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The stages of winter wheat breeding development in Kazakhstan

Abstract. The article presents information about the stages of formation and of winter wheat breeding development in Kazakhstan. Characteristics of productivity, grain quality and disease resistance of promising lines of local breeding are given.
Key words: breeding, winter wheat, productivity, grain quality, resistance to diseases.

Breeding is very complex science, time-consuming and it depends on the availability of valuable gene pool, the volume of processed hybrid constant material in different eco-climatic zones and qualitative evaluation of breeding material in analytical laboratories.

Breeding – a long-term system, to create a varieties in the best case, it takes an average of 12-14 years. Crucial in the breeding has, experience, professionalism, dedication and talent of the breeder [1-10]. Development of wheat breeding in Kazakhstan can be divided into several stages, reflecting the results of research for more than half a century, which led to the creation of more than a hundred high-yielding varieties of wheat breeding Kazakh that match the quality of grain, disease resistant varieties world breeding.

1954-1963 yy.

With the familiarization of millions hectares of virgin and fallow lands in the former Soviet Union (including Kazakhstan) there was a need of quality seed. The need for seed grain, and especially wheat was huge (≈ 4 million. tons). The seeds from various regions of the former Soviet Union were imported. It was necessary to develop breeding of high-yielding crops varieties and seed growing in the Republic. During these years, breeders have not had a sufficient amount of the collection, hybrid and constant material. There was no exchange of the original material. Moreover, one of the major research institutions in Kazakhstan – Kazakh Research Institute of Agriculture and Plant Growing (KazRIAPG) worked mainly on agro-technological themes: agriculture, soil science, agricultural chemistry, soil microbiology, plant protection.

1968-1968 yy.

By decisions of the Kazakh SSR Council of Ministers have been established and put into action the East breeding centers at the Kazakh Research Institute of Agriculture and Plant Growing. This decision of the government was a historic for breeding research development in Kazakhstan.

1970-1980 yy.

In Kazakhstan were created and planted local varieties – Krasnovodopadskay 49, Lutescens 12, Erythrospermum 7020, Zhuldiz, Almatinskay 31, Kyzyl Dan, Predgornay 26 and others with productivity of 20-25 t /ha for rain fed and 40-50 t / ha for irrigation.

The period also characterized by the creation in the former Soviet Union new high-yielding varieties of winter wheat exceeding predecessors 20% or more. These were the varieties: Mironovskaya 808, Bezostaya-1, Dneprovskay 521, Mironovskaya Jubileynay, Jntensivnay. Variety Mironovskaya 808 occupied in Kazakhstan area to 10 million hectares, Bezostaya -1 more than 7 million ha.

Among the varieties of spring wheat in the virgin lands were the most widespread varieties – Saratovskay 29, Saratovskay 42, Bezenchukskaya 98, Milturum 321, Milturum 553, Erythrospermum 841 and others. This period brought a breeding of deep scientific methods and overall progress in crop production of Kazakhstan.

In the ten years of the Eastern breeding centers in KazRIAPG more than 10 times the amount vol-

 Printed in Kazakhstan

ume of hybridization was increased, the average annual volume explored by hybrid populations and breeding lines reached 59.0 thousand.

It was established eight plots of breeding material testing in different eco-climatic zones of Kazakhstan, Table 1.

Table 1 – The stages and volumes of wheat breeding work in KazRIAPG, 1954-1984yy.

Stages of breeding	Volume of wheat breeding
The average annual volume of hybridization	
1954-1963	78 crossing combinations
1974-1984	879 crossing combinations
The average annual volume explored by hybrid populations and nursery lines	
1954-1963	8500
1974-1984	59 000
The number of breeding material testing plots	
1954-1963	1 – KazRIAP (irrigation) – 800 m. above sea level
1974-1984	1. KazRIAP, (irrigation) – 800 m. above sea level; 2. Rain fed plot «Karoy» – 400 m. above sea level. Sea, A-Ata region, bogara; 3. Mountain plot «Shoal-Adir» – 1650 m. above sea level, «natural phytotron»; 4. Aris – Turkestansky plot «Karaspan» – 250 m above sea level, hard bogara, SKO; 5. Krasnovodopad GSS – 300 m. above sea level, SKO; 6. Zyryanovskaya GSS – 1100 meters above sea level. Semipalatinsk region, middle zone; 7. Taldy-Korgan ASS «Zheldy Kara» – 1000 m. above sea level, hard bogara; 8. Ural ASS – 50 m above sea level.

