Using gene fund of wild relatives for common wheat improvement

Abstract. The article describes the research results, the method of distant hybridization can provide to get new genotypes with new parameters, high-yielding, immune, with a high content of protein in the grain and adapted to environmental conditions.

Key words: distant hybridization, drought resistance, forming, quality, density, cross-breeding, hybrids.

Introduction

A large variety of agroecological zones of wheat cultivation and breeding intensification puts before scientists of Kazakhstan a number of challenges: the varieties creation that combine high yield with complex resistance to diseases, to withstand adverse conditions (drought, the harsh winters) and high quality grain.

It is no coincidence that the most perspective breeding programs of the world along with the use of classical breeding methods, selection and hybridization, intraspecific wheat crosses are also used genetic methods with representatives of related genera of wheat – *Aegilops*, *Agropyron*, *Secale*, *Elymus* genotype carriers and other signs and properties.

It is the only method of creating fundamentally new plants that combine their hereditary basis of the most valuable features and characteristics of cultivated and wild plants.

Powerful formative process created by distant hybridization, is the source of unique forms and replenishing gene fund of cultivated plants [1, 2, 3]. In this paper, we analyzed the older generation hybrids (F8-F10) constant 2n = 42 forms, in combination (*T. aestivum* L x *Aegilops triaristata* Wild) according to the method described in UPOV, remembering the diversity of wheat on morphological characters [4, 5].

Results and their discussion

In our experiments in crossing varieties of common wheat (*Triticum* L.) with *Aegilops triaristata* Wild species, there was a completely different character formation. In the first generation is dominated by signs of wild forms. And only through cytogenetic analysis of ploidy 2n = 42 (in F1 - F4) and back crossing in F4 - F5 pollen of common wheat significantly shifts forming toward the formation of wheat and new varieties forms of common wheat.

These lines were chosen on the base of cytogenetic analysis. In hybrid lines for F1 - F4 on constancy 2n = 42 and starting in F4 for their relatively good agronomic traits, such as tillering, spike density, height, hardiness, quality, maturity, disease resistance, and others. Housekeeping valuable traits cicated in the foothills of the Zailisky Alatau. The experimental sowing plots were 1 to 6 rows depending on the number of hybrid seeds. The length of the row is 120-130 cm, the distance between the rows is 15 cm, the distance between the grains is 5 cm, and depth of seed placement is 4-5 cm. Used for crossbreeding varieties of winter wheat (2n = 42) *T. aestivum* L. (AABBDD) with wild species *Aegilops triaristata* Willd (CUCUMM), 2n = 28. Spike of *Aegilops triaristata* Willd has 3-4 spikelets. Spikelets are slightly convex, oblong, and most often pubescent. Inhabits on open dry rocky sunny slopes; common in Azerbaijan and Georgia; not observed in Kazakhstan.

Materials and methods

Field experiments were conducted in the Kazakh Research Institute of Agriculture and Plant growing in Karasai district of Almaty region, located in the foothills of the Zailisky Alatau. The experimental sowing plots were 1 to 6 rows depending on the number of hybrid seeds. The length of the row is 120-130 cm, the distance between the rows is 15 cm, the distance between the grains is 5 cm, and depth of seed placement is 4-5 cm. Used for crossbreeding varieties of winter wheat (2n = 42) *T. aestivum* L. (AABBDD) with wild species *Aegilops triaristata* Willd (CUCUMM), 2n = 28. Spike of *Aegilops triaristata* Willd has 3-4 spikelets. Spikelets are slightly convex, oblong, and most often pubescent. Inhabits on open dry rocky sunny slopes; common in Azerbaijan and Georgia; not observed in Kazakhstan.
for use in breeding programs. Presented new forms have not been previously known in the science.

$F_1$ (Bezostaya 1 x Aegilops triaristata Willd) x Bezostayal (1633- 26) variety (Triticum aestivum L.) – compactoides. Form of the spike is compact, the transition from soft to dwarf wheat. Spike is white, red grain, glumes are not downy. The bush type is erect, no erected flag leaf is missing, sheet waxy film is weakly expressed. Plant height is 105.2 cm, productive tillering 4.2 pc. Spike length is 8.4 cm, color is white, density of 22.0 units (very tight). In spike -70.0 pieces grains, weight of 1000 grains was 45.8. Spikelet glume: shoulder shape is straight, wave form is short, blunt. Grain yield was 58.4 t/ha, with yields of standart varieties Almali 62.2 t/ha. Protein in the grain is 18.2%, starch – 54.4, grain hardness -73, sedimentation – 74, gluten – 34.5. Winter resisted plant, the percentage of surviving plants after overwintering is high (96-98%). In the heading stage and milk stage is resistant to yellow rust. Susceptibility to leaf rust is 1-3 score. Resistant to mildew and septariose, dusty, smut.

