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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

STUDY OF AGROBIOLOGICAL SIGNS AND CHARACTERISTICS OF INTER-SPECIES WHEAT HYBRIDS AND USE IN PLANT BREEDING

Specialty: 3103.04 – **Breeding and seed production**
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The work was performed at the "Grains and legumes" field laboratory of the Azerbaijan State Agrarian University.

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GENERAL DESCRIPTION OF THE RESEARCH

Relevance and degree of completion of the topic. Being the main food crop, wheat (Triticum L.) is the major food source of the vast majority of the world's population and is ranked first among cereals in terms of both production and arable land (about 225.4 -240 million ha). Bread wheat flour is used for baking high-quality bread, and national types of bread - tandir (oven) bread, lavash (flatbread), most of all pasta, and the best types of confectionery are made of durum wheat flour. Wheat accounts for 32% of the total sown area of grain crops in the world (about 710 -760 million hectares). According to the official data of the Food and Agriculture Organization (FAO), the world's total wheat production was 681.9 million tons in next years. Wheat provides almost 20% of the total food energy needed by humans[1].

Bread provides humans with 50% of proteins and carbohydrates, 70- 80% of the daily requirement of vitamin B1 (thiamine), a significant portion of vitamins PP and E1, minerals, and other substances. According to official statistics, the annual increase in the number of people around the world is 78 million. To meet this increase, wheat production should reach 840 million tons by future years. Undoubtedly, this is possible by the intensification and diversification of the agricultural system, the development of new high-yielding wheat varieties that are tolerant to biotic and abiotic stress factors, and their rapid introduction.

For this reason, scientists and specialists working in the agricultural sector have an important task to further increase the productivity of cereals and legumes in the future, to improve the quality of products. In perspective, achieving competitive, export-oriented agricultural and food production by fully providing the population of our country with key strategic products at the expense of local production is always in the focus of the leaders.

1. Ismayilov, M.M. Some agro-technical measures to increase the productivity of wheat // - Ganja: Scientific works of ASAU, - 2014. - p. 31-33.

In addition to ensuring an increase in production per hectare, a system of measures must be developed and implemented to ensure that the product is environmentally safe and of high quality. Therefore, it is important to use breeding methods for the development of new environmentally friendly varieties having a high grain quality, which are more productive, and tolerant to lodging and diseases.

The purpose and tasks of the research. The main purpose of the dissertation was to study the agrobiological characteristics and features of interspecific wheat hybrids and use them in the breeding process. Other issues were to study the traits and indicators of the economic significance of the studied materials, productivity elements, their use in breeding work, and to make calculations following the methodology. The study of hybrid combinations was carried out using the guidelines adopted in the selection of cereals, the obtained hybrid samples were studied in accordance with the purpose of the study.

To achieve the solution of the issues envisaged in the research, the following main tasks were set:

- Breeding evaluation of interspecific wheat hybrids;
- Developing bread wheat x durum wheat hybrids under local conditions using the interspecific hybridization method;
- The study of the patterns of inheritance of quantitative traits of bread and durum wheat;
- The study of heterosis and combining ability in the first generation (F_1) hybrids;
- Carrying out genetic analysis, and identification of types of hereditary transmission of quantitative traits (phenotypic dominance) in the second generation (F_2) hybrids;
- The identification and study of quantitative traits in the second generation (F_2) hybrids;
- Identification of valuable sources in the breeding for various traits.

Research methods: In the breeding process, hybridization is carried out both by the restricted free pollination method developed

by Lukyanenko and by the Tvel method[1]. It should be noted that to carry out the hybridization process in our research, first of all, castration was performed. For this purpose, 1/3 of the flower petals were cut lengthwise, castrated and the spike was put on the parchment paper and isolated. The restricted free pollination method was applied 3-7 days after castration. Castrated spikes and obtained hybrid grains were counted. Based on the results of the two indicators, the success rate was determined for each combination. Interspecific hybridization was carried out by setpross method. The obtained first generation (F_1) hybrid grains were hand sown in the $1m^2$ field with row spacing 15 cm, sample spacing 30 cm, grain spacing 2-3 cm, and 40-50 grains in each row for performing the comparative study with the parental forms.

Phenological phases were determined. Thus, after sowing, phenological observations were carried out in the phases of emergence, tillering, spiking, and full maturation.

