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ABSTRACT

of the dissertation presented for the degree of Doctor of Philosophy (PhD)

PERSPECTIVES OF ECOLOGICAL AGRICULTURE IN AR-ID SOIL-CLIMATE CONDITIONS

Specialty: **2511.01 - Soil science**
2426.01-Ecology

Field of science: **Agrarian sciences**

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INTRODUCTION

The actuality and study level of the topic. The President of the Republic of Azerbaijan has issued several decrees in connection with the implementation of the Law on "Ecological pure agriculture" in the country (Decrees No. 818 of August 25, 2008 and No. 267 of May 24, 2010). These decrees and related decisions of the Cabinet of Ministers of the Republic of Azerbaijan dated January 8, 2009 and August 30, 2010 are of special importance for the development of production of ecological pure products in Azerbaijan[1].

One of the main strategic areas of the agricultural sector, grain growing, especially wheat, has a special role in ensuring food security of each country, including the population of the Republic of Azerbaijan. Development of this area is always in the focus of our state. It is no coincidence that the "Strategic Roadmap for production and processing of agricultural products in the Republic of Azerbaijan" approved by the Presidential Decree dated December 6, 2016 issues such as increasing the production of food soft and durum wheat and eliminating dependence on imports, strengthening and promoting the capacity of local seed production without expanding the existing arable lands in accordance with the 4th strategic goals of "Development of the market of means of production and improvement of services" reflected[2]. This once again confirms that grain growing is one of the main strategic areas in ensuring the national food security of Azerbaijan in the country's economy and one of the main indicators of economic prosperity of the state.

Taking into account of the above, one of the urgent problems is to determine the effective cultivation method and fertilizer norms that affect increasing the productivity, quality and soil fertility of wheat.

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[1] Babayev A.H., Basics of ecological agriculture. Textbook./ V.A. Babayev - Baku: "Ganun" publishing house, -2011, -544 p.

[2] Strategic Roadmap for the production and processing of agricultural products in the Republic of Azerbaijan, Decree No. 1138 of the President of the Republic of Azerbaijan dated December 6, 2016.

Goal and objectives of the research. The main goal of the research is to study the benefits of producing ecological pure and quality products by switching to ecological agriculture in arid soil-climatic conditions.

In order to achieve the goal of the research, the following tasks are envisaged:

- study of ecological soil conditions in this direction in the region where we conduct research;
- study of morphogenetic properties, agrochemical and physico-chemical properties of soils of the experimental field;
- study of the effect of soil cultivation and fertilizers on the accumulation of total nitrogen, phosphorus and potassium in the surface mass of autumn wheat;
- study of the effect of soil cultivation and fertilizers on the growth, structural elements, grain yield and quality of autumn wheat;
- Determine the impact of soil cultivations and fertilizers on the removal of nutrients from the soil with the yield of straw and grain of autumn wheat, the utilization coefficient from the soil and fertilizer and economic efficiency.

Predmet of the research. Wheat, soil cover, getting ecologically safety product with the application of ecological soil cultivation and organic fertilizers in the territory of Yevlakh district.

Object and methods of the research. The research was carried out on the farm "Arzu" in the territory of Malbinasi village of Yevlakh district with using Barakatli-95 variety of autumn wheat and applying the technology of traditional and minimum soil cultivation on irrigated meadow-grey soils in 2007-2011. The sowing norm was 200 kg per hectare. The experiment was carried out in 4 repetitions and 6 variants according to the following scheme: *Traditional soil cultivation:* plowing the soil with plow at a depth of 25-30 cm; 1. Control (without fertilizer); 2. Manure-30 t/ha; 3. Biohumus 5 t/ha. *Minimum soil cultivation*: to make a furrow the soil at a depth of 10-12 cm: 1. Control (without fertilizer); 2. Manure-30 t/ha; 3. Biohumus 5 t/ha. The total area of each variant is 100 m^2, and the protection zone is 1 m between each repetition. Sowing was carried out in the autumn in the last decade of October. A Russian-made SN-16 seed sowing machine was used for sowing.

During the research, soil and plant samples were taken, analyzed, phenological observations were made in the field of experiments, crop accounting and mathematical calculations were carried out on the stages of growth of autumn wheat. Conducting of field experiments, calculation of productivity, accuracy of experiment and mathematical analysis of correlative relations were performed by methods of B.A. Dospekhov[3], V.N. Peregudov[4] and P.N. Konstantinov[5] and A.M. Mesheryakov[6], economic efficiency by the method of N.N. Baranov[7].

The compounds were determined by the following methods in the soil samples taken during the research: pH - with a potentiometer; general humus - by the method of I.V. Tyurin; absorbed bases - K.K. Hedroys; absorbed ammonia - according to D.P. Konev; nitrate nitrogen by the method of Grandval-Lyaju; total nitrogen - according to İ.V. Tyurin; total phosphorus - according to A.M. Mesheryakov; mobile phosphorus - by the method of B.P.Machigin; water-soluble phosphorus - Denije method - with modification of Malyugin and Khrenova; total potassium - according to Smit; exchangeable potassium - by P.B.Protasov method; water-soluble potassium - by the method of V.Q. Alexandrov; granulometric composition – N.A. Kachinski, soil density and total porosity in the modification of N.A. Kachinski by simplified calculation of V.S. Zaytsev; soil moisture by drying in a thermostat at 105°C. Plant analysis was determined by the following methods: total nitrogen, phosphorus and potassi-

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[3] Dospehov B.A. Field experiment methodology. / B.A. Armor - M.: Agropromizdat, -1985. - 351s.

[4] Peregudov V.N. Planning of multifactorial field experiments with fertilizers and mathematical processing of the results. / V.N. Peregudov - M.: Kolos, - 1987. - 182 p.

[5] Jurbitsky Z.A. Theory and practice of the vegetation method. / BEHIND. Jurbitsky, - M.: Science, -1968. - 260 s.

[6] Meshcheryakov A.M. Simplification of calculations in the method of corrected deviations in the variational-static analysis of the results of field experiments. // Agrochemistry, - 1972, No. 9, p. 153-155

[7] Baranov N.N. Guidelines for determining efficiency in agriculture. / M.A. Karovkin, N.S. Yurgin – Moscow: “Kolos”, - 1981

um - according to K.E. Ginzburg, G.M. Sheglova and Y.V. Wulfius; protein nitrogen - according to the Barishteyin; vegetable gelatin - according to A.İ. Ermakov; absolute weight and vitreousness - according to DUIST 3040-55, protein fraction composition - according to A.I. Ermakov.

The main provisions of the defense:

1. Determination of morphogenetic, agrochemical, and physical-chemical properties of soils of the research area in the condition of ecological soil cultivation.

2. The effect of the application of organic fertilizers under autumn wheat in the conditions of ecological soil cultivation on the accumulation of common nitrogen, phosphorus and potassium in the surface mass of autumn wheat, growth and structural elements, removal and assimilation of nutritive substances from the soil with straw and grain products, effect of agrophysical properties of soils.

3. Ecologically safety grain yield and quality of wheat;

4. Economic efficiency.

Scientific innovation of the research. For the first time in irrigated grass-grey soils, soil fertility, productivity, crop quality indicator under winter wheat plant by applying traditional and minimum soil cultivation and effective rates of organic fertilizers (biohumus, manure) and plant fertilizer utilization coefficient have increased, an ecological pure product has been obtained.

Theoretical and practical significance of the research. In traditional soil cultivation, the grain yield of winter wheat in biohumus 5 t/ha variant is 35.9 s/ha on average for 3 years, the increase compared to control is 13 s/ha or 56.8%. In minimum soil cultivation, the grain yield of winter wheat was obtained 41.3 s/ha in biohumus 5 t/ha variant, the increase compared to control was 16.3 s/ha or 65.2%. The quality indicators of the grain yield have also increased compared to free fertilizer variant in both soil cultivations.

