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ABSTRACT

Of the dissertation for the degree of Doctor of Philosophy

THE STUDY OF BUCKWHEAT CULTIVATION AGROTECHNOLOGY IN THE GANJA-GAZAKH REGION

Specialty: **3103.07 – Plant-growing**

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THE GENERAL DESCRIPTION OF THE RESEARCH

Relevance and degree of completion of the topic. Buckwheat is a very valuable plant due to its nutritional value. Among other herbs, buckwheat is known as the best protein source. Buckwheat is mainly used as food and fodder. Whole grains, broken grains, cereals and flour of buckwheat are used as food. At the moment, there are two main types of buckwheat grown in the world - ordinary buckwheat and Tatar buckwheat. Tatar buckwheat is small-grained, thick-shelled, is most widespread in East Asia, China, India and Japan.

According to FAO and Russian researchers A.N.Fesenko, I.N.Fesenko, V.I.Mazalov, O.V.Biryukova, the world's leading buckwheat producers (Fagopyrum esculentum Moench.) are Russia and China. Between 2001-2010, buckwheat was planted in these countries, each year on 843,000 and 815,000 hectares, respectively. Compared to 1961-1970, the cultivation area of buckwheat has decreased, and its production has increased in the world. In the last century, the price of one ton of buckwheat was $ 284 but in 2011-2013 it rose to $ 899. In 1991-1995, China's exports of buckwheat to the world market amounted to 99.1 thousand tons, the United States - 19.7 thousand tons, Russia - 0.7 thousand tons, and in 2011-2013 - 72.7 thousand tons; 25.4 and 9.3 thousand tons. The largest importers of buckwheat in the world in 1991-1995, Japan - 96.9 thousand tons, France - 9.2 thousand tons; Lithuania-0.3 min tons; Belgium - 3.4 thousand tons; Italy - 1,300 tons and the Netherlands - 9,600 tons, in 2011-2013 - Japan - 63,400 tons, Guinea - 40,500 tons, France - 9,300 tons; Lithuania-2.7 thousand tons; Belgium - 2.4 thousand tons; Italy - 13.7 thousand tons and the Netherlands - 4.3 thousand tons. Despite the decline in buckwheat production in Russia, there is a great demand for this product on the world market. In recent years, the productivity of buckwheat in Russia has increased. This is due to the use of new productive determinant varieties, resistance to various soil-climatic conditions, external stress factors, and rapidly-growing varieties.

Every year, more than 3,000 tons of buckwheat are imported to the Republic of Azerbaijan. The demand for this valuable food is growing every year. Such an idea has been formed that the cultivation

of buckwheat in our republic is ineffective. However, the analysis of the soil – climatic conditions of buckwheat grown territories suggests that in Azerbaijan, which has 9 climatic zones, the possibility of growing this valuable plant has not been fully studied. Ganja-Gazakh region occupies one of the places of decisive importance in the field of agricultural products in our republic. Taking into account the importance of buckwheat in terms of food security in the region, determining the optimum sowing period, norm and effective fertilizer norms for improving its productivity and quality are some of the most important problems to be solved in the modern period.

The purpose and tasks of the research. The main purpose of the study is to develop an effective agro-technology, which ensures high and quality grain harvest from the buckwheat plant in the irrigated gray-brown (dark brown) soils of the Ganja-Gazakh region.
In order to achieve the objective set in the study, the following tasks are intended to be performed:

- study of agrochemical properties of experimental lands;
- study of soil and climatic conditions of the area in the years of research;
- to study the effects of sowing time, norm and fertilizers on the growth and development of the buckwheat plant in the development phases;
- study of the effect of sowing time, norm and fertilizers on the grain productivity and quality of buckwheat;
- determination of economic efficiency

Research methods. "Krupinka" buckwheat sort was taken as a research subject. The goal has been fulfilled experimentally.
Experimental studies were carried out in the field conditions, the analysis of soil and plant samples was carried out using the existing methods in the laboratory. The accuracy of research results was obtained by mathematical calculations[1]. In soil samples taken: pH, total humus, absorbed ammonia, nitrate nitrogen, total nitrogen, total phosphorus, mobile phosphorus, total potassium, exchangeable po-

[1] Dospekhov, B.A. Methods of field experience / BA Dospekhov.- M .: Agroprom-published.- 1985.- 351 p.

tassium, buckwheat protein, starch, fat and cellulose were determined by generally accepted methods. The accuracy of the research results was achieved by mathematical calculations. In soil samples taken: pH potentiometer, total humus IV Tyurin, absorbed ammonia D.P. Konev, nitrate nitrogen Grandval-Lyaju, total nitrogen, total phosphorus K.E. Ginzburg and G.M. Sheglova, mobile phosphorus was determined by the method of B.P. Machigin, total potassium according to Smith, exchangeable potassium was determined by the method of P.B.Protasov.[2]

Main points presented to the defense of the dissertation:

- provision of the research area with nutrients;
- height and leaf surface, depending on the duration of the sowing, the norm, the norms of fertilizer and pruning of buckwheat;
- structural indicators, productivity and quality depending on the agro-technology of buckwheat cultivation;
- substantiation of the impact of buckwheat cultivation technology on economic efficiency.

Scientific novelty of the research. For the first time in the study, the optimal sowing time, sowing rate and effective norms of mineral fertilizers against the background of manure, which affect the productivity and quality of buckwheat in the Ganja-Gazakh region, were determined. It was also determined that the effect of mineral fertilizers '$N_{60}P_{60}K_{30}$ norm on the grain productivity on the background of manure(10 t/ha)was more effective in the specified date and sowing rate.

Theoretical and practical significance of the research. The study of the agro-technology of buckwheat cultivation on a scientific basis has had a significant impact on productivity and product quality. In irrigation conditions in the region, sowing of buckwheat between April 10-15, sowing norm per hectare was 2,5 million seedlings and fertilization of manure in the norm of 10 t/ha+$N_{60}P_{60}K_{30}$ increased its yield to 25.1 s/ha in 3 years. Growth was 9.8 s/ha or 64.1% compared to the control (fertilizer-free)option, at the same time, the quality of grain products increased significantly compared

[2] Jafarov, Y.A. Methods of agrochemical analysis / YA Jafarov, EH Mehdiyeva. - Baku: Military Publishing House.- 2014.-. 264 s.

to the control option.

