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ASSESSMENT OF THE COMPOSİTİON AND QUANTİTY OF NUTRİENT ELEMENTS ENTERİNG THE SOİL THROUGH ATMOSPHERİC DEPOSİTİON AND IRRİGATİON WATER İN THE GANJA-GAZAKH REGİON

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ОЦЕНКА СОСТАВА И КОЛИЧЕСТВА ПИТАТЕЛЬНЫХ ЭЛЕМЕНТОВ, ПОСТУПАЮЩИХ В ПОЧВУ С АТМОСФЕРНЫМИ ОСАДКАМИ И ПОЛИВНОЙ ВОДОЙ В ГЯНДЖА–ГАЗАХСКОМ РЕГИОНЕ

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Abstract. The findings of this study demonstrate that accurate assessment of the nutrient balance in agricultural crops requires the determination of nutrient inputs to the soil through atmospheric deposition and irrigation water. The results of studies conducted in different regions and on various crop species indicate that atmospheric precipitation and irrigation water constitute important natural sources contributing to the replenishment of soil nutrient reserves. According to the available evidence, atmospheric deposition supplies the soil primarily with nitrogen in the form of ammonia, as well as nitrate nitrogen, phosphorus, and potassium. The quantity of these nutrients varies depending on annual precipitation, climatic conditions, seasonal variation, industrial emissions, and other environmental factors. Irrigation water also plays a significant role in maintaining soil fertility by supplying essential nutrients. In particular, potassium input through irrigation water has been reported to be relatively high, ranging from 20 to 39 kg ha^{-1} in numerous studies. The corresponding inputs of nitrogen and phosphorus have been estimated at 2.8–3.8 kg ha^{-1} and 0.9–1.4 kg ha^{-1}, respectively. The results also indicate that the application of appropriate irrigation regimes and modern cultivation technologies is essential for increasing the productivity of forage crops. The cultivation of annual forage species contributes to alleviating feed shortages during the summer–autumn period, while irrigation applied at the optimal time and in appropriate amounts promotes normal plant growth and enhances crop productivity. Overall, atmospheric deposition and irrigation water not only replenish soil moisture reserves but also supply the soil–plant system with essential nutrients, including nitrogen, phosphorus, and potassium. In doing so, they play a crucial role in nutrient cycling, the maintenance of soil fertility, and the improvement of agricultural crop productivity. Therefore, nutrient inputs from atmospheric deposition and irrigation water should be systematically considered when developing fertilizer management strategies.

Аннотация. Результаты исследования показывают, что для точной оценки баланса питательных веществ в сельскохозяйственных культурах необходимо определить поступление питательных веществ в почву с атмосферными осадками и поливной водой. Результаты исследований, проведённых в разных регионах и с участием различных видов сельскохозяйственных культур, свидетельствуют о том, что атмосферные осадки и поливная вода являются важными природными источниками, способствующими восполнению запасов питательных веществ в почве. Согласно имеющимся данным, атмосферные осадки обеспечивают почву в основном азотом в виде аммиака, а также нитратным азотом, фосфором и калием. Количество этих питательных веществ варьируется в зависимости от годового количества осадков, климатических условий, сезонных колебаний, промышленных выбросов и других факторов окружающей среды. Поливная вода также играет важную роль в поддержании плодородия почвы, обеспечивая её необходимыми питательными веществами. В частности, согласно многочисленным исследованиям, с поливной водой в почву поступает относительно большое количество калия — от 20 до 39 кг на гектар. Соответствующее поступление азота и фосфора оценивается в 2,8–3,8 кг на гектар и 0,9–1,4 кг на гектар соответственно. Результаты исследования также показывают, что для повышения урожайности кормовых культур необходимо применять соответствующие режимы орошения и современные технологии возделывания. Выращивание однолетних кормовых культур способствует решению проблемы нехватки кормов в летне-осенний период, а полив, осуществляемый в оптимальное время и в достаточном объёме, способствует нормальному росту растений и повышает урожайность. В целом атмосферные осадки и поливная вода не только пополняют запасы влаги в почве, но и снабжают систему «почва — растение» необходимыми питательными веществами, в том числе азотом, фосфором и калием. Таким образом, они играют важнейшую роль в круговороте питательных веществ, поддержании плодородия почвы и повышении урожайности сельскохозяйственных культур. Поэтому при разработке стратегий использования удобрений необходимо учитывать поступление питательных веществ из атмосферных осадков и поливной воды.

