UDC 633:11: 547:9497
AGRIS F03
https://doi.org/10.33619/2414-2948/116/38

DROUGHT STRESS, BİOCHEMİCAL, TECHNOLOGİCAL AND PHYTOPATHOLOGİCAL PROPERTİES OF FABA BEAN *Vicia faba* L. SAMPLES

*©**Mikayılova R.**, Ph.D., Institute of Genetic Resources, Baku, Azerbaijan, Mikailova.71@mail.ru*
*©**Mamedova Sh.**, Institute of Genetic Resources, Baku, Azerbaijan, shamsiye@bk.ru*
*©**Kelbieva Ye.**, Institute of Genetic Resources, Baku, Azerbaijan, Kalbiyeva@mail.ru*
*©**Mamedova A.**, Institute of Genetic Resources, Baku, Azerbaijan, m.afet63@mail.ru*
*©**Ismayilova V.**, ORCID: 0000-0002-4729-3707, Ph.D., Institute of Dendralogy; Azerbaijan State Pedagogical University, Baku, Azerbaijan, ismayilovavusala71@gmail.com*

ЗАСУХОУСТОЙЧИВОСТЬ, БИОХИМИЧЕСКИЕ, ТЕХНОЛОГИЧЕСКИЕ И ФИТОПАТОЛОГИЧЕСКИЕ СВОЙСТВА ОБРАЗЦОВ БОБОВ *Vicia faba* L.

*©**Микайлова Р. Т.**, канд. биол. наук, Институт генетических ресурсов, г. Баку, Азербайджан, Mikailova.71@mail.ru*
*©**Мамедова Ш. Э.**, Институт генетических ресурсов, г. Баку, Азербайджан, shamsiye@bk.ru*
*©**Келбиева Е. Э.**, Институт генетических ресурсов, г. Баку, Азербайджан, kalbiyeva@mail.ru*
*©**Мамедова А. Д.**, Институт генетических ресурсов, г. Баку, Азербайджан*
*©**Исмаилова В. М.**, канд. биол. наук, Институт дендрологии; Азербайджанский государственный педагогический университет, г. Баку, Азербайджан, ismayilovavusala71@gmail.com*

Abstract. The faba bean *Vicia faba* L. is one of the oldest cultivated plants in the world. Archaeological excavations show that this plant was first cultivated 10,000 years ago. During the Neolithic period (Stone Age), humans grew faba beans as a primary food source. In the Roman Empire, faba beans were widely used as both food and animal feed. Faba bean *Vicia faba* L. is a food crop known for its excellent taste and high-quality flavor. The composition of this plant contains 50-60% carbohydrates, 5-10% fiber, and 1-2% fats, mainly saturated fatty acids (oleic and linoleic acids). It is rich in B-group vitamins: B1 (thiamine), B2 (riboflavin), B3 (niacin), and B6 vitamins. The plant also contains microelements such as Fe, K, Mg, P, Ca, and Zn, and fresh beans have a higher content of vitamin C. Vitamin E has antioxidant properties. The research was conducted on 15 samples of faba bean *Vicia faba* L.. The aim was to determine the resistance of these samples to drought, salinity, and high temperatures. Leaf samples were taken to evaluate resistance to drought and salinity, and to measure photosynthetic indicators such as chlorophyll a, chlorophyll b, total chlorophyll (a + b), and carotenoids. The most drought- and stress-resistant samples were selected. Additionally, the protein content, amounts of essential amino acids like lysine and tryptophan, moisture content, 100-seed weight, cooking time, water absorption capacity, and resistance to fungal, bacterial, and viral diseases were also determined. The high levels of protein and essential amino acids in the faba bean make it valuable for both food and animal feed purposes.

