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ITEMS FROM THE RUSSIAN FEDERATION

AGRICULTURAL RESEARCH INSTITUTE FOR THE SOUTH-EAST REGIONS (ARISER)
Department of Genetics, Laboratory of Genetics and Cytology, 7 Toulaikov St., Saratov, 410010, Russian Federation.

The influence of a translocation with the combination Lr19+Lr25 on grain productivity and bread-making quality in the spring bread wheat cultivar Dobrynya.

S.N. Sibikeev and A.E. Druzhin.

At the Agricultural Research Institute for the South-East Regions (ARISER), NILs based on the Saratov-bred, spring bread wheat cultivar Dobrynya and carrying translocations with the combination *Lr19+Lr25* were produced and studied. The data from 2012–14 indicate that the interaction of these trans-

Table 1. Grain productivity and gluten values of near-isogenic lines (NILs) of the spring bread wheat cultivar Dobrynya, average for 2012–14. Gluten strength was evaluated by using the gluten deformation index.

NIL	Grain yield (kg/ha)	Gluten value	
		Content (%)	Strength
Dobrynya (*Lr19*)	3,164	38.03	71
Dobrynya (*Lr19+Lr25*)	3,323	38.87	76
LSD	NS	NS	NS

Table 2. Bread-making qualities of near-isogenic lines (NILs) and spring bread wheat cultivar Dobrynya (average for 2012–14).

NIL	Physical trait of dough (alveograph)			Bread-making quality		
	Dough extensibility (P)	P/L	Flour strength (W)	Loaf volume (cm^3)	Porosity	Crumb color
Dobrynya (*Lr19*)	142.3	2.33	368.7	847	4.9	yellow
Dobrynya (*Lr19+Lr25*)	126.3	1.83	351.0	920	4.9	yellow
LSD	NS	NS	NS	50	NS	

locations has a neutral influence on grain yield (Table 1, p. 60). However, the influence of the translocation on grain yield in different years was ambiguous. During this period, leaf rust epidemics were observed twice (2013 and 2014) and drought conditions once (2012). Grain productivity significantly increased during the two leaf rust epidemics in NILs with *Lr19+Lr25* (3,238 in 2013 and 5,012 kg/ha in 2014) and Dobrynya (2,988 in 2013 and 4,451 kg/ha in 2014) and was significantly reduced under drought conditions in the NILs (1,718 kg/ha) and Dobrynya (2,054 kg/ha). The main limiting factor for the use of translocations from *Secale cereale* in wheat breeding is the influence on bread-making quality. In the Dobrynya NILs, the *Lr19+Lr25* translocations did not influence gluten values. Dough extensibility (P) and strength of flour (W) were not significantly lower in the NILs with *Lr19+Lr25* compared with those of Dobrynya. For bread-making qualities, the NILs have a loaf volume significantly higher but porosity equal to that of Dobrynya (Table 2, p. 60). Thus, the *Lr19+Lr25* translocations had positive effects on resistance to disease, but reduced drought resistance and grain productivity in 2012. Grain yield increased in 2013 and 2014, years with leaf rust epidemics. For bread-making quality, the NILs with *Lr19+Lr25* translocations were evaluated as good or excellent.

The use of Triticum turgidum subsp. durum as valuable source of genes for improving spring bread wheat.

S.N. Sibikeev, A.E. Druzhin, T.D. Golubeva, and T.V. Kalintseva.

In the laboratory of Genetics and Cytology at ARISER, we produced a number of introgression lines with genetic material from *T. turgidum* subsp. *durum* cultivars Saratovskaya Zolotistaya, Zolotaya volna, Taro1, and Yazi10 with the aim of enlargement the genetic diversity of the gene pool of spring wheat. During prebreeding studies in 2014, these introgression lines were studied for their agronomic value. We noted that 2014 was most favorable for spring bread wheat and for many pathogens, which allowed us to objectively evaluate them for disease resistance, grain productivity, and quality.

All introgression lines were resistant to leaf rust and powdery mildew (Table 3). In some cases, the introgression lines were better in comparison with the standard cultivars for grain yield

Table 3. The reaction of powdery mildew, leaf rust grain productivity, grain protein content, and gluten deformation index, bread-making qualities of cultivars and near-isogenic lines (NILs).

