

## INFLUENCE OF WHEAT-RYE TRANSLOCATIONS ON GRAIN QUALITY INDICES DURING BREAD WINTER WHEAT BREEDING IN THE SOUTH OF UKRAINE

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**Topicality.** *The use of introgressive material developed due to the involvement of wheat-rye translocations 1AL.1RS, 1BL.1RS in the modern gene pool of bread winter wheat is quite relevant at this stage of breeding development. This makes it possible to expand the genetic diversity of breeding material to identify new genetic sources of valuable traits and obtain genotypes based on introgressive material with wheat-rye translocations 1AL.1RS, 1BL.1RS with a sufficiently high grain quality in breeding programs in the southern Ukraine. Purpose.* To establish the role of genetic environment as a factor of directional influence of wheat-rye translocations on bread-making properties, and to develop breeding techniques for neutralizing the negative effects of translocations to produce genotypes with high grain quality indices of valuable and strong wheat. **Materials and Methods.** *Field experiments were carried out in the fields of the Plant Breeding and Genetic Institute - National Center for Seed Breeding and Variety Research in the 2010–2020. Meteorological conditions over the years of research were generally typical arid for the Steppe zone. The lines developed by crossing local varieties-carriers of translocations and the best varieties of the Plant Breeding and Genetic Institute breeding were studied that to identify the influence of wheat-rye translocations 1AL.1RS, 1BL.1RS on the quality of winter wheat grain in the process of breeding. Results.* It was established that the winter wheat grain quality indices were changed (protein content increased, rheological properties decreased) by the introduction of wheat-rye translocations 1AL.1RS, 1BL.1RS into the local gene pool. These changes depend on the genetic environment, hybrid combination and the influence of genetic factors that reduce the negative effect of wheat-rye translocations on bread-making properties of the lines. It was proved that development of recombinant lines combining high yield and increased bread-making properties increases when using introgressive lines with wheat-rye translocations 1AL.1RS. **Conclusions.** *It is possible to reduce the negative impact of wheat-rye translocations on the bread winter wheat grain quality and develop varieties with quality parameters of valuable and strong wheat by combining wheat-rye translocations with alleles in genotype positively influencing bread-making properties, and also by creating heterogeneity in genotypes with and without wheat-rye translocations in a certain ratio. An example is the highly heat-resistant variety of strong wheat Oktava Odeska, which is included in the State Register for dissemination in all agroclimatic zones of Ukraine.*

**Key words:** *bread winter wheat, recombinant lines, bread-making quality, wheat-rye translocations 1AL.1RS and 1BL.1RS*

**Introduction.** Global trends in the food market indicate that the role of wheat as the main grain food crop is growing [1]. In Ukraine, the leading position is occupied by bread winter wheat, which provides high and stable yields of high quality grain due to its economic and biological properties [2]. Breeding new varieties plays an important role in increasing yield and improving the quality of wheat grain. Since 1972, the Wheat Breeding and Seed Production Department of the Plant Breeding and Genetics

Institute – National Centre for Seed Breeding and Variety Research (PBGi – NCSBVR) has been conducting a long-term experiment "History of Variety Changes". According to its data, in the process of crop breeding in the south of Ukraine, not only a phenomenal increase in the genetic potential of yields by 2.5 times (from 3–4 t/ha to 10–12 t/ha), preservation or increase of resistance to biotic and abiotic factors, but also a significant improvement in bread-making properties were achieved [3–4].

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Today, the best varieties bred by PBGI-NCSBVR reach the level of the world's best achievements of Canadian spring strong wheat varieties in terms of grain quality.

Further improvement of wheat varieties is possible by introducing new genetic sources of valuable traits and properties into the gene pool of breeding material and developing methods for targeted increase of genetic diversity, identification and selection of desirable genotypes. PBGI-NCSBVR focuses on the creation and use of introgressive materials [5–6]. In particular, during 2010–2020, studies were conducted on the efficiency of using the most common wheat-rye translocations (WRTs) in the world's breeding: 1AL.1RS and 1BL.1RS. The results of the impact of these translocations on the yield of recombinant lines and elements of plant productivity in the arid conditions of the South of Ukraine are described in our previous paper [7]. This article analyses the results of studying the impact of WRT on grain quality. This issue is no less important, as the scientific literature indicates a negative impact of translocation on bread-making properties of bread wheat due to the control of specific rye proteins – secalins (Sec locus), and the possibility of obtaining genotypes with a sufficiently high level of grain quality remains a matter of debate [8–9]. This problem is especially relevant for breeding programme in the South of Ukraine, where bread wheat varieties with only high grain quality are traditionally developed, and the soil and climatic conditions of the region are favorable for this [10].