During the experiments, all agro-technical measures for wheat cultivation, field research, and observations on plants, tolerance to lodging, grain shedding, frost, drought, the study of structural elements of the product were carried out following the existing methodological guidelines in this area[2].

Phenological observations were performed after sowing F_3 seeds. After the harvest, selection and analysis were performed. Good constant forms were chosen.

The study of the variability of quality traits in the first two generations of wheat hybrids was based on the arithmetic mean of the parameters and analysis of their parental pairs.

Assessment of grain quality was performed using guidelines.

1. Dagüstü, N. Inheritance of some cultivar features in 7x7 diallel hybrids of some bread wheat varieties and lines// - Bursa: Journal of Uludağ University Faculty of Agriculture, - 2002. t. 16(2), - p. 47-58.

2. Ahmadov, M.Q. Results of selection of hard and soft wheat under irrigation conditions / M.G. Ahmadov, H.N. Rustamov, V.F. Ibadov [et. al.] // Collection of Scientific Works of Azerbaijan Scientific-Research Agricultural Institute, - Baki: - 2015. t. 26, - p. 43-49.

The main quality indicators, including the protein content in the grain, were determined following the standard methodology[1].

Hybrid generations (F_1 and F_2) were planted according to the following scheme: P_1-F-P_2.

Main points presented to the defense of the dissertation:

The dissertation consists of the results of the following scientific-theoretical points of the research.

– Crossing parental forms; obtaining and testing hybrids.

– Assessment of the combining ability of bread and durum wheat varieties.

– The study of the variability of the protein content in the grain of the hybrids obtained by hybridization of durum and bread wheat varieties.

– Clarification of the fissure properties of hybrids (F_2) obtained by hybridization of durum and bread wheat varieties.

– Determining the degree of formation, heterosis, and its occurrence in interspecific hybrids.

Scientific novelty of the research.

For the development of new varieties, many local samples were used in interspecific hybridization, and as a result, promising hybrid lines with various positive traits and characteristics, i.e. high quantitative and qualitative indicators, resistance to lodging and diseases, fast-growing were obtained. The studied hybrid lines were grouped according to the required traits and characteristics, and hybrids with high indicators were identified.

Based on the results of our research, depending on the soil and climatic conditions of the experimental years and the biological characteristics of hybrid samples, the variability of quantitative and qualitative characteristics, and production elements, the regularities of hereditary transmission of important breeding properties (heterosis, dominance, etc.) obtained as a result of intraspecific hybridization were studied.

1. Methods of assessing the technological quality of grain: / - Moscow: «Scientific advice on the quality of grain», - 1971. - 136 -166 p.

Theoretical and practical significance of the research. Local samples of various economic importance, different in many biological features and indicators, elastic, suitable for many regions, were selected and evaluated according to breeding potential, and it was suggested to use these samples as a starting material for future selection processes. The samples used as the starting material were studied. The promising hybrids obtained as a result of the research will lead to the expansion of the breeding process by stimulating the production of intensive varieties.

Approbation and application of the work. The results of the research were presented at the final annual report meetings of the Azerbaijan State Agrarian University (2013 – 2017); at the Scientific-Practical Conference dedicated to the 90th anniversary of national leader Heydar Aliyev (Ganja 2013); the International Scientific-Practical Conference (Volume I, October 23-24, 2015 Ganja, Azerbaijan); the II International Scientific Conference of Young Scientists (October 26-27, 2017, Ganja), Academician Jalal Aliyev and Genetic Resources of Biological Diversity, the Republican Scientific-Practical Conference dedicated to the 90th anniversary of Academician Jalal Alirza oglu Aliyev (Ganja, 2018); the V International Scientific and Methodological Conference on the role of physiology and biochemistry in the introduction and selection of agricultural plants (Volume II, Moscow, April 15-19, 2019) and widely discussed at the Scientific Council of the Azerbaijan State Agrarian University.

Based on the results of the research, 14 scientific works reflecting the main provisions of the dissertation were published, of which 1 book, 9 articles and 4 conference materials.

Name of the organization where the dissertation was performed: The dissertation work was carried out in the field laboratory "Cereals and legumes" of the Azerbaijan State Agrarian University.

