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РЕСПУБЛИКИ КАЗАХСТАН

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SUSTAINABILITY TO RUST DISEASES OF SYNTHETIC WINTER WHEAT FORMS

Abstract. With new biological technologies introduction, in breedingprocess there are important targeted search of genes for specific traits, including wild relatives germplasm and created intermediate wheat-alien hybrids (WAH).

Among the genotypes studied, against the background of a strong yellow rust development, stable samples were isolated. Bezostaya 1 x *Ae.cylindrica*, (Bezostaya 1 x *T.militinae*) x *T.militinae-6*; (Bezostaya 1 x *T.militinae*) x *T.militinae*-9; (Bezostaya 1 x *T.militinae*) x *T.militinae*-4; Zhetysu x *T.timopheevi*; Zhetysu x *T.militinae*; Bezostaya 1 x *Ae.cylindrica* and Erythrospermum 350 x *T.kiharae*. Leaf rust was amazed on an artificial infectious background from all analyzed samples, only 5 of 60 %, including a variety-standard with a manifestation disease degree 40-80%.

The lesion by the leaf form of septoria and yellow spotting averaged 15.9-20.4%, with 0-40% variation in the cvs samples. High resistance to these pathogens was demonstrated by the samples (Bezostaya 1 x *T.militinae*) x *T.militinae*-6; (Bezostaya 1 x *T.militinae*) x *T.militinae*-9; (Bezostaya 1 x *T.militinae*) x *T.militinae*-4; Karakhan; Steklovidnaya 24 x *T.timopheevii*; (Bezostaya 1 x *Ae.triaristata*) x Karlygash and Erythrospermum 350 x *T.kiharae*. On the natural background, in the Karabalyk conditions, the number of Erythrospermum 350 x *T.kiharae* was distinguished for resistance to brown rust, as well as for other diseases, for the first time for winter wheat in the North of the RK. Genotypes Erythrospermum 350 x *T.kiharae* (58.0-75.0 c/ha), Zhetysu x *T.timopheevii* (49.0-61.5 c/ha) and Zhetysu x *T.militinae* (48.5-61.1 c/ha) were characterized by consistently high yields for long-term results, including on an infectious background: Erythrospermum 350 x *T.militinae*, Bezostaya 1 x *Ae.cylindrica* and (Bezostaya 1 x *T.militinae*) x *T.militinae*-9). Disease-resistant forms are an indispensable element of organic farming, in this regard the use of isolated wheat-alien winter wheat forms is an actual prospect in the new varieties breeding.

Key words: winter wheat, synthetics, wild relatives, resistance to diseases.

With new biological technologies introduction, the targeted search issue and specific traits gene transfer becomes topical. Preliminary it is necessary to identify sources and donors, incl. among wild relatives and established intermediate wheat-alien hybrids (WAH). These valuable forms can be used as an independent object of environmentally sustainable agro-systems, and as an effective transition bridge in breeding for the useful genes transfer to the wheat genome [1].

The *Triticumavestivum* genofund stock by limiting characters is rather limited and does not allow solving many actual modern breeding tasks. Therefore, along with the classical application methods of breeding, selection and hybridization, intraspecific crossing of wheat, genetic breeding and cytogenetic methods using representatives of close genera and wheat species *Aegilops, Agropyron, Secale, T.timopheevii, T.dicoccum, T. kiharae* and other genotypes of signs and properties. The optimal approach for evaluation and subsequent transfer of unique wheat alleles from its wild relatives are WAH. To maintain and preserve the identified allele in the norm of wheat-alien hybrids is much easier than tracking it in wild relatives populations.

In our studies we used material created over many years by successful wheat hybridization *Tr.aestivum* and species of *T.timopheevii, T.militinae, T.kiharae, T.dicoccoides, Ae.cylindrica, Ae.triaristata* and obtaining transitional hybrid forms and advanced constant samples [2].

The research importance is determined by the sources allocation and donors (genotypes), signs of resistance to diseases for wide and direct use in breeding programs when creating new wheat varieties adapted in Kazakhstan.

Aim: To study wheat-alien forms of wheat in diseases resistance on an artificial background; evaluate the productivity and grain quality, rank it on tolerant and susceptible genotypes.

Research material and methods. Field experiments were conducted on the basis of the "Research Institute for Biological Safety", located in the Gvardeisky village, Kordai district, Zhambyl region. According to natural and climatic conditions, field research belongs to the arid foothill agroclimatic region. During the vegetation period of grain crops, 80-190 mm of precipitation falls. The hydrothermal coefficient is 0.5-0.7. Effective temperatures sum varies between 3000-3500 °C, precipitation amount for the year is 250-400 mm. It should be noted that this spring there were favorable weather conditions for the development of airborne infection (frequent rains, a cool night and a long dew period). In the experiment, the control was a commercial variety of winter soft wheat Steklovidnaya 24. As the inoculum, uredospores stem (*Pucciniagraminis*), yellow (*P.striiformis*) and leaf rust *(P.triticiana*), as well as picnospores Septoria leaf (*Septoriatritici*) from the microorganisms collection Research Institute Of Biological Safety Problems.

In the spring, during the tillering phase, winter wheat crops were infected with uredospores of stem, leaf and yellow rust. The inoculum taken for infection was activated at a temperature of 37-40 °C for 30 minutes, followed by watering in a moist chamber at a temperature of 18-22 °C for 2-4 hours. Infectious material on the plants was applied by spraying with an aqueous spore suspension with 0.001% Tween 80 according to E.E. Geshele [3]. Spore infectious load was 20 mg/m2. After infection, the plots were covered with a polyethylene film for 16-18 hours to create high humidity.