**Purpose** of this study is to investigate the role of genetic environment as a factor of aimed influence of WRT on bread-making properties and to develop breeding methods to neutralise the negative effect of translocation with the aim of obtaining genotypes with high grain quality of valuable and strong wheat.

**Materials and Methods.** The research was carried out as part of the research programme of the Wheat Breeding and Seed Production Department of the Breeding and Genetics Institute – National Centre for Seed Science and Variety Research (PBGI – NCSBVR) to develop universal winter wheat varieties. Field trials were conducted during the breeding process in the period 2010–2020. The annual predecessor was black fallow to ensure an optimal agricultural background for the breeding work.

The meteorological conditions during the years of research and the field experiments methodology are presented in our previous publication [7]. It should be noted here that 7 out of 11 years of the research were arid to varying degrees, and only 4 of them were relatively wet, which was taken into account when analyzing the experimental data.

Identification of recombinant lines by the presence of WRT in the genotype began in the control nursery and was carried out by electrophoresis of reserve proteins partially (9.2 %) in the Department of Genetic Basis of Breeding by PBGI-NCSBVR (Rybalka O. I.), and the main volume (90.8 %) in the Institute of Plant Protection of NAAS (Kozub N. A., Sozinov I. O.).

The breeding lines of the competitive variety trials for the presence of translocations and their state using DNA markers were examined in the Department of General and Molecular Genetics of PBGI – NCSBVR (Fait V. I.).

The Department of Genetic Bases of Breeding of PBGI-NCSBVR (M. H. Parfentiev, L. S. Lyfenko) defined the grain quality indicators of recombinant lines on the material of the control nursery by the SDS-30 sedimentation method, in competitive variety trials according to the scheme of full technological analysis [11].

Mathematical processing and analysis of the research results were carried out according to the methods of B. O. Dospiekhov (1985) and P. F. Rokitsky (1973) using Microsoft Excel 2007.

**Results.** Based on the study of the collection material (2012–2014), we have identified samples that are carriers of wheat-rye translocations 1AL.1RS; 1BL.1 RS. Their characteristics according to the results of field studies and laboratory analyses of some biochemical (in the Biochemistry Laboratory, O. O. Molodchenkova) and technological parameters (in the Department of Genetic Basis of Breeding, M. H. Parfentiev, L. S. Lyfenko) are presented in Table 1.

The varieties with WRT of a different origin did not show any yield advantages compared to the varieties without WRT that were used as controls. At the same time, the locally bred varieties Kniahynia Olha (WRT 1AL.1RS) and Shchedirat Odeska (WRT 1BL.1RS) were significantly more productive. According to the average data, there is a tendency for higher protein content in WRT varieties and changes in the protein fractional composition towards an

**Table 1. Yield and grain quality of bread winter wheat varieties with WRT 1 AL/1RS and 1BL/1RS (collection of PBGI – NCSBVR, 2012–2014)**

