sona and Lerma Rojo possessed nonallelic resistance genes. Resistance gene possessed by each variety was capable of conferring complete resistance singly.

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