

## Inheritance of adult plant stripe rust resistance in wheat cultivars Capelle Desprez and Pari 73

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Wheat stripe rust caused by *Puccinia striiformis* Westend f. sp. *Tritici* is one of the most damaging diseases affecting bread wheat in high altitudes of the southern and northern areas of temperate zones [1]. This disease can result in weakened plants leading to high yield losses due to shriveled grain and damaged tillers [2]. Capelle Desprez, a bread wheat cultivar moderately resistant to stripe rust was widely cultivated in Europe without fungicide treatment during the 1960s and 1970s. Therefore, is considered to have durable resistance. This report deals with the inheritance of stripe rust resistance of Capelle Desprez and a Pakistani cultivar Pari 73 those have been showing good level of adult plant resistance in India under artificial inoculations since early eighties. Allelic relationship amongst the stripe rust resistance genes (*Yr* genes) in cultivars Capelle Desprez and Pari 73 and also with *Yr18*, a gene known to confer durable resistance to stripe rust is also reported.

Cultivars Capelle Desprez (Joncquois/Vilmorin 27) and Pari 73 (Ciano 67 sib//Sonora 64/Klein Rendidor/3/Penjamio 'S'/Gabo 55) were crossed to stripe rust susceptible cultivar WL71 1 (S308/Chris//Kalyansona). The F<sub>2</sub> and F<sub>3</sub> generations from these crosses were assessed for percent disease severity in field during normal season 2004-05 to determine the nature and number of genes controlling stripe rust resistance in these cultivars. Cultivars Capelle Desprez and Pari 73 were also crossed among themselves as well as with RL6058 (6\*/Thatcher/Terenzio), a reference stock for the gene *Yr18*. Only the F<sub>2</sub> generation from these intercrosses was evaluated for stripe rust severity to determine the allelic relationships.

The F<sub>2</sub> and F<sub>3</sub> generations were sown in 2m long paired rows placed 50cm apart. Two rows of each parent were planted on both sides of every F<sub>2</sub> generation. The susceptible cultivars WL711 and Agra Local were sown after every 20 experimental rows. The experimental plot was also surrounded by two rows each of the susceptible cultivars WL711 and Agra Local as disease spreaders. Stripe rust race 46S119, which is the most virulent and frequently identified race from Indian subcontinent [3] was used for field inoculations. This race has virulence on the Avocet near isogenic lines with known stripe rust resistance genes *Yr6*, *Yr7*, *Yr8*, *Yr9*, *Yr11*, *Yr12* and *Yr18*. The reaction of 46S119 on *Yr16* known to be present in Capelle Desprez is not known because a single gene line for *Yr16* is not yet available. Stripe rust epidemic was created by keeping pots having stripe rust infected wheat seedlings in between infector rows and also by hand brushing the urediniospores from infected seedlings on dew wet infector rows in the morning. The rust was made to spread by repeated inoculation of experimental material with urediniospore suspension of the race 46S119 in soap water solution. The inoculations done late in the evening started from third week of December and continued to mid-January when rust started appearing on susceptible cultivars WL711 and Agra Local. Field assessment for stripe rust severity was based on modified Cobb scale [4], which is expressed as percent leaf area covered with rust. In the field, every F<sub>2</sub> and F<sub>3</sub> plant was scored and plants showing disease severity equal to or more than that of the susceptible parent WL711 were classified as susceptible (S). All other plants were considered resistant (R). Chi-square analysis was applied to test the goodness of fit of observed ratios to theoretical expectations.

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Cultivar Capelle Desprez showed severity of TR whereas, cultivar Pari 73 showed stripe rust severity of 20S-30S. The pattern of segregation for disease severity against race 46S119 in  $F_2$  and  $F_3$  generations from crosses of Capelle Desprez and Pari 73 with WL711, their intercross as well as their cross with RL6058 is given in Table 1. Of the 375  $F_2$  plants studied from the cross Capelle Desprez WL711, 365 were resistant while 10 plants were susceptible. This gave a good fit for 63R : 1S ratio ( $c^2 = 2.64$ ). Because a 2m long row accommodated about 20 plants only, the  $F_3$  families segregating in 63R : 1S were not observed. Consequently, the resistant  $F_3$  families also include families segregating in a 63R : 1S ratio. Therefore, the  $F_3$  generation was tested for 43 HR : 12 (segregating 15R : 1S) : 8 (segregating 3R : 1S) : 1 HS ratio to confirm the number of genes segregating in Capelle Desprez/WL711 cross. The  $F_3$  families from this cross fitted the 43:12:8:1 ratio ( $c^2 = 0.09$ ). It is concluded from these results that three independently inherited dominant genes confer low disease severity in Capelle Desprez. In the  $F_2$  generation of the cross Pari73/WL711, of the 441 plants, 416 were resistant and 25 were susceptible. In the  $F_3$  generation, of the 280 families tested, 120 were homozygous resistant, 81 were segregating 15R : 1S 69 families segregated 3R : 1S and ten families were homozygous susceptible. Thus, the  $F_2$  and  $F_3$  generations from this cross segregated 15R : 1S ( $c^2 = 0.34$ ) and 7 Resistant : 8 Segregating (both in 15R : 1S and 3R : 1S) : 1 Susceptible ( $c^2 = 3.97$ ) ratios respectively, that is expected for a population segregating for two independently inherited dominant genes.

The  $F_2$  of the cross Pari73/Capelle Desprez segregated for susceptible plants indicating that Capelle Desprez and Pari 73 have different stripe rust resistance genes. The 263  $F_2$  plants from the cross Capelle Desprez/RL6058 (*Yr18*) did not segregate for susceptible plants indicating that Capelle Desprez may have *Yr18*. This gene was reported in Capelle Desprez earlier also [5]. The  $F_2$  generation of the cross Pari73/RL6058 contained 673 resistant and 9 susceptible plants. In addition to the segregation of  $F_2$  from the cross of Pari73/RL6058 for susceptible plants, cultivar Pari 73 did not show leaf tip necrosis (Ltn), a trait reported to be linked to *Yr18* [6]. These results suggest that none of the *Yr* genes in Pari 73 is allelic to *Yr18*. Loci unlinked to leaf tip necrosis, affecting stripe rust response, are already known to occur [7, 8]. Combination of *Yr18* with other genes conferring adult plant resistance is known to result in adequate levels of resistance suitable for development of wheat varieties suitable for most of the environments [9]. Thus cultivars Capelle Desprez and Pari 73 are good sources of stripe rust resistance that can be utilized in breeding programmes.

## References

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**Table 1.** Segregation<sup>+</sup> for adult plant stripe rust resistance against race 46S119 in crosses of cultivars Capelle Desprez and Pari 73 with WL711, their intercross and a cross with RL6058 (*Yr18*)

Cross	Generation									
	$F_2$				$F_3$					
	Number of plants				Number of families					
	R	S	Total	Expected ratio and ( $c^2$ )	R	Segregating		S	Total	Expected ratio and ( $c^2$ )
						15:1	3:1			
Capelle Desprez/ WL711	365	10	375	63:1(2.64)	220	42	33	4	299	43:12:8:1(0.09)
Pari 73/WL711	416	25	441	15:1(0.34)	120	81	69	10	280	7:8:1(3.97)
Capelle Desprez/ Pari73 (20S-30S)	663	9	672	511:1(45.23)***	-	-	-	-	-	-
Capelle Desprez/ RL6058	263	0	263	-	-	-	-	-	-	-
Pari73/ RL6058	700	11	711	63:1(1.86)	-	-	-	-	-	-

\*\*\* = Highly significant, + Resistant = R, Susceptible = S

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