MONOSOMIC ANALYSIS OF ADULT-PLANT RESISTANCE TO LEAF RUST IN THE BRAZILIAN WHEAT CULTIVAR 'TOROPI' [1].

Brammer, S.P.[2], Worland, A.[3], Barcellos, A.L.[2],
Fernandes, M.I.B. de M.[2]

Abstract

Favorable environment for the development of wheat leaf rust occurs in most of the Brazilian wheat areas. Under the high inoculum pressure of southern Brazil, cultivar Toropi has shown a long-term resistance (more than 15 years). This work was conducted at Embrapa Trigo and John Innes Centre. Genetic analysis of progenies from crosses between Toropi and a monosomic series of Cappelle Desprez indicated that the two genes for adult-plant resistance in Toropi are located in chromosomes 1A and 4D. The reaction against one isolate of a *Puccinia recondita* race was evaluated on flag leaf of the main tiller.

Key words: leat rust – monosomic analysis – wheat

Introduction

Wheat leaf rust, caused by *Puccinia recondita* Rob. ex Desm. f. sp. *tritici* is endemic in South America and one of the most important wheat diseases. Breeding programs are constantly challenged by the

---

[1] Resumo apresentado no 9th International Wheat Genetic Symposium – Saskatoon, Canada – Agosto de 1998

[2] Embrapa Trigo, BR 285, km 174, 99001-970 Passo Fundo, RS, Brazil
[3] John Innes Centre, Norwich Research Park, Colney, Norwich, NR 47UH, England.

continuous propagation and variability of the pathogen in the agroecosystem of central-southern Brazil. Adult-plant resistance has been associated with higher resistance durability. This type of resistance is presumed to have originated from southern regions of South America. Genetic studies of the slow rusting resistance and adult plant resistance show either mono or oligogenic inheritance (Lee & Shaner, 1985). Barcellos (1994) identified two genes, not yet described, for adult-plant resistance in the Brazilian wheat cultivar Toropi. This cultivar has shown a long-term resistance (more than 15 years) under the high inoculum pressure of wheat leaf rust in Southern Brazil.

Material and Methods

The crosses of the wheat cultivar Toropi onto the monosomic series of Cappelle Desprez, as well as the cytological selections, were made at John Innes Centre, Norwich, England. Monosomic progeny were not available for testing chromosome 1B. At Embrapa Trigo, two or three monosomic F_2 progenies and the parents were tested in the greenhouse for adult-plant leaf rust resistance. The expanded flag leaf of the main tiller was inoculated (1.5 mg spores/1ml mineral oil Soltrol) using an atomizer at spike emergence or after this stage, generally before anthesis. One isolate of the race MFT (North American System of Races Nomenclature - Long & Kolmer, 1989) of *Puccinia recondita* was used, based on results of preliminary trials that indicated a differential response between the 2 parents. After inoculation, the plants were kept overnight in a high humidity compartment, and the rust reaction evaluation was made 18 to 20 days later. The visual classification was made according to Roelfs "Wheat Leaf Rust Severity Scale", which is based on lesion size (from 1, resistant, to 8, susceptible), with severities of modified Cobb scale.

Results and Discussion

The adult plant evaluation was carried out on 1079 segregants from monosomic lines (Table 1). The chi-square analysis indicates the hypothesis of two recessive genes (7 resistant:9 susceptible). The same segregation rate was observed in previous genetic studies of adult plant resistance in the variety Toropi (Barcellos, 1994). The critical chromosomes identified here were 1A and 4D, indicating a possible location for the adult-plant resistance genes in the cultivar Toropi. There is no reference of genes for adult-plant resistance against wheat leaf rust on these chromosomes. So they offer a potential new and valuable source of adult plant resistance to leaf rust. Adult plant resistance can however be disease non-specific with Pink et al. (1983) reporting a correlated adult plant resistance to yellow rust and mildew and Worland and Law (1991) reporting that mutations which inactivated genes for susceptibility to yellow rust in the wheat variety "Hobbit sib" showed correlated levels of improved adult plant resistance to mildew and leaf rust. Interestingly one of the most potent genes for resistance detected in Worland and Law's study was also located on chromosome 4D. It could therefore be that the resistance detected in Toropi is of a similar nature to that induced in the mutant of Hobbit sib, with Toropi lacking a gene for susceptibility to disease at the adult plant stage that is present in many other varieties.

