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ABSTRACT

Of the dissertation for the degree of Doctor of Philosophy

EFFECT OF FERTILIZER ON AGROCHEMICAL PROPERTIES OF SOILS, WHEAT PRODUCTIVITY AND GRAIN QUALITY IN GOBUSTAN AND ABSHERON REGIONS

Specialty: **3101.01-Agrochemistry**

Field of science: **Agrarian sciences**

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GENERAL DESCRIPTION OF THE RESEARCH

Relevance and degree of using of the topic: According to the Food and Agriculture Organization of the United Nations (FAO), approximately 811 million people in the world do not have enough to eat on a daily basis. At the moment, when the world's population is living in hunger and poverty, providing the population with food products is one of the socio-economic problems of great importance for the state and its solution.

Correct and timely application of agro-technical measures allows to increase the volume of bread and durum wheat production for food supply without expanding the cultivated areas. It also eliminates dependence on imports and strengthens the potential of local seeds. In recent years, the increasing strategic importance of wheat in the world market has led to a number of problems, such as the development of a high-quality product. Therefore, all research in agriculture should be focused on solving this difficult problem.

The diversity of soil and climate conditions of our republic requires cultivation technology suitable for each region and variety. Taking these into account, we conducted research on open mountain grey-brown (chestnut) soils of Mountain Shirvan region, partially supplied with moisture, and irrigated brown-grey soils of Absheron region. For the first time in the study, which examines the impact of diverse standards and proportions of fertilizers on the soil's agrochemical properties, wheat productivity and grain quality, the significance of our work is covered by the "Gobustan" bread wheat variety.

The purpose and tasks of the research: The main purpose of the conducted research is to determine the norms and proportions of organic and mineral fertilizers in the open mountain grey-brown (chestnut) soils of the Gobustan RES, partially supplied with moisture, and the irrigated grey-brown soils of the Absheron AEF, in the ripening of the "Gobustan" bread wheat variety. It is to study the influence of the plant on the intensity of development depending on its stages, to determine the economically efficient complex

cultivation technology for farms by determining the fertilizer norms with high-
quality grain yield.

In order to achieve the goal in the research work, the following main tasks have been identified and set:

1. Study of the soil-climate conditions in the light grey-brown mountain (chestnut) and grey-brown soils;
2. Determination of agrochemical characteristics of the researched areas;
3. Studying the influence of rates and ratios of organic and mineral fertilizers under the wheat crop on the amount of mobile phosphorus and absorbable potassium in the soil, depending on the development stages of the crop;
4. Determining the amount of accumulation of above-ground dry biomass product of "Gobustan" bread wheat variety during different vegetation period, depending on the soil-climatic conditions, norms and rates of fertilizers;
5. Studying the influence of the soil-climatic conditions, norms and fertilizer rates on the nitrogen absorption depending on the development stages of the bread wheat variety "Gobustan";
6. Determining the productivity of the variety, the quality of the product, the protein yield per hectare depending on the soil and climate conditions, the rates and application of fertilizers;
7. Determining the balance of nitrogen in different soil-climate conditions depending on fertilizer norms and ratios;
8. Studying the impact of soil-climate conditions, different norms and proportions of fertilizers on the economic efficiency of the winter wheat crop and recommending it to farmers.

Methods of the research: Field experiments were carried out in 8 varieties, in 4 replications, according to the following pattern: **Gobustan RES:** 1. Control (without fertilizer); 2. N_{60}; 3. $N_{60}P_{60}K_{60}$; 4. Biohumus (ECO) 1 t/ha; 5. Biohumus (ECO) 1 t/ha+N_{30}; 6. $N_{90}P_{60}K_{60}$; 7. Biohumus (ECO) 1 t/ha+$N_{30}P_{30}K_{30}$; 8. $N_{120}P_{60}K_{60}$.
Absheron AEF: 1. Control (without fertilizer); 2. N_{90}; 3. $N_{90}P_{60}K_{60}$; 4. Biohumus (ECO) 1 t/ha; 5. Biohumus (ECO) 1 t/ha+N_{45}; 6. $N_{120}P_{60}K_{60}$; 7. Biohumus (ECO) 1 t/ha+$N_{45}P_{30}K_{30}$; 8. $N_{150}P_{60}K_{60}$.

In practice, the composition includes ammonium salt (with an active substance content of 34%) and simple superphosphate (with an active phosphorus content of 20,5%), effective potassium-46.0%, ECO-biohumus (contains 0,6% nitrogen, 0,03% phosphorus (P_2O_5), potassium-0.039% (K_2O), calcium-0.14% (Ca), humic acids-27, organic matter-25.0-28.4%, fulvic acids-18%) were used. The spraying rate is 4 million per hectare under drum conditions-pieces (187,1 kg), and 4,5 million in irrigation units (210,5 kg) of germinating seeds. In both regions, the annual standard of phosphorus, potassium, and Biohumus (ECO) was provided in pre-sowing cultivation, and 30% of the annual standard of nitrogen was given in pre-sowing cultivation, with the remaining 70% given in the form of feed in early spring. In the biohumus (ECO) versions, nitrogen fertilizer was sown in early spring. Every year, prior to the experiment, soil samples were taken from 5 places of the field where organic and mineral fertilizers were not applied, and agrochemical analyses were conducted. Also, depending on the soil-climatic conditions, the norms and rates of fertilizers, the total above-ground dry biomass, the percentage amount of nitrogen in the biomass, and the assimilation of nitrogen by grain and stubble at full maturity were determined in the samples taken at different development stages of the plant. To investigate the relationship between the main nutrients (P-phosphorus, K-potassium), and various vegetation periods of the plant, as well as soil-climate conditions, norms, and ratios of organic and mineral fertilizers, soil samples were taken and analyzed from both plough and sub-plough layers. In both regions, the grain yield obtained by harvesting with a combine harvester was converted into hectares. In the collected soil samples: calcium carbonate ($CaCO_3$)-in the Scheibler calcimeter[1], environmental response of the soil - pH (soil: water suspension) in the pH meter (McKeague, McLean)[2], organic matter - I.V. Tyurin (Walkley)[2], total nitrogen (N)-Kjeldahl[3], easily hydrolyzable nitrogen

