

REPUBLIC OF AZERBAIJAN

On the rights of the manuscript

ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

**CREATION OF DURUM WHEAT (*Triticum durum* Desf.)
STARTING MATERIAL USING INTRA-SPECIFIC
HYBRIDIZATION AND ITS USE IN SELECTION**

Specialty: **3103.4 - Breeding and seed production**

Field of science: **Agrarian sciences**

Applicant: **Sevda Taleh Hajiyeva**

BAKU-2025

The dissertation work was carried out at the Plant Breeding Department of the Agricultural Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan.

Scientific supervisors:

Doctor of Philosophy in Agrarian Sciences, assistant professor
Asad Jannat Musayev

Corresponding Member of ANAS,
Doctor of Agricultural Sciences, Professor
Zeynal Iba Akparov


Official opponents: Corresponding Member of ANAS,
Doctor of Biological Sciences, Professor
Panah Zulfiqar Muradov

Doctor of Agricultural Sciences,
assistant professor
Aladdin Qismat Eyvazov

Doctor of Philosophy in Agrarian Sciences,
assistant professor
Afet Sabir Huseynova

FD 1.29 Dissertation Council operating under the Agricultural Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan of the Higher Attestation Commission under the President of the Republic of Azerbaijan

Chairman of the dissertation council:

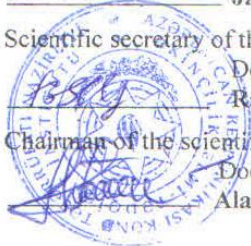
 Doctor of Agrarian Sciences, Professor
Jalal Shamil Mammadov

Scientific secretary of the dissertation council:

Doctor of Philosophy in Agrarian Sciences
Rahmina Mamash Zamanova

Chairman of the scientific seminar:

Doctor of Agrarian Sciences, assistant professor
Aladdin Alirza Taghiyev



INTRODUCTION

The actuality and degree of using of the topic. Wheat, as one of the most valuable food crops, constitutes an indispensable part of human nutrition and is widely used in the food industry. Flour, groats, bread, and pasta products obtained from the processing of soft and durum wheat form part of our daily diet and have long played a crucial role in meeting the population's demand for food. The rapid growth of the world's population and global climate changes require a sustainable increase in crop production. This is possible through the development of highly productive new wheat varieties resistant to biotic and abiotic stress factors and their rapid introduction into production.

Durum wheat, which is the object of this research, is cultivated across vast areas of the globe after bread wheat and is distinguished by its broad polymorphism. Just as soft and durum wheat differ in their chemical and biochemical properties, their grains also vary in terms of technological quality indicators. Durum wheat is an indispensable raw material for the production of high-quality pasta.

Taking these into account, the selection of initial material for the creation of wheat varieties with high yield potential, grain quality, and complex positive traits, as well as the provision of appropriate recommendations, reflects the relevance of the research topic aimed at meeting the increasing demand of the population.

The object and subject of the research. The research object consisted of local and introduced durum wheat genotypes possessing individual positive traits, created through folk and scientific breeding. The subject of the research was the transfer of these positive agrobiological traits to hybrid progeny through hybridization and the development of initial material resistant to biotic and abiotic stress factors, with high quantitative and qualitative indicators.

The purpose and objectives of the research. Considering the relevance of the problem, the main aim of the research is to create initial material with high quality indicators for the pasta industry, based on the study of agrobiological traits and characteristics of

newly developed durum wheat hybrids obtained through intraspecific hybridization.

In order to achieve the tasks set within the research, the following main objectives were identified:

- Creation of new durum wheat hybrids through intraspecific hybridization using local and introduced genotypes with high agrobiological indicators, selected by breeders as a result of long-term research;

- Investigation of the inheritance patterns of quantitative traits in the first generation (F_1) of durum wheat hybrids and the study of transgressive variability in the second generation (F_2);

- Study of the quantitative and qualitative traits of durum wheat hybrids and their resistance to diseases;

- Testing of hybrid lines at different stages of selection and identification of promising durum wheat genotypes distinguished by high agrobiological characteristics and optimal morphological parameters;

- Statistical analysis of correlation relationships in intraspecific hybrid lines of durum wheat, creation of a trait collection by selecting hybrid lines with individual positive traits, and identification of valuable initial material for breeding;

- Inclusion of selected lines in breeding programs and their use in the creation of new varieties.

Research methods. During the implementation of the dissertation, field experiments, phenological observations, study of structural elements of the crop, determination of true heterosis and heritability of individual traits in the first generation of hybrids, evaluation of the level and frequency of transgression in the second generation, assessment of leaf rust infections, analysis of grain quality indicators, and study of correlation relationships between quantitative and qualitative traits were carried out in accordance with methods commonly applied in this field

Main provisions submitted for defense:

1. New durum wheat hybrids were developed as a result of crossbreeding local and introduced wheat genotypes;

2. The inheritance patterns of quantitative traits in newly developed first-generation (F_1) durum wheat hybrids and the transgressive variability in the second generation (F_2) have been studied;

3. Durum wheat hybrids were investigated in terms of quantitative and qualitative indicators as well as resistance to diseases;

4. Trials of hybrid lines were conducted at different stages of selection, and promising hybrids with high agrobiological characteristics and optimal morphological parameters were identified;

5. Correlation analysis was carried out in intraspecific hybrid lines of durum wheat, hybrid lines possessing individual positive traits were selected, a trait collection was created, and valuable initial materials for breeding were identified;

6. Selected lines were included in the breeding program for the creation of new varieties.

Scientific novelty of the research. For the first time, the genetic parameters of hereditary variability-phenotypic dominance, heterosis, and the level and frequency of transgression-were determined in durum wheat hybrids (F_1 , F_2) created through intraspecific hybridization based on new local and introduced genotypes.

For the first time, donor capacity was identified in varieties with a short vegetation period (Garagylchig-2, Mirbashir-50, Barakatli-95, v. hordeiforme, etc.) and in varieties with high-yield elements (Barakatli-95, Garagylchig-2, Zatino, etc.).

The newly developed durum wheat hybrid lines were comprehensively evaluated for their agrobiological traits and characteristics (yield, quality indicators, disease resistance, and breeding potential). Lines with high pasta quality-k-ST/2016/13; k-ST/2016/16; k-ST/2016/50; k-ST/2016/78; k-ST/2016/160; k-ST/2016/18a, etc.-were selected and included in the breeding program as valuable initial material.

As a result of the research, new durum wheat varieties-Taj-20, Galib, and Zaur-95 possessing complex positive traits were developed.

Theoretical and practical significance of the research. In the initial breeding process, the extensive study of various durum wheat genotypes and the newly created hybrid progenies carrying positive traits enabled the selection of starting materials characterized by complex farming valuable agrobiological traits and high-quality indicators. This laid the foundation for obtaining new intensive-type varieties.

