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Initial Material For Creating Varieties Of Soft Spring Wheat (*Triticum Aestivum L.*) In The Conditions Of The Northern Forest Steppe Of Western Siberia

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Annotation

In the presented studies, 60 samples of the collection material of spring soft wheat from the VIR collection and from the Bioresource collection of agricultural plants of the Kemerovo Research Institute of Agriculture, branch of the SFSCA RAS) were assessed. The selection val-uable quantitative traits in the samples of spring-soft wheat were studied and the most adapted initial material of the conditions for the forest-steppe conditions of the forest-steppe registration of Siberia (Kuznetsk depression, Kemerovo region, Kemerovo district) in the conditions of 2015-2018 years was identified. According to plant height, 17 samples of spring soft wheat with lodging resistance of 9 points (on a nine-point scale) were identified, including five with low variability of the trait: Altai 70 (KP-076, RF Barnaul) – 2,86%, Siberian Alliance (k-65242, Bar-naul, Kemerovo) – 5,75%, AC Nonda (k-64562, Canada) – 7,70%, OmGAU 90 (k-65447, RF Omsk) – 8,33% , Valkeria (k-64552, RF Krasnoyarsk) – 8,86%. The height of plants largely de-termines the yield, r = 0,6011 and the elements of its productivity: the mass of 1000 grains r = 0,6580, the number of grains per ear, r = 0,6092, the mass of grain per ear, r = 0,5722 (R = 0,4821 Based on a set of features, the source material was selected for creating varieties of spring soft wheat with high adaptive properties (1000 grain weight, number of grains per ear, grain weight per ear): Biora (k-64358, Russian Federation Moscow), Ulgenya (KP-078), Karabalykskaya 89 (k-64702, Kazakhstan). Sources with high productivity were identified:

Ulgenya (KP-078, RF Kemerovo) with a yield of 268,3 g /m^2, with the lowest variability according to experience – 19,0%. PM-83-17 (KP-072, RF Kemerovo) – 283,7 g/m^2.

Keywords: *Triticum aestivum* L, soft wheat, source material, variety, plant height, 1000-grain weight, number of grains, ear productivity, yield**.**

Introduction

At the modern stages of development of agricultural production, the main requirements for varieties are high yield, ecological plasticity, responsiveness to the background of mineral nutrition, the ability to adapt to new resource-saving technologies (1, 2). Spring wheat occupies the largest area in Western Siberia from grain spring crops (3). In the harsh agroclimatic conditions of Western Siberia, spring wheat varieties must be resistant to abiotic and biotic environmental factors (4, 5, 6, 7).

The breeding process, including the formation of genotypic variability and the selection of economically valuable genotypes, is accompanied by microevolutionary processes that are caused by the influence of environmental factors (8, 9), an infectious background (10, 11), and artificial selection (12, 13).

Hybridization with subsequent selection of recombinant genotypes is one of the main ways to create varieties (14). The hybridization includes sources of valuable traits from the world collection of the All-Russian Institute of Plant Industry (VIR). When using the gene pool from the collection, their genotyping is to a large extent necessary (15, 16), but at the same time, a complete assessment of economically valuable traits is needed precisely in the conditions for which the variety is created (17, 18), with the identification of the most adaptive initial material (19, 20), which contributes to the creation of varieties with the necessary parameters (21, 22). The genotypic difference in varieties and changes in environmental conditions have a significant impact on the manifestation of quantitative traits in specific soil and climatic conditions (23). In this regard, research aimed at the study and selection of sources for selective valuable traits of spring bread wheat is relevant.

The aim of the research is to study selective valuable quantitative traits in samples of spring soft wheat to isolate the most adapted source material for the conditions of the forest-steppe of Western Siberia.

Experimental Methods

The experiments were carried out in the zone of the northern forest-steppe of Western Siberia (Kuznetskaya hollow, Kemerovo region, Kemerovo district) in 2015-2018 years. The objects of research are 60 samples of spring soft wheat from the VIR collection and from the Bioresource collection of agricultural plants of the Kemerovo Research Institute of Agriculture, branch of the SFSCA RAS (CCU DBK). When evaluating the samples, the following characteristics were studied: plant height, number of grains per ear, weight of 1000 grains, weight of grain per ear, yield. Meteorological conditions during the years of research differed in the hydrothermal regime during the growing season. To characterize the conditions of the growing season, the hydrothemic coefficient, the SCC, was calculated. The hydrothemic coefficient represents the ratio of the amount of precipitation for a period with a temperature above 10^0C to evaporation, expressed by the sum of temperatures for the same period, reduced by 10 times (24). According to the degree of moisture, the following values are presented: excessive moisture, HTC ≥ 2.2, waterlogged, HTC = 2,2-1,6, moist, HTC = 1,6-1,4, moderately moist, HTC = 1,4-1, 2, insufficiently moistened, HTC = 1,2-1,0. The most demanding spring soft wheat to the presence of moisture during tillering - heading, HTC in this period in 2016, 2017 years was 0,37-0,46, which characterizes insufficient moisture supply (table 1).