Varieties	Yield, t/ha	Indicators of grain quality					
		Protein content, %	Fractions of reserve proteins, %		Flour strength, (W) a.u.	Volume of bread, cm <sup>3</sup>	Bread evaluation, points
			gliadin	glutenin			
Control							
Syrena	5.78	12.2	23.7	32.2	322	1540	4.5
Kuialnyk	5.64	12.7	24.5	29.0	385	1527	4.7
$\bar{x}$ control varieties	5.71	12.4	24.1	30.6	354	1534	4.6
Varieties with WRT 1AL/1RS							
Kniahynia Olha	5.94	12.3	24.2	26.5	255	1320	3.4
Vykhovanka Odeska	5.78	12.6	23.3	27.9	196	1334	3.7
Kolumbiia	5.43	12.9	26.3	25.6	211	1167	2.8
Zolotovolosa	5.38	13.4	26.1	26.1	236	1205	3.1
Smila	5.08	13.8	-	-	224	1224	2.9
$\bar{x}$ varieties with WRT 1 AL/1RS	5.52	13.0	25.0	26.5	226	1250	3.2
Varieties with WRT 1 BL /1RS							
Shchedrist Odeska	6.38	12.7	26.2*	24.7*	156	1260	3.0
Kalynova	5.02	13.3	27.5*	23.2*	185	1420	3.7
Kolos Myronivshchiny	5.36	13.0	27.4*	24.4*	158	1120	2.7
Snizhana	5.04	13.6	57.4*	26.5*	124	780	1.7
$\bar{x}$ varieties with WRT 1 BL /1RS	5.46	13.2	34.6	24.8	151	1145	2.8

\*average for 2012–2013

increase in the alcohol-soluble fraction – gliadins and a decrease in the alkali-soluble fraction – glutenins. This is especially noticeable in varieties with the 1BL.1RS translocation.

These differences with the control varieties are most significant in bread-making parameters. In particular, in the WRT 1AL.1RS varieties, the indicators of flour strength (W, a.u.) and bread volume from 100 g of flour (V, cm<sup>3</sup>) were on average 36.2 % and 18.5 % lower than the standards, and in the varieties with WRT 1BL.1RS – by 57.4 % and 25.4 %, respectively.

Taking into account these data, two local varieties Kniahynia Olha and Shchedrist Odeska, which were bred at the Department of Wheat Breeding and Seed Production of PBGI – NCSBVR in 2001–2010, were used for further research [7]. Each of these two varieties was used in topcross hybridization with the best local varieties, but differing in grain quality and electrophoretic spectra of reserve proteins (Table 2).

The genetic effects of WRT on grain quality should be considered in conjunction with the grain productivity of the breeding material. The genetic effects of WRT on grain quality traits

should be considered together with the grain productivity of the breeding material. Most of the few published studies on the WRT effect on wheat grain quality do not take this feature into account [14–15]. In this study, one of the objectives was to identify the effects of translocation on the relationship between yield and grain quality indicators.

First of all, it should be noted that the presence of 1AL.1RS and 1BL.1RS translocations in the line genotypes significantly reduces the average level of SDS-30 sedimentation in the respective groups (Table 3), while the variability of sedimentation in these groups significantly increases. In terms of reduction of the average level of sedimentation and increase of the coefficient of variation and dispersion, the effect of translocation 1BL.1RS on this indicator is significantly higher than that of WRT 1AL.1RS.

A highly reliable negative correlation between line yields and the SDS-30 sedimentation index was established due to a large sample of recombinant lines in the control nursery (Table 3). At the same time, there is a clear pattern of

**Table 2. Characteristics of the original winter wheat varieties used in hybridisation with WRT donors – Kniahynia Olha (1AL.1RS) and Shchedrist Odeska (1BL.1RS)**

Variety	Yield, t/ha	Grain quality (indicators)					Formula for reserve proteins									
		Protein content, %	SDS-30, ml	W, a.u.	Volume of bread, cm <sup>3</sup>	Bread evaluation, point	Gliadins							Glutenins		
							1A	1B	1D	6A	6B	6D	2-1A	1A	1B	1D
Kuialnyk	7.23	11.0	58.6	364	1165	3.8	10	1	5	4	3	1	3	1	5	1
Antonivka	7.44	10.8	41.3	263	1003	3.1	2	1	5	4	2	3	1	2	1	1
Mudrist Od.	7.82	11.2	61.3	380	1287	4.1	10	15	5	1	4	1	3	2	5	1
Syrena Od.	6.54	11.6	54.8	312	1105	3.6	2	1	1	4	2	3	3	2	2	1
Misiia Od.	7.58	11.1	56.4	324	1274	3.7	4	1	4	3	2	4	1	2	1	1
Epokha Od.	7.38	11.4	60.3	343	1218	4.0	4	1	5	4	3	1	3	1	5	1
Zahrava Od.	7.88	12.2	54.4	228	990	3.5	2	1	4	3	2	1	1	2	1	1
Tradysiiia Od.	7.45	12.5	68.7	398	1355	4.4	10	1	5	1	4	1	3	2	5	1
Harantiia	7.65	11.8	58.7	328	1284	4.0	4	1	4	4	2	3	3	1	2	1

