

EFFECT OF MINERAL FERTILIZERS ON PROTEIN AND STARCH YIELD FROM OARS GRAIN BASED ON THE NUMBER OF IRRIGATION IN GRAY-BROWN SOILS

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Abstract. The paper is devoted to study of the effect of mineral fertilizers on the yield of protein and starch from oats grain against the background of the number of irrigations in the irrigated gray-brown soils of Ganja-Dashkasan economic region (Azerbaijan). The main purpose of the research is to determine the number of irrigations and effective mineral fertilizer norms that affect the productivity of the autumn oats plant, the quality of the crop and the improvement of soil fertility in the irrigated gray-brown (chestnut) soils of the western region. It was determined that the number of irrigations and mineral fertilizer rates significantly increased the yield of protein and starch from oats corn compared to the control-no-fertilizer option. Due to the effect of mineral fertilizers on the background of 2 times vegetation irrigation, the yield of protein from the grain crop increased by 120.86-244.98 kg/ha, and the yield of starch by 393.63-855.09 kg/ha compared to the control-no-fertilizer variant. The highest indicators were obtained in the $N_{90}P_{90}K_{60}$ variant. In the case of 3 times irrigation due to the effect of mineral fertilizers, the yield of protein from the grain product increased by 121.50-285.06 kg/ha, and the yield of starch by 407.88-994.90 kg/ha compared to the control-no-fertilizer option. The highest protein and starch yield was observed in the $N_{120}P_{120}K_{90}$ variant against the background of 3 times vegetation irrigation. In terms of the number of irrigations, protein and starch yields in 3 times irrigation were higher than in 2 times irrigation in each of the variants.

Keywords: oats grain, irrigation, gray-brown, mineral fertilizers, protein, protein yield, starch, starch yield.

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Received: 7 April 2023;

Accepted: 15 June 2023;

Published: 5 August 2023.

1. Introduction

Oats is a valuable food and fodder plant. Its grain is an invaluable feed for livestock and poultry. Cereals, cookies, coffee, (oatmeal, hercules) etc. from oats grain is being prepared. Since these foods contain easily digestible protein, fat, starch and vitamins in the body, they are of great importance for diet and children's food. Oats grain is rich in vitamins V1 and V2, iron compounds, calcium and phosphorus. Grain contains 12-13% protein, 40-45% starch, 4.5% fat. At the same time, it contains 11-12% cellulose, 3.5% ash, and 14% water. In the baking industry, oats flour is added to wheat or rye flour. It is of great importance to have significantly more protein, starch and fat in the composition of bare grain oats compared to veiled oats. It is equal to 99.8 feed units from 100 kg. Oats stubble is considered valuable for animals compared to stubble of other grains. The stubble contains 6.9% protein, 40.7% nitrogen-free extractives, 1.8% fat, 27.8% cellulose, 6.8% ash, 16% water. Its 100 kg contains 31 feed units (Mammadov & Ismayilov, 2012).

In the research conducted in the Republic of Mordava (Russia), it was determined that the productivity of oats depends primarily on the application of nitrogenous fertilizers (Kuznetsov *et al.*, 2014)

In recent times, the demand for oats has increased in the production of fodder and in the preparation of dietary foods. The grain yield from bare grain oats is 88-89%, crude protein 14.3-19.5%, fat 7.0-8.8%, and from covered grain oats 48-58%, crude protein 9-12% and fat 4.5 -5.8%. Golozerno variety oats is considered a valuable fodder for horses, cattle, pigs, sheep and birds. Products made from Golozerno variety oats have high nutritional value and energy value. The use of oats in fodder saves 20% of soybeans (Mammadov & Ismayilov, 2012, pp.13-15).

V.V. Vasin, A.V. Savachev and A.N. Burunov at Samara Agrarian University studied the effect of mineral fertilizer norms on grain yield of different varieties of oats. The highest grain yield was 2.18 t/ha in the Tumenskiy variety at the norm of mineral fertilizers (NPK)₃₀, and 1.0-1.39 t/ha in the non-fertilizer version (Vasin, 2021, pp.24-30).

In the studies carried out at the Bryansk Agrarian University, the effect of fertilizers Albit biopreparation on the grain yield of oats was studied. Three-year studies show that Albit biopreparation increases grain yield by 9% compared to control. Higher grain yield was 2.45 t/ha, and protein was 13.8%, when mineral fertilizers N₉₀P₉₀K₁₅₀ were applied together with Albit biopreparation (Drobyshevskaya *et al.*, 2017, pp.27-29).

In the studies carried out by A.D. Fedulova and others in the Russian Federation on grassy-podzol soils, the grain yield (NPK) was 2.75 t/ha in the 120+12 t/ha variant, and the protein and mass of 1000 grains were 1 ,94% and 12% increased (Fedudova, 2019, pp.16-20).