NIL or cultivar	Pedigree	Powedery mildew	Leaf rust	Grain yield (kg/ha)	Gluten value		Physical trait of dough (alveograph)			Bread-making quality	
					Content (%)	Strength	Dough extensibility (P)	P/L	Flour strength (W)	Loaf volume (cm³)	Porosity
Favorit		0	0	4,441	28.8	67	99	1.8	190	820	4.8
NIL 202	Saratovskaya Zolotistaya / Favorit // Favorit /3/ Favorit	0	0	4,496	29.5	59	165	3.1	347	740	4.6
L503		1	3	4,361	31.0	70	66	1.0	150	790	5.0
NIL 573	L503 / Taro1*2 // L503	1	0	3,733	30.7	72	165	3.0	307	770	4.6
Belyanka		1	0	4,900	30.0	68	77	1.0	196	700	4.6
NIL 345	Belyanka / Taro1*2 // Belyanka	3	0	4,926	22.6	53	93	1.9	164	690	4.5
Dobrynya		1	3	3,974	41.5	82	165	3.0	327	840	5.0
NIL 293	Dobrynya / Zolotaya volna // Dobrynya /3/ Dobrynya	0	0	4,290	30.8	62	165	3.0	379	860	5.0
NIL 216	Dobrynya*4 / Nik	0	3	4,228	29.7	65	141	3.5	255	830	5.0
L505		1	3	4,150	26.4	58	165	2.5	497	780	4.8
NIL 214	L505 / Yazi10 // L505 /3/ L505	1	0	3,895	32.5	69	165	3.0	386	700	4.6

and quality, some were not significantly different, and decreased in others. In NIL 573, from a cross between the cultivars L503 with Taro1, grain yield significantly decreased compared with the parental recipient cultivar, but in NIL 345, where Belyanka was crosse with Taro1, the grain yields were nearly similar (Table 3, p. 61). These lines were different in gluten content and strength of gluten; NIL 573 did not differ from L503, but those for NIL 345 were lower than those of Belyanka. In NIL 573, dough extensibility and strength of flour were were significantly higher than that of cultivar L503, whereas in NIL 345, they were slightly different from those of Belyanlka. Similar data were obtained in other lines obtained from crossing with durum wheat cultivars. Dough extensibility and strength of flour were significantly higher in NIL 202 than in Favorit, lower in NIL 216 than Dobrynya, and similar in NIL 293 and Dobrynya. In NIL 214, dough extensibility was equal to that of L505, but flour strength was lower (Table 3, p. 61). These studies show that grain yield and quality in introgression lines of spring wheat *using T. turgidum* subsp. *durum* is largely determined by the cross combination. We plan to continue studying the introgression lines carrying genetic material from *T. turgidum* subsp. *durum*.

The influence of translocations T7DS·7DL–7Ae#1L + T1BL·1R#1S and a 6D (6Ag^i) substitution on callusogenesis and regeneration in wheat plants.

E.M. Pankova, L.G. Kurasova, and Y.V. Lobachev.

Modern wheat biotechnology involves the use of somatic cell culture and tissues *in vitro*. Therefore, we studied the effect of T7DS·7DL–7Ae#1L + T1BL·1R#1S combination and A 6D (6Ag^i) chromosome substitution on callus formation and plant regeneration of spring bread wheat. Substitution line 6D (6Ag^i) has the gene combinations *Lr19/Sr25 + Pm8/Sr31/Lr26/Yr9* and *Lr6Ag^i*. Two experiments using a set of two pairs of near-isogenic lines (NILs) L-503R (*Lr*19 + *Lr*26 translocations) and L-503S (*Lr19* translocation), and L-400R (6D (6Ag^i) substitution chromosome) and L-400S (normal 6D). Donor plants were grown in the field and greenhouse. In the first experiment, the ratio of the mass of callus after 20 days of culture (W20) to the weight of the explants (Wi) in the NILs L-503R and L-503S were significantly different; the NIL L-400R significantly exceeded those of NIL L-400S. The second experiment revealed significant differences in the W20/Wi for both NIL pairs. No differences in the ratio of the number of regenerates to the weight of callus after 20 days of culture in both NIL pairs were not observed in the all experiments. Thus, the specific effects of T7DS·7DL–7Ae#1L + T1BL·1R#1S translocation combination and the 6D (6Ag^i) chromosome substitution on processes callusogenesis during culturing of somatic cells *in vitro* were found.

RUSSIAN STATE AGRARIAN UNIVERSITY
Department of Genetics, Biotechnology, Plant Breeding and Seed Production, Moscow Timiryazev Agricultural Academy, ul. Timiryazevskaya, 49, 127550 Moscow, Russian Federation

Natalia N. Kolesnikova and Liudmila S. Bolshakova, and Nina V. Poukhalskaya (Research Department, Agropark, Gostinichnii proezd, 4, 127106 Moscow, Russian Federation.

Aluminum tolerance in spring triticale.

Species, and genotypes within species, are known to differ widely in their tolerance to aluminum. Aluminum (Al) toxicity primarily affects cell division in the root apex. the root meristem and zone of elongation are highly sensitive to Al and accumulate it very easily, resulting in root damage. This study evaluated the levels of aluminum tolerance in spring triticale varieties, using root regrowth to characterize Al tolerance.