Approbation and application of the work. The results of the research were reported at the Scientific and Technical Council of the Agrotechnical Department of the Scientific Research Institute of Plant Protection and Technical Plants and the Scientific Council of the Institute (2016-2019), at the Republican Scientific Conference on "Actual Problems of Soil Science" dedicated to the 110th anniversary of H.Aliyev at the Institute of Soil Science and Agrochemistry of ANAS (Baku, December 21-22, 2017), at the XXIX International Scientific-Practical Conference on "Russian Science in the Modern World" (June 15, 2020, Moscow), at the international scientific-practical conference on "The main problems of quality assurance of university-industry relations" dedicated to the 50th anniversary of the Azerbaijan University of Technology (UTECA) (December 25-26, 2020), at the II International Scientific Conference on Humanities and Social Sciences (December 18, 2020, Baku), at the scientific-methodical seminar of the Agricultural Research Institute of the Ministry of Agriculture (2021).

Research results. In 2019, in the production company, "Amin" operating in the Karayeri settlement of Samukh region, under irrigated conditions, grey-brown (dark brown) soils were sown with Krupinka variety of buckwheat on April 10-15. The sowing rate was 2.5 million seedlings per hectare and manure and 10 t / ha + $N_{60}P_{60}K_{30}$ option was applied in the 2 ha area. As a result of the application, the buckwheat yield was 24.7 s / ha, the net income from the gross product was 1054.6 manats/ha, and the cost of the product from 1 quintal was 27.3 manats.

Name of the organization where the dissertation was performed: The thesis work was carried out at the Plant Protection and Technical Plants Scientific-Research Institute of the Agriculture Ministry.

Total volume of the dissertation in characters with an indication of the separate volumes of the structural units. The dissertation consists of an introduction, four chapters, results, a list of 181 references and appendices. There are 10 pictures, 15 tables and an appendix of 75 tables. The introduction to the content of the disserta-

tion is 4 pages of 8557 characters, the first chapter is 12 pages of 26509 characters, the second chapter is 12 pages of 26450 characters, the third chapter is 14 pages of 29572 characters, the fourth chapter is 68 pages of 105265 characters, the results are 2 pages of 2563 characters, 1 page consists of 552 characters and the list of 181 used literature consists of 21. pages and 32684 characters. The volume of the dissertation consists of 241 pages of computer writing (excluding appendices), the total volume is 255696 characters (202926 characters excluding the list of used literature, tables, pictures and appendices).

THE MAIN CONTENT OF THE WORK

The introductory part of the dissertation gives a brief description of the relevance of the work, its importance for science and practice.

Chapter I is "Literature Review", where studies in Russia, Turkey, America, India, China, Central Asia and other countries show the sown area of buckwheat in the world, production, importance, selection, seed production, varieties, organic, mineral fertilizers, sowing period, the norm, the effects of irrigation and other agrotechnical measures on soil fertility, plant size and development, productivity and quality have been studied by many authors in different years. In our country and in the Ganja-Gazakh region, where we conducted research, in recent years, almost no research has been conducted on the agrotechnology of buckwheat cultivation in the last century. Therefore, there is a need to conduct research on the development of effective cultivation agrotechnology that provides high and quality grain from buckwheat on irrigated grey-brown (dark brown) soils[3].

Chapter II "Botanical description, biological characteristics and agrotechnics of buckwheat plant" contains information on the

[3] Hasanzadeh, Sh.R. Study of agrotechnology of buckwheat cultivation in Ganja-Gazakh region // Materials of the Republican scientific conference "Actual problems of soil science" dedicated to the 110th anniversary of HA Aliyev at the Institute of Soil Science and Agrochemistry of ANAS (December 21-22, 2017). Baku: "MSV PUBLICATION", - 2017, p.109.

importance of buckwheat (Polygonum Fagopyrum), botanical description and biological characteristics, root system, body, branching, flower and leaf structure, development phases, agrotechnics, place in sequential planting, soil compaction, fertilization, preparation of seeds for sowing, sowing period, method and norm, care for planting, harvesting[4].

Chapter III. Land-climate conditions of Ganja-Kazakh region, object, methodology and experience of research agricultural properties of land of the area

3.1. Soil and climatic conditions of the study area

The place of our research is located in Samukh region. During the research years, the weather conditions changed slightly during the growing season compared to average multi-year indicators. Low rainfall and river water in summer are some of the main reasons hindering the cultivation of agricultural crops. According to the data, it rains more in the region in April, May and June. The amount of precipitation has changed dramatically over the years. In July and August, precipitation decreases sharply and there is a shortage of irrigation water, and existing subartesian wells do not meet water needs. As a result, the growth and development of agricultural crops weaken, which leads to a decline in productivity. Almost no rainfall in these months, as well as the lack of irrigation water in the regions, does not allow to provide the plants with moisture normally. There is great importance of relative humidity for the cultivation of agricultural crops. The relative humidity in our country is generally favourable for the cultivation of field crops. However, sometimes during the summer, it is very low. In the western regions, the average monthly relative humidity is quite high. The relative humidity is high in winter and low in summer.

The study area is located in the plains of the Lesser Caucasus Mountains in the Samukh region. In the years of field experiments (2016-2018), the average monthly temperature and the amount of

[4] Hasanzadeh, Sh.R., Aslanov H.A. Biological features and economic importance of buckwheat plant // Scientific Works of ADAU, - Ganja: ADAU Publishing House, - 2017, №1. - p.14-17.

precipitation were taken from the Ganja Regional Hydrometeorological Center. As can be seen, the average monthly temperature in 2016-2018 is 15.1-15.70C, and the amount of rainfall is 217.2-331.1 mm per year. In the years we studied, the weather conditions changed slightly during the growing season compared to average multi-year indicators[5].

Provides "the soil-climatic conditions of the Ganja-Gazakh region, the purpose of the research, its methodology and the agrochemical characteristics of the experimental area soils". The research was conducted in 2016-2018 on grey-brown (dark brown) soils irrigated with Krupinka buckwheat at Ganja RAEIM in the Samukh region of the Ministry of Agriculture of the Republic of Azerbaijan.