According to many authors, mineral fertilizers improve the productivity and quality of rural plants by increasing the amount of nutrients absorbed by plants in the soil. At the rate of 90 kg/ha of nitrogen fertilizer, the grain protein was 11.3%, starch was 47.6-62.9%, and fat was 2.18-4.88% (Abashev *et al.*, 2015, pp.11-15; Pasyukov *et al.*, 2016, pp.38-47).

In the studies by V.E. Torikov, O.V. Melnikova and etc. in the South-West region of Russia is noted that in this region, oats is widely used in the production of cereals, confectionery and fodder. Fertilization system should be developed in order to get high quality grain crop from oats. Therefore, in order to obtain a high and quality grain crop from oats in the region, mineral fertilizer norms should be studied and applied to farms based on the amount of nutrients in the soil (Torikov *et al.*, 2015, pp.10-15; Melnikova *et al.*, 2017, pp.562-568).

The application of mineral fertilizers under the oats plant against the background of the number of irrigation plays a key role in increasing the yield and soil fertility as one of the important agrotechnical measures. Therefore, taking into account its importance as food and fodder in the western region, which is of decisive importance in the production of agricultural products in our Republic, the irrigated gray-brown (chestnut) soils are fertile. Determining mineral fertilizer norms to improve soil moisture and quality and increase soil fertility is one of the urgent problems.

Taking into account the urgency of the problem, the main goal of the research is to determine the productivity of the autumn oats plant, the quality of the crop, and the soil fertility in the irrigated gray-brown soils of the western region. It consists of

determining the number of irrigations and effective mineral fertilizer norms that affect the growth of the year.

2. Materials and Methods

The researches were carried out in 2020-2022 at the Ganja Regional Agrarian Science and Innovation Center located in the Samukh district of the Ministry of Agriculture of Azerbaijan on irrigated gray-brown soils with the "Azerbaijan-60" variety of oats in the following scheme:

1. Control (without fertilizer);
2. Farm option N60;
3. N60P60K30;
4. N90P90K60;
5. N120P120K90;
6. N150P150K120.

The total area of each option is 56.0 m² (8.0x7.0), the calculated area is 50.4 m² (7.2x7.0), with a 0.8 m protection strip between each repetition, the experiment was set up in 4 repetitions, sowing in the usual row method 220 kg/ha of seeds per hectare (4.5 million germinating seeds) were harvested. Sowing was carried out in autumn in the first decade of October. Mineral fertilizers in the form of nitrogen-ammonium nitrate, phosphorus-simple superphosphate and potassium-potassium sulfate were used in the experimental field. Every year, phosphorus 60% and potassium fertilizers were applied 100% under the plow, nitrogen 50%, phosphorus 40% in early spring in the form of feeding in the bushing phase, and 50% of nitrogen at the beginning of the tuber. Phenological observations were carried out on 25 plants, and agrotechnical measures were carried out according to the rules adopted for the region. Protein in grain was determined by Barnstein (total nitrogen in grain is multiplied by a factor of 5.7), and starch was determined according to existing methods (Jafarov & Mehdiyeva, 2015).

3. Results and Discussion

The effect of mineral fertilizer rates on gray-brown (chestnut) soils on protein and starch yield from oats grain against the background of the number of irrigations was studied in our research in 2020-2022. The results of the study are given in the table as an average of 3 years.

As can be seen from the table, in the control (without fertilizer) variant with 2 times irrigation (1750-1850 m³/ha), the grain yield of oats is 23.7 s/ha, protein in grain is 12.38%, protein yield is 293.4 kg/ha, starch 39.76%, starch yield 942.31 kg/ha, grain yield 26.8 s, significantly increasing compared to the control-no-fertilizer variant in the management variant (N60) /ha, protein 12.50%, protein yield 335.0 kg/ha, starch 40.20% and starch yield 1077.36 kg/ha.

Depending on the effect of all three mineral fertilizers together with the background, depending on the grain yield and the amount of protein and starch in the grain composition, the yield of protein and starch was significantly higher than in the control-without-fertilizer and farming options. Thus, in the N₆₀P₆₀K₃₀ variant, grain

yield was 32.8 s/ha, protein 12.63%, protein yield 414.26 kg/ha, starch 40.73%, starch yield 1335.94 kg/ha.

Against the background of the number of irrigations twice, the highest indicators were observed in the $N_{90}P_{90}K_{60}$ variety, grain yield 41.8 s/ha, protein in grain 12.88%, protein yield 538, 38 kg/ha, starch was 43.00%, and starch yield was 1797.40 kg/ha.