Infection pathogen Septoria field plants was performed by spraying a spore suspension of a pathogen, this isolates used with a high concentration of conidia (107 spores / ml). The inoculum was prepared at the rate of 200 ml per 1 m2 suspensions inoculation. Plants were sprayed uniformly with a conidia suspension of the fungus and placed in a 100% humidity conditions [4].

After diseases manifestation on susceptible control varieties, the plants resistance to rust types according to established scales was assessed two to three times. The lesion type (in points) of yellow rust was determined according to G.Gassner and W. Straib [5], leafy – E.E.Mains and H.S.Jackson [6]. At the same time, 0 score means immunity, 1-2 points - stability, and 3-4 points - susceptibility.

The infection development on the plant was assessed (in%) according to the R.F. Peterson et al. (Modified Cobb's scale) [7], with 1-20% showing mild development, 21-40% average, 41-60% strong and more than 60% very severe infection. When registering during the emergence time in the tube - the spike, 2 lower sheets and middle tier were analyzed, and in the grain filling period - the upper 2 leaves, including the flag. Last account of leaf and yellow rust was carried out in grain milk-wax ripeness phase, and stem rust - during the grain wax ripeness.

Stability and susceptibility degree of wheat samples to leaf spot (septoria, yellow spot) was established (in%) according to the scale of W.S. James [8]. In this case, wheat varieties affecting 0-5% are highly resistant to disease, 6-20% - resistant, 21-40% - weak-responsive, 41-65% - susceptible, 90-100% - highly susceptible, respectively [8, 9].

In the field phenological observation, evaluation and counts plant status development phases were conducted according to Methodological instructions for VIR wheat collection study [10]. Wheat morphological features determination was carried out according to methodological guides for breeding and seed production. Thus, the winter hardness of winter and optional wheat varieties was determined at the end of the winter period, and spring regrowth in spring, during a mass plants growth period on a five-point scale (from 1 to 5) [11].

Research results and discussion. The experiment results showed that most of the winter wheat samples from this nursery studied are weakly and mediumly affected by a local yellow rust population. Most plants had a moderately resistant infection type, i.e. small pustules with necrosis or medium pustules, surrounded by necrosis and chlorosis. However, in the middle of May, the susceptible reaction disease types were noted in the individual leaves samples (Erythrospermum 350 x *T.militinae*, Steklovidnaya 24 x *T.timopheevii*; Karakhan; Zhetysu x *T.militinae* and St-2) and after 15 days the flag leaves were covered with pustules of the fungus on 20-40%. And by the first-decadeend of June on these samples, because of the strong disease development, the flag leaves dried up. Among the varieties studied, against the background of strong fungus development, stable specimens were isolated. Bezostaya 1 x *Ae.cylindrica*, (Bezostaya 1 x *T.militinae*-6; (Bezostaya 1 x *T.militinae*) x *T.militinae*-9; (Bezostaya 1 x *T.militinae*) x *T.militinae*-4; Zhetysu x *T.timopheevii*; Zhetysu x *T.militinae*; Bezostaya 1 x *Ae.cylindrica* and Erythrospermum 350 x *T.kiharae*. On the basis of the results obtained, it was found that high stability in the above-mentioned samples is due to the certain Yr-resistance genes presence to yellow rust.

As winter wheat samples studying result for resistance to sheet (brown) rust, the following data were obtained. On the samples of Zhetysu x *T.militinae*; Bezostaya 1 x *Ae.cylindrica* and Erythrospermum 350 x *T.kiharae* were absent from the visible disease symptoms, i.e. they are immune to leaf rust. In addition, high resistance to leaf rust in the field conditions showed samples (Bezostaya 1 x *Ae.triaristata*) x Karlygash; Erythrospermum 350 x *T.militinae*; Zhetysu x *T.timopheevii*), then the marked samples were found only single leaf rust pustules (up to 1-5%). These results lead to the conclusion that the Lr-resistance genes in these samples result in delayed disease development (slowrusting) and restrain the spread of infection over large areas. Overcome the problems, eliminate the epiphytoty risk, and also save the harvest. Only 5 specimens (Bezostaya 1 x *Ae.cylindrica*; (Bezostaya 1 x *T.militinae*) x *T.militinae*-6; (Bezostaya 1 x *T.militinae*) x *T.militinae*-9; (Bezostaya 1 x *T.militinae*) x *T.militinae*-4) and the control variety Steklovidnaya 24 were affected by leaf rust to a great extent, in which the disease manifestation degree reached 40-80%. Sample Steklovidnaya 24 x *T.timopheevii* has a longer latent period, a large pustules number per unit area of the leaf surface and a smaller size compared to other samples.