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[1]BURHAN KAJAR PROF. DR. SOIL ANALYSES. ANKARA, 3RD EDITION, OCTOBER 2012, P. 466

[2]GEORGE ESTEFAN, ROLF SOMMER, AND JOHN RYAN (2013). METHODS OF SOIL, PLANT, AND WATER ANALYSIS: A MANUAL FOR THE WEST ASIA AND NORTH AFRICA REGION. INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS (ICARDA). BOX 114/5055, BEIRUT, LEBANON, ICARDA, -P. – 243

-I.V. Tyurin, M. Using the Kononova method, total phosphorus (Lawrence), extractable phosphorus (P_2O_5) via a spectrophotometer, and exchangeable potassium (K_2O) through the Machigin method were determined.

In the plant samples, total nitrogen-Kjeldahl, protein nitrogen-Barnstein and Kjeldahl, 4, wet gluten-were determined by the accepted method. The accuracy of the experiments was calculated with the IBM SPSS Statistics 28 program.

The main theses of the defense: The dissertation consists of the conclusion of the scientific-theoretical propositions about the scientific research works mentioned below.

1. The amount of above-ground biomass produced varies across different vegetation stages of development, depending on the rate and ratio of fertilizers.
2. The effect of rates and ratios of fertilizers on nitrogen uptake from soil and fertilizer depending on the stages of plant development;
3. Depending on the rates and types of fertilizers, the productivity of the plant, the quality of the product;
4. Economic efficiency, profitability of fertilizers (wheat crop).

Scientific novelty of the research: initial investigation of the surface dry biomass and grain yield of bread wheat during the intensive development stages of the plant. This study specifically focuses on the light mountain grey-brown (chestnut) soils partially supplied with moisture from Gobustan RES and the irrigated grey-brown soils of Absheron AEF. For the first time, the research systematically examines the dependence of these crop parameters on the levels of extractable phosphorus (P_2O_5) and exchangeable potassium (K_2O).

3T.C. MINISTRY OF AGRICULTURE AND FORESTRY. SOIL FERTILIZER WATER PLANT ORGANIC MATERIAL AND MICROBIOLOGICAL ANALYSIS METHODS. LABORATORY HANDBOOK, ANKARA, 2018, p. 534

[4]Shafibeyov A.B. Methods agrochemical analysis of soil plants, Baku,1964, p. 204
[5]ГОСТ 26205-91. DETERMINATION OF MOBILE COMPOUNDS OF PHOSPHORUS AND POTASSIUM BY METHOD MACHIGIN, MOSCOW, 1992, P. 10
[6]Fataliyev H.K. Practical textbook on the technology of storage and processing of plant products, Baku, 2013, p.227

Additionally, the study aims to establish fertilizer norms that ensure the acquisition of high-quality, economically efficient grain products. This unique approach contributes to the advancement of knowledge in the field and holds significant implications for optimizing wheat cultivation in diverse soil and moisture conditions.

Theoretical and practical importance of the research: The results obtained from the research will play an important role in the theoretical knowledge of students studying agrochemistry and agriculture at the University and other educational institutions. The established, successfully tested fertilizer norms will serve as a recommendation to increase wheat production and improve product quality.

Approbation and application of the work: The results of the dissertation work at the scientific methodical seminars of the Azerbaijan Agricultural Scientific Research Institute (2012-2014); in the Azerbaijan Agrarian scientific journal; In the Proceedings of Research Institute Crop Husbandry; Baku State University, "Ecology: Nature and Society Problems" H.A. At the 2nd International Scientific Conference dedicated to Aliyev's 105th anniversary; At the scientific conference dedicated to the 85th anniversary of Ganja Agricultural Academy; At the Republican Scientific Conference dedicated to the 100th anniversary of the full member of ANAS, Jabrayil Mukhtar oglu Huseynov; Kazakhstan "Soil science and agrochemistry" journal, ANAS, Azerbaijan Society of Soil Scientists collection of works, Kurgan State Agricultural Academy on the topic "Development and application of modern scientific technologies for the modernization of the agro-industrial complex" at the III International scientific and practical conference dedicated to the 125th anniversary of the birth of T.S. Maltsev; Kurgan State Agricultural Academy on the topic "Development and application of modern scientific technologies for the modernization of the agro-industrial complex" at the III International scientific and practical conference dedicated to the 125th anniversary of the birth of T.S. Maltsev. S. Maltsev's birth; I.I. In the materials of the international scientific conference "Agrarian Landscapes, their Sustainability and Development Characteristics" at the Kuban State Agrarian University named after Trublina; XXVII International Conference of the Moscow Science Centre; It was discussed in the magazine "Science and Practice", Russian Federation.

Application: total 29.5 hectares in Gobustan and Aghstafa regions.

The findings from this research have been successfully applied on various farms per hectare, and the results have been confirmed through practical experience.

The name of the organization where the dissertation work was performed: The dissertation work was conducted at the Scientific Research Institute of Agriculture, Ministry of Agriculture of the Republic of Azerbaijan.

