

REPUBLIC OF AZERBAIJAN

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ABSTRACT

of the dissertation submitted for the degree of Doctor of Sciences

**IMPACT OF OPTIMIZATION OF FERTILIZATION AND
IRRIGATION RATES OF MIXED CROPPING IN CATCH
CROP SYSTEM ON CROP YIELD, QUALITY AND SOIL
FERTILITY IN KARABAKH ECONOMIC REGION**

Specialty: **3101.01- “Agrochemistry”**

Field of science: **Agricultural science**


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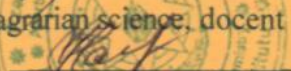
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COMMON CHARAKTERIZATION OF THE WORK

Relevance of the topic: According to the State program for guaranteeing the population with food, the goal set for grain production until 2015 is to increase yield per hectare and improve its quality. For this purpose, the forefront should be the use of scientific and technological progress in growing grain and the introduction of new technologies by farmers.

The strategic roadmap, approved by Decree of the President ¹of the Republic of Azerbaijan dated December 6, 2016 № 1138 for the production and processing of agricultural products, in key sectors of the national economy, including 9 strategic goals and 36 priority areas, set specific tasks to ensure sustainable development and strengthen a country of food security, diversification of the economy and the production of competitive agricultural products.

Currently, the introduction of such advanced new methods of irrigation and cultivation of agricultural crops, such as landless plowing, zero cultivation, mixed sowing; laser harrowing, etc. is expanding. The application of these methods not only increases production efficiency, but also ensures the sustainable use of natural resources.

No other organic substance can replace proteins in the diet of humans and animals. As a result of the lack of proteins in the diet of animals, their productivity decreases. Thus, a lack of protein in the diet is the cause of a serious metabolic disorder. In addition to grain crops, there is a large role for legumes in increasing the supply of proteins. The importance of a high concentration of proteins in feed crops is especially high.

Increasing the yield of mixed crops as a result of optimizing the number of irrigations and fertilizer rates and, based on this, a partial increase in the production of valuable high-quality feed for

¹ Strategic Road Map for the production and processing of agricultural products in the Republic of Azerbaijan". Decree of the President of the Republic of Azerbaijan dated December 6, 2016, 177 pages.

livestock breeding is of great importance for the national economy as one of the topical issues.

Aims and objectives of the study: Using favorable conditions of climate, soil and the amount of irrigation, obtaining 2 crops per year, increasing the yield of agricultural crops in order to meet the needs of livestock in feed, population with food, and industry with raw materials. Optimal fertilizer and irrigation rates standards and the amount of irrigation, to maintain soil fertility along with obtaining a large and high-quality crop of green mass from mixed stubble crops in gray-meadow soils from ancient times irrigated lands.

The research questions included:

1. The study of the effect of fertilizers on the nutritional regime of gray-meadow soils of mixed crops of stubble crops (corn and soy, sorghum and peas);

2. Determination of the impact of the introduction in the optimal norm of the number of irrigations and fertilizers on the yield of crops of mixed crops and the quality of the silage and the rationale for the introduction of economic efficiency².

Object of research: The object of research has long been irrigated gray-meadow soils of the municipality of Hindarkha, Agjabadi district in the low part of the Karabakh zone³.

Scientific novelties of the work: For the first time, ways to preserve the soil fertility of gray-meadow soils of the low part of the long-irrigated lands of the Karabakh zone, as well as to increase the yield and quality of crops of mixed crops on stubble and the amount of protein in green mass, along with the introduction of the optimal amount of fertilizers and irrigation rates, were studied.

The practical significance of the work. The silage mass of the crop of mixed crops by the amount of crude protein as a result of the introduction of optimal amounts of irrigation and fertilizer rates

² Dospikhov, B.A. Methodology of field experiment – M: Agropromizdat, 1985.- 280 p.

³ Jafarov Y.A., Mehdiyeva E.Kh. Methods of agrochemical analysis // -Baku: - 2014. 264p

in the optimal norm corresponds to the physiological nutrition of agricultural animals.

The main provisions submitted to the defense. The research work was carried out according to the plan and program on the farm of the village of Hindarkh, Agjabadi district of the low part of the Karabakh zone. As a result of the research, the following points were presented for discussion:

1. Agrochemical features of soils in the territory of ongoing studies of the low part of the Karabakh zone.

2. The influence of biological characteristics, amounts of irrigation and fertilizer rates of mixed crops of stubble crops on their growth and development.

3. The effect of the introduction of various norms of mineral and organic-mineral fertilizers against the background of different amounts of irrigation on the change in the nutritional regime of the soil in the sowing of mixed crops on stubble.

4. The effect of the joint application of irrigation and fertilizer norms on the amount of nutrients in the aerial mass of plants in sowing mixed crops on stubble.

5. The effect of irrigation and fertilizer norms on the yield of mixed crops on stubble.

6. The effect of irrigation and fertilizer norms on the quality indicators of the stern feed mixture of mixed crops.

7. The effect of irrigation and fertilizer application on the weight, chemical composition and amount of nutrients in the roots of mixed crops on stubble.

8. The effect of irrigation and fertilizer application on the fertility and agrophysical properties of stubble mixed crops.

9. The economic efficiency of the implementation of irrigation and fertilization standards for mixed crops on stubble and recommendations to farms.

Approbation of work. On the main provisions of the dissertation work in the finished reports of research works of the Azerbaijan State Agrarian University in 2002-2007, numerous discussions were held in scientific conferences and seminars.

Presentations were also made at the Lankaran State University, at the Research Institute of Agrochemistry and Soil Science, and discussions around research work. Around the research work, discussions and conclusions were also held at the following organizations and journals: Collection of international articles on agriculture (Tabriz, 2004), XIII International Conference: Innovation in the modern world. (Moscow 2013), International Scientific Conference "Applied Sciences and Europe: Common Challenges and Scientific Discoveries" (2014), Materials of the III International Scientific and Practical Conference "Modern Methodology of Science and Education" (May 31, 2017, Dubai, UAE). International Scientific and Practical Conference "World Science" No. 6 (22), Volume 6, June 2017-14. 16 sec Slovak International Scientific Journal No. 18 (2018, p. 3-4).

The volume and structure of the work. The dissertation, written in the Azerbaijani language, consists of an introduction, 7 chapters, conclusions, scientific and practical proposals, from a list of 315 references (among them 295 foreign literature), 25 tables and 345 pages with additions.

Chapter I. The main content of the work

The main content of the work: The analyzed review of the literature was reflected, and the relevance of the topic was studied.

The significance of stubble crops and its current state were studied. One of the main issues in the cultivation of crops in mixed stubble crops was reflected ways to obtain high-quality green mass harvest by creating complex agrophytocenoses.

As a result of cultivating crops on stubble, the field is always covered with green vegetation, which increases the utilization of solar energy and soil. But the right choice of crops for stubble crops is also the main condition for the cultivation of mixed crops, which is reflected in detail in the work.

Chapter II. Biological characteristics of mixed planted plants in Kuvshan, influence of fertilizer and irrigation norms on their height and development

The soil-climatic condition of the study area was studied, a favorable environment for obtaining 2 crops per year from a unit area was revealed. A review of the botanical description, the biological characteristics of mixed stubble crops, the technology of their cultivation, the need for irrigation and fertilizer was reviewed.

The influence of mixed stubble crops on their growth and development was studied (corn with soy, sorghum with peas, barley with alfalfa).

When determining the height of corn plants at the stage of milk-wax ripeness, it was revealed that various doses of mineral and organomineral fertilizers against the background of various amounts of vegetative irrigation fundamentally affect the growth of soy plants. So, against the background of 4 vegetation irrigations in the control variant without fertilizers, if the height of the corn plants was 184 cm, and the soybean plants 84 cm, as a result of the application of mineral and organomineral fertilizers along the stubble of the mixed crops of corn, the height of the plants varied between 189-284 cm, soybean spacing within 87-125 cm. On other options, these indicators also changed significantly. So, against the background of 4 vegetative irrigation, when applying doses of fertilizers in the ratio of $N_{120}P_{150}K_{150}$, plant growth, increasing significantly, amounted to 267 cm in corn and 117 cm in soybeans.

With the combined use of organic and mineral fertilizers, i.e. in the application of 10 tons of manure + $N_{70}P_{125}K_{90}$, the height of corn and soybean plants was 284 and 123 cm, respectively. As you can see, the combined use of organic and mineral fertilizers even had a better effect on plant growth.

During phenological observation, it was found that the use of organic and mineral fertilizers significantly affected the growth of plants. So, in the variant with the use of fertilizers in the ratio of $N_{40}P_{60}K_{60}$, the height of the corn plants was 209 cm, and soy plants

in 94 cm, in the variant with the use of fertilizers in the ratio of $N_{120}P_{150}K_{150}$ - 279 and 129 cm, in the variant of 10 tons of manure + $N_{70}P_{125}K_{90}$ 297 and 128 cm. As it can be seen that an increase in the number of irrigations with the combined use of organic and mineral fertilizers had an even better effect on plant growth.

Optimum irrigation and fertilizer rates more effectively affect the growth of mixed crops of corn and soybeans, which in turn contributes to an increase in green mass.

2.1. Influence of irrigation and fertilizer norms on the growth and development of plants of mixed crops on stubble (sorghum with peas). Against the background of various amounts of vegetation irrigation, the influence of the use of mineral and organomineral fertilizers in mixed crops of sorghum and pea stubble on plant growth was determined and noted.

When measuring the height of plants in the phase of milk-wax ripeness of mixed sowing of sorghum plants, it was determined that, against the background of various vegetative irrigation, the use of mineral and organomineral fertilizers significantly influenced the growth of sorghum and pea plants. So, while against the background of 3 vegetation irrigation in the control plot without fertilizers, the height of sorghum plants was 171 cm, and peas 75 cm, then in mixed crops on stubble sorghum, the height of sorghum plants varied between 178-254 cm, and the height of pea plants was 81-108 cm.

As a result of phenological observations, it became known that against the background of 3 vegetative irrigation, when the fertilizer norms were changed, the height of the plants increased as follows. So, in the variant with the fertilizer norm $N_{120}P_{150}K_{150}$, the height of sorghum and pea plants was 245 cm and 106 cm, respectively, with 10 t/hect of manure + $N_{70}P_{125}K_{90}$ - 254 cm and 108 cm. As you can see, the combined use of organic and mineral fertilizers had a better effect on plant height.

Against the background of 5 vegetation irrigations in the control variant without fertilizers, if the height of sorghum plants was 175 cm, and pea plants 79 cm, as a result of applying mineral and organomineral

fertilizers along stubble of mixed crops, the height of sorghum plants varied between 183-261 cm, of pea plants in within 84-112 cm.

So, in the variant with the use of fertilizers in the ratio $N_{40}P_{60}K_{60}$, the height of the sorghum plants was 183 cm, and the plants of peas 84 cm, in the variant with the use of fertilizers in the ratio $N_{120}P_{150}K_{150}$ - 252 and 108 cm, in the variant 10 t/hect of manure + $N_{70}P_{125}K_{90}$ 261 and 112 cm Based on the analysis, it is revealed that an increase in the number of irrigations with the combined use of organic and mineral fertilizers has a more positive effect on plant growth, which, in turn, helps to increase the yield of green mass.

2.2. Influence of irrigation and fertilizer norms on the growth and development of plants of mixed crops on stubble (barley and alfalfa). The effect of mineral and organomineral fertilizers on the growth and development of alfalfa after mowing barley against the background of different amounts of irrigation by year and crop was studied as a result of phenological observations.

As a result of phenological observations, it was determined that, depending on the amount of irrigation and fertilizer rates, the height of the plants has fundamentally changed. So, against the background of 4 irrigations in the control variant without fertilizers on the mowing (I, II, III and IV mowing), the height of the plants was 46 cm, 50 cm, 52 cm and 49 cm, in 5 irrigations, respectively 48 cm, 52 cm, 55 cm and 54 cm, in the application of fertilizers in a dose of $N_{30}P_{90}K_{60}$, respectively 51 cm, 54 cm, 57 cm and 54 cm, in 5 irrigations it changed between the indicators of 54 cm, 57 cm, 59 cm and 58 cm.

