BIOVIGYANAM 9 : 9—12, 1983.

Inheritance of Leaf Rust Resistance of *Durum* Wheats

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ABSTRACT

Inheritance of resistance to races 77 and 162 A of leaf rust in the crosses N-59 × Bijaga Red and N 1264 × Bijaga Red was studied and it is revealed that the resistance of Bijaga Red to race 77 and 162 A is controlled by the two recessive gene pairs in the first cross and by four complementary dominant genes in the latter cross.

Inter-relationship between genes in the cross N-59 × Bijaga Red indicated that the variety Bijaga Red carries two recessive genes for resistance against both the races77 and 162A. However, observations on the cross N-1264 × Bijaga Red, suggest that the variety Bijaga Red carried four pairs of genes in dominant condition, complementary in interection of which three coupled with one independent gene pair confer the resistance to both races 77 and 162 A.

INTRODUCTION

Brown or leaf rust of wheat (*Puccinia recondita* Roxb. ex. Desm) is assuming greater importance in recent years due to its occurrence in almost all wheat growing states of India. Race 77 is detected in 1953 and since then it is appearing every year as one of the most dominant races. Similarly the biotype 162 A of the race 162 is most virulent since 1957. Inheritance of the races 10, 20, 26, 77, 106 and 107 has been reported earlier in *aestivum* wheats (Luthra *et al.*, 1967, Sawhney *et al.*, 1970, Luthra, 1971). In addition voluminous literature is available on inheritance of leaf rust in bread wheats. Genetics of resistance to races 1, 5, 9, 15, 77, 122 and 123 have been worked out in tetraploid wheats (Harris *et al.*, 1954, Heyne and Johnston, 1955, Jasena, 1967, Stadler, 1973, Rashid *et al.*, 1976, Ortiz *et al.*, 1976). Thus relatively less information is available on 4*n* wheats. Hence the authors have attempted here the analysis of genetic behaviour of most virulent races, 77 and 162 A in *durum* wheats.

MATERIALS AND METHODS

Two *durum* varieties *viz.*, N-59 and N-1264 susceptible to races 77 and 162 A and a resistant variety Bijaga Red were included in the hybridization programme in 1973 at Agricultural Research Station, Niphad. Parents and hybrid generations were grown in pots in the glasshouse at the Regional Wheat Rust Research Station, Mahableshwar and tested for seedling resistance to leaf rust races 77 and 162 A in 1974. The F_2 population comprised of 296 seedlings in the cross N-59 × Bijaga Red and 845 seedlings in the cross N-1264 × Bijaga Red. One seedling was raised in each pot and the leaves were artificially inoculated with the races 77 and 162 A separately. The F_3 pupulation was studied in subsequent year.

The reaction types were recorded as per key given by Stakman *et al.* (1944). Reaction types 0, 0; 1 and 2 were considered as resistant whereas 3 and 4 were taken as susceptible.

RESULTS

Observations recorded on seedling reactions of parents and their F_1 hybrids against Race 77 and 162 A are given in Table I.

TABLE I

Seedling reactions of the parents and their F_1 hybrids against races 77 and 162 A·

Variety/cross	Seedling reactions	
	77	162 A
N-59	4	4
N-1264	4	4
Bijaga Red	0	0
N-59 × Bijaga Red	4	3—4
N-1264 × Bijaga Red	0;	0;

It will be seen from the above table that Bijaga Red is resistant to these races whereas N-59 and N-1264 are susceptible. Reactions on F_1 hybrids indicate resistance to be recessive in N-59 × Bijaga Red, whereas in N-1264 × Bijaga Red resistance is dominant. Date on F_2 generation is presented in Table II.

