Salinity level impact on humus and gross npp content in irrigated soils

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Abstract. This article presents information about the negative impact of soil salinity, its content of anions and cations, such as chlorine, sulfate, sodium, magnesium, on the amount of humus and the amount of nutrients in alluvial soils of irrigated meadows of the Bukhara region.Under the conditions of irrigated meadow-alluvial soils of the Bukhara region, the amount of humus and gross NPP (Nitrogen, Phosphorus, Potassium), control indicators, i.e. non-saline soils change compared to weakly, moderately and highly saline soils, and scientific justification for this is given.

1 Introduction

The agrochemical properties of the soil are important for soil fertility, plant growth and development, and crop production. At the same time, humus is one of the main indicators of the total amount of nutrients. These indicators were different in non-saline and saline soils. Because salinity has a significant negative impact on humification processes, the activity and vital activity of microorganisms. Therefore, the amount of humus in non-saline soil was higher than in weak, medium and strong saline soils. As salinity levels increased, the amount of humus in meadow-alluvial soils decreased significantly. This condition can occur for several reasons in saline soils. In particular, an increase in the osmotic pressure of the soil solution due to an increase in the concentration of water-soluble salts has a negative effect on plants and microorganisms. At the same time, the amount and percentage of harmful and toxic salts in water-soluble salts increases. This also reduces the activity of microorganisms. In particular, an increase in the percentage of chloride, sulfate, sodium and magnesium ions in saline soils has a sharp negative effect on the activity of microorganisms. These conditions affect the agrochemical properties of the soil, in particular the humus regime. Humus has a positive effect on all soil properties and significantly improves them. But in saline soils, especially in highly saline meadow-alluvial soils, due to the small amount and reserves of humus, the soil properties are in a state of deterioration.

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2 Materials and Methods

The object of the study was irrigated meadow alluvial soils of varying degrees of salinity, common in the Bukhara region. They were studied along genetic horizons using cross sections [1-22].

Soil samples taken from soil sections from bottom to top using generally accepted methods were analyzed in laboratory conditions based on the following methods:

1. determination of soil humus - according to the Tyurin method;
2. gross NPP - in one sample using the Maltseva-Gritsenko method.

The results obtained were analyzed mathematically and statistically.

3 Results and Discussion

The content of humus and gross nitrogen, phosphorus and potassium in irrigated meadow-alluvial soils of the Bukhara region was studied depending on the level of salinity. According to him, in non-saline and saline meadow-alluvial soils, the amount of humus decreased sharply from top to bottom along the soil profile. At the same time, the humus content was the lowest in the lower horizons of the section. For example, the amount of humus in the 0-31 cm layer of non-saline meadow-alluvial soils was 1.18%, while in layers 31-63 cm, 63-94, 94-113, 113-148 cm this figure was 0.95. section accordingly; 0.82; 0.67; amounted to 0.55% (Table 1). The humus content in slightly saline meadow-alluvial soil is 0-29; 29-49; 49-81; 81-109; 1.03 at horizons of 109-140 cm, respectively; 0.86; 0.71; 0.56; It was 0.50%. It was found that the amount of humus was even lower in meadow-alluvial soils of moderate and strong salinity. The abundance of water-soluble mineral salts has led to low organic matter content in the soil. 0-26 meadow-alluvial soils are moderately saline; 26-47; 47-80; The amount of humus in the horizons of 80-105 and 105-137 cm is 0.96, respectively; 0.82% 0.67; It was 0.52 and 0.46%, and 0-25 in highly saline meadow-alluvial soils; 25-49; 49-79; 0.81 in layers 79-108 and 108-138 cm, respectively; 0.72; 0.63; They were noted to be 0.42 and 0.31% (Table 1). Therefore, an excess of water-soluble salts in the soil negatively affects the microbiological processes of humus formation and leads to a decrease in the amount of humus. This leads to deterioration of soil properties. Therefore, the use of organic fertilizers on saline soils, especially in moderately and highly saline meadow-alluvial soils, and planting salinity-reducing crops, such as alfalfa, are important in improving their ameliorative condition. At the same time, a decrease in salinity in saline soils enhances the microbiological processes of humus formation and leads to an improvement in the condition of humus. This is fundamental to soil fertility.

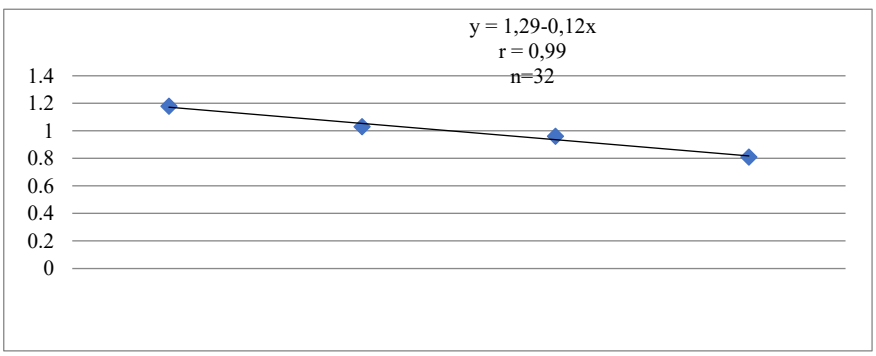

Fig. 1. Relationship between soil salinity and humus content

The correlation coefficient between soil salinity and the amount of humus was 0.99, and this relationship was expressed by the regression equation y=1.29-0.12x (u=a-bx). This means that conditions for the formation of humus in saline soils are poor. It was found that there is an inverse linear correlation between the degree of salinity and the correlation coefficient (Fig. 1).

