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EFFECT OF MINERAL AND ORGANIC FERTILIZER RATES ON THE YIELD AND SOIL FERTILITY OF COVER CROPS

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Abstract. Effective use of cultivated land and agro climatic resources is one of the urgent issues of the day. This has a positive effect on the protection of soil fertility, along with satisfying the population's food and animal feed needs. In the presented article, the influence of mineral and organic fertilizer norms on the productivity of cover crops and soil fertility is devoted to these issues. Effective mineral and organic fertilizer norms have been determined, which have a positive effect on the productivity, quality indicators and soil fertility of alfalfa plants in covered crops of barley in the gray-grass soils of the Karabakh region, which have been irrigated since ancient times. When $N_{45}P_{120}K_{90}$ mineral fertilizer was applied in the cover crops of barley and alfalfa, the green mass yield of alfalfa was 655 s/ha, which was an increase of 238 s/ha or 57.07% compared to the control option without fertilizer. The applied fertilizer rates were able to increase the productivity as much as the accuracy of the experiment. When $N_{45}P_{120}K_{90}$ mineral fertilizer was applied in the cover crops of barley and alfalfa, root mass increased significantly compared to other options, which significantly increased the amount of nitrogen, phosphorus, potassium and other elements in the planting layer. This, in turn, increased the amount of organic-biological substances in the soil and soil fertility.

Keywords: *Sowing time, cover cropping, alfalfa, fertilizer rates, soil, fertility, productivity.*

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1. Introduction

The role of food security is a basic indicator of human existence. Because lack of food lays the basis of hunger and death. The food problem has existed since the beginning of man and has changed its characteristics and dimensions with the development of man. According to FAO's calculations, the production volume of agricultural products should be doubled in 2030 in order to provide the population with food products. This requires effective use of the land under cultivation and agro climatic resources. In meeting the demand for food products, along with cereals, livestock products are of special importance. The development of animal husbandry is considered a priority direction in order to ensure the food security of the country. The creation of a balanced feed stock is the main factor in increasing the efficiency of agricultural enterprises in the development of animal husbandry. Therefore, attention should be paid to the development of fodder production in the republic in order to produce quality, ecologically clean and sufficient livestock products.

As animal husbandry develops, the demand for feed also increases. Therefore, the issue of providing cattle with protein is a problem. Leguminous perennial grasses are of

great importance in this regard as the main source of protein. The lack of protein in the feed share of animals leads to a decrease in productivity and inefficient use of feed.

It is the co-planting of legumes and cereals to improve the quality of forage, increase yield and increase the positive agro technical role of mixed annual forage crops. In pure products, cereal crops provide a mass rich in carbohydrates, but they are poor in terms of protein yield compared to legumes. This also requires the planting of cereals and legumes. Mixed planting of legumes and cereals minimizes agro technical measures, increases productivity, and improves the quality of fodder. While the quality of fodder is low in the products of pure crops, the richness of carbohydrates and proteins is created in mixed crops. A mixture of cereal and leguminous plants allows to obtain nutritionally rich feed in livestock (Allahverdiyev & Ashrafov, 2019; Alkenov *et al*., 2013; 2014).

Experiments show that with efficient use of agro climatic resources, very good results are obtained when sowing alfalfa under the cover of barley from cereal crops. During the trial period, more than 1 hectare of fodder was obtained in the second year of cover cropping compared to no cover cropping as a whole.

Relevance of the research: Currently, increasing the productivity of agricultural plants and their quality indicators in order to meet the needs of people for food, livestock feed and raw materials for industry, and for this purpose, effective use of agricultural land is considered to be one of the most urgent issues of the day. This requires increasing soil fertility. Cultivation of cover crops is considered more appropriate for increasing the productivity of fodder plants and its quality indicators. This allows for more efficient use of arable land and agro climatic resources.

The purpose of the research: to determine optimal fertilizer rates for barley and alfalfa crops in the region, while increasing productivity and quality indicators, and protecting soil fertility.

The development and increase in productivity of livestock is not associated with a lack of feed, but with an imbalance in terms of digestible protein and sugar. This leads to a significant reduction of livestock products for single feed (Antonenko *et al*., 2015). This problem should be solved not only by expanding the multi-component agrophytocenoses of legumes and cereals, which allow to take a high and stable yield from high-quality green fodder (Vasylenko, 2014).