3.2. Object and methodology of research Field experiments were placed in 3 factors (3x3x5) in the following scheme after the cotton predecessor: Factor A planting time: 1). 1-5 April; 2). April 10-15; 3). April 20-25. Factor B planting rate: 1). 2.0 million seedlings per hectare; 2). 2.5 million seedlings per hectare; 3). 3.0 million seedlings per hectare. Factor C fertilizer norms: 1). Control (without fertilizer); 2) Fertilizer 10 t / ha (background); 3) Fund + $N_{30}P_{30}K_{0}$; 4) Fon + $N_{60}P_{60}K_{30}$; 5) Fon + $N_{90}P_{90}K_{60}$.

The area of the accounting unit of each variant was 18.0 m2 (10x1.80 m), the sowing was carried out in 3 repetitions with 45 cm spacing. Nitrogen-ammonium nitrate 34.7%, phosphorus-simple superphosphate 18.7% and potassium-potassium sulfate 46% and semi-decomposed fertilizer (nitrogen 0.5%, phosphorus 0.25%, potassium 0.6%) were used. 100% of manure, 60% of phosphorus and potassium are applied under ploughing in autumn, the remaining 40% of phosphorus and potassium are given during feeding, between rows in the branching stage, and nitrogen is applied once.

Phenological observations and biometric measurements were carried out on 25 plants, and agro-technical measures were carried

[5] Hasanzadeh, Sh.R., Huseynova, L.R., Gasimova, N.A. Soil-ecological conditions of Ganja-Gazakh region // Soil Science and Agrochemistry / ANAS, Baku: "MSV PUBLICATION", -2018, p.23, №1-2.- p.94-100.

out in accordance with generally accepted procedures[6]. The results of the experiment were confirmed by mathematical calculations. The economic efficiency of fertilizer application was calculated based on the cost of additional products. The results of field experiments, calculation of productivity, leaf surface, accuracy of experiment and mathematical analysis of correlative relations were performed by B.A.Dospekhov, V.N.Peregudov and P.N.Konstantino, economic efficiency by N.N Baranov methods.

Chapter IV. Sowing terms, norms, fertilizers growth, structural indicators, grain productivity, quality and economics of Karabakh effect on efficiency

4.1. Influence of sowing time, norm, fertilizers on buckwheat height, development and structural indicators is devoted to "The effect of sowing time, norm, fertilizers on buckwheat growth, structural indicators, grain yield, quality and economic efficiency".

The effect of sowing time, norm and fertilizers on buckwheat length was studied at the stages of branching, budding and full ripening. Our experiments show that sowing time, norm and fertilizers have a significant effect on the height of buckwheat. When sowing on April 1-5, in the control (without fertilizer) variant, in the branching phase, the height of buckwheat was 13.5-14.2 cm at the rate of 2.0 million units per hectare, 11.0-11.8 cm at the rate of 2.5 million units per hectare, 9.3-9.8 units at the rate of 3.0 million units per hectare and was 60.0-61.6; 57.3-58.4, 54.2-55.3 cm in the full ripening phase.

As a result of the application of different norms of mineral fertilizers together with manure, the height of buckwheat was higher than the control and manure options of 10 t/ha. Thus, in the fon + $N_{30}P_{30}K_0$ variant, the height of buckwheat in the branching phase was 15.3-16.5 cm at the rate of 2.0 million.units per hectare, 13.8-14.5 cm at the norm of 2.5 million units per hectare, 11.7-12.5 cm at the norm of 3.0 million units per hectare.

[6] Hasanzade, Sh.R. Optimization of technological methods of cultivation of buckwheat in the conditions of the Ganja-Kazakh zone of Azerbaijan // M .: Agrarian science, -2018, No. 11-12. -s. 45-48

The highest values are in the fon + $N_{60}P_{60}K_{30}$ variant, in the branching phase, the height of buckwheat was 17.2-18.5 cm per hectare at the rate of 2.0 million units, 15.2-16.5 cm per hectare at the rate of 2.5 million units per hectare, 14.6-15.3 cm per hectare at the rate of 3.0 million units, and in full maturity it was 75.6-77.8 cm, 72.2-73.8 cm, 68.5-70.6 cm. The height of the plant decreased as the mineral fertilizer ratio ($N_{90}P_{90}K_{60}$) with the fon increased.

When sowing on April 10-15, in the control (without fertilizer) variant, in the branching phase, the height of buckwheat was 16.0-17.3 cm at the rate of 2.0 million units per hectare, 14.0-15.3 cm at the rate of 2.5 million units per hectare, 12.0-12.8 cm at the rate of 3.0 million units per hectare and was 65.4-66.8; 62.0-62.7 and 56.4-58.2 cm in the full ripening phase. In the 10 t/ha (fon) variant of manure, in the branching phase, the height values of buckwheat were 17.5-18.4; 15.8-16.8; 13.7-14.3 and values were 68.3-69.7; 64.6-65.8; 58.0-60.2 cm in full maturity. By observing the highest values in the fon+$N_{60}P_{60}K_{30}$ variant, by phases, the height of buckwheat was 23.7-25.8 cm, 20.8-22.7 cm, 17.2-18.5 cm and in full maturity it was 80.5-83.3 cm; 76.8-78.0 cm; 70.1-72.7 cm. When carried out on April 20-25, the height decreased compared to the 1st and 2nd sowing periods in each sowing norm and fertilizer norms, respectively. This can be attributed to late sowing. The highest growth rates of buckwheat by development phases were observed during sowing on April 10-15.

The effect of sowing time, norm and fertilizers on the leaf surface of buckwheat was studied during budding and flowering. When sowing on April 1-5, in the control (without fertilizer) variant, the leaf surface of buckwheat per hectare was 32.3-33.0 thousand m^2/ha, at the sowing norm of 2.5 million/ha was 31.1- 31.8 thousand m^2/ha, at the sowing norm of 3.0 million/ha was 29.6-30.1 thousand m^2/ha.