Scope and structure of work. The dissertation comprises of an introduction, 4 chapters, a conclusion, a proposal for production, a list of 186 references and appendices. There are 18 figures and 74 tables. In the structure of the dissertation, the title page and table of contents are 3 pages of 3939 characters, the introduction is 5 pages of 10220 characters, the first chapter is 25 pages of 53155 characters, the second chapter is 26 pages of 28963 characters, the third chapter is 52 pages of 93308 characters, the fourth chapter is 40 pages of 61212 characters. The results are 3 pages of 5216 characters, production recommendations are 1 page of 1355 characters, the list of used literature is 20 pages of 35507 characters, appendices are 31 pages of 26500 characters, abbreviations are 1 page of 222 characters. The total text part of the dissertation (excluding figures, tables, graphs, appendices and the bibliography) consists of 124 computer characters or 250797 characters. The total volume of the dissertation is 198 computer writings.

MAIN CONTENTS OF THE WORK

The general characteristics of the dissertation work are reflected in the introduction.

Chapter I. The role of grain products in human life, the role of the main nutrients (N, P, K) in plant life, depending on the soil and climate conditions, the norms and proportions of nutrients, organic and mineral fertilizers on the development of winter wheat crops, the collection of above-ground biomass products, detailed literature materials on the effect on productivity, grain quality and economic efficiency are provided.

Chapter II. The soil-climatic conditions of the researched region, the main agrochemical characteristics of the experimental areas, the material and methodology of the research, the amount of extractable phosphorus (P_2O_5) and exchangeable potassium (K_2O) in the soil depending on the development phases of the wheat crop are given. As a result of the research, it was determined that open mountain grey-brown (chestnut) soils have alkaline properties (pH-8.4-8.8). The amount of calcium carbonate at the depth of 0-25cm of the soil is 6.7-7.5%, and in the lower layers it is 7.9-16.4%, that is, the area is moderately carbonated. The amount of total humus is 2.21-2.28% in the depth of 0-25cm, and 0.69-1.45% in the lower layers, total nitrogen is 0.156-0.172% in the depth of 0-25cm, 0.041-0.092% in the lower layers, total phosphorus varies from 0.09 to 0.14% depending on the depth. Easily hydrolysable nitrogen was 45-56 mg in 1 kg of soil at a depth of 0-25 cm, active phosphorus was 21.5-30.6 mg, and exchangeable potassium was 235-265 mg. Easily absorbed forms of nutrients are significantly reduced in the lower layers. According to the gradation accepted in the country, the experimental area is poorly supplied with active phosphorus and exchangeable potassium.

Grey-brown soils are highly alkaline (pH 8.7-8.9). The amount of calcium carbonate in the upper layer of the soil varies between 13.0-14.5% and in the lower layers between 15.5-18.0%, i.e. the upper layer is medium and the lower layers are high in carbonate. The amount of total humus is 1.35-1.38% at a depth of 0-25 cm and decreases gradually in the lower layers. Total nitrogen and phosphorus are 0.082-0.085% and 0.10-0.11% respectively at a depth of 0-25 cm and gradually decrease in the lower layers. Extractable phosphorus (P_2O_5) and exchangeable potassium (K_2O) are 13.6-16.5

and 265-276 mg/kg respectively at 0-25 cm depth and gradually decrease in the lower layers. The experimental soils were very low and poorly supplied with extractable phosphorus and poorly supplied with exchangeable potassium.

As a result of the research, it was found that the amount of mobile phosphorus and exchangeable potassium varied depending on the growth phases of the bread wheat variety "Gobustan" in open mountain grey-brown (chestnut) and grey-brown soils, as well as on the rates and proportions of organic and mineral fertilizers. In light mountain grey-brown (chestnut) soils, at the end of the tillering growth phase, the amount of activated phosphorus at a depth of 0-25 cm was 24.7 mg/kg in the unfertilized, full and mineral fertilizer (NPK) were 28.8-31.7 mg per 1 kg of soil. Depending on the growth phase of the plant, the amount of activated phosphorus gradually decreased and reached 14.5-17.9 mg in the plough layer of 1 kg of soil in the full maturity phase. This is perfectly legal. Similar results were also noted in irrigated grey-brown soils. Specifically, during the stage of plant emergence in the tillering phase, the quantity of activated phosphorus in the 0-25 cm soil layer was 14.1 mg per 1 kg of soil in the unfertilized version, while it ranged from 17.2 to 17.6 mg, depending on the fertilizer norms and proportions of mineral fertilizer (NPK) with Biohumus (ECO) 1 ton/ha+N_{45} and Biohumus (ECO) 1 ton/ha+$N_{45}P_{30}K_{30}$ fertilizer, it was 13.7-16.7 mg/kg. At full plant maturity, the amount of activ phosphorus decreased to 8.8-12.0 mg per 1 kg soil (Table 1).

The amount of potassium exchanged also varied according to the soil-climate conditions and the growth stages of the wheat crop. In open mountain grey-brown soils with partial moisture supply, in the tillering emergence phase, in the three-year version without fertilizer, the average was 230 mg/kg, depending on the fertilizer rates, 260-267 mg/kg, and at full maturity, it decreased to 211 mg/kg in the version without fertilizer, organic and mineral, it was 207-246 mg/kg depending on the fertilizer rates and proportions (Table 1).

At the tillering emergence stage on irrigated grey-brown soils it was 248 mg/kg in the unfertilized variant and gradually decreased to 192 mg/kg in the fertilized variant and 188-201 mg/kg depending on the fertilizer rates.

From the results of the study, it was found that the amount of mobile phosphorus and exchangeable potassium in open mountain grey-brown soils was higher in wax and full maturity phases than in irrigated grey-brown soils.