Keywords: fertilizer, irrigation, nutrient elements, minerals, saline soils.

Ключевые слова: удобрение, орошение, питательные элементы, минералы, засоленные почвы.

One of the fundamental prerequisites for achieving high and stable agricultural productivity is the accurate assessment of the soil nutrient balance. The nutrient balance reflects the relationship between nutrient inputs to and outputs from the soil and is of critical importance for maintaining soil fertility and developing scientifically based fertilizer management systems. In addition to mineral and organic fertilizers, the input component of the nutrient balance also includes nutrients supplied to the soil through atmospheric deposition and irrigation water [1-3].

Atmospheric precipitation and irrigation water provide natural pathways for the transfer of nitrogen, phosphorus, potassium, and other essential macronutrients into the soil–plant system. The quantities of these nutrients vary depending on climatic conditions, precipitation intensity, irrigation rates, the chemical composition of irrigation water, and other environmental factors. Assessing nutrient inputs from these natural sources is of considerable scientific and practical importance for evaluating nutrient cycling, optimizing fertilizer application rates, and implementing environmentally sustainable agricultural production systems [4].

Materials and Methods

The nutrient content of soil is one of the principal agrochemical indicators of soil fertility. Soil contains up to 45 chemical elements, which occur in both organo-mineral and mineral forms and constitute approximately 85–90% of the solid phase of the soil. The essential elements required for plant nutrition include oxygen (O), carbon (C), hydrogen (H), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), and fluorine (F). In addition, normal plant growth and development require trace elements such as manganese (Mn), copper (Cu), molybdenum (Mo), cobalt (Co), and others. While some of these elements are present in sufficient quantities, others occur only in trace amounts [5].

Depending on soil type and fertility level, the 0–40 cm soil layer of one hectare typically contains approximately 6–30 tons of nitrogen, 3–15 tons of phosphorus, and 12–45 tons of potassium. The availability of nutrients to plants depends not only on their total reserves in the soil but also on the chemical forms in which these nutrients occur.

In agricultural production, the nutrient requirements of crops are met through the conversion of organic nutrient reserves in the soil into plant-available forms, together with the application of mineral fertilizers. The improvement of the agrochemical properties of soil fertility is achieved through a range of management practices, including the liming of acidic soils, the gypsum amendment of alkaline soils, the reclamation of saline soils by leaching, the application of organic and mineral fertilizers, and the appropriate selection and rotation of crops.

Soil is a dynamic natural body formed through the long-term action of physical, chemical, and biological processes on parent rock material. It consists of solid, liquid, and gaseous phases. The solid phase is composed of mineral and organic constituents with diverse physicochemical properties and plays a fundamental role in regulating the characteristics of the liquid and gaseous phases. Owing to the interactions among these phases, soil exhibits a range of agrophysical properties that develop during the processes of soil formation and land use. These properties are regarded as key indicators of soil fertility and exert a direct influence on agricultural productivity [6].

Soil is the principal means of agricultural production and the foundation of agroecosystems. Approximately 95% of the world's food supply is derived directly or indirectly from soil resources. Therefore, maintaining soil fertility and ensuring long-term soil health should be regarded as a primary priority of sustainable agricultural production.

As a vital habitat, soil provides a living environment for a wide diversity of organisms. It also serves as the mechanical support for plant growth, enabling the establishment, development, and persistence of vegetation.

