Effect of Fertilizers on The Productivity of Plants Under Different Ecological Conditions

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Abstract. In order to obtain a high and stable yield of wheat, corn, potato and sugar beet plants in different regions of Azerbaijan, it is necessary to select high-quality seed material, study the biological characteristics of these plants, soil and climatic conditions, and carry out timely and high-quality agrotechnical measures. The application of the results and recommendations from experiments conducted in our republic on farms demonstrates that it is possible to grow high-quality wheat, corn, potatoes, and sugar beets in various regions of Azerbaijan, thereby meeting the population's year-round demand for these crops. The purpose of the research is to improve the fertilization system based on calculations of soil fertility and the balance of nutrients of various agricultural plants in various zones of the country, taking into account the ecological balance. The methodology of the work consisted of field, laboratory experiments and analytical work. In field experiments, plant care and agrotechnical measures (except for seeding) were carried out in accordance with the adopted agrotechnical rules for experimental plants. Organic, mineral and micro fertilizers were used in the research. In order to eliminate the lack of nutrients in the soil, the effect of various rates and ratios of mineral, organic and micro fertilizers on plant productivity was studied. As a result, the preservation of environmental conditions, soil fertility, increased crop yields and improved quality indicators were achieved.

Keywords: wheat, corn, potato, sugar beet, mineral fertilizers, organic fertilizers, mikrofertilizers, soil fertility, ecological conditions.

1 Introduction

Increasing the productivity and quality of wheat in the region is a matter of special importance for the security of food needs. Determining the efficient cultivation method and fertilizer norms that influence the increase of wheat plant productivity, quality and soil fertility is one of the urgent problems.

Ensuring food security of the world population is an important aspect of global economic policy. Also, in this regard, agriculture, especially grain production, is given great importance in our country. The development of grain cultivation, expansion of production and improvement of its quality, as the main goal of agriculture, plays an important role in protecting the economic security of every country.

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Cereal farming occupies one of the main places in the economy of the republic. It is always in the center of the state's attention that the population's demand for grain-based food products, bread, vermicelli, pasta, semolina, and sweets is an important issue. Grain production is of great importance in the country's economy. The development of grain farming, increasing production plays a key role in the development of various sectors of the country's economy. Grain is used in the production of first-class flour food products needed by the population. In addition, in food and light industry, grain is widely used for the purchase of other products, as well as in the production of animal feed. Increase in the country's population, the improvement of the financial situation, the increase in the population's demand for food, and the further expansion of the industrial area have increased the demand for bread, especially high-quality wheat, every year. Development of animal husbandry also affects the increase of grain production.

Potato is an agricultural plant that is widespread in the world and has great importance in terms of human nutrition. Potatoes are called the second quarter due to the nutrients and taste. Potatoes are used both as a valuable food product and as fodder in animal husbandry and for various technical purposes. Potatoes contain a lot of carbohydrates (starch), sugars, mineral salts and vitamins.

Potato is one of the most important plants grown in Azerbaijan. According to the Ministry of Agriculture, 70% of Azerbaijani farmers grow potatoes. Yasas production areas are Ganja, Tovuz, Gadabay, Gusar and Jalilabad. Productivity in Azerbaijan is low compared to the international level - 13t/h. Average productivity in Scotland and Germany is 40 t/h.

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In folk medicine, potato juice is widely used against tuberculosis and other diseases of the respiratory organs. At the same time, potato juice is used in the treatment of stomach ulcer and duodenal ulcer. In addition, sweet potato juice helps those suffering from hypertensive disease.

However, the production of such an important potato plant in our republic does not meet the needs of the population. That is why large quantities of potatoes are brought to the republic every year. 30-35% of the product is spoiled by rotting during storage in hot weather conditions (20-25 days) since potato tubers contain 70-75% water. In addition, along with potatoes brought to the republic, diseases and pests also spread. After all, bringing potatoes requires a lot of money and effort.

Sugar beet is a very valuable technical crop and it is cultivated for sugar production in industry and as fodder in animal husbandry.

