

BREEDING VALUE AND HOMEOSTATICITY OF UKRAINIAN AND WESTERN EUROPEAN WINTER BREAD WHEAT VARIETIES BY SPIKE PERFORMANCE

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The results on the breeding value (Sc) and homeostaticity (Hom) of short-stemmed winter bread wheat genotypes of Ukrainian and Western European origins by grain weight per spike and grain number per spike are presented. The highest value by the studies parameters in the eastern Forest-Steppe of Ukraine was recorded for the Prydniprovskya, Błahodarka Odeska, Nota Odeska, and Manera Odeska.

Key words: *adaptability, homeostaticity, variability, spike performance, winter bread wheat, breeding value*

Introduction. Among priority breeding objectives, the issues of increasing the adaptive potential and performance of agricultural crops, including winter bread wheat, are becoming more and more important. The nutritional value of common wheat (*Triticum aestivum* L.) and diversity of its technological properties for different uses contribute to ensuring food security in many countries [1–3]. An increase in the gross grain harvest and stabilization of grain production determine the level of agricultural production intensification, which is necessary for the effective functioning of the agrarian sector of the economy of Ukraine [4]. However, different stressors that have recently been observed and are associated with climatic changes [5] pose significant obstacles on this path. Therefore, breeding fortification of varieties is mandatory for their successful introduction into production [5–7]. High breeding value and homeostaticity of structural constituents of yield, in particular spike performance, are guarantees for harvesting high and stable yields under certain agroecological growing conditions.

Literature Review and Problem Articulation. Increased gross harvest of grain and stabilized yields are mainly determined by genetic potential of the variety's yield, its adaptability and homeostaticity [8, 9, 10]. Advanced cultivation technologies are also a mandatory approach on this path [11, 12].

Varieties, as a factor of increasing performance and gross grain harvests are becoming more and more important [13, 14]. The portion of variety-attribute gain in the winter bread wheat yield increased from 15–18% to 40–50%, which is a result of hard work of several generations of breeders [13]. Scientists noted that, in general, the breeding contribution to the yield growth amounted to 50% [14, 15].

Breeding value and homeostaticity of major constituents of yield, viz, the number of productive stems per unit area, grain weight per spike, grain number per spike, and thousand-grain weight, are of decisive importance for increasing the genotype's yield and stability. [1, 16]. The spike performance (grain weight per spike) is an integral feature, which is determined by expression of its constituents, primarily the grain number per spike and thousand-grain weight. The grain weight per spike is closely correlated with the grain number per spike and moderately correlated with the thousand-grain weight [16]. The grain number per spike is closely correlated with yield in winter bread wheat [17]. The grain weight per spike is also significantly affected by grain size, spike length and weather. The spike performance significantly affects the grain weight per plant and yield, since there is a close positive correlation between the grain weight per spike

and yield [16, 18]. In general, the portion of the "grain weight per spike" trait in the yield is about 50%.

Fulfillment of the genetic potential of a variety's performance is limited by various biotic and abiotic factors of the environment [6]. Among the biotic factors, fungal diseases, losses from which can reach 25–50%, take the lead [6, 19, 20,]; among the abiotic factors, water deficit caused by droughts, which are usually associated with high temperatures, are becoming increasingly important, and this phenomenon is massively predicted in the context of climatic changes [5, 21].

The homeostaticity of a variety as a whole depends on the stability of physiological processes in plants under changing conditions of cultivation. That is, it is the ability of a genotype to minimize the influence of environmental stress factors [22]. It is closely related to variability - the ability of living organisms to acquire new features and properties during ontogenesis. Investigating the homeostaticity (Hom) and breeding value (Sc), O.A. Demyidov, S.O. Khomenko, et al. (2019) found that the higher they were, the more stable the genotype was in changing conditions of cultivation [23].

