REPUBLIC OF AZERBAIJAN

On the rights of the manuscript

ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

DEVELOPMENT OF PURE LINES OF ZONED TOMATO VARIETIES (L. ESCULENTUM MILL.) AND ORGANIZATION OF PRIMARY SOWING

Speciality: 3103.04-Selection and seed production

Field of science: Agricultural sciences

Applicant: **Majid Bilal Adigozalov**

Baku – 2024

The work was conducted in the laboratories of processing, storage, quality, and functional analysis at the public legal entity "Scientific Research Institute of Agriculture" under the Ministry of Agriculture of the Republic of Azerbaijan.

Scientific supervisor: doctor of Agricultural Sciences,
associate professor
Alisoltan Hajibaba oglu Babayev

Official opponents: doctor of Agricultural Sciences,
associate professor
Aladdin Nemat oglu Sadiqov

Ph.D. in Agricultural Sciences,
associate professor
Afat Sabir Huseynova

Ph.D. in Agricultural Sciences,
Konul Elchin Babayeva

Dissertation council BFD 1.29 of Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at the public legal entity Scientific Research Institute of Agriculture of the Ministry of Agriculture of the Republic of Azerbaijan

Chairman of the Dissertation council:
doctor of Agricultural Sciences
Jalal Shamil oglu Mammadov

Scientific secretary of the Dissertation council:
Ph.D. in Agricultural Sciences,
associate professor
Sevda Kamil Hajiyeva

Chairman of the scientific seminar:
doctor of Agricultural Sciences,
associate professor
Aladdin Alirza oglu Tagıyev

INTRODUCTION

Relevance of the topic and level of study. The Strategic Road Map (Strategic Goal 7.2.2, Priority 2.2.) emphasizes the importance of increasing self-sufficiency in food production by boosting output without expanding existing agricultural lands, progressively replacing imports, and enhancing local seed production. Notably, it highlights substantial opportunities to increase the production and export of several key products, including tomatoes[1].

Azerbaijan, with its favorable soil and climate conditions for vegetable cultivation, has long seen tomatoes dominate as the primary vegetable in terms of sown area, production volume, and consumption. Increasing tomato production is especially important for ensuring year-round availability of vegetables within recommended nutritional standards. As a profitable industry with strong export potential, tomato cultivation holds a significant role in the agricultural economy. Currently, tomato production stands as the most lucrative sector within Azerbaijan's non-oil industry.

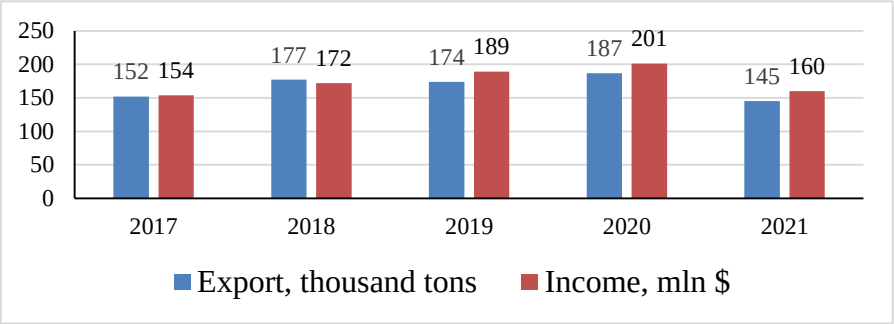

Figure 1. Export of tomatoes from the Republic of Azerbaijan [2]

[1] Azərbaycan Respublikasında kənd təsərrüfatı məhsullarının istehsalına və emalına dair Strateji Yol Xəritəsi // 6 dekabr 2016-cı il,-Bakı: Qanun,-2016. -177 s.

[2] Azərbaycan Respublikasında 2021-ci ildə kənd təsərrüfatı bitkilərinin əkin sahəsi, məhsul yığımı və məhsuldarlığı haqqında // Azərbaycan Respublikası Dövlət Statistika Komitəsi //-Bakı:-2022. -787 s.

Although tomato production and exports have increased in our country, challenges within the industry's seed production system remain significant[3]. Farmers still rely on imports for access to durable, high-yielding tomato varieties and hybrid seeds. Ensuring a stable supply of locally produced tomato seeds, reducing import dependence, and transitioning to domestic seed production are critical challenges for our country's agricultural sector, including advancements in breeding and seed science[4]. Therefore, our country needs to explore the potential of utilizing valuable, adaptable genotypes-particularly zoned varieties-in breeding programs. Building a breeding system that incorporates new technologies for tomato seed production and establishing a reliable seed fund are crucial steps forward.

According to principles of selective breeding and international best practices, the solution lies in utilizing adaptable local genotypes as source material. These local genotypes, having been cultivated in our country for many years, possess high adaptability and are regarded as valuable assets for breeding efforts. Their high productivity and excellent fruit quality make them well-suited to meet population needs.

Maintaining the productivity, stability, and flavor qualities of these genotypes-and reliably transferring these traits to new varieties and F1 hybrids through breeding-is achievable by using pure-line source material[5].

There is a pressing need to study the economic and biomorphological characteristics of zoned tomato varieties, their adaptability to stress and major diseases, and to develop pure lines and conduct foundational research for organizing primary seed production. This work is a crucial component of broader efforts to protect biodiversity in our country.

To ensure the stability and resilience of locally developed F1

[3] Azərbaycan Respublikasında "2008-2015-ci illərdə əhalinin ərzaq məhsulları ilə etibarlı təminatına dair Dövlət Proqramı" // 2 mart 2001-ci il (25 avqust 2008-ci il tarixdə olan dəyişiklik və əlavələr). //-Bakı: Qanun,-2009. № 3004.

[4] Toxumçuluq haqqında Azərbaycan Respublikasının Qanunu, I hissə // Azərbaycan Respublikasının Prezidenti Heydər Əliyev Bakı şəhəri, 11 mart 1997-ci il №257-IQ.

[5] Иоганнсен, В.Л. О наследовании в популяциях и чистых линиях / В.Л. Иоганнсен.-Москва-Ленинград: «Полиграфкнига», -1935.-78 с.

hybrids, a collection of genetically pure parental lines from zoned tomato varieties has been established, and primary seed production has been organized. In light of global climate change, it is increasingly pertinent to re-evaluate the influence of genetic and agroecological conditions on the biomorphological and economically significant traits of local genotypes.