Approbation and application of the research. The results of the research are published in the works of the Azerbaijan Geographical Society, in the collection of scientific works "Soil Science and Agrochemistry of ANAS", in the "Xeberler Majmuasi" of ANAS Ganja branch, in the journal "Bulleten nauki i practici", in the international scientific journal of Nature and Science, in the Society of Soil Scientists of Azerbaijan, it was reported at the conferences held at the Institute of Soil Science and Agrochemistry, Ganja State University, Baku State University, Dagestan, Belarus, Ukraine, Tbilisi, Agricultural Scientific Research Institute.

Application of the research. The results of the research were applied on the area of 5 hectares in the Malbinasi village of Yevlakh district in 2020 year. As a result of application, in the traditional cultivation in the variant of biohumus 5 t/ha, the grain yield of winter wheat is 34.8 s/ha, the net profit is 758.5 man/ha, and in the minimum cultivation, respectively, 40.2 s/ha and 1009.9 man / ha.

Name of the organization where the dissertation work is carried out. The dissertation was performed at the Azerbaijan State Agrarian University.

The total volume of the dissertation with characters, indicating the volume of the structural units of the dissertation separately. The dissertation consists of an introduction, five chapters, results, 177 used literatures, 34 tables and 23 figures. In addition, the results of mathematical calculations are presented in the appendices, consisting of 25 tables. Volume of the dissertation consists of 240 pages of computer writing.

Personal participation of the author: The author set the task in the dissertation, conducted the experiment, analyzed and summarized the obtained results.

Publication. 18 articles and theses dedicated to the results of the research conducted on the subject have been published.

THE MAIN CONTENT OF THE DISSERTATION

In the introduction part of the dissertation, a brief description of the actuality of the research, the goal of the research, scientific innoviation, the importance of science and practice, the methodology of relevant analysis of soil and plant samples are shown.

In the first chapter, based on literature, the main features of ecological agriculture in foreign countries and in the Republic, its role in the technology of cultivation of autumn wheat in arid climates are shown.

The second chapter provides information on the geographical location, climate, vegetation, soil cover, research object and methodology of the research area.

The third chapter reflects the morphological and diagnostic characteristics of the soils of the research area, agrochemical and physical-chemical properties of the soils, the characteristics of the agrophysical properties.

The fourth chapter examines the impact of ecological soil cultivation on the accumulation of common nitrogen, phosphorus and potassium in the surface mass of winter wheat, growth and structural elements, ecologically safety grain yield and product quality.

The fifth chapter identifies the impact of biohumus and manure in the conditions of ecological soil cultivation on the removal and assimilation of nutritive substances from the soil by straw and grain products of autumn wheat, agrophysical properties of soils and economic efficiency.

CHAPTER I. THE MAIN CHARACTERISTICS OF ECOLO GICAL AGRICULTURE AND ITS ROLE IN CULTIVATION TECHNOLOGY OF AUTUMN WHEAT IN ARID CLIMATE CONDITION

The primary goal of organic agriculture is to produce ecologically pure food. Produced quality product must be fresh, natural, pleasant and free from foreign substances. Such a pure and high-quality product can be produced in ecological agriculture. The main features of ecological agriculture in foreign countries and in the Republic, its role in the technology of cultivation of autumn wheat in arid climates are shown in this chapter based on literature.

CHAPTER II. LEARNING LEVEL OF RESEARCH TOPIC, OBJECT AND METHODOLOGY OF THE RESEARCH

Yevlakh district is located in the north-western part of the Kur-Araz lowland. The district is surrounded by Mingachevir reservoir in the north-west, Agdash district in the east, Barda district in the south-east, Goranboy region in the west.

The surface is mostly plain. It is a steep hill in the north and partly in the west and is up to 500 m high. Part of the Bozdag and Archandag ranges is in the area of Yevlakh district. Neogene sediments are distributed in the mountainous part and anthropogenic sediments in the plain part.

The lower reaches of the Alijan, Korchay and Injachay rivers, which belong to the Kur basin, pass through the district area, and the Kur river flows through the central part. Yukhari Karabakh canal starts from the Mingachevir reservoir in the north-western and western parts of the Yevlakh district. The south-eastern part of the Mingachevir reservoir is located in this region[8].

The area is mainly dark grey-brown, light grey-brown, ordinary grey-brown, meadow-grey, light grey, primitive grey, floodland meadow-forest, floodland-meadow and swamp-meadow soils. Grey-brown, meadow-grey, grey soil types are especially widely used in agriculture[9].

A soil map of Yevlakh district was compiled based on previous research. (Figure 1.) Materials of the Map Fund of the Institute of Soil Science and Agrochemistry of ANAS were used in preparation of the map. The scale of the used map materials is 1:100000 and the authors of the used map materials are M.E. Salayev, G.Sh. Mammadov, M.P. Babayev, Sh.G. Hasanov, V.H.Hasanov, Ch.M. Jafarova and others.

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[8] Hashimova A.V. Agroecological characteristics of irrigated grey-meadow soils located in the arid zone of the republic // held on the subject of “Techniques for increasing soil fertility and fertilizer efficiency” Materials of the International scientific and practical conference dedicated to the memory of scientists Anna Ivanovna Gorbyleva, Yuri Pavlov Sirotin and Vadim Ivanovich Tyulpanov / editor: T.F. Persikova (responsible ed.) [and others]. - Gorki: BSAA, - December 18-20 - 2018, part 2, Gorki 2019, “Belarusian State Agricultural Academy”, pp. 89-91

[9] Morphogenetic diagnosis, nomenclature and classification of the soils of Azerbaijan. / M.P. Babayev, V.H. Hasanov, Ch.M. Jafarova [etc.]. - Baku: Elm, - 2011. - 448 p.

