increase was in the leaf area of the cultivar Lada, which was 2.0% times the control. The leaf area of the cultivar Priokskaya increased 1.06% over the control and the cultivar Ester increased by 47.0%. The relationship between stimulation of leaf growth and plant productivity in Al-weak soils is the capability of greater productivity. We suggest that there is a possible adaptation mechanism of wheat cultivars that are able to initiate early growth because of Al in soils.

SARATOV STATE AGRARIAN UNIVERSITY NAMED AFTER N.I. VAVILOV
Department of Biotechnology, Plant Breeding and Genetics, 1 Teatralnaya Sg., Saratov, 410012. Russian Federation.

Effect of bacterial lipopolysaccharide on the morphogenetic potential of wheat callus cells in vitro.

O.V. Tkachenko and Yu.V. Lobachev and L.Yu. Matora, N.V. Evseeva, G.L. Burygin, and S.Yu. Shchyogolev (Institute of Biochemistry and Physiology of Plants and Microorganisms, Russian Academy of Sciences, 13 Entusiastov Ave., Saratov 410049, Russian Federation).

The major problem when cultivating plants *in vitro* is ensuring that the cells preserve their morphogenetic potential. Plant-associated methylobacteria stimulate plant growth and morphogenesis *in vitro* (Kalyaeva et al. 2001). Volkogon et al. (2006) also found that the nitrogen-fixing bacteria *Azospirillum* promote potato growth in an *in vitro* culture. However, inoculation of plants with whole bacterial cells in a *in vitro* culture is fraught with methodology-related difficulties. In view of this, a problem is using bacterial cell components that are responsible for plant–bacterial interaction, and not a bacterial suspension, to treat explants. The outer-membrane lipopolysaccharide (LPS) of the nitrogen-fixing bacteria *Azospirillum* is an active cell component that not only determines bacterial contact interactions with the roots of plants but also is involved in processes inducing plant responses to these interactions (Matora et al. 1995; Evseeva et al. 2009). Our work examined the influence of LPS on the morphogenetic parameters of cultivation of somatic wheat calli differing in the *Rht-B1c* gene.

Immature embryos of two near-isogenic wheat lines (genetic background of cultivar Saratovskaya 29) differing in the *Rht-B1c* gene were placed on Linsmaier–Skoog medium, an experimental nutrient medium for callus initiation, that contained LPS at 1, 2.5, 10, and 100 μg/mL. The resulting morphogenic calli were transferred to a regeneration medium with the same LPS content. The standard medium did not contain LPS. The morphological characteristics of the calli were assessed on day 30 of culturing by using two parameters: yield of morphogenic calli and their content of proliferative antigen of initials (PAI), a molecular marker for wheat meristematic cells (Evseeva et al. 2002).

Callus formation in the wheat lines was high (close to 100%) in all treatments. The addition of 10 μg/ml of LPS to the nutrient medium had a positive effect on morphogenic callus formation in the line with the *Rht-B1c* gene. The yield of morphogenic calli in this line increased almost twofold. LPS at 10 μg/ml also increased the content of PAI in the callus cells of all genotypes studied. Compared with the tall sister line and the original cultivar, the line with *Rht-B1c* showed a significant difference. In other treatments, we did not record any significant effect of LPS on the morphogenetic activity of the calli. Similarly, no substantial differences in the 'mass of morphogenic calli' parameter were found between the standard and experimental nutrient–medium versions. Overall, this study confirmed the previously found positive effect of the *Rht-B1c* gene on all stages of *in vitro* tissue culture compared with the *Rht-B1a* allele (Tkachenko and Lobachev 2008). In most cases, the influence of genotype was greater than the effect of introducing LPS into the nutrient medium.

References.

Evseeva NV, Matora LYu, Burygin GL, and Shchyogolev SYu. 2009. Influence of bacterial lipopolysaccharide on the functional activity of wheat-seedling-root meristems. Ann Wheat Newslett 55:185-186.

Evseeva NV, Tkachenko OV, Lobachev YuV, Mitrophanov AYu, Djatchouk TI, and Shchyogolev SYu. 2002. Studies on the embryogenic processes in the in vitro culture of wheat somatic tissues by using a proliferative antigen of initial cells. Wheat Inf Serv 94:1-4.