For livestock farms, it is important to obtain high-yield nutrient-rich green mass products. Because green fodder has high nutritional value and is well digested. It is easily absorbed by farm animals. The pleasant taste and aromatic smell of the fodder obtained from mixed sowing plants in cover cropping increases appetite and improves digestibility. The dry matter of the green mass is rich in complete protein, vitamins and minerals. In addition, green fodder obtained from mixed crops is more profitable than others (Trots & Khismatov, 2013).

Legumes are the main source of vegetable protein used in the feeding of agricultural animals. Alfalfa is the most common leguminous plant in field forage. Alfalfa is rich in digestible protein, as well as well-prepared protein, vitamin hay meal, hay and haulage compared to other legumes, even legumes. In addition to protein, alfalfa grass and fodder types contain vitamins, digestible carbohydrates, fat, organic-mineral compounds, calcium, phosphorus, potassium, magnesium, sulfur, sodium, etc. There is. As the alfalfa plant develops, the amount of nutrients in its content changes significantly (Allahverdiyev & Ashrafov, 2019).

One of the ways to increase the productivity of plants is the use of mixed products of legumes and cereals in agrocenoses (Persikova *et al*., 2010).

Analysis and discussions; Taking into account the above, we set ourselves the goal of conducting a study to determine the effective mineral and organic fertilizer norms that affect the productivity and quality indicators of alfalfa plants in cover crops of barley in the gray-grass soils that have been irrigated since ancient times in the territory of Agjabadi district of the Karabagh region. Field experiments were used in Elvin farm in Hindarkh settlement of Agjabadi region, barley (Hordeum) "Karabagh-7" and alfalfa (Medicago sativa) Aran variety.

On October 15, 2023, 190 kg of barley seeds and 15 kg of alfalfa seeds were sown per hectare. The experiment was carried out in 5 variants, 4 repetitions, in total 40 lacs. However, the width is 2.4m and the length is 10 meters.

As in the case of clean crops, the barley plant was harvested in the first ten days of June (June 4, 2023). Crops and plant residues (straw) were removed, feeding fertilizers were applied to the field and alfalfa plants were watered. The first harvest of alfalfa was carried out on June 30, 2023. The product is accounted for in parts according to the methodology. Thus, the 2nd harvest was carried out on July 25, the 3rd harvest on August 20 and the 4th harvest on September 25. The green mass productivity of alfalfa by variants and repetitions is calculated and listed in Table 1.

Table 1. The effect of fertilizer rates on green mass yield obtained from mixed sowing of alfalfa and barley, s/ha

s/s	Variants	Repetitions				Average productivity s/ha	Growth	
		I	II	III	IV		cent/ha	%
I	Control without fertilizer	424	422	411	410	417	-	-
II	$N_{30}P_{90}K_{60}$	550	546	555	557	552	135	33,15
III	$N_{45}P_{120}K_{90}$	654	659	655	652	655	238	57,07
IV	Manure 10 t/ha	481	477	487	491	484	67	16,06
V	Manure 10 t/ha+$N_{15}P_{60}K_{30}$	619	617	611	609	614	197	47,24

E=3,89s/ha; P=1.35%

As a result of the research, it was determined that the rates of mineral and organic fertilizers had a substantial effect on the green mass yield of alfalfa grown under barley and significantly increased productivity. Thus, in the control variant without fertilizer, the green mass yield by forms (I, II, III, IV forms) is 106; 105; 104; In the case of 102 s/ha, when mineral fertilizer norms $N_{30}P_{90}K_{60}$ are applied, the indicators for forms are 139, respectively; 137; 140; 136 s/ha, green mass yield 160 when $N_{45}P_{120}K_{90}$ is applied; 168; 171; 156 s/ha, 122 when organic fertilizer manure 10 t/ha; 121; 122; 119 s/ha, manure with organic and mineral fertilizer 10 t/ha+$N_{15}P_{60}K_{30}$ option 156; 152; 157; It has increased to 149 s/ha.