On the wheat samples studied, the leaves septoriosis symptoms were manifested along with the signs of yellow leaf spot. The disease development is noted mainly on the lower winter wheat leaves. It is known that on wheat, the count of septoria and yellow leaf spot can be taken separately or together, as in mushroom diseases. In our researches, the lesion with the leaf form of septoria and yellow spotting averaged 15.9-20.4%, with variance in the varietyof samples 0-40%. High resistance to these pathogens was demonstrated by the samples (Bezostaya 1 x *T.militinae*) x *T.militinae*-6; (Bezostaya 1 x *T.militinae*)

Table 1 – Field stability of winter wheat samples from the infectious nursery to yellow rust

Samples name	Type and degree of injury, score /%			
	Kazakhstan, Otar			
	2016		2015	
	1 account*	2 account**	1 account*	2 account**
(Bezostaya 1 x *Ae.triaristata*) x Карлыгаш	1/10	2/30	2/20	3/20
Erythrospermum 350 x *T.militinae*	3/20	4/30	2/20	2/20
Bezostaya 1 x *Ae.cylindrica*	1/5	2/5	0	1/5
(Bezostaya 1 x *T.militinae*) x*T.militinae*-6	0	0		
(Bezostaya 1 x *T.militinae*) x*T.militinae*-9	0	1/5	2/5	2/5
(Bezostaya 1 x *T.militinae*) x*T.militinae*-4	0	0		
KARAHAN (стандарт)	2/20	3/20	2/30	3/40
Steklovidnaya 24 x *T.timopheevii*	2/30	3/30	2/10	4/20
Zhetysu x *T.timopheevii*	1/5	1/10	2/30	2/10
Steklovidnaya 24 x *Ae.cylindrica*	2/20	3/20	0	2/10
Erythrospermum 350 x *T.kiharae-1*	2/10	4/30	2/20	2/20
Zhetysu x *T.militinae*	0	0	2/30	3/30
Erythrospermum 350 x *T.kiharae-2*	0	0		
Steklovidnaya 24	3/30	4/40	3/30	4/40

* 1 accounting was conducted on 05-06.05.2016.
** 2 counting was conducted 3-24.05.2016.

Table 2 – Field stability of winter wheat samples from infectious nursery to leaf rust

Samples name	Type and degree of injury, score /%					
	Kazakhstan, Otar					
	2016			2015		
	1 account	2 account	3 account	1 account	2 account	3 account
(Bezostaya 1 x*Ae.triaristata*) x Karlygash	0	2/5	2/5	1/10	4/10	4/30
Erythrospermum 350 x *T.militinae*	1/5	3/10	3/10	0	2/5	2/5
Bezostaya 1 x *Ae.cylindrica*	1/5	2/20	3/40	0	0	0
(Bezostaya 1 x*T.militinae*) x *T.militinae*-6	2/40	4/80	4/80			
(Bezostaya 1 x*T.militinae*) x *T.militinae*-9	2/20	4/60	4/80	2/5	3/5	3/5
(Bezostaya 1 x*T.militinae*) x *T.militinae*-4	2/40	4/80	4/80			
KARAHAN (standard)	1/10	3/40	3/40	1/10	2/10	2/10
Steklovidnaya 24 x *T.timopheevii*	2/5	2/20	2/50	0	1/5	1/5
Zhetysu x *T.timopheevii*	1/5	2/20	2/20	0	2/5	2/5
Steklovidnaya 24 x *Ae.cylindrica*	1/10	3/10	3/20	1/5	3/5	3/5
Erythrospermum 350 x *T.kiharae-1*	1/5	3/20	3/20	1/10	3/20	3/20
Zhetysu x *T.militinae*	0	0	0	1/5	3/10	3/10
Erythrospermum 350 x *T.kiharae-2*				0	0	0
Steklovidnaya 24				3/20	4/30	4/60
1 account was posted on 05-06.05.2016. 2 accounting was conducted on 23-24.05.2016. 3 accounting was conducted on 09-10.06.2016.						

x *T.militinae*-9; (Bezostaya 1 x *T.militinae*) x *T.militinae*-4; Karakhan; Steklovidnaya 24 x *T.timopheevii*; (Bezostaya 1 x *Ae.triaristata*) x Karlygash and Erythrospermum 350 x *T.kiharae*. The immunological evaluation results of winter wheat samples against yellow rust pathogens are presented in table 1, according to sheet rust in table 2.

The data obtained are comparable and detailed with the results on the genotypes resistance classification on natural backgrounds [12-14], which we conducted earlier in the Izmir, Turkey conditions [15].

On the infectious rust species background, similar studies were carried out with perspective KazRIAPG winter wheat lines. Among the studied winter wheat lines with resistance to two types of rust and leaf spot, it can be noted, such samples as 1680-4, 1680-9, 1712-8, 1718-55, 1718-60 and 1719-3. In addition, the promising lines 1717-210, 1717-450, 1718-62, 2044-3 showed high resistance to yellow and leaf rust.

Genotypes ofErythrospermum 350 x *T.kiharae*-2 in all accounting and in 1-2 accounting of genotypes Zhetysu x *T.militinae* and PEG x T.kiharae (table 3) were distinguished against the natural background in the North Kazakhstan conditions (Karabalyk ARS) for resistance to brown rust.

Thus, the data obtained to assess the winter wheat samples stability led to the conclusion that among the studied wheat breeding materials are stable and susceptible to disease forms. The state of individual winter wheat samples on an artificial infectious background of rust and leaf spots under the Research Institute for Biological Safety Problems (RIBSP, Otar) conditions is presented in figures 1–3.