By using the selected valuable samples, in collaboration with breeders of the Research Institute of Crop Husbandry, new durum wheat varieties Taj-20 and Galib, characterized by complex positive traits, were recommended for cultivation in the country's rainfed and moisture-supplied rainfed areas, while Zaur-95 was recommended for irrigated plains and fully moisture-supplied foothill regions. These varieties play an important role in ensuring food security.

The approbation and application of the work. The results of the research were reported annually at the final annual meetings of the Research Institute of Crop Husbandry (2016-2019); at the International Scientific-Practical Conference of the Faculty of Plant Protection of Kharkiv National Agrarian University named after V.V. Dokuchaev on "Fundamental and Applied Problems of Modern Ecology and Plant Protection" (Kharkiv, October 11-12, 2018); at the International Scientific-Practical Conference on "Ensuring Food Security of the Independent Azerbaijani State and Increasing the Competitiveness of the Agricultural Sector" dedicated to the 100 th anniversary of the Azerbaijan Democratic Republic, organized by the Ministry of Education of the Republic of Azerbaijan, Azerbaijan Cooperation University, Azerbaijan Economists' Union, and the Agrarian Science and Information Advisory Center of the Ministry of Agriculture of the Republic of Azerbaijan (Baku, June 1-2, 2018); at the International Scientific-Practical Conference of Kharkiv National Agrarian University named after V.V.Dokuchaev, Faculty of Plant Protection, "Problems of Ecology and Environmentally Oriented

Plant Protection” (Kharkiv, October 17-18, 2019); at the International Scientific-Practical Conference of Kharkiv National Agrarian University named after V.V.Dokuchaev (Kharkiv, October 29-30, 2020); and at the Scientific-Practical Conference on “The Role of Heydar Aliyev in the Development of Agricultural Science” dedicated to the “Year of Heydar Aliyev” organized by the Institute of Soil Science and Agrochemistry of the Ministry of Science and Education of the Republic of Azerbaijan and Lankaran State University (Lankaran, May 18-19, 2023). The results were also extensively discussed at the Scientific Seminar of the Research Institute of Crop Husbandry of the Ministry of Agriculture of the Republic of Azerbaijan (June 24, 2025).

Based on the research results, 18 scientific works reflecting the main provisions of the dissertation were published, and a patent was obtained for one regionally adapted durum wheat variety. Of the scientific works, 10 are articles (five published in journals included in international abstracting and indexing databases), and 8 are conference materials.

Institution where the dissertation was conducted. The dissertation was carried out at the Plant Breeding Department of the Research Institute of Crop Husbandry of the Ministry of Agriculture of the Republic of Azerbaijan.

The total volume of the dissertation with a sign indicating the volume of the structural sections of the dissertation separately. The dissertation consists of an introduction, four chapters, conclusions, recommendations, and a list of 190 references. It includes 36 tables, 25 figures, 2 graphs, and 34 pages of appendices.

The structure of the dissertation is as follows: title and table of contents 3 pages (4154 characters), introduction 11 pages (20847 characters), first chapter 19 pages (36385 characters), second chapter 22 pages (36912 characters), third chapter 40 pages (66202 characters), fourth chapter 40 pages (68104 characters), conclusions 2 pages (3564 characters), recommendations 1 page (1064 characters), references 22 pages (36612 characters). The total main

text of the dissertation (excluding figures, tables, references, and appendices) is 108 pages of computer-typed text, or 200272 characters.

MAIN CONTENT OF THE WORK

The introduction presents the relevance of the topic and the general characteristics of the dissertation.

CHAPTER I. LITERATURE REVIEW

In this chapter, an extensive literature review is presented under the headings: “The history and current state of wheat breeding in Azerbaijan”, “The importance of initial material in wheat breeding”, “Breeding for quantitative traits and main quality indicators in wheat”, and “Breeding activities aimed at disease resistance”. Scientific research conducted to date, as well as the achievements obtained worldwide and within the republic, were analyzed on the basis of extensive literature sources.

CHAPTER II. CONDITIONS, MATERIAL, AND METHODS OF THE RESEARCH

2.1. Brief characterization of the soil and climatic conditions of the study area. The soil of the Absheron Peninsula is not uniform and is mainly gray-brown, with poor nutrient supply. In the eastern part of the peninsula, saline gray soils predominate, while sandy, clayey, and saline soils are more common along the coastal area¹. The climate of the Absheron Peninsula belongs to the central desert and dry subtropical zone. Thus, semi-desert and dry steppe climate types prevail here. Summers are dry and hot, autumns are sunny, and winters are characterized climate types by mild weather².

2.2. Main agrochemical indicators and agrometeorological conditions of the experimental field during the years of research. The research was conducted during 2016-2020 under irrigated

¹ Mammadov, Q.S. Ecological Assessment of the Soils of Azerbaijan / Q.S. Mammadov – Baku: Elm Publishing, – 1998. – p. 281.

² Shikhlinski, E.M. Climate of Azerbaijan / E.M. Shikhlinski – Baku: – 1969. – 369 p.

conditions, with leguminous crops as precursors, at the Absheron Auxiliary Experimental Farm of the Research Institute of Crop Husbandry.

During the research years, the soil pH at a depth of 0-20 cm ranged between 8.35-8.51 depending on the year; at a depth of 20-40 cm it ranged between 8.57-8.83; and at a depth of 40-60 cm it ranged between 8.79-8.85, indicating an increase in pH in the lower layers. The topsoil layer (0-20 cm) is characterized as slightly alkaline.

The amount of calcium carbonate (CaCO_3) in the soil, depending on the year, ranged between 10,75-14,10% at a depth of 0-20 cm, 15,85-17,55% at a depth of 20-40 cm, and 18.55-20.20% at a depth of 40-60 cm, indicating that the upper layers are moderately carbonated while the lower layers are highly carbonated.

According to the analyses, it was determined that the soils of the experimental field were poorly supplied with nutrients. The total humus content, depending on the year, ranged between 1,27-1,37% at a depth of 0-20 cm, 0,61-0,82% at a depth of 20,40 cm, and 0,48-0,60% at a depth of 40-60 cm, gradually decreasing in the lower layers.

According to meteorological data, while the long-term average air temperature was 15.7°C , during the years of experimentation it varied between $15,5-16,0^\circ\text{C}$. Based on long-term indicators, the average annual precipitation was 300.5 mm, whereas during the years of experimentation the amount of precipitation ranged between 232,1-450,4 mm.

2.3. Agrotechnical practices of the research. After harvesting the preceding leguminous crops, the field was plowed, harrowed, and prepared for sowing. Depending on the material, each sample was sown manually in two variations on an area of 0,5-8,0 m². Along with sowing, 200 kg/ha of complex fertilizer (in physical weight) was applied, and 250 kg/ha of nitrogen fertilizer (NH_4NO_3) was applied during the bushing stage in early spring. During the growing season, the samples were irrigated two to three times depending on the year.