Table 1

Change of nutrients in the soil according to the development stages of the wheat plant

Variants	Tillering stage		Was stage		Whole maturity	
	Extractable phosphorus	Exchangeable potassium	Extractable phosphorus	Exchangeable potassium	Extractable phosphorus	Exchangeable potassium
Gobustan RES						
Control	24,7	230	21,8	220	16,3	211
N_{60}	23,9	232	20,4	224	14,5	207
$N_{60}P_{60}K_{60}$;	28,8	267	23,6	256	16,6	246
Biohumus 1 t/ha;	24,3	246	19,5	233	17,6	231
Biohumus (ECO) 1 t/ha+N_{30};	26,7	243	19,1	232	16,5	228
$N_{120}P_{60}K_{60}$	31,7	267	24,5	256	17,9	222
Biohumus (ECO) 1 t/ha+$N_{30}P_{30}K_{30}$	29,4	260	20,7	249	15,8	215
$N_{120}P_{60}K_{60}$	31,0	264	22,3	252	16,9	218
Absheron AEF						
Control	14,1	248	11,1	221	8,8	192
N_{90}	14,5	245	11,8	214	8,9	188
$N_{90}P_{60}K_{60}$;	17,5	263	15,2	234	10,8	200
Biohumus 1 t/ha;	14,2	253	12,7	229	11,5	201
Biohumus (ECO) 1 t/ha+N_{45};	13,7	251	12,2	226	11,6	196
$N_{120}P_{60}K_{60}$	17,6	274	14,8	237	11,5	203
Biohumus (ECO) 1 t/ha+$N_{45}P_{30}K_{30}$	16,7	255	14,7	230	12,0	198
$N_{150}P_{60}K_{60}$	17,2	270	14,1	234	10,1	201

Based on the results of the analysis of variance, the influence of different fertilization rates on the dynamics is significant at the 0.001 probability level.

Chapter III. In this chapter, the effect of rates and proportions of organic and mineral fertilizers on the above-ground dry biomass yield of "Gobustan" bread wheat variety, on the percentages of nitrogen in the above-ground biomass depending on the growth phases of the plant, and on the transfer of nitrogen with the above-ground dry biomass was studied. As a result of the research, it was found that the yield of above-ground dry biomass product depends on soil-climatic conditions, norms and rates of fertilization.

The above-ground dry biomass yield at the end of spring mulching in open mountain grey-brown and irrigated grey-brown soils with partial moisture supply did not differ significantly depending on soil-climate conditions and nutrient regime. This is because at the end of the bushing phase, above-ground biomass production is up to 13-15% of that at full maturity, which is provided by readily assimilable nutrients in the soil. The above-ground dry biomass yield at tillering emergence, waxing and full maturity varied greatly according to soil-climate conditions and nutrient standards. Thus, on average, in the phase of wax stages in 3 years, on open mountain grey-brown soils, partially supplied with moisture, the above-ground dry biomass yield was 64.33 s/ha in the unfertilized version, depending on the norms and proportions of organic and mineral fertilizers it was 81.35-110,85 s/ha.

In the irrigated grey-brown soils, the above-ground dry biomass yield was 79.83 s/ha in the wax stages phase and 96.20-139.33 s/ha depending on the fertilizer norms. Similar results were observed at the end of the tillering emergence and full maturity phases.

With the same nutrient rate ($N_{90}P_{60}K_{60}$ and $N_{120}P_{60}K_{60}$) in partially watered soils, the above-ground biomass yield was 116.98 and 119.02 s/ha in the fully mature phase of the plant, and 133.88 and 144.45 s/ha in the irrigated phase, respectively. This is because the main limiting factor in the kettle is lack of moisture.

The percentage of nitrogen in the above-ground dry biomass of the bread wheat variety "Gobustan" varied greatly depending on the growth phase of the plant, soil-climatic conditions, norms and proportions of organic and mineral fertilizers.

In the light greyish-brown, partially moist mountain soils, the amount of nitrogen in the above-ground biomass was 3.32-3.48 and 4.05-4.15%, depending on the nutrient standard and the year of the study; at the end of spring pruning, it was 1.85-2.04 and 2.44-2.47%; and in the wax stages phase, it varied between 1.03-1.23 and 1.22-1.38%. This is quite legitimate, since the above-ground biomass production increases according to the development phase, and the percentage of nitrogen in it decreases as the vegetative organs age. The difference at the same stage of development is related to nutrient deficiency. A similar pattern was found in irrigated grey-brown soils. However, the percentage of nitrogen in the above ground biomass was lower compared to that of the damiya. 2.99-3.08 and 3.55-3.89% at the end of spring flowering, 1.85-1.95 and 2.16-2.47% at the end of tillering growth, and 1.04-1.07 and 1.12-1.17% at wax stages. The decrease of nitrogen in the above-ground biomass compared to the growth phase and the non-moist area is quite legitimate, because the decrease depending on the growth phase is related to the increase of the above-ground biomass and the ageing of the vegetative organs. The fact that it is lower compared to the non-irrigated area is due to the fact that the soil fertility is lower in the irrigated area and the above-ground dry biomass product is higher in the irrigated area.

Nitrogen removal by above-ground biomass production of plants depends on the growth phase of the crop, the soil and climatic conditions, and the standards and proportions of organic and mineral fertilizers. At the end of spring tillage, the amount of nitrogen taken up by above-ground biomass in the unfertilized version was 37.75 kg/ha on average over 3 years in open mountainous grey-brown soils without moisture, and it was 49.21-64.40 kg depending on the fertilization norms. The highest result was obtained with the full fertilizer rates ($N_{90}P_{60}K_{60}$ and $N_{120}P_{60}K_{60}$) 63.40-64.40 kg/ha.