In the 10 t/ha (fon) variant of the manure, the leaf surface of the buckwheat was significantly increased in all 3 sowing norms compared to the control variant. As a result of application of different norms of mineral fertilizers together with manure, leaf surface per hectare increased compared to control (without fertilizer) and

manure 10 t/ha (fon) options. Thus, in the variant of fon + $N_{30}P_{30}K_0$, at the sowing norm of 2.0 million/ha it was 34.8-36.0 thousand m^2/ha, at the norm of 2.5 million/ha it was 33.7-34.5 thousand m^2/ha, at the norm of 3.0 million it was 31.3-32.5 thousand m2/ha while the maximum leaf surface was 36.7-38.0, 35.1-36.8 and 33.5-34.8 thousand m^2/ha in the fon + $N_{60}P_{60}K_{30}$ variant.

When sowing on April 10-15, the leaf surface of buckwheat was 33.3-34.6 thousand m^2/ha at the sowing norm of 2.0 million/ha, 32.2-33.8 thousand m^2/ha at the sowing norm of 2.5 million / ha, 30.0-31.4 thousand m^2/ha at the sowing rate of 3.0 mln/ha, and as a result of the application of various norms of mineral fertilizers together with manure, maximum leaf surface in the fon + $N_{60}P_{60}K_{30}$ variant at the sowing norm of 2.0 mln/ha was 39.3-42.8 thousand m^2/ha, at the sowing norm of 2.5 mln/ha was 37.3-40.2 thousand m^2/ha, at the sowing norm of 3.0 mln/ha was 34.0-35.8 thousand m^2/ha.

When sowing on April 20-25, the leaf area per hectare was reduced compared to the 1st and 2nd sowing periods in the appropriate sowing and mineral fertilizer norms. This can be explained by the late sowing of buckwheat.

The effect of sowing time, norm and fertilizers on buckwheat branching was studied[7]. Our experiments show that sowing duration, norm and fertilizers have a significant effect on the number of branches per plant. In the sowing carried out on April 1-5, the number of branches per plant was 6.8-7.5 units in the control variant (without fertilizer) at the sowing norm of 2.0 million/ha, at the sowing norm of 2.5 million/ha was 5.7-6.8 units and at the sowing rate of 3.0 million/ha was 4.8-5.7 units. As a result of the application of different norms of mineral fertilizers together with manure, the number of twigs per plant increased compared to the control (without fertilizer) and manure 10 t / ha (fon) options. Thus, in the fon + $N_{30}P_{30}K_0$ variant, the number of branches was 8.2-9.4 in the sowing

[7] Hasanzade, S.R. Effects of sowing time, rate and fertilizers on buckwheat plant height in gray-brown soils in Ganja-Kazakh region // Collection of Works of the Society of Soil Scientists of Azerbaijan, - Baku: Science, - 2019, XV v. - p. 481-484

norm of 2.0 million/ha, 7.5-8.8 in 2.5 million/ha, 3.0 million/ha in 5.8-7.0, and the maximum number of branches was 9.1-10.8 and 7.2-8.4 appropriate to the fon + $N_{60}P_{60}K_{30}$ variant.

In the control (fertilizer) variant of sowing carried out on April 10-15, the number of branches in the plant was 8.2-9.5 units at the sowing norm of 2.0 million / ha, 7.3-8.4 units at the sowing norm of 2.5 million/ha, 6.5-7.3 units at the sowing norm of 3.0 million/ha. These indicators are 9.0-10.8, 8.2-9.6 and 7.1-8.3 units in the 10 t/ ha (fon) variant of manure and as a result of the application of different norms of mineral fertilizers together with manure, the number of branches in the fon + $N_{60}P_{60}K_{30}$ variant is 13.8-15.7 units at the norm of 2.0 million/ha, 11.5-13.8 units at the norm of 2.5 million/ha, 10.3-11.8 units at the norm of 3.0 million/ha.

The number of branches was lower in the sowing, sowing norms and fertilizer norms we carried out on April 20-25 compared to the 1st and 2nd sowing periods.

The effect of sowing time, norm and fertilizers on the structural elements of buckwheat was also studied. Experiments show that sowing time, norm, and fertilizers have a significant effect on the number of flower clusters formed on a plant, the number of grains per plant, the mass of grain per plant, and the mass of 1,000 grains.

When sowing on April 1-5, the number of flower clusters formed on one plant at the norm of 2.0 million/ha was 8.8-9.8, the number of grains from one plant was 111.4-117.1, the mass of grain from the plant was 2, 37-2.55 g and the weight of 1000 grains was 21.3-21.8 g, the number of flower clusters formed on one plant at the rate of 2.5 million/ha was 7.8-8.7, the number of grains from one plant was 95, 7-98.6 units, grain weight from one plant was 1.91-2.03 grams and weight of 1000 grains was 20.0-20.6 grams, the number of flower clusters formed in one plant at the rate of 3.0 million/ha was 5, 3-6.3 units, the number of grains from one plant was 71.4-74.3 units, the weight of grain from one plant was 1.33-1.89 grams and the weight of 1000 grains was 18.6-19.2 grams, including manure, as a result of the application of different norms of mineral resources, each of the studied structural indicators significantly in-

creased compared to the control and manure options of 10 t/ha[8].

The highest indicators are observed in the fon + $N_{60}P_{60}K_{30}$ variant, at the sowing norm of 2.0 million/ha, the number of flower clusters formed on one plant was 12.0-12.4 units, the number of grains from one plant was 173.0-174.3 units, the grain mass coming out of one plant was 4,24-4,46 and gram the weight of 1000 grains was 24.5-25.6 grams, at the rate of 2.5 million/ha sowing, the number of flower clusters formed in one plant was 10.7-11.5, the number of grains coming out of one plant was 148.6-158.6, the weight of grain per plant was 3.52-3.85 grams, and the weight of 1000 grains was 23.7-24.3 grams, at the rate of 3.0 million/ha sowing, the number of flower piles formed in one plant was 7.4-8.8, the number of grains from one plant was 103.8-110.0, the weight of grain from one plant was 2.34-2.60 grams and the weight of 1000 grains was 21.7-23.6 grams.