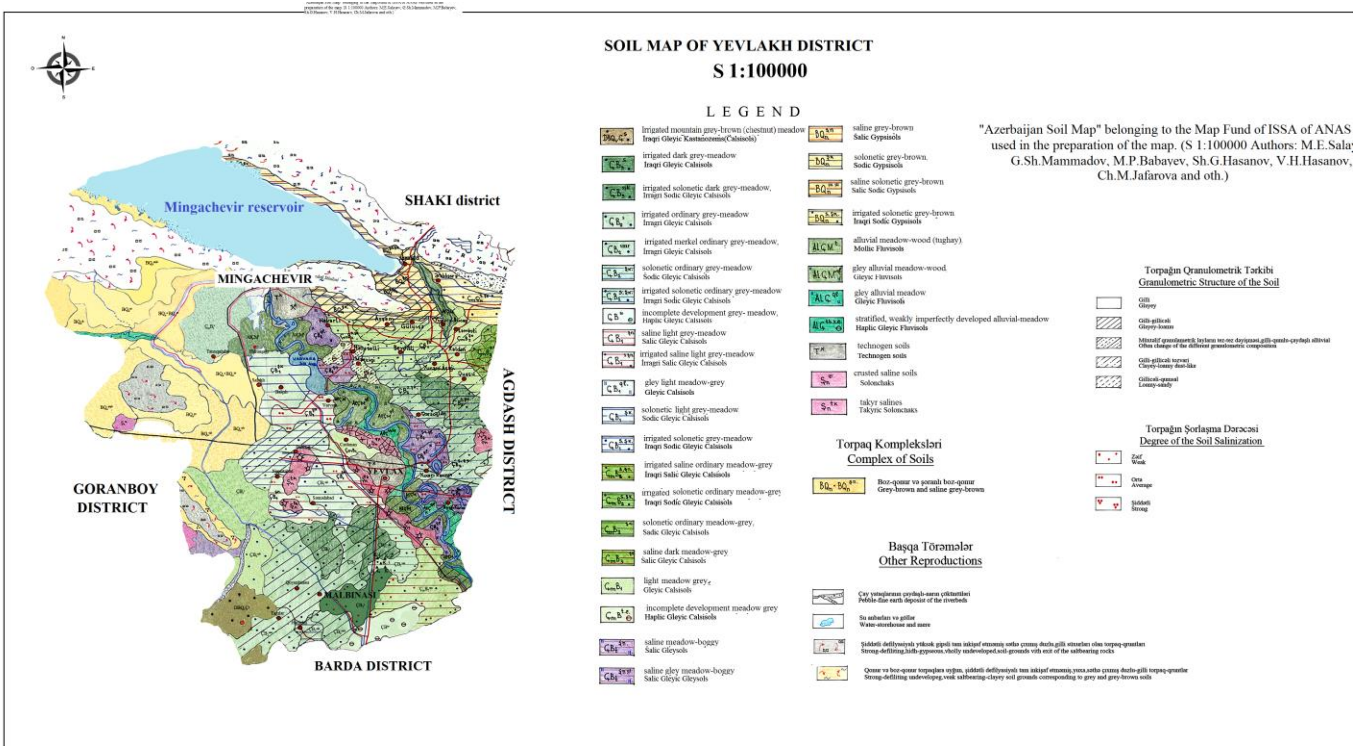

Fig. 1. Soil map of Yevlakh district

The composition of biohumus and manure was studied during the research. Moisture in biohumus is 40%, organic matter is 65%, total nitrogen content is 5.0%; phosphorus is 2.8%, potassium 1.9%, calcium 5.0%, magnesium 1.6%, iron 1.5%, manganese 70 mg/kg. Manure contains 0.5% nitrogen, 0.25% phosphorus, 0.6% potassium.

CHAPTER III. EXPERIMENTAL PART. CHARACTERISTICS OF SOILS OF THE RESEARCH AREA

Irrigated meadow-grey soils in Azerbaijan are mainly distributed in the Kur-Araz lowland, in a complex with raw soils. In terms of zoning, it forms a transition between irrigated grey and meadow soils[10].

Influence of groundwater and arid climate on soil formation is in a convex way in the profile. Although the amount of carbonates is relatively high, it is mainly accumulated under the humus horizon. Although carbonates appear as spots and dots, they are represented in elongated broad spots on the BCS horizons. Rust-like spots on the Bg-horizon of these soils are also characteristic. Their formation is excess moisture, which is formed under the influence of groundwater. Seasonal changes in groundwater contribute to the differentiation of spots.

Meadow-grey soils are formed in the dry subtropics, where the average annual temperature is 14-15^{0}C. The total temperature is 3900-4600^{0}C, the amount of possible annual evaporation is higher than 1200 mm and the amount of precipitation is 250-350 mm. Humidity coefficient varies between 0.25-0.30.

The density of uncultivated meadow-grey soils is higher than that of irrigated ones. In particular, cultivation in the upper horizon has reduced their density and increased their porosity.

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[10] Lands of the Republic of Azerbaijan (Kur-Araz lowland, Ganja-Gazakh sloping plain and irrigated lands of the Absheron peninsula and their productivity). / M.P. Babayev, E.A. Gurbanov, F.M. Ramazanova [and others]. - Baku: "MSV Nashr" LLC. - 2022. - 224 p.

The density varies mainly between 1.12-1.36 g/cm^3 and the porosity varies between 48-55%.

The amount of humus in the upper part of these soils is much higher than in non-irrigated ones. But in irrigated soils, humus migrates to the lower layers under the influence of irrigation. As a result, the humus is evenly distributed along the profile and the thickness of the humus horizon increases. The amount of humus in irrigated meadow-grey soils is mainly 1.50-2.85%. In many cases, the amount of humus in the subsoil horizon is high in the planting layer[11,12,13,14]. However, in irrigated meadow-grey soils or poorly cultivated soils, the amount of humus gradually decreases to the depth along the profile. Experience shows that the amount of humus in irrigated highly cultivated soils is relatively high. The C: N ratio is mostly 11-14.

Meadow-grey soils are high carbonate. The amount of carbonates along the profile increases mainly towards the depth and varies between 8-18%. These soils also have a high absorption capacity. The amount of absorbed bases fluctuates between 22-32 mg-eq. Among the absorbed cations, Mg and Na cations predominate over zonal soils above it. This advantage is relatively high compared to irrigated soils in raw soils.

The thickness of the humus horizon of irrigated meadow-grey soils in the research area is 55-65 cm. Here the transition between horizons is gradual. The reason is that these lands have been irrigated

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[11] Lands of the Republic of Azerbaijan (Kur-Araz lowland, Ganja-Gazakh sloping plain and irrigated lands of the Absheron peninsula and their productivity). / M.P. Babayev, E.A. Gurbanov, F.M. Ramazanova [and others]. - Baku: "MSV Nashr" LLC. - 2022. - 224 p.

[12] Morphogenetic diagnosis, nomenclature and classification of the soils of Azerbaijan. / M.P. Babayev, V.H. Hasanov, Ch.M. Jafarova [etc.]. - Baku: Elm, - 2011. - 448 p.

[13] Babayev M.P. Land degradation and protection in Azerbaijan. / E.A. Gurbanov, Hasanov V.H. - Baku, "Science". – 2010. - 216 p.

[14] Babayev Maharram. Integration of Azerbaijan's national land classification into the International System / Amin Ismayilov, Sultan Huseynova. - Baku. Science. – 2017. - 272 p.

for many years. As a result of irrigation, suspended silt materials entered the soil along with water. Therefore, silt and clay materials have accumulated in the planting and subterranean horizons. Hardening is most often observed in the subsoil. Due to siltation and clay in the planting horizon, a clod-granular structure was formed. Traces of gleyzation due to irrigation are visible in rust stains.

To study the agrochemical characteristics of the experimental field before the experiment, soil samples (0-20, 20-40, 40-60, 60-80, 80-100 cm layers) were taken from the field by the envelope method before fertilization. As can be seen from the analysis of agrochemical properties of irrigated meadow-grey soils of Yevlakh district, the reaction of the soil solution is weakly alkaline (pH 8.0-8.5). As a result of the research, it was determined that the total humus in the 0-20 cm layer of soil is 1.5%, and at a depth of 80-100 cm it is reduced to 0.4%. According to the profile, the total nitrogen in these soils was 0.21% - 0.05%, total phosphorus was 0.13-0.06%, total potassium was 2.45-0.9%. The amount of easily hydrolyzed nitrogen is 77-28 mg/kg per 1 kg of soil, water-soluble ammonia 6.06-1.80 mg/kg, absorbed ammonia 15.9-4.66 mg/kg, nitrates 6.70-2,11 mg/kg, water-soluble phosphorus 3.50-0.58 mg/kg, mobile phosphorus 18.3-5.1 mg/kg, water-soluble potassium 36.15-6.02 mg/kg, exchangeable potassium varies between 291.61-96.40 mg/kg[15,16].

