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Development and characterization of wheat–alien chromosome lines.

Alien chromosome lines between wheat and seven alien species including *Haynaldia villosa, Leymus racemosus, Roegneria kamoji, R. ciliaris, Secale cereale, Hordeum californicum, and Thinopyrum bessarabicum* have been developed and characterized by chromosome C-banding, in situ hybridization, and molecular marker analysis.

The powdery mildew-resistance gene *Pm21* of *H. villosa* was located on chromosome arm 6VS and a T6VS·6AL translocation was developed and is now widely used in breeding programs in China. Ten cultivars, including Nannong 9918, Neimai 8~10, Shimai14, and Shimai15, with high yield and good disease resistance have been developed and released. The yellow mosaic virus disease resistance gene of *H. villosa* was located on the short arm of chromosome 4V and a translocation line T4VS·4AL has been developed.

Three *T. aestivum–L. racemosus* addition lines with Fusarium head bright resistance were developed. The FHB-resistance genes were mapped to chromosomes 5Lr#1, 7Lr#1, and Lr#7. More than ten *T.aestivum–L. racemosus* translocation lines involving chromosomes 5Lr#1, 7Lr#1, and Lr#7 with FHB resistance have been developed. An FHB-resistance gene on chromosome 7Lr#1 was named as *Fhb3*. A *T. aestivum–R. kamoji* translocation line with FHB resistance has been developed, and the FHB-resistance gene was mapped to chromosomes 1Rk#1. A total of 10 *T. aestivum–R. ciliaris* alien addition lines have been developed. An FHB-resistance gene was mapped to chromosome 2Rc. Addition, substitution, and translocation alien chromosome lines of *T. aestivum–H. californicum* and *T. aestivum–Th. bessarabicum* have been developed. Chromosome 5J and 3J of *Th. bessarabicum* might contain salt tolerance gene(s).

Mass production of wheat–Haynaldia villosa translocation lines by irradiation of a Triticum turgidum subsp. durum–H. villosa amphiploid.

Haynaldia villosa possesses many important agronomic traits and is a useful gene resource for wheat improvement. In order to develop more wheat–*H. villosa* translocations involving different chromosomes and chromosome segments of *H. villosa*, a *T. turgidum* subsp. *durum–H. villosa* amphiploid was irradiated with ^{60}Co γ-rays. Pollen collected from the spikes 1, 2, and 3 day after irradiation was pollinated to emasculated spikes of common wheat cultivar Chinese Spring. Genomic *in situ* hybridization was used to identify wheat–*H. villosa* chromosome translocations in the M1. The transmission of the identified translocation chromosomes was analyzed in the following BC_1, BC_2, and BC_3 generations. An efficient method for inducing wheat–*H. villosa* chromosomal translocations has been established. A number of intergeneric translocations between *T. turgidum* subsp. *durum* and *H. villosa* have been identified. This provides a new strategy for rapid mass production of wheat-alien chromosomal translocations, especially terminal translocations that is more important for wheat improvement.

Inducing chromosome translocations with small alien segments by irradiating mature female gametes of whole-arm translocation lines.

The development of translocations with small alien chromosome segments, especially interstitial translocation, will be helpful for better utilization and cytology-based physical mapping of alien useful genes. The *T. aestivum–H. villosa* T6VS·6AL translocation line carries the powdery mildew resistance gene *Pm21*. In order to create small chromosome segment translocation lines of 6VS, the female gametes of wheat–*H. villosa* T6VS·6AL translocation line were irradiated by ^{60}Co-γ ray before flowering. Anthers were removed from the irradiated florets on the same day and the florets were pollinated with normal fresh pollens of *T. aestivum* cv. Chinese Spring. Genomic *in situ* hybridization (GISH) on preparations of root-tip cells at mitosis metaphase was used to detect chromosome structural changes with small segments of 6VS. More than 20 new translocations and deletions involved in different regions of chromosome 6VS have been obtained. Several intercalary translocations with powdery mildew resistance gene *Pm21* have been developed. Irradiating mature female gametes of whole arm translocation is a new and highly efficient approach for creation of small segment chromosome structural changes, especially for interstitial translocations.

Cloning and transfer of powdery mildew resistance gene.

A microarray analysis using the barley Affymetrix Gene-Chip was conducted to clone candidate genes of *Pm21*. A full length candidate clone has been identified. The candidate gene was transformed into a wheat variety Yangmai 158, which is susceptible to powdery mildew, using a shot-gun method. The transgenic plants showed high powdery mildew resistance, indicating its good compensation function.

ITEMS FROM CROATIA

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Preliminary testing of the new Bc winter wheat lines for resistance to Fusarium head blight (Fusarium graminearum Schw.).

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Diseases caused by fungi of the genus *Fusarium* spp. inflict heavy damages in many wheat-growing regions world wide. Fungi of the genus *Fusarium* produce micotoxins (DON and ZEN) that have harmful effect on health of humans and domestic animals. The spread of this disease is the result of intensive growth of semidwarf wheat cultivars in the narrow maize–wheat rotation. Among the measures of control of this disease, breeding for resistance is one of the most important. Development of reliable techniques for artificial inoculation is a prerequisite for wheat breeding for disease resistance to be able to test a large number of materials in the breeding process. Every year about 1,000 wheat genotypes are tested under conditions of artificial inoculation with *F. graminearum* at the Bc Institute. The hightest yielding and most resistant lines with other good agronomic traits were screened in preliminary trials to be tested in exact trial (Fig. 1). In a trial with four replications in Botinec in 2008, the 25 highest yielding winter wheat lines were planted with artificial inoculation with *F. graminearum* (Fig. 2, p. 52). These investigations compared resistance to Fusarium head blight of the wheat lines from the exact trial with the resistance scores of the lines from preliminary trials in 2007. Significant differences in levels of resistance among the tested wheat lines were obtained in the 2008 trial. Visual rating of infection (VRI) ranged from 0.58 to 47.81. The most resistant lines were Bc 14 (3.71), Bc 12 (3.85), and Bc 1 (8.25), followed by

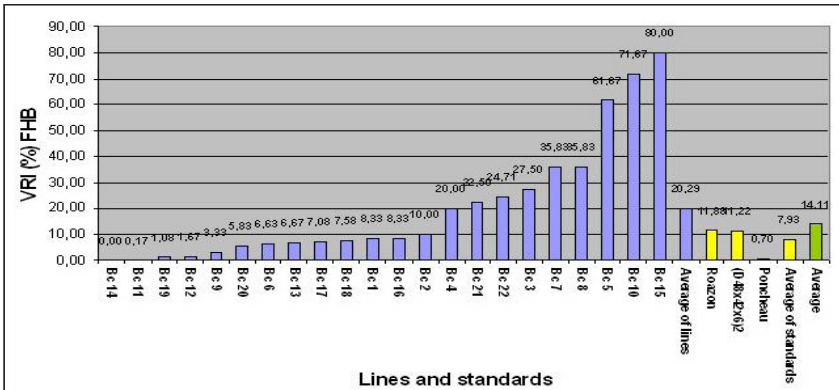

Fig. 1. Resistance to Fusarium head blight in 22 new Bc winter wheat lines in comparison with standards. Results are from preliminary trials screened after artificial infection, Botinec 2007.