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Transfer of the 1BL/1RS wheat-rye-translocation from hexaploid bread wheat to tetraploid durum wheat

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Summary. The present study describes a cytological stable alien chromosome translocation in tetraploid durum wheat. By crossing the hexaploid 1BL/1RS wheat-rye translocation line "Veery" to the tetraploid durum wheat cultivar "Cando" it was possible to select a 28 chromosomic strain homozygous for the 1BL/1RS translocation. The disease resistance potential of the short arm of rye chromosome 1R, which has been widely introduced in many hexaploid bread wheat cultivars could be now also used for the improvement of durum wheat.

Key words: Wheat-rye translocations – Durum wheat – C-banding

Introduction

The short arm of rye chromosome 1R has been shown to carry many important genes for disease resistance against the wheat pathogens stripe rust (*Puccinia striiformis* Westend f. sp. *tritici*), leaf rust (*Puccinia recondita* Rob. et Desm. f. sp. *tritici*), stem rust (*Puccinia graminis* Pers. f. sp. *tritici* Erikss. et Henn.) and powdery mildew (*Erysiphe graminis* DC. f. sp. *tritici* Marchal) (Bartoš and Bareš 1971; Bartoš et al. 1973, 1977; Zeller 1973; McIntosh 1983; Zeller and Fuchs 1983; Heun and Fischbeck 1987). This rye segment has been very successfully incorporated into many hexaploid wheat cultivars, either by translocation of the short arm of rye chromosome 1R and the long arm of wheat chromosome 1B or by translocation involving 1RS and the long arm of chromosome 1A of wheat. The 1BL/1RS and 1AL/1RS translocation lines show a race-specific resistance against rust and powdery mildew (gene loci *Yr 9, Lr 26, Sr 31* and *Pm 8;* McIntosh 1983) and are further characterized by a good yielding capacity (Rajaram et al. 1983). Rye chromatin might be also very interesting for improvement of durum wheats. However, up to now, no cytologically stable wheat-rye translocations in durum wheat has been obtained. The present study describes the successful transfer of the 1BL/1RS wheat-rye translocation from the hexaploid wheat cultivar "Veery" into tetraploid durum wheat.

Materials and methods

The donor of the 1BL/1RS translocation was the high yielding hexaploid spring wheat cultivar "Veery", which was selected by CIMMYT in a winter × spring wheat breeding programme for good disease resistance (Merker 1982). Since one of the parents used was the Soviet winter wheat "Kavkas", which is known to carry a 1BL/1RS translocation (Mettin et al. 1973; Friebe 1976), "Veery" should have obtained this rye segment from "Kavkas". The other parent was the North American durum wheat cultivar "Cando". "Veery" was kindly supplied by Dr. A. Merker and "Cando" by Dr. L. R. Joppa. Crosses were made using "Cando" as the female and "Veery" as the male parent. Chromosome identification was carried out according to the C-banding technique described by Giraldez et al. (1979).

Results and discussion

The hexaploid cultivar "Veery" was crossed with the tetraploid durum wheat "Cando". Five pentaploid F_1 plants were obtained, showing a chromosome number of 35, which were backcrossed to the tetraploid durum parent. In all, 23 BC_1 plant were obtained showing chromosome numbers ranging from 28 to 35 with a mean of 30.4. These plants were self-pollinated and the