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[15] Hashimova A.V. Agrochemical features of soils in the arid zone of the Republic of Azerbaijan // Ministry of Science and Higher Education, Ministry of Agriculture and Food of the Republic of Dagestan, Federal State Budgetary Institution "Federal Agrarian Scientific Center of the Republic of Dagestan", Federal State Budgetary Educational Institution of Higher Education "Dagestan State Agrarian University named after M.M. Jambulatov", Dagestan Branch of the All-Russian Soil Scientists named after V.V. Dokuchaeva, Current state of soil cover, preservation and reproduction of soil fertility, collection of scientific papers of the All-Russian scientific and practical conference - August 14-15, 2018. Makhachkala, - 2018, - pp. 91-95

[16] Hashimova A.V. Agrochemical, physical and chemical indicators of irrigated serozem-meadow soils of the arid zone of Azerbaijan // Bulletin of Science and Practice. - 2021. T. 7. No.8. -pp.91-96. https://doi.org/10.33619/2414-2948/69/12

In general, the amount of nutrients decreases in the lower layers. According to the gradation accepted for republican lands (Gulahmadov A.N., Akhundov F.H., Ibrahimov S.Z., 1980) [17], these lands are poorly supplied with nutrients.

In addition to agrochemical indicators, the main physical and chemical indicators of the experimental soils were studied. As it is clear from the results of the analysis, the planting and subsoil layers of meadow-grey soils (AY^1a+AY^{11}=0.40 cm) have a heavy granulometric composition. The amount of physical clays (<0.01 mm) is 54.68-70.60%. There is a sharp reduction in granulometric composition (<0.001 mm = 0.44%) in the soil-forming rocks.

Meadow-grey soils are completely saturated with bases. This is evident from the fact that the total amount of absorbed bases in the upper layers varies between 18.91-18.20 mg-eq. Although Ca^{2+} was 71.3% in the upper layer and 76.6% in the second layer, it decreased significantly in the third layer and was 48.20%. In contrast, the Mg^+ cation increased even more, reaching 37.5%. However, its content in the upper layers was 8.6-13.9%. The amount of Na^+ remained almost unchanged throughout the profile, is 14.3-14.8%. Such a high absorption capacity in meadow-grey soils is characterized by the percentage of humus, the clayey nature of the granulometric composition, the carbonate content of the soil profile ($CaCO_3$ = 11.50-11.63%) and especially the weak alkaline pH.

Salinization is not observed in these soils as a result of long-term irrigation. The amount of dry residue varies between 0.130-0.172%.

Its granulometric composition is of great importance in the agrophysical properties of soils. Our research shows that these soils are heavy clayey and clayey. The granulometric composition of the excavated piece along the horizons was studied in the research area. The amount of physical clay increases from the upper horizon to the

[17] Gulakhmedov A.N. Gradation according to the content of mobile forms of plant nutrients in the soil for the differentiated application of mineral fertilizers for agricultural crops. / F.G. Akhundov, S.Z. Ibrahimov - Baku. – 1980. -13 p.

depth, the main reason for which is the ancient irrigation of soils. Sludge particles entering the soil with irrigation water have long caused siltation in the soil. The amount of sludge starts from the subterranean horizon, which is due to the migration of sludge particles with water to the lower layers during irrigation. These lands are irrigated by the waters of the Kur river - the Upper Karabakh canal. The highest silt content in the soils is mainly in the third and fourth layers. The amount of physical clay also predominates in these layers. This figure is also typical for long-term irrigated lands.

One of the main indicators of soil fertility is its structural composition and the amount of water stable aggregates. The amount of particles larger than 10 mm in the structure of irrigated meadow-gray soils in the experimental area varies between 15.01-48.22%. This is due to its heavy granulometric composition. Although particles larger than 0.25 mm in the upper horizon were 79.59%, the amount of water stable aggregates was much lower at 22.82%. In the subsoil, both indicators are higher than in the upper layer. This shows that the amount of humus and physical clay in the subsoil does not differ significantly from the planting layer. Towards the depth, the amount of water stable aggregates in the lowest layer decreases significantly, the main reason for which is the decrease in humus and the increase in the amount of carbonates. Therefore, the amount of water stable aggregates decreases to a depth and the soil's resistance to erosion weakens.

The density indicators of the experimental area were also studied. In the upper horizon, its value is 1.25 g/cm^3, while a sharp increase in depth is observed. The main reason for this is the high density in the subsoil and the horizon below it. During cultivation and irrigation, the subsoil hardens and the sludge in the irrigation water migrates vertically, increasing the density and hardening of these horizons. This is especially true in the lower part of the irrigated area, which is less inclined.

The specific gravity of irrigated meadow-grey soils varies from 2.70 to 2.76 g/cm^3. Its highest value in the subterranean horizon is 2.76 g/cm^3. The lowest price is typical for the planting layer.

The overall porosity of the soil is very important in the growth of plants and the formation of heat-air regime, which affects the normal development of roots. The porosity weakens along the depth profile. The highest price was obtained in the top layer and is 54.0%. In the subsoil, this figure drops to 50.0%, and in the lower layer it falls to 47.0%. In the horizons below this layer, it reaches 45.0%.

CHAPTER IV. EFFECT OF SOIL CULTIVATIONS WITH ECOLOGICAL AGRICULTURAL TECHNOLOGIES TO PRODUCTIVITY AND QUALITY OF AUTUMN WHEAT

Effect of application of ecological soil cultivations and fertilizer norms on irrigated grey-meadow soils under autumn wheat on the accumulation of total nitrogen, phosphorus and potassium in the surface mass by stages of growth was studied. In the control (fertilizer-free) variant of the average from 2 years on traditional soil cultivation, in the spring bushing stage, due to dry matter in the air, total nitrogen was 2.56%, total phosphorus was 1.04% and total potassium was 1.68%, at full ripening were 1.9%; 0.65% and 0.52% in grain and 0.51%, 0.32% and 0.58% in straw. As a result of application of organic fertilizers in traditional soil cultivation, the total NPK has increased significantly. Thus, in the 30 t/ha variant of manure, total nitrogen was 3.0%, total phosphorus was 1.27% and total potassium was 2.21% in the bushing stage, and at full ripening, respectively was 2.37%; 0.72% and 0.57% in the grain and respectively was 0.65%; 0.39% and 0.59% in straw. In the 5 t/ha variant of biohumus, total nitrogen was 2.88%, total phosphorus was 1.22% and total potassium was 2.17% at the bushing stage, and in the grain 2.34%; 0.71% and 0.57% at full ripening; and 0.64%; 0.36% and 0.67% in straw respectively. As fertilizer rates increase, the amount of total NPK at each stage of growth decreases.

In the control (fertilizer-free) variant of the average of 2 years minimum soil cultivation in the spring bushing stage, due to dry matter in the air, total nitrogen was 2.51%, total phosphorus was 0.89% and total potassium was 1.55%, at full ripening were 1.83%; 0.64% and 0.50% in the grain and were 0.54%; 0.31% and 0.52% in straw., The total NPK for the growth phases was lower than the conventional cultivation in each of the variants for minimum soil cultivation. So that, in the variant of manure 30 t/ha, total nitrogen was 3.07%, total phosphorus was 1.14% and total potassium was 2.29% at the bushing stage, and in grain at full ripening were respectively 2.35%; 0.72% and 0.58%; and in straw were 0.73%; 0.41% and 0.69%. In the biohumus 5 t/ha variant, total nitrogen was 3.03%, total phosphorus was 1.08% and total potassium was 2.15% at the bushing stage, and at full ripening, respectively 2.33%; 0.72% and 0.57% in the grain and were 0.69%; 0.39% and 0.67% in straw. As fertilizer rates increase, the amount of total NPK at each stage of growth decreases. As a result of the application of ecological soil cultivations and organic fertilizers under autumn wheat, it was found that correlation between the grain product (s/ha) and amount of total nitrogen, phosphorus and potassium (%) in the grain at the stage of full ripening, according to the variants in average from 2 years were in traditional cultivation $r=+0.95\pm0.06$; in minimum cultivation $r=+0.84\pm 0.17$.