Table 1. Hydrothermal coefficient during the growing season of spring soft wheat

Year	Hydrothermal coefficient (HTC)			
	May	June	July	August
2016	0,50	0,37	1,73	0,63
2017	0,47	0,46	1,80	1,10
2018	0,0	2,41	1,92	0,42

In 2018, the laying of generative organs took place with excessive moisture, HTC = 2,41. Grain filling, during the years of research (2016-2018), took place during waterlogging, HTC = 1,73-1,92.

Agrotechnical methods of cultivation were used generally accepted for the zone. Sowing was carried out in the first ten days of May, the plot area was 1 m^2, the predecessor was pure fallow, the soil was leached heavy loamy chernozem in terms of particle size distribution. Humus content in soil 8,21 %, N-NO3 –28,0 mg/kg, P_2O_5 –134 mg/kg, K2O –110 mg/kg (pH 6,0). Statistical data processing was performed using the Snedecor software (developed by O.D.Sorokin, Russia) by methods of variational and variance analyzes. (25,26). The mean (*M*), standard deviations (± SD) and coefficients of variation (*Cv*,%) of the compared features were calculated. In the analysis of variance, the *F*-Fisher criteria were used at the 5% significance level, the mean (M) and their standard errors (± SEM) were determined, the share of the influence of factors in the total variance of the trait (qv^2, squared factor loading). The smallest significant difference was calculated at the 5% significance level (HCP_{05}). The OmGAU variety is the standard for comparison. 90. The standard was placed across 20 samples. The studies were carried out in accordance with the methodological instructions of the VIR (27, 28).

Results and discussion

In the breeding of grain crops, considerable attention is paid at all stages of the breeding process to the resistance of genotypes to lodging (29). Plant height is an important morphological trait that has a relationship with lodging resistance (30, 31). With plant heights over 120 cm, spring wheat has a high tendency to lodging (32). The height of spring soft wheat plants for each ecological-geographical zone has its own characteristics, which characterizes the optimal established ecotype (33, 34). Also, plant height can be considered as one of the indicators characterizing the ecological plasticity of genotypes (35), and also serve as a marker for the selection of plants with a well-developed root system (36).

According to the assessment of samples in the collection nursery, we identified 17 samples of spring soft wheat with a lodging resistance of 9 points (on a nine-point scale) in comparison with the OmGAU 90 standard (9 points), the average height of which over the years of research was 70,7 cm (table 2).

Таблица 2 Высота растений у образцов коллекционного питомника яровой мягкой пшеницы 2016-2018 гг.

№ in order	№ VIR / № CKP DBK Kem. NIISH	Name	A country origin	Plant height, cm				CV, %
				years of testing			Average by factor grade	
				2016	2017	2018		
1	65447	OmGAU -90 St.	R.F. Omsk	69,0	61,9	73,1	68,0	8,33
2	KP - 076	Altai 70	R.F. Barnaul	68,5	67,0	70,9	68,8	2,86
3	KP - 077	Nadezhda Kuzbassa	R.F. Kemerovo	61,9	61,2	87,5	70,2	21,3
4	65135	In memory of Aphrodite	R.F. Kemerovo	69,0	66,5	90,0	75,2	17,2
5	65242	Siberian Alliance	R.F. Barnaul, Kemerovo	75,5	80,8	84,7	80,3	5,75
6	KP - 078	Ульгеня	R.F. Kemerovo	71,6	71,0	88,0	76,9	12,5
7	KP - 079	PM -80-11	R.F. Kemerovo	68,3	66,8	86,4	73,8	14,8
8	KP - 080	PM -81-11	R.F. Kemerovo	60,7	56,3	78,2	65,1	17,8

9	64358	Biora	R.F. Moscow	54,7	57,2	94,8	68,9	32,6
10	KP - 089	Lutescens 6-17	R.F. Kemerovo	84,6	62,3	95,2	80,7	20,8
11	KP - 071	Lutescens 105/4	R.F. Kemerovo	86,7	57,4	90,0	78,0	23,0
12	64702	Karabalyk 89	Kazakhstan	65,0	69,5	86,0	73,5	15,0
13	KP - 072	Biora -83-17	R.F. Kemerovo	63,9	65,0	94,5	74,5	23,3
14	KP - 073	Lutescens 5-17	R.F. Kemerovo	86,7	62,4	92,3	80,5	19,8
15	64400	Long-98-5582	China	41,9	38,8	69,0	49,9	33,3
16	64552	Valkyrie	R.F. Krasnoyarsk	57,0	67,9	64,7	63,2	8,86
17	64562	AC Nonda	Canada	54,0	51,9	60,1	55,3	7,70
Average by factor years				67,0	62,6	82,7	70,7	
$HCP_{0,5}$ for factor grade – 13,2, for factor years – 5,5								