Object and subject of research: The study selected 77 tomato varietal samples, including zoned selection varieties of both local and foreign origin, promising lines, and gene pool material listed in the State Register, of which 74 were analyzed. This research focuses on the systematic and comprehensive evaluation of these genotypes as source material, the development of pure lines, and establishing a scientific foundation for the initial selection of these purified lines.

The purpose and objectives of the study. The objective of this research is to investigate the biomorphological and economically significant traits of zoned tomato varieties as source material, develop genetically pure lines, and establish a foundation of pure-line material for the selection of local F1 hybrids that exhibit heterosis effects and are resilient to stress factors.

To achieve this objective, the following tasks were addressed:

– Collecting and assessing the genetic diversity of zoned tomato varieties, with a focus on their key biomorphological and economically valuable traits;

– Developing pure lines through individual selection, based on principles of differentiation, uniformity, and stability, to identify defining characteristics of each varietal sample;

– Analyzing, refining, and categorizing the trait stability within the resulting pure-line samples to maintain varietal integrity;

– Evaluating the resilience of selected pure lines to stress factors, including major diseases, under field conditions in a natural setting;

– Organizing primary breeding of available pure lines based on scientific principles;

– Conducting on-farm trials of selected pure lines to assess their economic viability.

Research methods: During the organization of field experiments, the "Methodology for Organizing Field Experiments" by B.A. Dospeksov (1985) was employed. For phenological observations of plants, the "Methodology of Field Experiments in Horticulture" by S.S. Litvinov (2011) served as the primary reference. When obtaining pure lines through individual selection, the resource "On Heredity in Populations and Pure Lines" by V.L. Johansen (1935) was utilized. For organizing primary seed production, the "Methodological Bases for Primary Seed Production of Regional Varieties of Vegetables, Melons, and Potatoes"(ETI, 2013) and the "Rules for Approval of Primary Seed Production and Planting of Vegetables, Melons, and Potatoes" (TETI, 2019) were followed. The dispersion analysis of the research results and the relationships between quantitative and qualitative characteristics were conducted using Pearson correlation analysis. The appearance and taste of the fruits were evaluated by the organoleptic method. The dry matter content in the fruits was measured using the thermogravimetric method by drying the fruit at 105°C until reaching a constant weight or time, in accordance with AZS 937:2023. Total acidity was determined using the alkaline titration method (AZS 25555.0:2023), while sugar content was measured with a PA-130 refractometer from KEM Kyoto Electronics. Vitamin C levels were analyzed using the Murray method, and nitrate levels were assessed using a SOEKS nitrate tester.

The main provisions submitted for defense:

1. The potential of zoned tomato varieties as source material for breeding resistant varieties and F1 hybrids with heterotic effects under open-field conditions in a changing climate was scientifically validated.

2. The biomorphological and economically important traits of zoned tomato varieties were evaluated, and pure lines were developed.

3. To enhance the intensity and efficiency of breeding efforts, the assessed pure lines were classified based on maturity, productivity, and biochemical characteristics.

4. The correlations between quantitative and qualitative traits were analyzed and established.

5. The resistance of pure lines to stress factors and major dis-

eases was evaluated under field conditions.

6. Primary breeding of pure lines with desirable complex traits was conducted following scientific principles. Production trials were carried out, and the economic profitability of the lines was assessed.

Scientific novelty: The scientific novelty of this research lies in the comprehensive study of zoned tomato varieties to identify resistant varieties and develop local F1 hybrids. The work includes the production of genetically pure lines and the establishment of a source material collection comprising homozygous parental lines.

Practical and theoretical value of the work: The study of zoned tomato varieties, considered as local genotypes as the source material, obtaining pure lines and their grouping by important selection traits will speed up the selection of local F1 hybrids with the heterosis effect, the correct selection of parental lines, increasing the intensity of tomato production, have theoretical and practical significance in providing farms with local seeds in the future and in the production of environmentally friendly tomatoes.

Involvement of zoned breeding varieties in research work increases the practical significance of scientific work on the restoration of seed genetic diversity of tomatoes, and also has theoretical significance for further breeding work.

Approbation and application: Contributed to the preparation of a booklet (Tomato, 2018) and two books (Technology of Cultivation of Vegetable, Melon, and Potato Plants and Phenological Calendar, Baku, 2019; Annual Calendar of Vegetable Grower's Activities, Baku, 2020), all related to the dissertation topic. A total of 19 scientific works have been published, including 6 scientific articles and 13 conference proceedings presented at various prestigious events:

IV International Scientific and Practical Conference, held at the Mayak Experimental Station of the National Academy of Sciences of Ukraine (Chernihiv region, 2018); "Academician Jalal Aliyev and Genetic Resources of Biological Diversity," dedicated to the 90th anniversary of Academician Jalal Aliyev, held at the Azerbaijan State Agrarian University (Ganja, 2018); "Development of Ecological Agriculture in Azerbaijan," Republican Scientific and Practical Confer-

ence (Ganja, 2019); International Scientific and Practical Conference "Application of Innovations in the Development of Veterinary Science," held at the Veterinary Research Institute (Baku, 2019); II International Scientific and Practical Conference (Ukraine, 2020); III International Scientific and Practical Conference of the National Academy of Sciences of Ukraine (Kharkiv, 2020); Interdisciplinary Conference, dedicated to the 98th anniversary of the birth of National Leader Heydar Aliyev, titled "Heydar Aliyev's Legacy in the Development Strategy of Azerbaijan," held at West Caspian University (Baku, 2021); Republican Scientific Conference at West Caspian University, titled "New Directions for the Development of Agriculture and Environmental Protection" (Baku, 2021); IV International Scientific and Practical Conference, held at the Mayak Experimental Station (Kharkiv, 2021); III International Scientific and Practical Conference "Agriculture-2021" (Nikolaevsky, 2021); IV International Scientific and Practical Conference (Kharkiv, 2021); Scientific and Practical Conference "Republic," organized at the Azerbaijan State Agrarian University on the topic "Application of Scientific and Pedagogical Production Trends in the Development of Priority Production Areas in Horticulture" (Ganja, 2022, with two articles); Republican Scientific and Practical Conference, dedicated to the 100th anniversary of the birth of National Leader Heydar Aliyev, titled "New Views and Approaches in the Development of Applied Sciences and the Agricultural Sector" (Ganja, 2023).