Our republic has favorable soil and climate conditions for growing this valuable plant and obtaining high sugar content. Currently, in order to satisfy the population's demand for sugar, the need to cultivate sugar beet in the industrial direction has emerged.

17-19% sugar is collected in the beetroot of modern sugar beet varieties, which means approximately 5000 kg of sugar from each bush. Sugar beet is much better than fodder beet in terms of food quality, 100 kg of beets contain 26 nutrients and 1.5 kg of digestible protein, 0.5 kg of calcium and 0.5 kg of phosphorus. Sugar beet is also important as a predecessor plant [7].

2 Object and methodology of the research

The research was conducted with Barakatli-95 variety of winter wheat in Yevlakh district, applying traditional and minimum tillage technology on irrigated grass-gray soils.

Soil research and field experiments were carried out in the Ujar region on the territory of the Stronghold of the Institute of Soil Science and Agrochemistry.

The research was conducted in irrigated light gray brown (light chestnut) soils in Samukh district, Ganja-Gazakh region, with the potato variety "Arinda" in 4 replications and 10 variants.

Organic, mineral and microfertilizers were used during the research. Manure and biohumus were used as organic fertilizers. In practice, from mineral aggregates, ammonium salt of nitrogen (the active substance in its composition is 34%), simple superphosphate of phosphorus (the active substance in its composition is 18%), potassium-sulfate compounds of potassium with 46%, manganese-manganous sulfate (with 20%), boric acid (17.5%) forms were used. The numbers (NPK) were given in 3 periods with the annual rate of 3 places. The full annual norm of microfertilizers (Mn, B) was carefully mixed with macrofertilizers, divided into 2 parts, and given to the soil depth of 10-12 cm under the trowel before sowing and at the time of exit.

Plant care and agrotechnical measures (besides giving seeds) were carried out in accordance with the accepted agrotechnical rules for the potato plant.

The research was carried out in the irrigated fields belonging to farmers, located in Saatli district in Mugan-Salyan region. Experiments were carried out with NZ (high yield - high sugar) "Portofina KWS" variety of sugar beet plant produced in Turkey in 4 replications and 8 variants. The product report was conducted by Mesheryakov's method [12].

3 Results and discussions

The intensification of agricultural production and the increase in ecological pollution cause a number of difficulties in obtaining ecologically clean and stable products from cultivated plants. Of course, the method of cultivation and applied agrotechnical works are of great importance in obtaining an ecologically clean product. [1, 3, 5]

Winter wheat is the most widespread valuable cereal plant in Azerbaijan agriculture. This plant has a very large potential yield capacity. At the same time, it is sensitive and demanding to soil and climate conditions. The predecessor of the wheat plant, water-physical properties of the soil, the amount of nutrients in the soil, their forms, as well as moisture are the main factors that determine the productivity of this plant.

It is clear from numerous literature summaries that the fertilization system is the most important of the agrotechnical rules applied during planting in order to obtain a high, stable and quality ecologically clean product from the winter wheat plant.

From this point of view, we have researched the effect of organic fertilizers and biohumus on the productivity of the wheat plant in the research conducted with the winter wheat plant in grass-gray soils.

As can be seen from Table 1, the grain yield of winter wheat in the traditional soil cultivation was 24.7 c/ha in the control (free fertilizer) variant, while it was 30.5 c/ha in the manure 30 t/ha variant, compared to the control a relative increase was 5.8 c/ha or 23.5%; 34.9 c/ha in the biohumus 5 t/ha variant, the increase compared to the control was 10.2 c/ha or 41.3%. The highest grain yield was obtained in the biohumus 5 t/ha variant. In the case of minimum soil cultivation, the grain yield of winter wheat was 26.7 c/ha in the control (free fertilizer) variant, and 36.3 s/ha in the manure 30 t/ha variant, the increase compared to the control was 9.6 c/ha or 35.9%. The highest grain yield was obtained 42.3 c/ha in the variant of biohumus 5 t/ha, the increase compared to the control was 15.6 c/ha or 58.4%.