The use of fertilizers in various quantities and ratios more strongly affected the height of alfalfa plants. So, against the background of 4 irrigations in the variant of applying fertilizers in a dose of $N_{45}P_{120}K_{90}$, the height of the plants along the mowing areas will increase to 59 cm, 62 cm, 68 cm and 69 cm. Against the background of the number of irrigations to 5, the use of fertilizers in this norm changed the indicators to 60 cm, 65 cm, 70 cm, 68 cm.

During phenological observations, it became known that the use of organic and organomineral fertilizers against the background of various

amounts of irrigation had a profound effect on the height of alfalfa plants. So, against the background of 4 irrigations in the application of 10 t/hect of manure per hectare of area, if the height of the plants on the cuts was 50 cm, 55 cm, 56 cm, 55 cm, in 5 irrigations in the application 10 t/hect of manure per hectare of area, against the background of 4 irrigations in the joint application of 10 t/hect of manure + N₁₅P₆₀K₃₀, the indicators were 55 cm, 58 cm, 60 cm and 59 cm, respectively, in 5 irrigations, a variation of these indicators was observed between 56 cm, 60 cm, 63 cm and 61 cm.

In general, phenological observations suggest that the use of fertilizers in crops in the ratio of N₄₅P₁₂₀K₉₀ against the background of every 2 irrigations further increased the height of plants.

Chapter III. The effect of the application of fertilizer and irrigation rate on the change of the soil nutrient regime of the mixed spreading in current crops

3.1. Influence of irrigation and fertilizer norms in mixed stubble crops (corn with soybeans) on soil nutrient regime change. The effect of irrigation and fertilizer in mixed stubble crops on the dynamics of nutrients in the soil by development periods was studied in different periods. For this, average soil samples were taken from 2 soil horizons (0-30 cm and 30-60 cm) at 3 stages: staking, flowering and milk-wax ripeness in mixed crops (corn and soybeans). On soil samples taken, compounds of nitrogen, phosphorus, and potassium readily assimilated by plants were analyzed.

Against the background of 4 vegetation irrigation (4200 m³/ha) from the analysis of the taken soil samples, it becomes known that the amount of absorbed ammonium in the control variant without fertilizers at the stem stage in the arable and subsurface layer (15, VII) was 5.7-7.6 mg / kg, nitrates 3.5-5.1 mg / kg, mobile phosphorus 7.6-15.9 mg / kg, exchange potassium 223.4-265.7 mg / kg. With the introduction of various standards of irrigation and fertilizer, these indicators begin to gradually increase. So, in the variant of fertilizer application in the norm N₁₂₀P₁₅₀K₁₅₀, the indicators reached up to 8.4-9.9; 5.1-6.9; 11.4-22.2;

235.6-293.5 mg / kg, respectively. In the application of 10 t / ha of manure, the indicators were 8.4–9.5; 4.9-6.3; 11.1-20.9; 234.8-291.9 mg / kg.

Upon reaching the number of irrigations up to 6 (5600 m³ / ha), the indicators of effective fertility increased even more. In the variant of fertilizer application in the norm N₁₂₀P₁₅₀K₁₅₀, the indicators compared with other options were characterized by the highest numbers. So, absorbed ammonium 8.9-10.5 mg / kg, nitrates 5.6-7.5 mg / kg, phosphorus exchange 12.2-21.9 mg / kg, absorbed potassium was 238.4-299.8 mg / kg

With the combined use of organic and mineral fertilizers, the highest indicator was noted in the variant of applying fertilizer doses in the ratio of 10 t/hect of manure + N₇₀P₁₂₅K₉₀. The indicators ranged from 8.6-10.3 mg / kg, 5.5-6.9 mg / kg, 11.9-21.5 mg / kg, 239.6-298.7 mg / kg.

In the flowering phase, against the background of 4 vegetation irrigation, based on the analysis of soil samples taken, it becomes clear that in the control variant without fertilizers in the arable and subsurface layers of the soil, the amount of absorbed ammonium was 5.2-7.1 mg / kg, nitrates 3, -2-4.7 mg / kg, mobile phosphorus 7.1-12.5 mg / kg, and exchange potassium 203.7-242.7 mg / kg. In the ratio of the use of mineral fertilizers in the variant with the norm N₁₂₀P₁₅₀K₁₅₀, the indicators reached a level of 8.0-9.4, respectively; 4.8-6.3; 10.3-17.3; 215.6-268.5 mg / kg. In the variant of fertilizer application, the norm is 10 t / ha + N₇₀P₁₂₅K₉₀, the indicators were 7.4–9.6; 5.2-6.4; 10.5-18.4; 217.8-270.5 mg / kg.

Upon reaching the number of irrigations up to 6 in the control variant without fertilizers in the arable and subsurface layer of the soil in the flowering phase (25 VII), the amount of absorbed ammonium was 5.6-7.4 mg / kg, nitrates 3.6-5.2 mg / kg, mobile phosphorus 7.8-13.6 mg / kg, and exchange potassium 204.6-248.5 mg / kg. In the variant of the use of fertilizers in the ratio N₁₂₀P₁₅₀K₁₅₀, the indicators, characterized by even higher numbers, amounted to 8.3–9.8 mg / kg for absorbed ammonium, 5.3–6.8 for nitrates, and 11.5–18.4 mg / kg for mobile phosphorus. exchange potassium 217.4-270.5 mg / kg.

Against the background of 4 vegetation irrigation (4200 m³ / ha) based on the analysis of soil samples (12. IX) taken at the stage of milk-wax ripeness, it becomes clear that in the control version without fertilizers in the arable and subsurface layers of the soil the amount of absorbed ammonium amounted to 4.8-6.6 mg / kg, nitrates 3.1-4.0 mg / kg, mobile phosphorus 6.8-10.6 mg / kg, exchange potassium 182.2-221.3 mg / kg. In the application of mineral fertilizers in the ratio N₁₂₀P₁₅₀K₁₅₀, the indicators reached respectively 6.7-8.9; 4.6-5.8; 9.2-14.6; 196.1-245.6 mg / kg. In the variant of fertilizer application, the norm is 10 t/hect of manure + N₇₀P₁₂₅K₉₀, the indicators were 7.2-8.4; 4.6-5.7; 9.3-14.5 and 198.5-248.1 mg / kg.

In the control variant, without fertilizers at the stage of milk-wax ripeness against the background of 6-fold vegetative irrigation, the amount of absorbed ammonium was 5.1-6.9 mg / kg, nitrates 3.7-4.6 mg / kg, mobile phosphorus 7, 3-11.8 mg / kg, and exchange potassium 186.8-228.3 mg / kg. In the variant of fertilizer application in the ratio of N₁₂₀P₁₅₀K₁₅₀, the indicators were 6.7-9.4 mg / kg for absorbed ammonium, 5.1-6.4 for nitrates, 9.9-15.2 mg / kg for mobile phosphorus, and 206.5 for potassium exchange -255.7 mg / kg. With the combined use of organic and mineral fertilizers, the highest indicator was achieved in the variant of fertilizer application in the ratio of 10 t/hect of manure + N₇₀P₁₂₅K₉₀, which varied between 7.2 and 9.4, respectively; 4.0-6.1; 9.9-15.3 and 207.3-254.1 mg / kg.

Thus, against the background of varying amounts of vegetation irrigation, the use of mineral and organomineral fertilizers on mixed stubble crops (corn and sorghum) increases the amount of digestible soil nutrients. And this, in turn, has the necessary effect on productivity and its quality of mixed stubble crops. An analysis of soil samples during the study shows that the use of mineral and organomineral fertilizers against the background of various amounts of irrigation fundamentally affects effective soil fertility.

3.2. Influence of irrigation and fertilizer norms on changing the nutritional regime of mixed crops (sorghum and pea) soil on stubble. The influence of fertilizer and watering norms on the dynamics

of nutrient elements of the soil in mixed crops of stubble (sorghum and pea) by development phases in different periods has been studied at different phases of plant development. To do this, average soil samples were taken from two depths (0-30 and 30-60 cm) of mixed crops of 3 stages: the phase of stalking, flowering and the formation of ears. In the soil samples taken, compounds of nitrogen, phosphorus, and potassium readily assimilated by the plants were analyzed. Analysis of soil samples shows that the use of mineral and organic fertilizers against the background of various amounts of vegetation irrigation fundamentally affects the effective soil fertility.

Against the background of 3 vegetation irrigations (4200 m³ / ha) in mixed crops (sorghum and peas) from stubble, when analyzing soil samples taken, it becomes known that in the control variant, at the stage of stalking in the arable and subsurface layers of the soil (10, VII), the amount of absorbed ammonium was 5.2-7.3 mg / kg, nitrates 3.2-4.9 mg / kg, mobile phosphorus 7.3-15.7 mg / kg, and exchange potassium 221.5-260.1 mg / kg. When applying fertilizers in various norms, these indicators continue to increase to the maximum. So, when applying fertilizers in the ratio of N₁₂₀P₁₅₀K₁₅₀, the indicators reached up to 7.9-9.7; 4.8-6.6; 11.0-21.2; 231.6-288.2 mg / kg, respectively. In the application of fertilizers in the norm of 10 t/hect of manure + N₇₀P₁₂₅K₉₀, the indicators reached the amount of 7.4-9.2; 4.5-6.1; 10.9-20.7; 230.4-289.6 mg / kg.

When the number of irrigations reached 5 (5600 m³/ha), the indicators of effective fertility increased even more. When applying fertilizers in a ratio of N₁₂₀P₁₅₀K₁₅₀, indicators compared to other options were characterized by even higher values. So, the amount of absorbed ammonium was 7.9-9.8 mg / kg, nitrates 5.2-7.2 mg / kg, mobile phosphorus 11.8-21.3 mg / kg, exchange potassium 238.0-298, 6 mg / kg.

With the combined use of organic and mineral fertilizers, the highest indicator was obtained with the variant of fertilizer application in the ratio of 10 t/hect of manure + N₇₀P₁₂₅K₉₀. The amount of absorbed ammonium was varied in the range of 7.9-9.6 mg / kg, nitrates 5.2-6.7 mg / kg, mobile phosphorus 11.3-21.1 mg / kg, exchange potassium 237.8-297, 9 mg / kg.

Against the background of 3 vegetation irrigations, the analysis of the soil samples taken shows that in the control variant, in the flowering phase (21.VIII) in the arable and subsurface layers of the soil, the amount of absorbed ammonium was 5.0-6.9 mg / kg, and the application of mineral and organomineral norms fertilizers in mixed crops on stubble led to a change in the nutrient regime of the soil, in particular, the nitrate content ranged from 2.8-4.4 mg / kg, mobile phosphorus - from 7.0-11.6 mg / kg, and exchange potassium - 202.1-240.5 mg / kg. In the variant of fertilizer application in the ratio of N₁₂₀P₁₅₀K₁₅₀, the indicators increased respectively to 7.7-9.1; 4.5-6.1; 10.1-16.8; 212.6-265.6 mg / kg. In the variant of fertilizer application in the ratio of 10 t/hect of manure + N₇₀P₁₂₅K₉₀, the indicators reached the level of 7.3-8.7; 4.5-5.9; 9.2-16.7; 213.8-266.9 mg / kg.

When analyzing soil samples taken during the cob formation phase (15.IX), it became known that the intensity of increasing the nutrient content in the soil due to fertilizers decreases by the end of the growing season. So, against the background of 3 vegetation irrigation in the control version without fertilizers in the arable and subsurface horizons of the soil, the content of absorbed ammonium, nitrates, mobile phosphorus and exchange potassium amounted to 4.2-6.1, respectively; 2.8-3.7; 6.2-10.1 and 180.2-219.4 mg / kg. With the option of using mineral fertilizers in the norm of N₁₂₀P₁₅₀K₁₅₀, the indicators reached a level of 6.2-8.5, respectively; 4.2-5.4; 8.8-14.1 and 195.4-244.8 mg / kg. In the case of fertilizer application at a rate of 10 t/hect of manure + N₇₀-P₁₂₅K₉₀, the indicators were 6.8-8.1, respectively; 4.2-5.3; 9.1-14.0 and 196.9-246.7 mg / kg.