The economic winter wheat varieties features have been researched. In the field, phenological observations, evaluation and assessments of the plantsstate according to the developmental phases were carried out according to the methodological VIR instructions for studying the wheat collection [10]. Morphological signs and indicators determination of wheat productivity was carried out according to methodological guides for breeding and seed production. In the flowering-filling phase of grain, the height of the plants at the root, the length and width of the flag sheet were measured. The last indicators were used to determine the area of the wheat leaf, which was calculated according to the formula:

$$S = 2/3\ a\ b,$$

where S -is the sheet area; a -is the width of the leaf at its base; b - sheet length

Table 3 – Field winter wheat samples stability against brown rust on a natural background, Karabalyk, 2016

Samples name	Type and degree of damage, score /% brown rust		
	1 account	2 account	3 account
(Bezostaya 1 x*Ae.triaristata*) x Karlygash	5	75	–
Эритроспермум 350 x *T.militinae*	1	25	–
Bezostaya x *Ae.cylindrica*	25	100	–
(Bezostaya 1 x*T.militinae*) x*T.militinae*-6	5	50	–
(Bezostaya 1 x*T.militinae*) x*T.militinae*-9	–	–	4/80
(Bezostaya 1 x*T.militinae*) x*T.militinae*-4	–	–	4/80
KARAHAN (standard)	–	–	3/40
Steklovidnaya 24 x *T.timopheevii*	–	–	2/50
Zhetysu x *T.timopheevii*	5	75	2/20
Steklovidnaya 24 x *Ae.cylindrica*	1	50	3/20
Erythrospermum 350 x *T.kiharae-1*	0	25	3/20
Zhetysu x *T.militinae*	1	50	0
PEG x *T.kiharae*	0	50	–
Erythrospermum 350 x *T.kiharae-2*	0	0	0
Zhetysu x *T.kiharae*	25	100	–
Steklovidnaya 24	3/20	4/30	4/60

A

B

Figure 1 – Development of leaf spot (A) and yellow rust (B) on winter wheat

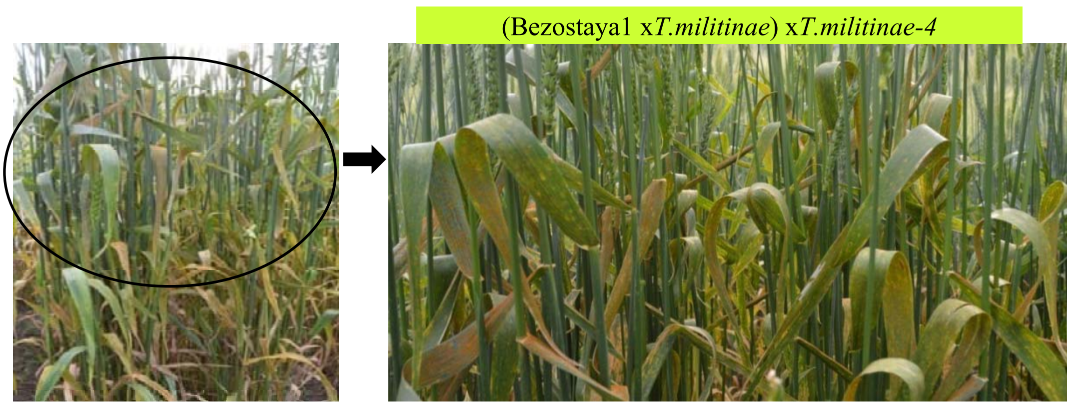

Figure 2 – Strong development of leaf rust on the winter wheat flag leaves


Figure 3 – General view of the researchedwinter wheat samples on the infectious background of rust and leaves blotch

After harvesting and threshing wheat yields were determined by weighing a plot, and also analyzed the following elements crop structure: spike length, number of spikelets main spike, grain quantity main spike, grain mass with main spike and 1000 grains weight. To determine the results reliability, the obtained digital data was processed using computer programs (EXEL) with the mean value characteristic determination. The diagrams were compiled using the GraphPadPrism 6 software packages (GraphPadSoftware, Inc., LaJolla, CA, USA).

The length of the vegetation period influences not only the variety yield level, but also its resistance to drought, diseases and other stress factors. In our experiments, the total growing season duration for winter wheat samples from 1 nursery was in the range from 242 to 249 days. The interphase periods duration from shoots to spike in all varieties changed insignificantly. The average growing season duration value for winter wheat samples is 247 days. Consequently, all the samples of this nursery, studied by us, matched their maturity period as mid-ripening.

Plant height is the main economic feature and determines the wheat resistance to lodging. A wide variation from 106 cm (sample ST-1) to 135 cm (Bezostaya 1 x *T.militinae*) x*T.militinae*-6 was observed for this indicator. The average studied winter wheat samples plants height was within 120 cm, which is 13 cm higher than that of the standard (Steklovidnaya 24).

In the plant biomass formation, the flag leaf development is of great importance, which is the main assimilates source for the spike and supplies about 60% of photosynthetic products for the grains formation. High indicator values were noted in the samples: Erythrosperm 350 x *T.militinae*, Erythrosperm 350 x *T.kiharae*, Syeklovidnaya 24 x *Ae.cylindrica* and Erythrospemum 350 x *T.kiharae*, while they had fairly large and approximately the same flag leaves area - respectively 22.4; 22.6; 22.8 and 23.9 cm^2. The least developed flag sheet was Karakhan (15.8 cm^2), Zhetysu x *T.timopheevii* (15.6 cm^2) and Erythrospermum 350 x *T.kiharae* (15 cm^2). The research results are shown in table 4.