On the irrigated greyish-brown soils, at the end of the spring mulch, the amount of nitrogen carried by above-ground biomass was

38.22 kg/ha in the non-fertilized version and 56.92-75.74 kg/ha depending on the fertilizer standard. Compared to soils without irrigation, the amount of nitrogen carried by above-ground biomass was 0.47 kg/ha in the non-fertilized version and 6.47 kg in the full fertilizer standard ($N_{120}P_{60}K_{60}$). Similar results were obtained at emergence, waxing and full maturity, but the amount of nitrogen carried by above-ground biomass was several times higher than that of the spring bushing.

On average over three years, nitrogen carried by above-ground biomass during the waxy phase amounted to 72.71 kg/ha in the control option, ranging from 92.66 to 145.84 kg/ha depending on fertilizer rates. In the irrigated grey-brown soils without fertilization, the nitrogen carried was 81.24 kg/ha, varying with different fertilizer rates. The highest nitrogen content was observed at 97.45-162.19 kg/ha with the full fertilizer rates. Similar results were obtained during the full maturity phase of the crop.

CHAPTER IV. This chapter provides detailed information on the effect of rates and proportions of organic and mineral fertilizers on the productivity, quality, protein yield per hectare and economic efficiency of the common wheat variety "Gobustan".

From the research results, it was found that the yield of bread wheat variety "Gobustan" depends on soil and climatic conditions, fertilizers. It was different according to the norms and proportions. The average yield of 31.54 centners per hectare was obtained in 3 years without fertilizer on partially moist soils. The average cereal yield per hectare varied between 37.77-53.08 centners in 3 years, depending on the fertilizer rates and quantities. The highest grain yield was obtained with the $N_{90}P_{60}K_{60}$ fertilizer rate, the increase over the control was 21.54 s/ha or 68.29%. The lowest increase compared to the nonfertilized variant was obtained in the variant where only nitrogen (N_{60}) and Biohumus (ECO) 1 t/ha were applied. The increase was 6.30 s/ha and 6.23 s/ha respectively (Figure 1). Similar results were obtained on the irrigated grey-brown soils, but the productivity was higher than that of the irrigated soil. Thus, depending on the research year, productivity in the unfertilized variant was 32.08-35.81 c/ha, with an average of 33.83 s/ha.

Depending on the rates and proportions of organic and mineral fertilizer, the average productivity over 3 years was 38.75-65.66 c/ha (Figure 1).

From the 3-year field trials, it was determined that the grain yield per hectare was 24.56 and 26.91 centner less than the full fertilizer standard ($N_{120}P_{60}K_{60}$) when only nitrogen fertilizer and only Biohumus (ECO) were applied. The highest grain yield was achieved with the $N_{120}P_{60}K_{60}$ fertilizer, resulting in an average yield of 65.66 centners per hectare over the 3-year period.

In the grey-brown soils irrigated with the same fertilizer rate ($N_{90}P_{60}K_{60}$ and $N_{120}P_{60}K_{60}$), the grain yield per hectare was 5.47 and 13.41 centners/ha higher, respectively, compared to the yield in the open mountain grey-brown soils partially supplied with moisture over the 3 years.

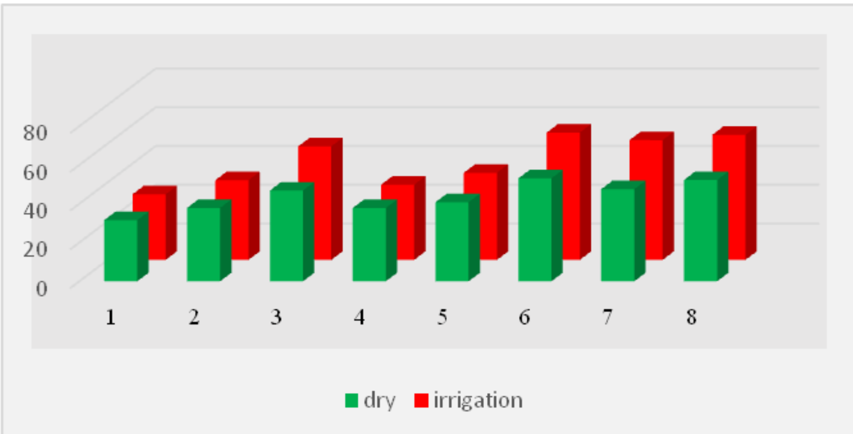

Figure 1. The effect of soil and climatic conditions, fertilizers on the productivity of the wheat variety Gobustan, (average of 3 years, s/ha)

Dry are
1.Control 2. N_{60};
3. $N_{60}P_{60}K_{60}$;
4. Biohumus (ECO) 1 t/ha;
5.Biohumus (ECO) 1 t/ha+N_{30};
6.$N_{90}P_{60}K_{60}$; 7. Biohumus (ECO) 1 t/ha+$N_{30}P_{30}K_{30}$;
8. $N_{120}P_{60}K_{60}$
Irrigftion
1. Control; 2. N_{90};
3. $N_{90}P_{60}K_{60}$;

4. Biohumus (ECO) 1 t/ha;
5.Biohumus (ECO) 1 t/ha+N_{45};
6.$N_{120}P_{60}K_{60}$; 7. Biohumus (ECO) 1 t/ha+$N_{45}P_{30}K_{30}$;
8. $N_{150}P_{60}K_{60}$

Despite the higher fertility and easily assimilable essential nutrient content in the partially irrigated experimental plots compared to the irrigated grey-brown soils, the limiting factor is the lack of water, which significantly influences the overall yield (Figure 1).

