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# Influence of Nutrients on Winter Wheat on Its Productivity of Old Irrigated Light Serosemes

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## *Abstract*

The consumption of nutrients by plants of winter wheat in certain periods of vegetation occurs unevenly and significantly increases with the use of fertilizers. The greatest amount of nitrogen enters the plants from earing to milk ripeness, phosphorus and potassium from tillering to earing. Removal of nutrients by winter wheat when applying high doses of fertilizers and the highest yield increased by 1.5-2 times compared with the control. Fertilizers improved the quality of grain, with a stronger impact of nitrogen fertilizers. The greatest amount of protein and gluten in the grain of wheat was observed with the introduction of high doses of nitrogen, as well as with the transfer of part of it into the fertilizing before the ear.

***Keywords:*** *Light Gray Soil; Winter Wheat; Elements of Wheat Crop Structure; Mineral Fertilizers; Grain Quality; Yield Index*

## *Introduction*

In experiments on old-irrigated light gray soils of the Fergana Valley of Uzbekistan, fertilizers increased the grain yield of winter wheat “Chillaki” by 16.4-29.4 centners / ha. The minimum amount of nutrients in the soil falls on the periods of their greatest consumption by plants. The removal of nitrogen, phosphorus and potassium was determined according to the variants of the experiment.

Winter wheat in Uzbekistan currently occupies about 40% of the area under grain crops. However, the fertilization of “Chillaki” wheat under irrigated conditions has not been studied enough. In this regard, we in 2018-2020. on a field experiment to study the effectiveness of increasing rates of mineral fertilizers on winter wheat conducted in the farm “Jalalabad” in Uchkurgan district, Namangan region.

## *Methodology*

Before the experiment was laid, the 0-30 cm layer of irrigated serozem (medium loamy) soil contained: 1.130% humus, respectively 0.118, 0.165 and 1.092% of gross NPK forms, 27.7 mg / kg N-$NO_3$, 25.5 mg / kg mobile $P_2O_5$ and 215 mg / kg exchangeable $K_2O$.

The variants of the experiment were laid in 4 repetitions, the arrangement was single-tier, the area of each plot was 224 $m^2$ (5.6 mx 40 m). We used $N_{aa}$ - ammonium nitrate (34% N), $P_{cr}$ - simple superphosphate (19% $P_2O_5$) and $K_x$ - potassium chloride (60% $K_2O$). The grain yield and its components were determined from 1 $m^2$ of the mown area after drying the samples in a thermostat (105 ° C).

The reliability of the research results was confirmed by statistical data processing (PROCGLM, ANOVA, LSD Alpha 0.05) using the software package SAS 9.1 (Khakimov: 2017).

This soil is typical of dry subtropical foothill desert-pasture adyr types and is located 300-600 meters above sea level. In terms of granulometric composition, sierozem is light and medium sandy.

For soils developed on alluvial rocks, it is characteristic of many large dusty fractions (40-50%), enrichment with clay molecules (<0.001) of the upper and middle layers (Methods of agrochemical analyzes of soils..: 1977).

Nitrogen, phosphorus, and potassium in plant samples were determined in one weighed portion by an accelerated method (Methods of agrochemical analyzes of soils..: 1977) with subsequent determination of nitrogen according to Kjeldahl, $P_2O_5$ - colorimetric, $K_2O$ - on a flame photometer. The determination of the average daily intake of nutrients by plants was carried out by calculation.

## *Results and Discussion*

Experiments have shown that during the period of growth with the use of various rates of mineral fertilizers, the greatest accumulation of nutrients in plants in most cases coincides with the periods of maximum average daily consumption. For example, the maximum nitrogen content in the crop was recorded in the spike phase (Table 1).

In the control variant, the total amount of nitrogen removal in plants during this phase was 165.0 kg / ha, and when fertilizers were applied at a dose of N250 P175 K125 kg / ha, which is 105.2 (270.2) kg / ha higher than the control.

On options N0 and N150 kg / ha, a decrease in nitrogen accumulation was observed as a result of lower yields (32.6 and 49.0 c / ha) and a smaller amount of dry matter (1148.2 and 1304.4 g / $m^2$). Where a double dose of nitrogen was applied (N200 and N250 kg / ha) and a higher yield (60.7 and 62.0 c / ha) of dry weight (1402.5 and 1438.8 g / $m^2$) was obtained, nitrogen accumulation in phase of earing and milk ripeness almost 1.5 times higher than its accumulation in the variant N250 kg / ha and amounted to 270.2 and 265.8 kg / ha (Davletyarov: 2012, p.5).