Аннотация. Бобы *Vicia faba* L. являются одним из древнейших окультуренных растений в мире. Археологические раскопки свидетельствуют о том, что это растение начали выращивать около 10 000 лет назад. В неолитический период (каменный век) человек использовал бобы как основной источник пищи. Во времена Римской империи бобы широко применялись как в питании людей, так и в кормлении животных. Бобы *Vicia faba* L. являются пищевой культурой, известной своим отличным вкусом и высокими вкусовыми качествами. В их составе содержится 50–60% углеводов, 5–10% клетчатки и 1–2% жиров, в основном насыщенные жирные кислоты (олеиновая и линолевая кислоты). Они богаты витаминами группы B: B1 (тиамин), B2 (рибофлавин), B3 (ниацин) и B6. Также растение содержит микроэлементы, такие как Fe, K, Mg, P, Ca и Zn, а в свежих бобах содержится больше витамина C. Витамин E обладает антиоксидантными свойствами. Исследование проводилось на 15 образцах бобов *Vicia faba* L.. Целью было определить устойчивость этих образцов к засухе, засолению и высоким температурам. Для оценки устойчивости к засухе и засолению, а также для измерения фотосинтетических показателей, таких как хлорофилл a, хлорофилл b, общий хлорофилл (a + b) и каротиноиды, были отобраны образцы листьев. Были выделены наиболее устойчивые к засухе и стрессу образцы. Дополнительно определялись содержание белка, количество незаменимых аминокислот, таких как лизин и триптофан, влажность, масса 100 семян, время приготовления, водопоглощающая способность и устойчивость к грибковым, бактериальным и вирусным заболеваниям. Высокое содержание белка и незаменимых аминокислот делает фава-бобы ценным источником как для питания человека, так и для кормов.

Keywords: beans, photosynthesis, abiotic stress, phytopathology.

Ключевые слова: бобы, фотосинтез, абиотический стресс, фитопатология.

Global climate changes occurring in the modern world have led to a deterioration in the ecological situation on Earth, the development of stress factors such as drought and salinity, and the destruction of several valuable plant species. This may cause serious difficulties in meeting the future food demands of humanity. Therefore, one of the urgent tasks is to create new plant varieties and forms that are more productive and resistant to stress factors, including drought and salinity, by using various stress-resistant plant genotypes that can be cultivated under unfavorable soil and climate conditions. Considering the relevance of these issues, significant progress has been made in the Republic of Azerbaijan in the areas of genetic resource collection, study, documentation, restoration, and multiplication.

From a biological perspective, stress is considered any change in the external environmental conditions that weakens or negatively alters the normal development of a plant [1]. Biotic (pathogens, competition with other organisms, etc.) and abiotic (drought, salinity, radiation, high and low temperatures, etc.) stresses cause changes in the physiological activities of plants, weaken the biosynthesis processes occurring in cells, disrupt normal life processes, and ultimately can lead to the death of plants.

Currently, among the land areas used on Earth, drought, a natural stress factor, covers more than 26% of the total area. Drought stress, being one of the most widespread environmental factors affecting growth and productivity, induces various physiological, biochemical, and molecular responses in plants, and plants form tolerance mechanisms to adapt to unfavorable environmental conditions. The study of these mechanisms is of great theoretical and practical importance in the creation of plant varieties and forms resistant to adverse external environmental factors. This stress factor significantly harms agriculture by causing losses in crop productivity. Therefore, the search for and development of effective ways to increase the resistance of plants to various abiotic stresses (selection, agro-technical methods, etc.) is one of the important tasks facing the agricultural sector. The successful resolution of these issues is not possible without applying diagnostic methods and techniques for plant resistance during the course of work. Plant resistance to stress characterizes the ability of plants to fully perform their life functions in unfavorable environmental conditions, and the degree of resistance ("weak," "strong") reflects the extent of this ability.

The degree of plant resistance to unfavorable environmental factors (such as drought, high temperature, salinity, etc.) can be determined by evaluating physiological parameters [2]. Since photosynthetic pigments are directly related to photosynthetic potential and primary productivity, the assessment of photosynthetic traits is of great importance in studying plant resistance to abiotic stresses. Photosynthetic pigments define plant activity and are dependent on various ecological factors. Therefore, determining them based on physiological indicators is of significant practical value. The pigment complex of a plant organism is sensitive to changes in environmental conditions. Abiotic stress factors such as drought, salinity, and high temperatures have a strong impact on the photosynthesis process. The study of these effects is crucial in clarifying the mechanisms of photosynthesis, investigating photosynthetic productivity, and determining the most suitable zones for planting specific plant varieties and samples in accordance with particular soil and climate conditions. One of the methods for using arid land areas for agricultural production purposes is the creation and cultivation of drought-resistant plants.