Results and Discussion

Determining the quantities of nutrient elements entering the soil through atmospheric deposition and irrigation water is an essential component of assessing the nutrient balance of agricultural crops. These natural nutrient inputs constitute an important part of the input side of the soil nutrient balance and should be taken into account when evaluating nutrient dynamics and developing fertilizer management strategies.

The results obtained in the study region indicate that atmospheric deposition supplied the soil with an average of 8.57–10.93 kg ha^{-1} of nitrogen annually, predominantly in the form of ammoniacal nitrogen, while nitrate nitrogen accounted for 1.33–1.95 kg ha^{-1} of the total nitrogen input. Annual phosphorus inputs ranged from 1.50 to 2.46 kg ha^{-1}, whereas potassium inputs varied between 4.29 and 5.56 kg ha^{-1}. The observed variation in nutrient inputs was primarily associated with differences in the amount of atmospheric precipitation. The quantity of nutrients deposited through atmospheric precipitation is influenced by climatic conditions, rainfall patterns, seasonal variability, and the proximity of agricultural land to industrial areas, among other environmental factors [1].

Studies conducted on grey-brown soils in the Ganja–Gazakh region have shown that atmospheric deposition contributes annually 1.31–1.41 kg ha^{-1} of phosphorus and 2.93–3.46 kg ha^{-1}

of potassium to the soil. In comparison, irrigation water supplies 1.04–1.33 kg ha^{-1} of phosphorus and 19.51–19.67 kg ha^{-1} of potassium annually [14].

In another study carried out in the region by H. A. Aslanov, PhD in Agricultural Sciences, annual nutrient inputs to potato fields through irrigation water were estimated at 2.80–2.92 kg ha^{-1} of nitrogen, 0.90–0.92 kg ha^{-1} of phosphorus, and 33.3–35.4 kg ha^{-1} of potassium. The corresponding nutrient inputs through atmospheric deposition were reported to be 5.45–6.20 kg ha^{-1} of nitrogen, 1.00–1.04 kg ha^{-1} of phosphorus, and 2.33–2.72 kg ha^{-1} of potassium [2].

Studies conducted on alfalfa (*Medicago sativa* L.) have shown that annual nutrient inputs through atmospheric deposition amounted to 2.55–3.00 kg ha^{-1} of nitrogen, 0.33–0.47 kg ha^{-1} of phosphorus, and 0.66–1.02 kg ha^{-1} of potassium. Under a seasonal irrigation regime of 5,800 m^3 ha^{-1}, irrigation water supplied 3.28–3.44 kg ha^{-1} of nitrogen, 1.24–1.26 kg ha^{-1} of phosphorus, and 21.26–23.73 kg ha^{-1} of potassium annually [6, 8].

Further investigations in the Ganja–Gazakh region revealed that atmospheric deposition contributed 4.94–6.41 kg ha^{-1} of nitrogen, 0.97–1.32 kg ha^{-1} of phosphorus, and 2.35–2.73 kg ha^{-1} of potassium to the soil each year. Under annual irrigation rates ranging from 4,150 to 4,850 m^3 ha^{-1}, the corresponding nutrient inputs through irrigation water were 2.84–3.23 kg ha^{-1} of nitrogen, 0.89–1.05 kg ha^{-1} of phosphorus, and 34.39–38.85 kg ha^{-1} of potassium [5, 13].

Studies conducted under the conditions of the Samukh district demonstrated that atmospheric precipitation contained 0.90–2.03 mg L^{-1} of ammoniacal nitrogen, 0.15–0.63 mg L^{-1} of nitrate nitrogen, 0.18–0.52 mg L^{-1} of phosphorus, and 0.83–1.25 mg L^{-1} of potassium. Nitrogen was the predominant nutrient present in atmospheric deposition. Annually, atmospheric precipitation supplied the experimental plots with 5.07–7.51 kg ha^{-1} of total nitrogen, of which 4.14–6.06 kg ha^{-1} was in the form of ammoniacal nitrogen and 0.93–1.45 kg ha^{-1} as nitrate nitrogen. The corresponding annual inputs of phosphorus and potassium were 0.92–1.37 kg ha^{-1} and 2.67–4.05 kg ha^{-1}, respectively. The annual nutrient inputs through irrigation water to the experimental plots ranged from 2.82 to 3.32 kg ha^{-1} for total ammoniacal and nitrate nitrogen, 1.01–1.08 kg ha^{-1} for phosphorus, and 31.09–34.50 kg ha^{-1} for potassium [9].