In addition to the productivity of the wheat crop, improving its quality indicators is one of the most important requirements for the future. The quality indicators of winter wheat depend on soil and climatic conditions, the variety and the supply of basic nutrients during the growing season.

The amount of protein in the grain of the variety varied between 12.63-13.77% on average in 3 years depending on the feeding regime. 12.63% in the control variety and 12.80-13.77% depending on the standards and proportions of organic and mineral fertilizers. The amount of protein in the grain decreased in the variant without fertilizer and only with Biohumus (ECO) 1 t/ha. Meanwhile, the amount of protein in grain was 12.68 and 12.80% on average in 3 years. The highest result was obtained with full fertilization ($N_{90}P_{60}K_{60}$) (13.77%). A similar pattern was obtained in irrigated grey-brown soils. In grey-brown soils, the amount of protein in grain in the unfertilized variant varied between 10.51% and 11.20-12.79% depending on the rates and proportions of organic and mineral fertilizers in 3 years. The highest indicator was obtained with the full fertilization ($N_{120}P_{60}K_{60}$) (12.79%). In the same nutrient regime, the cereal protein content was higher in the partially irrigated open mountain grey-brown soils than in the irrigated grey-brown soils. In the unfertilized version, the amount of protein in the grain was 12.63% and in the irrigated version it was 10.51%, in the $N_{90}P_{60}K_{60}$ fertilized version it was 13.77% in the field and 12.20% in the irrigated version. (Figure 2).

The high percentage of protein in the grain in the area that is not supplied with moisture at the same feeding rate means high fertility in the field and the productivity may be due to the fact that it is less than irrigation.

At present, protein deficiency is being eliminated all over the world remains one of the most important problems. Therefore, it is

very important to determine the dependence of the increase of protein
yield per hectare in food wheat on soil-climatic conditions, norms and ratios of organic and mineral fertilizers.

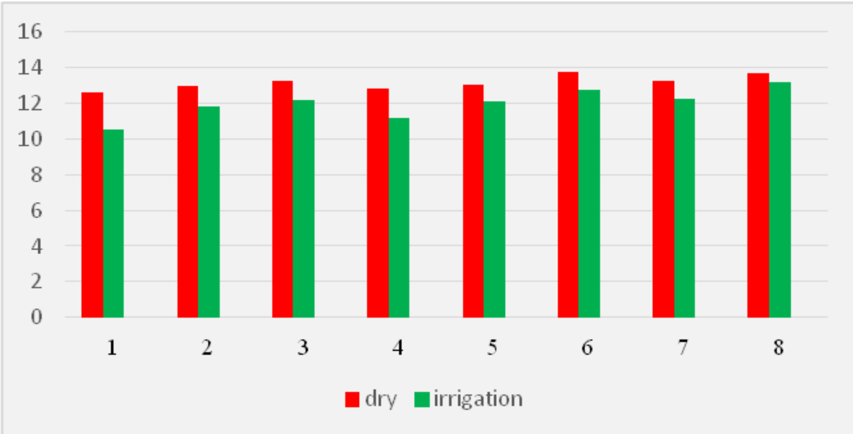

Figure 2. Effect of soil-climatic conditions, fertilizers on the amount of protein in the grain of the wheat variety "Gobustan" (average of 3 years)

Dry are
1.Control 2. N_{60};
3. $N_{60}P_{60}K_{60}$;
4. Biohumus (ECO) 1 t/ha;
5.Biohumus (ECO) 1 t/ha+N_{30};
6.$N_{90}P_{60}K_{60}$; 7. Biohumus (ECO) 1 t/ha+$N_{30}P_{30}K_{30}$;
8. $N_{120}P_{60}K_{60}$

Irrigftion
1. Control; 2. N_{90};
3. $N_{90}P_{60}K_{60}$;
4. Biohumus (ECO) 1 t/ha;
5.Biohumus (ECO) 1 t/ha+N_{45};
6.$N_{120}P_{60}K_{60}$; 7. Biohumus (ECO) 1 t/ha+$N_{45}P_{30}K_{30}$;
8. $N_{150}P_{60}K_{60}$

From the research results, it was found that in open mountainous grey-brown soils, which are not supplied with moisture, 398.35 kg of protein per hectare (depending on the years, 361.01-447.17 kg/ha) was accumulated in 3 years without fertilization, depending on the rates and proportions of fertilization. The protein yield per hectare was 483.58-731.05 kg (Figure 3).

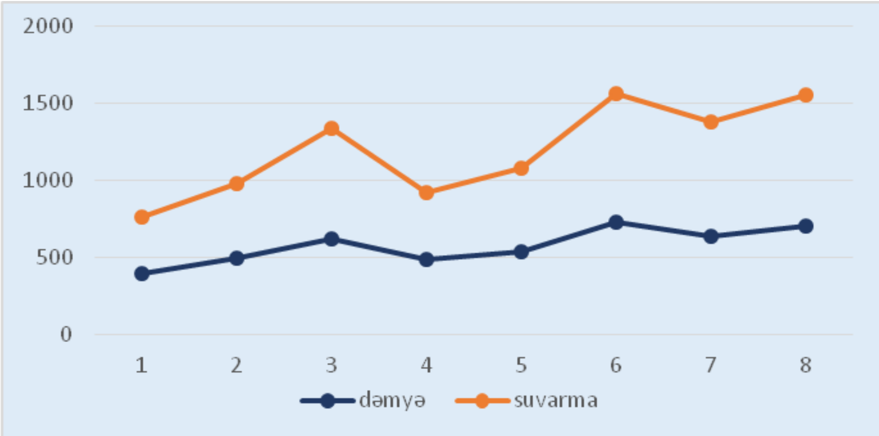

Figure 3. Effect of fertilizer on protein yield per hectare according to soil and climatic conditions (average of 3 years, kg/ha)