Comparative analysis of plant height of spring soft wheat samples made it possible to determine the response of genotypes to the environment. The share of the influence of environmental conditions on plant height was 47,9%, genotype – 24,0%. The least variability (CV) had the studied trait in the samples: Altai 70 (KP -076, R.F. Barnaul) – 2,86%, Siberian Alliance (k -65242, Barnaul, Kemerovo) – 5,75%, AC Nonda (k-64562, Canada) – 7,70%, OmGAU 90 (k-65447, R.F. Omsk) – 8,33%, Valkyrie (k-64552, RF Krasnoyarsk) – 8,86%. The average variability of plant height, depending on the conditions prevailing during the study period, had samples: Ulgenya (KP -078), CV = 12,5%, PM -80-11 (KP -079, R.F. Kemerovo), CV = 14,8%, Karabalyk 89 (k-64702, Kazakhstan), CV =15,0%, In memory of Aphrodite (k-65135), CV = 17,2%, PM -81-11 (KP -080), CV = 17,8%, Lutescens 5-17 (KP - 073, R.F. Kemerovo), CV = 19,8%. The rest of the studied varieties had a strong variability of the trait - plant height, CV = 20,8-33,3%. The shortest straw in terms of average values over the years of study had two samples: Long-98-5582 (k-64400, China) – 49,9 cm and AC Nonda (k-64562, Canada) – 55,3 cm, but only the AC Nonda sample had low trait variability – 7,70%. Based on the results of analysis of variance, a close positive relationship of plant height with the yield of spring soft wheat, r = 0,6011 and elements of its productivity, with a mass of 1000 grains, r = 0,6580, the number of grains in an ear r, = 0,6092, grain weight per spike r = 0,5722; spike length, r = 0,5898 (R = 0.4821) was established.

The mass of 1000 grains and the number of grains per ear, which determine the formation of the productivity of soft wheat (37, 38, 39). In this regard, when assessing sources, special attention is paid to the absolute mass of grain in combination with the grain content (40, 41).

High weight 1000 grains - 37,4 g, with low variability of the indicator (CV = 5,25 %) has a variety from Kazakhstan (k-64702) Karabalyk 89 (table 3).

Table 3. Weight of 1000 grains of samples in the collection nursery of spring soft wheat 2016-2018 years.

№ in order	№ VIR / № CKP DBK Kem. NIISH	Name	A country origin	Weight of 1000 grains, g				CV, %
				years of testing			the average	
				2016	2017	2018		
1	65447	OmGAU -90 St.	R.F. Omsk	33,2	34,6	32,0	32,3	3,91
2	KP - 076	Altai 70	R.F. Barnaul	32,7	34,3	37,7	34,9	7,32
3	KP - 077	Nadezhda Kuzbassa	R.F. Kemerovo	28,6	36,7	36,4	33,9	13,5
4	65135	In memory of Aphrodite	R.F. Kemerovo	29,1	34,0	35,5	32,9	10,2
5	65242	Siberian Alliance	R.F. Barnaul, Kemerovo	33,8	34,5	41,5	36,6	11,6
6	KP - 078	Ульгеня	R.F. Kemerovo	34,6	32,6	39,6	35,6	10,1
7	KP - 079	PM -80-11	R.F. Kemerovo	28,5	34,4	35,0	32,6	11,0
8	KP - 080	PM -81-11	R.F. Kemerovo	31,4	35,4	36,3	34,4	7,59
9	64358	Biora	R.F. Moscow	31,2	31,5	43,2	35,3	19,4
10	KP - 089	Lutescens 6-17	R.F. Kemerovo	35,8	30,2	29,5	31,8	10,8
11	KP - 071	Lutescens 105/4	R.F. Kemerovo	34,4	32,9	30,5	32,6	6,03
12	64702	Karabalyk 89	Kazakhstan	38,2	35,2	38,9	37,4	5,25
13	KP - 072	Biora -83-17	R.F. Kemerovo	35,7	31,9	40,1	35,9	11,4
14	KP - 073	Lutescens 5-17	R.F. Kemerovo	34,5	32,4	32,2	33,0	3,86
15	64400	Long-98-5582	China	22,3	30,3	31,0	27,9	17,3
16	64552	Valkyrie	R.F. Krasnoyarsk	29,6	32,2	30,1	30,6	4,50
17	64562	AC Nonda	Canada	23,2	30,2	30,2	27,9	14,5
Average by factor years				31,6	33,1	35,3	33,3	
$HCP_{0,5}$ or factor grade – 5,2, for factor years – 2,2								

Also, large grain in the collection nursery on average for three years was formed by samples: Siberian Alliance (k-65242, Barnaul, Kemerovo) – 36,6 g, Biora (k-64358, RF Moscow) – 35,3, Ulgenya (KP-078) – 35,6 g, PM-83-17 (KP-072, R.F. Kemerovo) – 35,9 g, in 2018, more favorable in terms of moisture, the mass of 1000 grains in these samples was 41,5 g, 43,2, 39,6 g, and 40,1 g, respectively, with an average variability of the trait, CV, % = 10,1-11,6%.

