Mapping of adult plant leaf rust and stripe rust resistance in the Austrian winter wheat cultivar 'Capo'

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INTRODUCTION

The Austrian cultivar Capo possesses quantitative and durable adult plant leaf rust resistance, but does not possess any effective major *Lr* gene to our knowledge. Aim of this work was to clarify the genetics of the durable rust resistance of the cultivar Capo.

MATERIALS AND METHODS

Plant material

F_6 derived RIL populations from the crosses: Capo/Isengrain (240 lines), Capo/Furore (201 lines), Capo/Arina (233 lines)

Resistance evaluation

Leaf rust resistance testing was done at field trials in Austria, Slovakia, Switzerland, Romania and Hungary. *Lr* was provoked by spreading field collected rust spores from the previous seasons. Rust severity was scored once or twice in each experiment using a percent scale. In addition the Capo/Furore population was tested for adult plant stripe rust resistance in one field test and for seedling resistance in a greenhouse test.

Genotyping and QTL mapping

The populations were genotyped with SSR, AFLP and DArT markers. QTL analysis was done in *QTL Cartographer* and/or *Qgene*.

RESULTS AND DISCUSSION

For the QTL mapping of leaf rust resistance QTL data from 6 field experiments were informative for the Capo/Isengrain population, 11 experiments for the Capo/Arina population and 6 experiments for the Capo/Furore population. Quantitative variation for leaf rust severity was evident in all three populations. The broad sense heritability estimate for leaf rust severity across experiments was 0.8 (Capo/Furore) to 0.9 (Capo/Isengrain and Capo/Arina), indicating that this trait segregated in these populations.

In the Capo/Isengrain population the largest effect QTL was derived from the susceptible parent Isengrain, mapping to chromosome 7BL, this QTL corresponds most likely to the gene *Lr14a.*

Capo-derived reproducible QTL for *Lr* resistance mapped to chromosomes 2A, 2B and 3B. QTL for stripe rust resistance were detected at 2B and 3BS. The 3BS rust resistance QTL from Capo is close to the *Lr27* and *Yr30* resistance loci.

Figure 1: symptoms of leaf rust (left) and stripe rust (right) on wheat leaves.

Table 1: QTL estimates for mean *Lr* severity (means over 6 informative experiments) in the population **Capo/Isengrain**

Chrom.	Closest marker	Resistance source	no of sign. exp.	SIM	
				LOD	R^2
3BS	*XS12M13_33*	*Capo*	4	4.4	8
7BL	*Xgwm132.1*	*Isengrain*	6	33.9	48

Table 2: QTL estimates for mean *Lr* severity (means over 11 informative experiments) in the population **Capo/Arina**

Chrom.	Closest marker	Resistance source	no of sign. exp.	SIM	
				LOD	R^2
2A	*wPt-665330*	*Capo*	10	7.2	19
2B	*wPt-8548*	*Capo*	5	4.4	13
3BS	*wPt-10192*	*Capo*	4	3.3	9.3

Table 3: QTL estimates for mean *Lr* severity (means over 6 informative experiments) and *Yr* severity (1 greenhouse and 1 field experiment) in the population **Capo/Furore**

Trait	Chrom.	Closest marker	Resistance source	no of sign. exp.	SIM	
					LOD	R^2
Lr	3BS	*wPt-7984*	*Capo*	6	13.5	32
Yr	2B	*wPt-743307*	*Capo*	1	12.4	27
(seedling)	3BS	*wPt-798970*	*Capo*	1	9	21
Yr	2B	*wPt-743307*	*Capo*	1	25.8	49
(adult plant)	3BS	*wPt-798970*	*Capo*	1	3.5	8.6

Summary

The obtained results indicate that CAPO possesses adult plant leaf rust resistance, with QTL mapping to chromosomes 2A, 2B and 3B and QTL for stripe rust resistance mapping to chromosomes 2B and 3B. Notably, the 3B QTL confers resistance to leaf rust and stripe rust and seems the most stable source of leaf rust resistance in Capo, significant over three populations. Whether some of the detected QTL are associated with already known *Lr* or *Yr*-genes needs further investigations. This QTL region therefore appears especially attractive for further genetic analysis. Markers for resistance breeding are available now.

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