Total volume of the dissertation in characters with an indication of the separate volumes of the structural units. The main part of the work includes an introduction, four chapters,

conclusions, recommendations for selection and production, a list of 157 references, and appendices. There are 20 tables and 17 (5 tables and 12 figures) appendices in the dissertation. The title section and table of contents consist of 3 pages with 4,049 characters, the introduction is 14 pages with 29,967 characters, the first chapter is 31 pages with 65,889 characters, the second chapter is 17 pages with 30,554 characters, the third chapter is 33 pages with 49,823 characters, the fourth chapter is 33 pages with 49,774 characters, conclusions contain 2 page with 2,436 characters, recommendations for selection and production is 1 page with 1,385 characters and the reference list contains 17 pages with 32,282 characters. The total volume of the dissertation is 170 pages, and the total text part of the dissertation (excluding figures, tables, appendices, and reference list) consists of 101 pages of computer typing or 200,001 characters.

CONTENT OF THE WORK

Introduction presents relevance and general descrıptıon of the research.

In **Chapter I**, an extensive literature review is given under the headings "Botanical description of wheat and its agricultural importance", "History and breeding of wheat in Azerbaijan", "Cultivation of wheat", "The role of breeding in increasing the productivity and quality of wheat", "Interspecific hybridization", "Productivity indices of bread and durum wheat" and “Main quality indices of bread and durum wheat”. Performed researches, scientific achievements in the world and the country to date, other issues related to the topic of the dissertation have been studied based on extensive literature sources, the analysis of literary data has been carried out.

Chapter II contains extensive information under the headings “Soil and climatic conditions of the experimental zone” and “Research method”. The research was conducted in the Ganja-Gazakh region. The Ganja-Gazakh region is located in the western part of the Azerbaijan Republic and occupies the area between the

foothills of the Lesser Caucasus Mountains and the Kura River from the border of the Republic of Georgia to the Inja River. The territory of the region consists mainly of forested plains and partly alluvial depressions. The wavy- hilly shapes of the relief are well visible. The light-chestnut, brown-chestnut, and meadow soils are mainly spread in the region. The territory of the region is divided into Kura lowland, Ganja light-chestnut land region, and Agstafa land subregion. Soils of the region are rich in microelements. Thus, the climatic and soil conditions of the region are very favorable for most areas of agriculture, first of all, cultivation of garden plants, autumn-winter, and early spring vegetable growing, and early vegetable growing under cover. The meteorological conditions in the experimental year correspond to the average multi-year data. Winter and spring were relatively cold, late, very rainy, and cloudy. The soil of the experimental field was characteristic of Ganja, light-chestnut, heavy clay soils, and humus content amounted to 2.85%

Following the purpose of the dissertation, local Girmizi bughda, Parzvan 1, Sheki 1, Azamatli 95 and Murov bread wheat varieties and Garabagh, Shiraslan 23, Alinja 84, Garagilchig, and Barakatli 95 durum wheat varieties were used as research materials. Interspecific hybridization was carried out by the setpross method.

The research was conducted in the experimental field of the "Cereals and legumes" field laboratory of ASAU in the Ganja-Gazakh zone.

Chapter III. EXPERIMENTAL PART

3.1. The principle of proper selection of parents in crossbreeding and a starting material. There are various regularities based on the actual material collected as a result of hybridization. There are some general principles in choosing the right parents for successful crossbreeding, which we also applied in our research: Ecological geographical method; Selection of parents according to product elements; Selection of parents according to the development period of the phases; Selection of parents based on their disease resistance.

3.2. Method and technique of crossbreeding. Following the methodology, we have selected well-developed plants for crossbreeding. We used a restricted free pollination method in our research.

We started pollinating the flowers on the mother plants 2-3 days before the stamens matured. Well-developed flowers were selected for castration, and good conditions were created for the normal development of hybrid seeds in the future. The upper part of the spike was cut off, and the remaining spikelets on the lower part of the spike were removed with tweezers. Then, 5-16 flowers of the mother spike, which were close to each other were castrated.

After that, we covered the spikes with a parchment bag. This process is for preventing any accident of fertilization with another pollen. Before fertilization, we selected healthy spikes from the envisaged father plants.

We also placed 5-8 flowering spikes of the father plant in a parchment bag. Then, we put on the insulator on the spike again and tied it. Self-pollination occurred there. The father plant spikes were put in a bottle full of water. After the spikes ripened, the mother spikes were cut and the bag was opened in the laboratory. Then hybrid seeds were selected and collected, and the following year a row of mother plants, next to which were hybrid seeds and a row of parent plants were planted ($P_1F_1P_2$).