In the panicle formation phase (15.IX) against 5 vegetative irrigations in the control variant without fertilizers, the amount of absorbed ammonium, nitrates, mobile phosphorus, and metabolic potassium amounted to 4.7-6.4 mg / kg, 3.4-4.4, respectively mg / kg, 6.8-11.2 mg / kg and 185.6-227.2, in the variant of fertilizer application in the norm N₁₂₀P₁₅₀K₁₅₀, the indicators were 6.2-8.8 mg / kg, 4.7-6, respectively 0 mg / kg, 9.3-14.9 mg / kg and 204.9-254.7 mg / kg, and with the combined use of organic and mineral fertilizers, normally the

highest rate varied between 6.7-8, 6; 3.7-5.8; 9.3-15.0 and 205.8-252.6 mg / kg.

In general, in the phase of flowering and panicle formation under the influence of irrigation and fertilizers, effective soil fertility was observed compared to the control variant without fertilizing, which remained at a sufficient amount. And this indicates that the plant showed a high demand for this nutrient. The decrease in the number of nutrients in the panicle formation phase indicates its connection with the removal of high yields. Analysis of soil samples during the study shows that the introduction of mineral and organic fertilizers against a background of varying amounts of irrigation has fundamentally affected the effective soil fertility.

3.3. Influence of irrigation norms and fertilizer on changing the nutritional regime of the soil in mixed crops of barley and alfalfa. The influence of irrigation norms and fertilizer on the change in the nutritional regime of the soil in mixed crops of barley and alfalfa for different crops is studied for the first time from our side in the republic. For this, average soil samples were taken from two depths of the soil (0-30 and 30-60 cm) after each mowing. Easily digestible compounds of nitrogen, phosphorus and potassium were analyzed in the soil samples taken. The analysis of soil samples shows that the introduction of mineral and organic fertilizers against various vegetation irrigation fundamentally affects the effective soil fertility.

Against the background of 4 vegetation irrigation after harvesting barley (3800 m³/ha) from the analysis of soil samples taken from alfalfa, it becomes known that in the control version without fertilizers at the 1st mowing the amount of absorbed ammonium, nitrates, mobile phosphorus and exchange potassium amounted to 5.2-6.6, respectively; 3.3-4.9; 7.2-12.7 and 217.5-254.7 mg / kg. With the introduction of fertilizers in various quantities, these indicators continue to increase. So, in the variant of fertilizer application in the norm N₆₀P₉₀K₉₀ on the soil horizon of 0-30 cm in the 1st mowing, the amount of absorbed ammonium, nitrates, mobile phosphorus and exchange potassium amounted to 6.2-8.3, respectively; 4.5-5.4; 9.4-13.2 and 256-263 mg / kg. As a result of

research on the 2nd and 3rd mowing, an increase in nutrients is also observed.

With an increase in the number of vegetation irrigation to 5 (4800 m³ / ha), the indicators of effective fertility increased even more. With the variant of fertilizer application in the norm N₆₀P₉₀K₉₀, the indicators in relation to other options were characterized by even higher indicators. So, the amount of absorbed ammonium, nitrates, mobile phosphorus and metabolic potassium was 6.7-9.2, respectively; 4.6-6.3; 9.9-17.8 and 258.1-279.3 mg / kg.

Nutrients, participating in biochemical processes occurring in various intensities and directions in the plant during the period of plant development, fundamentally affect the plant organism. Plants always lack essential nutrients from the soil, such as nitrogen, phosphorus, and potassium. The rational use of nutrients by plants is much dependent on the creation of an optimal irrigation regime. Therefore, in order to characterize the needs of alfalfa against the background of various amounts of irrigation, the amount of nitrogen, phosphorus and potassium in the terrestrial part of the plants was determined by different slopes. A nutrient analysis of the cut study shows that the highest total NPK is observed in the 2nd cut.

Chapter IV. The effect of the combined application of fertilizer and irrigation rate on the amount of nutrient elements on the development stages in the ground mass of plants mixed sowed in vertical crops

4.1. Influence of the introduction of irrigation and fertilizer norms on the amount of nutrients by development periods in the ground part of plants in mixed crops (corn and soy) on stubble. In order to clarify the nutritional needs of mixed-sowing plants, the dynamics of the accumulation of individual nutrients (nitrogen, phosphorus, potassium) in the terrestrial part of the plant by the development phases in field experiments was studied.

Based on the analysis of the dynamics of the amount of nutrients in the development phases as a result of the introduction of different

fertilizer norms against the background of 4 vegetation irrigation, it is seen that the highest NPK is observed in the stalk phase. So, in the growing season, 4 irrigation was carried out, in the control version without fertilizers, if it was 1.42%, 0.70%, 1.48%, the amount of nutrients in the flowering period, much decreasing, amounted to the total nitrogen 1, 09%, total phosphorus 0.54% and total potassium 1.21%. And in the phase of milk-wax ripeness, the amount of total nitrogen was 0.96%, total phosphorus 0.40%, and total potassium 1.14%.

Against the background of 4 vegetation irrigation with the use of fertilizers in the variant with the $N_{120}P_{150}K_{150}$ norm, the amount of total NPK in the stem phase was 1.72%; 0.89%; 1.82%, in the flowering phase 1.36%; 0.76%; 1.49%, and in the phase of milk-wax ripeness decreased to 1.15%; 0.56%; 1.31%.

With the combined use of organic and mineral fertilizers, the indicators have changed a lot. So, in the embodiment, when applying 10 t/hect of manure + $N_{70}P_{125}K_{90}$ in the staking phase, they reached 1.73%; 0.90%; 1.85%, in the flowering phase 1.39%; 0.78%; 1.49%, and in the phase of milk-wax ripeness to 1.16%; 0.56%; 1.32%.

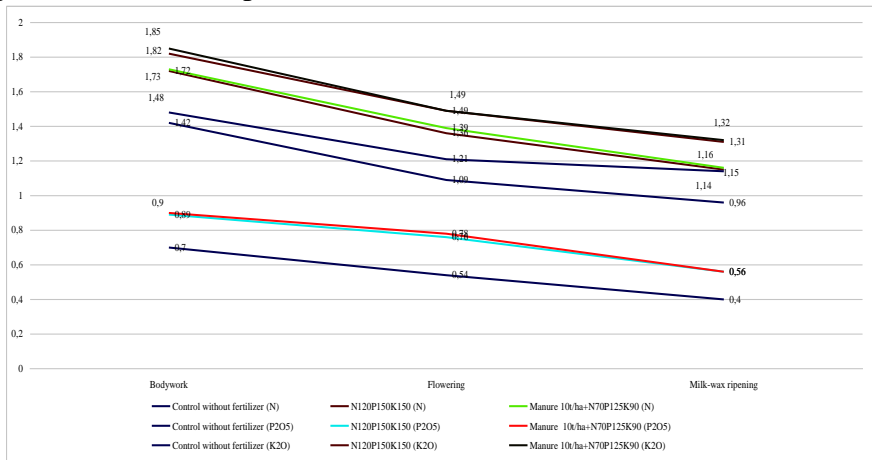


Fig.1. Suvarma və gübrə normalarının kövsənlik əkinlərdə qarışıq səpirlərə (qarğıdalı və soya) verilməsinin bitkilərin yerüstü kütləsində inkişaf mərhələləri üzrə qida elementlərinin miqdarına təsiri. (havada quru maddə %-lə)

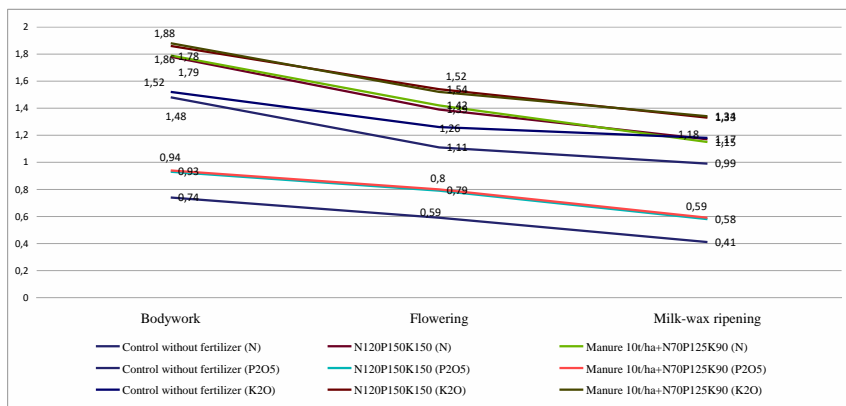


Fig.2. Effect of irrigation and fertilizer rates on mixed sowing (maize and soybeans) in fallow crops on the amount of nutrients in the above-ground mass of plants by developmental stages. (% dry matter in air)

When applying 6-fold irrigation during the growing season in mixed crops in the control variant without fertilizers, the amount of total nitrogen reached 1.48%, total phosphorus 0.74%, total potassium 1.52%, in the flowering phase, the amount of nutrients sharply decreased, reached the level of 1.11%; 0.59%; 1.26%, in the phase of milk-wax ripeness to levels of 0.99%; 0.41%; 1.18%, in the embodiment, when applying fertilizers in the norm $N_{120}P_{150}K_{150}$ in the stem phase, they reached the level of 1.78%; 0.93%; 1.86%, in the flowering phase 1.39%; 0.79%; 1.54%, and in the phase of milk-wax ripeness to levels of 1.17%; 0.58%; 1.33%.

With the combined use of organic and mineral fertilizers, the indicators have changed a lot. So, in the variant, when applying 10 t/hectare of manure + $N_{70}P_{125}K_{90}$ in the staking phase, they reached 1.79%; 0.94%; 1.88%. Superior features were noted at other stages of the growing season, in the flowering phase they reached 1.42%; 0.80%; 1.52%, and milky-wax ripeness to levels of 1.15%; 0.59%; 1.34%.

From the results of plant samples taken during the study for all phases of development, it becomes clear that the combined use of organic and mineral fertilizers at the optimum rate in mixed crops contributes to the accumulation of nutrients in plants in high quantities.

4.2. The influence of the application of irrigation and fertilizer norms on mixed crops (sorghum and peas) on stubble on the accumulation of nutrients in the land mass of plants (dry matter content in air,%). In order to determine the nutritional needs of mixed crops for plants, the dynamics of accumulation of nutrients (nitrogen, phosphorus, potassium) on the ground green mass were determined according to the development phases of field experiments separately. Based on analyzes of nutrients in plants by the phases of plant development, it can be seen that the highest NPK content is observed at the stem phase. So, against the background of 3-fold vegetation irrigation during the growing season in the control variant without fertilizers, if the content of total nitrogen, total phosphorus, total potassium was 1.39%, 0.68% and 1.44%, respectively, then in the flowering phase nutrients declining, reached the level of 1.09%; 0.56%; 1.24%, and in the phase of milk-wax ripeness reached 0.93%; 0.37%; 1.11%.