1980-1999yy.

The series (more than 20) varieties for irrigated and rain fed agro zones was created and regionalized. A large area sown by varieties: OPAKS-1, Bogarnay – 56, Komsomolskay -1, Komsomolskaya 56, Zhalyn, Progress, Almatinskay polukarlikovay, Karlygash, Yjnay 12, Zhetysu, Tolkyn, Erin, Erythrospermum 26, Krasnovodopadskay 210 Krasnovodopadskay 25, Oktiabrina 70, Pirotriks 50, Kazakhstanskay 10, Akterekskaya, Pamyt 47.

The varieties – Bogarnay 56, Pirotriks-50, Jubilee 60, Akterekskaya has exceptionally high heat-resistance to drought, broad ecological and geographical plasticity and grain quality. So far, they have successfully cultivated at providing semi-arid rain fed zones from the foothills of the Eastern Tarbagatay to the Southern tracts of Tajikistan and Kyrgyzstan. On grain quality and stability of its manifestations in different conditions of cultivation, varieties are masterpieces not only in Kazakhstan, but also of the world breeding.

The stage characterized by intensive research of foreign and local breeding varieties combining ability. Have been identified varieties – donors of economic – valuable attributes: Mironovskaya 808, Mironovskaya Jubileynay, Ilichevka, Odesskay 16, Odesskay 26, Priboy, Albatross Odesskiy, Obriy, Bezostaya-1 Bezostaya-2 Pavlovka, Rostavchanka, Caucasus, Aurora, Almatinskay 31, Dneprovskay 521, Kharkovskay 38, Kharkovskay 63, Donskay bezostaya, Khersonskay 83.

2000-2014yy.

The period characterized by the development and zoning of more than 10 varieties of intensive and semi-intensive type: Derbes, Naz, Egemen, Rasad, Ramin, Rausin, Sapaly, Alia, Almali, Zhadyra, Mayra, Farabi, Karasai, Alatau. Among the cultivated varieties, as for irrigation and rain fed was selected variety «Karasai» as a unique genotype, which integrates two very important traits – high productivity (irrigation – 94.4 t / ha, bogara 58.3 t / ha) and high grain quality (protein content of 15.9%, 35.4% gluten, deformation energy – 359). It is very rare in the breeding. As a rule, with an increase in the yield falls to adequately grain quality, especially at a level of productivity over 4.0 t / ha. While increasing productivity and quality it was raised resistance of local varieties to rust diseases. High-yielding varieties – Almaly and Naz has a complex resistance to rusts, especially to yellow, the most aggressive in area of their cultivation.

The past two decades to increase productivity among the varieties for irrigation, special emphasis was put on the building of wheat varieties with

high number of grains per spike. In the local breeding materials were identified varieties – donors of long and dense spike: Aruana, Botagoz, Bereke, Tolkyn, Zhalyn, where the number of grains per spike reach 45-50 pcs. As a result of long-term studies, genotypes with the number of 60-70 grains per spike – Almaly, Arap, Alia, Derbez, Daulet, Avicenna, Kyzylbidai, Diana, Egemen 20 obtained. Later, the inclusion in hybridization of super wheat collection (CIMMYT) led to the creation new varieties (Azharly, Matai) in which the number of grains per spike was 80-95 pcs. (2010-2014). The productivity of new varieties is about 8.0-10.0 t / ha under irrigation. The yield data and qualitative indicators of promising varieties and lines listed in Table 2.

