**AZERBAIJAN REPUBLIC**

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# EFFICIENCY OF MINERAL FERTILIZERS ON THE FON OF MANURE UNDER THE CABBAGE PLANT IN GANJA-KAZAKH REGION (IN THE EXAMPLE OF GADABAY DISTRICT)

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## SYNOPSIS

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# INTRODUCTION

Actuality and elaboration degree of the topic. In the decree of the President of the Republic of Azerbaijan I.H.Aliyev dated January 16, 2014 "On additional measures in the field of improving the activity of the agricultural and food products market", the development of the non-oil sector, including agriculture, was defined by the state as one of the priority directions of the economic policy. Currently, ensuring high productivity, increasing the competitiveness of local products, developing profitable areas of agriculture, more efficient organization of state support to farmers and achieving food security are considered important directions of state policy in the agricultural sector[1].

Also, in the "State Program for Food Safety in the Republic of Azerbaijan for 2019-2025" of President dated April 29, 2019, the strategic vision until 2025 is to fully provide the population with healthy and safe food, and thereby it involves achieving a significant reduction of diseases, as well as increasing the productivity and competitiveness of agricultural and food products, and increasing the volume of exports to the markets of developed countries[2].

According to the average statistical indicators of the last 5 years provided by the State Statistics Committee, cabbage was planted on 4,276.2 ha in the Republic and 130,560 tons were produced, and the average yield was 21.8 t/ha.

In the Ganja-Gazakh economic region, 35,938.4 tons of cabbage were produced from an area of 1244.4 ha, with an average yield of 28.9 t/ha. In the Gadabey region where the study was conducted, cabbage was planted on an area of 188.8 ha and 2874.2 tons of cabbage were produced. The average productivity indicator for the region was 15.5 t/ha[3].

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[1] Decree of the President of the Republic of Azerbaijan I.H. Aliyev dated January 16, 2014 "On additional measures in the field of improving the activity of the agricultural and food products market"

[2] "State Program for ensuring food safety in the Republic of Azerbaijan for 2019-2025", April 29, 2019.

[3] stat.gov.az

According to the FAO, cabbage is the third largest vegetable crop in developed countries, after potatoes and tomatoes, and the second largest source of cereals in developing countries[4].

White cabbage contains aqueous carbohydrates, proteins, vitamins C, B1, B2, B3, PP, K, U, biologically active substances and mineral salts, including the cruciferous family. Vitamin U (ulcus) has a beneficial effect on the healing of ulcers in the stomach and intestines, plays an important role in the treatment of liver, heart, multiple sclerosis and other diseases. Among the types of cabbage, white cabbage is of great economic importance and is grown in a wider area of the world. Cabbage contains 300 kcal / kg, 5-6% dry matter, 2% protein, 5-6% aqueous carbohydrates, including 2% sugar, 1.6% cellulose, as well as vitamins C, A, PP, B1, B2 vitamins and etc[5]

In order to increase the productivity, quality and soil fertility of the cabbage plant in terms of food security in the Ganja-Gazakh region, which occupies one of the crucial places in the production of vegetables in the country, determining the effective norms and ratios of mineral fertilizers on the manure fon, studying the balance of nutrients, increasing the coefficient of plant use from soil and fertilizers, which is important to solve in modern times is one of the current problems.

**Object and predmet of research.** Cabbage plant was taken as the object of research. Study of the effect of carbonate washed mountain-black soils, organic and mineral fertilizers on the productivity and quality of cabbage.

**Goals and objectives of the research.** The main purpose of the research is to determine effective mineral fertilizer norms on the manure fon, which provides high and quality yield of white cabbage in the irrigated mountain-black soils in the conditions of Gadabay district in Ganja-Gazakh region.

[4] Литвинов,С .С.,Лудилов, В.А. Состояние селекции и семеноводства овощных культур и задачи науки // Сб. научн. тр. по овощеводству и бахчеводству к 75-летию ВНИИО, Москва: - 2006. т.1, - с. 17-24.

[5] Mammadova, M.M. Vegetable farming. / M.M. Mammadova, M.M. Hasanova - Baku: Teacher publishing house, - 2018. -480 p..

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

-Study of agrochemical and physico-chemical properties of experimental fields;

-Study of soil-climatic conditions of the area in the years, which conducted research;

-Study of the effect of fertilizers on the dynamics of nutrients in the soil and plants on the growing phases of cabbage;

-Study of the effect of fertilizers on the growth and development, productivity and quality of cabbage;

-Study of the effect of fertilizers on the uptake of nitrogen, phosphorus and potassium by the cabbage plant;

-Determination to use ratio of cabbage plant from soil and fertilizer;

-Determination of economic balance and economic efficiency of nutrients.

**Research methods.** Field experiments were carried out in the irrigated mountain-black soils of Morukhlu village of Gadabay district on the share land belonging to the resident of the village I.Y. Hajiyev with the "Azerbaijan" variety of cabbage in 2015-2017. The "Azerbaijan" variety of cabbage is medium-sized. It takes 98-102 days from mass germination of this variety to individual maturation. It was included in the State Register in 1981. The authors of the variety are R.C.Alasgarzade and Z.A.Aliyeva, employees of the Azerbaijan SR Institute of Vegetable Growing.

The experiment is based on the following scheme: 1. Control (without fertilizer); 2.Manure 20 t/ha (fon); 3.Fon+$N_{60}P_{90}K_{60}$; 4.Fon+$N_{90}P_{120}K_{90}$; 5.Fon+$N_{120}P_{150}K_{120}$. Nitrogen-ammonium nitrate 34.7%, phosphorus-simple superphosphate 18.7% and potassium-potassium sulfate 46%, and manure in the semi-decomposed state (nitrogen 0.5%, phosphorus 0.25%, potassium 0.6%) were used. 100% of manure, 80% of phosphorus and potassium are fed under plowing, and the remaining 20% are fed to the rows at the beginning of the start. Nitrogen was given twice - 50% at the same time as sowing, and 50% in the form of feed at the beginning of the start.

Experimental studies were conducted in field conditions, analysis of soil and plant samples, using methods available in the laboratory. The accuracy of the results obtained from the study was carried out by mathematical calculations.

In soil samples taken: pH (in water suspension) in potentiometer, general humus I.V.Tyurin, granulometric composition N.A.Kachinski, absorbed bases K.K.Hedroys, absorbed ammonia nitrogen T.LIvanovskaya, nitrate nitrogen Grandval-Lyaju, total nitrogen, total phosphorus K.E.Ginsburg and G.Sheglov, mobile phosphorus by the method of B.P. Machigin, general potassium according to the Smit, exchangeable potassium by the method of P.B.Protasov in the photometer, the bulk density and total porosity of the soil were determined by V.S.Zaytsev's simplified calculation in the modification of N.A.Kachinski, the soil moisture by drying in a thermostat at a temperature of 105°C.

