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Morphological and Cytogenetic Characterization of Translocated Spring Triticale Line 131/7

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Abstract: In this paper present morphological and cytogenetic characterization of translocated spring triticale line 131/7. This line was created from crossing spring wheat cv Voronegskaya with spring rye cv Selenga and following pollination of spring triticale. It is differ from another cultivar by reduced height, more productive ear, leaf and stem rust and mildew resistance. Genomic in situ hybridization revealed that line 131/7 have wheat translocation in long arm rye chromosome and karyotype formula is (2n=42; 28W+12R+2R/W). The cytological analysis of meiosis has shown enough stable of this form. Thus, hexaploid the triticale line 131/7 can be used in the further plant breeding programs for creation of high-yielding forms spring triticale, and also for genetic researches.

Key words: GISH, plant breeding, rye, translocation, triticale *Triticosecale* Wittmack, wheat.

Introduction

In many countries of the Europe, Australia and America triticale now has received a wide distribution and it is cultivated on the area more than 3 million hectares (Oettler G., 1996).

One of the important triticale advantages – its ability to give compared with other crops a high harvest, especially on soils with a low level of fertility in various climatic conditions. The basic direction of use triticale - fodder: greenstuff on a silo and grain in fodder mixes. Rather important use of this crop for a feed: broad, cake, beer etc; industrial: ethanol. At this moment there are some problems which yet do not allow to use grain triticale for this purpose widely. The first problem, this poor quality gluten owing to which it is impossible to bake qualitative bread. The second

problem is development of grain processing technologies which would answer in a greater degree to qualitative structure of grain triticale (Pfeifer W., 1996).

Genome of hexaploid triticale consist of wheat and rye chromosomes that allows to spend manipulations with their quantitative structure and their ratio. Use in plant breeding of various chromosomal complements allows to solve problems as quality of grain triticale, and others agronomical valuable attributes of this new crop. Chromosome substitutions and translocations are influence morphological and qualitative traits (Lukaszevski A., 1990, Lukaszevski A., 1994, Lukaszevski A., 1998, Schlegel R., 1996, Hohmann U., et. al.,1998). Creation and studying of the forms having various variants of chromosomal complement, can help both for the decision of practical problems, and for understanding of triticale genetics.

The purpose: The purpose of our researches was studying a perspective spring triticale line 131/7 created on Department of Genetics RSAU-MTAA.

Research problems:

1. Analysis ploidy level and chromosome number of the line 131/7.
2. The comparative characteristic of morphological and yield parameters of the triticale line 131/7.
3. Research of the line 131/7 by a genomic in situ hybridization.
4. Cytogenetic characteristic of meiosis.

Materials and methods

As material the triticale line 131/7, created on Department of Genetics RSAU-MTAA by cross spring soft wheat cv Voronezhskaya with a spring rye cv Selenga and polyploidization of amphigaploid by colchicin. The line 131/7 selected in 3rd generation after pollination by spring triticale. For cytological investigations used a line triticale of 10-th generations.

For the cytological analysis used root meristems and pollen mother cells fixed by acetic alcohol (1:3). Analysis of chromosome number spent on squash preparations root meristems staining Shiff reagent. The analysis of meiosis carried out on squash preparations pollen mother cells staining 3 % acetocarmine.

Genomic in situ hybridization carried out by technique with some updating by Karlov et.al, (Karlov et.al., 2000). For visualization of a signal used a fluorescent microscope Axiophot with FITCs filter set. Results documented on color negative film Fuji film, ASA 400. For computer data processing negatives scanned on scanner EPSON Film Scan 200 at the resolution 1000 dpi. The received images contrasted by means of computer program Photoshop.

Results and discussion

Cytogenetic investigations. The studied triticale line 131/7 to attributes of an ear was similar to hexaploid form. Cytological analysis of line 131/7 has showed chromosome number 2n=42 (Fig. 1).

Fig. 1. Mitotic metaphase plate of spring triticale line 131/7

After genomic in situ hybridizations could be distinguished easily on chromosomes a genetic material rye (white) and wheat (grey) (Fig. 2).

Karyotype of line131/7 consist from 28 chromosomes (Fig. 2 – grey) that belong to wheat genome, 12 white chromosomes of rye genome and 2 chromosomes which most part of a long arm is presented by a genetic material of wheat (grey) and near centromere regions and a short arm - a material of a rye (white) (Fig. 2, arrows). Thus it is possible to see precisely enough a point recombination (Fig. 2, arrows). The genomic formula of triticale line 131/7 - 28W + 12R + 2R/W (W - wheat, the R - rye, R/W - chromosome rye-wheat translocations).