Environmental factors underlie the formation of grain properties (42), the share of the influence of the environmental factor was 17,0%, the role of the genotype in the formation of the grain mass was 23,9%. The number of grains in an ear of spring bread wheat largely depends on the hydrothermal regime in the tillering, flowering and grain phases; a significant influence of the year conditions was noted – 79,0%, genotype 11,8%. In comparison with the OmGAU 90 standard, there was a reliably high number of grains in terms of average indicators over the years of study: Lutescens 5-17 (KP-073, RF Kemerovo) – 25,4 pieces, Lutescens 6-17 (KP-089, RF Kemerovo) – 25,6, Karabalykskaya 89 (k-64702, Kazakhstan) – 27,6 piece, Ulgenya (KP-078) – 28,2 units, Biora (k-64358, RF Moscow) – 28,3 units, PM-80-11 (KP-079, RF Kemerovo) - 29,2 piece. (table 4).

Table 4. The number of grains in an ear in the samples of the collection nursery of spring bread wheat

№ in order	№ VIR / № СКР DBK Kem. NIISH	Name	A country origin	Number of grains in an ear, pcs.				CV, %
				years of testing			the average	
				2016	2017	2018		
1	65447	OmGAU -90 St.	R.F. Omsk	13,2	18,5	25,8	19,2	33,0
2	KP - 076	Altai 70	R.F. Barnaul	11,4	19,9	29,7	20,3	45,0
3	KP - 077	Nadezhda Kuzbassa	R.F. Kemerovo	10,9	13,4	26,5	16,9	49,5
4	65135	In memory of Aphrodite	R.F. Kemerovo	13,8	17,8	29,4	20,3	39,8
5	65242	Siberian Alliance	R.F. Barnaul, Kemerovo	12,0	15,1	38,5	21,9	66,3
6	KP - 078	Ульгеня	R.F. Kemerovo	18,2	24,0	42,4	28,2	44,8
7	KP - 079	PM -80-11	R.F. Kemerovo	18,2	25,0	44,4	29,2	46,6
8	KP - 080	PM -81-11	R.F. Kemerovo	14,1	14,1	28,9	19,0	44,9
9	64358	Biora	R.F. Moscow	22,3	20,8	41,7	28,3	41,2
10	KP - 089	Lutescens 6-17	R.F. Kemerovo	23,0	16,3	37,4	25,6	42,2
11	KP - 071	Lutescens 105/4	R.F. Kemerovo	20,2	15,7	34,6	23,5	42,0
12	64702	Karabalyk 89	Kazakhstan	23,4	20,4	38,9	27,6	36,0
13	KP - 072	Biora -83-17	R.F. Kemerovo	12,2	15,2	29,1	18,8	47,9
14	KP - 073	Lutescens 5-17	R.F. Kemerovo	19,0	20,0	37,2	25,4	40,3

15	64400	Long-98-5582	China	17,6	11,9	30,9	20,1	48,4
16	64552	Valkyrie	R.F. Krasnoyarsk	10,7	15,1	28,5	18,1	51,2
17	64562	AC Nonda	Canada	14,4	15,8	24,5	18,2	30,0
Average by factor years				16,1	17,6	33,4	22,4	
$HCP_{0,5}$ for factor grade – 5,4, for factor years – 2,3								

Variation of the trait, the number of grains in an ear as a whole in all studied samples is significantly high and ranges from 30,0% to 66,3%. With an increase in the number of grains in an ear, a decrease in its weight is possible (43, 44), when calculating the partial correlation coefficients, such a dependence is present, r = - 0,9232, but samples were noted in which, with an increase in the number of grains, the weight of the grain by average indicators does not decrease, but tends to increase (r = 0,3441): Ulgenya (KP-078, RF Kemerovo), the number of grains in an ear – 28,2 pcs., The weight of 1000 grains is 35,6 g, Biora (k-64358, RF Moscow), the number of grains in an ear is 28,3 pcs., the mass of 1000 grains is 35,3 g, Karabalyk 89 (k-64702, Kazakhstan), the number of grains in an ear is 27,6 pieces, the weight of 1000 grains is 37,4 g (the average number of grains in an ear is 22,4 pcs., 1000 grains weight 33,3 g). Accordingly, these samples developed a high productivity of the ear – 1,05-1,06 g (average for the experiment 0,78 g), the standard OmGAU 90 – 0,64 g (table 5).

Table 5. Ear productivity in samples from the collection nursery of spring bread wheat

№ in order	№ VIR / № CKP DBK Kem. NIISH	Name	A country origin	Ear weight, g				CV, %
				years of testing			the average	
				2016	2017	2018		
1	65447	OmGAU -90 St.	R.F. Omsk	0,45	0,64	0,84	0,64	30,3
2	KP - 076	Altai 70	R.F. Barnaul	0,38	0,69	1,12	0,73	50,9
3	KP - 077	Nadezhda Kuzbassa	R.F. Kemerovo	0,34	0,49	0,97	0,60	54,8
4	65135	In memory of Aphrodite	R.F. Kemerovo	0,41	0,61	1,05	0,69	47,5
5	65242	Siberian Alliance	R.F. Barnaul, Kemerovo	0,40	0,53	1,62	0,85	78,8
6	KP - 078	Ульгеня	R.F. Kemerovo	0,64	0,80	1,70	1,05	54,6
7	KP - 079	PM -80-11	R.F. Kemerovo	0,72	0,86	1,60	1,06	44,6
8	KP - 080	PM -81-11	R.F. Kemerovo	0,44	0,50	1,06	0,67	51,3
9	64358	Biora	R.F. Moscow	0,71	0,66	1,80	1,06	61,0
10	KP - 089	Lutescens 6-17	R.F. Kemerovo	0,82	0,51	1,12	0,82	37,3
11	KP -	Lutescens 105/4	R.F. Kemerovo	0,70	0,52	1,06	0,76	36,2