It is known that involvement of winter bread wheat accessions of the Western European ecotype in breeding improved yield constituents and increased resistance to pathogens of foliar diseases in domestic varieties [24]. Morphogenesis was quite long, but the gross harvest of grain increased significantly due to expanded pedigree basis of new varieties [24]. Determination of breeding value and homeostaticity of the spike performance in the genetic diversity of modern varieties of winter bread wheat and selection of genotypes with desirable levels of their expression is a vital stage on the way to create holistically valuable and varieties that would be adapted to certain agro-ecological growing conditions.

Purpose and Objectives. The purpose was to evaluate the breeding value and homeostaticity of the spike performance (grain weight and number per spike) of modern Ukrainian and Western European winter bread wheat varieties and to identify adapted to the Eastern Forest-Steppe of Ukraine sources of its strong expression.

Materials and Methods. Twenty-eight short-stemmed winter bread wheat (*Triticum aestivum* L.) accessions from three countries – fourteen Ukrainian accessions, seven accessions from Germany, and seven accessions France – were investigated. The study was conducted at the Laboratory of Genetic Resources of Cereals of the National Center for Plant Genetic Resources of Ukraine (NCPGRU) at the experimental basis of the Plant Production Institute named after V.Ya. Yuriev of NAAS, which is located on the territory of the Kharkivskiy District of the Kharkivska Oblast in the Eastern Forest- Steppe of Ukraine, in 2018–2021. The experiments were carried out in accordance with the requirements for field experiments in breeding [25]. Seeds were sown with a SSFK-7 planter at the sowing rate of 4.5 million seeds/ha after fallow in plots of 5 m² in three replications within the optimal timeframe. In the spring, the plots were fertilized with ammonium nitrate (N₄₀). Bunchuk was taken as a check variety and sown between every 20 accessions. The accessions were studied by appropriate methods [26, 27]. The breeding value (Sc) was determined by V. V. Khangildin's method, allowing for selection of genotypes that combine high or moderate yield capacity and its stable realization under changing conditions of cultivation [22]. The homeostaticity (Hom) of the winter bread wheat accessions was also determined by this method based on the experimentally established patterns of lower variability of the investigated traits and their smaller decrease under adverse conditions in highly homeostatic accessions. Data were statistically processed, as B.O. Dospikhov recommended [25].

Results and Discussion. Analyzing the weather during the growing periods in 2018–2021, we can conclude that various values of the hydrothermal coefficient (HTC) helped to differentiate the winter bread wheat accessions in terms of the spike performance.

The autumn weather in 2018 (HTC = 0.49) and 2020 (HTC = 0.46) was very dry, and quite wet in 2019 (HTC = 1.46).

The meteorological conditions during the spring-summer growing periods differed significantly in moisture availability and temperature: the springs in 2019 (HTC = 1.26) and 2021

(HTC = 1.46) were sufficiently wetted, while the 2020 spring-summer period was waterlogged (HTC = 2.05). The summer months in 2020 (HTC = 1.27) were also sufficiently wetted, while in 2019 (HTC = 0.62) and 2021 (HTC = 0.64) they were dry.

2020 was the most favorable year to form a large weight of grain per and a lot of grains per spike. In 2019 and 2021, these parameters were mostly lower. It should be noted that water deficit and high temperature in July 2021 (HTC = 0.09) led to heat injury of grain, which had a more negative effect on the spike performance compared to the previous study years.

So, the weather during the growing periods in 2018–2021 made it possible to differentiate the short-stemmed winter bread wheat genotypes according to their breeding value and homeostaticity of the grain weight and number per spike, as well as to identify sources of their strong expression that are adapted to the Eastern Forest-Steppe of Ukraine.

It was revealed that, in the group of short-stemmed domestic genotypes, the breeding value (Sc) of the grain weight per spike ranged 1.2 to 1.9, while the homeostaticity (Hom) varied from 11.0 to 27.9.