**Table 3. Statistical characteristic of the variability of SDS-30 sedimentation index in recombinant lines F5, grouped according to the principle of presence or absence and state of wheat-rye translocations (Control nursery, 2017)**

Group of lines *	Lines examined, pcs	$\bar{x} \pm m$ , mm	lim $\pm$ , mm	Coeff. of variation V, %	Variance $\sigma^2$	Coefficient of correlation (r) between yield/sedimentation
Control 1	280	68 $\pm$ 2.23	54 – 68	22.7	216	-0.32
WRT 1AL.1RS «-»*	111	63 $\pm$ 4.11	48 – 62	26.4	322	-0.38**
WRT 1AL.1RS « $\pm$ »*	199	57 $\pm$ 5.39	42 – 51	31.8	364	-0.45**
WRT 1AL.1RS «+»*	148	46 $\pm$ 5.85	40 – 51	36.5	388	-0.51**
Control 2	195	66 $\pm$ 2.64	53 – 70	25.7	238	-0.34**
WRT 1BL.1RS «-»*	159	54 $\pm$ 4.16	44 – 66	25.9	355	-0.47**
WRT 1BL.1RS « $\pm$ »*	289	48 $\pm$ 4.28	40 – 58	38.9	402	-0.51**
WRT 1BL.1RS «+»*	299	43 $\pm$ 5.13	40 – 48	44.5	456	-0.58**

\* «-» - translocation is absent, « $\pm$ » - heterogeneity, «+» - translocation is present,

\*\* - reliability at  $r = > - 0.32$

a significant increase in the correlation coefficient in groups of lines having WRT in their genotypes in the homo- or heterozygous state. And in this case, the effect of increasing the negative relationship between yield and sedimentation index significantly exceeds the same effect on lines with WRT 1AL.1RS.

With the general negative effect of WRT on sedimentation, it is important to establish the possibility of the desired combination of high-yielding lines and a sufficient sedimentation

value of SDS-30. According to the data of grouping lines by yield and sedimentation (Table 4), the highest frequency of the desired combination is observed in the control variants, where high sedimentation is combined with high yield with a frequency of 9.5–19.5 %, and with average yield – 31.3–54.3 %. The low percentage of positive combinations in lines without WRT, but with genetic sources of translocation in their pedigree, was unexpected, which may indicate the presence of other factors of negative

impact on sedimentation in their genotypes.

The presence of introgressive lines with WRT 1AL.1RS in the homozygous state, which combine high and medium yields with a sufficiently high level of sedimentation, even in small numbers (2.0–8.1 %), may be evidence of the possibility of such a positive combination. A significantly higher frequency of desired combinations (3.0–14.1 %) was observed in lines with WRT 1AL.1RS in the heterozygous (heterogeneous) state. In the groups of lines with WRT 1BL.1RS in the homozygous state, no recombinations with high sedimentation values were found at all, although the heterozygous (heterogeneous) state for this translocation provides a small frequency of such lines (3.8–7.3 %).

These patterns, which were revealed in the analysis of the average frequencies of combining yield and sedimentation in separate groups of lines according to the principle of presence or absence of WRT, are more clearly observed in lines grouped by their origin. Thus, among 24 introgressive homogeneous lines for WRT 1AL.1RS obtained using Kuialnyk x Kniahynia Olha combination, 5 lines (20.8 %) had positive combination of traits, and among 32 lines obtained using Zahrava x Kniahynia Olha combination, only 2 lines (6.2 %) had positive combination of traits.

The influence of the genetic environment on the nature of the combination of yield and sedimentation in lines with the 1BL.1RS translocation is manifested at an average level of sedimentation and high yield. Lines produced by direct and backcrosses of Mudrist Odeska x Shchedrist Odeska showed positive combination in 16 lines (12 %) out of 133 introgressive lines, and only 2 lines (1.4 %) out of 143 lines produced by the combination of Harantiia Odeska x Shchedrist Odeska.