In plant samples: absolute dry matter in a thermostat at a temperature of 105 °C, total nitrogen, phosphorus and potassium according to K.E.Ginsburg, G.M.Sheglova and E.V.Vulfus, common sugar in cabbage commodity Bertrand, ascorbic acid (Vitamin C) according to I.K.Murri, acid by titration with alkali according to acid-malic, nitrates were determined on an ionometer (EV-74), protein, ash by commonly accepted methods. The results of field experiments, calculation of produ-ctivity, accuracy of the experiment, mathematical analysis of correlative relations, economic efficiency were calculated by the method of, B.A.Dospekhov[6], V.N. Peregudov[7] P.N.Konsantinov[8] and N.N. Baranov[9] .

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[6]Dospehov B.A. Field experiment methodology. / B.A. Armor - M.: Agro promizdat, -1985. - 351s.

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

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

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

mplementation of experiments, results of field experiments, calculation of productivity, accuracy of the experiment, mathematical analysis of correlative relations, economic efficiency by the methods of B.A.Dospekhov, V.N.Peregudov, P.N.Konstantinov and N.N.Baranov has been replaced.

The main provisions of the defense:

-changes in the nutrient regime of the soil, total nitrogen, phosphorus and potassium in the surface mass according to the growing phases of the cabbage plant;

-economic indicators, productivity and quality of cabbage plant;

-economic balance of nutrients, absorbed nutrients by the product and used ratio from fertilizers;

- the level of rentabelity of fertilizer application.

Scientific novelty of the research. For the first time in the research, effective norms of mineral fertilizers on the manure fon were determined under cabbage plant in Ganja-Gazakh region in Gadabay district, productivity and product quality indicators were increased, ecologically safe cabbage product was obtained, plant soil and fertilizer use rate was increased, economic balance of nutrients was calculated and soil fertility indicators has increased.

Theoretical and practical significance of the research. It was determined that the application of organic and mineral fertilizers under cabbage had a positive effect on productivity and product quality. High productivity was 430.0 s/ha at the norm of manure 20 t/ha+$N_{90}P_{120}K_{90}$ on average for 3 years, the growth was 191.0 s/ha or 80.0% compared to the control (fertilizer-free) variant. At the same time, the quality of the product was significantly higher than the control variant, and the amount of nitrates was below the allowable limit (500 mg/kg in wet weight).

Approbation and application of the work. İt results of the research were presented at the all Republic scientific-practical conference on "New infrastructure of the agricultural sector in Azerbaijan: agroparks, the necessity of their creation and their role in innovative development" at Azerbaijan State Agrarian University

(Ganja, May 06-07, 2015), at the Institute of Soil Science and Agrochemistry of ANAS. At the Republican scientific conference "Actual Problems of Soil Science" dedicated to Aliyev's 110th anniversary (Baku, December 21-22, 2017), at the international scientific-practical conference in the Russian Federation (Kemerovo, September 28, 2019), the Department of Soil Science and it was reported at the agrochemistry department, at the scientific council of the Faculty of Agronomy (2015-2020), at the scientific-methodical seminar of the Institute of Soil Science and Agrochemistry of ANAS (March 10, 2022).

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

**The total volume of the dissertation with characters, indicating the volume of the dissertation.** In the content of the dissertation, the introduction is 5 pages with 8846 marks, the first chapter is 7 pages with 13208 marks, the second chapter is 11 pages with 21279 marks, the third chapter is 40 pages with 84709 marks, the fourth chapter is 23 pages with 39383 marks, the fifth chapter is 46 pages with 79431 marks, results It consists of 3 pages and 4916 signs, recommendations for production 1 page and 1422 signs, and the list of 208 used literature consists of 22 pages and 38848 signs. The general text part of the dissertation (excluding pictures, tables, graphs, results, business recommendations, appendices and the list of references) consists of 113 pages of computer writing and contains 237,520 characters. The total volume of the dissertation is 207 pages and 321695 characters.

**Personal participation of the author:** The author set the task in the dissertation, conducted the experiment in accordance with the scheme, prepared annual reports, calculated productivity, analyzed and summarized the obtained results, as well as compiled articles.

**Publication.** The main content of the dissertation is reflected in 10 articles and theses published in scientific publications of our republic and the Russian Federation. Of these, 2 articles and 1 thesis were published in foreign publishing houses.

## MAIN CONTENT OF THE WORK

**In the introduction of the dissertation** the actuality and elaboration degree of the topic, object and predmet of research, goals and objectives of research, object and methods of research, main provisions defended, scientific novelty of research, theoretical and practical significance, approbation and application, scientific and practical significance, structure, shown in a concise and reasoned form.

## CHAPTER I. SCIENTIFIC THEORETICAL ANALYSIS OF THE PROBLEM

This chapter talks about the teaching situation of the research work. References to the scientific works of foreign scientists and researchers of the country have been reflected in different years.

Our research shows that cabbage is an important food plant among vegetable crops. There fore, from the point of view of food safety, in the conditions of the Ganja-Gazakh economic region, in order to increase the productivity and quality of cabbage, determining effective mineral fertilizer norms against the background of manure is one of the most important current issues.

According to the information provided by Professor Z.R. Movsumov[10], the agricultural plants cultivated in our country extract a certain amount of nutrients from the soil with their main and secondary fruits[10].

İn the studies carried out with cabbage plant in the Guba-Khachmaz region, the application of mineral and organic fertilizers to the plant, the replacement of a part of the nutrients in the mineral form with the equivalent amount of nutrients in the organic form caused an increase in the absorption coefficient of nitrogen, phosphorus and potassium from the fertilizer.

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[10] Movsumov, Z.R. Fertility of Azerbaijani soils, use of mineral fertilizers and productivity level of plants //- Baku: ANAS Soil Science and Agrochemistry, - 2011. v.20, No.1, - p.444-448 .

İn the version of mineral and organic fertilizers $N_{175}P_{105}K_{210}$, and in the version of organic fertilizers equivalent to that standard, the amount of manure is 35 t/ha, the absorption coefficient of nitrogen is 35.5-36 If it was 4%, phosphorus 15.8-19.4%, potassium 19.9-24.0%, in those options, mineral nutrients are partially replaced with mineral nutrients in organic form and fully organic form. when replaced with $N_{75}P_{45}K_{90}$+20 t/ha, the reduction coefficient of nitrogen, phosphorus and potassium is 98.6%; It was 57.3% and 60.25%[11].

## CHAPTER II. ABOUT THE IMPORTANCE, ORIGIN AND HISTORICAL AREAL, BOTANICAL DESCRIPTION OF THE CABBAGE

Among the various species belonging to the genus cabbage *(Brassica L.)*, there are several species that are considered vegetable plants: cabbage (white cabbage and red cabbage varieties), savoy cabbage, Brussels sprouts, stone cabbage, Beijing cabbage, cauliflower and Chinese cauliflower. In addition to the types used for vegetables, there are also fodder and ornamental cabbages.