As can be seen from the Table 1., the green mass yield in the no-fertilizer-control variant is 417 s/ha, when the mineral fertilizer norms $N_{30}P_{90}K_{60}$ are applied, it is 552 s/ha, in the version with the $N_{45}P_{120}K_{90}$ norm, 655 s/ha and 491 s/ha when the organic fertilizer manure is 10 t/ha. , 609 s/ha were collected in 10 t/ha+$N_{15}P_{60}K_{30}$ variant, with organic and mineral fertilizers. As can be seen, the fertilizer rates have significantly increased productivity. Thus, when $N_{45}P_{120}K_{90}$ mineral fertilizer was applied, the average yield was 655 s/ha, which was an increase of 238 s/ha or 57.07% compared to the control option

without fertilizer. The applied fertilizer rates were able to increase the productivity as much as the accuracy of the experiment.

In the end, the mathematical calculation of the crop accounting shows the accuracy of the experiment E=3.89s/ha; P=1.35% proved. Due to mineral and organic fertilizers, the yield increase was several times higher than E s/ha indicated in the optimal option.

During the cultivation of agricultural plants, not only the increase of productivity and quality indicators of the product, but also the protection of soil fertility is considered one of the main issues ahead. Because it is impossible to talk about a high yield in soil without fertile conditions.

Today, one of the main problems of agriculture is the decrease in soil fertility, which is observed later in the decrease in the productivity and quality of the cultivated plants. Improperly performed agrotechnical measures, as well as excessive use of fertilizers and plant protection products, have caused a violation of the phytosanitary condition of the soil (Stepanova *et al*., 2012).

One of the most important factors in the production of agricultural products in the world is the selection of modern cultivation methods to restore and protect soil fertility while increasing productivity and its quality indicators (Meltsaev & Esedullaev, 2019).

The great agrotechnical importance of alfalfa replaces ameliorant in saline soils and accumulates nitrogen in the soil. The organic matter collected by 3-year-old alfalfa in the soil is equal to 60-70 tons of manure. It collects 180-220 kg of biological nitrogen per hectare and improves the physical properties of the soil and frees the soil from weeds (Shpakov, 2014).

The alfalfa plant absorbs 100-200 kg/ha of atmospheric nitrogen and collects 8-12 t/ha of root and root residues, which adds up to 40-60 t/ha of nutrients contained in manure. It is similar (Abasov *et al*., 2018; Allahverdiev *et al*., 2021).

Biological processes play an important role in providing nutrients in the formation of soil fertility. The decaying mineralization and humification processes of the root and stem residues in the soil are carried out by microorganisms living in the soil, organic substances are decomposed, and their content changes into an easily assimilated form. Organic and agrochemical indicators increase significantly due to root and stem residues (Allahverdiev *et al*., 2021; Li *et al*., 2013).

A decrease in the amount of humus in the soil causes changes in its agrophysical parameters, as well as chemical properties of black soils and a decrease in productivity (Kaidun, 2018).

Alfalfa roots contain root bacteria that absorb atmospheric nitrogen. Its roots contain 2.0-2.5% nitrogen. It is reported that 500-600 kg/ha of nitrogen is collected due to the destroyed and decaying roots every year. During the rotting of alfalfa roots, a slight increase in active phosphorus compounds is observed in the soil (Allahverdiyev & Ashrafov, 2019).

After harvest, agricultural crops add a large amount of organic matter to the soil in the form of root mass and tiller residues, which in turn improves soil fertility. Under favorable conditions, the root mass and root residues of plants rot and turn into organic matter under the influence of microorganisms (Rzayev & Abdullayeva, 2013).

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Taking into account the above-mentioned, in the research work, the root and shoot residues were collected in the covered planting according to the methodology, and the content of nitrogen, phosphorus and potassium was determined by analysis.

As a result of the research, it was determined that the application of mineral and organic fertilizer norms has a substantial effect on the mass, chemical composition and amount of nutrients of alfalfa plant roots after harvesting barley in cover cropping. According to the methodology, root masses from 0-50, 50-100 cm layer were taken by monolithic method, dried in air and prepared for analysis and analyzed and listed in table No. 2. Thus, in the control variant without fertilizer, 47 s/ha in the 0-50 cm soil layer and 16 s/ha in the 50-100 cm layer were collected, while when mineral fertilizer $N_{30}P_{90}K_{60}$ was applied in the norm, 53 in the 0-50 cm layer. s/ha, 19 s/ha in the 50-100 cm layer, 61 s/ha in the 0-50 cm layer, 24 s/ha in the 50-100 cm layer in the $N_{45}P_{120}K_{90}$ norm.