The results of previous investigations have demonstrated that atmospheric deposition supplies the land surface with appreciable quantities of nutrients that play a fundamental role in the development of the soil–plant system and the enhancement of crop productivity. On average, over a three-year period, atmospheric precipitation was found to contribute 37.2 kg ha^{-1} of nitrogen, 20.9 kg ha^{-1} of phosphorus, 13.3 kg ha^{-1} of potassium, and 17.3 kg ha^{-1} of sulfuric acid to the soil surface. These inputs are of considerable importance for the biochemical and reclamation processes that govern soil fertility and productivity [15].

The herbage of natural pastures begins to senesce from the middle of May and gradually dries out throughout the grazing season, becoming unsuitable for use during the summer–autumn period. The relatively low productivity of cultivated forage crops in these regions is primarily associated with the delayed implementation of modern cultivation technologies adapted to local environmental conditions. Additional contributing factors include the lack of scientifically validated recommendations regarding the production of annual forage crops for green fodder, hay, and seed, as well as the determination of optimal sowing periods. Furthermore, the identification and introduction of high-yielding cultivated forage species adapted to regional conditions have remained insufficient over an extended period [8].

To address the shortage of forage crops and ensure the production of high-quality feed under local environmental conditions, thereby improving livestock management, it is feasible to establish a forage base for the critical summer–autumn period through the cultivation of annual forage crops, such as grass pea (*Lathyrus sativus*), rye (*Secale cereale*), and other suitable species.

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To prevent soil crust formation, which may adversely affect normal plant growth and development, the first irrigation should be applied only after full seedling emergence or following the appearance of the third true leaf. Depending on the water requirements of the crop species and the sowing period, fields should be irrigated four to five times during the growing season. The first and second irrigations should be carried out during the active vegetative growth stage, whereas subsequent irrigations should be applied after each forage harvest. Surface (flood) irrigation is recommended, with an irrigation rate of 800–1000 m³ ha⁻¹ [12].

To determine the nutrient inputs to the soil through atmospheric precipitation, regular precipitation samples were collected from the Ganja Regional Hydrometeorological Center during the 2004–2006 study period. The concentrations of water-soluble ammonium nitrogen, nitrate nitrogen, phosphorus, and potassium were subsequently analyzed.

The concentrations and amounts of nutrients supplied to the soil through atmospheric precipitation and irrigation water during the experimental period are presented in Table 1.

During the study period, annual atmospheric precipitation ranged from 256.2 to 290.3 mm (Table). The concentrations of ammonium nitrogen, nitrate nitrogen, phosphorus, and potassium in atmospheric precipitation varied between 0.78–1.86 mg L⁻¹, 0.15–0.55 mg L⁻¹, 0.18–0.53 mg L⁻¹, and 0.83–1.18 mg L⁻¹, respectively. Nitrogen was the predominant nutrient present in atmospheric precipitation.