Table 1. The effect of different norms and proportions of biohumus and manure on the productivity of winter wheat in the conditions of ecological soil cultivation (Yevlakh district, Barakatli-95 variety).

№	Variants	Repetitions				Average yield, cen/ha	İncrease	
		I	II	III	IV		cen/ha	%
Traditional soil cultivation								
1	Control (free fertilizer)	23.8	24.5	25.6	24.9	24.7	-	-
2	Manure-30 t/ha	29.2	30.3	31.7	30.8	30.5	5.8	23.5
3	Biohumus 5 t/ha	33.3	34.7	35.9	35.6	34.9	10.2	41.3
Minimum soil cultivation								
4	Control (free fertilizer)	25.8	25.4	27.9	27.8	26.7	-	-
5	Manure-30 t/ha	35.2	35.9	37.6	36.6	36.3	9.6	35.9
6	Biohumus 5 t/ha	41.3	42.3	43.1	42.6	42.3	15.6	58.4

In the version where 5 tons of biohumus per hectare was applied with traditional cultivation, a small increase in wheat plant productivity was observed, which was associated with the direct effect of biohumus.

The effectiveness of fertilizers observed in our experiments is explained mainly by the low content of mobile forms of P_2O_5 and K_2O in the soil of the experimental field.

The green mass of corn with cobs was mowed in the phase of milky-waxy grain ripeness. The positive effect of applied fertilizers is observed according to the results of experiments based on both experimental schemes (Tables 2; 3).

Table 2. The influence of potassium fertilizers against the Fon of NP on the yield of green corn mass.

Variants	Repetitions, cen/ha				Average yield, cen/ha	Adding yield to the Fon	
	I	II	III	IV		cen/ha	%
Control (f/fert)	284	268	302	270	281	-	-
Fon $N_{90}P_{90}$	360	348	388	364	365	-	-
Fon+K $_{40}$	464	455	471	446	459	94	26.0
Fon+K $_{80}$	560	580	600	540	570	205	56.0
Fon+K $_{120}$	570	550	590	550	565	200	54.8

Table 2 shows the data obtained in field experiments to study the effect of potassium fertilizers against the Fon of NP on the yield of green mass of corn. As can be seen from the data presented, NP mineral fertilizers provided a significant increase in green mass yield by 76-94 c/ha or 27-35% compared to the control variant.

Comparison of individual experimental variants for their effect on corn development and yield shows fairly significant yield increases: 94 c/ha (26%) was obtained from using potassium fertilizer at a dose of 40 kg/ha. Increasing this dose led to a further increase in yield by 56%. The best results were obtained when using potassium fertilizers (K80 and K120) against the background of N90P90. Table 3 shows the data obtained in field experiments to study the effect of phosphorus fertilizers against the background of NK on the yield of green mass of corn. As can be seen from the presented data, NK mineral fertilizers provided a significant increase in green mass yield by an average of 126 c/ha or 48% compared to the control variant.

Table 3. The influence of phosphorus fertilizers against the Fon of NK on the yield of green corn mass

Variants	Repetitions, cen/ha				Average yield, cen/ha	Adding yield to the Fon	
	I	II	III	IV		cen/ha	%
Control (f/fert)	278	258	232	280	262	-	-
Fon $N_{90}K_{90}$	420	416	380	408	406	-	-
Fon+P $_{45}$	470	476	454	480	470	64	15.7
Fon+P_{90}	570	622	588	616	599	193	47.4
Fon+P $_{135}$	580	590	560	582	578	172	42.3

As the results of statistical processing of yield data show, the yield increases obtained from the use of various doses of phosphorus and potassium fertilizers are reliable in all cases. The resulting increases, on average for 4 repetitions, exceed HCP_{05} = 43.58 c/ha, i.e. exceed the least significant difference.

Fertilizers are one of the main factors that increase the productivity of agricultural plants. It is very important to give mineral fertilizers together with micro fertilizers in order to get a high yield from the potato plant.

A number of authors [4, 8, 13, 18, 19] have determined the positive effect of mineral fertilizers on the productivity of potato plants.