In addition to these conferences, reports and discussions were presented at meetings of scientific councils, departments, and laboratories of the Research Institute of Horticulture. The industrial testing of research findings was conducted on farms operated by AMBU LLC, Marso İcma Fermer LLC, and Amiri 600 LLC in the Lankaran region.

The name of the organization where the dissertation work was completed: The work was conducted in the laboratories of processing, storage, quality, and functional analysis at the public legal entity “Scientific Research Institute of Vegetables” under the Ministry of Agriculture of the Republic of Azerbaijan.

The total volume of the dissertation, with a breakdown of the volume for each structural section: The main part of the dissertation includes an introduction, five chapters, conclusions, recommendations, a list of references comprising 170 titles, and appendices. It features 12 figures, 25 tables, 3 graphs, and 37 appendices. The structure of the dissertation is as follows: The title page and table of contents span 3 pages, totaling 3834 characters. The introduction covers 9 pages with 17879 characters. The first chapter comprises 25 pages with 48056 characters. The second chapter spans 14 pages with 24063 characters. The third chapter contains 26 pages with 43869 characters. The fourth chapter consists of 13 pages with 24633 characters. The fifth chapter covers 17 pages with 30070 characters. The conclusions span 2 page with 1988 characters. The recommendations cover 1 page with 829 characters. The list of 170 references spans 34 pages with 831 characters. The total volume of the dissertation is 207 pages. The main text of the dissertation (excluding figures, tables, appendices, and the bibliography) consists of 107 pages of computer-generated text, amounting to 192412 characters.

I CHAPTER. LITERATURE REVIEW

This chapter presents a comprehensive review of the literature related to the study. It includes information on the origin, distribution, botanical classification, and biomorphological characteristics of tomato (*Lycopersicon esculentum* Mill.). Additionally, it explores factors contributing to the deterioration of varietal traits, as well as stress and adaptation mechanisms in tomatoes. Drawing from literary sources, the chapter provides an in-depth discussion on the breeding significance of zoned tomato genotypes for open-field selection, emphasizing modern requirements and key directions for open-field breeding. Topics such as the development of pure lines and the heterosis effect in tomato breeding are elaborated upon. Furthermore, the nutritional importance of tomatoes as a rich source of vitamins, essential amino acids, and minerals in promoting healthy diets is highlighted.

II CHAPTER. SOIL AND CLIMATIC CONDITIONS FOR THE RESEARCH, MATERIALS AND METHODOLOGY

2.1. Overview of soil and climatic conditions in the Absheron region where the research was conducted. The research provides an analysis of the geographical location and climatic conditions of the Absheron region, including long-term and current climatic indicators. It highlights that the region's poor soil nutrient content necessitates specialized cultivation practices for tomato production. Specifically, improving soil structure through the systematic application of organic and mineral fertilizers, along with other agrotechnical care measures, is essential.

The analysis shows that precipitation in the Absheron Peninsula is sparse and unevenly distributed, with only 10% falling during the hot months and 60–70% occurring in the colder months. Furthermore, the arid subtropical conditions of the region result in low soil water retention capacity, making artificial irrigation indispensable for successful tomato cultivation.

2.2. Key agrochemical properties and agrometeorological conditions of the experimental plot during the study period. The physicochemical properties of the soil in the experimental plot, along with its nutrient availability, are presented. The gray-brown soils of Absheron are characterized by low levels of humus, nitrogen, and phosphorus, an average supply of potassium, and a high concentration of carbonates, gypsum, and easily soluble salts throughout the soil profile. Additionally, the upper soil layers exhibit higher concentrations of nitrogen, phosphorus, and potassium compared to the lower layers. During the research period, starting in April, air temperatures in the spring gradually increase, followed by a sharp rise. Meanwhile, relative humidity remains significantly lower than long-term averages, adversely impacting plant growth and development.

2.3.Material and amethods of the research: The research titled "Development of pure lines of zoned tomato varieties (l. esculentum Mill.) and organization of primary sowing " was conducted between 2017 and 2021 at the Absheron Subsidiary Experimental Farm of the Research Institute of Vegetable Growing, in both open-field

and greenhouse conditions. As part of the study, 74 genetic varieties of tomatoes, including those currently listed in the State Register, gene pool materials, and pure lines, were evaluated for their biomorphological and economically significant traits.

In line with the breeding program, research was carried out in various nurseries, including the source material nursery, the breeding nursery, the control nursery, and the experimental nursery of agricultural products. Detailed information is provided on the agrotechnical conditions, the sequence of research activities, and the method of individual selection used to obtain pure lines.

III CHAPTER. ASSESSMENT OF ZONED TOMATO VARIETIES FOR ECONOMICALLY SIGNIFICANT TRAITS

3.1. Investigation of key developmental phases of the growing season: This chapter evaluates tomato variety samples based on early maturity, productivity, biochemical parameters, and resistance to biotic and abiotic stressors. Additionally, the samples were grouped using differential and systematic Pearson correlation analysis.

In the study of tomato genotypes as source material, the period of biological maturity was identified as a critical developmental stage. Following the methodology for assessing source material, the biological maturity of tomato varieties was evaluated by analyzing the phases from mass emergence to flowering and from mass flowering to the ripening of the first fruits. The first major phase of the growing season among tomato varieties ranged from 36 to 49 days. For 26 variety samples, including the control variety Utro, this phase was completed in the shortest time, lasting 36 days. The second phase ranged from 36 to 61 days, with the shortest duration of 43 days observed in 24 variety samples, including Utro. Regarding biological maturity (80–104 days), 9 varietal samples were classified as ultra-early ripening (Figure 2). Most of these genotypes are recommended for consideration as source material in future breeding programs targeting early-ripening traits.