	071							
12	64702	Karabalyk 89	Kazakhstan	0,91	0,73	1,52	1,05	39,3
13	KP - 072	Biora -83-17	R.F. Kemerovo	0,45	0,49	1,20	0,71	56,2
14	KP - 073	Lutescens 5-17	R.F. Kemerovo	0,67	0,66	1,20	0,84	36,6
15	64400	Long-98-5582	China	0,40	0,36	0,96	0,57	58,5
16	64552	Valkyrie	R.F. Krasnoyarsk	0,34	0,49	0,86	0,56	47,5
17	64562	AC Nonda	Canada	0,36	0,48	0,74	0,53	36,9
Average by factor years				0,54	0,59	1,20	0,78	
$HCP_{0,5}$ for factor grade – 0,28, for factor years – 0,12								

The productivity of an ear at the level of 1,06 g (according to average indicators over the years of testing) was noted for the sample PM-80-11 (KP-079, RF Kemerovo), but in this case the number of grains in an ear is the highest according to experience - 29,2 pcs., But the mass of 1000 grains was 32,6 g. Therefore, when selecting samples for economically valuable traits, it is necessary to pay attention to the grain size in combination with the grain size of the ear, which ultimately determines the weight of the ear, which correlates with the yield, r = 0,3000. The creation of varieties with high potential yields in breeding programs has been and remains of fundamental importance. (45). The annual yield varied in the samples from 100,8 to 411,0 g/m ^{2} (table 6).

Table 6. Productivity of the samples of the collection nursery of spring bread wheat

№ in or der	№ VIR / № CKP DBK Kem. NIISH	Name	A country origin	Productivity, g / m				CV, %
				years of testing			the avera ge	
				2016	2017	2018		
1	65447	OmGAU -90 St.	R.F. Omsk	140,0	180,0	213,2	177,7	20,6
2	KP - 076	Altai 70	R.F. Barnaul	140,8	180,0	197,1	172,6	16,7
3	KP - 077	Nadezhda Kuzbassa	R.F. Kemerovo	150,1	167,0	347,0	221,4	49,3
4	65135	In memory of Aphrodite	R.F. Kemerovo	140,8	173,0	343,0	218,9	49,6
5	65242	Siberian Alliance	R.F. Barnaul, Kemerovo	181,2	160,0	394,0	245,1	52,8
6	KP - 078	Ульгеня	R.F. Kemerovo	290,0	210	305.0	268,3	19,0
7	KP - 079	PM -80-11	R.F. Kemerovo	210,0	126	319,0	218,3	44,3
8	KP - 080	PM -81-11	R.F. Kemerovo	270,0	270,0	116,1	218,7	40,6
9	64358	Biora	R.F. Moscow	181,2	169,0	171,0	173,7	3,77

10	KP - 089	Lutescens 6-17	R.F. Kemerovo	225,0	170,0	275,0	223,3	23,5
11	KP - 071	Lutescens 105/4	R.F. Kemerovo	250,0	100,8	380,0	243,6	57,4
12	64702	Karabalyk 89	Kazakhstan	165,0	120,8	225,0	170,3	30,7
13	KP - 072	Biora -83-17	R.F. Kemerovo	220,0	220,0	411,0	283,7	38,9
14	KP - 073	Lutescens 5-17	R.F. Kemerovo	228,0	190	320,0	246,0	27,2
15	64400	Long-98-5582	China	136,8	136,8	288,0	187,2	46,6
16	64552	Valkyrie	R.F. Krasnoyarsk	189,0	189,0	240,0	206,0	14,3
17	64562	AC Nonda	Canada	156,0	110,0	240,0	168,7	39,1
Average by factor years				192,6	169,0	281,4	214,3	
$HCP_{0,5}$ for factor grade – 99,5, for factor years – 41,8								

In 2018, the highest yield was formed, on average for the nursery 281,4 g/m^2, with the range of variation from 116,1 to 411,0 g/m^2. The increase in yield was largely determined by sufficient moisture supply during the tillering-earing period of spring soft wheat, HTC = 2,41. The most stable yield over the years had the Ulgen sample (KP-078, RF Kemerovo), its variability is the lowest according to experience - 19.0% and amounted to 268,3 g. With excess to standard OmGAU 90 106,0 g/m^2 (HCP_{05} = 99,5) sample PM-83-17 (KP-072, R.F. Kemerovo).