Materials and methods. Sixteen cultivars of spring triticale were tested for Al tolerance. We used a method based on root activity exposure to solutions with aluminum (Aniol and Gustafson, 1984; Ma et al., 2000; Matos et al., 2005; Fontecha et al., 2007), with modifications.

Seeds were germinated at 20°C in a 10^{-4}M $CaSO_4$ solution. Seedlings with a root length of 1.0–1.5 mm were placed in plastic cups in 250 mL of a 10^{-4}M $CaSO_4$ solution and grown 48 h (Fig. 1), which was replaced daily. Five seedlings were placed in each cup, with three replications. The $CaSO_4$olution was replaced with one containing either 10, 20, or 40 mg $AlCl_3 \cdot 6H_2O$/L for 24 h. Roots were stained in a 0.15% Eriochrome (black) solution. Plants were grown for 48 h and root regrowth was measured. Plants that maintained the ability to regrow roots were observed (Fig. 2). Groups of Al tolerance were separated according Butnaru et al. (1998).

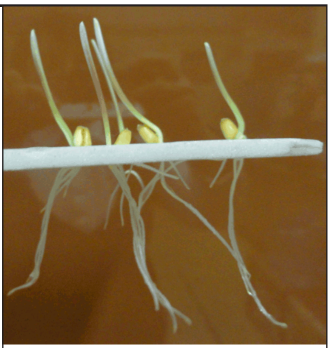

Fig. 1. Seedlings of spring triticale on a plastic float.

Results and discussion. The spring triticale varieties were classified as highly tolerant, tolerant, medium tolerant, and intolerant according to their root regrowth after an Al stress.

Highly tolerant (root regrowth on solution without Al after 24 h in a solution with Al concentrations of 10, 20, or 40 mg/L): Ulyana, Yarilo, Meksika 38, Meksica 51, Legalo, Presto/Tesmo, Dublet, Lana, and 131/7.

Tolerant (root regrowth in a solution without Al after 24 h in a solution with Al concentration 10 or 20 mg/L): Gabo, Wanad, and Hlebodar Harkovskij.

Medium tolerant (root regrowth in solution without Al after 24 h in a solution with an Al concentration 10 mg/L): Grebeshok and Activo.

Intolerant (no root regrowth): Sandro, Abaco, and Grego.

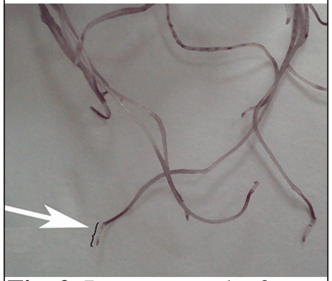

Fig. 2. Root regrowth after aluminum treatment.

We supposed that cereals differ in response to Al in decreasing order: rye, triticale, wheat. In some of our experiments with acid soils, triticale has Al tolerance, which is not confirmed in experiments using only one characteristic. A comparison in the decrease in yield of spring triticale and spring wheat, which were grown in pots with a soil application of 6 mg $AlCl_3$/kg of soil, was made (Fig. 3). We propose that the mechanisms of Al tolerance differ for triticale and wheat. The level of decrease was lower, even for the highly tolerant spring triticales Yarilo and Legalo. Tolerance was higher in spring wheat.

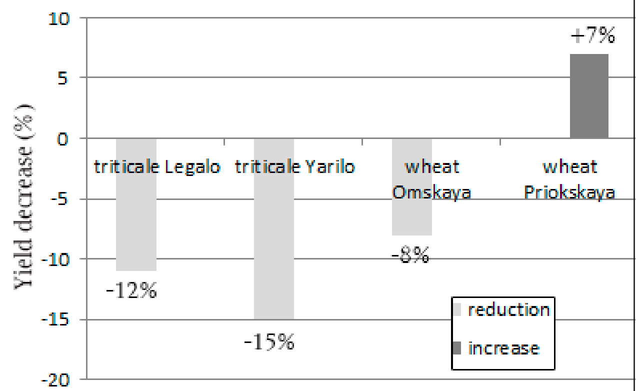

Fig. 3. A comparison of the decrease in yield of spring triticale and spring wheat grown in soils with Al^{3+}.

Conclusion. These results indicate that a single test for Al tolerance is not sufficient for grouping spring triticale varieties. Aluminum tolerance has different mechanisms, which have complex determinations on growth and yield of triticale and wheat in stress conditions. To estimate Al tolerance in triticale and wheat, a complex investigation is necessary, which would include testing at different stages of plant development and growth until harvest.

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