During the research years, phenological observations were made on wheat. The effects of soil cultivation and organic fertilizers on the growth and structural elements of autumn wheat have also been studied. In the average of 3 years in traditional soil cultivation, the height of autumn wheat was 91-104 cm, the number of productive stems was 329-401, the weight of 1000 grains was 36.5-41.2 g, the length of the spike was 7.6-8.7 cm, the number of grains in one spike was 22-27 pieces and the weight of the grain in one spike was 0.76-0.86 grams. In the minimum soil cultivation was 96-111 cm, 373-420 pieces, 38.4-43.5 grams, 8.1-9.0 cm, 25-32 pieces and 0.84-0.96 grams, respectively.

As a result of the application of organic fertilizers in minimum soil cultivation, the structural elements of autumn wheat have increased significantly. So that, in the minimum soil cultivation in the variant of biohumus 5t/ha, the height of autumn wheat was 111 cm, the number of productive stems was 420, the weight of 1000 grains was 43.5 grams, the length of the spike was 9.0 cm, the number of grains in one spike was 32 and the weight of the grain in one spike was 0.96 grams. The highest indicators were observed in the biohumus 5t/ha variant in both cultivation.

As a result of application of biohumus and manure under autumn wheat in ecological soil cultivation conditions, correlation between grain yield (s/ha) and height (cm), number of productive stems (number), weight of 1000 grains (gr), spike length (cm), number of grains in one spike (number), grain mass (gr) in one spike, in traditional cultivation, on average of 3 years were respectively r=+0.89± 0.12; r=+0.91±0.1; r= +0.99±0.01; r=+0.85±0.16; r=+0.89± 0.12; r = +0.86±0.15, and at minimum cultivation, were respectively r=+0.96 ±0.05; r =+0.99±0.01; r=+0.98±0.02; r=+0.98±0.02; r =+0.96 ±0.05; r =+ 0.90 ± 0.11.

In our research on autumn wheat in meadow-grey soils, the effect of organic fertilizers and biohumus on the productivity of wheat was studied by us. In traditional soil cultivation, the grain yield of autumn wheat is 22.9 s/ha in the control (fertilizer-free) variant for an average of 3 years, 35.9 s/ha in the biohumus 5 t/ha variant, an increase compared to the control 13 s/ha or 56.8%. The highest grain yield was obtained in the variant of biohumus 5 t/ha. In the minimum soil cultivation, the grain yield of autumn wheat is 25.0 s/ha in the control (fertilizer-free) variant, 34.7 s/ha in the 30 t/ha variant of manure, an increase of compared to the control 9.7 s/ha or 38.8% for average of 3 years. The highest grain yield was obtained in the variant of biohumus 5 t/ha, 41.3 s/ha, an increase of compared to the control was 16.3 s/ha or 65.2% (Figure 2). When manure and biohumus from organic fertilizers were applied separately by traditional methods, had a different effect on the yield of autumn wheat. So that, the productivity on variants which applied 30 tons of manure per hectare and biohumus increased, and the lowest yield in experiment was under the control (fertilizer-free) variant according to the results of 3 years of research. Mathematical calculation of the effect of different norms and ratios of biohumus and manure on the productivity of autumn wheat in the conditions of ecological soil cultivation proves the accuracy of the experiment. The accuracy of the experiment was P=0.47-1.46%, V=0.93-2.93%, $HCP_{0.95}$=0.49-1.52 s/ha in traditional cultivation, and it was P=0.56- 1.01%, V=1.10-1.99% and $HCP_{0.95}$ = 0.61-1.27 s/ha in minimum cultivation.

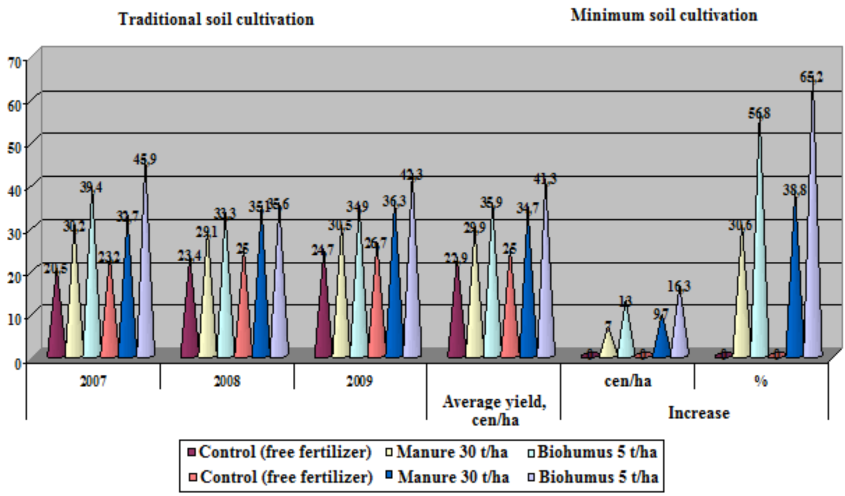

Fig. 3. Effect of different norms and ratios of biohumus and manure on the productivity of autumn wheat in the conditions of ecological soil cultivation (on average from 3 years, s/ha)

In traditional soil cultivation, on the average from 3 years straw yield of autumn wheat is 35.8 s/ha in the control (fertilizer-free) variant, while in the biohumus 5 t/ha variant it is 54.7 s/ha, an increase compared to the control 18,9 s/ha or 52.8%. The highest straw yield was obtained in the biohumus 5 t/ha variant. In minimum soil cultivation, on the average from 3 years straw yield of autumn wheat is 33.7 s/ha in the control (fertilizer-free) variant, it is 38.5 s/ha in the 30 t/ha variant of manure, an increase compared to the control 4,8 s/ha or 14.2%. The highest straw yield was obtained in the biohumus 5 t/ha variant 46 s/ha, an increase compared to the control was 12.3 s/ha or 36.5%.

Along with productivity, improving the quality of autumn wheat is an important challenge for agriculture. In our experiment, it was determined that the quality of wheat in meadow-grey soils varies depending on the norms and ratios of organic fertilizers. In the control (fertilizer) variant of traditional soil cultivation on average from 2 years, protein was 9.8%, gluten was 23.6%, vitreous was 74.5%, total nitrogen content in wheat was 1.60%, while manure 30 t/ha variant was respectively 11.9%, 28.0%, 81.5% and 2.43%, and it was respectively 13.0%, 29.6%, 86.5% and 2.27% in the biohumus 5 t/ha variant. In the control (fertilizer-free) variant of minimum soil cultivation, protein was 10.5%, gluten 25.4%, vitreous 83.0%, total nitrogen content in wheat grain was 1.58%, while in the 30 t/ha variant of manure it was 12,2%, 30.8%, 90.0% and 2.49%, and in biohumus 5 t/ha variant was 13.3%, 32.4%, 94.0% and 2.32%. Thus, it is clear from the results obtained that, unlike the traditional cultivation method, the minimum cultivation method yielded an ecological pure product and the quality of the product was higher. The highest indicators were observed in the biohumus 5 t/ha variant in both cultivations.

As a result of the application of different norms and ratios of biohumus and manure in the conditions of ecological soil cultivations under the autumn wheat, mathematical analysis between the grain yield and quality indicators shows that the correlation coefficient of these characteristics varies according to the variants. In traditional cultivation, on average from 2 years, r=+0.99±0.01 between grain yield (s/ha) and protein (%), and r=+0.98±0.03 between grain yield (s/ha) and gluten (%), r=+0.99±0.01 between grain yield (s/ha) and vitreous (%) and in minimum cultivation respectively r=+0.99±0.01; r=+0.98±0.02; r=+0.99±0.01 correlation was found. These once again show the accuracy of the results obtained.