In order to meet the growing demand for food products, there is a need for legume varieties and samples that are resistant to environmental abiotic stress factors, stable, and have high productivity. Legumes are at the forefront of food technology development due to their nutritional significance. The fields of use and the role of leguminous plants in human life are vast, diverse, and significant. This diversity arises from the fact that these plants are rich in protein, essential amino acids, fats, vitamins, and minerals. For example, the seeds of these plants are rich in proteins and essential amino acids such as tryptophan, lysine, valine, threonine, phenylalanine, leucine, and isoleucine. Legumes are considered important plants.

As an example, we can mention the faba bean we studied. The faba bean is a versatile leguminous plant cultivated worldwide and is considered a good source of proteins, dietary fibers, and micronutrients [3, 4]. Additionally, it has been discovered that the plant is rich in bioactive compounds such as phenols, which are known for their antioxidant and antimicrobial properties [5].

The faba bean is a reliable source of various mineral elements such as potassium, calcium, sodium, and magnesium. Both the whole and peeled faba beans have been observed to be rich in microelements such as K, Ca, P, S, Mg, Cu, Zn, and Mn [6].

Iron and zinc in faba bean flour are significantly higher compared to wheat flour [7].

The mineral content in whole faba beans is higher compared to the peeled samples. The main component of faba beans is carbohydrates, which account for approximately 63%. Epidemiological studies show that legumes have a lower glycemic index compared to starchy foods such as potatoes and grains [8]. Amylose and amylopectin represent the main components of starch, which significantly influence the functional properties and digestibility of foods. Thus, due to their potential effects in the prevention and management of chronic conditions such as cancer, cardiovascular diseases, and obesity, the consumption of legumes is recommended [9].

The fat content of faba beans is relatively low compared to other plant-based protein sources; therefore, it can be classified as a low-fat food [6]. The fatty acid composition of faba bean oil, extracted using hexane, contains equal amounts of both saturated and unsaturated fatty acids. The main fatty acids are oleic and palmitic acids. A deficiency of amino acids essential for growth and development in living organisms leads to metabolic disorders and a range of diseases. The nutritional needs of individuals and animals are based not only on the protein content but also on the specific amounts of essential amino acids. Faba beans contain sulfur-containing amino acids such as cysteine and methionine in smaller amounts, while amino acids like leucine, lysine, tryptophan, and phenylalanine are found in higher quantities [11].

A characteristic feature of these plant proteins is their easy solubility in water and neutral salt solutions. The protein content in leguminous plant seeds is 2-3 times higher than in cereals. In environments where stress factors are present, achieving high productivity from agricultural crops is only possible through the use of plant varieties and forms that are resistant to changing environmental factors such as drought, salinity, and high temperatures.

Leguminous plants are not only important as a food source but also have significant agro-technical value. They enrich the soil with nitrogen through bacteria, which enhances its fertility. Additionally, legumes serve as precursors for many crops, which helps improve soil structure during crop rotation, reduce fertilizer costs, and contribute to the control of diseases and weeds [12].

The promotion of legume production and utilization plays a crucial role in ensuring food security, preserving agricultural sustainability, and protecting the environment. During development, plants actively interact with various environmental factors, including both abiotic (non-living) and biotic (living) components. Extreme ecological conditions, such as drought, salinity, heat, cold, and other stress factors, negatively affect plants [13].

The effects of drought primarily manifest as a reduction in the availability of free intracellular water, which leads to changes in the hydration of cytoplasmic proteins and disrupts the function of enzymatic proteins. In plants that are not adapted to drought, the intensity of respiration increases significantly during dehydration (likely due to an increase in sugar content, which acts as a respiratory substrate), and then gradually decreases. In drought-tolerant plants, no significant changes or only slight increases in respiration are observed under these conditions.