The spike length in the samples research varied from 9.6 cm (for the Erythrospermum 350 x *T.kiharae*) to 13.3 cm (for Erythrospermum 350 x *T.militinae*). In the standard variety Steklovidnaya 24, the spike length was 10.8 cm. In the experiment, samples with an average spike length of 10.2 to 11.3 cm - more than 60% prevailed. The spike graininess is determined primarily by the spikelets number formed on the spike rod protrusions. As the results of the experiment showed, the samples studied differed significantly in the spikelets number in the spike from 18 to 27 pieces. At the same time, all prototypes exceeded the standard Steklovidnaya 24 by the number of spikelets in the spike.

The grains number in the spike varied from an average of 37 to 55 pieces. The largest grains number in the spike in comparison with the standard Steklovidnaya 24 (44 pcs.) Formed 9 samples (Erythrospermum 350 x *T.militinae*; Bezostaya 1 x *Ae.cylindrica*; (Bezostaya 1 x *T.militinae*) x*T.militinae*-9; Zhetysu x *T.timopheevii*; Zhetysu x *T.militinae*; Steklovidnaya 24 x *Ae.cylindrica*; Bezostaya 1 x *Ae.cylindrica*; (Bezostaya 1 x *T.militinae*) x *T.militinae*-9; Erythrospermum 350 x *T.kiharae*.One of the elements, which are important in the formation of the wheat spike productivity, is the grain mass from the spike obtained data on the wheat yield structure elements complex evaluation study, it follows that the mass in

Table 4 – Vegetation period and morphological features of synthetic winter wheat forms

Genotype	Vegetation period,days			Plants height, cm	Area of flag leaf, cm^2
	sprouting-earing	spike-ripening	shoots, ripening		
(Bezostaya 1 x*Ae.triaristata*) x Karlygash	203	46	249	114	20,5
Erythrospermum 350 x *T.militinae*	200	49	249	124	22,4
Bezostaya 1 x *Ae.cylindrica*	198	51	249	131	21,2
(Bezostaya 1 x*T.militinae*) x*T.militinae-6*	199	49	248	135	21,4
(Bezostaya 1 x*T.militinae*) x*T.militinae-9*	198	50	248	124	19,8
(Bezostaya 1 x*T.militinae*) x*T.militinae-4*	197	50	247	129	20,2
Karakhan (standard)	202	45	247	125	15,8
Steklovidnaya 24 x *T.timopheevii*	203	43	246	123	19,1
Zhetysu x *T.timopheevii*	201	46	247	123	21,8
Steklovidnaya 24 x *Ae.cylindrica*	200	46	246	121	20,2
Erythrospermum 350 x *T.kiharae*	199	48	247	120	22,6
Zhetysu x *T.militinae*	198	48	246	114	20,0
Erythrospermum 350 x *T.militinae*	197	49	246	123	16,7

the research course on the grain mass from the main spike, soft winter wheat samples Erythrospermum 350 x *T.militinae* (average 2.46 g), Zhetysu x *T.timopheevii* (2.04 g), Zhetysu x *T.militinae* (2.22 g), Steklovidnaya 24 x *Ae.cylindrica* (2.06 g), Bezostaya 1 x *Ae.cylindrica* (2.16 g) and (Bezostaya 1 x *T.militinae*) x *T.militinae* -9 (2.32 g).

The 1000 grains weight in the samples studied in the experiment ranged from 31.21 to 52.08 g. In the standard Steklovidnaya 24, it was 45.89 g. Nearly half of the soft winter wheat samples in this nursery (11 samples) formed a large grain-weight 1000 they had grains in excess of 40 g. The average size was characterized by 8 samples (35.1-40 g). The fine-grained samples with a 1000 grains weight of less than 35 g in the studied set were 7. On a 1000 grains weight, samples of Erythrosperm 350 x *T.militinae*, Zhetysu x *T.militinae*, Steklovidnaya 24 x *Ae.cylindrica*, (Bezostaya 1 x *T.militinae*) x *T.militinae*-9, ST-1, formed a mass of 1000 grains more than 46 grams (more control variety).

The final indicator in the wheat samples evaluation is the yield per unit area. Among the researchedwinter wheat breeding materials, the highest yield was observed in the samples of Erythrospermum 350 x *T.militinae*, Zhetysu x *T.militinae*, Erythrospermum 350 x *T.kiharae*, Bezostaya 1 x *Ae.cylindrica* and (Bezostaya 1 x *T.militinae*) x *T.militinae*-9, in which this figure was more than 900 g/m^2. The research results are shown in figure 4 and table 5.

The grain of the synthetic forms of winter wheat in the infectious nursery was characterized by technological properties as a low-grade from 618 g / l (Bezostaya 1 x *Ae.cylindrica*) to 724 g/l (Bezostaya 1 x *T.militinae*) x T.militinae-4 relative to the control of 703 g/l (Bezostaya 1 x *Ae.triaristata*) x Karlygash to 778 g/l (Erythrospermum 350 x *T.militinae*). Overall, the decrease in protein in the block as a whole, from 13.2% to 17.5%, versus the control 14.1-17.3%. The hardness index varied within 32-73 units SKCS against the control 28-69 units SKCS.

The initial results for the grain block of the infectious nursery are characterized by a decrease in physical condition. The variability nature of biochemical and technological properties requires detail, associated primarily with the analyzed material volume in subsequent reproductions.