The first classification of cabbage was given by Linney. Later, Pascal and Miller gave the latest classification to the Soviet scientist T.V. Lizgunov. Currently, the most widely used classification given by T.V. Lizgunov. According to this classification, cabbage belongs to the family Cabbage (*Brassicaceae Juss*), the genus Cabbage (*Brassica L.)* and has the following cultural species: leaf cabbage (*Brassica subspontonea; Lzg.*), stone cabbage (*Brassica Caularapa, Pasg.*). savoy cabbage (*Brassica Sabauda; Lizg.*), head cabbage (*Brassica capitata*), cauliflower (*Brassica gauliflora; Mill.*), Chinese cabbage (*Brassica pecinensis*), Chinese cabbage (*Brassica chinensis*)[12].

The best predecessors for cabbage in the rotation system are alfalfa, legumes, cucumbers, melons, onions, etc. can be selected.

[11] Jafarov, V.I. Optimizing fertilizer rates and balance of nutrients under cabbage plants in irrigated grass-brown soils of Guba-Khachmaz region: / Ph.D. in agricultural sciences diss. abstract. / - Baku, - 2011. - 19 p.

[12] Mammadova, M.M. Vegetable farming. / M.M. Mammadova, M.M. Hasanova - Baku: Teacher publishing house, - 2018. -480 p.

The main plowing for early spring sowing should be in November, after intermediate sowing in May-June, in April-June.

## CHAPTER III. SOIL CLIMATE CONDITION OF GADABAY DISTRICT AND AGROCHEMICAL CHARACTERISTICS OF THE EXPERIMENTAL FIELD

Gadabay region is located in the west of the Republic of Azerbaijan, in the north-eastern part of the Lesser Caucasus Mountains. The relief of the region is mainly mountainous. From the geomorphological point of view, the upper part of this range is considered highly eroded glacial mountains. The relief of the area is very indented, with its dense division by a dense network of rivers and valleys, deep ravines, depressions, very high mountains, sloping and very steep slopes. Deep river valleys are widespread in the district. The climate of Gadabay region belongs to the types of temperate-hot climate with dry summers and cold climates with dry winters.

The following landscape zones and land zones are allocated in Dashkasan-Gadabay cadastral region: 1.Alpine and subalpine meadow and meadow steppes; grassy mountain-meadow; grassy peat mountain-meadow; dark mountain-meadow; forest-meadow mountain-meadow steppe; 2.Soils of mesophilic forests: typical brown mountain-forest; steppe brown mountain-forest; washed grassy carbonate mountain-forest. 3. Xerophilous forest, shrubs and steppes: washed brown mountain-forest; typical brown mountain-forest; carbonate brown mountain-forest soils[13].

Before starting the research, samples were taken from the soil of the area where we will conduct the experiment in Morukhlu village of Gadabay district, soil samples were taken at different

[13] Babayeva, A.D. Ecological-economic assessment and monitoring of the North-Western slopes of the Lesser Caucasus / A.D.Babayeva. - Baku: Elm, - 2010. – 356p.

depths by convert method and archeochemical, physical-chemical analysis was carried out.

According to the results of agrochemical analysis of soil samples, the pH in the aqueous solution was 6.9 in the 0-20 cm layer, and 7.9 in the 80-100 cm layer, gradually increasing to the lower layers. Humus, nitrogen, phosphorus and potassium in a layer of 0-20 cm is 4.15; 0.33; 0.23; 2.85%. However, it gradually decreased to the lower layers, in the 80-100 cm layer, was respectively 0.98; 0.10; 0.09; 1.43%. Respectively absorbed ammonia nitrogen fluctuated between 28.5-8.7 mg/kg, nitrate nitrogen 12.5-3.2 mg/kg, mobile phosphorus 26.5-10.5 mg/kg, and exchangeable potassium 350.6-151.7 mg/kg. The total absorbed bases were 35.8 mg/eq in the 0-20 cm layer and 25.0 mg/eq in the 80-100 cm layer. The amount of physical clay along the profile is 72.8-64.2%, the amount of sludge is 36.2-30.5%, the moisture content is 20.5% in the 0.5 cm layer, the volume weight is 1.24 g / $cm^3$, the total porosity is 54,8%, in the layer of 80-100 cm it is 10.5%, 1.33 g/$cm^3$, 47.6%, respectively. These soils are considered to be medium and heavy clayey in granulometric composition[14]

Thus, our agrochemical analysis of mountain-black soils shows that according to the gradation accepted in our country these soils (for vegetable crops) are poorly provided with phosphorus and potassium[15].

There fore, the application of fertilizers is very important to maintain soil fertility in these lands, to obtain high and quality products from cabbage.

[14]Hacıyeva, G.İ. Basic agrochemical parameters of the mountain black soils spread in the northwest of the Little Qafqazın // - Ganja section: Azərbaycan Milli Elmlar Academy.-2016.-№ (66),- p.107-111.

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

## CHAPTER IV. EFFECTS OF FERTILIZERS ON THE CHANGE OF NUTRIENT REGIME IN THE SOIL AND ACCUMULATION OF NİTROGEN, PHOSPHORUS AND POTASSİUM IN THE CABBAGE

The effect of mineral fertilizers on the fon of manure in mountain-black soils under cabbage, on the change of soil nutrient regime was studied. Soil samples were taken from two different depths (0-20 and 20-40 cm) in three phases of 9-10 leaf formation, pre-emergence and ripening phases. Nitrogen, phosphorus and potassium compounds easily absorbed by plants were analyzed in the taken soil samples. The maximum amount of nutrients was observed in the phase of 9-10 leaf formation, and the minimum amount was observed in the phase of full maturity at the end of vegetation.

Thus, in the control (fertilizer-free) variant, absorbed ammonia nitrogen and nitrate nitrogen absorbed in the phase of 9-10 leaf formation are 19.8-20.5 and 9.5-10.5 mg/kg in a layer of 0-20 cm, mobile phosphorus 19, 3-20.8 mg/kg, exchangeable potassium 322.5-330.5 mg/kg, in layers of 20-40 cm respectively 15.3-16.8 and 7.8-8.3; 15.5-16.3 and 265.8-270.6 mg/kg and at the end of the vegetation, the amount decreased due to the absorption of nutrients by the plant, in the 0-20 cm layer absorbed ammonia nitrogen and nitrate nitrogen 13.8-15,5 and 6.1-6.5 mg/kg, mobile phosphorus 12.8-13.5 mg/kg, exchangeable potassium 773.5-280.7 mg/kg, 20-40 cm layer respectively 11,5-12.5 and 4.3-4.5; 10.3-10.8 and 215.6-220.5 mg/kg. As a result of the application of organic and mineral fertilizers, the amount of nutrients studied in the soil has increased significantly compared to the control (without fertilizer) variant. Ammonia nitrogen and nitrate nitrogen absorbed in the phase of formation of 9-10 leaves in the 20 t/ha (fon) variant of manure in the layer of 0-20 cm 24.5-25.6 and 12.5-12.8 mg/kg, mobile phosphorus 23.3-24.1 mg/kg, exchangeable potassium 335.7-338.6 mg/kg, in layers of 20-40 cm, respectively 19.8-20.3 and 10.2-10.5; 18.8-19.3 and 273.6-278.5 mg/kg, and at the end of the vegetation, the absorbed ammonia nitrogen and nitrate nitrogen decreased by 15.5-