CHAPTER V. IMPACT OF ORGANIC FERTILIZERS (BIOHUMUS AND MANURE) IN THE CONDITION OF ECOLOGICAL SOIL CULTIVATIONS ON THE REMOVAL AND ASSIMILATION OF NUTRIENTS WITH THE YIELD OF STRAW AND GRAIN OF AUTUMN WHEAT AND TO ECONOMIC EFFICIENCY

During the research years, the effect of organic fertilizers and soil cultivations on the removal of nutrients with the yield of straw and grain was studied. On average from 2 years, nitrogen removed from the soil in the control (fertilizer-free) variant in traditional soil cultivation was 57.04 kg/ha, phosphorus 24.23 kg/ha and potassium 29.41 kg/ha, in the variant of 30 t/ha manure was respectively 105.25, 42.24 and 95.82 kg/ha, and in the variant of biohumus 5 t/ha was 123.80, 47.39 and 62.04 kg/ha, respectively.

In the control (fertilizer-free) variant in minimum soil cultivation, nitrogen removed from soil was 59.24 kg/ha, phosphorus was 24.19 kg/ha and potassium was 27.07 kg/ha, in the variant of manure 30 t/ha was respectively, 109.74, 41,38 and 48.42 kg/ha and in the variant of biohumus 5 t/ha was respectively 129.77, 48.21 and 57.30 kg/ha. The amount of removed nutrients was higher than the control (fertilizer-free) variant, depending on the yield and its chemical composition.

Thus, along with increasing the productivity application of soil cultivations and fertilizers under winter wheat, also increases the amount of nutrients removed from the soil comparative to the control (fertilizer-free) variant. Mathematical analysis was carried out between grain yield and the amount of nutrients removed from the soil as a result of the application of ecological soil cultivations and organic fertilizers under autumn wheat. The correlation between the grain yield (s/ha) of autumn wheat and the removal of nutrients (kg/ha) was on average from 2 years, in traditional cultivation $r = +0.85 \pm 0.16$, in minimum cultivation $r = +0.99 \pm 0.01$.

Our conducted researches show that soil cultivations and fertilizers also increase the utilization coefficient from fertilizers of autumn wheat. Fertilizer utilization coefficient of autumn wheat, assimilation of nitrogen, phosphorus and potassium in both soil cultivations were higher in other variants comparative to the control (fertilizer-free) variant in the research years. On average from 2 years, the fertilizer utilization coefficient of autumn wheat compared to the control (fertilizer-free) variant in traditional soil cultivation nitrogen was 48.2 kg/ha or 40.2%, phosphorus was 18 kg/ha or 69.3% and potassium was 18.5 kg/ha or 39.7% in the variant of 30 t/ha manure. The highest amount of assimilation was in the variant of biohumus 5 t/ha, nitrogen was 66.75 kg/ha or 60.7%, phosphorus was 23.2 kg/ha or 66.6%, potassium 32.6 kg/ha or 81,6%.

Fertilizer utilization coefficient of autumn wheat compared to the control (fertilizer-free) variant in the variant of 30 t/ha manure nitrogen was 50.45 kg/ha or 42.1%, phosphorus was 34.4 kg/ha or 72.7% and potassium was 21,4 kg/ha or 42.8% in minimum soil cultivation. The highest amount of assimilation in the variant of biohumus 5 t/ha nitrogen was 70.5 kg/ha or 64.1%, phosphorus was 24 kg/ha or 68.9%, potassium was 30.3 kg/ha or 76.9 %.

Thus, ecological soil cultivations and organic fertilizers also increase the assimilation coefficient of nutrients. The highest amount of assimilation coefficient of nutrients was observed in the variant of biohumus 5 t/ha in both cultivations.

Impact of ecological agricultural cultivation technologies on agrophysical properties of soils

One of the main spheres of ecological agriculture is to improve the agrophysical properties of soils. According to our experiments, the amount of water stable aggregates (greater than 0.25 mm) in the top 0-30 cm layer in the control free-fertilized variant in the traditionally cultivated field was 24.50%. In the variant, which applied manure, this figure increased to 27.60%, and in the variant, which applied biohumus, it increased to 28.80%.

Experiment shows that the amount of water stable aggregates is influenced by humus, granulometric and mineralogical composition. Its amount was more than 3.10% in the variant of manure applied and it was more than 4.30% in the variant of biohumus. This is due to the increase in the amount of humus in the soil in these variants. In general, this indicator is considered expedient.

One of the main features of minimum cultivation technology is that it has less mechanical impact on the soil. Therefore, in this cultivation technology, the structural particles are less dispersed or protected.

Ecological cultivation technologies affect soil density indicators. For example, in the traditional cultivation technology, the density in the control variant at a depth of 0-10 cm was 1.32 g/cm^3, in the variant of 30 tons of manure per hectare, the density was 1.27 g/cm^3 and in the variant of 5 tons of biohumus per hectare was 1.30 g/cm^3. It is known that the application of manure to the soil has a positive effect on the good growth of the root system of plants, primarily by affecting its density. In the given variant of biohumus, the density does not differ much. (Table 1). Density changes are also observed in the second 10-20 cm layer of soils. In the control variant in traditional cultivation, this 1.36 g/cm^3, the same indicator was obtained in the given variants of manure and biohumus.

Table 1.
Changes in density and porosity of soils depending on ecological cultivation technology

Number	Experiment variants	Depth, cm	Density, g/cm^3	Spesific mass, g/cm^3	Total porosity, %
Traditional cultivation					
1	Control (free fertilizer)	0-10 10-20	1,32 1,36	2,68 2,68	50,74 49,25
2	Manure 30 t/ha	0-10 10-20	1,27 1,31	2,68 2,69	52,61 51,30
3	Biohumus 5 t/ha	0-10 10-20	1,30 1.31	2,68 2,69	51,30 51,30
Minimum cultivation					
1	Control (free fertilizer)	0-10 10-20	1,32 1,36	2,68 2,70	50,74 49,62
2	Manure 30 t/ha	0-10 10-20	1,29 1,34	2,68 2,69	51,86 50,18
3	Biohumus 5 t/ha	0-10 10-20	1,30 1,35	2,69 2,70	52,04 50,00

The minimum cultivation technology has a relatively high density, which is mainly due to the fact that the soil is less soft. In almost all variants, the density in this cultivation technology was high.

Porosity of soils differs from traditional cultivation technology due to minimal cultivation. Porosity in minimal cultivation technology is low especially in the layer of 10-20 cm, in traditional cultivation is low in all variants. In general, it can be concluded that the application of ecological agriculture against the fon of cultivation technologies serves to improve the agrophysical properties.

At the end of the research, the amount of humus in the 0-20 cm layer of the soil increased from 1.5% to 1.6%; 1.1% to 1.15% in a layer of 20-40 cm; from 0.8% to 0.10% in a layer of 40-60 cm; from 0.5% to 0.53% in a layer of 60-80 cm; in the 80-100 cm layer, it increased from 0.4% to 0.43%. From here, we come to the conclusion that the cultivation of the soil by the method of ecological agriculture not only ensures the economic efficiency of the wheat plant, but also ensures the purchase of high-quality products, increases the fertility of the soil and enriches it with humus.

Impact of different norms of biohumus and manure on the economic efficiency of autumn wheat in the condition of ecological soil cultivations

Impact of application of soil cultivations and fertilizers under autumn wheat on irrigated meadow-grey soils on economic efficiency has been studied. Estimates from 2020 year were used to calculate the economic efficiency of the results of experiments. One ton of manure is 20 manats, one ton of biohumus is 150 manats. The sowing of 30 tons of manure per hectare cost 20 manats. The application of 5 tons of biohumus per hectare costs 20 manat.