In 2018–2021, we identified six sources (42.9%) of high performance of the spike (grain weight per spike exceeded 2 g; 1.6 g in the check variety – Bunchuk) in the group of domestic short-stemmed winter bread wheat genotypes (Table 1). Prydniprovskia had the greatest weight of grains per spike (2.5 g).

Table 1

Breeding value and homeostaticity of the grain weight per spike in the domestic short-stemmed winter bread wheat genotypes, 2018–2021

Accession	Country of origin	Grain weight per spike, g					
		max	min	mean	Sc	CV, %	Hom
Bunchuk, check variety	UKR	1.9	1.4	1.6	1.2	16.5	9.7
Prydniprovskia	UKR	2.5	2.1	2.3	1.9	9.2	24.7
Blahodarka Odeska	UKR	2.4	2.1	2.2	1.8	9.6	22.6
Nota Odeska	UKR	2.4	2.0	2.2	1.8	9.1	24.2
Manera Odeska	UKR	2.2	1.9	2.1	1.8	7.4	27.9
Zoreslava	UKR	2.3	1.9	2.1	1.7	9.5	22.1
MIP Feieriia	UKR	2.3	1.7	2.1	1.5	15.6	13.3
MIP Valensiia	UKR	2.2	1.6	1.9	1.4	15.8	12.2
Rodzynka Odeska	UKR	2.0	1.7	1.9	1.6	9.1	20.8
Kruhozir	UKR	1.9	1.6	1.8	1.5	8.7	20.4
Orzhysia Nova	UKR	2.0	1.5	1.7	1.3	14.5	11.9
Shpalivka	UKR	1.9	1.4	1.7	1.2	15.1	11.0
Pronia	UKR	1.9	1.5	1.7	1.4	12.0	14.4
Soborna	UKR	1.8	1.4	1.6	1.3	12.7	12.8
Avrora Myronivska	UKR	1.7	1.5	1.6	1.4	6.3	25.6
LSD _{0.05}		–	–	0.1	–	–	–
min		1.7	1.4	1.6	1.2	6.3	11.0
max		2.2	2.1	2.3	1.9	15.8	27.9
Mean		2.1	1.7	1.9	1.5	11.0	18.9

The breeding value of >1.5 (mean) in this group was recorded for Prydniprovskia (Sc = 1.9), Blahodarka Odeska (Sc = 1.8), Nota Odeska (Sc = 1.8), Manera Odeska (Sc = 1.8), Zoreslava (Sc = 1.7), Rodzynka Odeska (Sc = 1.6) (UKR), and Bunchuk (Sc = 1.2) (Table 2). These varieties and Kruhozir were characterized by high homeostaticity and low variability (CV ≤10.0%) of the grain weight per spike. The percentage of such varieties in the study was 57.1%:

Manera Odeska (Hom = 27.9), Avrora Myronivska (Hom = 25.6), Prydniprovska (Hom = 24.7), Nota Odeska (Hom = 24.2), Blahodarka Odeska (Hom = 22.6), Zoreslava (Hom = 22.1), Rodzynka Odeska (Hom = 20.8), and Kruhozir (Hom = 20.4).

Moderately homeostatic accessions included the following varieties: Pronia (Hom = 14.4), MIP Feieriia (Hom = 13.3), Soborna (Hom = 12.8), MIP Valensiia (Hom = 12.2), Orzhytsia Nova (Hom = 11.9), Shpalivka (Hom = 11.0), and Bunchuk (check variety) (Hom = 9.7). The percentage of accessions with an average homeostaticity of the spike performance among the domestic short-stemmed genotypes was 42.9%. There were no accessions with low homeostaticity or high variability (CV>20.0%) of the grain weight per spike among the domestic accessions. This is a result of breeders' long-term work aimed at selecting genotypes that would be adapted to certain growing conditions.