In the process of adaptation, the factors that create unfavorable conditions are essential as they ultimately help strengthen the plant's resistance and reduce the damage caused. To address these issues, it is necessary to apply stress-resistant methods and techniques and to determine the technical indicators of plant health, including their resistance to fungal and bacterial diseases.

Materials and methods

The subject of the research is the faba bean (Vicia faba L.) plant, and its drought resistance, along with a number of technical characteristics (e.g., protein content, lysine, moisture, 100-seed weight, cooking time, and seed water absorption capacity), as well as its physiological resistance to fungal, bacterial, and viral diseases, were studied.

In the flowering phase, the leaves of 15 faba bean samples were collected, and discs were obtained from them. The discs were placed in distilled water and a 20% sucrose solution for 24 hours. After 24 hours, the stressed discs were filtered, dried with filter paper, and then placed in 96% ethanol for 7 days. During this period, the chlorophyll from the leaf discs was transferred into the ethanol. The chlorophyll content was determined using a spectrophotometer (UV-3100PC) at two wavelengths (E665-E649). By comparing the percentage change in pigments (chl "a" and chl "b") in relation to the control, the stress-depression degree was calculated, and the degree of resistance of the samples to stress factors was determined. The less the pigment content changes under stress, the more resistant the samples are [14].

Additionally, a number of technological, quality, and biochemical indicators (100-seed weight, water absorption capacity, cooking time, color, moisture content, and the amounts of total nitrogen, lysine, and tryptophan (protein, Nx6.25)) were studied in the faba bean seed samples. The total nitrogen content was determined using the Kjeldahl method, lysine was measured using the method of A. S. Museyko and A. F. Siseyeva, and tryptophan was determined using the method of A. Ermakov and N. R. Yaroš [15].

Furthermore, a phytopathological evaluation was carried out on the faba bean samples, based on the natural background, in accordance with the balance system for fungal diseases and pest infestations.

Table 1

DETERMINATION OF THE DROUGHT STRESS RESISTANCE OF FABA BEAN SAMPLES

Sample name	*Chlorophyll (a+b) content (µg per unit leaf area)*			
	Chlorophyll a+b		*Change in chlorophyll content under drought, %*	*Stress depression level, %*
	Control	*Sucrose*		
Aze vifa-28	5,73	8,23	144,0	0
Aze vifa-64	5,04	7,11	141,0	0
Vifa-4-100	4,18	5,43	129,0	0
Vifa-8-98	4,88	5,92	121,0	0
Vifa-70	5,45	6,08	111,0	0
Aze vifa-60	5,0	5,36	107,0	0
Aze vifa-73	5,0	5,27	105,0	0
Aze vifa-71	4,73	4,96	105,0	0
Aze vifa-72	6,15	6,29	102,0	0
Aze vifa-3-95	6,54	6,37	97,0	3,0
Aze vifa-27	5,54	5,32	96,0	4,0
Aze vifa-62	5,19	4,59	88,4	11,6
Aze vifa-61	5,81	5,11	88,0	12,0
Aze vifa-63	6,15	5,06	82,0	18,0
Aze vifa-7-97	6,66	5,44	82,0	18,0

Results and discussion

Out of the 15 faba bean samples studied, 9 samples — Aze/VIFA-28, Aze/VIFA-60, Aze/VIFA-64, VIFA-70, VIFA-8-98, VIFA-4-100, Aze/VIFA-71, Aze/VIFA-72, Aze/VIFA-73 — were selected for their high drought tolerance. In these samples, the change in chlorophyll content due to drought ranged from 102.0% to 144.0%, with the chlorophyll stress-depression index being 0. Four of our samples (Aze VIFA-27, Aze VIFA-3-95, Aze VIFA-61, Aze/VIFA-62) were rated as drought-tolerant. The remaining samples were classified as moderately drought-tolerant. The protein content in our samples varied between 23.9% and 28.9%. The highest protein content was recorded in the samples Aze VIFA-64 (28.2%), Aze VIFA-60 (27.9%), and Aze VIFA-71 (27.7%). The lysine content ranged from 680 to 1198 (100 mg/g). The tryptophan content varied between 145 and 245 (100 mg/g). Based on the results of the analysis, the protein and lysine content were high in three samples (Aze VIFA-64, Aze VIFA-60, and Aze VIFA-71).