2.4. Research material and brief description of the varieties and samples used in hybridization. As research material, 33 durum wheat hybrid combinations (P-30; F₀-33) were created through intraspecific hybridization involving 30 local and foreign durum wheat varieties and samples with complex and individual positive traits, selected by breeders of the “Plant Breeding” Department from among 130 durum wheat genotypes studied during the 2015-2016 growing season. Hybrid lines selected from them as a result of segregation were also included in the study.

2.5. Research methodology. Field studies and observations on plants, as well as the study of yield structure elements, were conducted in accordance with existing methodological guidelines³ in this field. In F₁ hybrids, the degree of dominance⁴ and heterosis⁵ was calculated, while in F₂ hybrids the level and frequency⁶ of transgression were determined. Leaf rust diseases were evaluated according to the internationally accepted CIMMYT scale, while the level of infection with powdery mildew was assessed using the 9-point scale applied by CIMMYT. Grain quality analysis was performed in the “Grain Quality” Laboratory of the Research Institute of Crop Husbandry based on the methodological guidelines⁷ for the evaluation of grain quality. Correlation relationships between quantitative and qualitative indicators were determined, and mathematical-statistical calculations⁸ were carried out.

³ Musayev, A.J., Huseynov, H.S., Mammadov, Z.A. Methodology of field experiments on research work in the field of cereal plant breeding / - Baku: Teacher, - 2008. - 87 p.

⁴ Beil, G.M., Atkins, R.E. Inheritance of Quantitative Characters in Grain Sorgh // Lower State Journal of Science, - 1965. v. 39, №3, - p. 321-324.

⁵ Omarov, D.S. On the methodology of accounting and evaluation of plant heterosis // - Moscow: S.-kh. Biology, - 1975. V.10, No.1, - p. 123-128.

⁶ Voskresenskaya, G.S., Shpota, V.I. Transgression of hybrids and methods of quantitative accounting of this phenomenon // - Moscow: Reports of VASKhNIL, - 1967. No. 7, - p. 18-20.

⁷ Handbook of grain quality / Ed. by candidate of agricultural sciences G.P.Zhemela. - Kyiv: Harvest, - 1977. - 53 p.

⁸ S-PLUS 2000 Professional User's Manual/MathSoft.Seattle, -1999.-570 p.

CHAPTER III. OBTAINING AND STUDYING THE INITIAL MATERIAL OF DURUM WHEAT THROUGH HYBRIDIZATION

3.1. Obtaining hybrid generations. In the studies, local varieties and samples, such as v.hordeiforme, v.apulikum, v.hordeiforme-v.mursika, etc., which were created through folk selection and adapted to local conditions in the 2015-2016 vegetation year, Sharq, Shirvan-5, Turan, Kahraba, Mirvari, Mirbashir-50, Karagylchig-2, Tartar, which were cultivated in the vast fields of the republic in the 1940s-1990s, Garabagh, Barakatli-95, newly created Goytepe, Zangezur, etc., which are currently widely planted and cultivated in farms, Zatino of French origin, and Karol Odesskaya of Ukrainian origin, were used.

In accordance with the methodology, as a result of hybridization, 1,023 florets were emasculated on 59 spikes across 30 wheat genotypes. During pollination, viable pollen with fertilizing ability was used, resulting in 647 hybrid grains and 33 combinations, with a grain set of 63,3% (Table 1).

Table 1
Results of hybridization carried out under Absheron conditions(2015–2016 vegetation year)

Number of hybridized samples, pcs	Number of emasculated spikes, pcs	Number of emasculated florets, pcs	Number of hybrid grains, pcs	Grain set, %	Number of obtained hybrid combinations, pcs
30	59	1023	647	63,3	33,0

3.2. Study of the vegetation period in different generations of intraspecific durum wheat hybrids. In the 2016-2017 growing season, the vegetation period of first-generation (F₁) hybrid combinations was studied, and the number of days from germination to full maturity was compared with the parental forms.

In the F₁ hybrid generation, the vegetation period lasted 202-206 days, while in the parental forms it was 202-208 days. According

to the results obtained, among 33 F₁ hybrid combinations, 39,39% matured earlier than the parents (by 1-4 days), with heterosis values of $h_{true} = -0,98, -2,42$ and phenotypic dominance was in the levels of $h_p = -1, -5$; 15,15% matured later than the parents (by 1–3 days), with heterosis $h_{true} = +0,49$ and phenotypic dominance was in the levels of $h_p = +1, +3$; 39,39% occupied an intermediate position between the parental forms, with heterosis $h_{true} = -0,49, -1,94$ and phenotypic dominance was in the levels of $h_p = -0,5, +1$; and 6,07% matured at the same time as the parental forms, with heterosis $h_{true} = 0$ and phenotypic dominance was in the level of $h_p = 0$. The shortest vegetation periods were observed in the following hybrid combinations: [v. hordeiforme × (Tartar × Garabagh)] × Karol Odesskaya (201 days), Barakatli-95 × Shirvan-5, [Garabagh × Tartar-2] × Mirvari, [Tartar × Kahraba] × Barakatli-95, Mirbashir-50 × Sharq, v. hordeiforme × Mirvari, [v. hordeiforme × (Tartar × Garabagh)] × Zatino (202 days).

In the 2017-2018 growing season, the vegetation period of second-generation (F₂) hybrid combinations was studied. Among the F₂ hybrids, 33,33% matured earlier than both parents, 27,27% matured later than both parents, 36,36% occupied an intermediate position between the parental forms, and 3,04% matured at the same time as the parents.

From the hybrids that matured earlier than both parents, the following combinations matured 1-5 days earlier than the maternal parent and 1-4 days earlier than the paternal parent: Zangezur × Kahraba, [Garabagh × Tartar-2] × Mirvari, [Tartar × Kahraba] × Barakatli-95, Mirbashir-50 × Sharq, [v. hordeiforme × (Tartar × Garabagh)] × Karol Odesskaya, v. hordeiforme × Mirvari, [v. hordeiforme × (Tartar × Garabagh)] × Zatino, v. apulikum × [Tartar × Mirvari], v. apulikum × [Turan × Zedoni-3D-56], v. hordeiforme, v. mursika/2 × [Fadda 98 × Garabagh]. The second-generation (F₂) hybrids listed above also demonstrated earliness compared to both parental forms in the first generation (F₁). Hybrids with early

maturity in the first (F₁) and second (F₂) generations retained this trait in the third (F₃) and fourth (F₄) generations.

3.3. Study of the inheritance of quantitative traits in first-generation (F₁) intraspecific durum wheat hybrids. It is known that tall varieties do not meet the requirements of intensive farming, productivity and quality of grain decreases as a result of lying on the ground in high agrofon. In our research, the analysis of 33 first-generation (F₁) hybrid combinations in the 2016-2017 growing season showed that, in terms of plant height, 9,1% of the hybrids exhibited positive heterosis, 90,9% negative heterosis, 9,1% strong dominance, 6.1% partial dominance, 51,5% intermediate inheritance, and 33,3% depression (Table 2).