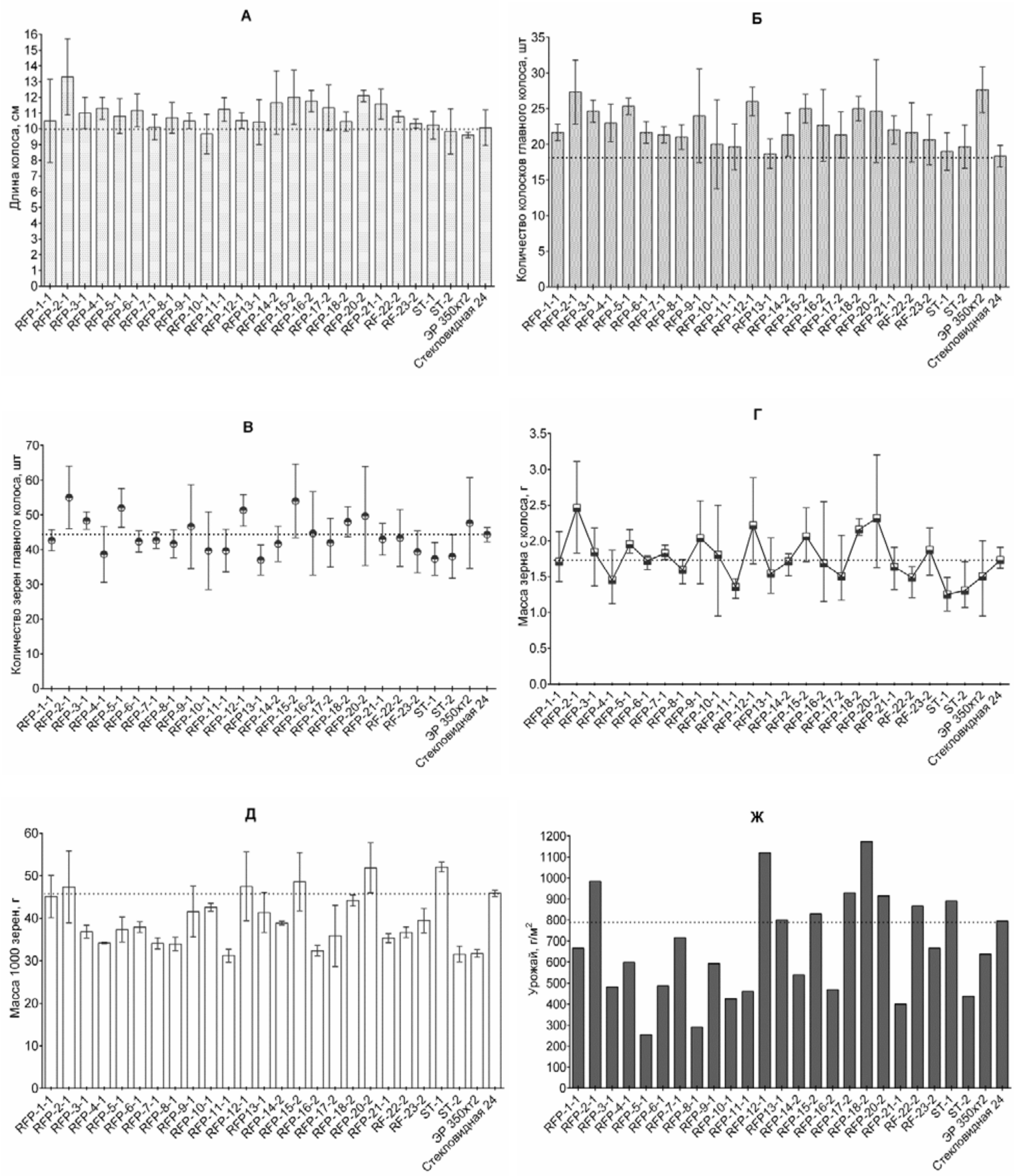

Figure 4 – Structural analysis results of the winter wheat samples yield characteristics (the synthetics nursery):
A – the spike length, B1 – the spikelets number of the main spike; B2 – the grains number of the main spike;
G – the grain mass from the spike; D – the 1000 grains weight; F – the yield per unit area

Table 5 – Structural analysis of yield characteristics of synthetic winter wheat forms (infectious nursery), RIBSP,-2016