Table 2

RESULTS OF TECHNOLOGICAL AND BIOCHEMICAL ANALYSES
OF FABA BEAN SEED SAMPLES

Sample name	*Seed Capacity ml*	*Cooking Time min*	*Color*	*Moisture %*	*100 Seeds g*	*Tryptophan mg/100 g*	*Lizin 100 mq/q*	*Protein %*
Aze vifa -28	13	42	coffee	11,0	102,0	235	870	23,9
Aze vifa -60	14	42	coffee	11,0	102,0	180	1198	27,9
Aze vifa -70	14	40	coffee	11,8	104,0	180	680	23,9
Aze vifa-64	14	45	coffee	11,7	103,0	190	920	28,2
Aze vifa-8-98	10	55	coffee	10,3	102,0	245	755	25,3

Sample name	*Seed Capacity ml*	*Cooking Time min*	*Color*	*Moisture %*	*100 Seeds g*	*Tryptophan mg/100 g*	*Lizin 100 mq/q*	*Protein %*
Aze vifa-72	11	50	coffee	10,0	100,0	200	740	26,4
Aze vifa-71	11	55	coffee	10,8	100,0	210	885	27,7
Aze vifa-27	12	56	coffee	10,0	102,0	145	790	26,4
Aze vifa-4-100	13	50	coffee	10,0	100,0	235	888	26,8

Table 3

SAMPLES OF FABA BEAN PLANTS WITH HIGH RESULTS ACCORDING TO TECHNOLOGICAL AND BIOCHEMICAL INDICATORS

Sample name	*Seed Capacity, ml*	*Cooking Time, min*	*100 Seeds, g*	*Moisture, %*	*Tryptophan, mg*	*Protein, %*
Aze vifa-70	14	40	11,8	104,0	235	23,9
Aze vifa-28	13	42	11,0	102,0	180	23,9

Thus, among the 9 drought-resistant faba bean samples, 4 samples (Aze VIFA-60, Aze VIFA-64, Aze VIFA-71, Aze VIFA-4-100) were selected based on the results of biochemical analyses, which showed high values. These samples demonstrated high levels of protein and lysine. According to technological indicators, 3 samples showed good results in terms of 100-seed weight, water absorption capacity, cooking time, moisture content, and protein levels.

Table 4

RESULTS OF PHYTOPATHOLOGICAL EVALUATION OF FABA BEAN (*Vicia faba* L.) PLANTS INFECTED WITH VARIOUS FUNGAL DISEASES

Sample Variety Name	Place of Origin	Number of Plants	Number of Diseased Plants			Disease Name	Disease Resistance
			sayı	faizlə	balla		
Aze vifa -28		19	-	-	0	-	immun
Aze vifa-60		21	-	-	0	-	immun
VİFA-4-100		19	-	-	0	-	immun
Aze vifa-73		21	-	-	0	-	immun

Additionally, 4 (Aze vifa -28, Aze vifa-60, VİFA-4-100, Aze vifa-73) of the drought-resistant plant samples showed high results in the phytopathological evaluation. These samples demonstrated high resistance to fungal, bacterial, and viral diseases, surpassing the standard in terms of productivity characteristics, and were selected as the most promising forms.

Results

Thus, as a result of the conducted research, drought-resistant samples of the faba bean plant were identified. Their biochemical composition was studied, and samples with high levels of protein and essential amino acids were selected. Technological parameters and phytopathological evaluations were also conducted, indicating that these samples are suitable for use as donor plants in future selection efforts.

References:

1. Aliev, R. T., Abbasov, M. A., & Ragimli, V. R. (2014). Stress i adaptatsiya rastenii. Baku. (in Azerbaijani).

2. Mikailova, R. T. & Mikailova, R.T. (2023). Diagnostika zasukho i soleustoichivosti razlichnykh obraztsov konskogo boba (Visia Faba L.). *Aktual'nye issledovaniya,* (37(167)), 6-9. (in Russian).

