

## **STUDY OF WHEAT VARIETIES WITH WHEAT-RYE TRANSLOCATIONS 1BL/1RS, 1AL/1RS FOR A COMPLEX OF AGRONOMICALLY VALUABLE TRAITS AND PROPERTIES**

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One of the modern ways of improving agronomically valuable traits and properties is the use of wheat-rye translocations, the presence which provides genetic control of productivity and adaptability [1]. Wheat-rye translocations 1AL/1RS and 1BL/1RS are widely used in many breeding programs of bread winter and spring wheat and are an example of the successful use of a alien resource to improve the wheat plant. These translocations cause the greatest interest among breeders due to the positive genetic impact on biological valuable traits and properties, such as productivity, resistance to biotic and abiotic factors [2].

However, in addition to these positive effects, rye translocations contain the Sec-1 allele, which controls the synthesis of rye protein secalins with a negative effect on the rheological properties of dough and baking properties of wheat flour [3]. The greatest decrease in grain quality is observed in genotypes with 1DL/1RS translocation, less negative impact - 1BL/1RS and the least - 1AL/1RS [4]. The most common is the rye translocation 1BL/1RS in more than 300 varieties, much less than 1AL/1RS in 100 varieties.

Therefore, the aim of this study was to investigate varieties with wheat-rye translocations 1BL/1RS, 1AL/1RS for a complex of agronomically valuable traits and properties in the conditions of Southern Ukraine. Materials for this research were varieties of different genetic and ecological origin, including 25 varieties with 1AL/1RS translocation and 13 varieties with 1BL/1RS translocation. The research of varieties with rye translocations for adaptive and productive traits was carried out in comparison with the best varieties of Plant Breeding and Genetics Institute – National Center of Seed and Cultivar Investigation - Al'batros odes'kyy, Viktoriya odes'ka, Antonivka, Kuyal'nyk. Varieties were grouped by geographic origin, and each of them was considered as a separate genetic system. As a result of the study of collection samples varieties with translocations 1AL/1RS, 1BL/1RS have different levels of adaptability and productivity depending on the ecotype of the sample and individual characteristics of the variety it was established. A direct relationship between the presence of rye translocations in the wheat genotype and the main adaptive properties (frost and winter hardness and drought and heat resistance) was not found. However, according to the parameters of frost and winter hardness 16 varieties with 1AL/1RS translocation were selected, including 5 varieties of American origin (TAM 107:CV-718, KS 92WQR C22, KS 92WQR C21, KS 92 HW 151-6, Nekona), 6 varieties of Ukrainian breeding (Knyahynya Ol'ha, Vykhovanka odes'ka, Smuhlyanka, Zolotokolosa, Slavna, Yasnohirka). With the 1BL/1RS translocation 8 varieties were selected (Shchedrist' odes'ka, Snizhana, Kalynova, Ekonomka, Demetra, Lehenda Myronivs'ka, Kolos Myronivshchyny, Myronivs'ka 65).

Often In the South of Ukraine during the spring-summer vegetation period are observed very extremely high temperature and lack of moisture. Due to such conditions, several varieties with a high level of drought tolerance were selected: with translocation 1AL/1RS – Knyahynya Ol'ha, Zolotokolosa, Slavna; with translocation 1BL/1RS – Shchedrist' odes'ka, Snizhana, Myronivs'ka 65, Kalynova, Voloshkova, Ekonomka, Kolos Myronivshchyny. All the mentioned varieties formed full-filled, high-natured seeds, and by yield, they were equal to or exceeded the standard varieties - Al'batros odes'kyy, Viktoriyu odes'ka and Kuyal'nyk. The study of the effects of 1AL/1RS, 1BL/1RS translocations on quality parameters and baking properties of flour was carried out on Ukrainian varieties. The standard was high-quality varieties without translocations - Kuyal'nyk, Syrena odes'ka. The absolute homogeneity of varieties according to translocations 1AL/1RS, 1BL/1RS was established with molecular markers. Studies have shown that the presence of wheat-rye translocations 1AL/1RS, 1BL/1RS in bread winter wheat varieties with a sufficient protein content (from 11%) negatively affects the quality of the grain and baking properties of flour. This is due to the increased amount of water-soluble proteins in flour - albumins and secalins (Sec-1 allele) from rye. With the optimal protein content in 2012 and 2014, the varieties, regardless of the type of translocation, was observed the increase of albumin content - from 19.3-23.3% and 17.9-22.2%, respectively, in contrast to the varieties without translocations - 14,5 % and 15.5%, respectively. However, in 2013, at a low protein level (up to 9%) in varieties without translocation Sirena Odes'ka and Kuyal'nik was observed the increase in content of water-soluble albumin proteins to the level of varieties with translocations 1AL/1RS, 1BL/1RS.