Table

COMPOSİTİON AND QUANTİTY OF NİTROGEN, PHOSPHORUS, AND POTASSİUM İNTRODUCED İNTO THE EXPERİMENTAL PLOTS THROUGH İRRİGATİON WATER

Irrigation period	*Irrigation rate, m³ ha⁻¹*	*2026*							
		Composition, mg L⁻¹				*Quantity, kg ha⁻¹*			
		N		*P_2O_5*	*K_2O*	*N*		*P_2O_5*	*K_2O*
		NH_3	*NO_3*			*NH_3*	*NO_3*		
7.V	800	0,38	0,21	0,24	4,81	0,30	0,17	0,19	3,85
5.VI	800	0,35	0,18	0,22	4,73	0,28	0,14	0,18	3,78
27.VI	1000	0,25	0,21	0,20	4,90	0,25	0,21	0,20	4,90
12.VII	1000	0,35	0,33	0,24	5,01	0,35	0,33	0,24	5,01
28.VII	800	0,27	0,25	0,27	4,78	0,22	0,20	0,22	3,58
18.VIII	800	0,31	0,28	0,25	4,63	0,25	0,22	0,20	3,70
15.IX	800	0,28	0,25	0,20	5,01	0,22	0,20	0,16	4,01
Total	6000					1,87	1,47	1,39	28,83
						3,34			

As shown in the tables, atmospheric precipitation contributed 4.23–5.58 kg ha⁻¹ of nitrogen annually to the experimental plots. Nitrogen was mainly present in the form of ammonium nitrogen, accounting for 3.09–4.46 kg ha⁻¹, while nitrate nitrogen ranged from 0.90 to 1.14 kg ha⁻¹. The amounts of phosphorus and potassium supplied through atmospheric precipitation were 1.00–1.12 kg ha⁻¹ and 2.65–2.95 kg ha⁻¹, respectively. Irrigation water not only provides the soil with the required moisture but also serves as an important source of nutrient inputs due to the dissolved mineral elements it contains. Therefore, irrigation water plays a significant role in the cycling and migration of nutrients within the soil system. The experimental plots were irrigated with water obtained from the Ganja River. Depending on weather conditions, the irrigation rate varied between 800 and 1000 m³ ha⁻¹, while the total amount of irrigation water applied during the vegetation period ranged from 6000 to 6400 m³ ha⁻¹. Taking into account the irrigation rates, the composition and quantity of nitrogen, phosphorus, and potassium introduced into one hectare of land through irrigation water were determined. The results indicated that the concentrations of ammonium nitrogen, nitrate nitrogen, phosphorus, and potassium in irrigation water were 0.25–0.38 mg L^{-1}, 0.20–0.35 mg L^{-1}, 0.18–0.25 mg L^{-1}, and 4.63–5.15 mg L^{-1}, respectively. Overall, the annual input of nutrients into the hayfield through irrigation water varied within the following ranges: the total amount of ammonium and nitrate nitrogen was 3.34–3.83 kg ha^{-1}, phosphorus was 1.26–1.39 kg ha^{-1}, and potassium ranged from 28.83 to 31.26 kg ha^{-1}.

Results

The analysis of the conducted studies demonstrates that atmospheric precipitation and irrigation water represent important natural sources contributing to the nutrient supply of agricultural soils. Atmospheric precipitation primarily introduces nitrogen in ammonium and nitrate forms, as well as phosphorus and potassium, into the soil. Irrigation water, in addition to regulating the soil water regime, contributes to the input of nutrients into the soil–plant system, particularly potassium, along with certain amounts of nitrogen and phosphorus. The results of studies conducted in different regions and on various crops indicate that the concentrations of nutrients in atmospheric precipitation and irrigation water vary depending on climatic conditions, precipitation amounts, irrigation rates, chemical composition of water, and other environmental factors. Nevertheless, nutrients supplied through these sources significantly influence soil nutrient balance formation, nutrient cycling, and the maintenance of soil fertility. The studies conducted during 2024–2026 revealed that atmospheric precipitation annually contributed an average of 4.23–5.58 kg ha^{-1} nitrogen, 1.00–1.12 kg ha^{-1} phosphorus, and 2.65–2.95 kg ha^{-1} potassium to the soil. Meanwhile, irrigation water supplied 3.34–3.83 kg ha^{-1} nitrogen, 1.26–1.39 kg ha^{-1} phosphorus, and 28.83–31.26 kg ha^{-1} potassium. These findings confirm the particularly important role of irrigation water as a source of potassium input into agricultural soils.