Of course, the SDS-30 sedimentation value is not a direct criterion for assessing grain quality, but in field experiments of solid sowing at the control nursery and variety testing in our studies, this indicator has a fairly close correlation with bread-making properties [16]. Therefore, the selection of lines in the control nursery was carried out both by yield and sedimentation index.

An analysis of the efficiency for selection in different groups of lines in terms of yield and plant productivity elements is presented in our

previous publication [7]. In this paper, we describe the characteristics of individual lines that were selected based on the results of a two-year variety trial (2018–2019) for the optimal combination of high yield and relatively high values of the SDS-30 sedimentation index (Table 4).

In the pedigree of these lines, in addition to the WRT source, the second parental component is the Kuialnyk variety of extra strong wheat with several alleles that have a positive effect on flour bread-making properties (Table 2). In addition, the recombinant lines were grouped according to the presence/absence of genetic factors that could reduce the negative impact of WRT on the bread-making properties of the lines: homogeneous or heterogeneous state of WRT; presence or absence (or lack) of alleles with a positive impact on flour bread-making properties in the genotypes of these lines.

As shown in Table 4, all selected introgressive lines, regardless of the WRT state, significantly exceeded the Antonivka standard variety in terms of yield.

However, while the lines with WRT 1AL.1RS (average yield of 8.28 t/ha) exceeded the standard by 1.24 t/ha (17.6 %), the lines with WRT 1BL.1RS (average yield of 7.32 t/ha) showed an increase over the standard by only 0.28 t/ha (4 %). These differences were explained by the negative effect of 1BL.1RS translocation on the drought and heat resistance of the lines, which in the arid conditions of the South of Ukraine significantly reduced their yields [7]. This fact explains the slightly higher protein content in introgressive lines with WRT 1BL.1RS, given that a shrunken grain with a changed endosperm structure always leads to a certain increase in protein content [17].

In general, the low agronomic background of field trials did not ensure the full manifestation of the genetic potential of grain quality of the lines. However, on average, the lines with WRT 1AL.1RS showed a slight advantage over the lines with WRT 1BL.1RS in terms of the main indicators of bread-making properties, and the lines of *ErythrospERMum* 2124/17 with a homogeneous state under WRT 1AL.1RS and the line of *ErythrospERMum* 2146/17 with a heterogeneous state of this translocation have all grain quality indicators significantly higher than the standard.

**Table 4. Factors reducing the negative impact of wheat-rye translocations on flour bread-making properties in wheat recombinant lines (average for 2018-2019)**

Variety, line, hybrid combination	Yield, t/ha	Protein content, %	Flour strength, a.u.	Bread volume from 100 g of flour, cm <sup>3</sup>	Bread evaluation, point
Antonivka (standard)	70.4	11.6	225	1100	3.8
I. Homogeneous state of the lines with WRT 1AL.1RS					
ErythrospERMum 2124/17 (Kuialnyk x Kniahinia Olha)	7.98	12.4	240	1400	4.0
ErythrospERMum 2136/17 (Kuialnyk x Kniahinia Olha)	8.14	11.7	202	1010	3.4
ErythrospERMum 2138/17 (Kuialnyk x Kniahinia Olha)	8.36	11.9	194	980	3.1
Average	8.16	12.0	212	1130	3.5
II. Heterogeneous state of the lines with WRT 1AL.1RS					
ErythrospERMum 2146/17 (Kuialnyk x Kniahinia Olha)	8.15	12.8	271	1450	4.2
ErythrospERMum 2157/17 (Kuialnyk x Kniahinia Olha)	8.49	11.3	210	1140	3.8
ErythrospERMum 2167/17 (Kuialnyk x Kniahinia Olha)	8.54	11.5	203	1100	3.3
Average	8.39	11.9	228	1230	3.8
III. Presence of alleles with a positive effect on grain quality (Gld 1A4, 1A10, 1B1, 1D4, Glt 1B5). Lines with WRT 1BL.1RS in a homogeneous state.					
ErythrospERMum 2372/17 (Kuialnyk x Shchedrist)	7.26	13.3	215	1020	3.2
ErythrospERMum 2378/17 (Kuialnyk x Shchedrist)	7.34	12.4	198	990	2.8
ErythrospERMum 2386/17 (Kuialnyk x Shchedrist)	7.36	12.8	204	970	2.5
Average	7.32	12.8	206	993	2.8
IV. Absence (insufficient number) of alleles with a positive effect on grain quality. Lines with WRT 1BL.1RS in a heterogeneous state.					
ErythrospERMum 2396/17 (Kuialnyk x Shchedrist)	7.18	13.1	155	890	2.0
ErythrospERMum 2418/17 (Kuialnyk x Shchedrist)	7.35	12.6	148	880	2.0
Average	7.26	12.8	152	885	2.0