As the rates of mineral fertilizers increase, the grain yield, protein and starch yield of oats significantly decrease compared to the $N_{90}P_{90}K_{60}$ variant, and the grain yield in the $N_{120}P_{120}K_{90}$ variant is 39.9 s/ha, and the protein in the grain is 12.79 %, protein yield 510.32 kg/ha, starch 42.53%, starch yield 1696.94 kg/ha, and in $N_{150}P_{150}K_{120}$ variety 37.4 s/ha; 12.71% and 475.35 kg/ha, 41.53% and 1553.22 kg/ha.

As can be seen from the table, against the background of 3-time irrigation of vegetation (2500-2700 m³/ha), grain yield, protein and starch yield of sorghum was significantly higher than with 2-time irrigation. This can be related to the number of irrigations, as in other indicators.

So, as can be seen from the table, in the control (without fertilizer) variant with 3 irrigations, the grain yield of oats is 26.8 s/ha, protein in grain is 12.58%, protein yield is 337.14 kg/ha, starch is 40.03 %, starch yield is 1072.80 kg/ha, the studied indicators in the effected variant (N60) significantly increased compared to the control-no-fertilizer variant, grain yield 30, 4 s/ha, protein 12.69%, protein yield 385.77 kg/ha, starch 40.31%, starch yield 1225.42 kg/ha.

Protein yield, kg/ha Starch in grain, % Starch yield, kg/ha

Table 1. Influence of mineral fertilizers on the yield of protein and starch from oats grain against the background of irrigation number (average over 3 years)

s/s	Mineral fertilizer norms	Grain yield, s/ha	Protein in grain, %	Protein yield kq/ha	Starch in grain, %	Starch yield, kg/ha
3 times Vegetation Irrigation						
1	Control (no fertilizer)	23,7	12,38	293,4	39,76	942,31
2	Farm option N_{60}	26,8	12,50	335,0	40,20	1077,36
3	$N_{60}P_{60}K_{30}$	32,8	12,63	414,26	40,73	1335,94
4	$N_{90}P_{90}K_{60}$	41,8	12,88	538,38	43,00	1797,40
5	$N_{120}P_{120}K_{90}$	39,9	12,79	510,32	42,53	1696,94
6	$N_{150}P_{150}K_{120}$	37,4	12,71	475,35	41,53	1553,22
3 times Vegetation Irrigation						
1	Control (no fertilizer)	26,8	12,58	337,14	40,03	1072,80
2	Farm option N_{60}	30,4	12,69	385,77	40,31	1225,42
3	$N_{60}P_{60}K_{30}$	36,0	12,74	458,64	41,13	1480,68
4	$N_{90}P_{90}K_{60}$	40,6	13,00	527,80	43,26	1756,35
5	$N_{120}P_{120}K_{90}$	47,1	13,21	622,20	43,90	2067,70
6	$N_{150}P_{150}K_{120}$	43,2	13,09	565,48	43,63	1884,81

The indicators studied from the combined effect of all three mineral fertilizers significantly increased as compared to the control-without-fertilizer and 2 times

irrigation background. Thus, in the $N_{60}P_{60}K_{30}$ variant, the grain yield is 36.0 s/ha, protein - 12.74%, protein yield - 458.64 kg/ha, starch - 41.13%, starch yield - 1480.68 kg/ha. For the $N_{90}P_{90}K_{60}$ variant these indicators were 40.6 s/ha; 13.00%; 527.80 kg/ha and 43.26%, correspondingly.

In the case of 3 times irrigation, the highest indicators were observed in the $N_{120}P_{120}K_{90}$ variant, with grain yield 47.1 s/ha, protein 13.21%, protein yield 622.20 kg/ha, starch 43.90%, and starch yield 2067.70 kg. /ha. At the high rate of mineral fertilizers, grain yield of oats yield of protein and starch in grain significantly decreased compared to the $N_{120}P_{120}K_{90}$ variant, and in the $N_{150}P_{150}K_{120}$ variant, respectively, the protein yield was 565.48 and the starch yield was 1884.81 kg/ha.

Thus, the number of irrigations and mineral fertilizer rates significantly increased the yield of protein and starch from wheat grain compared to the control-without-fertilizer option. Due to the effect of mineral fertilizers on the background of 2 times vegetation irrigation, the yield of protein from the grain crop increased by 120.86-244.98 kg/ha, and the yield of starch by 393.63-855.09 kg/ha compared to the control variant without fertilizers. The highest indicators were obtained in the $N_{90}P_{90}K_{60}$ variant. Against the background of the number of irrigations 3 times, due to the influence of mineral fertilizers, the yield of protein from the corn crop increased by 121.50-285.06 kg/ha, and the yield of starch by 407.88-994.90 kg/ha compared to the control-no-fertilizer variant. The highest protein and starch yield was observed in the $N_{120}P_{120}K_{90}$ variant against the background of 3 times vegetation irrigation. Against the background of the number of irrigations, protein and starch yields in 3 times irrigation were higher than in 2 times irrigation in each of the variants.

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