The greatest accumulation of phosphorus was noted in the phase of milky-wax ripeness. When applied for winter wheat N250 kg / ha, the accumulation of this element in the heading phase increased to 109.0 kg / ha. As for the control and variants with medium doses of fertilizers, the greatest accumulation of phosphorus occurred in the full ripeness phase. Consequently, with the introduction of increased doses of phosphorus fertilizers, as well as with a ratio of N: P2O5 = 2:1, phosphorus accumulated by plants more intensively and its maximum amount was noted in earlier periods, after which it decreased in the

yield. By full ripeness, the phosphorus content was 81.1-90.4% of the maximum accumulated amount (Zavalin & Pasynkov: 2010).

Table 1 Removal of nutrients in the development phase of winter wheat, kg / ha, (average for 2018-2019)

| № | Development phases | Mineral fertilizers rates (kg / ha) | Removal of nutrients, kg / ha | | |
|---|---|---|---|---|---|
| | | | N | P | K |
| 1 | Eating | $N_0 P_0 K_0$ | 29,2 | 4,5 | 19,8 |
| | | $N_{150} P_{105} K_{75}$ | 41,6 | 8,4 | 30,3 |
| | | $N_{200} P_{140} K_{100}$ | 51,1 | 11,9 | 38,7 |
| | | $N_{250} P_{175} K_{125}$ | 55,8 | 14,4 | 43,2 |
| 2 | Trumpet | $N_0 P_0 K_0$ | 58,2 | 12,6 | 42,0 |
| | | $N_{150} P_{105} K_{75}$ | 81,2 | 19,1 | 59,4 |
| | | $N_{200} P_{140} K_{100}$ | 94,1 | 23,5 | 73,6 |
| | | $N_{250} P_{175} K_{125}$ | 98,2 | 25,3 | 80,3 |
| 3 | Spike | $N_0 P_0 K_0$ | 165,0 | 35,9 | 111,5 |
| | | $N_{150} P_{105} K_{75}$ | 207,6 | 50,6 | 144,7 |
| | | $N_{200} P_{140} K_{100}$ | 242,4 | 61,7 | 175,8 |
| | | $N_{250} P_{175} K_{125}$ | 270,2 | 76,7 | 187,0 |
| 4 | Milky-wax ripeness | $N_0 P_0 K_0$ | 135,2 | 46,5 | 102,1 |
| | | $N_{150} P_{105} K_{75}$ | 229,1 | 79,9 | 146,9 |
| | | $N_{200} P_{140} K_{100}$ | 245,2 | 95,6 | 165,6 |
| | | $N_{250} P_{175} K_{125}$ | 265,8 | 109,0 | 198,9 |
| 5 | Full ripeness | $N_0 P_0 K_0$ | 113,0 | 41,0 | 87,4 |
| | | $N_{150} P_{105} K_{75}$ | 180,4 | 68,3 | 132,4 |
| | | $N_{200} P_{140} K_{100}$ | 218,8 | 83,3 | 157,7 |
| | | $N_{250} P_{175} K_{125}$ | 229,0 | 97,5 | 188,7 |

Potassium accumulated in significant amounts already in the earliest phases of plant development. By the end of milk-wax ripeness, wheat accumulated it up to 198.9 kg / ha and more, and in the heading phase its amount was the highest both in the control variant and in the variants with high doses of fertilizers. In milk ripeness, the amount of potassium accumulated by plants decreased by more than 50%, and by the end of the growing season it was 2.6 times less compared to the period of maximum accumulation (Zavalin & Sergaliev: 2010; Sarimsakov: 2020).

Table 2 shows that with a grain yield of 32.6 c / ha, winter wheat tolerates N-135.2, $P_2O_5$-46.5, $K_2O$-102.1 kg / ha. On the variant with an increased dose of fertilizers and a yield of 62.0 c / ha, the removal increased to 265.8, 109.0 and 198.9 kg, respectively. In the control variant, the removal of nitrogen per 10 centners of grain was 42.8 kg, and in the variant with the introduction of N200 - 36.1 kg. With an increase in the dose of phosphorus to P175 kg / ha per 10 centners of grain, 15.6 kg were required against 15.5 in the control.