3. Labba, I. C. M., Frøkiær, H., & Sandberg, A. S. (2021). Nutritional and antinutritional composition of fava bean (Vicia faba L., var. minor) cultivars. *Food Research International*, *140*, 110038. https://doi.org/10.1016/j.foodres.2020.110038

4. Crépon, K., Marget, P., Peyronnet, C., Carrouée, B., Arese, P., & Duc, G. (2010). Nutritional value of faba bean (Vicia faba L.) seeds for feed and food. *Field crops research*, *115*(3), 329-339. https://doi.org/10.1016/j.fcr.2009.09.016

5. Boudjou, S., Oomah, B. D., Zaidi, F., & Hosseinian, F. (2013). Phenolics content and antioxidant and anti-inflammatory activities of legume fractions. *Food chemistry*, *138*(2-3), 1543-1550. https://doi.org/10.1016/j.foodchem.2012.11.108

6. Samaei, S. P., Ghorbani, M., Sadeghi Mahoonak, A., & Aalami, M. (2020). Antioxidant activity of Faba Bean (Vicia Faba) proteins hydrolysates produced by alcalase and trypsin. *Research and Innovation in Food Science and Technology*, *9*(1), 1-10. https://doi.org/10.22101/JRIFST.2019.09.21.e1285

7. Cardador-Martínez, A., Maya-Ocaña, K., Ortiz-Moreno, A., Herrera-Cabrera, B. E., Dávila-Ortiz, G., Múzquiz, M., ... & Jiménez-Martínez, C. (2012). Effect of Roasting and Boiling on the Content of Vicine, Convicine and L-3, 4-dihydroxyphenylalanine in V icia faba L. *Journal of Food Quality*, *35*(6), 419-428. https://doi.org/10.1111/jfq.12006

8. Valente, I. M., Maia, M. R., Malushi, N., Oliveira, H. M., Papa, L., Rodrigues, J. A., ... & Cabrita, A. R. (2018). Profiling of phenolic compounds and antioxidant properties of European varieties and cultivars of Vicia faba L. pods. *Phytochemistry*, *152*, 223-229. https://doi.org/10.1016/j.phytochem.2018.05.011

9. Turco, I., Bacchetti, T., Bender, C., Zimmermann, B., Oboh, G., & Ferretti, G. (2016). Polyphenol content and glycemic load of pasta enriched with Faba bean flour. *Functional Foods in Health and Disease*, *6*(5), 291-305. https://doi.org/10.31989/ffhd.v6i5.254

10. Jamalian, J. (1999). Removal of favism-inducing factors vicine and convicine and the associated effects on the protein content and digestibility of fababeans (Vicia faba L). *Journal of the Science of Food and Agriculture*, *79*(13), 1909-1914. https://doi.org/10.1002/(SICI)1097-0010(199910)79:13<1909::AID-JSFA454>3.0.CO;2-H

11. Chudinova, L. A., & Orlova, N. V. (2006). Fiziologiya ustoichivosti rastenii. Peri'. (in Russian).

12. Guseinova, T. N. (2021). Adaptatsiya rastenii k abioticheskim stressam. Lambert. (in Russian).

13. Drozdov, S. N. (1988). Diagnostika ustoichivosti rastenii k stressovym vozdeistviyam. L.: VIR, 226 s. (in Russian).

14. Ermakov, A. I., Yarosh, N. P., & Mikhailov, A. A. (1969). Opredelenie triptofana v semenakh. *Byulleten' VIR*, (14), 31-35. (in Russian).

Список литературы:

Əliyev R.T., Abbasov M.Ə., Rəhimli V.R. Stres və bitkilərin adaptasiyası. Bakı-Elm, 2014, səh3-5.

2. Микаилова Р.Т. Диагностика засухо и солеустойчивости различных образцов конского боба (Visia Faba L.) //Актуальные исследования. 2023. Вып. 37., Ч.1., с.6-8.