On April 10-15, when sowing, the number of flower balls formed in one plant in the norm of sowing 2,0 mln/ha in the non-fertilized version was 9,6-10,8, the number of grains coming out of one plant 104,3-111,4, the grain mass coming out of one plant 2,50-2,68 grams and the grain mass 2.03-2.19 grams and 1000 grain mass 20.6-21.6 grams, in the norm of sowing 3,0 mln/ha, the number of flower balls formed in a plant was 6.0-6.8 pieces, the number of grains coming out of one plant was 74.3-77.1 units, the mass of grains coming out of one plant was 1.40-1.53 and the mass of 1000 grains was 18.8-19.8, at the sowing rate of 3.0 million/ha, the number of flower piles was 6.0-6.8, the number of grains from one plant was 74.3-77.1, the weight of grain from one plant was 1.40-1.53 grams and the weight of 1000 grains was 18.8-19.8 grams. The highest indicators are observed in the background + $N_{60}P_{60}K_{30}$ variant, at the sowing norm of 2.0 million/ha, the number of flower clusters formed on one plant was 12.8-14.6, the number of grains was 4.48-4.62 grams, and the weight of 1000 grains was 26.5-24.4 from one plant was 167.4-180.1, the

[8] Hasanzadeh, Sh. R. Influence of sowing time, norms and fertilizers on the structural indicators of buckwheat, on irrigated gray-brown soils // Bulletin of Science and Practice, 2020, T. 6, No. 7, pp. 81-87.

weight of the grain per plant grams, at the sowing rate of 2.5 million/ha, the number of flower clusters formed in one plant was 11.6-12.7, the weight of grains from one plant was 3.81-4.14 grams and the weight of 1000 grains was 24.5-26.1 grams, at the sowing rate of 3.0 million/ha, the number of flower clusters formed in one plant was 7.8-9.6, the number of grains from one plant was 105.7-113.0, the weight of grains from one plant was 2.43-2.78 grams and the weight of 1000 grains was 22.0-23.6 grams. When sowing buckwheat on April 20-25, the indicators of structural elements were lower than in the corresponding sowing norms and fertilizer norms compared to the 1st and 2nd sowing periods, and the highest results were obtained in the sowing carried out on April 10-15.

4.2. Influence of sowing unit, norm, fertilizers on productivity and quality of buckwheat. The effect of sowing time, norm and fertilizers on buckwheat productivity was studied (Figure 1-3). In the sowing carried out on April 1-5, at the sowing norm of 2.0 mln/ha, in the control variant (without fertilizer), the average yield from 3 years was 14.0 s/ha, at the sowing norm of 2.5 mln/ha, it was 14.8 s / ha, in the sowing norm of 3.0 mln/ha, it was 13,4 s/ha. As a result of the application of various norms of mineral fertilizers on the background of manure, the grain yield increased significantly compared to the control and manure 10 t/ha (fon) variants. Thus, in the fon + $N_{30}P_{30}K_0$ variant, at the sowing norm of 2.0 mln/ha, growth compared to control was 3.8 s/ha or 27.1%, at the sowing norm of 2.5 mln / ha, it was 19.0 s/ha, an increase was 4.2 s/ha or 28.4%, at the sowing rate of 3.0 ml /ha, it was 16.1 s/ha, an increase was 2.7 s/ha or 20.2%. The highest indicators were observed in the fon + $N_{60}P_{60}K_{30}$ variant, at the sowing norm of 2.0 mln/ha, it was 21.3 s/ha, the increase was 7.3 s/ha or 52.1% compared to the control, at the sowing norm 2.5 mln/ha, it was 23,2 s/ha, the increase was 8.4 s/ha or 56.8%, at the sowing norm 3.0 mln/ha, it was 19.3 s/ha, the increase was 5.9 s/ha or 44.0%. The accuracy of the experiment was P = 1.78-2.65%, E = 0.32-0.45 s/ha at the sowing rate of 2.0 million / ha, P = 1.76-3.00%, E = 0.50-0.61 s/ha at the sowing rate of 2.5 million/ha, and P = 2.12-3.00%, E = 0.35-0.51 s / ha in the sowing norm of 3.0 mln/ha and

the difference between variants was three and more times higher than E. This proves the accuracy of the experiment.

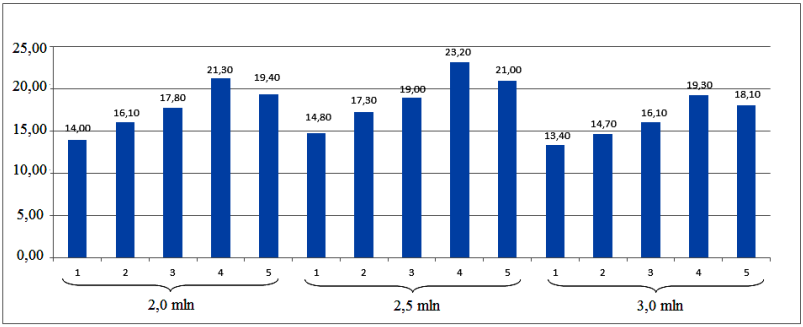

Figure 1. Influence of sowing period, norm and fertilizers on buckwheat productivity (average s / ha from 3 years, April 1-5):
1. Control (without fertilizer); 2. Manure 10 t / ha (Fon); 3. Fon + $N_{30}P_{30}K_0$; 4. Fon + $N_{60}P_{60}K_{30}$; 5. Fon + $N_{90}P_{90}K_{60}$

As shown in Figure 2, when sowing was carried out on April 10-15, the productivity was higher than in the early sowing period (April 1-5) and late sowing (April 20-25) in all three sowing norms and fertilizer norms. Thus, in the control (fertilizer-free) variant, at the sowing norm of 2.0 million/ha, in 3 years the average yield was 14.4 s/ha, in the sowing norm of 2.5 million/ha, it was 15.3 s/ha. The highest rates were observed in the fon + $N_{60}P_{60}K_{30}$ variant, at at the sowing rate of 2.0 million/ha, it was 22.2 s/ha, growth compared to the control was 7.8 s/ha or 54.2%, at the sowing rate of 2.5 million/ha it was 25,1 s/ha, the increase was 9.8 s/ha or 64.1%, in the sowing norm of 3.0 mln/ha it was 20.0 s/ha, the increase was 6.7 s/ha or 47.4%.