Despite the limited number of lines, this comparison reveals the effects of reducing the negative impact of WRT on flour bread-making properties: to a minor extent – from the heterogeneous state of lines with the 1AL.1RS translocation (probably depending on the ratio of genotypes with and without WRT); to a major extent – from the presence of alleles with a positive effect on grain quality in lines with WRT 1BL.1RS (probably depending on the number of alleles and their interaction). A detailed study of the directional impact of these factors is the subject of further research.

Based on these results, the ErythrospERMum 2146/17 line (Kuialnyk x Kniahynia Olha)

was submitted for state variety testing and, after a successful examination, was included in the State Register of Plant Varieties under the name Oktava Odeska for dissemination in all agroclimatic zones of Ukraine [18]. During the years of state variety testing (2017–2019), the variety Octave Odeska is characterized by the following indicators: yield for the Steppe – 5.75 t/ha, Forest Steppe – 6.73 t/ha, Polissia – 6.19 t/ha, average for all zones – 6.19 t/ha, which is 0.76 t/ha (14.0 %) higher than the conventional standard; thousand grain weight – 42.5 g, 43.2 g, 45.5 g, respectively; gluten content – 28.4 %, 28.6 %, 28.4 %; flour strength – 286 a.u., 300 a.u., 294 a.u.; bread volume from 100 g of flour –

1160 cm<sup>3</sup>, 1100 cm<sup>3</sup>, 1120 cm<sup>3</sup>. According to these grain quality indicators, the Oktava Odeska variety is classified as strong wheat.

### Conclusions.

Introduction of 1AL.1RS, 1BL.1RS translocations into the local gene pool of bread wheat by hybridization changes grain quality indicators. Protein content increases more significantly under the influence of 1BL.1RS translocation. In addition to the genetic effects of increasing grain protein content, it is evident that the decrease in drought and heat resistance under the influence of WRT 1BL.1RS and, as a result, the formation of shrunken grain with altered endosperm structure also modifies the increase in protein content.

In the arid conditions of the South of Ukraine, WRT due to the synthesis of specific secalin, on the whole, reduce all indicators of bread-making qualities and, above all, the rheological properties of the dough, which is reflected in a decrease in flour strength and bread volume from 100 g of flour. This negative effect is more pronounced in recombinant wheat lines

with WRT 1BL.1RS and depends on the genetic environment and the hybrid combination from which the lines were obtained.

The frequency of obtaining recombinant lines that combine high yield and a sufficient level of bread-making properties (not lower than valuable and strong wheat) is exceptionally low (1.7–6.1 %), but introgressive lines with WRT 1AL.1RS have advantages in this indicator.

Using genetic factors such as combining WRT with alleles with a high positive effect on bread-making properties (controlled by the method of electrophoresis of reserve proteins), as well as creating heterogeneity in the composition of genotypes with and without WRT in a certain ratio, it is possible to reduce the negative impact of WRT on the grain quality of bread winter wheat and create varieties with quality parameters of valuable and strong wheat. This methodological approach was used to create Oktava Odeska variety, which is highly heat-resistant and environmentally plastic, and is entered in the State Register for dissemination in all agroclimatic zones of Ukraine.

