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RFLP Report

Extended genetic maps of the homoeologous group 3 chromosomes of wheat, rye and barley

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Markers

Three clones, containing sequences coding for a thiol protease (pHv14; Chandler et al. 1984) and for isozymes III and V of (1→3)-β-glucanase (p7E and G5; G. Fincher, personal communication), and 15 genomic probes, including eight *Pst*I (PSR689, PSR754, PSR909, PSR910, PSR916, PSR923, PSR930 and PSR931; Devos et al. 1992), five *Hpa*II (PSR1060, PSR1067, PSR1077, PSR1149, PSR1196; Cheung et al. 1992) and two PERT clones (PSR1203 and PSR1205; Clarke et al. 1992), were assigned to the homoeologous group 3 chromosomes in addition to the 25 RFLP and two isozyme markers described in Devos et al. (1992). These markers are presented with their chromosome arm location, copy number and relative hybridization strength in wheat, rye and barley (Table 1).

Maps

Mapping was carried out using populations of 120 F_2 plants or their F_3 families from a wheat cross 'Chinese Spring' × 'Synthetic', a rye cross Ds2 × RxL10, and a barley cross, *H. vulgare* cv 'Captain' × *H. spontaneum* (IPSR#2370).

A further 16 loci, one on chromosome 3A, three on 3B, seven on 3D and five on 3R, were incorporated into the previously published genetic maps (Devos et al. 1992) (Fig. 1). An additional 3A locus, *Xpsr1203*, known from ditelosomic analysis to be located on the long arm of chromosome 3A, shows, however, no linkage with other markers on that chromosome. The three newly mapped loci on chromosome 3B, *Xpsr1205*, *Xpsr931* and *XGlb35*, establish the linkage between *XEmbp* and both the centromeric and distal linkage groups, and therefore determine the orientation of *Xpsr454* and *Est-5*. The 3D map now comprises 21 loci in one linkage block and spans a genetic distance of 179 cM.

A RFLP map of 12 loci, constructed for comparison in barley (Fig. 1) shows that, compared to wheat and rye, recombination is less localized, resulting in a more even spread of the markers along the chromosome. Gene order is, however, generally conserved over the group 3 chromosomes of wheat, rye and barley. The observed co-linearity allows, with reasonable confidence, the additional placement of a further 31 loci on the wheat and five loci on the rye maps. The consensus maps for chromosomes 3A, 3B, 3D and 3R, displaying both the mapped and placed loci, are shown in Fig. 2. A number of the RFLP loci mapped were observed not to have strongly hybridizing homoeoloci in all five of the A, B, D, R and H genomes. These non-conserved class *c*, *d*, *e* and *f* loci are identified in Fig. 2.

Rearrangements in 3RL

The presence of a 3RL/6RL translocation has been postulated on the basis of 6RL locations for the genes controlling grain colour and *sphaerococcum* grain shape (Miller 1984) and the isozymes *Est-5* (Ainsworth et al. 1986) and *Ndh-3* (Liu and Gale 1991), which are located on 3L in wheat. This was confirmed by linkage analysis of *XGlb33*, *Xpsr1205*, *Xpsr1203*, *Est-5* and *Xpsr454* with markers on 6RL (Devos et al. 1993). Therefore, the breakpoint of this translocation can now be defined to the interval between *XCxp1* and *XGlb33*.

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Table 1. Chromosomal location in wheat, copy number in wheat (W), barley (B) and rye (R) and relative hybridization strength in rye and barley for different classes of group-3 probes