Table 2 Removal of nutrients by winter wheat yield, kg / ha,

| № | Mineral fertilizers rates (kg / ha) | 2018 г | | | 2019 г | | |
|---|---|---|---|---|---|---|---|
| | | N | P | K | N | P | K |
| 1 | $N_0P_0K_0$ | 113,0 | 41,0 | 87,4 | 131,8 | 60,3 | 112,7 |
| 2 | $N_{150}P_{100}K_{75}$ | 180,4 | 68,3 | 132,4 | 174,3 | 79,5 | 141,6 |
| 3 | $N_{200}P_{140}K_{100}$ | 218,8 | 83,3 | 157,7 | 200,1 | 87,8 | 160,1 |
| 4 | $N_{250}P_{175}K_{125}$ | 229,0 | 97,5 | 188,7 | 218,5 | 95,2 | 176,3 |

On the control variant for the creation of 10 centners of grain, winter wheat consumed 33.1 kg of potassium, while the addition of K100 kg / ha contributed to an increase in its absorption to 30.1 kg. However, the size of the removal of N, $P_2O_5$ and $K_2O$ by the crop does not yet give a complete picture of the need of winter wheat for these nutrients. Based on these data, it is impossible to accurately calculate the dose of fertilizer required to obtain the maximum yield.

As our experiments have shown, under irrigation conditions, when applying fertilizers for “Chillaki” winter wheat, it is possible to obtain high yields. The data given in table-3 show that the application of average doses to both (N200P140K100 kg / ha) of mineral fertilizers provided practically the same and rather high yield increases (18.1 c / ha). With an increase in the doses of fertilizers in the experiment with wheat at the rates of N250P175K125 kg / ha, a decrease in their efficiency was observed compared to the experiment with N200P140K100 kg / ha. The largest increments according to these norms of the use of mineral fertilizers, respectively, amounted to 18.1 and 19.4 c / ha. Lower yield efficiency (16.4 c / ha) of fertilizers in experiments with wheat N150P100K75 kg / ha.

Table-3 Influence of fertilizers on the yield of winter wheat, kg / ha

| Option number | Mineral fertilizers rates (kg / ha) | | | Grain yield (c / ha) | | Harvest index | |
|---|---|---|---|---|---|---|---|
| | N | $P_2O_5$ | $K_2O$ | 2018 г. | 2019 г. | 2018 г. | 2019 г. |
| Variety "Chillaki" | | | | | | | |
| 1 | 0 | 0 | 0 | 26,4d* | 38,7c | 0,32 | 0,37 |
| 2 | 150 | 100 | 75 | 45,5c | 52,4b | 0,38 | 0,37 |
| 3 | 200 | 140 | 100 | 60,7b | 60,6a | 0,42 | 0,36 |
| 4 | 250 | 175 | 125 | 62,6a | 61,3a | 0,42 | 0,34 |
| *Least Average Difference (LSD)* | | | | *1.21* | *0.94* | □ | □ |
| *Coefficient of variation (CV)* | | | | *1.60* | *1.15* | □ | □ |
| ** The difference in values with the same letters within one year and variety is not statistically significant.* | | | | | | | |

Of the individual types of mineral fertilizers, nitrogen fertilizers had the greatest effect on the wheat yield. With the exclusion of NPK from fertilizers, the yield decreased by 16.4 c / ha. The payback of 1 kg of N in the experiment with wheat with the introduction of N in doses of 150-200 kg / ha was 32.6-30.4 kg / ha of grain. With a further increase in doses to N250 kg / ha, the nitrogen efficiency decreased (24.8 kg / ha). The payback of phosphorus fertilizers when applied at a dose of P105 kg / ha was 46.7 kg / ha of grain, an increase in the dose to P140-175 kg / ha reduced (43.4-35.4 kg / ha) their effectiveness.