The F_2 segregations given in Table II indicate the presence of two pairs of complementary factors in the cross N-59 × Bijaga Red for both the races. However, four pairs of complementary genes are exhibited in the cross N-1264 × Bijaga Red for these races, thus the resistance of Bijaga Red to race 77 and 162 A is governed by two recessive genes in the cross N-59 × Bijaga Red and by four pairs of dominant factors complementary in interaction in the cross N-1264 × Bijaga Red. Inter-relationships of the genes responsible for resistance to these two races in the crosses are summerized in Table III.

It would be seen that in the cross N-59 × Bijaga Red the same 136 seedlings resistant to race 77 were also, resistant to the race 162 A. Not a single recombinant could be recovered in this cross. It is therefore, clear that the same two recessive genes control resistance to the races 77 and 162A.

These F_2 findings are confirmed in F_2 generation. However, in the cross N-1264 × Bijaga Red only a few recombinants than expected were realised resulting in very large χ^2 value suggesting lack of independent assortment.Four pairs of genes responsible for resistance to race 77 and 162 A may be linked or some of them may be common. Joint segregation ratio of 243 : 81 : 81 : 619 on the basis of three common pairs of genes reduced the χ^2 value to 9·99. Thus the races 77 and 162A are controlled by 3 common pairs of genes in addition to the fourth pair of gene segregating independently.

DISCUSSION

Crosses of Bijaga Red with N-59 and N-1264 showed different behaviour in both the F_1 and F_2 generations. Resistance of Bijaga Red is recessive for two pairs of complementary factors for both the races when Bijaga Red was crossed with N-59 whereas it was dominant and expressed by presence of four pairs for complementary factors for both the races when crossed with N-1264. However Ortiz *et al.*, (1976) noted incomplete dominant gene in Cocorit, recessive gene in Jori-69 and two recessive genes in Crane's' for resistance to race 77. Raut (1980) observed monogenic control of races 10, 77, 108 and 162 A in two inter-varietal crosses of *T. durum* and trigenic control in one inter-varietal *durum* cross and two inter-specific crosses. In MACS-9 × *T. carthlicum* he noted trigenic comple-

TABLE II

F_2 segregation for races 77 and 162A.

Cross	No. of seedlings		Ratio	P Value
	Resistant	Susceptible		
	Race 77			
N-59 × B· Red	136	160	7:9	0.30 to 0.50
N-1264 × B. Red	276	569	81:175	0.50 to 0.70
	Race 162 A			
N - 59 × B. Red	136	160	7:9	0.30 to 0.50
N - 1264 × B. Red	245	600	81:175	0.10 to 0.20

TABLE III

Joint segregation for race 77 with race 162 A in F_2 population

Cross	No of seedlings Resistant : Susceptible		χ^2	P Value
	Race 77 (7R : 9 S) with race 162 A (7R : 9 S)			
N-59 × Bijaga Red				
Resistant	136	0	both factors common	
Susceptible	0	160		
	Race 77 (81 R : 195 S) with race 162A (81 R : 175S)			
N—1264 × Bijaga Red				
Resistant	186	90		
Susceptible	59	510		
χ^2 for independant assortment			20	< 0.001
χ^2 for three factors common			9.99	0.01 to 0.02

mentary interaction of genes controlling these four races, resistance being dominant in all the crosses. Inter-relationship of genes in N-59 × Bijaga Red indicated that same two pairs of recessive genes for resistance control the race 77 and 162 A. In N-1264 × Bijaga Red cross the same three complementary dominant genes coupled with one independent gene were found to control the resistance to races 77 and 162A. Here it must be emphasized that the two resistant recessive gene pairs complementary in interaction detected in Bijaga Red operate only when it is crossed with N-59. However these two recessive genes of Bijaga Red, controlling the resistance became inactive when N-1264 is crossed with Bijaga Red. In this cross another four pairs of dominant genes operate for the resistance of race 77 and 162 A out of which three are common for both the races. Such cases could be confirmed only after analysis of the genetic behaviour of two susceptible parents involved.

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(*Received December* 29, 1981; *Revised July* 14, 1982).