Kalyaeva MA, Zacharchenko NS, Doronina NV, Rukavtsova EB, Ivanova EG, Alekseeva VV, Trotsenko YuA, and Bur'yanov YaI. 2001. Plant growth and morphogenesis in vitro is promoted by associative methylotrophic bacteria. Rus J Plant Physiol 48(4):514-517.

Matora LYu, Solovova GK, Serebrennikova OB, Selivanov NYu, and Shchyogolev SYu. 1995. Immunological properties of *Azospirillum* cell surface: the structure of carbohydrate antigens and evaluation of their involvement in bacteria-plant contact interactions. **In:** Azospirillum VI and Related microorganisms: Genetics, physiology, ecology (Fendrik I, del Gallo M, De Zamaroczy M, and Vanderleyden J, Eds). Springer, Berlin, Germany. Pp. 377-382.

Tkachenko OV and Lobachev YuV. 2008. Using isogenic analysis to study genotype effect in in vitro cell and tissue culture culture of wheat. Ann Wheat Newslett 54:122.

Volkogon VV, Dimova SV, and Mamchur OE. 2006. Interaction peculiarities of *Azospirillum* genus bacteria with cultivated in vitro potato plants. **In:** Sil'skogospodarska mikrobiologiya (Volkogon VV, Ed). 3:19-25.

STATE SCIENTIFIC INSTITUTION ALL-RUSSIAN SCIENTIFIC-RESEARCH INSTITUTE OF GRAIN CROPS AFTER I.G. KALINENKO (SPI ARRIGC AFTER I.G. KALINENKO)
Russian Academy of Agricultural Sciences, Town of Zernograd, Rostov Region, Russian Federation.

A.V. Alabushev, E.V. Ionova, N.N. Anisimova, V.L. Gaze, and T.A. Gritchannikova.

Drought resistance in winter wheat.

Drought resistance is the ability of a plant to change metabolic processes as little as possible during conditions of insufficient water supply. The adaptiveness of a plant determines the structural degree of the fibers. The physiological functions of a plant are connected closely with its morphology and anatomy. The xerophytic structure of winter wheat promotes its resistance to drought during all vegetative periods. The harder and longer the drought, the greater the influence of xerophytic characters on yield elements.

The xerophytic nature of a plant can be assessed using stomata number per leaf area. To determine this value in wheat, we measured stomata/leaf are in flag leaves, in the middle of the leaf, and along the both sides of a central vein. The greater the number of stomata, the more xerophytic the cultivar. Other criteria for drought resistance are a water deficit determination, such as the lack of water present in a plant during a drought and residual water deficit, which is the amount of water present in the early morning. Our work revealed a correlation between residual water deficit signs with a level of variety drought resistance (r = 0.91). Field observations were made during the drought conditions in 2003, 2005, 2007, and 2009.

Xerophytic cultivars posses high levels of complex plant stability index (distinguished at the primary developmental stages). The greatest number of stomata/leaf area, i.e., more xerophytic, and water and temperature stress resistance were the cultivars Don 93, Ermak, and Zarnitsa. Winter wheat cultivars have a high (r = 0.99) correlation dependence of xerophytes value and complex resistance index. Xerophytic structure promotes the economic and efficient consumption of water by the leaves and is expressed more in genotypes resistant to drought. These conclusions were confirmed in the laboratory and by evaluating the drought resistance of winter wheat in a field experiment.

In the field, increased water content in the leaves increases drought resistance if not accompanied by a decrease in ventilation. We took into consideration the degree of leaf ventilation, i.e., we determined a number of open stomata per leaf square. Cultivars with an increase in xerophytic characteristics possess a high water holding ability. For example, Don 105 has the lowest residual water deficit at flowering (10%) and has the greatest number of stomata/leaf are ($27/mm^2$). The cultivars Deviz, Don 95, and Don Kolos, which had the greatest moisture deficits of 27, 30, and 36%, respectively, possessed the smallest number of stomata/leaf area, 13, 12, and $8/mm^2$, respectively. The correlation between xerophytic value and the residual deficit is r = 0.42 (medium).

Drought-resistant cultivars can lose water without harm and need not close stomata significantly longer, even in periods of a harvest drought, positively influencing assimilation speed, increasing CO_2, and strengthening the photosyn-