If at the rate of N150P100K75 kg / ha the productivity of the wheat varieties studied in the experiment was almost equal, then at N200P140K100 kg / ha the advantage of “Chillaki” was obvious, although the main quality indicators of grain (gluten and protein) were better. An increase in the rate of mineral fertilizers to N250P175K125 kg / ha, although it is associated with statistically proven yield increases in comparison with the rate of N200P140K100 kg / ha, but they are insignificant (1.2-1.7 c / ha) and without a significant effect on the quality of grain crops (Movsumov: 2013: Khakimov: 2017).

The yield index (the ratio of grain weight to total dry weight of a plant) varied depending on NPK norms, variety and year of experience (see Table 3). In the first year of the experiment, the increase in the yield index for the "Chillaki" variety was in line with the grain yield. In the second year, the yield index declined with increasing rates of mineral fertilizers. Such a change in the yield index in connection with the studied factors, apparently, is associated with differences in climatic conditions during the years of research.

Mineral fertilizers had a significant impact on the quality of winter wheat grain (Table 4). The highest percentage of protein in grain and its harvest from 1 hectare was observed in the variant with the highest dose of nitrogen, phosphorus and potassium. Of the individual types of fertilizers, the most effective were nitrogen.

Table-4 Impact of fertilizers on the quality of winter wheat grain

| Years | Mineral fertilizers rates, kg / ha | Humidit, (%) | Natural weight (g/l) | Glass visibility (%) | Gluten, (%) | Protein, (%) | Flour output, (%) |
|---|---|---|---|---|---|---|---|
| 2018 | $N_0\ P_0\ K_0$ | 6,7c | 695,0c | 40,0c | 23,0c | 9,8c | 55,8c |
| | $N_{150}\ P_{105}\ K_{75}$ | 7,9b | 759,0b | 48,0b | 27,0b | 11,2b | 64,9b |
| | $N_{200}\ P_{140}\ K_{100}$ | 8,5ba | 785,0ba | 53,0a | 30,0a | 11,8a | 70,1a |
| | $N_{250}\ P_{175}\ K_{125}$ | 9,3a | 796,0a | 55,0a | 31,0a | 12,0a | 70,8a |
| 2019 | $N_0\ P_0\ K_0$ | 7,3d | 698,0c | 56,0c | 21,8c | 9,2c | 57,7c |
| | $N_{150}\ P_{105}\ K_{75}$ | 9,1c | 782,0b | 64,0b | 26,7b | 12,2b | 68,9b |
| | $N_{200}\ P_{140}\ K_{100}$ | 10,7b | 840,0a | 76,0a | 29,7a | 13,5a | 74,1a |
| | $N_{250}\ P_{175}\ K_{125}$ | 11,7a | 854,0a | 77,0a | 30,4a | 14,2a | 74,8a |
| 2-year average | $N_0\ P_0\ K_0$ | 7,0 | 696,5 | 48,0 | 22,4 | 9,5 | 56,8 |
| | $N_{150}\ P_{105}\ K_{75}$ | 8,5 | 770,5 | 56,0 | 26,9 | 11,7 | 66,9 |
| | $N_{200}\ P_{140}\ K_{100}$ | 9,6 | 812,5 | 64,5 | 29,9 | 12,7 | 72,1 |
| | $N_{250}\ P_{175}\ K_{125}$ | 10,5 | 825,0 | 66,0 | 30,7 | 13,1 | 72,8 |
| *Statistics: Anova Linear (LSD Alpha 0.1)* | | | | | | | |
| ** The difference in values with the same letters within one year and variety is not statistically significant.* | | | | | | | |

## *Conclusion*

A positive effect (2018-2019 average) on the protein content (13.1%) in grain was exerted by fertilizing wheat with nitrogen 250 kg / ha. Due to the introduction of N150-200 kg / ha during this period, the amount of protein increased by 1.33-1.37%.

Analysis of the effect of fertilizers on the amount of wet gluten in grain shows that its content fluctuated within 21.8-31.0%. The largest amount of gluten was noted on the variant N250P175K125 kg / ha. The percentage of gluten here was the maximum (8.3% more than in the control).

When determining the quality of gluten, it was found that winter wheat "Chillaki" has good quality gluten, even on options without fertilization. An improvement in the quality indicators of gluten was noted with the introduction of nitrogen fertilizers. Phosphate and potash fertilizers had a negative effect on the quality of gluten. The percentage of starch decreased during fertilization.

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