3.3. Crossing parental forms, obtaining and testing hybrids. We used ten varieties to obtain the hybrid material. These varieties and forms differed in productivity, grain quality, shrub height, and resistance to lodging, as well as morphological, biological, physiological, and other characteristics.

Durum wheat crosses badly with bread wheat. Thus, the results of the comparative analysis of many studies confirm that the formation of seeds in such crosses of wheat is different.

By hybridizing between bread and durum wheat, we have shown that the formation of upper and lower testes in hybrid seeds depends on the parental forms.

In our experiment, the germination percentage of the combinations ranged between 62.5% and 90%. Clearly, germination was less in unfilled grains compared to well-filled ones. At best, 90.0% of the 40 seeds sown were germinated (Garagilchig 2 x Azamatli 95). At worst, it amounted to 62.5% (Sheki 1-Alinja 84).

Along with the germination ability, the viability of these hybrids has also been studied. The viability of the F_1 generation plants ranged between 73.5% and 93.5%.

According to the results, the highest viability was 93.5% (Girmizi bughda 1 x Barakatli 95), the lowest was 73.5% (Alinja 84 x Murov 2) (table 1).

Based on the estimations, the incidence rates of loose smut and brown rust diseases were not significant during F_1 hybrid testing. The percentage of loose smut incidences did not exceed 5- 10%.

Table 1. Germination ability and viability of the inter-species wheat F_1 hybrids

№	Name of hybrids	Number		Germination percentage %	Number of plants stored before harvest, in numbers	Viability %
		Sown seeds	Sprouts			
1	Girmizi bughda 1 – Barakatli 95	40	31	77,5	29	93,5
2	Sheki 1-Alinja 84	40	35	62,5	22	87,4
3	Garagilchig 2 - Azamatli 95	40	36	90,0	31	86,1
4	Alinja 84 x Murov 2	40	30	85,0	25	73,5

Based on the results of the structural analysis, the average height of the interspecific hybrids (F_1 and F_2) was different. The highest among the F_1 hybrids was Girmizi bughda 1 x Alinja 84 (128 cm) and the lowest combination was Barakatli 95 x Murov 2 (61 cm). Among F_2 hybrids, the highest was Sheki 1x Garabagh (108 cm) and the lowest -Alinja 84 x Sheki 1 (61 cm) (figure 1).

Interspecific hybrids (F_1 and F_2) differed in tillering productivity. The highest tillering productivity (4.5) among F_1 hybrids was observed in Sheki 1 x Alinja 84, the lowest tillering productivity (1.5) was found in Murov 2 x Barakatli 95. In F_2 hybrids, the highest tillering productivity (7.3) was detected in Garabagh x Murov 2 and the lowest (4.4) in Parzvan 1x Garagilchig 2 (figure 2).

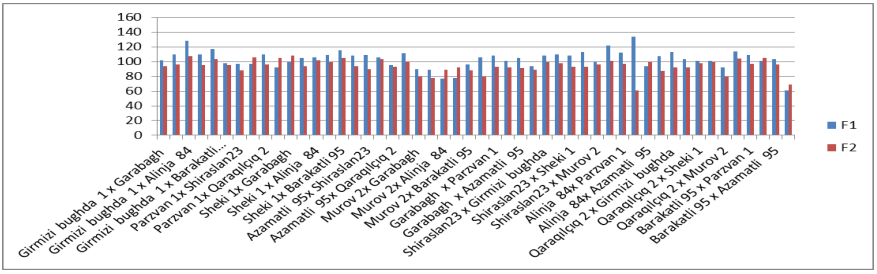

Figure 1. Average height of the interspecific hybrids (in cm)

According to the results of the research, there were differences in the average length of the main spike of interspecific hybrids (F_1 and F_2). Thus, the longest spike among F_1 hybrids was 8.8 cm (Alinja 84 x Sheki 1), the shortest spike was 3.5 cm (Garabagh x Sheki 1). Among the F_2 hybrids, the longest hybrid was 11.5 cm (Murov 2x.