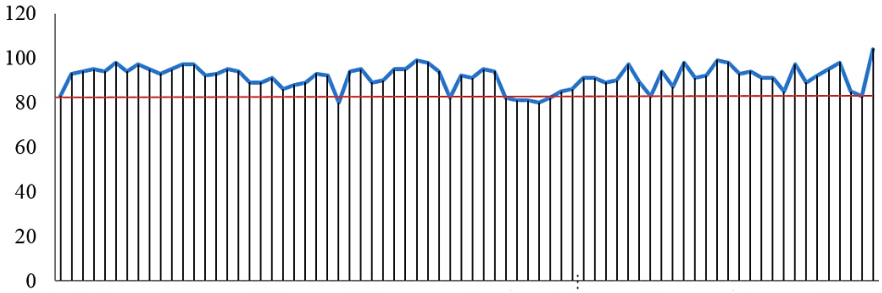

Figure 2. Comparative analysis of the biological maturity of studied tomato varieties against the control variety

It has been established that the period of biological maturity of tomato varieties has significantly decreased compared to the previous years. This is due to the severe impact of climate change and the dry subtropical climate of Absheron. Based on the theory, it can be said that tomato is a plant with genetic potential and the ability to adapt. The need to change the duration of the main phases and periods of its development under the complex influence of abiotic factors has been reflected in practice.

The results of the correlation analysis between the main phases of vegetation and biological maturity show r=-0.389** from sowing to mass shoots and from mass shoots to the beginning of flowering and r=-0.370** from mass shoots to the beginning of ripening. However, there is a significant positive relationship between mass shoots - the beginning of ripening and mass shoots - the beginning of flowering r=0.491**, and between mass shoots and the beginning of ripening there is a significant positive correlation r=0.627**.

3.2. Evaluation of tomato varieties based on the main biomorphological characteristics: The biomorphological characteristics of the tomato varieties were thoroughly assessed. In the studied varieties, the first flower cluster appeared after the development of 5–6 or 7–8 leaves. Low bush growth and determinacy were identified as key indicators of early maturity. Among the 74 varietal samples analyzed, 66 (89.2%) were determinate, 5 (6.8%) were indeterminate, and 3 (4%) were semi-determinate. In terms of bush height, 22 varieties (29.7%) were classified as having short bushes, 48 varieties

(64.9%) as medium-sized bushes, and 4 varieties (5.4%) as tall bushes.

The average fruit height ranged from 20.0 to 79.0 mm, while the average diameter varied between 22.0 and 73.0 mm. The fruit shapes, which were most influenced by external environmental factors, included round, flat-round, oblong, cylindrical, and oval forms.The analysis revealed that 48 samples (65%) had round fruits, 17 samples (23%) had flat-round fruits, and 9 samples (12%) had cylindrical or oval fruits.

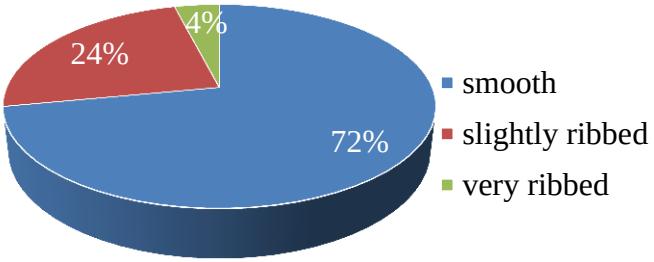

Figure 3. Assessment of tomato fruits by surface ribbing (%)

Based on the condition of the fruit surface, 53 varieties (72%) were classified as smooth, 18 varieties (24%) as slightly ribbed, and 3 varieties (4%) as very ribbed (Figure 3). Regarding the structure of the seed cavities, 58 samples (78.4%) exhibited a regular structure, while 8 samples (10.8%) showed an irregular structure, and another 8 samples (10.8%) displayed a mixed structure (Figure 4).

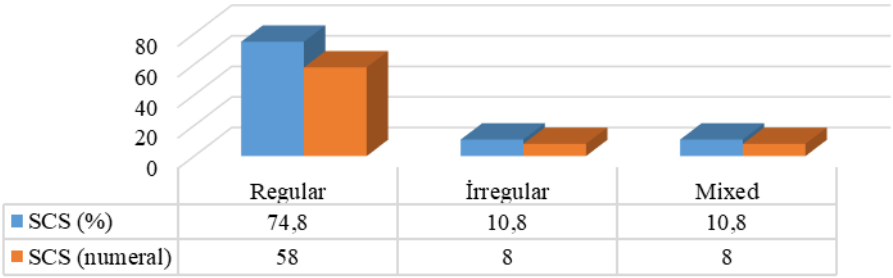

Figure 4. Structure of seed cavities in tomato fruits

Based on the number of seed cavities, 45 variety samples were classified as multi-chambered and 29 as less-chambered, in accordance with AZS TS 794:2023. After evaluating fruit weight, average height, diameter, shape index, pericarp thickness, and the number of seed cavities, the correlations among these characteristics were analyzed. The analysis revealed a positive correlation between fruit weight and average fruit height, diameter, and the number of seed cavities. Additionally, an increase in the number of seed cavities was associated with greater ribbing on the fruit surface.

3.3. Assesment of productivity: The economic efficiency and net income of a farm are directly influenced by the yield obtained per unit area. It was determined that while a large number of fruits on a single plant contributes to productivity, it is not sufficient to achieve high yields. The primary determinant of increased yield is the weight of the fruits. During the research period, the yield per plant ranged on average from 808.0 g to 1,908.0 g. Based on these figures, the total yield for each variety was calculated. The highest productivity was observed in the Ilkin variety, with 778.5 centners per hectare, while the lowest yield was recorded for the Sabirabad variety, at 329.7 centners per hectare. Furthermore, the correlation between productivity elements and overall yield was analyzed, highlighting the significant influence of fruit weight and other factors on productivity.

The correlation analysis revealed a strong positive correlation ($r=0.789^{**}$) between total yield and yield per plant, as well as a moderate positive correlation ($r=0.434^{**}$) with fruit weight. In contrast, a weak negative correlation ($r=-0.038$) was observed between total yield and the number of fruits per plant. Additionally, a weak but positive correlation ($r=0.378^{**}$) was identified between yield per plant and fruit weight. A statistically significant negative correlation ($r=-0.742^{**}$) was found between the number of fruits per plant and fruit weight, indicating that as the number of fruits on a plant increases, individual fruit weight tends to decrease. These findings suggest that when selecting varieties and hybrids for productivity, it is more effective to prioritize lines with large-fruited parental traits (Table 1).

Table 1

Correlation analysis of genotype productivity indicators

İndicators	Productivity	Number of fruits per plant	Fruit weight	Yield per plant
Productivity	1	-0.038	0.434**	0.789**
Number of fruits per plant		1	-0.742**	0.096
Fruit weight			1	0.378**
Yield per plant				1

Note: the obtained difference *,** - 0,05, the probability is accurate to 0.01.