It is noteworthy that low variability of an investigated trait is a criterion for the homeostaticity of genotypes. Therefore, Prydniprovska (Sc = 1.9; Hom = 24.7; CV = 9.2), Blahodarka Odeska (Sc = 1.8; Hom = 22.6; CV = 9.6), Nota Odeska (Sc = 1.8; Hom = 24.2; CV = 9.1), Manera Odeska (Sc = 1.8; Hom = 27.9; CV = 7.4), and Zoreslava (Sc = 1.7; Hom = 22.1; CV = 9.5) (UKR) are valuable genotypes with of high breeding value and homeostaticity of the grain weight per spike. The selected accessions are promising starting material to develop new breeding-valuable and stable short-stemmed genotypes with high performance of the spike.

The vast majority (78.6%) of the domestic short-stemmed accessions had large numbers of grains per spike (more than 36), viz. MIP Valensiia, Prydniprovska, MIP Feieriia, Blahodarka Odeska, Nota Odeska, Rodzynka Odeska, Manera Odeska, Orzhytsia Nova, Shpalivka, Zoreslava, Kruhozir (UKR), Bunchuk (check variety) – 37.3.

The breeding value (Sc) of the grain number per spike varied from 26.8 to 48.4. Seven sources (50%) with values exceeding the mean (Sc = 37.5) were identified: Prydniprovska (Sc = 48.4), MIP Valensiia (Sc = 45.7), Blahodarka Odesa (Sc = 44.6), MIP Feieriia (Sc = 41.8), Nota Odeska (Sc = 41.3), Rodzynka Odeska (Sc = 40.9), Manera Odeska (Sc = 39.1) (UKR), and Bunchuk (check variety) (Sc = 29.3).

The homeostaticity (Hom) of the domestic short-stemmed accessions ranged 289 to 680. High homeostaticity of the grain number per spike was intrinsic to nine varieties (64.3%). They included the following varieties: Prydniprovska (Hom = 680), Manera Odeska (Hom = 653), Blahodarka Odeska (Hom = 613), Nota Odeska (Hom = 586), Rodzynka Odeska (Hom = 562), Pronia (Hom = 463), Zoreslava (Hom = 451), Kruhozir (Hom = 451), Avrora Myronivska (Hom = 356) (UKR), and Bunchuk (check variety) (Hom = 309).

Moderate homeostaticity was observed in five accessions or in 35.7%. They included the following varieties: MIP Valensiia (Hom = 440), MIP Feieriia (Hom = 404), Orzhytsia Nova (Hom = 335), Shpalivka (Hom = 330), and Soborna (Hom = 289) (UKR). There were no accessions with low homeostaticity or high variability (CV >20.0%) of the grain number per spike (Table 2).

So, the genotypes that were noticeable for high breeding value and homeostaticity of the grain number per spike included Prydniprovska (Sc = 48.4; Hom = 680; CV = 8.3), Blahodarka Odeska (Sc = 44.6; Hom = 613; CV = 8.7), Nota Odeska (Sc = 41.3; Hom = 586; CV = 8.3), Rodzynka Odeska (Sc = 40.9; Hom = 562; CV = 8.5), and Manera Odeska (Sc = 39.1; Hom = 653; CV = 6.8) (UKR).

In the group of Western European short-stemmed winter bread wheat genotypes, four varieties, Dromos, Akrotos, Rotax (DEU) and Sailor (FRA), were distinguished by high performance of the spike (grain weight per spike >2 g); it corresponds 28.6% of the total number of studied accessions, which is 14.3% less compared to the domestic varieties. It was found that the breeding value of the grain weight per spike in this study group ranged 1.0 to 1.7, while the homeostaticity varied from 6.9 to 24.5.

Three varieties (21.4% of the total number) with high breeding value (Sc >1.7) in the group of Western European short-stemmed accessions were selected due to for their high breeding value (Sc > 1.7); their portion was is 21.5% less compared to the domestic genotypes.

These genotypes included Dromos (Sc = 1.7; Hom = 12.8; CV = 18.9), Akrotos (Sc = 1.7; Hom = 13.2; CV = 18.2) (DEU) and Evklid (Sc = 1.7; Hom = 24.5; CV = 7.9) (FRA).