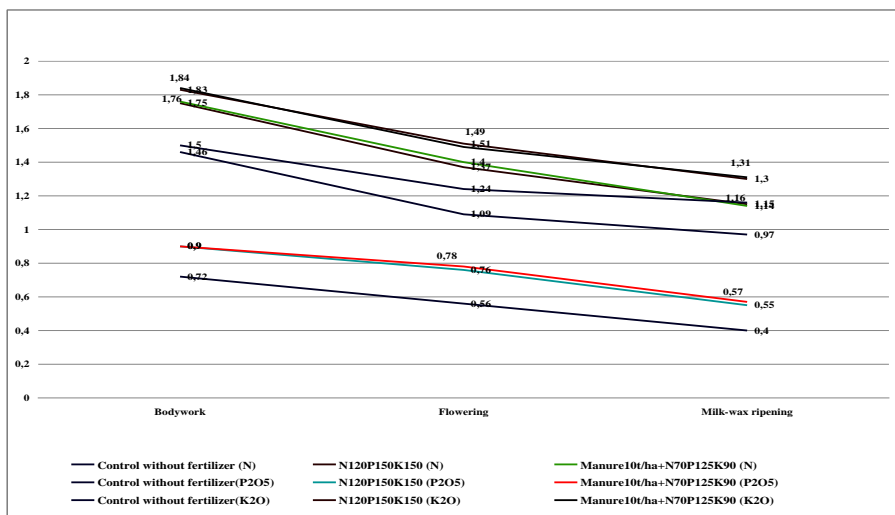


Fig.3. Effect of irrigation and fertilizer rates on mixed sowing (sorghum and pea) on the amount of nutrients in the above-ground mass of plants by development stages. (% dry matter in air) 5 times irrigation (5200 m³/ha)

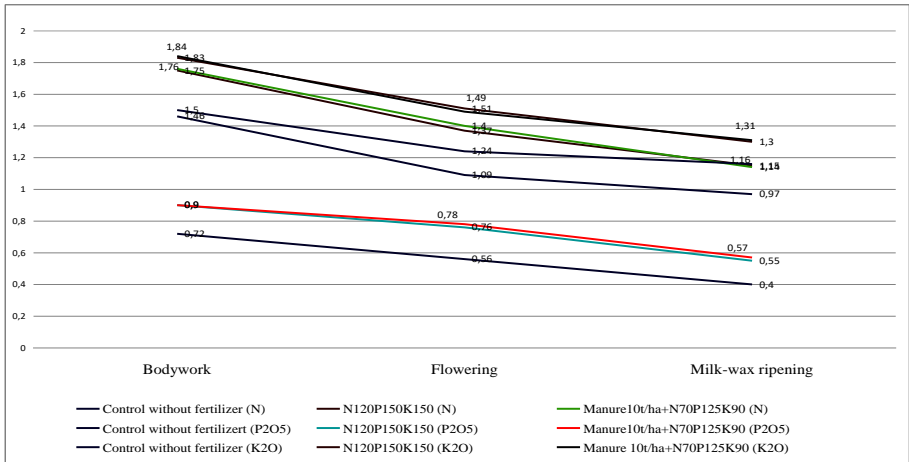


Fig.4. Effect of irrigation and fertilizer rates on mixed sowing (sorghum and pea) on the amount of nutrients in the above-ground mass of plants by development stages. (% dry matter in air) 5 times irrigation (5200 m³/ha)

Against the background of various amounts of vegetation irrigation, the use of organic and mineral fertilizers had a profound effect on the amount of nutrients. So, against the background of 3-fold vegetation irrigation in the variant of fertilizer application in the norm N₁₂₀P₁₅₀K₁₅₀, the NPK content reached 1.71% in total nitrogen, 0.86% in total phosphorus, and 1.8% in total potassium. The superior features shown were also observed at other stages of the growing season. If in the flowering phase the content of total nitrogen was 1.32%, total phosphorus was 0.73%, and total potassium 1.46%, then in the phase of milk-wax ripeness, these indicators, decreasing, amounted to 1.12%, respectively; 0.54%; 1.29%.

In the variant of fertilizer application, the norm of 10 t / ha of manure + N₇₀P₁₂₅K₉₀ in the stalling phase, the total nitrogen content was 1.70%, total phosphorus 0.87%, total potassium 1.81%, in the flowering phase 1.37%; 0.75% and 1.45%, respectively, then in the phase of milk-wax ripeness reached the level of 1.13%; 0.53%; 1.30% respectively.

Against the background of 5-fold vegetation irrigation, the dynamics of nutrient accumulation on the ground green mass was studied for individual phases of plant development. In the control version without

fertilizers, if the total nitrogen content was 1.46%, the total phosphorus was 0.72%, and the total potassium was 1.50%, then in the flowering phase it was 1.09%, respectively; 0.56%; 1.24%, in the phase of milk-wax ripeness, respectively, 0.97%; 0.40%; 1.16%.

In the variant of fertilizer application in the norm N120P150K150, the NPK content in the stem phase is 1.75% for total nitrogen, 0.90% for total phosphorus, and 1.83% for total potassium. The superior features shown were also observed at other stages of the growing season. So, if in the flowering phase the content of total nitrogen was 1.37%, total phosphorus 0.76%, total potassium 1.51%, in the phase of milk-wax ripeness, the indicators decreased to the level of 1.15%; 0.51%; 1.30%.

In the variant of fertilizer application, the norm of 10 t / ha of manure + N₇₀P₁₂₅K₉₀ is the total nitrogen, phosphorus and potassium content, if they reached the level of 1.76%, 0.90% and 1.84% in the staking phase, then in the flowering phase they amounted to 1.40 %; 0.78%; 1.49%, and in the phase of milk-wax ripeness amounted to 1.14%; 0.57% and 1.31%, respectively. As can be seen, in mixed plantings, the dynamics of the accumulation of nutrients in the terrestrial green mass gradually decreased according to the development phases.

As a result of analyzes of plant samples taken for all phases of plant development during the study, it becomes clear that the combined use of organic and mineral fertilizers at the optimal level in mixed crops (sorghum and peas) contributes to the accumulation of nutrients in plants in high quantities.

4.3. The influence of the joint application of irrigation and fertilizer norms on the accumulation of nutrients in the ground mass by crop cuts in mixed crops (barley and alfalfa). From studies conducted at different periods of time, it becomes clear that the chemical composition of forage crops directly depends on the level of mineral nutrition of plants. To characterize the nutritional needs of alfalfa plants after barley mowing, against the background of various amounts of irrigation in the land mass of plants, the dynamics of nutrients such as nitrogen, phosphorus, and potassium was studied in field experiments.

Against the background of various amounts of irrigation, the use of organic and mineral fertilizers greatly increased the amount of total nitrogen, phosphorus and potassium in the slopes. So, in the control version without fertilizers when applying 4 irrigation in the 1st mowing, the content of total nitrogen in the ground mass was 2.32%, total phosphorus 0.60%, total potassium 1.84%, in the second mowing the indicators were respectively 2.38; 0.64%; 1.97%, in the third mowing 2.42; 0.66; 2.10, and in the fourth 2.25; 0.59; 1.78%. In the variant of fertilizer application in the norm $N_{30}P_{90}K_{60}$ in the 1st mowing, the indicators were N-2.49%, P_2O_5 -0.62%, K_2O -1.89%, respectively, in the 2nd - 2.46; 0.65%; 2.11%, in the 3rd - 2.47; 0.68; 2.21, and in the 4th - 2.00; 0.67; 2.10%. When applying the norms of fertilizers $N_{45}P_{120}K_{90}$ N content; P_2O_5 , and K_2O in the 1st mowing, respectively, 2.55; 0.70 and 1.94, in the 2nd mowing 2.48; 0.66 and 2.07, in the 3rd mowing 2.47; 0.69 and 2.05%, respectively. From this it becomes clear that a favorable nutritional regime for alfalfa depends on the optimization of fertilizer rates for various amounts of irrigation. The use of organic and mineral fertilizers in the optimal norm contributed to the accumulation of nutrients in the plant in high quantities. It also has a positive effect on the accumulation of nutrients in the terrestrial part of alfalfa plants by mowing.

Chapter V. The effect of fertilizer and irrigation rate on the green mass productivity of mixed sowing and the quality indicators of the received forage in current crops

5.1. Influence of irrigation and fertilizer norms on the yield of green mass of plants of mixed crops (corn and soy) stubble. The effect of fertilizer norms and irrigation quantities on the yield of green mass of mixed crops of corn and soybean was studied. The conducted studies prove that the right choice of crops in mixed crops, the implementation of complex agrotechnical measures in the right order and the use of mineral and organic fertilizers greatly increase the quantity and quality of the total crop.

The use of organic fertilizers against the background of various amounts of irrigation during the study had a positive effect on the yield of mixed crops of corn and soy.

As a result of the studies, it was determined that against the background of 4 vegetation irrigation (4200 m³), if the yield of mixed crops in the control variant without fertilizers was 354 cen/hect, the yield increased under the influence of mineral and organic fertilizers, varied between 451 cen/hect and 614 kg/hect. Thus, as a result of the study, it becomes clear that in the economy during the shortage of water against the background of 4-fold vegetation irrigation (4200 m³), the use of organic and mineral fertilizers significantly increases the yield of mixed crops of corn and soy. So, if the yield of mixed crops of the control variant without fertilizers was 354 kg/hect, then with the application of fertilizer standards N₁₂₀P₁₅₀K₁₅₀ the yield of 614 kg/hect was achieved, which indicates an increase of 260 kg/hect or 73.4% compared with the control variant.

Table 1
Influence of irrigation and fertilizer norms on the yield of green mass of plants of mixed crops (corn and soy) stubble

№	Options	3 timeswatering (3100 m ³)			5timeswatering (5200 m ³)		
		Average productivity, cent/hect	increase		Average productivity, cent/hect	increase	
			cent/hect	%		cent/hect	%
I	Control option	354	-	-	375	-	-
II	N ₄₀ P ₆₀ K ₆₀	451	97	27,4	486	111	29,6
III	N ₆₀ P ₉₀ K ₉₀	520	166	46,8	534	159	42,4
IV	N ₉₀ P ₁₂₀ K ₁₂₀	601	247	69,8	635	260	69,3
V	N ₁₂₀ P ₁₅₀ K ₁₅₀	614	260	73,4	651	276	73,6
VI	manure 10 t/hect + p ₃₅	423	69	19,5	454	79	21,6
VII	manure 10 t/hect + n ₁₀ p ₆₅ k ₃₀	505	151	24,65	522	147	39,2
VIII	manure 10 t/hect + n ₄₀ p ₉₅ k ₆₀	574	220	62,1	617	242	64,5
IX	manure 10 t/hect + N ₇₀ P ₁₂₅ K ₉₀	581	227	64,1	628	253	67,5

E=10,83
P=2,1

E=3,41
P=0,62

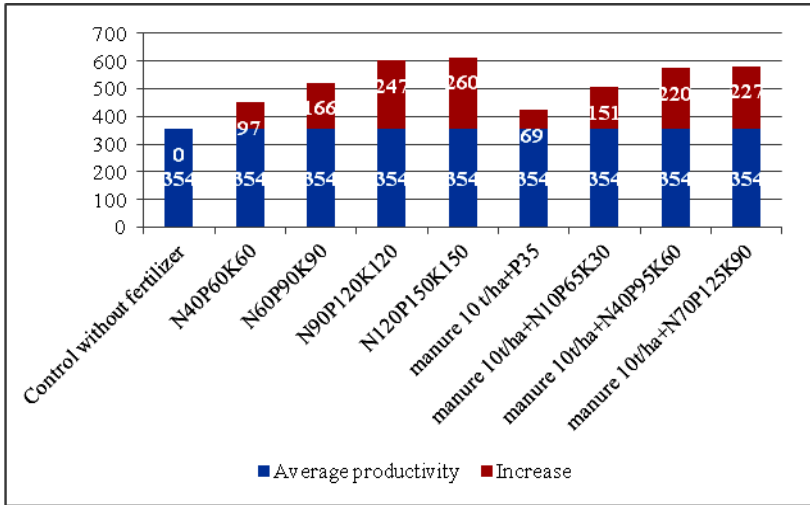


Fig.5.The effect of fertilizer and irrigation rates on the green mass productivity of the mixed sowing of corn and soybeans in the corner crops (2003-2005, average s/ha over 3 years) - 4 times irrigation (4200 m³)

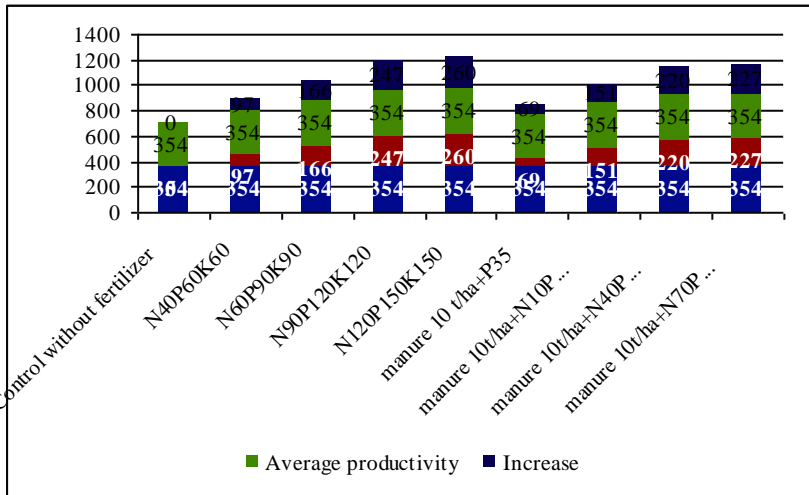


Fig.6.The effect of fertilizer and irrigation rates on the green mass productivity of the mixed sowing of corn and soybeans in stubble crops (2003-2005, 3-year average s/ha) - (6 times irrigation 6300 m³)

When using mineral and organomineral fertilizers, a sharp increase in productivity was noticed. So, in the application of 10 t/hect of manure + N₇₀P₁₂₅K₉₀, a yield of 581 kg/hect was obtained. And this means a yield increase of 227 kg/hect or 64.1% compared with the control without fertilizers.