Genotype	Length of spike, cm	Number of spikelets main spike, pcs	Number of grains of main spike, pcs	Grain weight from the main spike, g	Weight of 1000 grains, g
	average				
(Bezostaya 1 x*Ae.triaristata*) x Karlygash	10,5±0,7	21,7±1,2	42,7±1,5	1,7±0,7	45,1±0,8
Erythrospermum 350 x *T.militinae*	13,3±0,5	27,3±0,8	55,0±1,7	2,5±0,8	47,4±0,7
Bezostaya 1 x *Ae.cylindrica*	11,0±0,6	24,7±1,2	48,3±1,9	1,8±0,9	36,9±0,9
(Bezostaya 1 x *T.militinae*) x*T.militinae-6*	11,3±0,5	23,0±0,9	38,7±2,0	1,5±0,7	34,2±0,9
(Bezostaya 1 x *T.militinae*) x *T.militinae*-9	10,8±0,7	25,3±1,2	52,0±1,5	1,9±0,9	37,4±0,8
(Bezostaya 1 x *T.militinae*) x*T.militinae*-4	11,2±0,6	21,7±1,2	42,3±1,9	1,7±0,8	37,9±0,7
KARAHAN (standard)	10,1±0,5	21,3±0,9	42,7±1,7	1,8±0,7	34,1±0,9
Steklovidnaya 24 x *T.timopheevii*	10,7±0,5	21,0±0,8	41,7±2,0	1,6±0,9	34,0±0,8
Zhetysu x *T.timopheevii*	10,5±0,6	24,0±1,2	46,7±1,7	2,0±0,8	41,6±0,7
Steklovidnaya 24 x *Ae. cylindrica*	9,67±0,7	20,0±0,9	39,7±1,5	1,8±0,7	42,6±0,7
Erythrospermum 350 x *T.kiharae*	11,2±0,6	19,7±1,2	39,7±2,0	1,4±0,8	31,2±0,9
Zhetysu x *T.militinae*	10,5±0,7	26,0±0,8	51,3±1,9	2,2±0,9	47,5±0,7
Erythrospermum 350 x *T.militinae*	10,4±0,5	18,7±1,2	37,0±1,7	1,5±0,8	41,4±0,8
Zhetysu x *T.timopheevii*	11,7±0,6	21,3±0,9	41,7±2,0	1,7±0,7	38,9±0,9
Steklovidnaya 24 x *Ae.cylindrica*	12,0±0,7	25,0±1,2	54,0±1,9	2,1±0,7	48,6±0,7
KARAHAN (standard)	11,8±0,6	22,7±1,2	44,7±1,7	1,7±0,9	32,4±0,9
Erythrospermum 350 x *T.kiharae-1*	11,3±0,5	21,3±0,9	42,0±2,0	1,5±0,9	35,9±0,9
Bezostaya 1 x *Ae.cylindrica*	10,5±0,7	25,0±1,2	48,0±1,5	2,2±0,8	44,2±0,7
(Bezostaya 1 x *T.militinae*) x*T.militinae*-9	12,1±0,6	24,7±0,9	49,7±1,9	2,3±0,7	51,9±0,8
(Bezostaya 1 x *Ae. triaristata*) xKarlygash	11,6±0,6	22,0±0,8	43,0±1,7	1,6±0,8	35,3±0,9
Zhetysu x *T.militinae*	10,8±0,5	21,7±1,2	43,3±2,0	1,5±0,9	36,7±0,9
Steklovidnaya 24 x *T.timopheevii*	10,3±0,7	20,7±0,9	39,3±1,7	1,9±0,7	39,5±0,8
Erythrospermum 350 x *T.kiharae-2*	9,6±0,6	27,7±0,8	47,7±1,5	1,5±0,9	31,7±0,9
standard	10,2±0,7	19,0±0,8	37,3±1,5	1,2±0,7	52,1±0,7
standard	9,8±0,7	19,7±1,2	38,0±1,5	1,3±0,8	31,6±0,9
Steklovidnaya 24	10,8±0,5	18,3±0,9	44,3±1,9	1,7±0,9	45,9±0,7

Conclusion. Among the studied varieties, against the background of a strong yellow rust development, stable samples were isolated. Bezostaya 1 x *Ae.cylindrica*, (Bezostaya 1 x *T.militinae*) x *T.militinae*-6; (Bezostaya 1 x *T.militinae*) x *T.militinae*-9; (Bezostaya 1 x *T.militinae*) x *T.militinae*-4; Zhetysu x *T.timopheevi*; Zhetysu x *T.militinae*; Bezostaya 1 x *Ae.cylindrica* and Erythrospermum 350 x *T.kiharae*. The high resistance of the above-mentioned samples is due to the presence of certain Yr-resistance genes to yellow rust.

On an artificial infectious background of all analyzed samples, only 5 of 60, including the standard variety, were affected by leaf rust, the manifestation disease degree reached 40-80%.

The leaf form lesion of septoria and yellow spotting averaged 15.9-20.4%, with a variation of 0-40% in variety samples. High resistance to these pathogens was demonstrated by the samples (Bezostaya 1 x *T.militinae*) x *T.militinae*-6; (Bezostaya 1 x *T.militinae*) x *T.militinae*-9; (Bezostaya 1 x *T.militinae*) x *T.militinae*-4; Karakhan; Steklovidnaya 24 x *T.timopheevii*; (Bezostaya 1 x *Ae.triaristata*) x Karlygash and Erythrospermum 350 x *T.kiharae*.

On the natural background, in the Karabalyk conditions, the number of Erythrosperm 350 x *T.kiharae* was distinguished for resistance to brown rust, as well as for other diseases, for the first time for winter wheat in the North of the RK. Genotypes Erythrospermum 350 x *T.kiharae* (58.0-75.0 q/ha), Zhetysu x *T.timopheevii* (49.0-61.5 q/ha) and Zhetysu x *T.militinae* (48.5-61, 1 q/ha) showed the stability of increased yields for long-term results, including on an infectious background: Erythrosperm 350 x *T.militinae*, Bezostaya 1 x *Ae.cylindrica* and (Bezostaya 1 x *T.militinae*) x *T.militinae*-9).

Disease-resistant forms are an indispensable element of organic farming, in this regard, the promise of isolated wheat-alien forms of winter wheat is very important in the new varieties breeding [12-14, 16-20].

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КҮЗДІК БИДАЙ СИНТЕТИКАЛЫҚ ТҮРЛЕРІНІҢ ТОТ АУРУЛАРЫНА ТҰРАҚТЫЛЫҒЫ

Аннотация. Жаңа биологиялық технологияларды енгізуде нақты белгілік гендерді анықтауда мақсатты бағытталған сұраныс өзектілігі артуда. Соның ішінде, жабайы туыс және бидай-бөгде бидай аралық туыс гибридтерінен алынған гермоплазма.