References:

1. Ahundov, F. G. (1989). Agrohimiya koncentrirovannyh i slozhnyh udobrenij. Baku. (in Russian).

2. Aslanov, G. A. (2006). Vliyanie ceolita i udobrenij na balans pitatel'nyh veshchestv v pochve. *Kartofel' i ovoshchi,* (7), 16a-17. (in Russian).

3. Bayramova, A. A., Guliyeva, R. Z., Akhundova, S. T., & Hajiyeva, I. I. (2024). Adaptation mechanism of some exotic plants used in the greening of Ganja city. *Ботанические сады в современном мире*, (5), 3-6.

4. Bayramova, A., Hajiyeva, I., Mammadova, M., & Mahmudov, E. (2025). Phytosanitary Status of Dendroflora of Ganja City and Scientific and Practical Directions of its Improvement. *Bulletin of Science and Practice, 11*(6), 81-86. https://doi.org/10.33619/2414-2948/115/11

5. Bayramova A. A., & Allahverdiyeva H. E. (2026). Ecosystems ın the northeastern Part of the Lesser Caucasus. *Science Time,* (2 (145)), 44-47.

6. Mahmudova, U. T. (2022). Ehkologo-fitomeliorativnaya ocenka rastitel'nogo pokrova zagryaznennyh territorij Gyandzhi i ee okrestnostej: avtoref. … kand. s.-h. nauk. Baku.

7. Novruzov, V., & Bayramova, A. (2026). Assessment of the Resılıence of Bıodıversıty of Ecosystems Around the Ganja Alumınum Plant durıng Clımate Change. *ANAS Reports*, *82*(1).

8. Novruzov, V., & Bayramova, A. (2025). The Role of AI ın the Study of Zangılan Flora: A Case Study on AI-Assisted Exploration of Zangilan's Plant Diversity. *Shusha Scientific Journal*, *1*(1), 31-37. https://doi.org/10.66366/ssj.2025.13

9. Gasanova, A. O. (2012). Optimizaciya norm vneseniya udobrenij pri vyrashchivanii tomatov v Gyandzha-Gazahskom regione: diss. ... kand. s.-h. nauk. Gyandzha. (in Russian).

Т. 12. №9 2026
https://doi.org/10.33619/2414-2948/130

10. Alieva, I. M. (2025). Ocenka biofizicheskih parametrov rastenij pri izuchenii zagryaznitelej pochvy v Gyandzha–Gazahskoj zone: Avtoref. diss. … kand. s.-h. nauk. Baku.

11. Aliyeva, I. M., Mammadova, L. M., Verdiyeva, F. B., Nasibova, A. N., & Khalilov, R. I. (2019). Effect of Waste Dust Collected from the Ganja Aluminum Plant Area on the Development of Barley (Hordeum) Seedlings. In *Actual Problems of Modern Natural and Economic Sciences: Proceedings of the International Scientific Conference, Ganja,* 294.

12. Aliyev, Ch. S., Kosayev, E. M., Zeynalov, K. N., & Salmanov, R. S. (2011). Technology of Cultivation of Annual Forage Crops Using Modern Technical Means in the Mountainous Regions of the Republic. *Azerbaijan Agrarian Science,* (2), 91–92.

13. Aliyeva, I. M., & Khalilov, R. I. (2022). Assessment of the Ecological Situation in Ganja City and Surrounding Areas. In *Actual Problems of Modern Natural and Economic Sciences: Proceedings of the International Scientific Conference, Ganja,* 49.

14. Mammadov, M. I. (2010). The Input of Phosphorus and Potassium into Soil through Atmospheric Precipitation and Irrigation Waters. *In Proceedings of the Azerbaijan Society of Soil Scientists, 11,* 494–499.