Some scientists have studied the great role of potassium fertilizer in increasing potato yield [9, 16, 17].

The application of microelements against the background of nitrogen, phosphorus and potassium fertilizers significantly increases the yield of agricultural crops.

The positive effects of microelements differ depending on their application methods and doses [11].

Researchers have shown that depending on the type of soil, 60-100 kg of nitrogen, 70-120 kg of phosphorus, 80-180 kg of potassium fertilizers should be given per hectare depending on the type of soil [6].

Summarizing the conducted research, the authors note that the potassium nutrient requirement of potatoes varies depending on the vegetation phases. Thus, the most demanding occurs in budding and flowering phases. Applying potassium fertilizer during that period increases productivity and significantly improves the quality of potatoes. The amount of potassium in a potato unit is 1.5 times higher than nitrogen and 3.5 times higher than phosphorus. Therefore, in order to get a high and stable potato crop, one of the important conditions is to give potassium fertilizers together with nitrogen-phosphorus.

From the literature summary mentioned above, it is clear that the fertilization system is the most important of the agrotechnical measures applied in agriculture in order to obtain high and quality fruit from the potato plant. At this time, microfertilizers are also given against the background of mineral fertilizers. Based on the results obtained from the research conducted with the potato variety "Arinda" in Samukh district, it can be noted that different norms and ratios of fertilizers had a positive effect on the productivity of the potato plant. It is clear from the table that among the different norms and rates of fertilizers, the most favorable was the variant applied per hectare N90P90K120+Mn_5+B_5 due to the active ingredient. Thus, the yield increase in this option was 98.50 cen/ha or 84.5% compared to the control (free fertilizer) variant. Due to the effect of manganese and boron fertilizers, the increase in this variant was 19.0 cen/ha or 9.7% compared to the Fon.

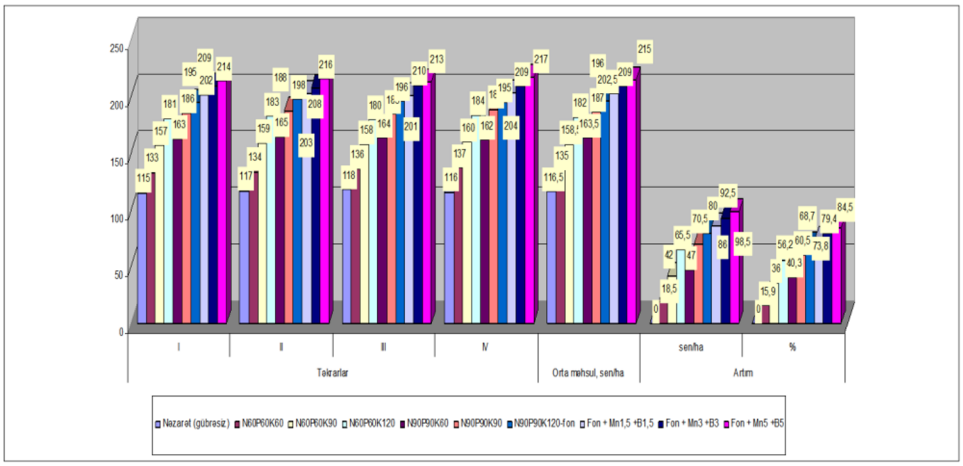

Fig. 1. The effect of different norms and proportions of fertilizers on the productivity of the potato plant (Samukh district, "Arinda" variety).

Many researchers have studied the effect of the seeds on the sugar beet crop and its quality [2, 9, 10, 14, 15]. The productivity and sugar content of sugar beet increased during the application of mineral aggregates, as well as their mixture with organic aggregates, on the gray-brown soils of Absheron, either on a saline or non-saline fon [20].