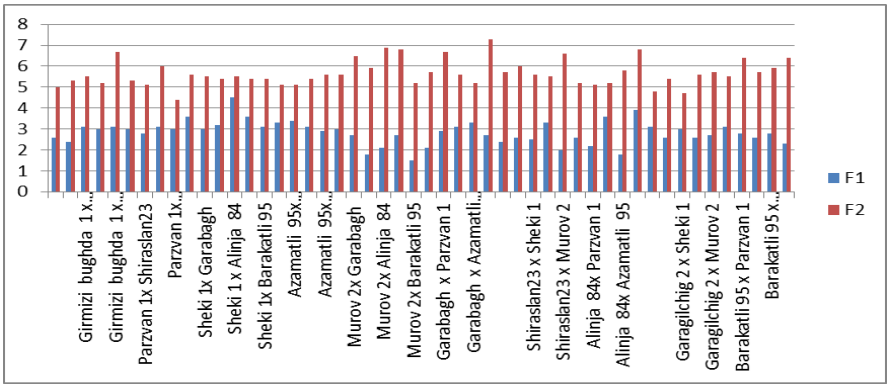

Figure 2. Tillering productivity of the interspecific hybrids (in numbers)

Alinja 84), and the shortest hybrid - 7.5 cm (Garagilchig 2 x Sheki 1) (figure 3).

There were also differences in the average number of spikelets per the main spike between interspecific hybrids (F_1 and F_2). Among the F_1 hybrids, the highest value (22) was observed in the Girmizi

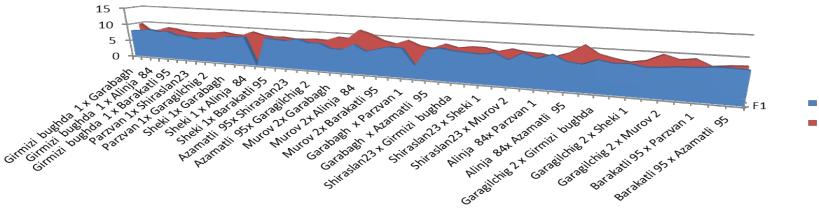

Figure 3. Average values of interspecific hybrids (F_1 and F_2) for the length of the main spike (in cm)

bughda 1 x Garagilchig 2 combination, and the lowest value (15) in the Murov 2 x Shiraslan 23 combination. The highest parameter for F_2 hybrids (Garabagh x Azamatli 95), was equal to 30 and the lowest (Garabagh x Murov 2) amounted to 17 (figure 4).

The highest average number of grains per the main spike among the F_1 interspecific hybrids was 35 (Shiraslan 23 x Murov 2), the lowest number was 4 (Barakatli 95 x Murov 2). The highest

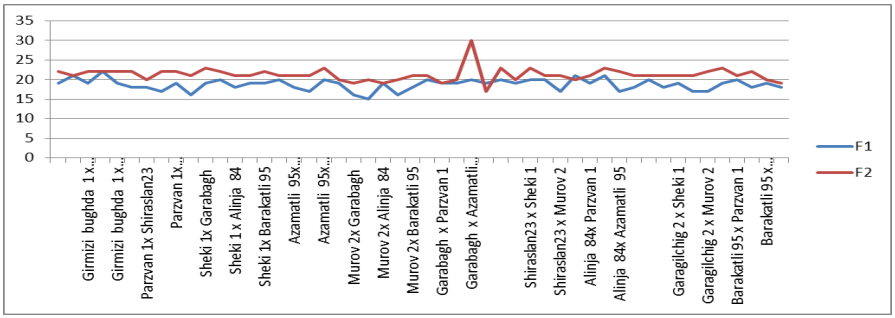

Figure 4. Average values of interspecific hybrids (F_1 and F_2) for the number of spikes in the main spike (in numbers)

number among the F_2 interspecific hybrids was 43 (Garabagh x

Murov 2), and the lowest number was 22 in two combinations Barakatli 95 x Parzvan 1 and Barakatli 95 x Murov 2 (figure 5).