Conclusions

Thus, in the study of collection samples of spring soft wheat, sources were identified for valuable economically useful traits. By plant height, 17 samples of spring soft wheat were identified with lodging resistance of 9 points (on a nine-point scale), including those with low variability of the trait five - CV = 2,86-8,86% and six with an average - CV = 12,5-19,8%. A close positive relationship of plant height with the yield of spring soft wheat, r = 0,6011 and elements of its productivity, with a mass of 1000 grains r = 0,6580, the number of grains in an ear, r = 0,6092, a grain weight with ears, r = 0,5722 (R = 0,4821). Large grain in combination with high grain content in the collection pytombook on average for three years formed the following samples: Biora (k-64358, Russian Federation Moscow) – 35,3 g, Ulgenya (KP-078) – 35,6 g, Karabalykskaya 89 (k-64702, Kazakhstan) – 37,4 g (the number of grains in an ear is 27,6-28,3 pcs.), which determined the overall high productivity of an ear – 1,05-1,06 g (on average, according to experience 0,78 g), standard OmGAU 90 – 0,64 g. A sample with the most stable yield by years of Ulgen (KP-078, Kemerovo RF) was selected, with the lowest variability in experience – 19,0%. With excess to the standard OmGAU 90 106,0 g/m^2 (NSR05 = 99.5), the sample PM-83-17 (KP-072, R.F. Kemerovo).

References

1. Mergoum M., Singh P.K., Anderson J.A., Peca R.J., Singh R.P., Xu S.S., Ransom J.K. Springwheat breeding. In: Cereals. Handbook of Plant Breeding, vol. 3. M. Carena (ed.). *Springer, NY*. 2009 (doi: 10.1007/978-0-387-72297-9_3).

2. Syzdykova G.T., Sereda S.G., Malitskaya N.V. Podbor sortov yarovoy myagkoy pshenitsy (Triticum aestivum L.) po adaptivnosti k usloviyam stepnoy zony Akmolinskoy oblasti Kazakhstana. Sel'skokhozyaystvennaya biologiya. 2018. 53 (1): 103-110 (DOI: 10.15389 / agrobiology.2018.1.103rus.). 3. Novokhatin V.V. Obosnovaniye geneticheskogo potentsiala u intensivnykh sortov myagkoy pshenitsy ((Triticum aestivum). Sel'skokhozyaystvennaya biolo-giya. 2016. 51 (5): 627-635 (doi: 10.15389 / agrobiology.2016.5.627rus). 4. Likhenko I.Ye., Sovetov V.V., Anosov S.I., Likhenko N.N. Formirovaniye urozhaya sibirskikh sortov yarovoy myagkoy pshenitsy v usloviyakh kontinen-tal'nogo klimata strany Sibiri. Dostizheniya nauki i tekhniki APK. 2014. 1: 27-30. 5. Goncharenko A.A. Ekologicheskaya ustoychivost' zernovykh kul'turnykh i za-dachi selektsii. Zernovoye khozyaystvo Rossii. 2016. 44 (2): 31-36. 6.Sapega V.A., Tursumbekova G.SH. Urozhaynost' srednespelykh sortov yarovoy pshenitsy i parametry ikh adaptivnosti v razlichnykh usloviyakh Severnogo Zaural'ya. Uspekhi sovremennogo yestestvoznaniya. 2016. 11: 65-69. 7. Sapega V.A., Tursumbekova G.SH. Urozhaynost', ekologicheskaya plastich-nost' i adaptivnost' srednerannikh sortov yarovoy pshenitsy v Severnom Zaural'ye. Vestnik NGAU. 2017. 43 (2): 62-70. 8. Fudzimura S., Shi P., Ivama K., Chzhan X., Gopal Dzh., Dzhitsuyama YU. Sravneniye rosta i urozhaynosti yarovoy pshenitsy v Lkhase, Tibetskoye plato, s urozhayem v Sapporo. Yaponiya. Zavod Prod. Sci. 2009. 12 (1): 116-123 (DOI: 10.1626 / pps.12.116).

9. Malik A.H., Prieto - Linde M.L., Kuktaite R., Anderson A., Johansson E. Individual and interactive effects of genetic background and environmental conditions on amount and size distribution of polymeric proteins in wheat grain. Czech J. Genet. *Plant Breed*. 2011, 47(Special issue): 186-189.

10. Haberle J., Holzapfel J., Hartl L. Die Genetik der Fusariumresistenz in europaischem Winterweizen. In: Abwehrstrategien gegen biotische Schaderreger, Zuchtung von Hackfruchten und Sonderkulturen. *Irdning*. 2009: 5-8.

11. Kosva K., Chrpova J., Sip V. Cereal resistance to Fusarium head blight and possibilities of its improvement through breeding. Czech J. Genet. *Plant Breed*. 2009. 45(3): 87-105.

12. El - Hendawy S.E., Ruan Y., Hu Y., Schmidhalter U. A comparison of screening criteria for salt tolerance in wheat under field and controlled environmental conditions. *Journal of Agronomy & Crop Science*. 2009. 195(5): 356-367 (doi: 10.1111/j.1439-037X.2009.00372.x).

13. Guo R., Wu Q., Liu Y. Single-plant similarity-difference selection in wheat breeding. *Advance Journal of Food Science and Technology*. 2013. 5(11): 1413-1417.