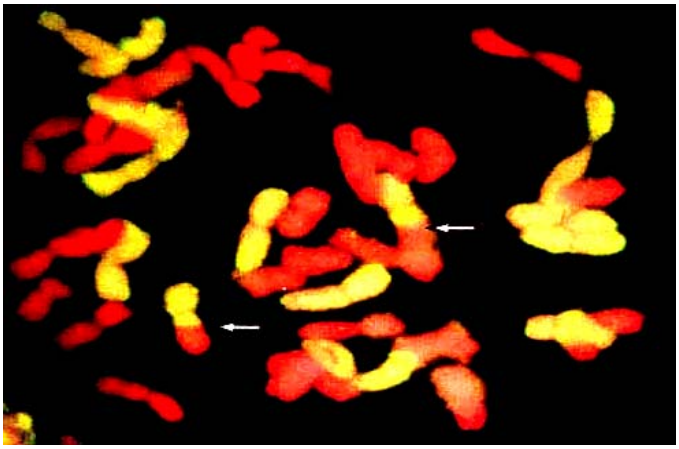
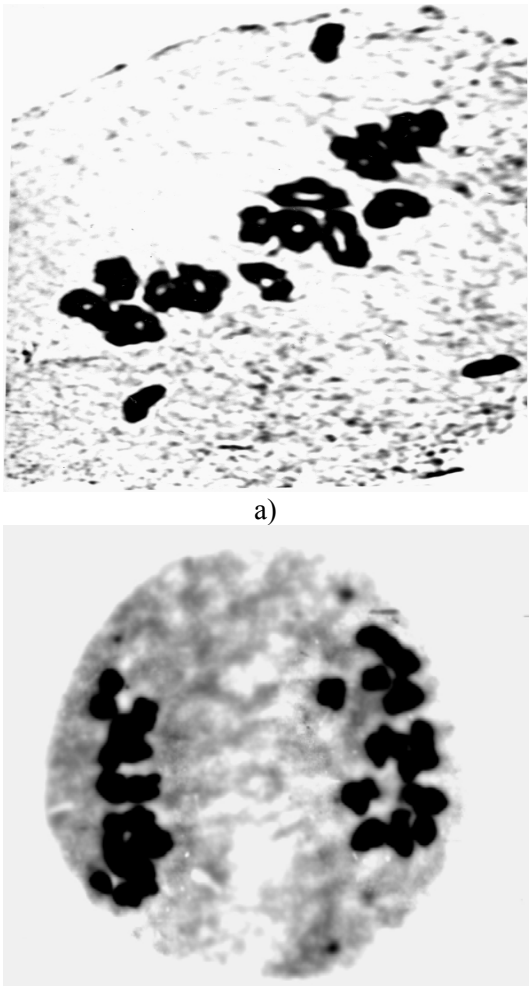


Fig. 2. GISH of mitotic chromosome plate of triticale line 131/7 (white – chromosomes of rye, grey – chromosomes of wheat, rows – rye-wheat translocations)

Translocation between wheat and rye chromosomes widespread enough phenomenon both for wheat and for triticale (Schlegel R., 1996). However these translocation into rye chromosomes meet seldom and basically in tetraploid forms (Meinkoth J., Wahl G., 1984).

The cytological analysis meiosis has shown presence bivalent chromosomes. Practically all microsporocyte in a metaphase-I had 21 bivalent (Fig. 3 a). At anaphase-I the normal divergence of chromosomes without any anomalies (Fig. 3 b) was observed.



a)

b)

Fig. 3 Meiosis metaphase-I plate (a) and anaphase-I (b) of spring triticale line 131/7

These data confirm that the investigated line is enough stable form.

Comparative characteristic of agronomic traits triticale and wheat

After carrying out of the comparative characteristic of morphological, structural and qualitative traits of a triticale line 131/7 in comparison with soft wheat and another triticale following laws have been revealed.

The studied triticale line 131/7 differs from others in reduced height a plant (up to 72 cm), a productive ear (1,7-1,9 g), leaf and stem rust and mildew resistance. The scale for mildew and leaf rust is 1 - very susceptible, 9 – resistant (Tab. 1).

Tab. 1 Agronomic traits of translocated triticale line 131/7 in compare with soft wheat and triticale

Crop and varieties	Chromosome number	Vegetation period, days	Plants height, cm	Length of main ear, cm	Grain yield, g/main ear	Disease resistance, number	
						mildew	leaf rust
Triticale 131/7	2n = 42 with translocation	100	66,9 ± 4,1	9,5 ± 0,7	1,65 ± 0,20	9	9
Soft wheat Ivolga	2n = 42	98	78,2 ± 4,0	9,0 ± 0,8	1,21 ± 0,21	7	8
Triticale к-1242	2n = 42	100	81,6 ± 3,8	9,4 ± 1,2	1,52 ± 0,29	8	8

Within all years of studying on this line it was not revealed grains sprouting. The line 131/7 is characterized by rather short period of vegetation that is especially important for spring triticale at conditions of the center of Russia.

Conclusions

- The line of spring triticale 131/7 has 2n=42.
- Genomic in situ hybridization has showed the present of wheat translocations into a long arm of rye chromosomes.
- Line 131/7 is cytogenetic stable form.
- Line 131/7 has valuable characteristics - reduced height a plant and short period of vegetation.
- Line 131/7 is used in plant breeding program of spring triticale.

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MORFOLIŠKA I CITOGENETIČKA KARAKTERIZACIJA TRANSLOKACIONE LINIJE 131/7 JAROG TRITICALE

- originalni naučni rad -

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Rezime

U ovom radu data je morfološka i citogenetička karakterizacija translokacione linije 131/7 jarog triticale. Ova linija je dobijena iz ukrštanja jare pšenice cv Voronegskaja i jare raži cv Selenga uz naknadnu polinaciju jarog triticale. Ona se razlikuje od drugih kultivara, nižom stabljikom, produktivnijim klasom, rezistentnošću na lisnu i stabljičnu rđu i pepelnicu. Genomska in situ hibridizacija je otkrila da linija 131/7 poseduje translokaciju hromozoma pšenice na dugom kraku hromozoma raži, tako da je formula kariotipa (2n= 42; 28W+12R+12R/W). Citološke analize mejoze su pokazale dovoljnu stabilnost ove forme. Na taj način, heksaploidna triticale linija 131/7 može biti upotrebljena u budućim programima oplemenjivanja za dobijanje visokoprinosnih formi jarog triticale i genetička istraživanja.