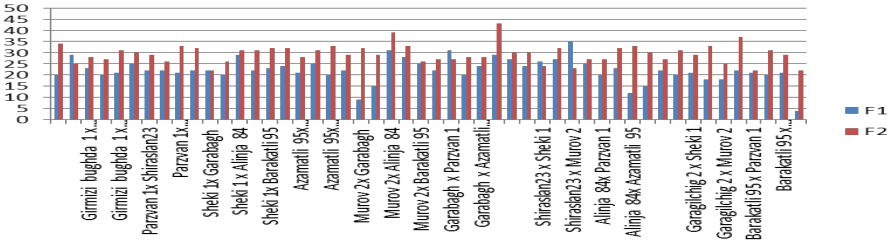

Figure 5. Average number of grains in the main spike of interspecific hybrids (F_1 and F_2)

According to the results of the study, the average mass of grains per main stalk was different in interspecific hybrids. Thus, the highest average mass was 2.0 g (Garabagh x Murov 2), the lowest 0.4 g (Murov 2 x Garabagh) in the F_1 hybrids, whereas, in the F_2 hybrids, the highest value was 1.7 g (Murov 2x Alinja 84), and the lowest amounted to 0.9 grams (Barakatli 95 x Murov 2).

The number of grains per plant also was different in the interspecific hybrids. The greatest number of grains in the F_1 hybrids was 77 (Murov 2 x Garagilchig 2), the smallest number was 16 (Alinja 84 x Murov 2), while in the F_2 hybrids, the greatest number was 245 (Murov 2 x Alinja 84), and the smallest number was 106 (Shiraslan 23 x Sheki 1).

According to the results of the analysis, the average mass of grains per plant in the interspecific hybrids (F_1 and F_2) was also different. Thus, the highest value for the F_1 hybrids was 4.1 grams in the Garabagh x Murov 2 combination, the lowest value was 0.7 grams in the Alinja 84 x Azamatli 95 combination. The highest value for the F_2 hybrids was 9.5 g in the Murov 2x Alinja 84 combination, and the lowest value was 4.0 g in the Shiraslan 23 x Sheki 1 combination .

The duration of the vegetation in the studied third generation (F_3) hybrid combinations was 226-228 days. Of the 50 third-generation (F_3) hybrid combinations studied, 7 combinations (14%)

were early maturing (226 days), 37 combinations (74%) - medium maturing (227 days), and 6 combinations (12%) - late maturing (228 days).

Chapter IV. EVALUATION OF GENETIC BREEDING OF HYBRIDS AND THEIR PARENTAL FORMS

4.1. Evaluation of combining ability of bread and durum wheat varieties. According to the results of dispersion analysis, based on the general combining ability (GCA), the statistical differences of the first-generation hybrids and their parental pairs under the Ganja-Gazakh conditions, were true for 6 traits of the first harvest (2n = 42) and one trait (the number of grains per plant) of the second harvest (2n = 28) varieties.

Differences in specific combining ability (SCA) and reciprocal effects (RE) were confirmed for only two (productive tillering and number of grains per plant) and four (the number and mass of grains per plant and main spike) traits.

In F_1, the difference in SCA was not determined for any trait. This can be explained by the fact that RE (reciprocal effects) are well manifested during the hybridization of wheat varieties with different chromosomes.

In the F_1 and F_2 tests, the first harvest varieties were superior to the second harvest varieties in 7 traits. In the starting materials that do not pass the initial selection due to the combining ability of individual traits, GCA was superior to SCA. It can be concluded that the variability of most traits studied in F_2 is due to the additive effect of genes of durum wheat varieties in a small number of bread wheat varieties. The variability of the quantitative traits of the plant and main spike grains is attributed to the non-additive effect of genes.

4.2. Combining ability of the first harvest varieties (Tr. aestivum). The height of the plant. According to the GCA, the diversity was not confirmed in F_1. However, in F2, these variations were profound.

One of the most important features in the selection of bread and durum wheat varieties is short stature, which is associated with resistance to lodging. It is known that short stature and short-

stemmed varieties are usually more resistant to lodging. Thus, the parental forms, which are distinguished by low GCA, are of interest. According to this trait, the level of GCA in F_2 was lower in Garabagh and Shiraslan 23 varieties, and higher in the Alinja 84 variety.

In general, the following conclusions can be drawn from the study of durum wheat varieties used for the hybridization between bread and durum wheat.

When testing F_2, the GCA for all observed productivity indices of the Alinja 84 variety was middle or high for 6 traits in the Garabagh variety and for 3 traits in the Garagilchig 2 variety. However, in contrast to the Alinja 84 variety, GCA for plant height of these two varieties was lower. This trait, along with resistance to lodging, is very important in the selection for short stature.

In general, according to the results of the experiment, the GCA values were stable in the Alinja 84 variety. The Barakatli 95 variety was ranked second.

In the year of testing, the first-generation hybrids, due to climatic conditions, the differences of many traits in the varieties according to the GCA remained latent.