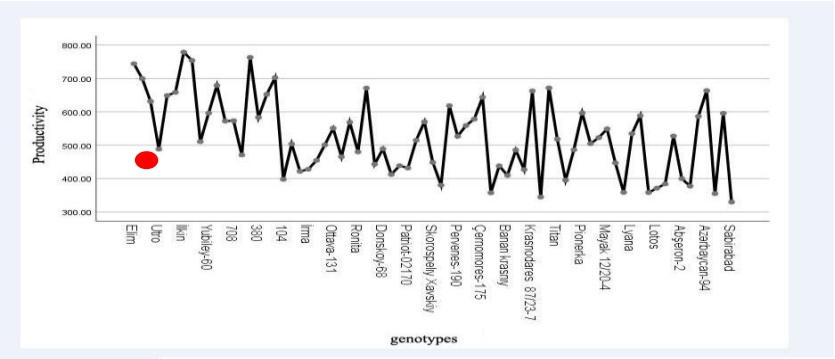

Figure 5. Comparison of the yield per plant with control variety.

The average yield per plant was higher in 41 variety samples (57%) and lower in 31 variety samples (43%) compared to the control variety. The Utro variety demonstrated an average productivity of 488.2 centners per hectare (Figure 5).

Based on the productivity cluster analysis, 17 varieties with productivity ranging from 618.3 to 778.5 centners per hectare were classified as the most productive samples within the primary cluster.

3.4. Assessment of pure line tomato varieties based on key biochemical characteristics. The economic and market value of tomatoes is closely tied to their quality characteristics. Enhancing fruit quality has consistently been a priority in tomato breeding, regardless of the breeding direction. Among the key quality require-

ments for breeding are high biochemical content and superior taste, which are considered essential indicators of fruit excellence. Tomatoes intended for fresh consumption should exhibit an appealing appearance, fleshiness, and good transportability. While fruit quality is influenced by the agricultural practices applied, it is also an inherent trait of the variety, genetically passed down through generations. Recognizing the potential to significantly enhance these traits through selective breeding, one of the primary objectives of this research was to identify tomato varieties with superior quality indicators.

One of the key quality indicators of tomato varieties is the high dry matter content in the fruits, which plays a crucial role in storage, transportation, and product yield in the canning industry. While the dry matter content is influenced by agricultural practices, it is also an inherent varietal trait. In this study, the dry matter content in the fruits ranged from 3.8% to 7.2%. Compared to the control variety Utro (5.0%), 52 variety samples exhibited higher dry matter content (71.2%), while the remaining 21 samples showed lower (28.8%) values.

As illustrated in Figure 6, the resulting dendrogram categorizes the samples into three main groups based on their dry matter content. The first group, located at the bottom of the dendrogram, comprises 31 samples with the highest dry matter content. Within this group, the first subgroup contains 19 tomato varieties, while the second subgroup includes 12 varieties, grouped according to their similarities. The second and third groups each consist of 21 samples, also organized based on the principle of similarity in their dry matter content.

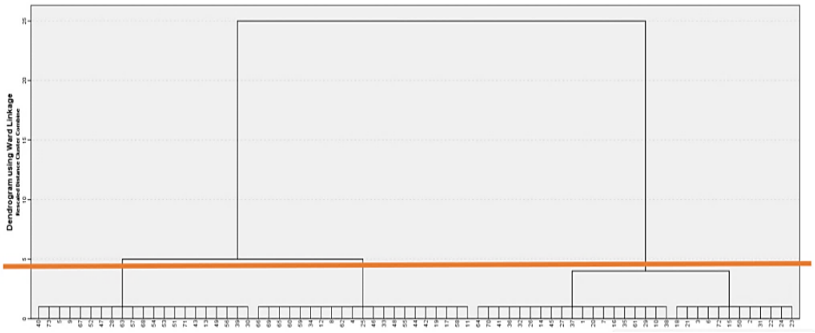

Figure 6. Dendogram for dry matter content

The sugar content in the varietal samples ranged from 1.2% to 8.5%. Tomato fruits predominantly contain up to 1% (0.9 g/100 g) of malic and citric acids. The analysis revealed that the taste quality of tomatoes is highest when the sugar-to-acid ratio is 4–5 or greater. This balance is achieved with a sugar content of 2.5–3.5% and an acidity level of 0.5–0.7%, making these varieties particularly valued for their superior taste. A positive correlation was identified between the productivity of tomato varieties and their fruit quality indicators, including dry matter, sugar content, total acidity, and overall yield. Conversely, a negative correlation was observed between dry matter content and nitrate levels, indicating that an increase in nitrate content leads to a reduction in dry matter.

The nitrate content in the studied tomato varieties was within acceptable limits, except for the Chernomorets-175 variety, where it exceeded the norm (165 mg/kg). The quality of tomato fruits also depends on their richness in vitamins, which contribute to their nutritional value. Among these, the amount of vitamin C in the tomatoes, which is generally sufficient, ranged from 13.7 to 33.3 mg%. The taste qualities of the tomatoes, including their nutritional and flavor characteristics, were assessed through taste testing during the period of peak ripening. In laboratory conditions, the storage capacity, processing suitability, and intended purposes of the variety samples were evaluated. Based on these assessments, scientific recommendations were provided. The Krasnodares 87/23-7 and Lyana varieties were identified as highly suitable for the production of tomato products due to their high yield, fleshiness, and vibrant red color. Additionally, the varieties Utro, Novichok, Vkusny-3, Tamara, and Irma were considered dominant, as they produce 25-30% of their total harvest within the first ten days of ripening.

IV CHAPTER. INVESTIGATION OF STRESS RESISTANCE IN SELECTED PURE LINES

4.1. Investigation of the stability of selected pure lines under greenhouse conditions: Currently, breeding complexes established in greenhouse settings play a crucial role in evaluating source

material, selecting appropriate parental forms for hybridization, and assessing plant resistance to diseases, drought, cold, and other stress factors in an accurate and timely manner. To expedite research efforts, studies on the response of selected pure lines to stress factors and hybridization between pure lines were continued during the off-season under greenhouse conditions. For this purpose, 45 varietal samples were selected from the purchased pure lines, and their seeds were sown on October 19, 2018. Standard seedlings were transferred to a substrate for cold resistance studies, and phenological observations, along with agrotechnical care, were conducted for tomato plants grown under low-temperature conditions.