Table 2
Combinations differing in the inheritance of plant height in first-generation (F₁) intraspecific durum wheat hybrids

№	Name of the combination	Plant height, cm			h _{true}	h _p
		♀	F ₁	♂		
1.	[Fadda 98 x Garabagh] x Tartar	103	88,0	100	-14,6	-9,00
2.	Zatino x Garagylchig-2	85,0	80,0	89,0	-10,1	-3,50
3.	Turan x Mirbashir-50	102	80,0	98,0	-21,6	-10,0
4.	Turan x Shirvan 5	102	90,0	105	-14,8	-9,00
5.	Mirvari x Turan	88,0	83,0	92,0	-9,78	-3,50
6.	[(Tartar-2 x Zedoni-3D-56) x Tartar 2] x Mirbashir-50	93,0	95,0	98,0	-3,06	-0,20
7.	[Tartar x Kahraba] x Barakatli-95	79,0	78,0	93,0	-16,1	-8,00
8.	Garabagh x Mirbashir-50	91,0	85,0	98,0	-13,3	-2,71
9.	Garagylchig-2 x Barakatli-95	89,0	82,0	93,0	-11,8	-4,50
10.	v.hordeiforme, v.mursika x [Tartar x Mirvari]	140	110	90,0	-21,4	-0,20
11.	[v.apulikum x Altun] x Karol Odesskaya	144	110	95,0	-23,6	-0,39

Note: hp = 0 - no dominance; hp = 1 - complete dominance; hp > 1 - overdominance; 0.5 < hp < 1 - partial dominance; - 0.5 < hp < 0.5 - intermediate inheritance; hp < - 1 - depression.

As seen in Table 2, first-generation (F₁) hybrid combinations obtained from local genotypes Mirvari, Turan, Tartar, Mirbashir-50, Garagylchig-2, Barakatli-95, Garabagh, [Fadda 98 × Garabagh], [Tartar × Kahraba], and foreign genotypes such as Zatino (France)

and Karol Odesskaya (Ukraine), had plant heights below 90 cm (78-88 cm). This indicates that they can be used as genetic sources for developing short and medium-statured varieties.

According to spike length, high heterosis and overdominance were observed in the following first-generation (F_1) durum wheat hybrids: [Parinj x Turan] x Mirvari ($h_{\text{true}} = +4,1\%$; $hp = +3,0$), Zatino x Garagylchig-2 ($h_{\text{true}} = +9,45\%$; $hp = +2,40$), Barakatli-95 x Garagylchig-2 ($h_{\text{true}} = +9,46\%$; $hp = +7,0$), Barakatli-95 x Mirvari ($h_{\text{true}} = +20,5\%$; $hp = +31,0$), Garagylchig-2 x Barakatli-95 ($h_{\text{true}} = +27,0\%$; $hp = +21,0$), and others.

Based on the number of spikelets per spike, the analysis of 33 F_1 hybrids showed that 69,70% of the combinations exhibited overdominance, 6,06% complete dominance, 9,09% partial dominance, and 15,15% depression. Positive heterosis was observed in 72,73% of the hybrids, while negative heterosis occurred in 27,27%.

The number of grains per spike is considered one of the main yield components of wheat and is influenced by environmental factors. In the analysis of 33 hybrids, 54,55% showed overdominance, 3,03% complete dominance, 3,03% partial dominance, 12,12% intermediate inheritance, and 27,27% depression. Positive heterosis was recorded in 51,52% of the hybrids, while 48,48% exhibited negative heterosis.

Regarding grain weight per spike, 66,67% of the combinations exhibited overdominance, 3,03% showed no dominance, and 30,30% showed depression. Positive heterosis was recorded in 63,64% of the hybrids, while 36,36% exhibited negative heterosis. A similar situation was observed in terms of grain weight per spike across the studied combinations. As a result of the research, the F_1 durum wheat hybrids [Parinj x Turan] x Mirvari, Garagylchig-2 x Barakatli-95, Turan x Mirbashir-50, Turan x Shirvan-5, and others demonstrated high heterosis and dominance across all quantitative traits. These genotypes were selected as initial material to be used as donors in hybridization programs.

3.4. Study of transgressive variability in the second (F₂) generation intraspecific durum wheat hybrids. The plant height of 33 second-generation (F₂) hybrids was studied in comparison with the parent forms. Analysis revealed that 33,33% of the hybrid lines showed positive transgression, while 66,67% exhibited negative transgression. The lowest transgression for plant height in the second (F₂) generation was observed in [v.apulikum x Altun] x Karol Odesskaya (Tgs = -17,2), v.hordeiforme, v.mursilka x [Tartar x Mirvari] (Tgs = -16,1), [Giorgio-12-571 x Parinj] x Garabagh (Tgs = -13,0), Mirvari x Turan (Tgs = -9,52), and others.

For spike length in the second (F₂) generation, 75,76% of combinations showed positive transgression, while 24,24% showed negative transgression. The highest transgression for spike length was recorded in Barakatli-95 x Garagylchig-2 (Tgs = +25,0%), [(Tartar-2 x Zedoni-3D-56) x Tartar-2] x Mirbashir-50 (Tgs = +19,2%), [v.hordeiforme x (Tartar x Garabagh)] x Zatino (Tgs = +19,2%), and others. Depending on the combinations, the frequency of transgression for spike length in the second (F₂) generation varied between 12,0% and 100%.

For the number of grains per spike in the second (F₂) generation, both the degree and frequency of transgression were studied. In the parent forms, the number of grains per spike ranged from 46,0 to 65,7, while in the F₂ hybrids it ranged from 48,0 to 68,3. Among the 33 second-generation hybrids studied, 54,55% exhibited positive transgression, while 45,45% exhibited negative transgression. Depending on the combination, the frequency of transgression for the number of grains per spike ranged from 24,0% to 100%.

For grain weight per spike in the second (F₂) generation, the degree and frequency of transgression were examined. In the parent forms, the grain weight per spike ranged from 1,95 g to 3,28 g, while in the F₂ hybrids it ranged from 2,08 g to 3,45 g. Of the 33 second-generation hybrids studied, 66,67% exhibited positive transgression, while 33,33% exhibited negative transgression. Depending on the

combination, the frequency of transgression for grain weight per spike ranged from 36,0% to 100%.

CHAPTER IV. EVALUATION OF DISEASE RESISTANCE IN INTRASPECIFIC HYBRID GENERATIONS OF DURUM WHEAT AND STUDY OF AGRONOMICALLY IMPORTANT TRAITS IN SELECTED GENOTYPES

4.1. Evaluation of hybrid generations for disease resistance and selection of resistant samples. The development and application of disease-resistant varieties through breeding is one of the most relevant issues. During the research years, the infection of first-, second-, and third-generation hybrids by yellow rust, brown rust, stem rust, and powdery mildew diseases was studied, and highly susceptible hybrids were discarded.

In the 2019-2020 growing season, the infection levels of the fourth-generation (F₄) durum wheat hybrids varied (Table 3).