If the yield amounted to 375 kg/hect in the control variant without fertilizers against the background of 6-fold vegetation irrigation, while using mineral and organic-mineral fertilizers, the green mass, increasing, varied between 486 and 651 kg/hect.

Against the background of 6-fold vegetation irrigation (6300 m³ / ha), a manifestation of a similar effect is visible. So, when applying the N₁₂₀P₁₅₀K₁₅₀ fertilizer norms, a yield of 651 kg/hect was achieved, which, compared to the control version without fertilizers, indicates a yield increase of 276 kg/hect and 73.6%.

Against the background of 6-fold vegetation irrigation (6300 m³ / ha) with the use of mineral and organomineral fertilizers, a multiple increase in yield also became clear. So, in the application of 10 t/hect of manure + N₇₀P₁₂₅K₉₀, a yield of 628 kg/hect was achieved. And this amounts to an increase of 253 kg/hect or 67.5% compared with the control variant without fertilizers.

But it should be noted that irrigation water in our country is lacking mainly in the Aran zone. Therefore, with a 6-fold watering, the resulting crop is not very economically sound.

The mathematical calculations carried out at the end of the experiment prove the accuracy of the experiment. The indicator E (kg/hect) obtained from fertilizer is many times high.

Based on the results of the study, we can say that during the simultaneous sowing of corn and soybeans to obtain a high yield of green mass, the optimal irrigation and fertilizer rates were determined.

5.2. Influence of irrigation and fertilizer norms on the yield of green mass of mixed crops of sorghum and pea on stubble. The use of fertilizers along with other agrotechnical measures on mixed stubble crops had a decisive influence. So, during our research, we

studied the effect of irrigation and fertilizer rates on the yield of green mass of mixed sorghum and field pea crops on stubble.

Against the background of 3-fold vegetation irrigation in the control version without fertilizers, when obtaining a green mass yield of 360 kg/hectare with the use of various fertilizer norms, the yield increased to 458-617 kg/hectare. So, when applying the norms of fertilizers in $N_{120}P_{150}K_{150}$, a yield of 617 kg/hectare was achieved. Despite the fact that the highest yield was achieved by applying fertilizers in the norm of $N_{120}P_{150}K_{150}$, but in mathematical calculations it becomes clear that the most exemplary option is the variant with the fertilizer norm of $N_{90}P_{120}K_{120}$ with a yield of 607 kg/hectare, which indicates compared to the control variant without fertilizers to increase productivity by 247 kg/hectare or 68.61%. In the application of 10 t/hectare of manure + $N_{70}P_{125}K_{90}$, the yield of green mass was 592 kg/hectare, which compared to the control version without fertilizers is a yield increase of 232 kg/hectare or 64.44%.

Against the background of 5-fold vegetation irrigation in the control variant without fertilizers, when harvesting 376 kg/hectare, using different fertilizer norms, the yield increased to 482-655 kg/hectare. So, when applying fertilizer standards in $N_{120}P_{150}K_{150}$, a yield of 655 kg/hectare was achieved.

As a result of the combined use of mineral and organic fertilizers against the background of 5-fold irrigation during the growing season, the yield of green mass has increased significantly. So, in the variant of fertilizer application at a rate of 10 t/hectare of manure + $N_{70}P_{125}K_{90}$, the yield was 632 kg/hectare, which means an increase of 256 kg/hectare or 68.08% compared to the control version without fertilizers. The mathematical calculations carried out at the end of the study prove the accuracy of the experiment. Obtained from fertilizers E is much higher in terms of yield. Based on the results of the study, we can say that when sorghum and peas were sown together to obtain a high yield of green mass, the optimal irrigation and fertilizer rates were determined.

Studies have shown that the right choice of plants in mixed crops, the implementation of complex agrotechnical measures in the right order positively affects the increase in overall productivity.

Table 2

The effect of fertilizer norms and irrigation quantities on the green mass productivity of mixed crops of sorghum and pea on stubble (average 3 years)

№	Options	3 times watering (3100 m ³)			5 times watering (5200 m ³)		
		Average productivity, cent/hect	increase		Average productivity, cent/hect	increase	
			cent/hect	%		cent/hect	%
I	Control option	360	-	-	376	-	-
II	N ₄₀ P ₆₀ K ₆₀	458	98	27,22	482	106	28,19
III	N ₆₀ P ₉₀ K ₉₀	520	160	44,44	554	178	47,34
IV	N ₉₀ P ₁₂₀ K ₁₂₀	607	247	68,61	642	266	74,74
V	N ₁₂₀ P ₁₅₀ K ₁₅₀	617	257	71,38	655	279	74,20
VI	manure 10 t/hect + P ₃₅	427	6	18,61	457	81	21,54
VII	manure 10 t/hect + N ₁₀ P ₆₀ K ₃₀	509	149	41,38	546	170	45,21
VIII	manure 10 t/hect + N ₄₀ P ₉₅ K ₆₀	582	222	61,66	622	246	65,42
IX	manure 10 t/hect + N ₇₀ P ₁₂₅ K ₉₀	592	232	64,44	632	256	68,08

E = 2,3 cen/hect

P = 0,44%

E = 7,54 cen/hect

P = 1,36%

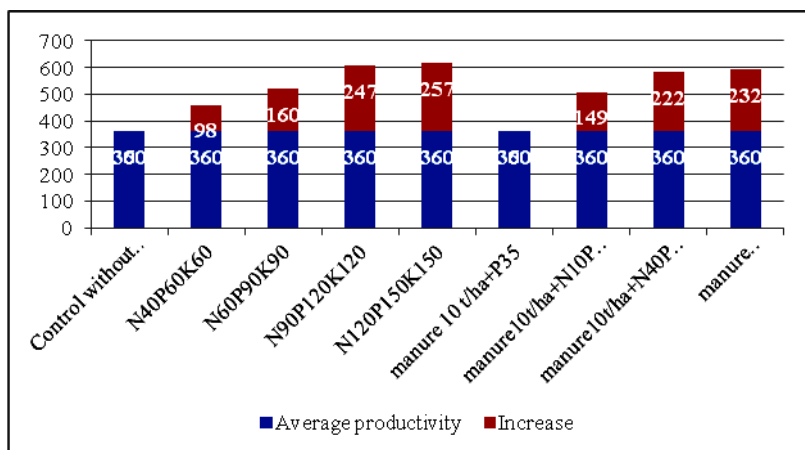


Fig.7. The effect of fertilizer and irrigation rates on the green mass productivity of mixed sowing of sorghum and chickpeas in stubble crops (2006-2008, average of 3 years) (3 times irrigation 3100 m³/ha)

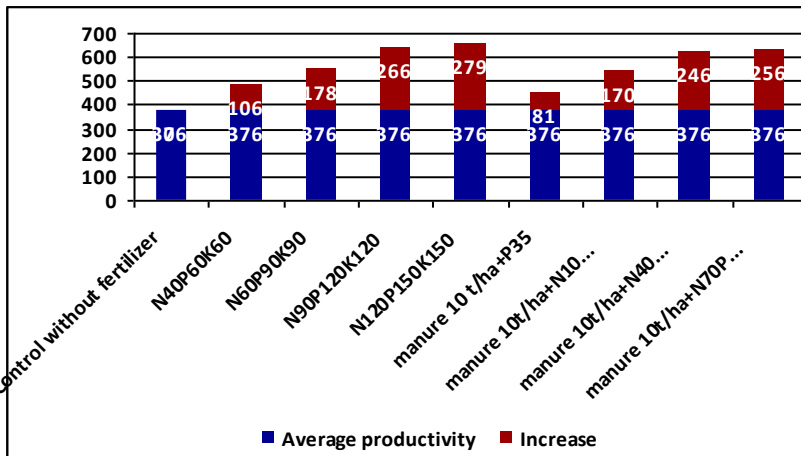


Fig.8. The effect of fertilizer and irrigation rates on the green mass productivity of mixed sowing of sorghum and chickpeas in stubble crops (2006-2008, average over 3 years) (5 times irrigation 5200 m³/ha)

5.3. Influence of irrigation and fertilizer norms on the yield of green mass of mixed crops of barley and alfalfa on stubble.

Watering and fertilizer rates fundamentally affected the yield of green mass of alfalfa under barley and greatly increased its yield. So, if against the background of 4-fold vegetation irrigation in the control variant without fertilizers on cuts (I, II, III and IV), the yield was 104; 105; 110 and 100 kg/hect, in the application of the norms of fertilizer N₄₅P₁₂₀K₉₀ the yield of green mass was 160; 168; 173 and 156 kg/hect, respectively, in the case of application of fertilizer norms in the norm of 10 t/hect of manure + N₁₅P₆₀K₃₀, these indicators increased to 152; 156; 158 and 149 kg/hect, respectively.

Against the background of 5-fold irrigation in the control version without fertilizers, the crop of green mass on the cuts (I, II, III, IV cuts) if it was 112; 116; 119 and 105 kg/hect, respectively, the use of fertilizers in various norms significantly increased productivity. So, in option N₄₅P₁₂₀K₉₀ if the yield of green mass was 178; 183; 187 and 175 kg/hect, in the application of 10 t/hect of manure + N₁₅P₆₀K₃₀, the indicators increased to the level of 156; 163; 167 and 151 kg/hect.

Table 3
The influence of fertilizer and watering rates on the yield of green mass of mixed sowing of barley and alfalfa

№	Options	Yield, cent/hect				Average productivity, cent/hect	Increase	
		I mowing	II mowing	III mowing	IV mowing		Cent/hect	%
4 times watering, 3800 m ³ /ha								
I	Control option, without fertilizer	104	105	110	100	419	-	-
II	N ₃₀ P ₉₀ K ₆₀	135	145	148	134	562	143	34,12
III	N ₄₅ P ₁₂₀ K ₉₀	160	168	173	156	657	238	56,80
IV	Manure 10 t/hect	120	124	127	119	490	71	16,94
V	Manure 10 t/hect + N ₁₅ P ₆₀ K ₃₀	152	156	158	149	615	196	46,77
5 times watering, 4800 m ³ /ha								
I	Control, without fertilizer	112	116	119	105	452	-	-
II	N ₃₀ P ₉₀ K ₆₀	158	165	168	158	650	198	43,87
III	N ₄₅ P ₁₂₀ K ₉₀	178	183	187	175	723	271	59,95
IV	Manure 10 t/hect	142	151	154	138	585	133	29,42
V	Manure 10 t/hect + N ₁₅ P ₆₀ K ₃₀	156	163	167	151	637	185	40,92

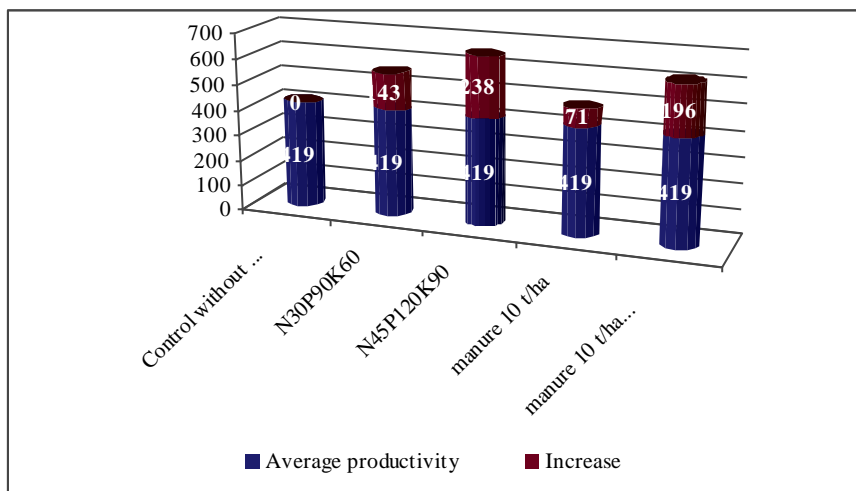


Fig.9. Effect of fertilizer and irrigation rates on green mass productivity of mixed-seeded alfalfa (3-year average (s/ha)) (4 times irrigation 3800 m³/ha)

As can be seen from the table, against the background of 4-fold irrigation, the best option was the option N₄₅P₁₂₀K₉₀, in which the

average yield for 3 years was 657 kg/hect. Compared to the control variant without fertilizers, the increase was 238 kg/hect or 56.8%.