Evklid (Hom = 24.5) (FRA) and Nordkap (Hom = 17.8) (DEU) (they constituted 14.3%) were Western European short-stemmed genotypes with high homeostaticity of the grain weight per spike.

Table 2

Breeding value and homeostaticity of the grain number per spike in the domestic short-stemmed winter bread wheat genotypes, 2018–2021

Accession	Country of origin	Grain number per spike					
		max	min	mean	Sc	CV, %	Hom
Bunchuk (check variety)	UKR	42	33	37.3	29.3	12.1	309
MIP Valensiia	UKR	67	51	60.0	45.7	13.6	440
Prydniprovskia	UKR	62	53	56.7	48.4	8.3	680
MIP Feieria	UKR	62	48	54.0	41.8	13.4	404
Blahodarka Odeska	UKR	57	48	53.0	44.6	8.7	613
Nota Odeska	UKR	53	45	48.7	41.3	8.3	586
Rodzynka Odeska	UKR	50	43	47.7	40.9	8.5	562
Manera Odeska	UKR	48	42	44.7	39.1	6.8	653
Orzhytsia Nova	UKR	50	39	43.7	34.1	13.0	335
Shpalivka	UKR	48	37	43.3	33.4	13.1	330
Zoreslava	UKR	44	37	41.3	34.8	9.2	451
Kruhozir	UKR	43	37	41.3	34.8	9.2	451
Avrora Myronivska	UKR	39	32	35.3	28.9	9.9	356
Pronia	UKR	38	33	35.0	30.4	7.6	463
Soborna	UKR	38	30	34.0	26.8	11.8	289
LSD _{0.05}		–	–	4.7	–	–	–
min		38	30	34	26.8	6.8	289
max		67	53	60	48.4	13.6	680
Mean		49.9	41.1	45.6	37.5	10.1	472

The following varieties showed moderate homeostaticity: Akrotos (Hom = 13.2), Dromos (Hom = 12.8), Bonanza (Hom = 8.9) (DEU); Praktik (Hom = 18.6), Boomer (Hom = 17.2), Bardotka (Hom = 16.7), Memory (Hom = 16.5), (FRA); their portion was 50.0%.

In the group of Western European varieties, 35.7% of the accessions showed low homeostaticity combined with high variability (CV >20.0%) of the grain weight per spike. These genotypes included the following varieties: Mattus (Hom = 6.9), Aspekt (Hom = 7.3), Rotax (Hom = 8.0) (DEU); Matchball (Hom = 7.4), and Sailor (Hom = 8.7) (FRA) (Table 3).

In the group of Western European short-stemmed accessions under investigation, we found no varieties with the genotypic ability to form a large weight of grain per spike (>2 g) in combination with its high breeding value and homeostaticity. Evklid (FRA) was the best in the studied group in terms of breeding value and homeostaticity of the grain weight per spike (Sc = 1.9; Hom = 24.5), being similar to best Ukrainian variety, Prydniprovskia, (Sc = 1.9; Hom = 24.7).

The majority of Western European varieties (13 genotypes or 92.9% of the total number of accessions in this group) had a lot of grains per spike (> 36); as to the variety number, this group was 14.3% more numerous than the group of domestic varieties. These included the following varieties: Dromos, Akrotos, Rotax, Aspekt, Bonanza, Mattus (DEU); Sailor, Evklid,

Bardotka, Matchball, Praktik, Memory, and Boomer (FRA). The breeding value of the grain number per spike varied from 35.3 to 63.7, while the homeostaticity ranged 242 to 487.