16.5 and 7.2-7.5 mg/kg, in a layer of 0-20 cm, mobile phosphorus 14.8-15.3 mg/kg, exchangeable potassium 280.7-286.6 mg/kg, in the layer of 20-40 cm, respectively 12.8-13.6 and 5.0-5.4; 11.7-12.2 and 215.6-227.6 mg/kg, in the high norm of mineral fertilizers together with the fon (manure 20 t / ha) in $N_{120}P_{150}K_{120}$ in 0-20 cm layer respectively 33.7-35,3 and 16.8-18.3; 31.5-32.8 and 351.3-356.7 mg/kg, 20-40 cm layer 30.5-31.8 and 14.2-15.8; 28.7-29.6 and 295.5-298.3 mg/kg, and at the end of vegetation in layers of 0-20 cm, respectively 21.5-22.7 and 10.3-10.8; 20.1-20.8 and 290.5-295.6 mg/kg and in the 20-40 cm layer 18.3-19.6 and 8.3-8.8; 17.2-18.5 and 225.7-230.1 mg/kg.

At the end of the vegetation, absorbed ammonia nitrogen, which is absorbed by two layers on average, is 2.1-14.5 mg/kg, nitrate nitrogen is 1.4-9.0 mg/kg, mobile phosphorus is 2.2-16.2 mg/kg and exchangeable potassium 6.1-27.1 mg/kg, which is higher than the control-fertilizer-free variant, which in turn has a significant impact on high yields of cabbage[16].

Mathematical-statistical calculations of application of fertilizers under cabbage show that there is a correlation between the yield (t / ha) and the amount of nutrients in the soil (mg/kg), and this relationship is hesitated between $r = + 0.930 \pm 0.060$ and $r = + 0.940 \pm 0.050$ at the end of the growing season.

The effect of the accumulation of total NPK on the head of cabbage in the variants we applied different organic mineral fertilizer norms was also studied. As a result of the analysis, the total amount of NPK in the head of the cabbage in each of the variants was less at the beginning of the vegetation, and significantly increased towards the end of the vegetation. Thus, in the control (fertilizer-free) variant, the total nitrogen content was 2.15% in the 9-10 leaf formation phase, 2.65% at the beginning of the flowering period, and 2.95% in the full ripening phase. In 2017, the nitrogen change under this

[16] Hajiyeva, G.I. The effect of fertilizers on the accumulation of total nitrogen, phosphorus and potassium in cabbage in mountain black soils // Ganja: Scientific works of ADAU, Ganja, 2018, No. 4, p. 61-64

variant was 2.21% at the beginning of the vegetation period, i.e during the 9-10 leaf formation period, but increased to 2.68-2.98% at the beginning of the flowering period and during the full ripening period, respectively. The amount of phosphorus and potassium in this variant is 0.53-0.55% and 1.83-1.88% for different years (during the period of 9-10 leaf formation), 0.64-0.66; 1.98-2.03%, at the beginning of the flowering period and at the end of the vegetation (ie during full maturity) it varied between 0.98-1.02 and 3.01-3.16%, respectively.

As a result of the use of organic and mineral fertilizers, the amount of total NPK in cabbage has increased significantly compared to the control (without fertilizer) variant. Total nitrogen, phosphorus and potassium is 2.65-2.71%; 0.60-0.63% and 1.95-2.01% in the phase of 9-10 leaf formation in 20 t/ha (fon) variant of manure in 2015-2016; total nitrogen at the beginning of the headache 2.96-3.35%, total phosphorus and potassium 0.77-0.79; 2.27-2.32%, total nitrogen in the full ripening phase was 3.15-3.17%, total phosphorus was 1.05-1.15%, and total potassium was 3.25-3.31%. In other variants, where we apply organic and mineral fertilizers (manure 20 t/ha), the total nitrogen, phosphorus and potassium accumulation in the plant is even higher. The highest accumulation was observed in the Fon + $N_{90}P_{120}K_{90}$ norm. Thus, the total nitrogen in the phase of formation of 9-10 leaves on this variant was 3.09-3.71%, total phosphorus and potassium were 0.95-0.98; 3.01-3.11%, respectively. During the full ripening period, the accumulation of total nitrogen, phosphorus and potassium in this variant increased significantly, the accumulation of total nitrogen in different years was 3.41-3.50%, total phosphorus 2.15-2.24%, and total potassium 3.85-3. 86%.

At the end of the growing season, the total nitrogen in the head of the cabbage increased by 0.20-0.46%, phosphorus by 0.07-1.17% and potassium by 0.24-0.85% compared to the Control non-fertilizer variant. The highest amount of total NPK was observed in 20 t/ha manure (fon)+$N_{90}P_{120}K_{90}$ variant. Mathematical-statistical calculations show that there is a high correlation between cabbage product

(t/ha) and total nitrogen, phosphorus, potassium (%) in cabbage, and the relationship was r = + 0.950 ± 0.046 and r = + 0.980 ± 0.020.

## CHAPTER V. EFFECTS OF FERTILIZERS ON CABBAGE HEİGHT AND GROWING, PRODUCTIVITY, QUALITY, NUTRIENT BALANCE AND ECONOMIC EFFICIENCY

The effect of manure and mineral fertilizers on the height and growing of the cabbage plant has also been studied in our research. In the control (without fertilizer) variant, the weight of one cabbage in the full ripening phase is 1.38-1.45 kg, diameter 16.2-16.5 cm, height 16.3-16.8 cm and diameter of the leaf axil 17.6-18,1 cm, in the variant of manure 20 t/ha (fon) significantly increased, respectively 1.69-1.74; 18.5-19.3; 17.5-18.1 and 20.7-21.4 cm.

As a result of the combined use of organic and mineral fertilizers, the height and growing of cabbage has increased. Thus, in the variant of manure 20 t/ha (fon) + $N_{60}P_{90}K_{60}$, the weight of one cabbage is 1.95-2.01 kg, diameter 20.8-21.3 cm, height 20.1-20.8 cm and diameter of the leaf axil. 25.1-25.7 cm and the highest values are observed in the norm of mineral fertilizers $N_{90}P_{120}K_{90}$ together with the background (manure 20 t/ha), the weight of one cabbage is 2.52-2.73 kg, diameter 24.6-25.0 cm, height 22.5-23.0 cm and diameter of the leaf axil 29.2-30.0. As the mineral fertilizer norms increased with the fon (fon+$N_{120}P_{150}K_{120}$), the studied indicators decreased compared to fon + $N_{90}P_{120}K_{90}$.

At the end of the growing season, the weight of one cabbage is 0.24-1.28 kg, diameter is 2.0-8.5 cm, height is 1.0-6.2 cm and the diameter of the leaf axis is 2.6-11.9 cm, increased compared to the control-non-fertilizer variant. The highest amount of the studied indicators was observed in manure 20 t/ha (fon) + $N_{90}P_{120}K_{90}$ variant.