Net income is determined on the basis of all costs incurred in the additional product and on the basis of the market selling price of that product. The market price of one kilogram of autumn wheat was 0.45 manat. Expenditures on application of fertilizers under autumn wheat was 620 man/ha in manure-30 t/ha variant, 770 man/ha in 5 t/ha variant of biohumus in traditional soil cultivation; it was 620 man/ha in manure-30 t/ha variant, biohumus in the 5 t/ha variant it was 750 man/ha in minimum soil cultivation. Expenditures on soil cultivations and agrotechnical measures were 428 man/ha in traditional cultivation and 378 man/ha in minimum cultivation. The difference here is that in traditional cultivation 25-30 cm of plowing is 35 man/ha, while in minimal cultivation 10-12 cm of plowing is 25 man/ha and harrowing is not carried out. The remaining agrotechnical measures were the same. Net income from one hectare of land in traditional cultivation was 613.5-782.5 manat, the cost of 1 quintal of the product was 35.1-33.1 manat, profitability varied between 58.5-65.3%. The highest indicators in traditional cultivation were in the variant of biohumus 5 t/ha, net yield was 782.5 man/ha, the cost value of 1 quintal of the product was 33.1 man, and the profitability was 65.3%. Net income from one hectare of land in minimum soil cultivation was 820.5-1037.5 manat, the cost of 1 quintal of product was 28.8-27.3 manat, profitability varied between 82.2-92.0%. The highest indicators of minimum cultivation were in the variant of biohumus 5 t/ha, the net income was 1037.5 man/ha, the cost value of 1 quintal of the product was 27.3 man, and the profitability was 92.0%. In the minimum cultivation, the cost of production per 1 quintal, the net income per 1 hectare and the level of profitability were higher than the traditional cultivation.

RESULTS

1. As a result of the analysis of the agrochemical characteristics of the irrigated meadow-grey soils in the research area, it was determined that the reaction of the soil solution is alkaline (pH 8.0-8.5) and the total humus in the 0-20 cm layer of the soil is 1.5%, and it decreased to 0.4% at the depth of 80-100 cm. According to the profile, total nitrogen in these soils was 0.21%-0.05%, total phosphorus was 0.13-0.06%, total potassium was 2.45-0.9%. The amount of easily hydrolyzable nitrogen in 1 kg of soil is 77-28 mg/kg, water-soluble ammonia 6.06-1.80 mg/kg, absorbed ammonia 15.9-4.66 mg/kg, nitrates 6.70-2,11 mg/kg, water-soluble phosphorus 3.50-0.58 mg/kg, active phosphorus 18.3-5.1 mg/kg, water-soluble potassium 36.15-6.02 mg/kg, exchangeable potassium varied between 291.61-96.40 mg/kg.
2. Planting and subsoil layers of meadow-grey soils ($AY^{1}_{a}+AY^{11}$=0,40 cm) have a heavy granulometric composition. The amount of physical clays (<0.01 mm) is 54.68 - 70.60%. Meadow-grey soils are completely saturated with bases. This is evident from the fact that the total amount of absorbed bases in

the upper layers varies between 18.91-18.20 mg-eq. Although Ca^{2+} was 71.3% in the upper layer and 76.6% in the second layer, it decreased significantly in the third layer and was 48.20%.

3. Application of biohumus and manure under autumn wheat in the condition of ecological soil cultivations has affected the increase of the total amount of nitrogen, phosphorus and potassium in the surface part compared to the control (fertilizer-free) variant. High levels of total nitrogen, phosphorus and potassium in the surface mass of the plant at the beginning of the vegetation eventually lead to the accumulation of more nutrients in the grain of autumn wheat. High levels of total nitrogen, phosphorus and potassium were observed in both cultivations in the variant of biohumus 5 t/ha.
4. Biohumus and manure compared to the control (fertilizer-free) variant in the condition of ecological soil cultivations, had a significant effect on the growth and structural elements of autumn wheat. The highest indicators were observed in the variant of biohumus 5t/ha in both cultivations.
5. In the traditional soil cultivation under ecological soil cultivations, the grain yield of autumn wheat is 22.9 s/ha in the control (fertilizer-free) variant for an average from 3 years, while 35.9 s/ha in the 5 t/ha variant of biohumus, increase compared to the control is 13 s/ha or 56.8%. The highest grain yield was obtained in the variant of biohumus 5 t/ha. In the minimum soil cultivation, the grain yield of autumn wheat is 25.0 s/ha in the control (fertilizer-free) variant on average from 3 years, 34.7 s/ha in the 30 t/ha variant of manure, an increase compared to the control 9,7 s/ha or 38.8%. The highest grain yield was obtained in the variant of biohumus 5 t/ha, 41.3 s/ha, an increase compared to the control was 16.3 s/ha or 65.2%.
6. It is clear from the obtained results that the product quality indicators were higher in the minimum cultivation method, in contrast to the traditional cultivation method. In both cultivations, the quality indicators of winter wheat grain increased significantly in the variant of biohumus 5 t/ha, and an ecological pure product was obtained.

7. On average from 2 years, nitrogen removed from the soil in the variant of biohumus 5 t/ha in traditional soil cultivation was 123.80 kg/ha, phosphorus was 47.39 kg/ha and potassium was 62.04 kg/ha, in minimum soil cultivation was respectively 129.77, 48.21 and 57.30 kg/ha. Fertilizer utilization coefficient of autumn wheat in traditional soil cultivation in biohumus 5 t/ha variant nitrogen was 66.75 kg/ha or 60.7%, phosphorus was 23.2 kg/ha or 66.6%, potassium was 32.6 kg/ha and or 81.6%. In the minimum soil cultivation in biohumus 5 t/ha variant nitrogen was 70.5 kg/ha or 64.1%, phosphorus was 24 kg/ha or 68.9%, potassium was 30.3 kg/ha or 76.9%. The highest amount of assimilation coefficient of nutrients was observed in the variant of biohumus 5 t/ha in both cultivations.
8. At the beginning, the amount of water-resistant aggregates in the planting layer was determined. Depending on the cultivation technology, the amount of water-resistant aggregates in the upper horizon changed to 22.82%. In contrast to the traditional cultivation technology, in minimal cultivation, the structure collapse was prevented and humus increased in the upper horizons. The amount of water-resistant aggregates was 24.50% in the traditional control variant, 27.60% in 30 t/ha manure; while biohumus is 28.80% in 5 t/ha, 25.50% in control in minimal cultivation, 29.50% in 30 t/ha manure; biohumus was 28.60% in the version given 5 t/ha.
9. It has been determined that in the traditional cultivation technology, the density in the control variant at a depth of 0-10 cm was 1.32 g/cm^3, in the variant of 30 tons of manure per hectare, the density was 1.27 g/cm^3 and in the variant of 5 tons of biohumus per hectare was 1.30 g/cm^3. In the given variant of biohumus, the density does not differ much. Density changes are also observed in the second 10-20 cm layer of soils. In the control variant in traditional cultivation, this 1.36 g/cm^3, the same indicator was obtained in the given variants of manure and biohumus. At the end of the research, the amount of humus in the 0-20 cm layer of the soil increased from 1.5% to 1.6%; in the 80-100 cm layer, it increased from 0.4% to 0.43%. From here, we come to the conclusion that the cultivation of the soil by the method of ecological ag-

riculture not only ensures the economic efficiency of the wheat plant, but also ensures the purchase of high-quality products, increases the fertility of the soil and enriches it with humus.

10. Economic analysis of application of soil cultivations and fertilizers under autumn wheat shows that the highest indicators in traditional cultivation was in the variant of biohumus 5 t/ha, net income was 782.5 man/ha, the cost of the product from 1 quintal was 33,1 man, and the profitability was 65.3%. The highest indicators of minimum cultivation were in the variant of biohumus 5 t/ha, net income was 1037.5 man/ha, the cost value of 1 quintal of the product was 27.3 man, and the profitability was 92.0%. In the minimum cultivation, the cost of production per 1 quintal, the net income per 1 hectare and the level of profitability were higher than the traditional cultivation on all variants.