Varieties exhibiting resistance to multiple stress factors, particularly low temperatures, were identified for their positive impact on plant development and productivity. It was also found that the nutritional value and taste qualities of regionalized tomato varieties significantly surpassed those of introduced foreign varieties grown under the same conditions.

4.2. Investigation of the stability of selected pure lines in open field conditions: Although the direct method is complex and labor-intensive, it provides more accurate and reliable results. Therefore, the drought and salinity resistance of the pure lines, used as breeding material, were studied in the field, and the results were compared. Drought resistance of the pure lines was assessed in 2019 on the drip-irrigated experimental site of TETI. Salt tolerance was evaluated in 2020 through field experiments conducted on the institute's premises, where irrigation was carried out using mineralized water from an artesian well. For comparison, water from the Absheron channel was used as the control irrigation option.

4.3. Fusarium wilt resistance testing: The study of resistance to major diseases is a critical aspect of tomato breeding, regardless of the intended purpose of the variety. Observations revealed that none of the studied varieties demonstrated complete resistance to any specific disease.

The experimental field study monitored the plants from the seedling stage to the final harvest, recording their resistance to individual diseases throughout the growth cycle. Over the course of the experiment, the most frequent issue observed was blossom-end rot, a

condition primarily described in the literature as a non-infectious disorder. This was particularly evident in the Banana Red variety and fixed line No. 104, mainly during the first harvest. Although affected fruits were removed, this did not significantly impact overall productivity, as the condition did not spread extensively.

Fusarium wilt, one of the most prevalent diseases affecting tomato plants, was also studied. Selected samples with strong economic performance, derived from purchased pure lines of regionalized tomato varieties, were evaluated for resistance to Fusarium wilt under natural field conditions.

4.4. **Intraspecific crosses of parental lines:** The extended flowering phase of plants under greenhouse conditions facilitated the execution of appropriate crosses and enabled the study of the combinability of pure lines. During the research, hybrids were successfully obtained by establishing suitable combinations with different breeding objectives. The evaluation of the combinatorial capacity of the 41 obtained hybrids was conducted in a hybrid nursery under optimal agrotechnical conditions.

V CHAPTER. PRIMARY SEED PRODUCTION, BIOMORPHOLOGICAL CHARACTERIZATION, COMMERCIAL TESTING, AND ECONOMIC EFFICIENCY OF PURE LINES SELECTED FOR COMPLEX TRAITS

5.1. Organization of primary seed production: The seed is the golden fund of the harvest, and the foundation of the food chain. Tomato seed production focuses on enhancing seed quality by preserving the biological and economic traits of varieties, eliminating factors that diminish their characteristics, and implementing strict selection practices during primary seed production. Additionally, it ensures the annual sowing of pure varietal seeds. Achieving high-quality seeds requires adherence to the principles of elite seed production and the timely implementation of appropriate measures.

Seed production in self-pollinating vegetable plants is not aimed at improvement but at preserving the biological and economic characteristics of the variety to the maximum extent possible. Since tomatoes are self-pollinating plants, pure line production was carried

out using the method of individual selection, adhering to the principles of similarity, stability, and uniformity characteristic of each original variety. For this purpose, healthy, typical plants were selected and monitored to ensure they reflected the varietal characteristics of each variety. Seeds were then collected from the most representative fruits of these plants. The seeds were manually extracted and dried to a moisture content of 11% to ensure proper preservation.

5.2. Mathematical and statistical analysis of average productivity indicators: The performance of the varietal samples included in the study was analyzed using a comprehensive assessment system, leading to the selection of 16 varieties as the most favorable. The total yield per hectare ranged from 488.2 to 778.5 centners (Table 2).

Table 2

Mathematical and statistical analysis of average productivity indicators of selected pure lines (sen/ha, average for 2017–2019)

№	Name of varieties	2017	2018	2019	orta
1	Elim	739,3	718,1	774,5	744,0
2	Vatan-1	677,7	506,7	913,9	699,4
3	Zarrabi	661,0	581,4	650,8	631,1
4	Utro	512,4	382,9	569,2	488,2
5	Zafar	685,4	665,0	624,2	658,2
6	İlkin	825,0	822,1	688,3	778,5
7	Yubiley-60	575,3	647,1	565,9	596,1
8	Leyla	832,3	717,6	714,0	763,0
9	Elnur	778,5	628,3	700,1	702,3
10	Donskoy-68	-	513,3	465,1	489,2
11	Mayak 12/20-4	-	546.6	550,8	548.7
12	Simferopolskiy-765	-	585,3	554,9	570,1
13	Yevqeniya	-	636,5	520,2	578,3
14	Chernomores-175	-	667,1	620,2	643,6
15	Volqaqradskiy 5/95	-	714,8	628,3	671,6
16	Charodey	-	554,9	621,8	588,3

$\sum X = 10150,6$

$\bar{x}$ = 634,4 s/ha

S^2 =8058,1

S =89,8 s /ha

V =14,15 %

$S_{\bar{x}}$ = 22,4 s

S_x %=3,54 %

S_d = 31,74 s/ha

LSD_{05} = 65,7 ≈ 66,0 s/ha

LSD_{05} =10,4 %

Following the adopted methodology (A.I. Ismailov, 2005; B.A. Dospeksov, 1979), several statistical parameters were calculated, including the average value ($\bar{x}$), the relative error of the sample mean (S_x %), the coefficient of variation (V), the variance (S^2), the standard deviation (S), the average sampling error ($S_{\bar{x}}$), and the least significant difference (LSD).

Based on the conducted studies and selected varietal samples, the yield was determined to vary within the range of $\bar{x}\pm t_{05}xS_{\bar{x}}$=634,4±46,4(588±681) centners per hectare (Table 2).

5.4. Commercial testing and cost effectiveness: To evaluate the efficiency of cultivating the selected lines on a farm, a trial was conducted using three varieties from the pure lines. The farm trials were carried out under the soil and climatic conditions of the Lankaran region, a key area for vegetable production.