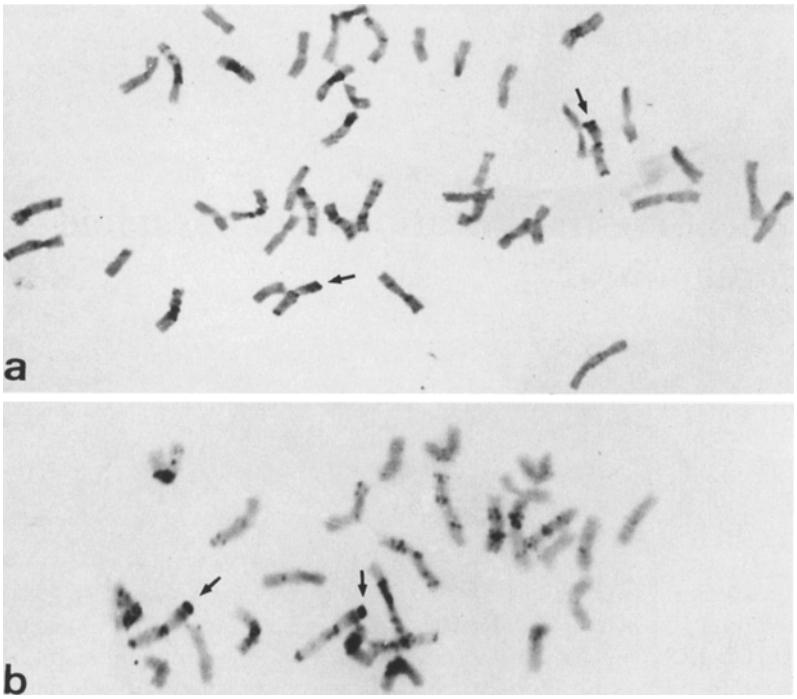

Fig. 1. C-banded somatic metaphase cells of the hexaploid wheat cultivar "Veery" (**a**) and the selected tetraploid durum strain homozygous for the 1BL/1RS translocation (**b**). *Arrows* point to the rye segment of the 1BL/1RS translocation

progenies were analysed according to their chromosome numbers and the presence of the 1BL/1RS translocation by using the C-banding technique. In two of the self-pollinated BC_1 progenies, the 1BL/1RS translocation was present and the following combinations could be selected:

1 plant ($2n=29$) 2× 1BL/1RS
5 plants ($2n=28$) 1× 1BL/1RS
2 plants ($2n=28$) 2× 1BL/1RS.

Of the two 28 chromosomic plants homozygous for the 1BL/1RS translocation, one survived and showed a good seed set. All progeny of this plant possessed $2n=28$ chromosomes and were homozygous for the 1BL/1RS-translocation, indicating that the translocation was cytologically stable.

Giemsa-C-banding has proved to be a very useful tool in chromosome identification in cereals and is now a standard technique in cytogenetic analysis. By using C-banding, the chromosomes of rye in general are characterized by large blocks of C-heterochromatin at telomeric regions, while those of wheat are marked by smaller and pericentromeric and intercalated C-bands (Endo 1986; Schlegel et al. 1986). The short arm of rye chromosome 1R possesses a large C-band at the telomere and in addition, a smaller band adjacent to the secondary constriction.

Figure 1 a shows a C-banded somatic metaphase cell of the cultivar "Veery". The two 1BL/1RS translocated chromosomes could be easily identified by their characteristic C-banding pattern. These results are in agreement with those of Merker (1982) and confirm the presence of a 1BL/1RS translocation in the wheat cultivar "Veery". Figure 1 b shows the C-banding pattern of the selected 28 chromosomic plant homozygous for the 1BL/1RS translocation. In addition to the translocated chromosome pair, this plant further possesses a complete set of the A-genome and from 2 up to 7 chromosome pairs of the B-genome of wheat. Meiosis in PMCs of plants heterozygous for the 1BL/1RS translocation is normal and in general 13 ring bivalents and one rod bivalent consisting of chromosome 1B and 1BL/1RS were observed.

Mochizuki (1968) produced a complete set of monosomics in tetraploid durum wheat, but these show in general reduced vigour and low fertility. Furthermore, several disomic substitution lines were obtained in which one chromosome pair of the A- or B-genome was replaced by the homoeologous chromosome pair of the D-genome (Joppa 1973; Joppa and Williams 1977; Mochizuki and Nagayoshi 1977; Joppa et al. 1978; Ono et al. 1980). Although several alien addition and substitution lines of tetraploid durum wheat could be established (Sakanaga 1957; Mochizuki 1962; Rao and Ruikar 1972; Makino 1976; Tsujimoto et al. 1984) up to now no cytological stable translocation line has been obtained. Rao (1978) attempted to transfer a segment carrying a resistance gene for stem rust of *Elytrigia elongata* of the hexaploid wheat-*Elytrigia* translocation

line "Thatcher" to durum wheat. He succeeded in getting the translocated chromosome in a heterozygous condition but failed to obtain homozygous plants. The wheat-*Elytrigia* translocation heterozygote shows a normal female but no male transmission. A similar failure of male transmission has been also reported for a wheat-rye translocation in durum wheat (Rao 1978), where no plants homozygous for the translocated chromosome could be selected.

It has been assumed that the difficulties in getting cytologically stable alien translocation lines in durum wheat might be caused by the reduced buffering effect of the tetraploid genome as compared with the hexaploid background. The presented results show no such difficulties for 1BL/1RS wheat-rye translocation, where the short arm of rye chromosome 1R compensates the loss of 1BS. This translocation line could be now used for the improvement of the rust resistance potential of durum wheat cultivars. The possibility of getting cytologically stable alien translocation and substitution lines also in tetraploid durum wheat may stimulate further attempts for alien genetic transfer into durum wheat.

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