14. Piskarev V.V., Zuyev Ye.V., Brykova A.N. Iskhodnyy material dlya selektsii yarovoy myagkoy pshenitsy v usloviyakh Novosibirskoy oblasti. Vavilovskiy zhurnal genetiki i selektsii. 2018. 22(7):784-794. (doi: 10.18699/VJ18.422).

15. Friedrich C., Longin H., Reif J.C. Redesigning the exploitation of wheat genetic resources. *Trends Plant Sci*. 2014. 19(10):631-636. (doi: 10.1016/j.tplants.2014.06.012).

16. Addison Ch.K., Mason R.E., Brown-Guedira G., Guedira M., Hao Yu., Miller R.G., Subramanian N., Lozada D.N., Acuna A., Arguello M.N., Johnson J.W., Sutton A.M., Harrison S.A. QTL and major genes influencing grain yield potential in soft red winter wheat adapted to the southern United States. *Euphytica*. 2016. 209:665-677. (doi: 10.1007/s10681-016-1650-1).

17. Piskarev V.V., Zuyev Ye.V., Brykova A.N. Iskhodnyy material dlya selektsii yarovoy myagkoy pshenitsy v usloviyakh Novosibirskoy oblasti. Vavilovskiy zhurnal genetiki i selektsii. 2018. 22(7):784-794. (doi: 10.18699/VJ18.422). 18. Piskarev V.V., Boyko N.I., Kondrat'yeva I.V. Istochniki khozyaystvenno tsennykh priznakov dlya selektsii pshenitsy myagkoy yarovoy (Triticum aestivum L.) v usloviyakh lesostepi Priob'ya Novosibirskoy oblasti. Vavilovskiy zhurnal genetiki i selektsii. 2016;20(3):277-285. (doi: 10.18699/VJ16.166).

19. Tadesse W., Amri A., Ogbonnaya F.C., Sanchez-Garcia M., Sohail Q., Baum M. Wheat. In: Genetic and Genomic Resources for Grain Cereals Improvement. *Elsevier Inc.* 2016. 2:81-124. (doi: 10.1016/ B978-0-12-802000-5.00002-2).

20. Nikotra A. B., Atkin O. K., Bonser S. P., Davidson A. M., Finnegan E. J., Mathesius U., Poot P., Purugganan M. D., Richards C. L., Valladares F., van Kleunen M. Plant phenotypic plasticity in a changing climate. Trends Plant Sci. 2010;15(12):685-692. (doi: https://doi.org/10.1016/j.tplants.2010.09.008).

21. Randhawa H.S., Graf R.J., Pozniak C., Clarke J.M., Asif M., Hucl P., Spaner D., Fox S.L., Humphreys D.G., Knox R.E., Depauw R.M., Singh A.K., Cuthbert R.D. Application of molecular markers to wheat breeding in Canada. Plant Breed. 2013. 132(5):458-471.

22. Wessels E., Botes W.C. Accelerating resistance breeding in wheat by integrating marker-assisted selection and doubled haploid technology S. Afr. J. *Plant Soil*. 2014; 31(1):35-43.

23. Khotylova L.V., Kil'chevskiy A.V., Shapturenko M.N. Teoreticheskiye aspek-ty geterozisa. Vavilovskiy zhurnal genetiki i selektsii. 2016. 20(4): 482-492. (doi: 10. 18699/VJ16. 1746). 24. Agroklimaticheskiye resursy Kemerovskoy oblasti. L.:Gidrometeoizdat. 1973. S.21. 25. Sorokin

O.D. Prikladnaya statistika na komp'yutere. Krasnoobsk. 2004. 26. Dospekhov B.A. Metodika polevogo opyta: monografiya. M. 1985. 27. Rudenko M.I., Shitova I.P., Korneychuk V.A. Metodicheskiye ukazaniya po izucheniyu mirovoy kollektsii pshenitsy. L.: VIR. 1977. 28. Merezhko A.F., Udachin R.A., Zuyev Ye.V., Filatenko A.A., Serbin A.A., Lyapunova O.A., Kosov V.YU., Kurkiyev U.K., Okhotnikova T.V., Navruzbekov N.A., Boguslavskiy R.L., Abdulayeva A.K., Chikida N.N., Mitrofanova O.P., Potokina S.A. Popolneniye, sokhraneniye v zhivom vide i izucheniye mirovoy kollektsii pshenitsy, egilopsa i tritikale. Metodicheskiye ukaza-niya. SPb.: VIR. 1999. 29. Ageyeva Ye.V., Leonova I.N., Likhenko I.Ye. Poleganiye pshenitsy: geneticheskiye i ekologicheskiye faktory i sposoby preodoleniya. Vavilovskiy zhurnal genetiki i selektsii. 2020. 24(4):356-362. (doi: 10.18699/VJ20.628).