Зерттелген генотиптер арасында белсенді сары тот ауруының дамуына тұрақты түрлер бөлініп алынды. Безостая 1 х *Ae.cylindrica*, (Безостая 1 х *T.militinae*) х *T.militinae-6*; (Безостая 1 х *T.militinae*) х *T.militinae-9*; (Безостая 1 х *T.militinae*) х *T.militinae-4*; Жетысу х *T.timopheevi*; Жетысу х *T.militinae*; Безостая 1 х *Ae.cylindrica* және Эритроспермум 350 х *T.kiharae*. жасанды инфекционды фонда сабақтық тот ауруына сарапталған 60 үлгінің тек 5-іне жұқтырылды, соның ішінде аурудың 40-80% айқындалды.

Септориоздық сабақтық пен сары дақтық түрімен ауруы 15,9-20,4%, сорт үлгілері бойынша 0-40%. (Безостая 1 х *T.militinae*) х *T.militinae*-6; (Безостая 1 х *T.militinae*) х *T.militinae*-9; (Безостая 1 х *T.militinae*) х *T.militinae*-4; Карахан; Стекловидная 24 х *T.timopheevii*; (Безостая 1 х *Ae.triaristata*) х Карлыгаш және Эритроспермум 350 х *T.kiharae*үлгілері осы патогендерге жоғары тұрақтылықты көрсетті. Қарабалық жағдайында табиғи фонда қоңыр тот ауруына тұрақтылық бойынша Эритроспермум 350 х *T.kiharae*бөлініп алынды.ҚР солтүстігінде күздік бидай үшін алғаш рет басқа аурулар бойыншада тұрақтылықпен ерекшеленді. Эритроспермум 350 х *T.kiharae* (58,0-75,0 ц/га), Жетысу х *T.timopheevii* (49,0-61,5 ц/га) және Жетысу х *T.militinae* (48,5-61,1 ц/га) генотиптері көпжылдық нәтижелер бойынша жоғарғы тұрақтылықпен сипатталды, соның ішінде Эритроспермум 350 х *T.militinae*, Безостая 1 х *Ae.cylindrica* және (Безостая 1 х *T.militinae*) х *T.militinae-9)* генотиптері инфекционды фонда. Органикалық егіншілікте ауруларға тұрақты формалар негізгі міндетті элемент болып табылады.Осы орайда бөлінген күздік бидайдың бидай-бөгде түрлерінде бөлініп алынған түрлерін селекцияда жаңа сорттарды қолдануда маңызы зор.

Түйін сөздер: күздік бидай, синтетиктер, жабайы туыстар, ауруларға тұрақтылық.

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УСТОЙЧИВОСТЬ К РЖАВЧИННЫМ БОЛЕЗНЯМ СИНТЕТИЧЕСКИХ ОЗИМЫХ ФОРМ ПШЕНИЦЫ

Аннотация. С внедрением новых биологических технологий актуальным становится вопрос целенаправленного поиска генов конкретных признаков, в том числе из гермоплазмы диких сородичей и созданных промежуточных пшенично-чужеродных гибридов (ПЧГ).

Среди изученных генотипов на фоне сильного развития желтой ржавчины выделились устойчивые образцы Безостая 1 х *Ae.cylindrica*, (Безостая 1 х *T.militinae*) х *T.militinae-6*; (Безостая 1 х *T.militinae*) х *T.militinae-9*; (Безостая 1 х *T.militinae*) х *T.militinae-4*; Жетысу х *T.timopheevi*; Жетысу х *T.militinae*; Безостая 1 х *Ae.cylindrica* и Эритроспермум 350 х *T.kiharae*. Листовой ржавчиной поражались на искусственном инфекционном фоне из всех анализированных образцов только 5 из 60, включая сорт-стандарт со степенью проявления болезни 40-80%.

Поражение листовой формой септориоза и желтой пятнистости в среднем составило 15,9-20,4% с варьированием по сортообразцам 0-40%. Высокую устойчивость к данным патогенам проявили образцы (Безостая 1 х *T.militinae*) х *T.militinae*-6; (Безостая 1 х *T.militinae*) х *T.militinae*-9; (Безостая 1 х *T.militinae*) х

T.militinae-4; Карахан; Стекловидная 24 х *T.timopheevii*; (Безостая 1 х *Ae.triaristata*) х Карлыгаш и Эритроспермум 350 х *T.kiharae*.На естественном фоне в условиях Карабалыка по устойчивости к бурой ржавчине выделился номер Эритроспермум 350 х *T.kiharae*, как и по другим болезням, впервые для озимой пшеницы на Севере РК. Генотипы Эритроспермум 350 х *T.kiharae* (58,0-75,0 ц/га), Жетысу х *T.timopheevii* (49,0-61,5 ц/га) и Жетысу х *T.militinae* (48,5-61,1 ц/га), характеризовались стабильно повышенной урожайностью по многолетним результатам, в том числе и на инфекционном фоне: Эритроспермум 350 х *T.militinae*, Безостая 1 х *Ae.cylindrica* и (Безостая 1 х *T.militinae*) х *T.militinae-9)*.Устойчивые к болезням формы являются обязательным элементом органического земледелия, в этом плане использования выделенных пшенично-чужеродных форм озимой пшеницы актуальна перспективность в селекции новых сортов.

Ключевые слова: озимая пшеница, синтетики, дикие сородичи, устойчивость к болезням.

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