Dry are
1.Control 2. N_{60};
3. $N_{60}P_{60}K_{60}$;
4. Biohumus (ECO) 1 t/ha;
5.Biohumus (ECO) 1 t/ha+N_{30};
6.$N_{90}P_{60}K_{60}$; 7. Biohumus (ECO) 1 t/ha+$N_{30}P_{30}K_{30}$;
8. $N_{120}P_{60}K_{60}$

Irrigftion
1. Control; 2. N_{90};
3. $N_{90}P_{60}K_{60}$;
4. Biohumus (ECO) 1 t/ha;
5.Biohumus (ECO) 1 t/ha+N_{45};
6.$N_{120}P_{60}K_{60}$; 7. Biohumus (ECO) 1 t/ha+$N_{45}P_{30}K_{30}$;
8. $N_{150}P_{60}K_{60}$

The highest protein yield was obtained with the $N_{90}P_{60}K_{60}$ fertilizer rate (731.05 kg/ha). Depending on the years of research, 699.14-778.44 kg/ha, the lowest amount of protein in the application of organic and mineral fertilizers was obtained in the variant given Biohumus (ECO) 1 t/ha. 445.26-532.03 kg/ha depending on the years of research, 483.58 kg/ha averaged over 3 years.

In the grey-brown soils, the protein yield per hectare varied according to the nutrient regime, as in the open grey-brown soils of the mountains. In the unfertilized variant, the average over 3 years was 359.33 kg/ha and 435.58-850.17 kg/ha protein, depending on the rates and proportions of fertilizer applied. In the fertilization variants, the lowest amount of protein was obtained in the variant with Biohumus (ECO) 1 t/ha, 435.58 kg, and the highest in the fertilization rates $N_{120}P_{60}K_{60}$, Biohumus (ECO) 1 t/ha+$N_{45}P_{30}K_{30}$ and $N_{150}P_{60}K_{60}$ (Figure 3).

Any new research can only be widely used on farms if it is economically viable. The results of the research showed that the net yield of the bread wheat variety "Gobustan" depends on the soil and climatic conditions, the norms and proportions of organic and mineral fertilizers and the years of research.

In open mountainous grey-brown soils, it was 499.5-705.7 manats per hectare (590.5 manats averaged over 3 years) in the unfertilized variant, depending on the research years.

One of the main limiting factors that led to a noticeable difference depending on the research years was the variation of rains depending on the years.

The lowest net profit in fertilizer application is Biohumus (ECO)1 t/ha was purchased at the given fertilizer rate (547.2 man/ha on average in 3 years). In general, depending on the norms and proportions of organic and mineral fertilizers, the net income per hectare was 547.2-781.8 manats on average over 3 years. The highest net income was obtained with the $N_{90}P_{60}K_{60}$ fertilizer rate (781.8 manats).

A similar regularity was observed in the irrigated grey-brown soils. Net income per hectare in the fertilizer-free version was 569.1 manats over 3 years. Depending on the study year, it varied between 5200-631.2 manats. The lowest net income was obtained when Biohumus (ECO) was applied at 1 t/ha. When Biohumus (ECO) was applied at 1 t/ha, the net income obtained was 109.4 manat/ha or 23.8% less than the option without fertilizer. The net income per hectare varied between 459.7 and 953.5 manats, depending on the amount and type of organic and mineral fertilizer. The highest result was obtained with the $N_{120}P_{60}K_{60}$ fertilizer rate (953.5 manats).

The cost of 1 tonne of product ranged from 73.8 to 114.1 manats, depending on the standards and proportions of fertilizers, in open mountain grey-brown soils without moisture, and from 110.5 to

124.3 manats in irrigated grey-brown soils. Profitability varied from 118.5 to 238.8% depending on the standards and proportions of fertilizer in the soil without moisture and from 90.3 to 156.4% in the irrigated grey-brown soil. Depending on the soil-climatic conditions, the net yield obtained in the irrigated grey-brown soils with the same fertilization rate $N_{90}P_{60}K_{60}$ was 34.9 manats in the open mountain grey-brown soils without moisture and 234.5 manats in the fertilization rate $N_{120}P_{60}K_{60}$. As can be seen from the research results, when the nitrogen rate was increased from 90 kg to 120 kg in the phosphorus-potassium background, there was no significant difference in the net yield on the soils without moisture, because there was no increase in yield due to the lack of moisture, which is the main limiting factor.

RESULTS

1. The yield and quality of autumn cereals depend on the availability of easily assimilable forms of the main nutrients in the soil. The experimental open mountain grey-brown soils were poor in available phosphorus and medium in exchangeable potassium. The irrigated grey-brown soils are very poorly supplied with phosphorus and poorly supplied with exchangeable potassium.
2. In the open mountainous grey-brown soils of Mountain Shirvan region, which are partially supplied with moisture, and in the irrigated grey-brown soils of Absheron, productivity was also high in the variants with high levels of active phosphorus and exchangeable potassium in the soil at the end of the spring bushing and emergence phases of the plant. Thus, the amount of active phosphorus and exchangeable potassium in light mountain grey-brown and irrigated grey-brown soils in the full mineral fertilizer standard in the tillering emergence phase is on average 11-21 mg in 1 kg of soil higher than in the control, Biohumus alone, and the productivity is 15.0 -20.0 s/ha, provided the increase.
3. Depending on the development phases of the bread wheat variety "Gobustan", the collection of above-ground dry biomass product depended on the soil-climatic conditions, the norm and the ratio of

organic and mineral fertilizers. In open mountainous grey-brown soils, the highest biomass yield was 15.80-15.75 s/ha for the $N_{90}P_{60}K_{60}$ and $N_{120}P_{60}K_{60}$ varieties in the bushing phase, 40.95-42.50 s/ha in the tillering emergence phase and 106. In the case of the $N_{120}P_{60}K_{60}$ and $N_{150}P_{60}K_{60}$ fertilizers, the values were 19.18, 54.75, 139.33 and 144.45 s/ha and 20.08, 55.68, 137.47 and 147.87 s/ha respectively.