4.3. Variability of protein content in durum and bread wheat hybrid grains. Analysis of the obtained results showed that F_2 grains (taken from different F_1 plants) differed significantly in protein content. Depending on the combinations of crosses, the variability of these indicators was 2.3% -10.9%.

Depending on the direction of crossing, some combinations were found to vary in the protein content of the grain. Thus, the protein content, in the Girmizi Bughda1 x Garabagh combination, ranged from 13.4% to 21.5% (difference 8.1%), and in the reverse combination, it ranged between 18.6 and 20.9% (difference 2.3%). In the spectrum of the variability of this trait, the difference between the direct and reverse combinations of Girmizi Bughda1 x Alinja 84 was not so great (11.7%-20.4%, difference 8.7% and 11.6-18.9%, difference 7.6%). When crossbreeding, families with higher (20.4 - 22.2%) protein levels as well as families with lower (10.3 %- 12.3%) protein levels compared to their parental pairs were found.

The difference in the protein content of the grain of interspecific hybrids is attributed to the polymer inheritance of this trait.

Plants with 20.3% - 22.2% protein were obtained in the 10 combinations we studied. Some generations of durum and bread wheat varieties of F_2 plants (F_3 seeds) carry a trait of high seed protein content. The maintenance of a high degree of seed protein in the offspring indicates a positive transgression for this trait.

4.4. Fission characteristics of hybrids obtained from hybridization between bread and durum wheat (F_2). In our study, we described the fission spectra of some interspecific hybrids.

As a result of the interspecific hybridization (F_2) between durum and bread wheat, 1.9%-52.3% of bread wheat type and similar plants, 1.6%-64.6% of durum wheat type and similar plants, 7.3% - 52.5% intermediate plants of different degrees, 3.2%-30.7% different persicoids, 0.6%-11.8% compactoids, 0.6%-14.6% speltoids, 0.6%-6.9% dicocoids, 0.4%-5.2% turgidoids, 0.4%-2.4% of round-grain and 0.5%-8.7% of turanicum plants were obtained.

Similar results were obtained in the reciprocal combinations in which durum wheat was used as the mother form (1.4%-52.5%, 3.4%-58.2%, 17.9%-60.4%, 1.1%-24.6%, 0.5%-4.9%, 0.8%-20%, 0.6%-11.9%, 1.4%-1.6%, 0.7%-3.1% and 0.6%-1.7 %).

However, diversities or differences between these combinations are also observed when the mother forms are the same and the father forms are different. Diversities are often observed during the fission of bread wheat type, close intermediate, and also compactoids.

By studying the nature of crossbreeding of interspecific hybrids, the following conclusions can be drawn. The fission spectrum in F_2 depends primarily on the genotype of the varieties used for crossbreeding, cultivation conditions, and the direction of crossing.

4.5. Shaping, heterosis, and the degree of its emergence in interspecific hybrids. Some of the studied first-generation hybrids

were superior (by17.3%) to the parental forms in height (Parzvan 1 x Garagilchig 2). In many combinations, heterosis was 2% -10%.

The same dominant effect of the genes that determine the height of the plant was observed. The additive effect of heterosis in hybrids obtained from autumn durum wheat varieties, such as Alinja 84, Garabagh, etc. was weaker compared to that of the hybrids obtained from crossing short stature varieties –Garagilchig 2, Shiraslan 23 (1.0%-5.0%). Thus, when Garagilchig 2, Shiraslan 23, and others were crossed with the Parzvan 1, Sheki 1 varieties, the heterosis for plant height was 13.0%-16.3%. Thus, heterosis in hybrids obtained from crossbreeding of short stature autumn durum wheat varieties was higher than in tall ones.

The effect of heterosis for the length of the spike is weaker than the effect for the height of the plant. Higher results (20.0 %-32.9%) were observed in Sheki 1 x Alinja 84, Garagilchig 2 x Azamatli 95, Garabagh x Murov 2, Murov 2 x Alinja 84, and other hybrids.

In most hybrid combinations, heterosis was 1.0% – 5.0% relative to the best parent. However, it was absent in some combinations.

In Alinja 84 x Azamatli 95, Garagilchig 2 x Girmizi Bughda 1, Murov 2 x Shiraslan 23, Parzvan 1x Alinja 84 hybrids, the spike was 80 %-90% longer than in the best mother forms.