Table 3
Infection level of fourth-generation (F₄) intraspecific durum wheat hybrids with diseases

Yellow rust	Brown rust	Stem rust	Powdery mildew
35,0% - R	90,0% - R	95,0% - 0	90,0% - 1-2 points
20,0 % - 5-10MR	5,0% - 5-10MS	5,0% - 10 -20S	10,0% - 3-4 points
17,5% - 5-20MS	5,0% - 5-10S	-	-
27,5% - 5-40S	-	-	-

Note: 0 - plants show no visible infection, R - resistant, MR - moderately resistant, MS-moderately susceptible, S-susceptible. Powdery mildew: 1-2 points - resistant, 3-4 points - moderately resistant, 5-6 points - moderately susceptible, above 6 points - susceptible

Of the 40 fourth-generation (F₄) hybrids studied, 35,0% were resistant (R) to yellow rust, 20,0% were moderately resistant (5-10 MR), 17,5% were moderately susceptible (5-20 MS), and 27,5% were susceptible (5-40 S). Among the hybrids, 90,0% were resistant (R) to brown rust, 5,0% were moderately susceptible (5-10 MS), and 5,0% were susceptible (5-10 S). In durum wheat hybrids, 95,0% showed no infection (0) with stem rust, while 5,0% were susceptible

(10-20 S). For powdery mildew, 90,0% of the hybrids were resistant (1-2 points), and 10,0% were moderately resistant (3-4 points). The research results showed that, compared to brown rust (5.0%) and stem rust (5,0%), hybrids were more affected by yellow rust (27,5%). Since highly infected hybrids were eliminated in the third (F₃) generation, the infection rate in the fourth (F₄) generation was relatively low.

4.2. Study of coleoptile length, plant height, structural elements, and productivity in fourth-generation (F₄) intraspecific durum wheat hybrid lines. The study of coleoptile length in wheat at the initial stage allows obtaining information about the genotype. In the 2019-2020 growing season, coleoptile length was studied in 40 fourth-generation (F₄) intraspecific durum wheat hybrid lines in comparison with the standard durum wheat variety Bärəkətli-95 (Figure 1).

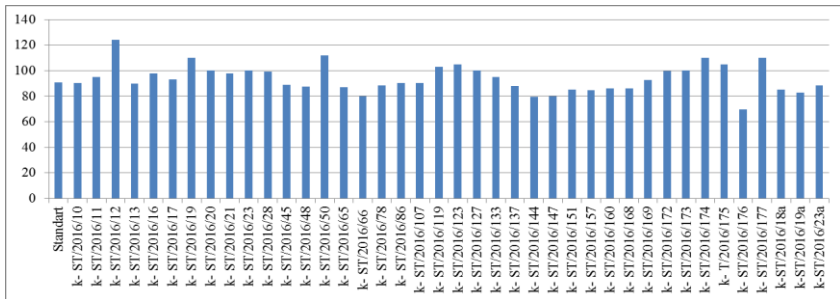


Figure 1. Coleoptile length in fourth-generation (F₄) intraspecific durum wheat hybrids, cm

Sowing was carried out on October 23, 2019, and germination was observed 8-10 days after sowing, depending on the hybrid lines. In the newly emerged seedlings, the coleoptile length of the standard Barakatli-95 variety was 4,8 cm, while in the hybrid lines it ranged from 3,8 to 6,2 cm. In 72,5% of the studied hybrids, the coleoptile was 0,2-1,4 cm longer than that of the standard Barakatli-95 variety, while in 27,5% it was 0,1-1,0 cm shorter than the standard.

In the research, the plant height of 40 fourth-generation (F_4) intraspecific durum wheat hybrid lines was studied in comparison with the parental forms (Figure 2).

Since the parental forms used in hybridization had different heights, the plant height of the fourth-generation (F_4) hybrids also varied. The height of the standard Barakatli-95 variety was 90,8 cm, while the height of the hybrid lines ranged from 69,8 to 124 cm. 50% of the hybrid lines were 0,6-21,0 cm shorter than the standard, while 50% were 1,9-33,2 cm taller.

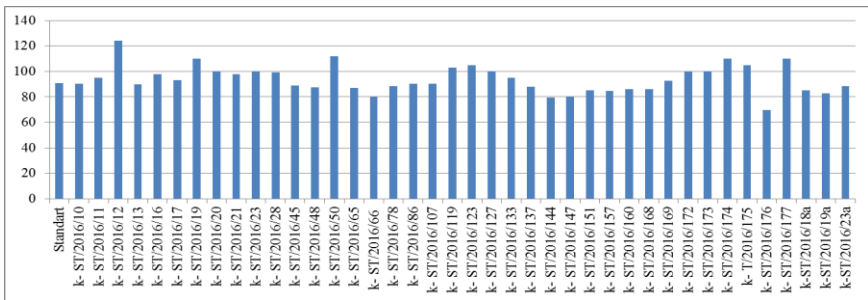


Figure 2. Plant height in fourth-generation (F_4) intraspecific durum wheat hybrids, cm

As a result of hybridization, short-stemmed hybrid lines such as (v. hordeiforme × (Tartar × Garabagh) × Garabagh) × Zatino, k-ST/2016/176 - 69,8 cm; [Turan × Zedoni-3D-56] × Garagylchyg 2, k-ST/2016/144 - 79,6 cm; [Garabagh × Tartar-2] × Mirvari, k-ST/2016/66; [Turan × Zedoni-3D-56] × Garagylchyg 2, k-ST/2016/147 - 80,0 cm, and others are recommended for use as initial material in the hybridization process for the development of short-stemmed varieties. Considering the importance of yield components in increasing productivity, the spike length, number of spikelets, number of grains per spike, grain weight, and 1000-grain weight were studied in the hybrid lines, and their yield components were compared and grouped with those of the widely cultivated durum wheat variety Barakatli-95 in the republic. In the 2019-2020 growing season, while the Barakatli-95 variety had a spike length of 6,5 cm, number of spikelets 19,6, number of grains per spike 39,4,

grain weight 2,2 g, and 1000-grain weight 55,2 g, in 87,5% of the hybrid lines the spike length was higher by 0,1-3,9 cm; in 77,5% the number of spikelets was higher by 0,2-6,8; in 75,0% the number of grains per spike was higher by 0,8-41,4; in 85,0% the grain weight was higher by 0,1-2,3 g; and in 20,0% the 1000-grain weight was higher by 0,1-2,6 g compared to the standard. Hybrid lines such as [Parinj × Turan] × Mirvari, k- ST/2016/13, [Garabagh × Tartar-2] × Mirvari, k- ST/2016/65, Garabagh × Mirbashir-50, k- ST/2016/160, and others, with all yield components exceeding the standard, are recommended for use as valuable initial material in hybridization to enrich the germplasm of local wheat genotypes. These samples have been included in trials for the creation of new durum wheat varieties in the irrigated regions (Tartar Regional Experimental Station, Nakhchivan Autonomous Republic Araz Scientific Production Unit) and rainfed (unirrigated) regions (Jalilabad Regional Experimental Station) of the republic.