Probe[a]	Chromosomal location in Chinese Spring			Copy number[b]			Signal strength[c]	
	A	B	D	W	B	R	B	R
cDNA class *a* Probes hybridizing within a homoeologous group and showing strong signals in rye and barley								
pHv14 (*XTlp*)	3AL	3BL	3DL	3	3	3	+ + +	+ + +
p7E (*XGlb33*)	3AL	3BL	3DL	M	M	M	+ + +	+ + +
G5 (*XGlb35*)	–	3BL	3DL	M	M	M	+ + +	+ + +
gDNA class *a* Probes hybridizing within a homoeologous group and showing strong signals in rye and barley								
PSR689, PSR910	3AS	3BS	3DS	1	1	1	+ +	+ +
PSR754, PSR1077	3AL	3BL	3DL	1	1	1	+ +	+ + +
PSR916, PSR923	3AL	3BL	3DL	1	1	1	+ +	+ +
PSR1060	3AL	3BL	3DL	1	1	1	+ + +	+ +
PSR1149	3AL	3BL	3DL	1	1	1	+ + +	+ + +
gDNA class *c* Probes hybridizing within a homoeologous group and showing weak signals in rye and/or barley								
PSR909	3AS	3BS	3DS	1	–	–	–	–
PSR930	3AS	3BS	–	1	1	–	+ + +	+
PSR931	3AL	3BL	3DL	1	1	–	+ +	–
PSR1196	3AS	3BS	3DS	1	1	–	+ + +	+
PSR1205	3AL	3BL	3DL	1	–	–	–	+
gDNA class *f* Chromosome specific probes, showing weak signals in rye and/or barley								
PSR1067	–	–	3DL	1	–	–	–	–
PSR1203	3AL	–	–	1	–	1	–	+ + +

[a] Underlined probes have not been mapped

[b] The copy number is determined from the minimum number of hybridizing bands per genome over four restriction digests. M, moderately repeated probe (> 4 copies)

[c] The relative strength of the hybridization signal in comparison to wheat: + + +, signal comparable in strength to wheat; + +, weaker, but adequate signal; +, weak signal; −, no detectable hybridization

