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The winter wheat cultivar Kalach 60.

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Breeding of the winter wheat cultivars at ARISER began in 1915. The main task in the first stage of selection was creating cultivars adapted to the steppe zone of the Volga Region. Since the beginning, 26 cultivars have been developed from which seven are currently patented and registered.

Kalach 60 is an intensive type cultivar; to obtain high yield and high-quality grain, it requires the application of fertilizers and observing agronomical practices. Kalach 60 was developed using individual selection. The cultivar is of the variety lutescens. Plant height is 20–30 cm shorter compareed to that of Mironovskaya 808. The straw is thick. Kalach 60 has increased winter hardiness, lodging and drought resistance, early mature growth, high grain quality, and high grain yield (2.7 t/ha). These characters allow the use of Kalach 60 in intensive farming to obtain high-quality grain. Early ripening allows Kalach 60 to be used in a system used by large farms, which sow winter crops on large areas.

In 2011, Kalach 60 was planted in rhe Saratov region on 13.7 x 10^3 hectares (2.8%). In 2012, it was listed in the National Register of the Russian Federation in the lower Volga Region.

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The role aluminum salts ($AlCl_3$, $Al(NO_3)_3$, and $Al_2(SO_4)_3$ in the formation of spring wheat resistance to aluminum toxicity.

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We are researching the toxicity of aluminum, at present, because of insufficient data about the toxicity of various Al^{+3} salts (sulfates, nitrates, and chlorides). Our data show that aluminum toxicity changes in the presence of different ions. We studied the comparative degree of toxicity of aluminum ions when using sulfates, nitrates, and chlorides on spring wheat.

Materials and methods. Aluminum tolerance was observed at germination in laboratory experiments under controlled environmental conditions. Seedlings of two cultivars of spring wheat were grown under greenhouse conditions. Sprouts of plants were grown on solutions of $AlCl_3$, $Al(NO_3)_3$, and $Al_2(SO_4)_3$ with various concentration of aluminum (0, 0.4, 3, 5.13, 15, and 40 mg of Al/L. Absorption from the solutions was measured in vessels each containing the same number of plants. Plants were grown on plastic floats (rafts) on the surface of the solution. The seed was planted in apertures in the floats. Experiments also were made in rolled culture and in soil. The same aluminum salts were used at 1.3 mg/100 g soil for the vegetative trials.

Results and discussion. During germination, wheat plants reduce the absorption from solutions in different ways. Absorption decreases as follows: $Al(NO_3)_3 = Al_2(SO_4)_3 > AlCl_3$. Plants absorb a solution more actively if there are ions that do not interfere with metabolism, but apparently, more active absorption of a 'bad' aluminum ions also occurs.

Effects of aluminun toxicity. The root tip is deformed (Fig. 1, p. 213). The root becomes thickened; cell division continues but the stretching processes slow down. Our results show that growth in root tips is connected with the ability to adapt to the aluminum toxicity than the reaction of the entire root system. The reaction of the shoot to aluminum toxicity is defined by the degree of growth inhibition of the root. However, we found a high correlation with leaf growth (Table 1). Such plants can have a stronger inhibition of root growth. The ability to respond to aluminum ions during the first stages of development corresponds to the genotypes that are capable of increased metabolic activity under stress. Genotypes with notable resistance to aluminum stress also had high yields.

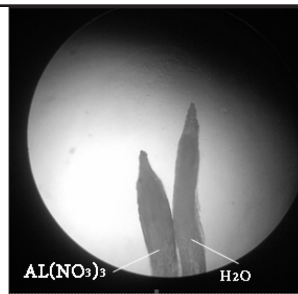

Fig. 1. Effect of aluminum toxicity on a root tip as seen under a microscope, left, growing in aluminum nitrate; right, water control.

Table 1. The apex (head) length at developmental stage VI after Kuperman of spring wheat.

Variant	Apex length (mm)	Seed/head
Yugo-vostochnaya 2		
Control	5.7	14
$AlCl_3$	10.5	14
$Al_2(SO_4)_3$	7.8	14
Kerba		
Control	17.8	17
$AlCl_3$	12.3	16
$Al_2(SO_4)_3$	16.0	17
LSD 0.05	0.3	0.7

Kernel number/spike was lower when aluminum ions were present. Aluminum sulfate caused a greater reduction in the length of roots compared to those grown in aluminum chloride. The length of the root system decreased more in an aluminum sulfate solution than those in an aluminum chloride solution.

Vegetative growth may be strengthened as a reaction to aluminum toxicity. Aluminum sulfate inhibited root growth to a greater degree and activated leaf growth leading to better adapted plants. In the variant with aluminum sulfate, the resistance of cultivar Kerba was 0.97 s/cm, an increase of 13.0% and 24.8 % in Yugo-vostochnaya 2, 25.6% higher in the different background (Fig. 2). Thus, we established that the ability of plants for active vegetative growth can be used to test adaptive potential. Apparently, we are unable to make conclusions about the stability of a genotype to aluminum toxicity or on the level of decrease in root length in aluminum solutions. We believe that the stability of plants can be made, connecting vegetative growth in plants to solutions of aluminum and loss of final productivity (Fig. 3).

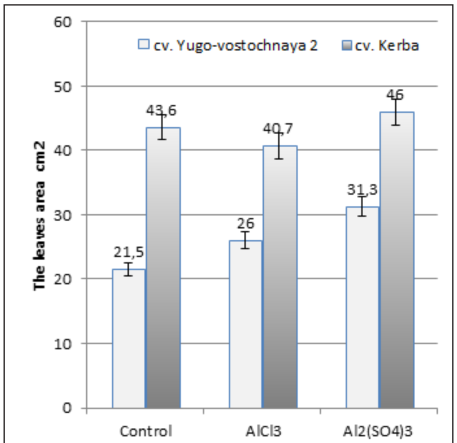

Fig. 2. Leaf area of plants of cultivar Yugo-vostochnaya 2 and Kerba grown in $AlCl_3$ and $Al_2(SO_4)_3$ (cm^2) solutions.

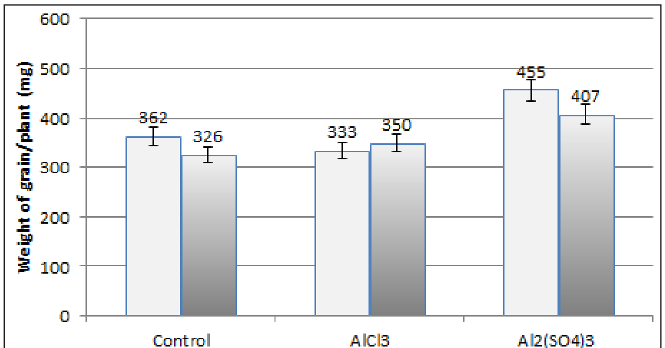

Fig. 3. The final productivity (grain/plant (mg)) of cultivars Yugo-vostochnaya 2 and Kerba under aluminun chloride and sulfate.