30. Maccaferri M., Sanguineti M.C., Corneti S., Ortega J.L., Salem M.B., Bort J., Ambrogio E., Moral L.F., Demontis A., El-Ahmed A. Maalouf F., Machlab H., Martos V., Moragues M., Motawaj J., Nachit M., Nserallah N., Ouabbou H., Royo C., Slama A., Tuberosa R. Quantitative trait loci for grain yield and adaptation of
durum wheat (*Triticum durum* Desf.) across a wide range of water availability. *Genetics*. 2008. 178:489-511.

31. Sadeque A., Turner M.A. QTL analysis of plant height in hexaploid wheat doubled haploid population. *Thai J. Agric. Sci*. 2010. 43:91-96.

32. Packa D., Wiwart M., Suchowilska E., Dienkowska T. Morpho-anatomical traits of two lowest internodes related to lodging resistance in selected genotypes of *Triticum*. *Int. Agrophys*. 2015. 29:475-483. (doi: 10.1515/intag-2015-0053).

33. . Baresel J.P. Weizenzüchtung für den Ökologischen Landbau: Dissertation TU München D 91. Berlin: *Verlag Dr. Köster*. 2006.

34 Acquaah G. Principles of Plant Genetics and Breeding. Malden.: *BLACWELL PUBLISHING*. 2007.

35. Ripberger Ye.I., Bome N.A., Trautts D. Izmenchivost' vysoty rasteniy gibridnykh form yarovoy myagkoy pshenitsy (Triticum aestivum L.) kak sposob ikh adaptatsii v razlichnykh ekologo-geograficheskikh usloviyakh. Vavilovskiy zhurnal genetiki i selektsii. 2015. 19(2):185-190. (doi: 10.18699/VJ15.023). 36. Shamanin V.P., Pototskaya I.V, Shepelev S.S., Pozherukova Ye.V., Mor-gunov A.I. Morfometricheskiye parametry kornevoy sistemy i produktiv-nost' rasteniy u sinteticheskikh liniy yarovoy myagkoy pshenitsy v usloviyakh Zapadnoy Sibiri v svyazi s zasukhoustoychivost'yu. Sel'skokhozyaystvennaya biologiya. 2018. 53(3): 587-597. (doi: 10.15389/agrobiology.2018.3.587rus).

37. Pakul V.N. Sources of efficiency of spring-sown soft field for conditions of western Siberia. *Materials of the II international research and practice conference. publishing office Accent Graphics communications.* Westwood. Canada. 2013. Vol. II: 295-299.

38. Afonnikov D.A., Genayev M.A., Doroshkov A.V., Komyshev Ye.G., Pshe-nichnikova T.A. Metody vysokoproizvoditel'nogo fenotipirovaniya ras-teniy dlya massovykh selektsionno-geneticheskikh eksperimentov. Genetika.2016. 52(7): 788-803 (doi: 10.7868/S001667581607002X)..

39. Huang M., Wang Q.G., Zhu Q.B., Qin J.W., Huang G. Review of seed quality and safety tests using optical sensing technologies. *Seed Sci. Technol.*, 2015, 43(3): 337-366 (doi: 10.15258/sst.2015.43.3.16).

40. Fischer R.A. The importance of grain or kernel number in wheat: A reply to Sinclair and Jamieson. *Field Crop Res*., 2008, 105: 15-21.

41. Atkinson J.A., Wingen L.U., Griffiths M., Pound M.P., Gaju O., Foulkes M.J., Le Gouis J., Griffiths S., Bennett M.J. Phenotyping pipeline reveals major seedling root growth QTL in hexaploid wheat. *J. Exp. Bot*, 2015, 66: 2283-2292 (doi: 10.1093/jxb/erv006).

42. Khlostkina Ye.K., Zhuravlova Ye.V., Pshenichnikova T.A., Usenko N.I., Moro-zova Ye.V., Osipova S.V., Permyakova M.D., Afonnikov D.A., Otmakhova YU.S. Realizatsiya genetich-eskogo potentsiala sortov yarovoy myagkoy psheni-tsy pod vliyaniyem usloviy vneshney sredy: sovremennyye vozmozhnosti uluchsheniya kachestva zerna i khlebopekarnoy produktsii. Sel'skokhozyay-stvennaya biologiya. 2017. 52(3): 501-514. (doi: 10.15389/agrobiology.2018.3.587rus).

43. Rebetzke G.J., Bonnett D.G., Reynolds M.P. Awns reduce grain number to increase grain sizeand harvestable yield in irrigated and rainfed spring wheat. *J. Exp. Bot*., 2016, 67(9): 2573-2586 (doi: 10.1093/jxb/erw081).

44. Griffiths S., Wingen L., Pietragalla J., Garcia G., Hasan A., Miralles D., Calderini D.F., Ankleshwaria J.B., Waite M.L., Simmonds J., Snape J., Reynolds M. Genetic dissection of grainsize and grain number tradeOffs in CIMMYT wheat germplasm. *PLoS ONE*, 2015, 10(3): e0118847 (doi: 10.1371/journal.pone.0118847).

45. Potanin V.G., Aleynikov A.F., Stopochkin P.I. Novyy podkhod k otsenke ekologicheskoy plastichnosti sortov rasteniy. Vavilovskiy zhurnal gene-tiki i selektsii. 2014. 18(3): 548-552.