15. Yagubov, G. Sh., Gunel, R. A., & Gasimzade, T. E. (2011). Study of Nutrient Elements Entering the Soil Surface through Atmospheric Precipitation and Their Effect on the Development of the Soil–Plant System. *Soil Science and Agrochemistry, 20*(1), 289–292.

Список литературы:

1. Ахундов Ф. Г. Агрохимия концентрированных и сложных удобрений. Баку: Элм, 1989, 189 с.

2. Асланов Г. А. Влияние цеолита и удобре ний на баланс питательных веществ в почве // Картофель и овощи. 2006. №7. С. 16а-17.

3. Bayramova A. A., Guliyeva R. Z., Akhundova S. T., Hajiyeva I. I. Adaptation mechanism of some exotic plants used in the greening of Ganja city // Ботанические сады в современном мире. 2024. №5. С. 3-6.

4. Bayramova A., Hajiyeva I., Mammadova M., Mahmudov E. Phytosanitary Status of Dendroflora of Ganja City and Scientific and Practical Directions of its Improvement // Бюллетень науки и практики. 2025. Т. 11. №6. С. 81-86. https://doi.org/10.33619/2414-2948/115/11

5. Bayramova A. A., Allahverdiyeva H. E. Ecosystems ın the northeastern Part of the Lesser Caucasus // Science Time. 2026. №2 (145). P. 44-47.

6. Махмудова У. Т. Эколого-фитомелиоративная оценка растительного покрова загрязненных территорий Гянджи и ее окрестностей: автореф. … канд. с.-х. наук. Баку, 2022.

7. Novruzov V., Bayramova A. Assessment of the Resılıence of Bıodıversıty of Ecosystems Around the Ganja Alumınum Plant durıng Clımate Change // ANAS Reports. 2026. V. 82. №1.

8. Novruzov V., Bayramova A. The Role of AI ın the Study of Zangılan Flora: A Case Study on AI-Assisted Exploration of Zangilan’s Plant Diversity // Shusha Scientific Journal. 2025. V. 1. №1. P. 31-37. https://doi.org/10.66366/ssj.2025.13

9. Гасанова А. О. Оптимизация норм внесения удобрений при выращивании томатов в Гянджа-Газахском регионе: дисс. ... канд. с.-х. наук. Гянджа, 2012, 206 с.

10. Алиева И. М. Оценка биофизических параметров растений при изучении загрязнителей почвы в Гянджа–Газахской зоне: Автореф. дисс. … канд. с.-х. наук. Баку, 2025. 40 с.

11. Aliyeva I. M., Mammadova L. M., Verdiyeva F. B., Nasibova A. N., Khalilov R. I. Effect of Waste Dust Collected from the Ganja Aluminum Plant Area on the Development of Barley

(Hordeum) Seedlings // Actual Problems of Modern Natural and Economic Sciences: Proceedings of the International Scientific Conference, Ganja, 2019. P. 294.

12. Aliyev Ch. S., Kosayev E. M., Zeynalov K. N., Salmanov R. S. Technology of Cultivation of Annual Forage Crops Using Modern Technical Means in the Mountainous Regions of the Republic // Azerbaijan Agrarian Science. 2011. №2. P. 91–92.

13. Aliyeva I. M., Khalilov R. I. Assessment of the Ecological Situation in Ganja City and Surrounding Areas // Actual Problems of Modern Natural and Economic Sciences: Proceedings of the International Scientific Conference. Ganja, 2022. P. 49.

14. Mammadov M. I. The Input of Phosphorus and Potassium into Soil through Atmospheric Precipitation and Irrigation Waters // Proceedings of the Azerbaijan Society of Soil Scientists. 2010. V. 11. P. 494–499.

15. Yagubov G. Sh., Gunel R. A., Gasimzade T.E. Study of Nutrient Elements Entering the Soil Surface through Atmospheric Precipitation and Their Effect on the Development of the Soil–Plant System // Soil Science and Agrochemistry. 2011. V. 20. №1. P. 289–292.

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