### References

1. Lyfenko, C. P., Lytvynenko, M. A. (2000). Advances in the breeding of winter soft wheat. *Visnyk ahrarnoi nauky*, 12. 15–19. [in Ukrainian].
2. Lyfenko, S. P., Lytvynenko, M. A. (2001). Seleksiya i henetyka v Ukraini na mezhi tysiacholit [Breeding and genetics in Ukraine on the verge of a millennium]. Kyiv: Lohos. Vol. 2, 334–335. [in Ukrainian].
3. Lytvynenko, M. A. (2016). 100 years of development of breeding programs for bread winter wheat. *Sortovyvchennia ta okhorona prav na sorty roslyn* [Plant Varieties Studying and Protection], 2. 75–82. doi: 10.21498/2518-1017.2(31).2016.70324 [in Ukrainian].
4. Lytvynenko, M. A. (2012). Variety policy as an important factor in increasing the efficiency of winter wheat grain production. *Posibnyk ukrainskoho khliboroba* [Manual of the Ukrainian Farmer], 3. 157–159. [in Ukrainian].
5. Motsnyi, I. I., Molodchenkova, O. O., Lytvynenko, M. A., Holub, Ye. A. (2019). Application of introgressive lines of soft winter wheat to increase protein content in grain. *Seleksiya i nasinnytstvo* [Selection and Seed Production], 115. 75–92. [in Ukrainian].
6. Rybalka, O. I. (2008). Alien genetic variability in improving wheat grain quality. *Tsytolohiya i henetyka* [Cytology and Genetics], 4. 18–22. [in Ukrainian].
7. Lytvynenko, M. A., Holub, Ye. A., Fanin, Ya. S. (2022). Wheat-rye translocation effects and the yield of lines, elements of plant productivity depending on drought and heat tolerance in the breeding process of bread winter wheat in the South Ukraine. *Zernovi kultury* [Grain Crops], 6. 1. [in Ukrainian].
8. Rybalka, O. I., Lytvynenko, M. A. (2007). Use of 1RS/1BL translocation in wheat breeding. *Visnyk ahrarnoi nauky* [Bulletin of Agricultural Science], 12. 36–40. [in Ukrainian].
9. Lytvynenko, M. A., Topal, M. M. (2014). Genetic factors of positive effect on grain quality in soft winter wheat lines with 1AL/1RS rye translocation. *Visnyk ahrarnoi nauky* [Bulletin of Agricultural Science], 5. 36–42. [in Ukrainian].
10. Lytvynenko, M. A. (2010). Implementation of genetic potential, problems of productivity and quality of grain of modern varieties of winter wheat. *Nasinytstvo* [Seed Production], 4. 1–8.
11. Rybalka, O. I., Chervonis, M. V., Lytvynenko, M. A. (2009). Evaluation of wheat grain quality in the early stages of breeding. *Visnyk ahrarnoi nauky* [Bulletin of Agricultural Sciences], 1. 44–48. [in Ukrainian].
12. Dospekhov, B. A. (1985). Methodology of field research with the basics of statistical processing of research results (5-th ed., rev.). Moscow: Agropromizdat. [in Russian].
13. Rokitskiy, P. F. (1973). *Biologicheskaya statistika* [Biological statistics]. Minsk: Vysshaya Nauka. [in Russian].
14. Kozub, N. O., Sozinov, I. O., Bidnyk, H. Ya., Demianova, N. O., Blium, Ya. B., Sozinov, O. O. (2016). Creation of soft winter wheat lines with recombinant 1RS shoulder as a source of new combinations of resistance genes against pathogens and pests. *Zakhyst i karantyn roslyn* [Plant Protection and Quarantine], 62. 143–150. [in Ukrainian].