Table 3

Breeding value and homeostaticity of the grain weight per spike in the Western European short-stemmed winter bread wheat genotypes, 2018–2021

Accession	Country of origin	Grain weight per spike, g					
		max	min	mean	Sc	CV, %	Hom
Bunchuk (check variety)	UKR	1.9	1.4	1.6	1.2	16.5	9.7
Dromos	DEU	2.7	1.9	2.4	1.7	18.9	12.8
Akratos	DEU	2.7	1.9	2.4	1.7	18.2	13.2
Rotax	DEU	2.6	1.5	2.1	1.2	26.7	8.00
Aspekt	DEU	2.5	1.5	1.9	1.2	26.5	7.3
Bonanza	DEU	2.1	1.4	1.8	1.2	19.9	8.9
Mattus	DEU	2.1	1.3	1.7	1.0	24.3	6.9
Nordkap	DEU	1.5	1.3	1.4	1.2	8.1	17.8
Sailor	FRA	2.7	1.6	2.2	1.3	25.3	8.7
Evklid	FRA	2.1	1.8	1.9	1.7	7.9	24.5
Bardotka	FRA	2.1	1.5	1.8	1.3	16.7	10.8
Matchball	FRA	2.2	1.5	1.7	1.2	23.3	7.4
Praktik	FRA	2.1	1.5	1.7	1.2	18.6	9.4
Memory	FRA	1.9	1.4	1.6	1.2	16.5	9.7
Boomer	FRA	1.7	1.2	1.5	1.0	17.2	8.6
LSD _{0.05}		–	–	0.2	–	–	–
min		1,5	1.2	1.4	1.0	7.9	6.9
max		2,7	1.9	2.4	1.7	26.7	24.5
Mean		2,2	1.5	1.9	1.3	19.2	11.0

High breeding value in the group of Western European short-stemmed accessions for the grain number per spike was recorded for four varieties, or 28.6% (by 21.4% less compared to the domestic accessions). These genotypes included the following varieties: Dromos (Sc = 49.8), Akratos (Sc = 46.1), Rotax (Sc = 43.7) (DEU) and Sailor (Sc = 41.7) (FRA) (Table 4).

Three varieties (21.4%) showed high homeostaticity of the grain number per spike: Nordkap (Hom = 388.4) (DEU), Bardotka (Hom = 486.5) and Evklid (Hom = 451.3) (FRA). Moderate homeostaticity was intrinsic to 11 accessions (78.6%). These were the following varieties: Dromos (Hom = 483), Akratos (Hom = 469), Bonanza (Hom = 363), Rotax (Hom = 360), Aspekt (Hom = 250), Mattus (Hom = 242) (DEU); Sailor (Hom = 360), Praktik (Hom = 307), Memory (Hom = 296), Boomer (Hom = 287), and Matchball (Hom = 256) (FRA). There were no accessions with low homeostaticity or significant variability (CV >20.0%) of the grain number per spike in the group of Western European varieties.

It should be noted that samples with the ability to form a large number of grains in an ear in combination with high breeding value and homeostaticity were not found in this study group. But according to the set of these characteristics, Dromos and Akratos (DEU) were the best among Western European varieties.

The short-stemmed genotypes with high breeding value and homeostaticity in terms of the grain weight and number per spike are valuable starting material to breed highly productive and stress-adapted winter bread wheat varieties for the Eastern Forest-Steppe of Ukraine.

Table 4

Breeding value and homeostaticity of the grain number per spike in the Western European short-stemmed winter bread wheat genotypes, 2018–2021