If we compare the results obtained in the sowing carried out on April 10-15 in all 3 sowing norms, we can see that the highest grain yield is in the fon + $N_{60}P_{60}K_{30}$ variant, among the sowing norms, more was obtained at 2.5 million / ha, and at least 3.0 million / ha. The accuracy of the experiment is P = 2.27-2.95% at the sowing rate of 2.0 million/ha, E = 0.41-0.56 s / ha, P = 1.80-2.48% at the sowing rate of 2.5 million/ha, E = 0.36-0.52 s/ha, P = 1.77-2.28% at the sowing rate of 3.0 million / ha, the difference between E = 0.29-0.41 s/ha and variants was three or more times higher than E.

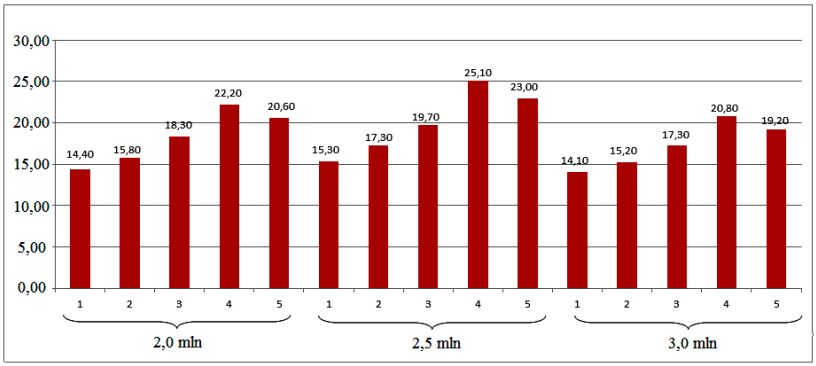

Figure 2. Influence of sowing time, norm and fertilizers on buckwheat productivity (average s/ha from 3 years, April 10-15):
1. Control (without fertilizer); 2.Manure 10 t / ha (Fon); 3.Fon + $N_{30}P_{30}K_0$; 4.Fon + $N_{60}P_{60}K_{30}$; 5. Fon + $N_{90}P_{90}K_{60}$

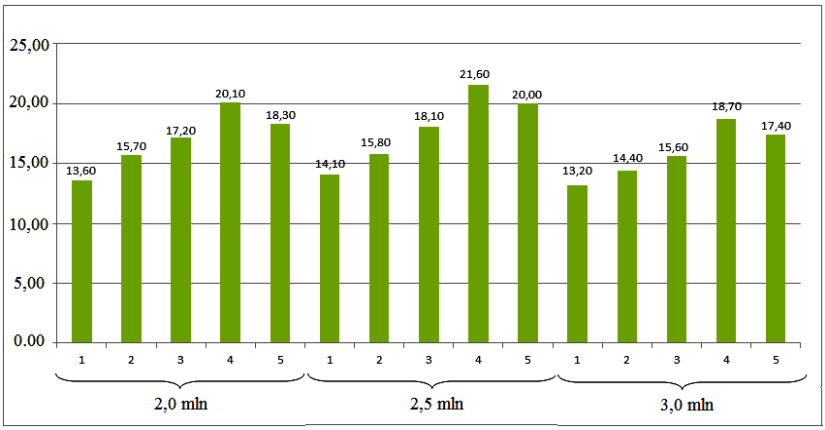

Figure 3. Influence of sowing time, norm and fertilizers on buckwheat productivity (average s/ha from 3 years, April 20-25):
1. Control (without fertilizer); 2.Manure 10 t / ha (Fon); 3.Fon + $N_{30}P_{30}K_0$; 4.Fon + $N_{60}P_{60}K_{30}$; 5.Fon + $N_{90}P_{90}K_{60}$.

As shown in Figure 3, in late sowing (April 20-25) the yield of grain decreased compared to the 1st and 2nd sowing periods in the appropriate sowing and fertilizer norms.

The effect of sowing time, norm and fertilizers on the quality indicators of buckwheat crop was also studied. In the sowing carried out on April 1-5, in the control (fertilizer) variant at the sowing rate of 2.0 mil-

lion/ha, the protein was 8.15-8.35%, starch was 68.10-68.35%, fat was 1.15-1.26% and cellulose was 2.80-2.98%, at the sowing rate of 2.5 million/ha, it was 8.05-8.25; 67.05-67.25; 1.10-1.25; 2.70-2.88% and at the sowing rate of 3.0 million/ha, it was 7.88-8.02; 66.35-66.75%; It was 1.03-1.10 and 2.61-2.70%. As a result of the application of various norms of mineral fertilizers on the background of manure, the quality of the product has significantly increased compared to the control and manure options of 10 t / ha (fon). Thus, in the fon + $N_{30}P_{30}K_0$ variant, in the sowing norm of 2.0 mln/ha, the protein was 8.46-8.63%, starch was 69.15-69.40%, fat was 1.30-1.45% and cellulose was 2.97- 3.13%, at the sowing rate of 2.5 million/ha, it was 8.25-8.48; 68.65-68.90; 1.23-1.35; 2.87-3.05%, at the sowing rate of 3.0 million/ha, it was 8.10-8.21; 67.20-67.65%; 1.15-1.25 and 2.83-2.95%. According to the fon+$N_{60}P_{60}K_{30}$ option, the highest rates were in the sowing norm of 2.0 ha/million, the protein was 8.65-8.90%, starch was 70.20-70.50%, fat was 1.45-1.70%, cellulose was 3.25--3.48%, in the sowing norm of 2.5 ha/million, it was 8.48-8.78; 69.55-69.50; 1.40-1.58; 3.18-3.30%, in the sowing norm of 3.0 ha/million, it was 8.30-8.48; 67.70-67.90%; 1.28-1.43 and 3.10-3.18%.