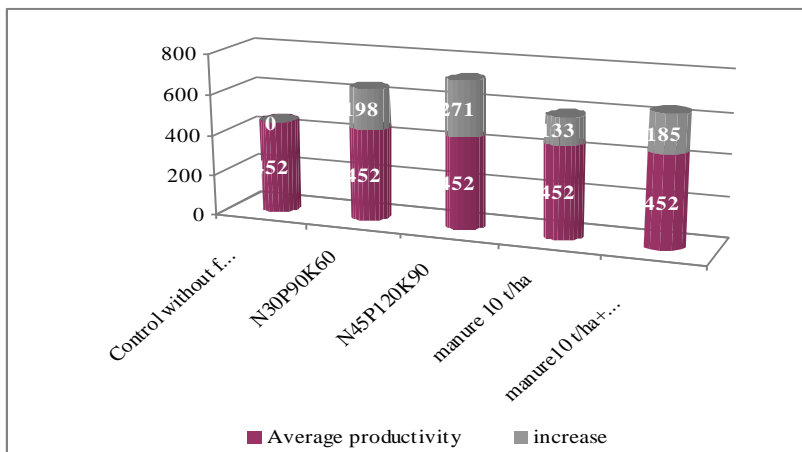


Fig.10. The effect of fertilizer and irrigation rates on green mass productivity of mixed sown alfalfa (3-year average (s/ha)) (5 irrigations 4800 m³/ha)

The highest indicator against the background of 5-fold vegetation irrigation was achieved in option N₄₅P₁₂₀K₉₀, in which the average yield for 3 years was 723 cen/hect, the increase compared with the control was 271 cen/hect or 59.95%. An even higher fertilizer rate increased the yield to the level of experience accuracy.

Ultimately, a mathematical calculation when accounting for the crop proved the accuracy of the experiment. The yield increase due to irrigation and fertilizer was several times greater than the indicated indicator E in kg/hect.

Chapter VI. The effect of the application of fertilizer and irrigation rate on the mass, chemical composition, amount of nutrient substance and soil fertility of mixed crop residues

6.1. Influence of irrigation and fertilizer norms on quantitative indicators of feed obtained from mixed crops of corn and soybeans on stubble. During the study, the effect of

optimizing the norms of mineral and organic fertilizers and the amount of irrigation, both on the yield of mixed crops and on the quality indicators of the feed, was also studied.

On stubble crops against the background of 4-fold irrigation in the control variant without fertilizers mixed corn and soybean crops, if the increase in the amount of crude protein was 6.0-6.2%, when applying the fertilizer norms $N_{90}P_{120}K_{120}$, the increase increased to 6.9- 7.1%, with a norm of $N_{120}P_{150}K_{150}$ - 7.1-7.3%.

Against the background of 4-fold vegetation irrigation, a similar case occurred in the variants of combined use of organic and mineral fertilizers. So, when applying fertilizers in the norm of 10 t/hect of manure + $N_{40}P_{95}K_{60}$, the increase was 7.0-7.1%, in the version of 10 t/hect of manure + $N_{40}P_{125}K_{90}$ the increase was 7.2%.

From the results of the analysis, it becomes clear that the amount of dry matter in relation to the absolute dry weight has increased significantly under the influence of fertilizer and watering rates. For example, in the control version without fertilizers, the amount of dry matter, if it was 25.0-26.0%, when applying fertilizers in the norm $N_{120}P_{150}K_{150}$ increased to the level of 26.0-26.5%.

A similar situation also occurred in the options for the combined use of organic and mineral fertilizers. So, in the application of fertilizers in the norm of 10 t/hect of manure + $N_{40}P_{95}K_{60}$, the amount of dry matter was 24.5-26.0%, while the norm of 10 t/hect of manure + $N_{70}P_{125}K_{90}$ is 26.0-26.5%.

In the experiment, the effect of fertilizers on the amount of nitrate accumulation in the green mass of feed was determined. The results show that mineral and organic fertilizers increase the amount of nitrate nitrogen in green feed. So, in the variant without fertilizers, if nitrates are accumulated in natural mass in the amount of 65-71 mg / kg, then when applying $N_{90}P_{120}K_{120}$, these indicators reached the level of 78-87 mg / kg, with the norm of fertilizers $N_{120}P_{150}K_{150}$ increased to the level of 85-92 mg / kg.

A similar situation also occurred in the options for the combined use of organic and mineral fertilizers. So, in the application of 10 t/hect of manure + $N_{70}P_{125}K_{90}$, this figure was 86-91

mg / kg. These indicators were much less than the maximum permissible degree in forage crops (200 mg / kg in natural weight). And this proves that the product is environmentally friendly.

During the study, the yield of feed units in the crop of green mass obtained from mixed crops and the amount of digestible protein when using mineral and organomineral fertilizers were also studied. If in the control variant without fertilizers the yield of feed units from an area of 1 ha was 8057 units, the digestible protein 718 kg/hectare, when using fertilizers in the norm $N_{120}P_{150}K_{150}$ - 13580 units, and the digestible protein increased to the level of 1210,4 kg.

A similar situation also occurred in the options for the combined use of organic and mineral fertilizers. So, using fertilizers at a rate of 10 t/hectare of manure + $N_{40}P_{95}K_{60}$, 12649 kg of feed units and 1127.4 kg of digestible protein were produced, using fertilizers at a rate of 10 t/hectare of manure + $N_{70}P_{125}K_{90}$ 12,931 kg of feed units, 1152.5 kg of digestible protein.

So, the use of fertilizers to the optimal border and the implementation of the right timely irrigation significantly improve the quality of the crop along with the yield of mixed crops.

6.2. Influence of irrigation and fertilizer standards on the quality of feed obtained from mixed crops of sorghum and peas.

During the study, the effect of optimizing fertilizer rates and irrigation rates along with the yield of mixed crops (sorghum and peas) and on the quality of the feed was also studied. As a result of the analyzes, the amount of crude protein, the amount of absolute dry matter, the amount of nitrate nitrogen in the natural mass, the yield of feed units per hectare of area and the amount of digestible protein were determined.

If the amount of crude protein in the control variant without fertilizers of mixed crops of sorghum and soybean against the background of 3 irrigation on stubble was 6.0-6.2%, when applying fertilizers in the norm $N_{90}P_{120}K_{120}$ was 6.9-7.1%, when applying fertilizer norm $N_{120}P_{150}K_{150}$ increased to 7.2-7.3%.

A similar situation also occurred in the options for the combined use of organic and mineral fertilizers. So, when using fertilizers at a rate of 10 t/hect of manure + N₄₀P₉₅K₆₀, the amount of crude protein was 7.0-7.1%, while using fertilizers at a rate of 10 t/hect of manure + N₄₀P₁₂₅K₉₀ this figure was 7.2-7.3%.

From the results of the analysis, it becomes clear that the amount of dry matter in absolute dry weight has significantly increased under the influence of fertilizer and watering rates. For example, in the control version without fertilizers, if the dry matter content was 21.5-22.0%, when applying fertilizers in the norm N₉₀P₁₂₀K₁₂₀ it increased to 25.3-26.1%, when applying fertilizers in the norm N₁₂₀P₁₅₀K₁₅₀ it increased to 25.5 -26.5%.

A similar situation also occurred on options with the combined use of organic and mineral fertilizers. So, when applying 10 t/hect of manure + N₄₀P₉₅K₆₀, the amount of dry matter was 26.3-27.0%, in the application of 10 t/hect of manure + N₇₀P₁₂₅K₉₀ the amount of dry matter was 26.7-27.0%.

The results show that mineral and organomineral fertilizers increase the amount of nitrate nitrogen in green feed. So, if nitrates in the area without fertilizers accumulated to the level of 61-66 mg/kg, when applying fertilizers in the norm of N₉₀P₁₂₀K₁₂₀ they reached the level of 74-81 mg / kg, when applying fertilizers in the norm of N₁₂₀P₁₅₀K₁₅₀ they reached the level of 82-89 mg/kg.

A similar situation also occurred on options with the combined use of organic and mineral fertilizers.

So, when applying 10 t/ha of manure + N₄₀P₉₅K₆₀, this figure was 75-82 mg / kg, in the case of fertilizer application, the norm is 10 t/hect of manure + N₇₀P₁₂₅K₉₀ - 85-90 mg/kg. These indicators were much less than the maximum (in natural weight 200 mg / kg) limit. And this proves that the produced crop is safe from an environmental point of view.

During the study, the yield of feed units with a green mass yield and the amount of digestible protein were also studied. If in the control variant without fertilizers the output of feed units from 1 ha of area was 7434 kg, the amount of digestible protein was 662.6

kg/hectare, when applying the fertilizer standards in $N_{90}P_{120}K_{120}$ 12,621 kg of feed units, 1124.8 kg of digestible protein, when applying the fertilizer norms $N_{120}P_{150}K_{150}$ 12894 kg of feed units, and the amount of digestible protein increased to 1149.2 kg.

A similar situation also occurred on options with the combined use of organic and mineral fertilizers. So, in the case of applying fertilizer standards in 10 t/hectare of manure + $N_{40}P_{95}K_{60}$, there were 12,054 kg of feed units, 1,074.3 kg of digestible protein, in the case of applying fertilizer standards in 10 t/hectare of manure + $N_{70}P_{125}K_{90}$ 12201 kg of feed units, 1087.4 kg digestible protein, which means a significant increase in yield compared to the control version without fertilizers.

Thus, the use of fertilizers to the optimal border and the implementation of the right timely irrigation significantly improves the quality of the crop of mixed crops.

6.3. Influence of irrigation and fertilizer norms on the quality of feed obtained from mixed crops of barley and alfalfa. Against the background of various amounts of irrigation, as with other plants and alfalfa, quality indicators and the chemical composition of the obtained feeds vary depending on the applied organic and mineral fertilizers. In the research work, the effect of organic and mineral fertilizers on the quality indicators of the alfalfa green mass yield and their chemical composition after barley mowing against the background of various amounts of irrigation was studied.

The use of various amounts of irrigation and fertilizer rates has fundamentally affected the quality indicators of alfalfa plants and the chemical composition. So, the introduction of irrigation and fertilizer standards has greatly increased the amount of crude protein, protein, crude ash, feed unit, digestible protein and other quality indicators.

Against the background of 4-fold irrigation in the control version without fertilizers with a crude protein content of 14.3%, protein 11.24%, the amount of nitrates in the green mass up to 155.3 mg / kg, the amount of crude ash at 6.68% when applying the

fertilizer standards in $N_{45}P_{120}K_{90}$, the indicators were 14.9%, respectively; 12.11%; 164.2 mg / kg and 7.12%. In the variant of combined use of organic and mineral fertilizers in the norm of 10 t/hect of manure + $N_{15}P_{60}K_{30}$, the indicators reached the level of 15.4%; 11.44%; 157.5 mg / kg and 6.84%.