There is a correlation between the yield of cabbage and the economically important indicators of cabbage. Correlation coefficient between cabbage yield (t/ha) and weight of one cabbage (kg) r = + 0.910 ± 0.080 and r = + 0.920 ± 0.070; r = + 0.990 ± 0.010 and r = + 0.990 ± 0.010 between the cabbage product (t/ha) and the

diameter (cm) of one head of cabbage; r = + 0.990 ± 0.010 and r = + 0.980 ± 0.020 between cabbage yield (t/ha) and cabbage height (cm); r = + 0.990 ± 0.010 and r = + 0.990 ± 0.010 between the cabbage yield (t/ha) and the diameter (cm) of the leaf axis of one cabbage[17].

The average productivity of cabbage for 3 years is 239.3 s/ha in the control (non-fertilizer) variant, 297.7 s/ha in the 20 t/ha manure (fon) variant, in comparison with the control is 58.4 s /ha or 24.0%.

Growing rates of mineral fertilizers in the fon of manure significantly increased the yield of cabbage compared to the control and variant of 20 t/ha manure (fon). Thus, the productivity in the fon + $N_{60}P_{90}K_{60}$ variant was 359.0 s/ha, the increase compared to the control was 119.7 s/ha or 50.0 %, and the highest productivity was observed in the fon+ $N_{90}P_{120}K_{90}$ variant and was 430.3; 191.0 s/ha or 80.0%. As the mineral fertilizer norms increase with the fon ($N_{120}P_{150}K_{120}$), the productivity decreases to 397.0; 157.7 s/ha or 66.0%. Compared to the 20 t/ha manure (fon) variant, the cabbage yield per kilogram of NPK was 51.0; 63.0 and 33.0, respectively. Mathematical calculation of the effectiveness of the application of mineral fertilizers under the cabbage plant against the fon of manure proves the accuracy of the experiment. Thus, the increase in variants was more than three times higher than E, s/ha, E = 4.20-8.00 s /ha, and the accuracy of the experiment was P=1.21-2.37%. Mathematical calculations show that there is a correlation between cabbage yield (t/ha) and vegetative mass (s/ha) between r = + 0.992 ± 0.008 and r = + 0.964 ± 0.031.

As a result of our research, it was found that the application of fertilizers under the cabbage plant, along with productivity, significantly affected the amount of dry matter, vitamin C, total sugar, protein, cellulose, ash and nitrate from the biochemical parameters of cabbage. Biochemical parameters of cabbage in the controlled (non-

[17]Hajiyeva, G.I. The effect of fertilizers on the growth and development of cabbage in the Ganja-Kazakh region // - Ganja branch, Azerbaijan National Academy of Sciences, - 2019. №2 (76), -p.39-43.

fertilized) variant of dry matter is 8.1-8.8%, vitamin C 30.0-31.1 mg/%, total sugar 3.0-3.2%, protein 1.26-1.31%, cellulose 1,30-1,33%, ash 0,53-0,56% and nitrates 101,5-104,2 mg/kg, in the 20 t/ha manure (fon) variant increased dry matter is 8.8-9.1%, vitamin C 31.1-31.8 mg/%, total sugar 3.1-3.4%, protein 1.33-1.35%, cellulose 1.45-1.53%, ash 0, 60-0.63% of venitrates were 125.2-130.3 mg/kg.

The application of manure fon mineral fertilizers significantly increases the biochemical performance of cabbage compared to the control (without fertilizer) and manure 20 t/ha (fon) variant. Thus, in the fon + $N_{60}P_{90}K_{60}$ variant dry matter 9.3-9.7%, vitamin C 32.4-33.2 mg/%, total sugar 3.4-3.9%, protein 1.36-1.40%, cellulose 1.87-1.93%, ash 0.65-0.68% and nitrates 177.1-187.8 mg/kg, and the highest values were observed in the fon + $N_{90}P_{120}K_{90}$ variant and respectively 10,1-10.3%; 36.7-37.8mq/%; 4.1-4.4%; 1.42-1.45%; 2.29-2.37%; 0.70-0.75% and 203.5-210.7 mg/kg. As the mineral fertilizer rates increased ($N_{120}P_{150}K_{120}$) with the fon, the biochemical parameters of cabbage decreased. Thus, in the fifth variant, the content of dry matter in cabbage during 2015-2017 was 9.8-10.4% (average 10.1% over 3 years), vitamin C 34.5-35.3 mg /%, total sugar 3, 9-4.2%, protein 1.38-1.42%, cellulose 2.08-2.15%, ash 0.66-0.70% and nitrates 236.2-245.6 mg/kg.

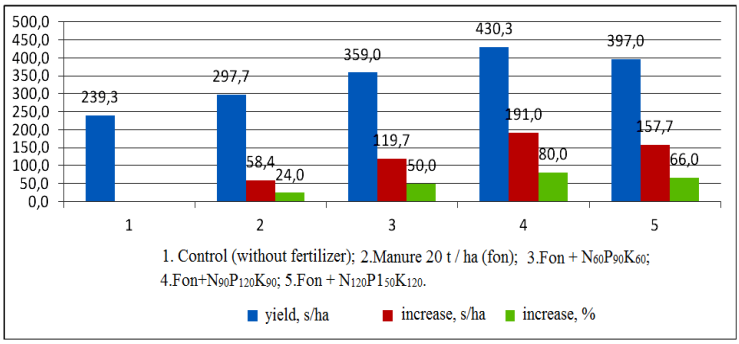


**Figure 1. Effect of fertilizers on cabbage yield (average 3 years)**

Due to the effect of fertilizers, the dry matter in cabbage (according to the average of 3 years) compared to the control

(without fertilizer) variant is 0.5-1.7%, vitamin C 1.2-7.0 mg/%, total sugar 0.14-1.14%, protein increased by 0.05-0.14%, cellulose by 0.16-1.01%, ash by 0.07-0.18%, nitrate nitrogen by 24.64-138 mg/kg. The highest values were observed in the variant of manure 20 t/ha (fon) + $N_{90}P_{120}K_{90}$ (according to the average values of 3 years, dry matter 10.2%, vitamin C 37.2 mg/%, total sugar 4.2%, protein 1.43%, cellulose (2.33%) and the amount of nitrates was below the allowable level (208.6 mg/kg). It should be noted that the allowable limit of nitrates in cabbage is 500 mg/kg in wet weight. Mathemati-cal analysis of the application of fertilizers under cabbage between the product and biochemical indicators shows that the correlation coefficient of these characteristics varies regularly over the years[18].

In our research, we also determined the amount of nutrients extracted by commercial cabbage products and vegetative mass. The amount of nutrients extracted from the soil varies depending on the productivity, dry matter and its chemical composition, relative to the control (fertilizer-free) variant. Thus, in the control variant, extracted nitrogen from soil was 60.5-64.7 kg/ha, phosphorus 20.09-22.10 kg/ha, potassium 61.7-68.6 kg/ha, in the manure 20 ton/ha (fon) variant were removed from the soil with marketable cabbage products, nitrogen carried by the product was 84.7-86.8 kg/ha, phosphorus and potassium were 28.2-31.5; 87.4-90.7 kg/ha, respectively.