$F_2$ (Erythroserum 350 x Aegilops triaristata Willd) x Almali (2003-2) Variety (Triticum aestivum L.) – preude-glauca-ferrugineum. Color of spike scales is smoky gray on a red background, the infliant presence – absence, the presence of Ligula – absence, name of the variety on V.F. Dorofeev et al. – Pseudocaesium (Greb) Manst. The bush type is erect, non erect flag leaf is missing, waxy film on the leaf sheaths is average. Plant height is 110.3 cm, productive tillering – 3.7 pc., spike is spinous, pyramidal. Spike length – 15.0 cm; density – 20.0 units. 70.0 grains per spike piece., weight of 1000 grains – 46.7. Grain yield – 68.7 t/ha, with yields of standard varieties Almali – 62.2 t/ha. Protein in the grain – 18.3%, starch – 53.8; grain hardness – 73, gluten – 36.4; sedimentation -75. The plant is winter resisted, the percentage of surviving plants after overwintering is high about- 98%. In the heading stage and milk stage is resistant to stem and yellow rust. Susceptibility to leaf rust is 1-3 score. Resistant to mildew and septariose, dust and smut.
hardness-85, gluten -35.7; sedimentation – 80. The plant is winter resisted, the percentage of surviving plants after overwintering is high -97%. In the heading stage and milk stage is resistant to stem and yellow rust. Susceptibility to leaf rust is 1-3 score. Resistant to mildew and septariose, dust and smut.

F7 (Erythrospermum 121 x Aegilops triarista-ta Willd) Erythrospermum x 121 (2005-4) variety (Triticum aestivum L.) – maesto-milturum - (spike white, red corn, spike barless). Color of spike scales is smoky gray on a red background, the inflyant presence – absence, the presence of Ligula – absence. The plant is erect, tall -107.4 cm, sloping flag leaf is missing, productive tillering - 4.1 pc. Spike length - 16.0 cm, number of spikelets per spike developed to 22.2-pcs. Number of grains per spike 88, 1 pcs., weight of grains per plant - 7.2 g, weight of 1000 grains-48.9, grain yield is 52.4 t/ha, at the standard-50.2 kg/ha. The protein content -22.6%, gluten-40.8%, grain hardness – 79, sedimentation – 83. The level of plants stability in this combination was high-97.2%. Plant resistance to lodging, hardy, the percentage of surviving plants after overwintering is high - 98%. In the heading stage and milk stage is resistant to stem and yellow rust. Susceptibility to leaf rust is 2 points. Resistant to mildew and septariose, dust and smut.

F7 (Erythrospermum 121 x Aegilops triaristata Willd) x Erythrospermum 121 (2005 – 13) variety (Triticum aestivum L.) – Sub.Lutescens. The presence of spines and awn typed cusps the spike of the type inermis, but the upper spikelets are 2-3cm, awn typed cusp longer than 2.0 cm. Plant height 107.4 cm, the bush type is erect, productive tillering -3.8 pc. Anthocyanin coloration in the leaf is weak. Curved leaf flag is missing, the wax coating on the leaf sheaths is weak. Spike length – 16.4 cm, the spike pieces 20.1., 1 pcs., weight of grains per plant - 7.2 g, weight of 1000 grains-48.9, grain yield is 52.4 t/ha, at the standard-50.2 kg/ha. The protein content -22.6%, gluten-40.8%, grain hardness – 79, sedimentation – 83. The level of plants stability in this combination was high-97.2%. Plant resistance to lodging, hardy, the percentage of surviving plants after overwintering is high - 98%. In the heading stage and milk stage is resistant to stem and yellow rust. Susceptibility to leaf rust is 2 points. Resistant to mildew and septariose, dust and smut.

References

1. Kozhahmetov K. Distant hybridization and creation of valuable wheat grades in selection of grain cultures // Kajinar. Alma-Ata, 1983, p. 91-100.
2. Golubovskaja I.N., Shkutina F.M., Hvostova V.V. Non stability of chromosome number, revealed at wheat-rye and noncomplete wheat-rye amidiploids / Genetics, 1967. - No. 1. - P. 28-41.
3. Savin T.V., Abugalieva A.I., Kozhahmetov K.K. Study of wild wheat relatives Feuzn content on the ground of cultural forms and hybrids // Mat. Bot., gen., sel. - Vol. 166. – Sankt-Peterburg, 2009, P. 220-224.
4. Abugalieva A.I. Patentability of grades in correspondance with UPOV convention in selection and grain breeding strategy of crops. – Almaty, 2011, P. 168.
5. Zuev E.V., Amri A., Pjukkenen V.P., Mitrofonova O.I. // Atlas of diversity of soft wheat (Triticum aestivum L.) on traits of spike and weevil. – Sankt-Peterburg-Novosibirsk, 2013., p. 131.