Table 2 – Yields and qualitative indicators of the best varieties and lines of winter wheat variety, «KazRIAP» 2012-2014.

Variety/line	Yield, t /ha.				YR	test weight k/l	protein%
	2012	2013	2014	average			
ST. Zhetisu	7,05	7,15	7,40	7,20		-	-
Almaly	7,75	7,70	7,81	7,63	R	780	14,2
Г- 18214-2	-	6,98	8,16	75,7	MS	770	14,8
Sultan 2-2	7,58	6,79	8,58	7,62	MS	695	13,4
Г-18212-10	6,59	6,68	7,78	7,02	MR	705	15,4
SWW F_4 978-1	7,02	6,82	7,66	7,17	MS	690	13,3
SWW F_4 154-4	7,70	6,64	7,68	7,34	MR	705	13,1
Л-07-08-5025	-	-	7,90	7,90	MS	710	13,5
Г-18226-26-1	7,16	7,74	8,38	7,76	MS	805	14,2
Г- 20197-17	-	7,68	8,39	8,03	MS	790	14,1
CONCHA	7,15	6,98	7,50	7,21	MS	660	14,1
Avizenna	7,85	7,09	8,55	7,85	MS	770	14,9
SWW 1-97	7,88	7,95	8,40	8,08	MR	685	13,0
Matay	7,99	7,88	8,69	8,19	MR	695	13,5

Note: YR – yellow rust; R – resistance; MR – average resistance; MS – average susceptibility.

For more than 50 years during the development of breeding research in Kazakhstan for more than 70 wheat varieties in the Kazakhstan National Register of breeding achievements entered. Development of new varieties of crops contributed to the development of a strong breeding and seed industry.

The criteria for success: significant volumes of hybridization (more than 500) based on the selected donors; the large volume of explored hybrid populations F3-F6 and older, as well as breeding lines (over 50.0 thousand). However, no matter how voluminous nor was a hybrid pool, in the case of testing it in a narrow ecological niche, a significant shift for transgressive selection will not work. Widespread environmental test was a fundamental factor in the successful wheat breeding in Kazakhstan.

The environmental testing of Kazakh breeding varieties in the Kyrgyz Republic, the climatic conditions that are favorable for the cultivation of winter wheat, revealed a significant number of varieties: Rausin, Derbez, Erythrospermum 350, Steklovidnay 24, Naz, Arap, Ujnay 12, Kazakhstanskay 10, Karasai, Zhadyra, Nureke, Alia, Mayra and Sapaly that were included in the State register of Kyrgyz Republic breeding achievements.

For these varieties, it was established seed production in all ecological zones of the Kyrgyz Republic, since Chui Valley to the highlands of Issyk-Kul. These varieties are successfully cultivated in production with the best varieties of Kyrgyz Republic: Zubkov, Asil, Adir, Kairat, Almira, Djamin, Tilek, Kiyal et al., Table 3.

Table 3 – Productivity and quality parameters of winter wheat varieties of Kazakh breeding in the conditions of the Kyrgyz Republic

Name of varieties	Yield, t / ha		Gualitative indicators		
	Irrigation	Rain fed	Protein %	Gluten,%	W, volume
Standards varieties of the Kyrgyz Republic					
Tilek	87,2	-	13,4	31,2	368
Adyr	-	47,8	13,1	29,9	302
Varieties of Kazakh breeding					
Karasay	94,4	58,3	15,9	35,4	354
Jadyra	86,9	47,2	15,4	33,5	359
Nureke	86,5	47,0	15,2	32,6	358
Naz	80,7	52,2	13,2	34,9	357
Aliy	95,3	42,4	14,2	35,3	210
Mayra	93,5	42,7	13,5	32,3	299
Mereke 70	85,5	46,1	13,8	31,7	260
Rassad	94,0	43,7	13,8	32,0	187
Batjan	82,4	46,1	14,2	32,9	312

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