When mineral fertilizers are applied together with manure, the amount of nitrogen, phosphorus and potassium extracted from the soil by the commercial product of cabbage increases significantly depending on the dry matter and productivity. Thus, in the fon + $N_{60}P_{90}K_{60}$, extracted nitrogen is 113.5-118.3 kg/ha, phosphorus is 40.3-42.6 kg/ha and potassium is 127.1-132.6 kg/ha, a high amount was observed in the fon + $N_{90}P_{120}K_{90}$ variant. According to this variant, the extraction of nitrogen, phosphorus and potassium by commercial cabbage is 144.9-159.9 kg/ha for nitrogen, 91.4-102.4 kg/ha for phosphorus, and 164.0-175.9 kg for

[18] Hajiyeva, G.I. Effect of organic and inorganic fertilizers on nutrient balance and efficiency of growing cabbage // - Russia: Elmi 136. journal, ISSN 2414-2948 Volume 5, Number 11. Bulletin of Science and Practice, -2019, p.212. -217.

potassium. The correl-ation between the commodity yield of cabbage (t/ha) and the extraction of nutrients (kg / ha) was r = + 0.967 ± 0.027 and r = + 0.993 ± 0.007.

Fertilizers also affected the amount of nutrients taken from the soil by the vegetative mass of the cabbage plant. The amount of nutrients carried varies depending on the amount of vegetative mass and dry matter.

The lowest amount of nutrients extracted by the vegetative mass of cabbage was observed in the control (without fertilizer) variant, and the highest amount was observed as a result of the application of fertilizers. Thus, the extracted nitrogen in the control variant is 11.4-11.9; phosphorus 2.6-3.8; potassium 7.4-7.8 kg/ha, in the manure 20 t/ha (fon) variant these indicators were increase. In the manure 20 t/ha (fon) variant, cabbage from each hectare extracted 13.6-15.6 kg/ha of nitrogen, 4.5-5.3 kg/ha of phosphorus, 9.6-10.3 kg/ha of potassium through its vegetative mass.

The application of mineral fertilizers in combination with manure at different rates significantly increased the amount of nutrients taken from the soil by vegetative mass compared to the control and 20 t/ha manure variant. Thus, in the fon + $N_{60}P_{90}K_{60}$ variant extracted nitrogen is 22.7-26.6 kg/ha, phosphorus is 7.8-9.1 kg/ha and potassium is 19.1-21.7 kg/ha. The highest amount was observed in the fon + $N_{90}P_{120}K_{90}$ variant and respectively 20.1-21.3; 7.0-7.2; 18.2-19.3 kg/ha, in the high norm of mineral fertilizers together with the fon (fon+$N_{120}P_{150}K_{120}$) extraction of nitrogen was 18.8-22.9 kg/ha for different years, extraction of phosphorus was 6.7-8.3 kg/ha, and extraction of potassium was 14.6-17.0 kg/ha.

In 2015, compared to the control variant with commercial cabbage, nitrogen extracted from the soil was 24.2-84.4 kg/ha, phosphorus 8.11-71.3 kg/ha and potassium 25.7-102.3 kg/ha, vegetative by mass was 2.2-11.3; 0.7-4 kg/ha and 2.2-14.3 kg/ha, respectively. According to the results of analytical samples taken from the head and vegetative mass of cabbage in 2016, on the year compared to the control variant 22.1-95.2 kg/ha of nitrogen, 9.4-80.3 kg/ha of phosphorus, 22.1- 107 kg/ha of potassium extracted with commercial cabbage, 3.7-14.7 kg/ha of nitrogen, 2.7-6.5 kg/ha of phosphorus, 2.5-11.3 kg/ha of potassium

extracted with vegetative mass already. The highest amount of nutrients was observed in the 4th variant, where we applied the norm of mineral fertilizers $N_{90}P_{120}K_{90}$ on the fon of 20 tons of manure.

The correlation coefficient between the vegetative mass of cabbage (s/ha) and nutrient extraction (kg/ha) is r = 0.997 ± 0.003 and r = + 0.993 ± 0.007; r = 0.944 ± 0.050 and r = + 0.926 ± 0.063 between the vegetative mass of cabbage (s / ha) and dry matter (%); It was determined that r = 0.997 ± 0.003 and r = + 0.961 ± 0.036 between the commodity yield (t/ha) of cabbage and the total extracted nutrients (kg/ha) and the vegetative mass (s/ha).

The economic balance of nitrogen, phosphorus and potassium on all variants was compiled on the basis of income and expenditure of nutrients in the soil. The balance is calculated by the "difference method". In the "soil-plant" system, in the non-fertilized variant, all the elements of the balance are negative. In the control (fertilizer-free) variant for 2015-2016, 60.5-69.4 kg/ha of nitrogen, 23.8-20.09 kg/ha of phosphorus, 61.7-73.6 kg/ha of potassium extracted with commodity products of cabbage from the soil, 11.4-11.7 kg/ha of nitrogen 2.5-3.8 kg/ha of phosphorus, 7.4-7.7 kg/ha of potassium extracted with vegetative mass and the balance was negative. They were nitrogen + 1,7-6,3 kg/ha, phosphorus + 13,4-17,3 kg/ha and potassium + 19,4-23,0 with complete elimination of negative balance of nutrients of manure 20 t/ha (fon).

In different years, on the fon of manure (20 t/ha), as a result of applying different norms of mineral fertilizers under the cabbage plant, a positive balance was obtained in all variants, and nitrogen, phosphorus and potassium deficiencies in the soil were completely eliminated. Thus, the balance of nitrogen in manure 20 t/ha (fon) + $N_{60}P_{90}K_{60}$ +20.4-24.2 kg/ha, the balance of phosphorus +91.5-94.4 kg/ha and the balance of potassium +34.6-41.2 kg/ha. Fon+ $N_{90}P_{120}K_{90}$ with a positive balance of nitrogen, phosphorus and potassium, respectively +0.30-23.3; 58.1-70.8 and +16.2-24.3 kg/ha. Along with the background, a higher positive balance ($N_{120}P_{150}K_{120}$) was determined at the highest rate of mineral fertilizers. According to this variant, the balance of nitrogen in the soil was +60-83.4 kg/ha, the balance of phosphorus was +104.3-114.9 kg/ha, and the balance of potassium was +70.6-76.6 kg/ha. As can be seen from

the results, in the fon + $N_{120}P_{150}K_{120}$ variant, the amount of nitrogen, phosphorus and potassium in the soil remained more after the plant assimilated. Net income from cabbage was calculated for all costs incurred in the additional product and economic efficiency based on the market selling price of the product. Net income from one hectare of cabbage area 4212.0-8606.0 manat, cost of 1 ton of cabbage product 100.0-122.0 man, net income from fertilizers was 1378.0-4394.0 man/ha, and the level of rentability was between 24.7-51.06%. Among the highest net income variants, 20 t/ha (fon) of manure + $N_{90}P_{120}K_{90}$, 8606.0 man/ha of gross product, 100.0 man of cost of 1 ton of product, 4394.0 man/ha of net income from fertilizers and the level of rentability was 51.06%