Against the background of 5-fold irrigation during the growing season in the control version without fertilizers, if the amount of crude protein was 14.8%, the protein was 11.45%, the amount of nitrate was 160.6 mg / kg, the amount of crude ash was 6.75%, variant $N_{45}P_{120}K_{90}$ these indicators amounted to 15.4%; 12.35%; 168.3 mg / kg and 7.31%. In the case of combined use of organic and mineral fertilizers in a dose of 10 t/hect of manure + $N_{15}P_{60}K_{30}$, the indicators increased to the level of 15.8%; 12.12%; 165.2 mg / kg and 6.91%.

The permissible limit of nitrate content in the composition of green feed is taken as 200 mg / kg. In our study, the amount of nitrate was greatest in the variant of fertilizer application in the norm $N_{45}P_{120}K_{90}$ (168 mg / kg), which is significantly below the allowable limit. And this gives reason to believe that the resulting green mass yield is an environmentally friendly crop.

Along with this, such basic qualitative indicators as the yield of feed units and the amount of digestible protein were studied. So, if against the background of 4-fold vegetation irrigation in the control version without fertilizers, the output of feed units from 1 hectare of area was 9218 kg/hect, the amount of digestible protein was 1594.8 kg/hect, then in the variant of fertilizer application in the norm $N_{45}P_{120}K_{90}$ the indicators were respectively 14454 and 2500.6 kg/hect. In the variant of fertilizer application in the norm of 10 t/hect of manure + $N_{15}P_{60}K_{30}$, the indicators increased to the level of 13530 kg of feed units and 2340.8 kg/hect of digestible protein, respectively.

Against the background of 5-fold vegetation irrigation in the control version without fertilizers, the yield of fodder units per 1 ha is 9944 kg, the amount of protein transferred is 1720.4 kg/hect, in the $N_{45}P_{120}K_{90}$ variant the indicators were 15906 and 2751.9 kg/hect,

respectively. In the case of fertilizer application at a rate of 10 t/hect of manure + $N_{15}P_{60}K_{30}$, the indicators increased respectively in terms of feed units output to 14014 kg/hect, in terms of the amount of digestible protein 2424.5 kg/hect (as explained in the table).

According to the table, it becomes clear that against the background of every two quantities of irrigation in the variant of application of the fertilizer norms in $N_{45}P_{120}K_{90}$, the quality indicators of alfalfa feed were the highest.

Chapter VII. Economic efficiency of the application of fertilizer and irrigation standards to mixed spreading in corn crop and farm recommendations

7.1. Influence of the introduction of irrigation and fertilizer norms on the amount of nutrients, the chemical composition of root residues and stubble of mixed crops of corn and soy. In the low-lying region of the Karabakh zone on gray-meadow soils, stubble residues were taken from the mixed crops of corn and soy according to the monolithic method and, drying, weighed in the open air. The stubble residues in the control variant without fertilizers, if they amounted to 5 kg/hect, as a result of the introduction of organic and mineral fertilizers amounted to a significant increase. So, in the variant of fertilizer application in the norm $N_{90}P_{120}K_{120}$, stubble residues in the amount of 8 kg/hect were accumulated, when applying $N_{120}P_{150}K_{150}$ 9 kg/hect, and with the combined use of organic and mineral fertilizers in the norm of 10 t/hect of manure + $N_{70}P_{125}K_{90}$ - 8.7 kg/hect. Thus, it was found that with the introduction of organic and mineral fertilizers against the background of 4 irrigation during the growing season on mixed crops of corn and soybean, the mass of stubble residues increased significantly.

As a result of the analyzes, it was determined that the amount of nitrogen, phosphorus and potassium in the composition of the stubble residues thoroughly varies depending on the norms of fertilizers. If in the control variant the amount of total nitrogen, total phosphorus and total potassium in the norm of $N_{120}P_{150}K_{150}$ was

0.95%, 0.35%, and 0.96%, respectively, with the combined use of organic and mineral fertilizers in the norm of 10 t/hect of manure + P₃₅ amounted to 0.96%; 0.36% and 0.99%, in the case of organic fertilizers, the norm of 10 t/hect of manure + N₁₀P₆₅K₃₀ was 1.07%; 0.41% and 1.22%. And this, in turn, fundamentally affects not only the amount of accumulated nutrients in the stubble, but also the improvement of the water-physical properties of the soil and its structure.

In the variants, when applying 6 waterings during the growing season, a similar situation was also created. If the stubble residues in the control version without fertilizers were 5.6 cen/hect, then when using mineral fertilizers in the norm N₁₂₀P₁₅₀K₁₅₀ they were 9.4 cen/hect, and when combined with organic and mineral fertilizers in the 10 t / ha version of manure + N₇₀P₁₂₅K₉₀ the stubble residue was accumulated in the amount of 9.3 cen/hect.

As a result of the analyzes, it was determined that in the composition of the stubble residues, the amount of total nitrogen, total phosphorus and total potassium substantially changes depending on the norms of fertilizers. In the control variant without fertilizers, if the amounts of total nitrogen, total phosphorus and total potassium were 0.96%, 0,97% and 0.36%, respectively, when applying fertilizers in the norm N₁₂₀P₁₅₀K₁₅₀ 1.07%, 0.46% and 1,21%, with the combined use of organic and mineral fertilizers in the norm of 10 t/hect of manure + N₇₀P₁₂₅K₉₀, these indicators amounted to 1.08%, respectively; 0.42% and 1.22%. And this, in turn, fundamentally affects not only the amount of accumulated nutrients in the stubble, but also the water-physical properties of the soil and the improvement of its structure.

Studies have shown that the use of organic and mineral fertilizers in mixed crops significantly affects not only the stubble mass, but also the root mass so that it plays a large role in increasing soil fertility.

If the root mass in the control version at 4 waterings accumulates in an amount of 23 kg/ha, using organic and mineral fertilizers is a significant increase. So, when using mineral fertilizers

in the norm of $N_{120}P_{150}K_{150}$, the root mass if it was 30 kg/hect, then when combined with organic and mineral fertilizers in the norm of 10 t/hect of manure + $N_{70}P_{125}K_{90}$, the root mass was accumulated in the amount of 29 kg/hect.

The amount of total nitrogen, total phosphorus and total potassium in the composition of the root mass varies significantly depending on the norms of fertilizers. So, in the control version without fertilizers, if the content of total nitrogen, total phosphorus and total potassium was 0.84%, 0.19% and 0.72%, when applying fertilizers in the norm $N_{120}P_{150}K_{150}$ amounted to 1.00%, 0.24% and 0.96%, and when using 10 t/hect of manure + $N_{70}P_{125}K_{90}$ was 0.91%, 0.23% and 0.98%, respectively.

During the growing season, 6 irrigations were applied. If in the control version without fertilizers the root mass is accumulated in an amount of 23.5 cent/hect, then with the use of organic and mineral fertilizers this amounted to a significant increase. In particular, when applying the norms of fertilizers, the $N_{120}P_{150}K_{150}$ was 30.5 cent/hect, while the combined use of organic and mineral fertilizers in the norm of 10 t/hect of manure + $N_{70}P_{125}K_{90}$, the root mass was accumulated in the amount of 29.7 cent/hect. And this, in turn, as a result of microbiological processes, decomposing, will be of great importance in the accumulation of biological nitrogen, in maintaining soil fertility. So in the control version without fertilizers, if the amount of total nitrogen, total phosphorus and total potassium was 0.84%, 0.18% and 0.73%, with a fertilizer rate of $N_{120}P_{150}K_{150}$ these indicators were 1.01%; 0.24%; 0.97%, and with the combined use of organic and mineral fertilizers in the amount of 10 t/hect of manure + $N_{70}P_{125}K_{90}$ amounted to 0.93%, 0.24% and 0.99%.

The use of organic and mineral fertilizers at the optimum rate, along with a positive effect on the root mass and stubble residues of mixed crops significantly increases the soil fertility in quantitative and qualitative terms. And this proves that corn and soy are good precursors for subsequent sowing crops.

7.2. The effect of irrigation and fertilizer application on the amount of root mass and stubble, on the chemical composition and amount of nutrients. The main role in the accumulation of organic matter in the soil is the root residues and stubble residues, giving the greatest amount of phytomass. During the study, the mass of accumulated stubble residues was determined.

The norms of organic and mineral fertilizers had a profound effect on the mass of stubble residues of mixed crops of sorghum and pea. So, if in the control version without fertilizers in the mixed crops of sorghum and peas, the amount of accumulated stubble residues was 6 cen/hect, when applying fertilizers in the norm $N_{120}P_{150}K_{150}$ 10 cen/hect, in the variant in case of combined use of organic and mineral fertilizers in the norm 10 t/hect of manure + $N_{70}P_{125}K_{90}$ - 9.4 kg/hect.

As a result of the study, it was determined that the amount of nutrients in the composition of stubble residues, i.e. total nitrogen, total phosphorus and total potassium vary depending on fertilizer rates.

So, in the control variant, if the amount of total nitrogen, total phosphorus and total potassium was 0.96%, 0.37% and 0.98%, there were no such differences when applying fertilizer in the norm of $N_{120}P_{150}K_{150}$, i.e. when combined organic and mineral fertilizers in the norm of 10 t/hect of manure + $N_{70}P_{125}K_{90}$ indicators amounted to total nitrogen, total phosphorus and total potassium, respectively 1.11%, 0.45% and 1.22%. And this, in turn, fundamentally affects not only the amount of nutrients accumulated in the stubble, but also the water-physical properties of the soil, the improvement of its structure, and the increase in soil fertility.

Against the background of 5 vegetation irrigation, the use of organic and mineral fertilizers in the mixed crops of sorghum and peas thoroughly affects the mass of stubble residues. So, in the control version without fertilizers in mixed crops of sorghum and peas, if stubble residues are accumulated in an amount of 6.2 cen/hect, in the variant of fertilizer application in the norm $N_{120}P_{150}K_{150}$ 10.2 cen/hect, with the combined use of organic and

mineral fertilizers in the norm 10 t/hect of manure + N₇₀P₁₂₅K₉₀ accumulated stubble residues in the amount of 9.9 cen/hect.

As a result of the study, it became clear that in the composition of the accumulated stubble residues, the number of nutrients, i.e. total nitrogen, total phosphorus and total potassium vary depending on fertilizer rates. So, in the control variant without fertilizers, if the amounts of total nitrogen, total phosphorus and total potassium were 0.95%, 0.37% and 0.98%, respectively, there was no such difference when applying the N₁₂₀P₁₅₀K₁₅₀ fertilizer norms, i.e. the amounts of total nitrogen, total phosphorus and total potassium were 1.09, 0.48 and 1.25%, respectively, and with the combined use of organic and mineral fertilizers in the norm of 10 t/hect of manure + N₇₀P₁₂₅K₉₀, the indicators were 1.12, 0, respectively. 46 and 1.23%. And this, in turn, fundamentally affects not only the amount of accumulated nutrients, but also the improvement of the water-physical properties of the soil and its structure, and the increase in its fertility.

In our study, strict control was taken on the conformity of soil monolith samples to the plant nutrition area in order to obtain reliable information on the accumulation of root residues from mixed crops of corn, soy and sorghum.

As can be seen from the table, if in the control version without fertilizers, when applying 3 irrigations, the root mass accumulates in the amount of 24 kg/hect, with the combined use of organic and mineral fertilizers in the norm of 10 t/hect of manure + N₇₀P₁₂₅K₉₀, the root mass accumulates in the volume of 30 kg/hect. Thus, with the combined use of organic and mineral fertilizers against the background of 3 irrigation in mixed crops of sorghum and peas, the root mass increases significantly. And this, in turn, will be of great importance in the accumulation of biological nitrogen, in maintaining soil fertility as a result of the decomposition of ongoing microbiological processes in the soil.

As a result of the application of irrigation and fertilizer norms, the amount of total nitrogen, total phosphorus and total potassium in the composition of the root mass varies significantly depending on the norms of fertilizers. So, in the control version without fertilizers,

if the amounts of total nitrogen, total phosphorus and total potassium were 0.86, 0.20 and 0.73%, respectively, when applying the $N_{120}P_{150}K_{150}$ fertilizer standards, these indicators were 1.02, 0.26 and 0.98%, with the combined use of organic and mineral fertilizers at a rate of 10 t/hect of manure + $N_{70}P_{125}K_{90}$, the amounts of total nitrogen, total phosphorus and total potassium were 1.07, 0.27 and 0.99%, respectively. And this, in turn, proves a thorough effect on the number of nutrients accumulated in the root mass.