When sowing was carried out on April 10-15, the studied indicators of buckwheat were higher in all 3 sowing norms and fertilizer norms compared to the early sowing period (April 1-5**).** Thus, in the control (without fertilizer) variant at the sowing rate of 2.0 mln/ha, the protein was 8.25-8.48%, starch was 68.30-68.60%, fat was 1.21-1.30%. and cellulose was 2.90-3.05%, at the sowing rate of 2.5 million/ha, it was 8.13-8.25; 67,18-67,30; 1.17-1.26; 2.78-2.85% and at the sowing rate of 3.0 million/ha, it was 7.95-8.05; 66,60-66,90; 1.09-1.18 and 2.67-2.73%. In the 10 t / ha (fon) variant of manure, in the sowing norm of 2.0 mln/ha, protein was 8.40-8.57%, starch was 68.65-68.90%, fat was 1.28-1.40% and cellulose was 3.01-3.15%, 8.21-8.37 and in the sowing rate of 2.5 million/ha, it was 67,45-67,60; 1.25-1.35; 2.86-2.98% and in the sowing rate of 3.0 million/ha it was 8.08-8.15; 66.80-67.15%; 1.17-1.27 and 2.73-2.85%. As a result of the application of various norms of mineral fertilizers on the background of manure, the quality of grain product increased compared to control (without fertilizer) and manure 10 t / ha (fon) options. In the fon + $N_{30}P_{30}K_0$ variant, in the sowing norm of 2.0, pro-

tein was 8.55-8.70% , starch was 69.45-69.70%, fat was 1.35-1.65%; cellulose was 3.15-3.38% and in the sowing norm of 2.5 million/ha, it was 8.35-8.48; 68.70-69.05; 1.30-1.48; 3.10-3.255% and 8.16-8.30 and in the sowing norm 3.0, it was million/ha; 67.48-67.60%; 1.26-1.38 and 2.86-2.98%. According to the fon + $N_{60}P_{60}K_{30}$ option as in the first sowing period, the highest rates at 2.0 million/ha were 9.85-10.35%; 71.75-72.60%; 1.75-2.10%; 3.75-4.05%; at 2.5 million/ha 9.15-9.85; 70,15-70,90; 1,65-1,85; 3,45-3,65% and at 3.0 million / ha 8.75-9.25; 68.80-69.10%; 1.43-1.75; 3.13-3.30% were observed. As mineral fertilizer norms increased with manure ($N_{90}P_{90}K_{60}$), grain quality decreased compared to the fon + $N_{60}P_{60}K_{30}$ variant during all three sowings. If we compare the results obtained from the norm of all 3 sowings in the sowing carried out on April 10-15, we can see that the quality grain was obtained in the fon + $N_{60}P_{60}K_{30}$ variant. Depending on the food sector, quality grain was obtained at a higher rate of 2.5 million/ha and at a lower rate of 3.0 million/ha, depending on the sowing area. Thus, when buckwheat was sown on irrigated gray-brown soils on April 10-15, the amount of protein, starch, oil and cellulose in the grain was higher than in all three sowing norms compared to early and late sowing (April 1-5 and 20-25). Compared to the fertilizer-free variant at the rate of 10 t/ha + $N_{60}P_{60}K_{30}$, in the seed at the rate of 2.0 mln/ha protein was 1.60-1.87%, starch 3.45-4.00%; fat 0.54-0.80; cellulose 0.85-1.00% was increased and at the rate of 2.5 million/ha - 1.02-1.60; 2.97-3.60; 0.48-0.59; 0.67-0.80% and at 3.0 million/ha - 0.68-0.80; 1.90-2.50; 0.38-0.42; 0.46-0.57% was increased. The correlational relationship between the yield of buckwheat and quality indicators has changed steadily[9].

The net income from the study was determined based on all costs incurred in the additional product and the market selling price of that product (Figure 4).

[9] Hasanzadeh, Sh.R. Influence of sowing period, norm and fertilizers on the economic efficiency of buckwheat in Ganja-Gazakh region // Materials of the international scientific-practical conference on "Main problems of quality assurance of university-industrial relations" dedicated to the 50th anniversary of Azerbaijan University of Technology (UTECA) (December 25-26 2020), Ganja: 2020, Part I, -p.64-68.

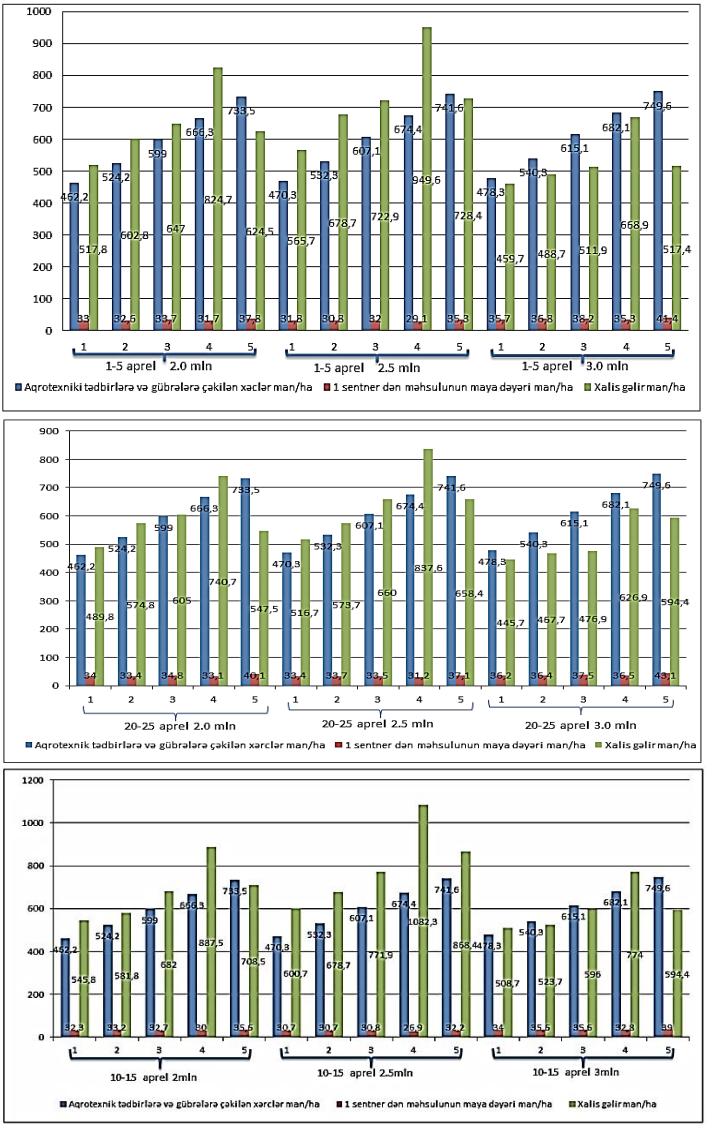

Figure 4. Influence of sowing period, norm and fertilizers on the economic efficiency of buckwheat (2016-2018):
1.Control (without fertilizer) 2. Manure 10 t / ha (Fon)
3. Background + $N_{30}P_{30}K_0$ 4. Fon + $N_{60}P_{60}K_{30}$ 5. Fon + $N_{90}P_{90}K_{60}$.