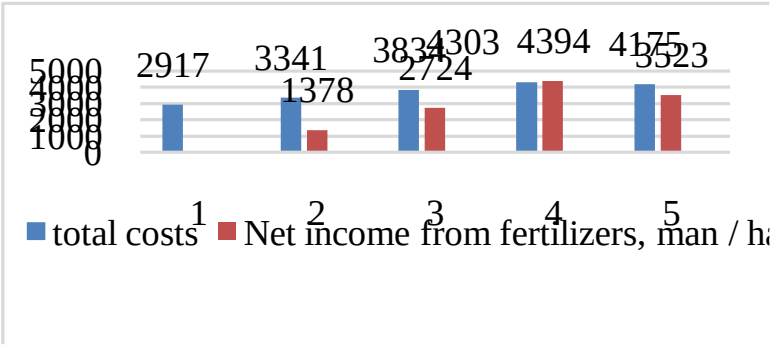


**Figure 2 The effect of fertilizers on the economic efficiency of cabbage (Average of 3 years) 1. Control (without fertilizer); 2. Manure 20 t/ha; (fon) 3. Fon + $N_{60}P_{90}K_{60}$; 4. Fon + $N_{90}P_{120}K_{90}$; 5. Fon + $N_{120}P_{150}K_{120}$**

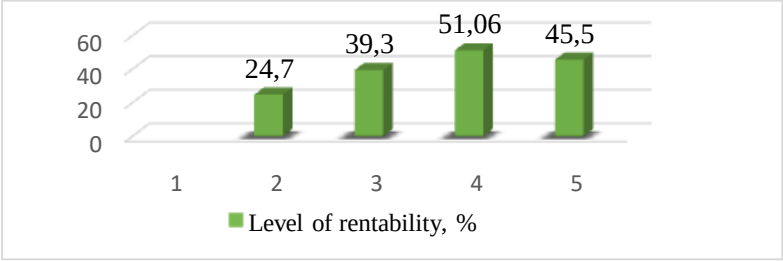


**Figure 2. The effect of fertilizers on the economic efficiency of cabbage 1. Control (without fertilizer); 2. Manure 20 t/ha (fon); 3. Fon + $N_{60}P_{90}K_{60}$;4. Fon + $N_{90}P_{120}K_{90}$; 5. Fon + $N_{120}P_{150}K_{120}$**

Thus, our economic calculations show that the combined application of organic and mineral fertilizers under cabbage in irrigated mountain-black soils has significantly increased soil fertility, productivity, quality and fertilization utilization rates, as well as economic efficiency.

In the different years of our research, we have also studied the effect of cabbage on the soil and fertilizer utilization rate when applying organic and mineral fertilizers together. Based on the results we have received, we can say that the coefficient of use of cabbage fertilizers was higher in other variants compared to the control (without fertilizers) variant in the research years. Thus, nitrogen, phosphorus, and potassium concentrations were higher in the options where organic and mineral fertilizer norms were applied. When calculating the coefficient of use of fertilizers, nitrogen 0.5%, phosphorus 0.25% and potassium 0.6% of the semi-rotted manure we applied were taken.

In the case of manure 20 t/ha (background), the fertilizer use coefficient of the plant by year is nitrogen 25.8-26.4 kg/ha, phosphorus 8.8-12.1 kg/ha, potassium 24.6-27.9 kg/ha or nitrogen 25.8-26.4%; phosphorus 17.6-24.2%; potassium was 20.5-23.2%.

Adding manure together with fertilizers has significantly increased the plant's use of fertilizers. Thus, the coefficient of use of fertilizers in manure 20 t/ha (fon) + $N_{60}P_{90}K_{60}$ and soil is 57.7-60.7 kg/ha for nitrogen element, 21.7-24.3 kg/ha for phosphorus and for potassium element it is 68.9-69.7 kg/ha. With average prices from 2 years, the expression of the coefficient of use of fertilizers for that variant of cabbage is as follows: nitrogen 36.9%, phosphorus 16.5%, potassium 38.5%. The highest amount of fertilizer utilization coefficient of the plant was observed in the manure 20 t/ha (fon) + $N_{90}P_{120}K_{90}$ variable soil. So, in 2015, the coefficient of assimilation of the nitrogen element contained in the fertilizer of cabbage was 94.8 kg/ha, and for phosphorus and potassium, it was 75.3-116.6 kg/ha, respectively. The percentage of assimilation of nitrogen element according to that option was 49.9%, phosphorus 44.3%, potassium 55.5%.

Let's pay attention to the result of the fertilizer use coefficient of cabbage in 2016 under that option: nitrogen 109.9 kg/ha or 57.8%,

phosphorus 86.8 kg/ha or 51.06% and potassium 118.6 kg/ha or was 56.5%.

As the norms of mineral fertilizers increased along with manure (fon+$N_{120}P_{150}K_{120}$), the fertilizer use coefficient of cabbage decreased to 84.4 kg/ha, phosphorus 71.6 kg/ha, potassium 94.2 kg/ha or 38.4, 32.5, 39.4% respectively.

Application of fertilizers under cabbage is significantly higher than the control option (without fertilizer). The highest indicators were observed in the version of manure 20 t/ha (fon) + $N_{90}P_{120}K_{90}$.

## Results

1. Agrochemical analysis of mountain-black soils shows that due to the gradation accepted in our republic, these soils are poorly supplied with nutrients easily absorbed by plants. That is, in the soil we studied, in the 0-20 cm layer, total nitrogen was 0.33%, total phosphorus 0.23%, and total potassium 2.85%. Also, ammonium and nitrate nitrogen in soil samples taken from 0-20 cm layer was 28.5-12.5 mg/kg, mobile phosphorus was 26.5 mg/kg, and exchangeable potassium was 350.6 mg/kg. It is very important to apply fertilizers to maintain the fertility of these soils and get a high and quality product from white cabbage.
2. Application of mineral fertilizers on the fon of manure, under the cabbage increased the amount of ammonia and nitrate nitrogen, mobile phosphorus and exchangeable potassium in the 0-40 cm layer of soil. Thus, in the control (fertilizer-free) variant, absorbed ammonia nitrogen and nitrate nitrogen in the phase of 9-10 leaf formation are 19.8-20.5 and 9.5-10.5 mg/kg in a layer of 0-20 cm, mobile phosphorus 19.3-20.8 mg/kg, exchangeable potassium 322.5-330.5 mg/kg, 15.3-16.8 and 7.8-8.3, 15.5-16.3 and 265.8-270.6 mg/kg respecti-vely, in layers of 20-40 cm and at the end of the vegetation, the amount of absorbed ammonia nitrogen and nitrate nitro-gen decreased due to the absorption of nutrients by the plant in the 0-20 cm layer 13.8-15,5 and 6.1-6.5 mg/kg, mobile phosphorus 12.8-13.5 mg/kg, exchangeable

potassium 273.5-280.7 mg/kg, 20-40 cm layer respectively 11.5-12.5 and 4.3-4.5; 10.3-10.8 and 215.6-220.5 mg/kg. As a result, the effective fertility of the soil increases, the agrochemical properties improve, which ultimately ensures a high yield of white cabbage.

