Mapping of Resistance Genes to Brown Rust in 1R Chromosome of Rye (*Secale cereale* L.)

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Abstract

Five resistance genes to single-pustule isolates Nos. 12, 81,108 and 7 of brown rust were mapped on 1R chromosome of rye using two different F_2 populations. Under segregation analysis it was found linkage between genes controlling resistance to single-pustule isolates No. 12, 81, 108 and 25 and isozyme locus Prx7, which to be localized on chromosome 1R. The recombination frequencies are 0.32, 0.28, 0.29 and 0.32 correspondingly. Also we were found linkage between Prx7 and gene, controlling resistance to single-pustule isolate No. 7. Recombination frequency in this case was equal 0.10 and 0.29 in dependence on analyzing hybrids.

Keywords: genetic mapping; resistance genes; brown rust; Isozyme; Prx7; *Secale cereale* L.*;* 1R chromosome

INTRODUCTION

Brown leaf rust (*Puccinia dispersa* Eriks et E. Henn) is one of the most widespread and destroying disease in winter rye. Therefore, research on resistance genetic and, in particular, mapping of resistance genes (*R*-genes) in rye is very important and actual problem today. At present, only several *R*-genes to brown rust were mapped on the 1R, 6R (WEHLING & LINZ 1996; WEHLING & LINZ 2000 – pers. commun.) and 5R (BARANOVA *et al*. 2001) chromosome of rye. Same years ago, we have started the program of localization of resistance genes to brown rust on rye chromosome using different hybrids between self-incompatibility plants of rye and self-fertility lines from collections St-Petersburg University.

MATERIALS AND METHODS

We analyzed two hybrids populations, produced by crossing between self-incompatibility plant and self-fertile lines No. 5 carrying mutation of self-fertility at the S locus (chromosome 1R). Hybrids was founded by means of series be crosses of resistant selfincompatible plants on susceptible variety Ilmen, and in last crossing was used selffertile line No. 5 as susceptible parent.

The F_2 plants were tested for the resistance to five single-pustule isolates *of P. dispersa* using leaf segments preserved in 40 ppm benzimidazole solution**.** The plants were evaluated by means of method. Type of reaction was registered according to the scales of MAINS and JACKSON (1923).

Isozyme analysis was carried out with leaf extracts. For resolution of peroxidases isoelectric focusing in a pH 3.5–10 gradient of ampholines was used. For the staining of isozymes standard procedures were used as described by SHAW and PRASAD (1970).

R-genes identified by genetic analysis were subjected to molecular marker analysis by use of isozymes markers. Linkage data were calculated according to ALLARD (1956).

RESULTS AND DISCUSSION

The segregation data for resistance to single-pustule isolates to brown rust Nos. 12, 7, 81, 108 and 25 presented in Table 1. With the exception of 29 F_2

Table 1. Segregation ratio in hybrids population F_2 from resistance to brown rust

Hybrid	No. of clone	Real segregation	Theoretical segregation	χ^2	*P*
		R:S	R:S		
	12	76:19	3:1	1.267	0.500
	7	54:41	1:1	1.779	0.200
29	81	73:21	3:1	0.355	0.750
	108	70:24	3:1	0.014	0.850
	25	73:21	3:1	0.355	0.750
6	7	52:62	1:1	0.877	0.500

populations the segregation data (Table 1) display the typical monogenic ratio of resistant to single-pustule isolates to brown rust No. 12, 81, 108 and 25. From five resistance genes only *R*-gene to single-pustule isolate No. 7 in both hybrid populations was show segregation ratio 1:1, it can be concerned by a linkage to of self-incompatibility genes in rye (S-locus).

The segregation data for *R*-genes mapped on chromosome 1R are presented in Table 2.

Under segregation analysis of the F_2 hybrid No. 29 we found linkage between five resistance genes controlling resistance to single-pustule isolates of brown rust and isozyme locus Prx7, which is known to be localized on chromosome 1R. The recombination frequencies are presented in Table 2. Besides of that always genes controlling resistance to single-pustule isolates of brown rust was linked between itself. In both hybrids we found linkage between resistance gene controlling resistance to single-pustule isolates of brown rust No. 7 and isozyme marker Prx7. Recombination frequency in this case was equal 0.10 and 0.29 in dependence on analyzing hybrids.

To conclude five genes controlling resistance to single-pustule isolates of brown rust have been mapped to 1R chromosome of rye by means of isozyme marker Prx7.

Table 2. Linkage of resistance genes to single-pustule isolates of brown rust with isozyme marker Prx7 in 1 R chromosome of rye (*Secale cereale* L.)

Hybrid	Chromosome	Genes	Recombination frequency
		Prx7 – R7	9.91 ± 3%
		Prx7 – R12	32.4 ± 5%
		Prx7 – R81	28.13 ± 5%
		Prx7 – R108	29.39 ± 5%
		Prx7 – R25	32.09 ± 5%
		R12 – R81	13.46 ± 3%
		R12 – R108	32.22 ± 6%
29	1R	R12 – R25	31.91 ± 6%
		R81 – R108	26.25 ± 5%
		R81 – R25	28.88 ± 5%
		R108 – R25	20.54 ± 4%
		R12 – R7	28.20 ± 5%
		R81 – R7	22.14 ± 4%
		R108 – R7	24.92 ± 5%
		R25 – R7	26.85 ± 5%
6	1R	Prx7 – R7	29.4 ± 5%

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