Heterosis in hybrids was very high for the number of spikelets per the main spike. The highest result (10.5%-16.7%) was recorded in Azamatli 95 x Shiraslan 23, Garagilchig 2 x Sheki 1, and other hybrids.

Our studies showed that the fertility of spikes of interspecific hybrids was 33.3% (Azamatli 95 x Barakatli 95) and 72.0% (Sheki 1 x Alinja 84). Fertility was 42.55% on average compared to the best hybrid component in many combinations.

From the above, it is clear that heterosis is not the same in F_1 hybrids. In many hybrids, somatic heterosis is observed for plant height, spike length, and other traits. In some hybrids, heterosis is 10

-15% compared to the best mother form. Heterosis can be high or medium for some traits and can be absent for others.

Conclusions

1. Hybrids obtained as a result of the research can be used as a starting material in breeding programs. These forms are the starting material for complex biological and economic traits, i.e. for productivity, resistance to lodging, and diseases. Durum wheat varieties-Garagilchig 2 and Garabagh are distinguished by high resistance to lodging and high productivity. The Alinja 84 variety is more valuable due to its high adaptability.

2. Germination percentage in combinations ranged between 62.5% and 90%. Germination percentage was less in unfilled grains than in filled ones. At best, 90.0% of the 40 seeds sown (Garagilchig 2 x Azamatli 95) were germinated. At worst, it was 62.5% (Sheki 1 x Alinja 84). The viability of F_1 plants was 73.5%-93.5%. The highest was 93.5% (Girmizi Bughda 1 x Barakatli 95), the lowest - 73.5% (Alinja 84 x Murov 2).

3. As a result of reciprocal crossbreeding, it was found that GCA was high for all productivity elements in the Alinja 84 variety. In the Garabagh and Garagilchig varieties, it was medium or high for 6 traits. However, in contrast to the Alinja 84 variety, in these two varieties, GCA was lower for the plant height. This can play a very important role in selection for short stature and resistance to lodging.

4. Stable GCA values were obtained for Alinja 84, Girmizi Bughda 1, Sheki 1 and, Barakatli 95 varieties.

5. Certain similarities were found in the genotypic variability of model populations and hybrids. This allows predicting the degree of genotypic variability in future hybrid populations to be created by hybridization of parental pairs in model populations.

6. As a result of the research, a selection material consisting of families having many positive traits was created by interspecific hybridization.

7. As a result of interspecific hybridization, new forms of durum and bread wheat have been developed. Most of them are very important for breeding. Thus, the development of families with high protein and lysine content is of great importance.

8. The incidence rate shows that the tested F_1 hybrids are not infected significantly with loose smut and brown rust. The loose smut incidence rate does not exceed 5-10%.

Recommendations

1. It is advisable to use varieties of 61-100 cm height in hybridization as a starting material for future research.

2. The hybrid lines selected for the highest protein content in the grain were analyzed. The protein content was found to change from 13.4% to 21.5% in the Girmizi Bughda 1 x Garabagh combination (8.1% difference for families), and in the reverse combination, it ranged between 18.6% and 20.9% (2.3% difference). At the same time, in the spectrum of the variability of this trait, the difference between the direct and reverse combinations of Girmizi Bughda 1 x Alinja 84 was not so great. (11.7-20.4%, difference-8.7% and 11.6-18.9%, difference-7.6%). Thus, when these varieties are used in interspecific hybridization, a higher effect is obtained for the protein content. In this regard, it is proposed to use these varieties as a starting material for hybridization.

3. The duration of the vegetation period was studied in the hybrids and several hybrid lines distinguished by this trait were identified. The minimum vegetation period (226 days) was observed in the hybrid lines: Girmizi bughda 1 x Alinja 84, Girmizi bughda 1 x Barakatli 95, Parzvan 1x Garagilchig 2, Sheki 1x Shiraslan 23, Sheki 1 x Alinja 84, Azamatli 95x Garabagh, Azamatli 95x Shiraslan 23. It is advisable to use these hybrid lines as a starting material for future breeding work.

List of published scientific works on the topic of the dissertation:

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2. Babayeva K.E., Gurbanov F.H. Study of new forms of wheat and maize and their use in selection, Proceedings of the republican scientific and practical conference dedicated to the 90th anniversary of the national leader Heydar Aliyev, Ganja 2013, pp. 30-31(in Azerbaijani).

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