Farm trials were conducted on pure lines derived from three tomato varieties: the Leyla variety on a 0.20-hectare area at AMBU LLC, the Vatan-1 variety on a 0.30-hectare area at Amiri 600 LLC, and the Elnur variety on a 0.30-hectare area at Marsosobshchestvo of Farmer LLC. In all three trials, the Utro variety, which is regionalized for this area, was used as the control. All agrotechnical work during the production experiment was carried out in accordance with the methodology established for the region. Sowing took place in early February, with seedlings transplanted in mid-April into a forage plot with a spacing of 70x35 cm. Throughout the growing season, phenological observations were conducted, the dynamics of crop ripening were studied, and productivity data were recorded. In the Lankaran region, where the production trials were conducted, cultivating 1 hectare of tomatoes using the open-field technology required an expenditure of 7,452.5 manats (Table 3).

The analysis revealed that the economic indicators of the pure lines were superior to those of the control variety, Utro. As the productivity of the pure lines increased, the cost of production decreased.

Table 3

Economic efficiency of growing selected varieties of tomatoes

Pure lines sen/ha	Average productivity sen/ha	Costs per 1 hectare, in manats	Cost per centner of product, in manats	Total income per 1 hectare, in manats	conditional net income			profitability	
					Per centner of product, in manats	Per 1 ha of area, in manats	By control, %	%	By control, %
Utro (st)	400	7452,5	18,63	24000	41,4	16547,5	100	222,0	-
Leyla	567	7452,5	13,14	34020	46,9	26567,5	160,5	356,5	160,5
Utro (st)	395	7452,5	18,87	23700	41,1	16247,5	100	218,0	-
Vatan-1	540	7452,5	13,80	32400	46,2	24947,5	153,5	334,7	153,5
Utro (st)	404	7452,5	18,45	24240	41,5	16787,5	100	225,0	-
Elnur	550	7452,5	13,55	33000	46,4	25547,5	152,2	342,8	152,2

Among the tested varieties–Elnur, Vatan–1, and Leyla–the pure line derived from the Leyla variety demonstrated the highest performance under the soil and climatic conditions of the Lankaran region. Farm trials of the selected lines confirmed the reliability of the experimental results, establishing their effectiveness for agricultural use. Based on these findings, we recommend cultivating the pure lines developed from all these tomato varieties.

RESULTS

1. The potential of regionalized tomato varieties as source material for developing locally resistant varieties and F1 hybrids exhibiting heterosis has been both theoretically and practically validated. Additionally, a collection of pure lines serving as source material has been successfully established.
2. Among the obtained pure lines, 26 variety samples were identified as valuable during the first growth phase, from mass emergence to

the beginning of flowering, and 24 samples during the second phase, from mass flowering to the onset of ripening. Additionally, 9 variety samples were recognized as valuable breeding material for early maturity due to their short period to reach biological maturity.

3. The results of the correlation analysis showed a weak positive correlation (r = 0.491**) between the period of biological maturity and the first growth phase. In contrast, a significant positive correlation (r = 0.627**) was observed between the period of biological maturity and the second growth phase.
4. Based on the productivity clustering, 25 genotypes were classified as productive (454.5–329.7 c/ha), 31 as moderately productive (596.5–465.2 c/ha), and 17 as highly productive (778.5–618.3 c/ha).
5. The correlation analysis revealed a strong positive correlation (r=0.789∗∗) between total yield and yield per plant, a positive correlation (r=0.434∗∗) with fruit weight, a weak negative correlation (r=−0.038) between total yield and the number of fruits per plant. A significant negative correlation (r=−0.742∗∗) was found between the number of fruits per plant and fruit weight. These findings suggest that when selecting varieties and hybrids for productivity, it is more effective to prioritize lines with large-fruited parental traits.
6. The correlation analysis revealed a positive relationship between biochemical indicators and yield, while a negative relationship was observed between dry matter content and nitrate levels. Cluster analysis showed that 31 variety samples had the highest dry matter content in fruits, ranging from 5.7% to 7.2%.
7. The resistance of pure lines to stress factors under both open-field and greenhouse conditions demonstrates that local genotypes are valuable source material with exceptional adaptability.
8. The initial seeding of 16 pure lines, selected based on a combination of agro-biological traits, was carried out. The economic performance of the pure lines derived from the Leyla, Vatan-1, and Elnur varieties was evaluated, and their economic efficiency was successfully determined.

RECOMMENDATIONS

1. Elim, Vatan-1, Zarrabi, Utro, Zafar, Ilkin, Yubiley-60, Leyla, Elnur, Donskoy-68, Mayak 12/20-4, Simferopolsky-765, Evgeniya, Chernomorets-175, Volgogradsky 5/95, Charodey, and other varieties are recommended for open-field cultivation on farms due to their valuable and favorable characteristics.
2. The cultivation of high-yielding and flavorful varieties such as Garant, Chernomorets-175, Evgeniya, Elnur, Gertsegovina, Lyana, Podarok Absheron-3, Zapadno-Virginia, Donskoy-68, Krasnyy Banana, Patriot 02170, Severyanka, Nevskiy, Saatli, Leningradsky Krupnyy Rozovsky, Skorospely Khavskiy, Lyana, and Ronita is recommended for greenhouse conditions.
3. Drip irrigation is a highly cost-effective technology, offering numerous benefits such as water and nutrient conservation, reduced incidence of diseases and weeds, as well as significant savings in energy and time, making it a valuable method for sustainable agriculture.

List of scientific papers published on the topic of the dissertation

1. Babayev, Ə.H., Adıgözəlov, M.B. Tərəvəz sortlarının və hibridlərinin yaradılmasında təmiz xətlərdən istifadənin əhəmiyyəti // - Bakı: Azərbaycan Aqrar Elmi, - 2018. № 3, - s. 26-28.
2. Adıgözəlov, M.B. Pomidorun saf xətli formalarının alınmasında genetik ehtiyatlardan istifadənin əhəmiyyəti // Akademik Calal Əliyev və bioloji müxtəlifliyin genetik Ehtiyyatları, Respublika Elmi-Praktik konfransı, - Gəncə: ADAU elm şöbəsi, - 30 noyabr, - 2018, - s. 274-279.
3. Adıgözəlov, M.B. Pomidorun yeni sortlarının və hibridlərinin yaradılmasında genetik ehtiyatlardan istifadənin əhəmiyyəti // - Bakı: Azərbaycan Aqrar Elmi, - 2019. № 3, - s. 174-176.
4. Adıgözəlov, M.B. Pomidor sortlarının genetik ehtiyatlarının qorunması ekoloji kənd təsərrüfatının tərkib hissəsidir // Azərbaycanda ekoloji təmiz kənd təsərrüfatının inkişafı, Respublika elmi-praktik konfransı, -Gəncə: ADAU elm şöbəsi, - 29 oktyabr, - 2019, - s. 100-103.