4. The collection of dry biomass product in the main stages of plant development depends on soil-climatic conditions and fertilization rates. In open mountain grey-brown soils, partially supplied with moisture, the highest biomass yield in the control option was 29.10% of the biomass collected from spring bushing to the end of tillering emergence, while this indicator was 21.61-22.47% in the fertilized norms. Due to the lack of nutrients and moisture in the control option, the collection of above-ground biomass product was weakened in the later stages of development.

5. The percentage of nitrogen in the dry above-ground biomass product of "Gobustan" bread wheat variety was determined depending on the soil-climatic conditions and the rates and ratios of fertilizers. Thus, in open mountainous grey-brown soils, the amount of nitrogen in the bushing phase was 3.32-3.48% in the unfertilized version and 3.62-4.15% in the fertilized version, and in irrigated conditions, it was 2.99-3.08% in the unfertilized version and 3.73-3.89% in the fertilized version. This regularity was also observed in the later stages of development. As it can be seen, the percentage of nitrogen in the above-ground biomass is higher in the open, highly fertile and partially irrigated grey-brown mountain soils throughout the vegetation period than in the less fertile irrigated grey-brown soils.

6. It was found that nitrogen removal by above-ground biomass product depends on soil and climatic conditions, fertilizer rates and proportions, and plant development stages. From the research results it was found that the major part of nitrogen nutrition in the unfertilized version, i.e. 42.02-47.97% of what was done at full maturity, was done in the tillering phase, 17.18-27.83% in the tillering emergence phase.

7. In determining the influence of soil-climatic conditions and the form, rate and proportion of fertilizers on the quality indicators of the variety "Gobustan" bread wheat, it was found that in open mountainous grey-brown soils, partially supplied with moisture, the amount of protein and gluten in the grain was 12.63% and 12.63%, respectively, in the control variant, 23.13%, 13.71% and 31.69%, depending on the form, rate and proportion of fertilizers. 23.13%, 13.71% and 31.69% respectively, depending on the form, rate and proportion of fertilizer. The highest rate of protein 12.80-13.77%, gluten 25.91-31.69% was obtained in the $N_{90}P_{60}K_{60}$ fertilizer rate, and in irrigated grey-brown soils the highest rate of protein 12.79%, gluten 27.37% was obtained in the $N_{120}P_{60}K_{60}$ fertilizer rate. The quality indicators of the bread wheat variety "Gobustan" on open mountain grey-brown soils were higher compared to irrigated grey-brown soils.

8. Grain yield of bread wheat variety "Gobustan" on open mountain grey-brown soils was 31.54-53.08 s/ha, depending on nutrient conditions. The highest indicator was 53.08 s/ha, averaged over 3 years, for "Gobustan" bread wheat at $N_{90}P_{60}K_{60}$ fertilizer rate. On the irrigated grey-brown soils, the highest indicator was obtained with the $N_{120}P_{60}K_{60}$ fertilizer rate. Productivity averaged 65.66 s/ha in 3 years.

9. The bread quality of the bread wheat variety "Gobustan" was the highest, 4.9 and 4.8 points, respectively, in the $N_{90}P_{60}K_{60}$ open mountain partially watered grey-brown soils and in the $N_{120}P_{60}K_{60}$ irrigated grey-brown soils.

10. The highest net yield was 781.8 man/ha $N_{90}P_{60}K_{60}$ on open mountain grey-brown partly watered soils and the highest net yield was 953.5 man/ha $N_{120}P_{60}K_{60}$ on irrigated grey-brown soils.

SUGGESTIONS FOR PRODUCTION

It is recommended that farmers maintain soil fertility in partially humid and irrigated areas to ensure the purchase of good quality, economically viable crops.

1. It is recommended to apply $N_{90}P_{60}K_{60}$ fertilizer per hectare in the open mountain grey-brown (chestnut) soils of Mountain Shirvan region so that 25-30% of nitrogen fertilizer, the annual rate of phosphorus and potassium fertilizer can be applied before sowing and the rest of nitrogen can be applied to the field in early spring. It is advisable to give it time.

2. In open mountainous grey-brown (chestnut) soils of Mountain Shirvan region it is recommended to apply Biohumus 1 ton/ha + $N_{30}P_{30}K_{30}$ fertilizer per hectare, it is recommended to apply the annual rate of Biohumus, phosphorus and potassium in pre-sowing cultivation, and the annual rate of nitrogen in the form of feeding in early spring.

3. On Absheron irrigated grey-brown soils it is recommended to apply $N_{120}P_{60}K_{60}$ fertilizer per hectare, it is recommended to give 25-30% of nitrogen fertilizer, annual rate of phosphorus and potassium fertilizers in pre-sowing cultivation, and the rest of nitrogen in early spring when it is possible to go to the field.

4. On Absheron grey-brown soils it is recommended to apply Biohumus 1 ton/ha + $N_{45}P_{30}K_{30}$ fertilizer per hectare. It is recommended to apply the annual rate of Biohumus, phosphorus and potassium in pre-sowing cultivation and the annual rate of nitrogen in the form of early spring feeding.

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