Accession	Country of origin	Grain number per spike					
		max	min	mean	Sc	CV, %	Hom
Bunchuk (check variety)	UKR	42	33	37.3	29.3	12,1	309
Dromos	DEU	69	54	63.7	49.8	13,2	483
Akratos	DEU	67	52	59.3	46.1	12,7	469
Rotax	DEU	68	49	60.7	43.7	16,8	360
Aspekt	DEU	58	41	47.7	33.7	19,0	250
Bonanza	DEU	48	39	42.3	34.4	11,7	363
Mattus	DEU	52	36	44.0	30.5	18,2	242
Nordkap	DEU	39	33	35.3	29.9	9,1	388
Sailor	FRA	65	49	55.3	41.7	15,4	360
Evklid	FRA	44	37	41.3	34.8	9,2	451
Bardotka	FRA	45	38	41.3	34.9	8,5	487
Matchball	FRA	52	37	44.0	31.3	17,2	256
Praktik	FRA	51	38	44.7	33.3	14,6	307
Memory	FRA	46	35	41.7	31.7	14,1	296
Boomer	FRA	45	35	39.0	30.3	13,6	287
LSD _{0.05}		–	–	5.1	–	–	–
min		39	33	35.3	29.9	8.5	242
max		69	54	63.7	49.8	19.0	487
Mean		53.5	40.9	47.2	36.2	13.8	357

Conclusions. 1. The study of Ukrainian and Western European short-stemmed winter bread wheat genotypes demonstrated that, in the Eastern Forest-Steppe of Ukraine, the domestic varieties had a high breeding value and homeostaticity in combination with a large weight of grains per spike (> 2 g): Prydniprovskya (Sc = 1.9; Hom = 24.7; grain weight per spike = 2.3 g), Blahodarka Odeska (Sc = 1.8; Hom = 22.6; grain weight per spike = 1.8 g), Nota Odeska (Sc = 1.8; Hom = 24.2; grain weight per spike = 1.8 g), Manera Odeska (Sc = 1.8; Hom = 27.9; grain weight per spike = 1.8 g), Zoreslava (Sc = 1.7; Hom = 22.1; grain weight per spike = 1.7 g), Rodzynka Odeska (Sc = 1.6; Hom = 20.8; grain weight per spike = 1.6 g) (UKR); their portion was 42.9%.

2. More than 36 accessions (35.7%) had a lot of grains per spike in combination with high breeding value and homeostaticity, for example Prydniprovskya (Sc = 48.4; Hom = 680; grain number per spike = 56.7 g), Blahodarka Odeska (Sc = 44.6; Hom = 613; grain number per spike = 53.0 g), Nota Odeska (Sc = 41.3; Hom = 586; grain number per spike = 48.7 g), Rodzynka Odeska (Sc = 40.9; Hom = 562; grain number per spike = 47.7 g) and Manera Odeska (Sc = 39.1; Hom = 653; grain number per spike = 44.7 g) (UKR).

3. The accessions of the Western European ecotype turned out to be less adapted to the stressful conditions of the Eastern Forest-Steppe of Ukraine, where droughts cause heat injury of grain, and large grain weights and numbers per spike were not associated with high homeostaticity of these traits.

4. Of the Western European accessions, Evklid (FRA) (Sc = 1.7; Hom = 24.5; grain weight per spike = 1.9 g) was the best genotype in terms of breeding value and homeostaticity of the grain weight per spike.

5. Dromos (Sc = 49.8; Hom = 483; grain number per spike = 63.7) and Akratos (Sc = 46.1; Hom = 469, grain number per spike = 59.3 g) (DEU) showed high breeding value in terms of the grain number per spike in combination with moderately high homeostaticity.

The selected short-stemmed genotypes with high breeding value and homeostaticity of the grain weight and number per spike are valuable starting material to breed highly productive and winter bread wheat varieties that would be adapted to stressful conditions of cultivation in the Eastern Forest-Steppe of Ukraine.

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СЕЛЕКЦІЙНА ЦІННІСТЬ ТА ГОМЕОСТАТИЧНІСТЬ ПРОДУКТИВНОСТІ КОЛОСУ СОРТІВ ПШЕНИЦІ М'ЯКОЇ ОЗИМОЇ ВІТЧИЗНЯНОГО ТА ЗАХІДНОЄВРОПЕЙСЬКОГО ПОХОДЖЕННЯ

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Мета і задачі дослідження. Метою роботи було визначення селекційної цінності та гомеостатичності маси зерна з колосу та кількості зерен у колосі в сучасних сортів пшениці м'якої озимої вітчизняного та західноєвропейського походження, виділення джерел високого рівня їх прояву адаптованих до умовах східного Лісостепу України.