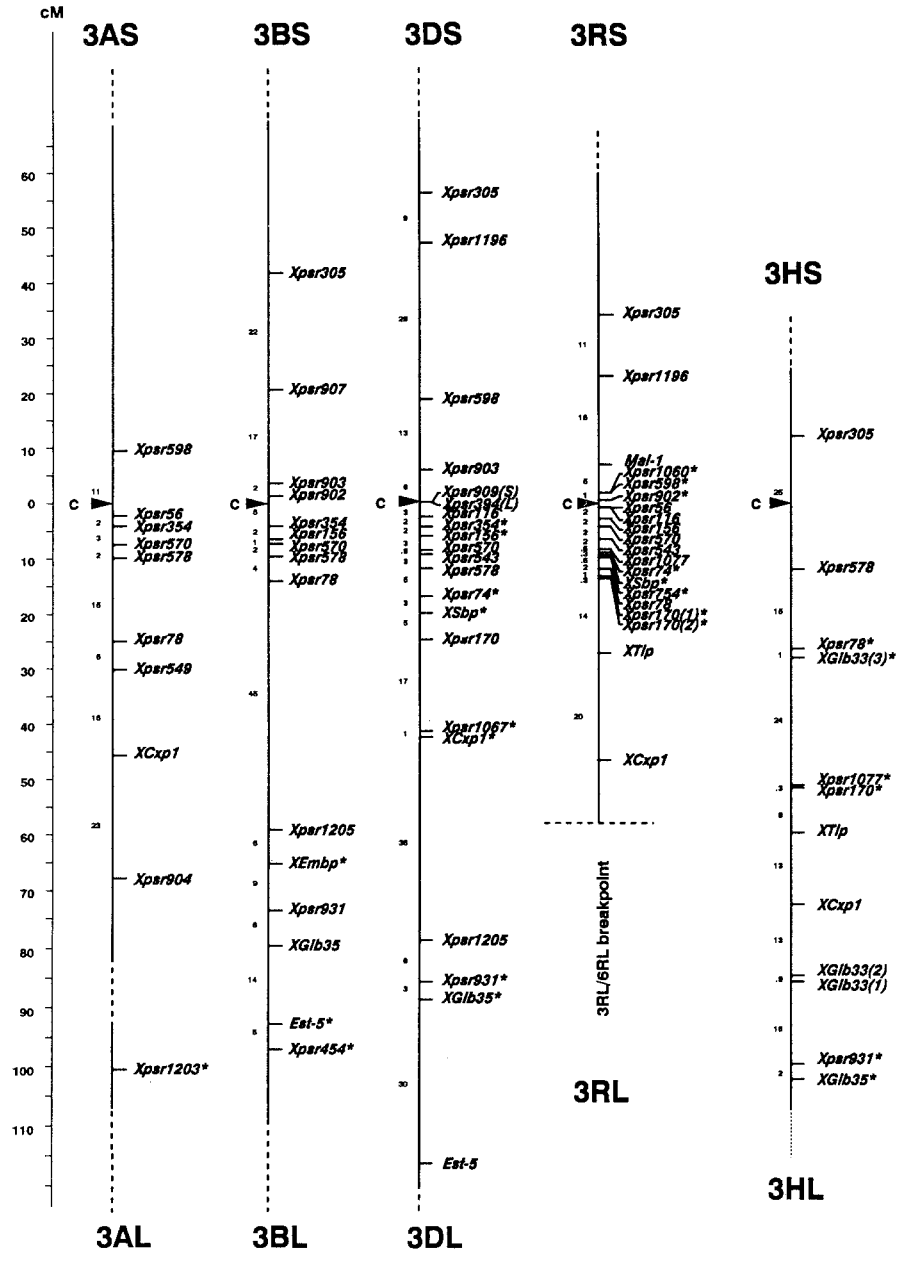

Fig. 1. Extended RFLP maps of the homoeologous group 3 chromosomes of wheat, rye and barley. * indicates preferred map locations, obtained with a LOD < 2.5

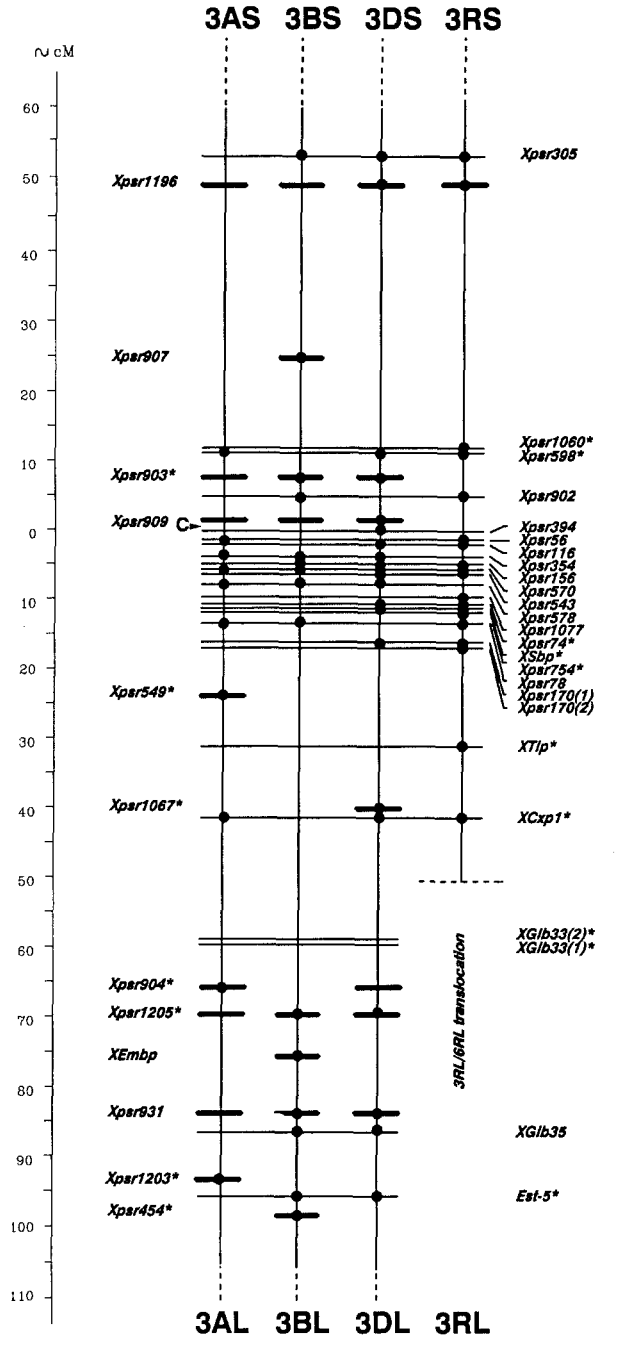

Fig. 2. Consensus maps of the homoeologous group 3 chromosomes of wheat and rye. • indicates mapped loci; *full lines* over the A, B, D and R chromosomes indicate loci detected by class *a* and *b* probes; *bold line fragments* indicate map positions of non-conserved loci; * indicates the most probable position of loci for which the relative order on the consensus maps could not be established unequivocally

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