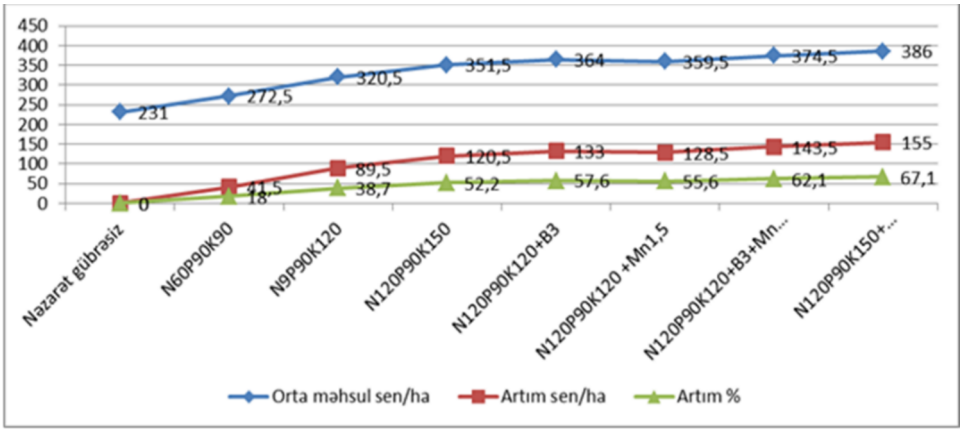

Fig. 2. The effect of different norm and rates of fertilizers on sugar beet root and fruit yield (Saatli district "Portofina KWS" variety) (c/ha).

The effect of different rates and proportions of fertilizers on the productivity of sugar beet plants was studied on the "Portofina KWS" sugar beet variety in Saatli district. During the conducted researches, among the different rates and rates of fertilizers, $N120P90K150+B_3+Mn_{1.5}$ applied per hectare was the most favorable variant. Thus, the yield increase in this variant was 155.0 cen/ha or 67.1% compared to the control (free fertilizer) variant, and 34.5% compared to the Fon.

4 Conclusion

1. 1. The fertilization system is the most important of the agrotechnical rules used during sowing in order to obtain high-quality, stable and environmentally friendly products from winter wheat plants.
2. Long-term agricultural use and irrigation of the sierozem-meadow soils of the Shirvan steppe led to an increase in the content of physical clay. Intensive use of arable land led to a decrease in the humus content, the content of mobile forms of phosphorus and potassium, and an increase in the alkaline reaction (alkalinization) compared to soils that were not subject to anthropogenic load.
3. 3. As a result of the experiments conducted against the background of N90K80, the effect of phosphorus fertilizers at rates corresponding to 50, 100 and 150% of the plant needs contributed to an increase in the yield of green mass of corn by an average of 15.7-47.4%; the application of potassium fertilizers against the background of N90P90 at rates corresponding to 50, 100 and 150% of the plant needs contributed to an increase in yield by 26-56%% compared to the background.
4. Over three years of experiments against the background of N90K60, the effect of phosphorus fertilizers at rates corresponding to 50, 100 and 150% of the plant needs contributed to an increase in the yield of green mass of corn by an average of 19-49%; the application of potassium fertilizers against the background of the N90P90 rate corresponding to 50, 100 and 150% of the plant needs contributed to an increase in yield by 24-51% relative to the background.
5. The effect of different fertilizer rates on the productivity of potato plants was studied using the "Arinda" variety in the Samukh district. Among the various fertilizer treatments, the most effective combination was N90P90K120+Mn5+B5 applied per hectare. This treatment resulted in a yield increase of 98.5 centners per hectare (or 84.5%) compared to the control (no fertilizer) variant. The inclusion of manganese and boron fertilizers contributed to an additional yield increase of 19.0 centners per hectare, or 9.7%, compared to the baseline treatment.
6. The effect of different rates and doses of fertilizers on the productivity of sugar beet plants was studied on the sugar beet variety "Portofina KVS" in the Saatli district. In the course of the studies, among various rates and doses of fertilizers, the most favorable option was N120P90K150 + B3 + Mn1.5 applied per hectare. Thus, the increase in yield in this option was 155.0 cents / ha or 67.1% compared to the control (without fertilizers) option and 34.5% compared to the background.

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