Monosomic analysis of Brazilian wheat for important agronomic genes was previously done: the resistance to high levels of soil aluminum toxicity in the soil was also located in chromosome 4D, in the cultivar BH 1146 (Lagos et al., 1991). Using RFLP markers, Riede & Anderson (1996) located this gene in chromosome 4 DL. They proposed the symbol *Alt* $_{BH}$ to designate the major gene for Al tolerance in BH 1146.

References

BARCELLOS, A. L. **Genetica da resistencia de planta adulta a ferrugem da folha na cultivar brasileira de trigo Toropi (*Triticum aestivum* L. em Thell).** Porto Alegre:UFRGS, 1994. 163 p. Ph. D. Theis.

LAGOS, M. B.; MORAES FERNANDES, M. I. B.; CAMARGO, C. E. DE O.; FEDERIZZI, L. C.; CARVALHO, F. I. F. Genetics and monosomic analysis of aluminum tolerance in wheat (*Triticum aestivum* L.). **Brazilian Journal of Genetic**, v. 14, n. 4, p. 1011-1020, 1991.

LEE, T. S.; SHANER, G. Oligogenic inheritance of length of latent period in six slow leaf-rusting wheat cultivars. **Phytopathology**, v. 75, p.636-643, 1985.

LONG, D. L.; KOLMER, J. A. A North American system of nomenclature for *Puccinia recondita* f. sp. *tritici.* **Phytopathology**, v. 79, p. 525-529, 1989.

PINK, D. A. C.; BENNET, F. G. A.; CATEN, C. A.; LAW, C. N. Correlated effects of homeologous group 5 chromosomes upon infection of wheat by yellow rust and powdery mildew. **Z. Pflanzenzuchtg**, v. 91, p. 278-294, 1983.

RIEDE, C. R.; ANDERSON, J. A. Linkage of RFLP markers to an aluminum tolerance. **Crop Science**, v. 36, n. 4, p. 905-909, 1996.

WORLAND, A. J. AND LAW, C. N. Improving disease resistance in wheat by inactivating genes promoting disease susceptability. **Mutational Breeding Newsletter**, v. 38, p.25, 1991.

Table 1 Segregation of adult-plant leaf rust resistance in F_2 progenies between the Cappelle Deprez monosomic series and the wheat Brazilian cultivar Toropi

Monosomic	Resistant Plants		Susceptible Plants		χ^2	Probability
	Number	%	Number	%	2 recessive genes	
1 A	21	26.9	57	73.1	8.30	.001-.01
2 A	24	51.1	23	48.9	0.75	.30-.50
3 A	16	34.0	31	65.0	1.42	.20-.30
4 A	26	51.0	25	49.0	0.81	.30-.50
5 A	23	36.5	40	63.5	1.07	.30
6 A	26	51.0	25	49.0	0.81	.30-.50
7 A	-	-	-	-	-	-
1 B *	-	-	-	-	-	-
2 B	24	43.6	31	56.4	0.01	.90-.95
3 B	23	51.1	22	48.9	0.71	.30-.50
4 B	25	49.0	26	51.0	0.38	.50-.70
5 BL-7BL	24	46.2	28	53.9	0.04	.70-.90
5 BS-7BS	27	42.9	36	57.1	0.0002	>.95
6 B	21	52.5	19	47.5	0.91	.30-.50
7 B	24	33.8	47	66.2	2.47	.10-.20
1 D	15	39.5	23	60.5	0.14	.70-.90
2 D	17	42.5	23	57.5	0.00	>.95
3 D	12	63.6	21	36.4	0.46	.50
4 D	15	23.8	48	76.2	9.38	.001-.01
5 D	26	47.3	29	52.7	0.16	.50-.70
6 D	19	51.4	18	48.6	0.59	.30-.50
7 D	19	43.2	25	56.8	0.006	.90-.95

* not tested.