Table 1. Content of proteins and baking properties of flour in varieties with wheat-rye translocations 1AL/1RS and 1BL/1RS

Variety	Flour protein, %			Gliadins, %			Glutenins, %			Bread volume, cm <sup>3</sup>		
	2012	2013	2014	2012	2013	2014	2012	2013	2014	2012	2013	2014
Control												
Syrena od.	14,7	8,6	11,7	25,3	28,5	17,5	31,7	27,0	37,9	1540	1500	1580
Kuyal'nyk	14,3	8,2	11	30,2	23,0	20,4	30,2	28,3	28,6	1720	1340	1520
Varieties with wheat-rye translocation 1AL/1RS												
Knyahyn ya Ol'ha	13,9	9,0	11,4	26,8	26,4	19,3	26,9	23,2	29,3	1200	1360	1400
Vykhova nka od.	14,5	9,5	10,4	21,9	26,1	22,0	29,7	27,4	26,5	1200	1380	1420
Kolumbi ya	13,5	9,6	11,2	23,9	29,5	25,6	27,9	23,7	25,2	1140	1220	1140
Zolotokol osa	14,2	9,5	10,8	25,6	28,4	24,4	28,9	25,1	24,2	1060	-	1300
Smila	14	9,0	-	25,2	30,4	-	29,1	23,0	-	1180	1260	-
Varieties with wheat-rye translocation 1BL/1RS												
Shchedris t' od.	13,5	9,4	10,1	23,2	29,2	17,2	28,4	21,0	30,3	1080	1260	1080
Kalynova	16,2	9,5	-	26,2	28,8	-	25,4	20,9	-	1220	1420	-
Kolos Myr.	14,9	8,8	-	26,9	28,0	-	26,1	22,7	-	1060	1120	-
Snizhana	14,6	8,9	-	27,6	29,8	-	25,2	22,8	-	860	780	-



Under such conditions and equal proportions of fractional proteins in varieties with and without translocations, it is not possible to detect differences in protein quality by the sedimentation method. In 2012 and 2014, when the protein content was higher than 11%, the SDS30 sedimentation index in varieties without translocation reached a high level - 76-92 ml, compared to varieties with rye translocation: 1AL/1RS - 37-63 ml, 1BL/1RS - 38 -57 ml. In contrast, other results were obtained in 2013, when the protein content was at a low level (on average up to 9%). The control varieties Kuyalnyk, Syrena Odes'ka in terms of sedimentation index (43-44 ml) slightly exceeded the varieties with translocation 1BL/1RS (31-36 ml) and did not differ from the varieties with translocation 1AL/1RS (39-45 ml).

Significant differences were observed in protein content in different years of research, but when considering each year separately, significant difference between varieties with and without translocations was not found. Against the background of the negative effect of translocation, differentiation in the varieties in terms of baking properties of flour was observed (Table 1). Such changes are associated with the genotypic environment in which the translocation is located and the agro-meteorological conditions of plant cultivation. Paradoxically that, the varieties with translocations 1AL/1RS, 1BL/1RS at a low protein level (up to 9%) show an improvement in the baking properties of flour. This happens due to a decrease in the amount of glutenin proteins and an increase in the content of gliadin proteins, which positively affects the stretchability of the dough, increases the volume of bread and improves baking properties.

The effect of wheat-rye translocations 1AL/1RS, 1BL/1RS on frost, winter hardness, drought resistance and the formation of productivity is manifested due to the cumulative effect of the interaction of genes localized in the translocation with genes that control these traits in the wheat genotype. In addition to this translocation 1AL/1RS, 1BL/1RS in the wheat genotype act as an auxiliary genetic background that strengthens the adaptive properties of the genotype in the formation of yield under various stress conditions and increases the probability to obtain high-yielding genotypes.

The presence of wheat-rye translocations 1AL/1RS, 1BL/1RS negatively affects grain quality and baking properties of flour due to an increased amount of water-soluble proteins - albumins and secalins (Sec-1 allele) from rye. At the same time, against the background of the negative impact of translocations in genotypes observed differentiation in their effects on the baking properties of flour. This is explained that the influence of translocations on the baking properties of flour is largely determined by the genotypic environment and agro-climatic conditions of growing plants.

### References

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