The productivity and grain quality indicators of the fourth-generation (F₄) intraspecific hybrid lines and parental forms were studied. The productivity of the parental forms used in hybridization varied between 310-650 g depending on the genotype, while the productivity of the hybrid lines ranged from 300-998 g (Table 4).

Table 4
Fourth-generation (F₄) durum wheat hybrid lines with higher productivity than both parents

№	Hybrid lines	Yield, g/m ²		
		♀	F ₄	♂
1.	[Fadda 98 x Garabagh] x Tartar, k- ST/2016/16	586	697	522
2.	[[Fadda 98 x Garabagh] x Tartar, k- ST/2016/19	586	852	522
3.	[[Fadda 98 x Garabagh] x Tartar, k- ST/2016/20	586	956	522
4.	[Fadda 98 x Garabagh] x Tartar, k- ST/2016/21	586	938	522
5.	Zatino (France) x Garagylchig-2, k- ST/2016/45	420	560	510
6.	Zatino (France) x Turan, k- ST/2016/50	420	594	510
7.	Mirvari x Turan, k- ST/2016/78	366	640	510
8.	Garabagh x Mirbashir-50, k- ST/2016/160	430	648	444
9.	v.hordeiforme x (Tartar x Mirvari), k-ST/2016/18a	540	650	475
10.	v.apulikum x (Tartar x Mirvari), k-ST/2016/23a	330	530	475

The productivity of the indicated hybrid lines - [Fadda 98 x Garabagh] x Tartar, k-ST/2016/17 - 998 g; [Fadda 98 x Garabagh] x Tartar, k-ST/2016/20 - 956 g; [Fadda 98 x Garabagh] x Tartar, k-ST/2016/21 - 938 g; [Fadda 98 x Garabagh] x Tartar, k-ST/2016/23 - 774 g, and others - was higher than that of both parent forms.

4.3. Study of quality indicators in intraspecific fourth (F₄) generation hybrid lines of durum wheat. In the studies, the following quality traits were examined in the grain of 40 fourth-generation (F₄) intraspecific durum wheat hybrid lines and their parent forms: 1000-grain weight (g), vitreousness (%), gluten content (%), and Gluten Deformation Index (GDI, device indicator). In the parent forms, the 1000-grain weight ranged from 33,6 to 56,2 g, while in the hybrid lines it ranged from 43,0 to 57,8 g. The vitreousness of the parent grains varied from 72,8% to 100%, while in the hybrid lines it ranged from 32,5% to 100%.

The amount and quality of gluten directly determine the baking quality of bread. Gluten content ranged from 20,4% to 36,8% in the parent forms and from 17,2% to 32,0% in the hybrid lines. The protein content in durum wheat hybrids ranged from 12,3% to 13,4% in the parent forms, and from 12,6% to 14,7% in the hybrid lines (Table 5).

Table 5.
Fourth-generation (F₄) durum wheat hybrid lines distinguished by quality indicators

	Hybrid lines	Weight of 1000 grains, gr	Vitreousness, %	Gluten, %	GDI, c.g.	Protein, %
1.	[Fadda 98 x Garabagh] x Tartar, k- ST/2016/16	45,2	82,0	27,8	102,8	13,7
2.	[Fadda 98 x Garabagh] x Tartar,k- ST/2016/19	43,4	53,5	22,8	99,9	14,0
3.	k- ST/2016/20	44,2	52,5	25,4	98,2	14,2
4.	k- ST/2016/21	41,8	60,5	25,8	93,3	14,0
5.	k- ST/2016/45	44,8	78,5	25,6	100,3	13,9
6.	k- ST/2016/50	48,2	100	31,6	103,4	14,0
7.	k- ST/2016/78	48,0	86,0	27,5	94,9	14,3
8.	k- ST/2016/160	54,0	100	28,8	100,4	13,8
9.	k- ST/2016/18a	43,8	87,0	28,8	100	14,5
10.	k-ST/2016/23a	50,8	87,2	31,8	97,5	14,3

Although hybrid lines such as [Parinj x Turan] x Mirvari, k-ST/2016/16, [Fadda 98 x Garabagh] x Tartar, k-ST/2016/17, [Fadda 98 x Garabagh] x Tartar, k-ST/2016/20, v.hordeiforme x (Tartar x Mirvari), k-ST/2016/18a, etc., had moderate productivity, their complex technological-quality indicators were generally high, and they were selected as initial material and included in the breeding program.

4.4. Statistical analysis of correlation relationships in intraspecific fourth (F₄) generation hybrid lines of durum wheat.

In 40 fourth-generation (F₄) durum wheat hybrid lines, correlations among quantitative traits were studied. Between coleoptile length and plant height, spike length, number of spikelets, number of grains per spike, grain weight, and 1000-grain weight, there was an insignificant positive correlation ($r=+0,026-0,267$). Between plant height and spike length, number of spikelets, and grain weight per spike, there was an insignificant positive correlation ($r=+0,067-0,295$); with the number of grains per spike there was a little significant positive correlation ($r=+0,400^*$), and with 1000-grain weight there was a low negative correlation ($r=-0,342^*$). Between spike length and plant height and 1000-grain weight, there was an insignificant positive correlation ($r=+0,172-0,267$), while with number of spikelets, number of grains per spike, and grain weight, there was a moderately significant positive correlation ($r=+0,530^{**}-0,838^{**}$). Between the number of spikelets and number of grains per spike and grain weight, there was a significant positive correlation ($r=+0,662^{**}-0,826^{**}$), but with 1000-grain weight an insignificant negative correlation ($r=-0,018$). Between number of grains per spike and grain weight per spike, there was a significant positive correlation ($r=+0,802^{**}$), while with 1000-grain weight it was insignificant and negative ($r=-0,018$). Between grain weight per spike and 1000-grain weight, an insignificant positive correlation ($r=+0,244$) was observed.

Between productivity and protein, there was an insignificant positive correlation ($r=+0,238$); with 1000-grain weight, an insignificant negative correlation ($r=-0,193$); with GDI a low

negative correlation ($r=-0,402^*$); with vitreousness ($r=-0,705^{**}$) and gluten a moderately significant negative correlation ($r=-0,531^{**}$). Between 1000-grain weight and vitreousness, gluten, and protein, there was an insignificant positive correlation ($r=+0,049-0,097$), but with GDI an insignificant negative correlation ($r=-0,011$). Between vitreousness and gluten, there was a significant positive correlation ($r=+0,765^{**}$); with GDI a significant positive correlation ($r=+0,453^*$); with protein an insignificant negative correlation ($r=-0,140$). Between gluten and GDI, there was a significant positive correlation ($r=+0,551^{**}$), while with protein it was insignificant and positive ($r=+0,184$).