5. Adıgözəlov, M.B. Pomidorun açıq sahə üçün yaradılmış heterozis effektli F_1 hibridlərinin ilkin toxumçuluğunun vacibliyi haqqında // Baytarlıq elminin inkişaf istiqamətlərində innovasiyaların tətbiqi. Beynəlxalq Elmi-Praktik konfrans, - Bakı: - 25 oktyabr, 2019, - s. 427-430.
6. Адыгезалов, М.В. Селекция томатов и ее направление в условиях Апшерона // Национальна Академия Аграрных наук Украины, Институт овощеводства и бахчеводства опытная станция «Маяк» II Міжнародноі науково-практичноі конференцй (у рамках у наукового форуму «Науковий тиждень у Крутах-2020»), - Kiyev : - 2020, - с.14-24.
7. Адыгезалов, М.В. Гибридизации томатов на Апшероне // III Міжнародноі науково- практичноі конференціі:"Теоремичні і практичні аспекти розвитку галузш овочidybündf в сучасних умовах», -Украины, Kiev: 2020, - с. 68-74.
8. Адыгезалов, М.В. Изучение гибридизации томатов вусловиях Апшерона Азербайджанской республики // - М: Аграрная Наука, - 2021. № 3, - с. 81-84.
9. Adıgözəlov, M.B. Pomidorun saf xətlərinin alınması və toxumçuluğu // - Gəncə: "Elmi xəbərlər" məcmuəsi, Azərbaycan Texnologiya Universiteti,-2021,c.4,№37,-s.67-71.
10. Адыгезалов, М.В. Оценка хозяйственно-ценных показателей чистых линий томата // -Нижни-Вартовск: Бюуллетень науки и практики, - 2021. Vol. 7, № 9. - с. 125-129.
11. Адыгезалов, М.В Изучение исходного материала томатов, получение чистых линий и организация первичного семеноводства // -Нижни-Вартовск: Бюуллетень науки и практики, - 2021. Vol. 7, № 10, - с. 84-90.
12. Adıgözəlov, M.B. Pomidorun genefond materiallarının öyrənilməsi və onların əsasında yeni sort və hibridlərin yaradılması // Aqrar təsərrüfatların inkişafının yeni istiqamətləri və ətraf mühitin mühafizəsi, Qərbi Kaspi Universiteti, - Bakı: 30 yanvar, - 2021, - s. 641-644.
13. Adıgözəlov, M.B. Pomidorun rayonlaşmış süfrə sortlarının öyrənilməsi və onların əsasında aparılan seleksiya işləri / Azərbaycanın inkişaf strategiyasında Heydər Əliyev irsi" mövzusunda

tidissiplinar konfransın materialları. Qərbi Kaspi Universiteti, https://azertag.az/xeber/ multidissiplinar konfransın materialları, - Bakı: 1 may, - 2021, - s. 24-30.
14. Адыгезалов, М.В. Изучение гибридизации культурой томатов // Сельское хозяйство-2021. Международной научно-практической Интернет-конференции, - Никалаевский: - 30 апреля, - 2021, - с. 14.
15. Адыгезалов, М.В. Изучение исходного материала томатов в условиях Апшерона // Теоретические и практические аспекты развития отрасли овощеводства в современных условиях» IV Международной научно-практической конференции: - Xarkov: - 20 мая, - 2021, - с. 42-45.
16. Əliyeva, Z.K, Adıgözəlov, M.B, Adıgözəlova, S.H. İstixanalarda pomidor meyvələrinin çatlama səbəblərinin araşdırılması // "Bağçılıqda prioritet istehsal sahələrinin inkişafında elm-tədris istehsalat tendensiyasının tətbiqi: Nəzəriyyədən praktikaya gedən yol" Respublika elmi-praktik konfransı, - Gəncə: ADAU elm şöbəsi, - 23 iyun, - 2022, - s. 149-152.
17. Adıgözəlov, M.B Pomidorun perspektiv sortlarının yaradılmasında başlanğıc material problemləri və prespektivləri // "Bağçılıqda prioritet istehsal sahələrinin inkişafında elm-tədris istehsalat tendensiyasının tətbiqi: Nəzəriyyədən praktikaya gedən yol" Respublika elmi-praktik konfransı, - Gəncə: ADAU elm şöbəsi, - 23 iyun, - 2022, - s. 162-166.
18. Adıgözəlov, M.B. Pomidorun heterozis effektli F_1 hibridlərinin seleksiyası üçün genefond materiallarından zəngin donorların seçilməsi // Ümummilli Lider Heydər Əliyev 100 illiyinə "Tətbiqi elmlər və aqrar sahənin inkişafına yeni baxışlar və yanaşmalar" mövzusunda Respublika elmi-praktiki konfransının materialları, - Gəncə: ADAU elm şöbəsi, - 29 mart, - 2023, - s. 151-158.
19. Adıgözəlov, M.B.Pomidorun genefond materiallarının ərzaq təhlükəsizliyində rolu // "Heydər Əliyev və müasir biologiya elminin inkişafı: nailiyyətlər və çağırğşlar".Beynəlxalq konfrans, - Azərbaycan Respublikası Təhsil Nazirliyi, AMEA, Bakı: 19-20 dekabr, - 2023

The defense will be held on 26 december 2024 at 11^00 at the meeting of the Dissertation council BFD 1.29 of Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at the public legal entity 'Scientific Research Institute of Agriculture,' under the Ministry of Agriculture of the Republic of Azerbaijan

Address: Address: Scientific Research Institute of Agriculture, Az 1098, Baku, Pirshagi settlement, Sovkhoz №2

Dissertation is accessible at the library of the public legal entity Scientific Research Institute of Agriculture, under the Ministry of Agriculture of the Republic of Azerbaijan.

Electronic versions of dissertation and its abstract are available on the official website (www.aetei.az) of the public legal entity Scientific Research Institute of Agriculture, under the Ministry of Agriculture of the Republic of Azerbaijan.

Abstract was sent to the required addresses on 23th november 2024.

Signed for print: 14.11.2024

Paper format: 60x84$^{1/16}$

Volume: 37363 simvols

Number of hard copies: 20