Матеріали та методи дослідження. Матеріалом дослідження були 28 короткостеблих зразків пшениці м'якої озимої з трьох країн, у т.ч. – 14 зразків походженням з України та по сім – Німеччини та Франції. Вивчення зразків проводили згідно відповідних методик використовуючи при цьому загальнонаукові, спеціальні та генетико-статистичні методи дослідження.

Обговорення результатів. У результаті проведеного вивчення визначено, що частка зразків з генотиповою здатністю формувати високу селекційну цінність та гомеостатичність у поєднанні з великою масою зерна з колосу серед вітчизняних сортів складає 42,9 %, до яких відносяться Придніпровська, Благодарка одеська, Родзинка одеська (UKR) та ін. Великою кількістю зерен у колосі та високою селекційною цінністю у поєднанні з гомеостатичністю даної ознаки характеризуються Придніпровська, Благодарка одеська, Нота одеська, Родзинка одеська та Манера одеська (UKR), які складають 35,7 %. Зразки західноєвропейського екотипу при формуванні великої маси зерна з колосу та кількості зерен у колосі не поєднували їх з високою гомеостатичністю даних ознак, у зв'язку з чим були менш цінними.

Висновки. У результаті проведених досліджень визначено, що високу селекційну цінність та гомеостатичність у поєднанні з великою масою зерна з колосу та кількістю зерен у колосі мають вітчизняні сорти: Придніпровська, Благодарка одеська, Нота одеська, Манера одеська, які є цінним вихідним матеріалом для створення високопродуктивних та перспективних сортів пшениці м'якої озимої в умовах східної частини Лісостепу України.

Ключові слова: адаптивність, пшениця м'яка озима, селекційна цінність, гомеостатичність, мінливість, продуктивність колосу, сорт

BREEDING VALUE AND HOMEOSTATICITY OF UKRAINIAN AND WESTERN EUROPEAN WINTER BREAD WHEAT VARIETIES BY SPIKE PERFORMANCE

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Purpose and Objectives. The purpose was to evaluate the breeding value and homeostaticity of the grain weight and number per spike in modern Ukrainian and Western European winter bread wheat varieties and to identify adapted to the Eastern Forest-Steppe of Ukraine sources of strong expression of these traits.

Materials and Methods. Twenty-eight short-stemmed winter bread wheat (*Triticum aestivum* L.) accessions from three countries – fourteen Ukrainian accessions, seven accessions from Germany, and seven accessions France – were investigated. The accessions were studied by appropriate methods using general-scientific, special and genetic-statistical methods of research.

Results and Discussion. It was determined that the portion of accessions with the genotypic ability to show high breeding value and homeostaticity in combination with a large weight of grains per spike among domestic varieties was 42.9%; such accessions included Prydniprovska, Blahodarka Odeska, Rodzynka Odeska (UKR) and others. A lot of grains per spike and high breeding value in combination with homeostaticity of this trait were recorded for Prydniprovska, Blahodarka Odeska, Nota Odeska, Rodzynka Odeska, and Manera Odeska (UKR); such accessions accounted for 35.7%. Accessions of the Western European ecotype with large weights of grains per spike and lots of grains per spike did not combine these features with high homeostaticity of these traits, and therefore were less valuable.

Conclusions. It was revealed that domestic varieties, Prydniprovska, Blahodarka Odeska, Nota Odeska, and Manera Odeska showed high breeding value and homeostaticity in combination with a large weight of grains per spike and lots of grains per spike, which makes them valuable starting material to breed highly productive and promising winter bread wheat varieties for the Eastern Forest-Steppe of Ukraine.

Key words: *adaptability, homeostaticity, variability, spike performance, winter bread wheat, breeding value*