Results

1. The study of hereditary variability and the transmission of traits (phenotypic dominance, heterosis, transgression) in the first and second (F_1-F_2) generations of intraspecies durum wheat hybrids makes it possible to evaluate the potential genetic characteristics of genotypes used in hybridization for variety creation at the initial stages of breeding. Thus, in our research, the donor ability for early maturity was identified in local varieties and samples such as Shirvan-5, Mirvari, Sharg, Garagylchyg-2, Mirbashir-50, Barakatli-95, [v.hordeiforme x (Tartar x Garabagh)], v.hordeiforme, and in foreign varieties such as Zatino (France), Karol Odesskaya (Ukraine), etc.

2. As a result of the research, among the 33 combinations of first-generation (F_1) durum wheat hybrid lines, Barakatli-95 x Shirvan 5, Zangezur x Kahraba, [Garabagh x Tartar-2] x Mirvari, [Tartar x Kahraba] x Barakatli-95, Mirbashir-50 x Sharg, v.hordeiforme x Mirvari, etc., were selected for early maturity; [Fadda 98 x Garabagh] x Tartar, Zatino x Garagylchyg-2, Turan x Shirvan 5, Mirvari x Turan, [Tartar x Kahraba] x Barakatli-95, etc., were selected for semi-dwarf and medium plant height; [Parinj x Turan] x Mirvari, Barakatli-95 x Shirvan 5, Zatino x Garagylchyg-2, Barakatli-95 x Garagylchyg-2, etc., were selected for high

productivity elements, and included in the hybridization program for use in future breeding work.

3. In the first-generation (F_1) durum wheat hybrids, high dominance for yield components was observed for spike length in Barakatli-95 x Mirvari (hp=+31,0), Garagylchyg-2 x Barakatli-95 (hp=+21,0), [v.apulicum x Altun] x Karol Odesskaya (hp=+20,6), etc.; for the number of spikelets per spike in Turan x Shirvan-5 (hp=+29,0), [Parinj x Turan] x Mirvari (hp=+16,5), Zatino x Garagylchyg-2 (hp=+7,00), etc.; for the number of grains per spike in Garabagh x Mirbashir-50 (hp=+21,0), v.hordeiforme x [Icasyr x Mirvari] (hp=+8,50), [Fadda 98 x Garabagh] x Tartar (hp=+6,00), etc.; and for grain weight per spike in [Turan x Zedoni-3D-56] x Garagylchyg-2 (hp=+21,0), Turan x Shirvan 5 (hp=+18,0), Garabagh x Mirbashir-50 (hp=+17,0), etc.

4. In the 33 second-generation (F_2) hybrids studied, the highest degree and frequency of transgression were observed in spike length (75,76-100%) and in grain weight per spike (66,67-100%).

5. Stable hybrid lines resistant to complex diseases such as k-ST/2016/40, k-ST/2016/123, k-ST/2016/172, k-ST/2016/137, k-ST/2016/160, k-ST/2016/169, k-ST/2016/93, etc., were included in trials at the higher stages of breeding.

6. Among the stabilized hybrid lines, k-ST/2016/16, k-ST/2016/48, k-ST/2016/65, k-ST/2016/66, k-ST/2016/78, k-ST/2016/86, etc., were selected for early maturity; k-ST/2016/176, k-ST/2016/144, k-ST/2016/66, k-ST/2016/147, etc., for short plant height; k-ST/2016/13, k-ST/2016/65, k-ST/2016/160, k-ST/2016/173, k-ST/2016/174, k-ST/2016/176, k-ST/2016/18a, etc., for complex high productivity and quality indicators, and a trait collection was created.

7. As a result of the research, 40 stabilized hybrid lines with high productivity, quality indicators, and disease resistance such as k-ST/2016/13, k-ST/2016/16, k-ST/2016/21, k-ST/2016/50, k-ST/2016/78, k-ST/2016/86, k-ST/2016/160, k-ST/2016/18a, etc., were selected and included in trials in irrigated regions of the republic (Tartar Regional Experimental Station, Araz Scientific-

Production Association of the Nakhchivan Autonomous Republic) and in non-irrigated rainfed regions (Jalilabad Regional Experimental Station).

8. As a result of the conducted research, the new durum wheat varieties Taj 20, Galib, and Zaur-95, of which I am a co-author, were submitted to the Agrarian Services Agency under the Ministry of Agriculture of the Republic of Azerbaijan for regionalization.

9. The durum wheat variety Taj 20 (Patent No. 00353), of which I am a co-author, has been registered since 2023 in the “State Register of Protected Breeding Achievements Permitted for Use in Agricultural Production in the Territory of the Republic of Azerbaijan.”

Recommendations

1. It is recommended to use the hybrid lines created through hybridization - [v.hordeiforme x (Tartar x Garabagh) x Garabagh] x Garagylchyg 2, [v.hordeiforme x (Tartar x Mirvari)] x Tartar, [Turan x Zedoni-3D-56] x Garagylchyg 2, [Garabagh x Tartar-2] x Mirvari, v.apulicum x [Tartar x Mirvari], [Giorgio-12-571 x Parinj] x Garabagh, Garabagh x Mirbashir-50, v.apulicum x [Tartar x Mirvari], [Fadda 98 x Garabagh] x Tartar - as initial material in the hybridization process for the development of short-stemmed (70-90 cm) varieties.

2. It is advisable to use hybrid lines with catalog numbers k-ST/2016/13, k-ST/2016/16, k-ST/2016/21, k-ST/2016/50, k-ST/2016/78, k-ST/2016/86, k-ST/2016/160, and k-ST/2016/18a, which possess complex positive traits, as valuable initial material.

3. The durum wheat variety Taj 20, patented in 2023 (Patent No. 00353) and registered in the “State Register,” as well as the durum wheat varieties Galib (2021) and Zaur-95 (2024), created during the research years and submitted to the “Agrarian Services Agency” for regionalization, are recommended for cultivation in the country’s rainfed, moisture-supplied rainfed, irrigated plain, and fully moisture-supplied foothill regions.

The list of published scientific papers on the dissertation topic

1. Hajiyeva S.T. Investigation of some quantitative traits in the first-generation (F_1) hybrids of durum wheat // Baku: Proceedings of the Scientific Works of the Research Institute of Crop Husbandry, - 2018, vol. 29, - pp. 111–116.

2. Hajiyeva S.T., Mamedova S.M., Hajiyeva S.K., Karimova Sh.R. Resistance of the first-generation (F_1) hybrids of durum wheat to fungal diseases under Absheron conditions // Fundamental and Applied Problems of Modern Ecology and Plant Protection, Proceedings of the International Scientific and Practical Conference of the Faculty of Plant Protection of Kharkiv National Agrarian University named after V.V. Dokuchaev, October 11-12, 2018, - Kharkiv, - pp. 39-41.