In the sowing carried out on April 1-5, the net income at the sowing norm of 2.5 million/ha was high for all options, 565.7-949.6 man/ha, the cost of 1 quintal of the product was 29.1-35.3 man, the level of profitability fluctuated between 98.2-140.8%. In the 10 t / ha + $N_{60}P_{60}K_{30}$ variant of manure, the highest net income was 29.1 man, 949.6 man/ha and profitability was 140.8%.

In the sowing carried out on April 10-15, the net income at the rate of 2.5 million sowings was 600.7-1082.6 manat/ha, the cost of 1 quintal of the product was 26.9-32.2 manat, and the level of profitability fluctuated between 117,1-160.5%. The highest net income was 26.9 manat and profitability was 160.5%.

In the sowing carried out on April 20-25, the net income at the sowing norm of 2.5 million / ha was higher than in all variants, 516.7-837.6 manat/ha, the cost of 1 quintal of the product was 31.2-37.1 manat and the level of profitability fluctuated between 88.8-124.2%. The fertilizer was 10 t / ha + 1082.6 man/ha according to the variant $N_{60}P_{60}K_{30}$. According to the variant of manure 10t / ha + $N_{60}P_{60}K_{30}$., the highest net income was 837.6 man/ha, 31.2 man and the profitability was 124.2%.

Thus, on April 10-15, at the rate of 2.5 million / ha sowing and 10 t / ha + $N_{60}P_{60}K_{30}$ fertilizer, more economic benefits were obtained from buckwheat than from dense and sparse sowing.

Conclusions

1. As a result of agrochemical analysis, it was determined that the irrigated grey-brown (dark brown) soils were poorly provided with the adopted forms of nutrients due to the gradation accepted in our republic. Therefore, it is important to apply organic and mineral fertilizers to get a stable, high-quality and high yield of buckwheat in these soils.
2. The irrigated grey-brown (dark brown) soils of the Ganja-Gazakh region are suitable for growing buckwheat. To get a stable, high-quality and high-yield crop, it is determined to sow on April 10-15, sow 2.5 million seedlings per hectare and fertilize at the rate of 10 t / ha + $N_{60}P_{60}K_{30}$.

3. Optimal sowing time, sowing rate and mineral fertilizer norms based on manure have a significant effect on the height, branching and the formation of more leaf surface. During all three sowings and in the sowing norm, the reduced and increased norms of mineral fertilizers along with the soil did not have much effect on height and development.
4. When sowing buckwheat on April 10-15, at the norm of all three sowings in all variants, the number of flower clusters per plant, the number of grains per plant, the mass of grain per plant and the mass of 1000 grains was more. The highest values were observed in the norm of 2.5 million / ha of seedlings and 10 t/ha+$N_{60}P_{60}K_{30}$ of manure.
5. During the optimal sowing period of buckwheat (April 10-15) and in the norm of all three sowings, more crop was obtained for all options than the early and late sowings (April 1-5 and 20-25). On average from 3 years the highest grain yield was 25 million s/ha at the norm of 2,5 million s/ha seedlings and fertilizer 10 t / ha + $N_{60}P_{60}K_{30}$, the increase compared to the non-fertilized variant was 9.8 s / ha or 64, 1%.
6. It was found that the optimal application of mineral fertilizers (manure 10 t / ha + $N_{60}P_{60}K_{30}$) increases the amount of protein, starch, fat and cellulose in buckwheat grain during the optimal sowing period (April 10-15) and compared to the norm without the fertilizer variant.
7. The economic analysis of the study of buckwheat cultivation shows that when sowing is carried out on April 10-15, when 2.5 million / ha of seedlings are sown, and the highest net income of fertilizers at the rate of 10 t / ha + $N_{60}P_{60}K_{30}$ is 1082.6 man / ha. The cost of the product was 26.9 manat per 1 quintal and the level of profitability was 160.5%.

Recommendatıons for breeders and producers

1. In the irrigated gray-brown (dark brown) soils of Ganja-Gazakh region, it is considered expedient to sow buckwheat on April 10-15 to get high-quality grain from Krupinka variety.

2. In order to get high-quality grain from buckwheat, it is expedient to sow 2.5 million seedlings per hectare.
3. It is recommended to provide fertilizers at the rate of 10 t / ha + $N_{60}P_{60}K_{30}$ to get the economically efficient and high-yield grain product from buckwheat.

List of published scientific works on the topic of the dissertation

1. Hasanzadeh, Sh.R., Aslanov H.A Biological features and economic importance of buckwheat plant // Scientific Works of ADAU, - Ganja: ADAU Publishing House, - 2017, №1. - p.14-17.
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7. Hasanzade, Sh.R. Influence of sowing dates, norms and fertilizers on the branching of buckwheat // Collection of articles of the XXIX international scientific-practical conference (15 June 2020 part I). -Moscow: "Research and Publishing Center" Relevance.

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10. Hasanzadeh, Sh. R. Influence of sowing period, norm and fertilizers on the economic efficiency of buckwheat in Ganja-Gazakh region // Materials of the international scientific-practical conference on "Main problems of quality assurance of university-industrial relations" dedicated to the 50th anniversary of Azerbaijan University of Technology (UTECA) (December 25-26 2020), Ganja: 2020, Part I, -p.64-68.

The defense of the dissertation will be held on the 07 october 2022, at 14^{00} o'clock, at the meeting of the FD 1.29 Dissertation Council operating under the Ministry of Agriculture, Research Institute of Crop Husbandry.

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Dissertation is accessible at the library of Research Institute of Crop Husbandry.

Electronic versions of the dissertation and its abstract are available on the official website of the Research Institute of Crop Husbandry.

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