RECOMMENDATIONS FOR FARMS

It is recommended to farmers to maintain soil fertility in irrigated meadow-grey soils of Yevlakh district area, to get ecological pure, high and quality grain yield from autumn wheat:

1. When cultivating the soil by traditional methods, plow to a depth of 25-30 cm annually and fertilize it with the norm of biohumus 5 t/ha;
2. When cultivating the soil with a minimum method, it is expedient to make a furrow at a depth of 10-12 cm every year and fertilize it with the norm of biohumus 5 t/ha.

The main content of the dissertation is in the following articles reflected:

1. Hashimova A.V. The role of organic fertilizers in the production of ecological pure products // - Baku: ANAS Soil Science and Agrochemistry collection of scientific works MSV PUBLICATION-2018. volume 23 (No. 1-2;), - p. 378-381
2. Hashimova A.V. The impact of the chemicalization of agriculture on human health // Ministry of Education of the Re-

public of Azerbaijan, Ganja State University, International scientific conference "Actual problems of modern natural and economic sciences" dedicated to the 95th anniversary of the national leader Heydar Aliyev's birth, Ganja: - May 04-05, - 2018, part I, p. 355-357

3. Hashimova A.V. Agrochemical features of soils in the arid zone of the Azerbaijan Republic //, Ministry of Science and Higher Education, Ministry of Agriculture and Food of the Republic of Dagestan, Federal State Budgetary Institution "Federal Agrarian Scientific Center of the Republic of Dagestan", Federal State Budgetary Educational Institution of Higher Education "Dagestan State Agrarian University named after M.M. Jambulatov", Dagestan Branch of the All-Russian Soil Scientists named after V.V. Dokuchaeva, Current state of soil cover, preservation and reproduction of soil fertility, collection of scientific papers of the All-Russian scientific and practical conference, Makhachkala: - August 14-15, - 2018, - p. 91-95
4. Hashimova A.V. Agroecological characteristics of irrigated sierozem-meadow soils located in the arid zone of the republic // held on the subject of "Techniques for increasing soil fertility and fertilizer efficiency" Materials of the International scientific and practical conference dedicated to the memory of scientists Anna Ivanovna Gorbyleva, Yuri Pavlov Sirotin and Vadim Ivanovich Tyulpanov / editor: T.F. Persikova (responsible editor) [and others]. "Belarusian State Agricultural Academy", -Gorki: BSAA, - December 18-20, 2018, - 2019, part 2, - p. 89-91
5. Hashimova A.V. Agroecological characteristics of Kur-Araz lowland soils / V.I. Jafarov, H.J. Bagirov, G.N. Khasiyeva [etc.]. // ANAS Ganja section "Xabarlar Majmuasi", Elm publishing house, - Ganja: -2020 No. 1 (79), ", - p. 75-80
6. Hashimova A.V. Agrochemical, physical and chemical indicators of irrigated serozem-meadow soils of the arid zone of Azerbaijan // Russia: Bulletin of Science and Practice. - 2021.

T. 7. No. 8. - With. 91-96. https://doi.org/10.33619/2414-2948/69/12
7. Hashimova A.V. Influence of ecological cultivation technology on growth and structural elements of autumn wheat on arid soil-climatic conditions // National Academy of Agrarian Sciences of Ukraine Institute of Vegetable and Melon Growing Experimental Station "Mayak" Basic, less common and non-traditional plant species - from study to implementation (agricultural and biological sciences) Materials of the VI International Scientific and Practical Conference (within the framework of the VII Scientific Forum “Science Week in Kruty - 2022”, Kruty village, Chernigov region, Ukraine), Kruty - 2022, In two volumes Volume 2, - p. . 115-119
8. Hashimova A.V. Morphological, diagnostic characteristics and agrophysical properties of irrigated meadow-grey soils in arid land-climatic conditions (Azerbaijan) // Russia: Bulletin of Science and Practice. - 2022. T. 8. No. 5, - p. 162-167. https://doi.org/10.33619/2414-2948/78/21
9. Hashimova A.V. The effect of soil cultivation on the quality indicators of winter wheat grain in the production of ecological pure products. // - Baku: Nature and Science international scientific journal, - 2022. Volume 4, Number 7. - p. 69-73 Impact Factor: 1.642. ISSN: 2707-1146 e-ISSN: 2709-4189
10. Hashimova A.V. The effect of organic fertilizers and soil cultivation on wheat plant productivity in arid soil-climate conditions // Agricultural Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan. "Actual problems of modern agricultural and biological sciences: global challenges and innovations" / Proceedings of the virtual international scientific-practical conference. - Baku: "Muallim" publishing house, - 2022. - p. 260-264. DOI: 10.54824/CHAZ202201000029. ISSN 2664-4037
11. Hashimova A.V., Supervisor: Prof. A.H. Babayev Soil Degradation in Yevlakh district and sustainable development problems // Theses of Students’ International Scientific Conference for South Caucasus countries on Ecological prob-

lems, -Tbilisi: Georgian State Agrarian University, TEMPUS-TACIS MP_JEP-23193-2002, - 2005, - page 13-15
12. Hashimova A.V. The role of organisms in the formation of soil fertility // VI republican scientific conference dedicated to the 94th anniversary of the birth of national leader Heydar Aliyev at the Baku State University on the topic "Actual problems of ecology and soil sciences in the XXI century", - Baku: May 4-5, -2017, - p. 165-166
13. Hashimova A.V., Jafarov V.I., Mirmovsumova N.Z. The effect of fertilizers on the production of ecological pure pro ducts // Biological and Medical Sciences Division of ANAS, Society of Soil Scientists of Azerbaijan, Institute of Soil Science and Agrochemistry, materials of the republican scientific conference on "Actual problems of soil science" dedicated to the 110th anniversary of the birth of the outstanding scientist and public figure H. Aliyev, - Baku: "MSV PUBLICATION", December 21-22, - 2017, - p. 98
14. Hashimova A.V. Characteristics of small and small land use in arid zones // Baku State University Faculty of Ecology and Soil Science, Materials of the III International Scientific Conference on "Ecology: Nature and Society Problems" dedicated to the 110th anniversary of Academician H. Aliyev, - Baku, - December 26-27 , -2017, -p.32-34
15. Hashimova A.V. The effectiveness of the application of minimum cultivation under the wheat plant // The 8th republican scientific conference dedicated to the 96th anniversary of the birth of national leader Heydar Aliyev at the Baku State University on the topical problems of ecology and soil sciences in the XXI century, - Baku: - May 3-4, - 2019, - p. 154-157.
16. Hashimova A.V. The role of biohumus in increasing the productivity of agricultural plants // Baku State University, Materials of the II Republican Scientific Conference "Ecology and Soil Sciences in the XXI Century" dedicated to the 98th anniversary of the birth of national leader Heydar Aliyev, Baku: May 5-6, 2021, -p. 119-121

17. Hashimova A.V. The main characteristics of ecological agriculture // Baku State University Faculty of Ecology and Soil Science, materials of the III Republican Scientific Conference on Ecology and Soil Science in the XXI Century, dedicated to the 99th anniversary of the birth of national leader Heydar Aliyev, Baku: May 11-12, 2022 , p. 216-218
18. Hashimova A.V. The effect of organic soil cultivation and organic fertilizers on the quality indicators of winter wheat grain in arid soil-climate conditions // Ganja State University. Current problems of modern natural and economic sciences international scientific conference dedicated to the 99th anniversary of the birth of national leader Heydar Aliyev, Ganja: - 2022. Part II, p. 84

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