3. Labba I. C. M., Frøkiær H., Sandberg A. S. Nutritional and antinutritional composition of fava bean (Vicia faba L., var. minor) cultivars // Food Research International. 2021. V. 140. P. 110038. https://doi.org/10.1016/j.foodres.2020.110038

4. Crépon, K., Marget, P., Peyronnet, C., Carrouée, B., Arese, P., & Duc, G. Nutritional value of faba bean (Vicia faba L.) seeds for feed and food // Field crops research. 2010. V. 115. №3. P. 329-339. https://doi.org/10.1016/j.fcr.2009.09.016

5. Boudjou S., Oomah B. D., Zaidi F., Hosseinian F. Phenolics content and antioxidant and anti-inflammatory activities of legume fractions // Food chemistry. 2013. V. 138. №2-3. P. 1543-1550. https://doi.org/10.1016/j.foodchem.2012.11.108

6. Samaei S. P. et al. Antioxidant activity of Faba Bean (Vicia Faba) proteins hydrolysates produced by alcalase and trypsin // Research and Innovation in Food Science and Technology. 2020. V. 9. №1. P. 1-10. https://doi.org/10.22101/JRIFST.2019.09.21.e1285

7. Cardador-Martínez A. et al. Effect of Roasting and Boiling on the Content of Vicine, Convicine and L-3, 4-dihydroxyphenylalanine in V icia faba L // Journal of Food Quality. 2012. V. 35. №6. P. 419-428. https://doi.org/10.1111/jfq.12006

8. Valente I. M., Maia M. R., Malushi N., Oliveira H. M., Papa L., Rodrigues J. A., Cabrita A. R. Profiling of phenolic compounds and antioxidant properties of European varieties and cultivars of Vicia faba L. pods // Phytochemistry. 2018. V. 152. P. 223-229. https://doi.org/10.1016/j.phytochem.2018.05.011

9. Turco I., Bacchetti T., Bender C., Zimmermann B., Oboh G., Ferretti G. Polyphenol content and glycemic load of pasta enriched with Faba bean flour // Functional Foods in Health and Disease. 2016. V. 6. №5. P. 291-305. https://doi.org/10.31989/ffhd.v6i5.254

10. Jamalian J. Removal of favism-inducing factors vicine and convicine and the associated effects on the protein content and digestibility of fababeans (Vicia faba L) // Journal of the Science of Food and Agriculture. 1999. V. 79. №13. P. 1909-1914. https://doi.org/10.1002/(SICI)1097-0010(199910)79:13<1909::AID-JSFA454>3.0.CO;2-H

11. Чудинова Л. А., Орлова Н. В. Физиология устойчивости растений. Перьиь, 2006. 123 с.

12. Гусейнова Т. Н. Адаптация растений к абиотическим стрессам. Lambert, 2021. 73 с.

13. Дроздов С. Н. Диагностика устойчивости растений к стрессовым воздействиям. Л.: ВИР, 1988. 226 с.

14. Ермаков А. И., Ярош Н. П., Михайлов А. А. Определение триптофана в семенах // Бюллетень ВИР. 1969. №14. С. 31-35.

Работа поступила в редакцию 10.05.2025 г.

Принята к публикации 17.05.2025 г.

Ссылка для цитирования:

Mikayılova R., Mamedova Sh., Kelbieva Ye., Mamedova A., Ismayilova V. Drought Stress, Biochemical, Technological and Phytopathological Properties of Faba Bean Vicia faba L. Samples // Бюллетень науки и практики. 2025. Т. 11. №7. С. 300-307. https://doi.org/10.33619/2414-2948/116/38

Cite as (APA):

Mikayılova, R., Mamedova, Sh., Kelbieva, Ye., Mamedova, A., & Ismayilova, V. (2025). Drought Stress, Biochemical, Technological and Phytopathological Properties of Faba Bean Vicia faba L. Samples. *Bulletin of Science and Practice, 11*(7), 300-307. https://doi.org/10.33619/2414-2948/116/38