15. Zaitseva, H. P., Anikina, H. Ye., Tverdokhlib, O. V., Popov, V. M. (2015). Distribution of wheat-rye translocation in samples of soft winter wheat (*Triticum aestivum* L.) of Ukrainian selection. *Faktory eksperymentalnoi evoliutsii orhanizmiv* [Factors in Experimental Evolution of Organisms], 17. 303–307. [in Ukrainian].
16. Lytvynenko, M. A., Holub, Ye. A. (2017). Efficiency of the SDS-30 sedimentation method in the selection of soft winter wheat (*Triticum aestivum* L.) according to its bread-making properties. *Zbirnyk naukovykh prats SHI-NTsNS* [Collection of Scientific Papers of the Plant Breeding and Genetics Institute - National Center of Seed and Cultivar Investigation], 29 (69). 6–18. [in Ukrainian].
17. Litvinenko, M. A., Golub, E. A., Litvinenko, R. I. (2011). The role of varieties in increasing the bread quality of winter wheat. *Zbirnyk naukovykh prats SHI-NTsNS* [Collection of Scientific Papers of the Plant Breeding and Genetics Institute - National Center of Seed and Cultivar Investigation], 18. 11–23. [in Ukrainian].
18. Kataloh sortiv ta hibrydiv Seleksiino-henetychnoho instytutu - Natsionalnoho tsentru nasinnyeznavstva ta sortovyvchennia [Catalog of Varieties and Hybrids of the Plant Breeding and Genetics Institute - National Center of Seed and Cultivar Investigation] (2021). Odesa: N. p. [in Ukrainian].

УДК 633.11."327":631.527:631.524.85:631.

**Литвиненко М. А., Голуб Є. А., Фанін Я. С. Вплив пшенично-житніх транслокацій на показники якості зерна в процесі селекції пшениці м'якої озимої на півдні України.**

*Зернові культури. 2022. 6 (2). 19–26.*

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**Актуальність теми.** Використання інтрогресивного матеріалу від залучення в сучасний генофонд пшениці м'якої озимої ПЖТ 1AL.1RS, 1BL.1RS є досить актуальним на даному етапі розвитку селекції. Це дає можливість розширення генетичного різноманіття селекційного матеріалу для ідентифікації нових генетичних джерел цінних ознак. **Постановка проблеми.** Можливості отримання генотипів з достатньо високим рівнем якості зерна на основі інтрогресивного матеріалу з ПЖТ 1AL.1RS, 1BL.1RS в селекційних програмах півдня України, залишаються дискусійною проблемою. **Мета дослідження** – встановлення ролі генетичного середовища, як фактора направленого впливу ПЖТ на хлібопекарські властивості та розробка селекційних прийомів нейтралізації негативних ефектів транслокацій для отримання генотипів з високими показниками якості зерна цінної і сильної пшениці. **Матеріали і методи.** Польові експерименти проводились на полях СГІ–НЦ НС в період 2010–2020 рр. Метеорологічні умови за роки проведення досліджень в цілому були типові для степової зони – посушливими. Вплив ПЖТ 1AL.1RS, 1BL.1RS на показники якості зерна пшениці м'якої озимої в процесі селекції було досліджено на лініях, створених від схрещування місцевих сортів–носіїв транслокацій, та кращих сортів селекції СГІ–НЦНС. **Результати досліджень.** Встановлено, що введення в місцевий генофонд пшениці м'якої озимої ПЖТ 1AL.1RS, 1BL.1RS змінює показники якості зерна (вміст білка підвищується, реологічні властивості знижуються). Це залежить від генетичного середовища, гібридної комбінації та наявності–відсутності «генетичних факторів», які можуть зменшувати негативний вплив ПЖТ на хлібопекарські властивості ліній. Показано, що частота отримання рекомбінантних ліній, що поєднують високу врожайність та підвищений рівень хлібопекарських властивостей, підвищується при використанні інтрогресивних ліній з ПЖТ 1AL.1RS. **Висновки.** Комбінування в генотипі ПЖТ з алелями, що позитивно впливають на хлібопекарські властивості, а також створюючи гетерогенність в складі генотипів з ПЖТ і без них у певному співвідношенні, можна направлено зменшувати негативний вплив ПЖТ на якість зерна пшениці м'якої озимої і створювати сорти з параметрами якості цінних і сильних пшениць. Прикладом є високо-жаростійкий сорт сильної пшениці Октава одеська, який занесений до Реєстру для поширення у всіх агрокліматичних зонах України.

**Ключові слова:** пшениця м'яка озима, рекомбінантні лінії, хлібопекарна якість, пшенично-житні транслокації 1AL.1RS і 1BL.1RS