3. Hajiyeva S.T. The role of initial material in the development of new high-yielding durum wheat varieties in Azerbaijan // National Academy of Agrarian Sciences of Ukraine, V.Ya. Yuryev Institute of Plant Production, “Modern Technologies for Increasing the Genetic Potential of Plants,” Proceedings of the International Scientific and Practical Conference dedicated to the 100th anniversary of the National Academy of Agrarian Sciences of Ukraine and the 110th anniversary of the founding of the V.Ya. Yuryev Institute of Plant Production, July 4-5, 2018, - Kharkiv, - pp. 53-54.

4. Hajiyeva S.T., Mammadova S.M., Hajiyeva S.K., Khudayev F.A., Asgarli R.R. Investigation of technological-quality indicators of durum wheat accessions of various geographical origins // Ministry of Education of the Republic of Azerbaijan, Azerbaijan Cooperation University, Azerbaijan Economists Union, Agrarian Science and Information Advisory Center of the Ministry of Agriculture of the Republic of Azerbaijan. Proceedings of the International Scientific and Practical Conference dedicated to the 100th anniversary of the Azerbaijan Democratic Republic: “Ensuring food security of the Independent Azerbaijan State and increasing the competitiveness of the agrarian sector,” June 1-2, 2018, - Baku, - pp. 614-617.

5. Hajiyeva S.T., Mammadova S.M., Karimova Sh.R., Ibrahimov E.R. Investigation of the resistance to rust diseases of the third (F_3) generation durum wheat hybrids in the Absheron condition // “Problems of Ecology and Environmentally Oriented Plant Protection,” Proceedings of the International Scientific and Practical Conference of the Faculty of Plant Protection of Kharkiv National Agrarian University named after V.V. Dokuchaev, October 17-18, 2019, - Kharkiv, - pp. 24-25.

6. Hajiyeva S.T., Mammadova S.M., Hajiyeva S.K. Dependence of crop productivity parameters and technological quality indicators on parental forms // Research in: Agricultural & Veterinary Sciences, - Azerbaijan, Vol. 4, No. 3, - 2020, - pp. 116-124.

7. Hajiyeva S.T. Investigation of plant height in the fourth-generation hybrid lines of durum wheat // Baku: Proceedings of the Research Institute of Crop Husbandry, “Muellim” Publishing House, - 2020, vol. 2 (31), No. 2, - pp. 52-57.

8. Hajiyeva S.T., Karimova Sh.R., Hajiyeva E.A. Investigation of the resistance of the fourth-generation (F_4) hybrids of durum wheat to rust diseases under Absheron conditions // “Problems of Ecology and Environmentally Oriented Plant Protection,” Proceedings of the International Scientific and Practical Conference of the Faculty of Plant Protection of Kharkiv National Agrarian University named after V.V. Dokuchaev, dedicated to the 130th anniversary of academician T.D. Strakhov, October 29–30, 2020, - Kharkiv, - pp. 32-35.

9. Hajiyeva S.T. Investigation of the vegetational period in the fourth lines of durum wheat // Research in: Agricultural & Veterinary Sciences, - Azerbaijan, - 2021, - pp. 78-83.

10. Hajiyeva S.T. Hybrid generations obtained in durum wheat varieties and their investigation // Ganja: Scientific News Journal of Azerbaijan Technological University, Ministry of Education of the Republic of Azerbaijan, - 2022, No. 1/38, - pp. 189-195.

11. Hajiyeva S.T., Khudayev F.A. Heritability of plant height in first-generation (F_1) hybrids of durum wheat // Baku: Proceedings

of the Pedagogical University, Series of Mathematics and Natural Sciences, - 2022, vol. 70, No. 2, - pp. 115-122.

12. Hajiyeva S.T., Khudayev F.A., Mammadova S.M. Prospects for the development of durum wheat varieties with high yield and technological-quality indicators // Ministry of Agriculture of the Republic of Azerbaijan, Research Institute of Crop Husbandry. Proceedings of the Virtual International Scientific and Practical Conference “Current Issues of Modern Agrarian and Biological Sciences: Global Challenges and Innovations,” - Baku, - 2022, - pp. 25-29.

13. Hajiyeva S.T., Khudayev F.A., Hajiyeva S.K. The role of initial material in the development of new durum wheat varieties // Interdisciplinary Scientific and Applied Journal *Biosphere*, - 2022, St. Petersburg, vol. 14, No. 4, - pp. 420-422.

14. Hajiyeva S.T., Hajiyeva S.K. Study of yield elements in fourth-generation (F_4) hybrid lines of durum wheat // Journal *Bulletin of Science and Practice*, - Russia, - 2023, vol. 9, No. 10, - pp. 57-61.

15. Hajiyeva S.T., Novruzlu Q.A., Karimova Sh.R. Prospects for the development of new disease-resistant durum wheat varieties // Ministry of Science and Education of the Republic of Azerbaijan, Institute of Soil Science and Agrochemistry, Lankaran State University. Proceedings of the Scientific and Practical Conference “The Role of Heydar Aliyev in the Development of Agrarian Science,” dedicated to the “Year of Heydar Aliyev,” May 18–19, 2023, - Lankaran, - pp. 89-91.

16. Khudayev F.A., Abdullayev A.M., Hajiyeva S.K., Asadov Sh.S., Ismayilov T.T., Huseynov S.I., Azizova N.H., Hajiyeva S.T. “Tac 20” durum wheat variety, variety code: 2007451, Patent No. 00248, included in the State Register of protected plant breeding achievements permitted for use in agricultural production in the Republic of Azerbaijan, Official Publication, November 18, 2023, - pp. 221-280 (info@axa.gov.az, Plant Variety Registration).

17. Khudayev F.A., Abdullayev A.M., Hajiyeva S.K., Hajiyeva S.T., Valiyeva S.J. Study of the gene pool of durum wheat (*T. durum* Desf.) and its use in breeding // Baku: Proceedings of the

Research Institute of Crop Husbandry, - 2024, vol. 6(35), No. 1, - pp. 33-43.

18. Abdullayev A.M., Khudayev F.A., Hajiyeva S.T. Investigation of the vegetational period in intra-varietal first-generation (F₁) hybrids of durum wheat // Research Institute of Crop Husbandry, Institute of Viticulture and Winemaking. Proceedings of the International Scientific and Practical Conference "Modern Agriculture under Global Climate Change: Current Problems, Development Trends, Prospects," - Baku, - 2024, - pp. 112-113.

A handwritten signature in blue ink, appearing to read 'Hajiyeva'.

The dissertation defense will take place on "21" *october* 2025 at 11⁰⁰ o'clock during the meeting of the Dissertation Council FD 1.29 operating under the Agricultural Scientific Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan.

Address: AZ1098, Pirshaghi settlement, No. 2 Sovkhoz, Agricultural Scientific Research Institute, Baku, Azerbaijan Republic.

The dissertation is available for review at the library of the Agricultural Scientific Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan.

The electronic version of the abstract has been posted on the official website of the Agricultural Scientific Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan (www.aetei.az).

Abstract was sent to the required addresses on "18" *september* 2025

Printed and signed on: 04.09.2025

Paper format: 60x84^{1/16}

Volume: 38163

Number of copies printed: 20