If in the control case without fertilizers the root mass of plants accumulates in the amount of 24.4 cen/hect, with the combined use of organic and mineral fertilizers this amounted to a significant increase. So, when using mineral fertilizers in the norm of $N_{120}P_{150}K_{150}$, if the yield was 31.4 kg/hect, with the combined use of organic and mineral fertilizers in the norm of 10 t/hect of manure + $N_{70}P_{125}K_{90}$, the root mass was accumulated in the amount of 30.1 kg/hect. Thus, the use of organic and mineral fertilizers against the background of 5 irrigations of mixed crops of sorghum and peas significantly increased the root mass. And this, in turn, will be of great importance in the accumulation of biological nitrogen, in maintaining soil fertility as a result of the decomposition of ongoing microbiological processes in the soil.

The amount of total nitrogen, total phosphorus and total potassium in the composition of the root mass varies significantly depending on the norms of fertilizers. So, in the control version without fertilizers, if the content of total nitrogen, total phosphorus and total potassium was 0.87%, 0.21% and 0.73%, when applying fertilizers in the norm $N_{120}P_{150}K_{150}$ amounted to 1.01%, 0.26% and 0.99%, and when using 10 t/hect of manure + $N_{70}P_{125}K_{90}$ was 1.05%, 0.26% and 1.01%, respectively. And this, in turn, indicates a thorough influence on the number of nutrients accumulated in the root mass.

In general, we can say that the use of organic and mineral fertilizers in the optimal norm, in quantitative and qualitative terms, effectively affecting the root mass and stubble remnants of mixed crops, significantly increases soil fertility. This proves that sorghum

and peas in mixed sowing are good precursors for subsequent sowing crops.

7.3. Influence of the application of irrigation and fertilizer rates on the mass of root residues of mixed crops of barley and alfalfa, chemical composition and amount of nutrients. The study determined that the application of various norms of irrigation and fertilizer fundamentally affects the mass of root residues, their chemical composition and the number of nutrients in alfalfa in cover crops after barley mowing. To do this, root masses were taken in a monolithic way, which were dried in air, transferred for analysis and after analysis were noted in the tables. So, in the control version without fertilizers, when applying 4 irrigation in a soil layer of 0-50 cm, if the root mass is accumulated in the amount of 52 kg/hect, in the soil layer 50-100 cm if the root mass is accumulated in the volume of 19 kg/hect, variant $N_{45}P_{120}K_{90}$ in the layer of 0-50 cm - in the volume of 63 kg/hect, in the soil layer of 50-100 cm - 26 kg/hect. With the combined use of organic and mineral fertilizers, the indicators have changed in the following order. In the application, 10 t/hect of manure + $N_{15}P_{60}K_{30}$ in the soil layer of 0-50 cm 58 cent/hect, in a layer of 50-100 cm of the root mass was accumulated in the volume of 23 cent/hect. And this indicates the greatest accumulation of root residues in the arable soil layer.

Against the background of 6-fold irrigation in the control version without fertilizers in the arable soil layer of 0-50 cm, the indicator was 45 cent/hect, in the layer of 50-100 cm 20 cent/hect, in the $N_{45}P_{120}K_{90}$ variant in the soil layer of 0-50 cm 66 cent/hect, in the soil layer 50-100 cm 25 cent/hect.

A similar situation was observed with the combined use of organic and mineral fertilizers and changed in the following order. With the combined use of organic and mineral fertilizers in the application of 10 t/hect of manure + $N_{15}P_{60}K_{30}$ in the soil layer of 0-50 cm, this figure was 61 kg/hect, in the soil layer of 50-100 cm 23 kg/hect of root weight. And this once again proves the high accumulation of root residues in the arable soil layer and, as a result,

an increase in organobiological substances. The use of organic and mineral fertilizers fundamentally affects the increase in root mass. High accumulation of root mass, along with an increase in the amount of organobiological substances, had a profound effect on the amount of nutrients accumulated in the soil.

8.1. Cost-effectiveness of applying irrigation and fertilizer norms to mixed stubble crops and recommendations to farms

As a result of the influence of fertilizer and watering norms on plants in mixed crops, the economic efficiency of the obtained crop was calculated. So, against the background of 4-fold vegetation irrigation in the variant of fertilizer application in the norm $N_{40}P_{60}K_{60}$, a crop of green mass of 97 kg/hectare from mixed crops of corn and sorghum on stubble was obtained, which allows you to get a net income of 99.44 man / ha.

The highest result was obtained in the application of 10 t/hectare of manure under the crop. Here, the yield increase per 1 hectare of area amounted to 247 centner / ha, the cost of increasing the crop amounted to 1482 manat, the cost of the crop amounted to 881.6 manat, net income was 600.4 manat.

In the variant of using organic fertilizers against the backdrop of 4-fold vegetation irrigation with a norm of 10 t/hectare of manure + $N_{60}P_{90}K_{90}$, the surplus yield per hectare of area was 220 cen/hectare, the cost of the surplus crop was 1320 manat, the cost of the surplus crop was 764.2 manat, and net income of 555.8 manat, which is considered profitable compared to other options.

The increase in the yield of green mass per hectare of area in such a volume indicates, in the end, its high influence on increasing economic efficiency.

In general, from the economic calculation we can come to such a result that the norms of mineral and organomineral fertilizers applied to mixed crops positively affect, along with productivity, soil fertility, the digestibility coefficient of fertilizers and economic indicators.

Results and suggestions

1. In the territories of widespread gray-meadow soils that have long been irrigated soils of the Karabakh zone, according to the gradation level adopted in the republic, the insufficient level of total nitrogen, mobile phosphorus and exchange potassium necessitated the use of additional amounts of mineral and organic fertilizers and their mixtures. Therefore, it is important to use fertilizers to obtain plants from mixed crops grown on stubble.
2. Even though you can get a high yield of green mass from corn, sorghum, it contains little protein. Therefore, in order to improve the quality of feed, it is advisable to apply the joint sowing of cereal grains with legumes. As a result of the study, it was concluded that, against the background of various irrigation, the use of mineral and organomineral fertilizers positively affects the growth and development of mixed crops. In the application of fertilizer norms in the norm $N_{120}P_{150}K_{150}$, the growth indicators of mixed crops increased significantly. In the variant of combined use of organic and mineral fertilizers at a rate of 10 t/hect of manure + $N_{70}P_{125}K_{90}$, the growth rates of organic and mineral fertilizers of mixed crops have substantially increased so that this is the reason for the increase in yield.
3. Against the background of various amounts of vegetation irrigation, the use of mineral and organomineral fertilizers increases the number of nutrients absorbed from the soil in mixed crops of stubble crops. And this, in turn, has the desired effect on productivity and its quality of crops of mixed stubble crops. The decrease in nutrients in the panicle formation phase in mixed stubble crops indicates their connection with ablation with the crop.
4. An important task of fertilizing in crops is to provide plants with nutrients in their greatest need and in their greatest sensitivity to their lack. From analyzes of plant samples taken

from all periods of the growing season, it becomes clear that mineral fertilizers in the norm of $N_{120}P_{150}K_{150}$ and in the application of organic and mineral fertilizers in the norm of 10 t/hect of manure + $N_{70}P_{125}K_{90}$ are not the reason for the high accumulation of nutrients in mixed crops.

5. The use of mineral and organomineral fertilizers against the background of various amounts of vegetative irrigation increased the yield of mixed crops on stubble by an average of 73-253 kg/hect for 3 years. During the mathematical calculation of the crop, the reliability of the yield increase due to irrigation and fertilizer was confirmed.
6. The use of fertilizers in the optimal limit and the implementation of the right timely irrigation significantly increase the quality of the crop of mixed crops on stubble. Against the background of different amounts of vegetation irrigation in the control version without fertilizers, if the crude protein content was 6.0-6.2%, when using fertilizers in the norm $N_{120}P_{150}K_{150}$ increased to 7.2-7.3%, in the variant of fertilizer application in the norm 10 t/hect of manure + $N_{70}P_{125}K_{90}$ increased to 7.2-7.3%.

The combined use of mineral and organomineral fertilizers in mixed crops fundamentally affects the yield of feed units in the crop of green mass and the amount of digestible protein. In the control version without fertilizers, if the output of feed units from 1 hectare of area was 7434 kg/hect, and the digestible protein was 662.5 kg/hect, when using fertilizers in the norm $N_{120}P_{150}K_{150}$, the yield of feed units was 12894 kg/hect, and the digestible protein was 1149.2 kg, in the variant of fertilizer application, the norm is 10 t/hect of manure + $N_{70}P_{125}K_{90}$ - 12201 kg/hect of feed units and 1087.4 kg of digestible protein, which means a significant increase compared to the control variant without fertilizers.

7. The importance of root residues and stubble residues of mixed crops in maintaining and improving soil fertility. Mineral and organomineral fertilizers affected the higher accumulation of

root and stubble residues in mixed crops, which greatly increased the amount of total nitrogen, phosphorus and potassium. If the amount of stubble residues in the mixed crops in the control variant without fertilizers was 5 kg/hectare, when using mineral fertilizers in the norm $N_{120}P_{150}K_{150}$ 9 kg/hectare, when applying fertilizers in the norm of 10 t/hectare of manure + $N_{70}P_{125}K_{90}$, stubble residues were accumulated in the amount of 8, 7 kg/hectare.

As a result of the analyzes, it was found that the amount of total nitrogen, phosphorus and potassium in the composition of the stubble residues substantially changes depending on the norms of fertilizers. In the control version without fertilizers, if the amount of total nitrogen, phosphorus and potassium was 0.95, 0.35 and 0.96%, respectively, when using fertilizers in the norm of $N_{120}P_{150}K_{150}$, these indicators were 1.07, 0.41 and 1.22%, respectively. And this, in turn, fundamentally affects not only the amount of nutrients accumulated in the stubble, but also the improvement of the water-physical properties of the soil and its structure.

8. The introduction of optimal norms of irrigation and fertilizer on crops of mixed crops on stubble is most effective from an economic point of view. The highest income with the use of mineral fertilizers alone was obtained with the application of the $N_{90}P_{120}K_{120}$ fertilizer standards, where the net income was 600,4 man / ha, with the combined use of organic and mineral fertilizers in the application of 10 t/hectare of manure + $N_{70}P_{125}K_{90}$ net income amounted to ... man / ha.
9. As a result of phenological observations on the slopes, it was determined that a high influence on the growth indicators of alfalfa plants was achieved in the variant of fertilizer application in the norm of 10 t/hectare of manure + $N_{15}P_{60}K_{30}$.

Mineral and organomineral fertilizers used for alfalfa greatly increase the effective soil fertility and the amount of nutrients, the amount of assimilable ammonium and nitrate nitrogen, metabolic potassium and mobile phosphorus. An increase in

nutrients was observed when they were accumulated in the greatest amount in the root mass of alfalfa plants in the arable and subsurface soil layer. In the analysis, it becomes clear that in the soil samples taken in the 1st and 2nd mowing, the number of nutrients in comparison with the 3rd and 4th mowing was much larger. And it depends on the removal of nutrients with a high yield.

Production Recommendations

Based on the field studies, the following recommendations are recommended from the results obtained from field trials to feed production farms:

1. Rationally using stubble cultivated soils to obtain a high yield of green mass with high quality, it is considered advisable to add mineral fertilizers to the mixed crops of grain and leguminous crops in the norm $N_{90}P_{120}K_{120}$, and with the combined use of organic and mineral fertilizers in the norm 10 t/hect of manure + $N_{40}P_{95}K_{60}$.

2. To obtain a high yield of good quality green mass from mixed sowing of alfalfa with barley, the use of only mineral fertilizers in the norm of $N_{45}P_{120}K_{90}$, and the combined use of organic fertilizers with mineral fertilizers in the norm of 10 t/hect of manure + $N_{15}P_{60}K_{30}$ is considered the most profitable both with agronomic and from an economic point of view.

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