3. Application of mineral fertilizers on the fon of manure increases the amount of total nitrogen, phosphorus and potassium in the main part of the cabbage in the grow stages. At the end of the growing season, the effect of fertilizers increases the total nitrogen in the head of cabbage by 0.20-0.46%, phosphorus by 0.07-1.1% and potassium by 0.24-0.82%. The highest amount of total NPK was observed in manure 20 t/ha (fon) + $N_{90}P_{120}K_{90}$.
4. Application of mineral fertilizers on the fon of manure also increases important indicators of cabbage height and growing. At the end of the vegetation, in the control (fertilizer-free) variant, the weight of one cabbage in the full ripening phase is 1.38-1.45 kg, diameter 16.2-16.5 cm, height 16.3-16.8 cm and diameter of the leaf axil 17.6-18.1 cm, the weight of cabbage is 0.24-1.28 kg, diameter is 2.0-8.5 cm, height is 1.0-6.2 cm and the diameter of the leaf axis is 2.6-11.9 cm increases relative to the control-fertilizer variant. The highest amount of the studied indicators was observed in 20 t/ha manure (fon) + $N_{90}P1_{20}K_{90}$ variant.
5. It was found that application of mineral fertilizers on the fon of manure significantly increases the yield of cabbage compared to the control variant. The highest cabbage yield was 430.3 s/ha in the fon + $N_{90}P_{120}K_{90}$ variant on average for 3 years, the increase was 191.0 s/ha or 80.0% compared to the control (239.3 s/ha).
6. Application of fertilizers under the cabbage plant, along with productivity, also increases the biochemical parameters of cabbage. Dry matter (according to the average of 3 years) 0.5-1.7%, vitamin C 1.2-7.0 mg/%, total sugar 0.14-1.14% compared to the control (fertilizer-free) variant in cabbage due to the effect of fertilizers, protein increased by 0.05-0.14%, cellulose by 0.16-1.01%, ash by 0.07-0.18%, nitrate nitrogen by 24.64-138 mg/kg.

The highest values were observed in the variant of manure 20 t/ha (fon) + $N_{90}P_{120}K_{90}$ (dry matter 10.1-10.3%, vitamin C 36.7-37.8 mg/%, total sugar 4.1-4.4%; protein 1.42-1.45%; cellulose 2.29-2.37%, ash 0.70-0.75% and nitrate content 203.5-210.7 mg/kg). The amount of nitrates was below the allowable level (500 mg/kg in wet weight).

7. In the "soil-plant" system, all elements of the balance (economy) in the non-fertilized variant are negative. As a result of the application of different norms of mineral fertilizers on the fon of manure (20 t/ha), the deficiency of nitrogen, phosphorus and potassium in the soil in all variants is completely eliminated. Balanced application of fertilizers ensures high and ecological pure production.
8. The application of fertilizers under cabbage significantly increases the coefficient of fertilizer use of the plant compared to the control variant (without fertilizers). The highest rate of plant fertilizer use was observed in 20 t/ha manure (fon)+$N_{90}P_{120}K_{90}$ variant, nitrogen 49.9-57.8%; phosphorus was 44.3-51.0% and potassium was 55.5-56.5%.
9. The economic analysis of the application of mineral fertilizers under cabbage in the fon of manure shows that the highest net income observed in the variant of manure 20 t/ha (fon) + $N_{90}P_{120}K_{90}$ net income is obtained from the gross product, 8606.0 manat/ha, cost of 1 ton of product 100.0 manat, net income from fertilizers 4394.0 manat/ha and rentability level was 51.06 %.

## Recommendations for farms

1. In order to obtain high and high-quality ecological pure products from cabbage in mountain-black soils of Ganja-Gazakh region and to maintain soil fertility, farms should be provided with fertilizers on a balance basis.
2. It was recommended to farms to fertilize cabbage under at the rate of manure 20 t/ha (fon)+$N_{90}P_{120}K_{90}$ annually.

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


1. Hajiyeva, G.I. Cabbage is an important agricultural plant //Conference material ADAU, Materials of the All-Republic scientific and practical conference, 2015,
2. Hajiyeva, G.I. The main agrochemical indicators of mountain black soils distributed in the northwest of the Lesser Caucasus // - Ganja branch: Azerbaijan National Academy of Sciences - 2016. - No. (66), - p.107-111
3. Study of the effectiveness of fertilizers under the cabbage plant // Institute of Soil Science and Agrochemistry (Materials of the Republican Scientific Conference on "Actual Problems of Soil Science"), №1, 2017, p.107.
4. Hajiyeva, G.I. Studying the effectiveness of fertilizers under cabbage plants // Institute of Soil Science and Agrochemistry ("Materials of the Republican Scientific Conference on the topic of "Actual problems of soil science"), - Baku: -2017, No.1, - p.107.
5. Hajiyeva, G.I., Aslanov, H.A. The effect of organic and mineral fertilizers on the change of the nutrient regime in the soil under the cabbage plant // - Baku: Azerbaijan Agrarian Science, - 2018. No. 4, - p.38-41.
6. Hajiyeva, G.I. The effect of fertilizers on total nitrogen, phosphorus and potassium accumulation in cabbage in mountain black soils // Ganja: scientific works of ADAU, Ganja, 2018, No. 4, p. 61-64.
7. Hajiyeva, G.I., Aslanov, H.A. Effect of fertilizers on soil nutrient removal by cabbage crop in mountain black soils. // Baku: Collection of works of the Azerbaijan Society of Soil Scientists, XV vol., - 2019, - p. 437-440.
8. Hajiyeva, G.I. The effect of fertilizers on the growth and development of cabbage in the Ganja-Kazakh region // - Ganja branch, Azerbaijan National Academy of Sciences, - 2019. №2 (76), -p.39-43.

9. Hajiyeva, G.I. Influence of fertilizers on the yield of white cabbage in the western zone of Azerbaijan //- Moscow: Agrarnaya nauka, -2019. No. 2, p. 74-76.
10. Hajiyeva, G.I. Effect of organic and inorganic fertilizers on nutrient balance and efficiency of growing cabbage // - Russia: Elmi 136. journal, ISSN 2414-2948 Volume 5, Number 11. Bulletin of Science and Practice, -2019, p.212. -217.
11. Hajiyeva, G.I. Biochemical composition of white cabbage in arid conditions of the Ganja-Gazakh massif // Scientific forum: development trends of social sciences", Kemerovo, September 28, 2019, p. 51-55.

The defense of the dissertation will be held at the meeting of the Dissertation Council FD 1.32 operating under the Ministry of Science and Education Republic of Azerbaijan İnstitute of Soil Science and Agrochemistry, on "____" _____ 2024 at ___ o'clock.

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