When organic and organic-mineral fertilizers were applied together, the indicators changed accordingly as follows. From organic fertilizers, 50 s/ha in a 0-50 cm layer, 17 s/ha in a 50-100 cm layer, in the case of application of 10 t/ha of organic fertilizers, 10 t/ha of organic and mineral fertilizers + $N_{15}P_{60}K_{30}$, 0-56 s/ha in the 50 cm layer, 22 s/ha in the 50-100 cm layer was collected. More root mass was collected in the planting layer in the variant with $N_{45}P_{120}K_{90}$ norm mineral fertilizer.

Table 2. The effect of application of fertilizer and irrigation rates on the mass, chemical composition and amount of nutrients of the root residues of barley and alfalfa intercropped

s/s	Variants	Depth, cm	Air-dry root mass per hectare		Amount of nutrients						Amount of conversion of root mass to humus, in %
					N		P_2O_5		K_2O		
			cent/ha	%	%	kg/hec	%	kg/hec	%	kg/hec	
			4 times irrigation (3800 m^3)								
I	Control without fertilizer	0-50	47	74,61	1,16	54,52	0,20	9,40	0,74	34,78	8,46
		50-100	16	25.39	1,03	16.48	0,13	2,08	0,50	8,00	2,88
		0-100	63	100		71,00		11,48		42,78	11.34
II	$N_{30}P_{90}K_{60}$	0-50	53	73,61	1,27	67,31	0,28	14.84	0,98	51,94	9,54
		50-100	19	26.39	1,14	21,66	0,16	3,04	0,54	10,26	3,42
		0-100	72	100		88,97		17,88		62,20	12,96
III	$N_{45}P_{120}K_{90}$	0-50	61	71,76	1,34	81,74	0,34	20,74	1,04	63,44	10,98
		50-100	24	28,23	1,18	28.32	0,22	5,28	0,60	14,4	4,32
		0-100	85	100		110,06		26,02		77,84	15.20
IV	Manure 10 t/ha	0-50	50	74,63	1,21	60,51	0,24	12,0	0,91	45,50	9,00
		50-100	17	25,37	1,08	18,36	0,14	2,38	0,53	9,01	3,06
		0-100	67	100		78,87		14,38		54,51	12,06
V	Manure 10 t/ha+$N_{15}P_{60}K_{30}$	0-50	56	71,79	1,27	71,12	0,28	15,68	0,94	52,64	10,08
		50-100	22	28,21	1,12	24,64	0,18	3,96	0,55	12,10	3,96
		0-100	78	100		95,76		19,64		64,74	14,04

The loss of humus affects the soil's resistance to erosion processes, various types of pollution, the spread of pathogenic microflora and causes biological decline (Kudeyarov, 2019; Nasiyev *et al*., 2015).

The accumulation of root residues in the planting layer and the increase in the amount of organic-biological substances have been proven once again. In the research, the amount of root mass conversion into humus was calculated by multiplying the plant

residues by a factor of 0.18.

Thus, in the no-fertilizer-control variant, the amount of root mass conversion to humus in the 0-100 cm soil layer is 11.34%, when mineral fertilizer $N_{30}P_{90}K_{60}$ is applied in the norm, it is 12.96%, in the variant given in the norm $N_{45}P_{120}K_{90}$, it is 15.20%, from organic fertilizers it was 12.06% in the variant where manure was applied at 10 t/ha and 14.04% when organic and mineral fertilizer was applied together at 10 t/ha+$N_{15}P_{60}K_{30}$.

2. Conclusion

The study shows that mineral and organic fertilizer rates significantly increase the yield of alfalfa under cover crops.

In addition to increasing the amount of organic and biological substances, the excess accumulation of root mass restores soil fertility by having a fundamental effect on the amount of nutrients in the soil, its water-physical properties and its structure. This proves once again that the alfalfa plant is a good predecessor for the plants planted after it.

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