The amount of gross nutrients in the soil is important in determining the potential fertility of the soil. They form mobile nutrients that can be absorbed by the plant. The amount of gross nitrogen in the soil depends on the amount of humus. Because up to 99% of gross nitrogen is contained in organic matter, including humus.

Nitrogen does not accumulate in the soil in mineral form. Soil microorganisms have the ability to denitrify nitrogen in the form of ammonium and nitrate, that is, mineral nitrogen. Because excessive accumulation of ammonium and nitrates in the soil is harmful and toxic to the organisms in it. Therefore, the mechanism for removing excess mineral nitrogen in the soil is created through the microbiological processes of nitrification and denitrification, which protects these organisms from the effects of excess nitrogen.

Therefore, the main part of gross nitrogen is organic nitrogen, and the amount of gross nitrogen varies depending on the amount of humus. With an increase in the amount of humus, the amount of total nitrogen also increases, and vice versa, with a decrease in the amount of humus, the amount of total nitrogen decreases. Agrotechnological measures aimed at increasing the amount of humus lead to an increase in the total amount of nitrogen. It was noted that the amount of total nitrogen in non-saline meadow-alluvial soil is higher than in saline meadow-alluvial soil. Increased salinity has led to a decrease in total nitrogen content in the soil. At the same time, in the profile of non-saline and saline meadow-alluvial soils, the amount of total nitrogen decreased significantly from top to bottom. For example, if the amount of gross nitrogen in a layer of 0–31 cm of non-saline meadow-alluvial soil was 0.121%, in the horizon of 31–63 cm – 0.105%, in the horizon of 63–94 cm – 0.096%, in the horizon 0.073%. in the layer 94-113 cm, and in the horizon 113-148 cm - 0.058%, this indicator is slightly saline meadow-alluvial soil 0-29; 29-49; 49-81; 0.110 in layers 81-109 and 109-140 cm, respectively; 0.094; 0.083; 0.065; It amounted to 0.057%. The negative effect of salinity on the content of total nitrogen is more pronounced in moderately and highly saline meadow-alluvial soils. For example, if moderately saline meadow-alluvial soil contains 0.101% of total nitrogen in the 0-26 cm layer, 0.089% in the 26-47 cm layer, 0.073% in the 47-80 cm layer, 0.058% in the 80 cm layer. in a layer of 105 cm, and in a layer of 105-137 cm - 0.051%, this figure is 0-25 for highly saline meadow-alluvial soil; 25-49; 49-79; 0.089 in horizons 79-108 and 108-138 cm, respectively; 0.079; 0.070; was 0.055 and 0.039% (Table 1).

Table 1. The amount of humus and the amount of nutrients in irrigated pasture-alluvial soils with different levels of salinity in the Bukhara region

Soil horizons, см	**Humus, %**	**Gross, %**			**CO_2 carbonates (%)**	**C:N**
		N Nitrogen	**P Phosphorus**	**P Potassium**		
Unsalted						
0-31	1,18	0,121	0,19	2,40	9,15	5,6
31-63	0,95	0,105	0,16	2,25	9,85	5,2
63-94	0,82	0,096	0,13	2,20	10,50	4,9
94-113	0,67	0,073	0,11	1,97	11,25	5,3
113-148	0,55	0,058	0,10	1,82	11,88	5,5
Lightly salted						
0-29	1,03	0,110	0,17	2,45	8,26	5,4
29-49	0,86	0,094	0,15	2,25	8,95	5,3

49-81	0,71	0,083	0,13	2,25	9,63	4,9
81-109	0,56	0,065	0,11	2,00	9,91	5,0
109-140	0,50	0,057	0,09	1,91	10,78	5,0
Moderately salted						
0-26	0,96	0,101	0,15	2,33	7,85	5,5
26-47	0,82	0,089	0,13	2,24	8,37	5,3
47-80	0,67	0,073	0,12	2,08	9,00	5,3
80-105	0,52	0,058	0,11	1,88	9,42	5,2
105-137	0,46	0,051	0,09	1,76	10,05	5,2
Strongly salted						
0-25	0,81	0,089	0,14	2,15	7,38	5,2
25-49	0,72	0,079	0,12	1,96	8,20	5,2
49-79	0,63	0,070	0,10	1,80	8,90	5,2
79-108	0,42	0,055	0,09	1,72	9,15	4,4
108-138	0,31	0,039	0,08	1,66	9,61	4,6

Thus, the negative impact of salinity on soil microbiological processes led to a decrease in the total nitrogen content.

The content of total phosphorus exceeded the content of total nitrogen and amounted to 0.08-0.19%, depending on soil salinity and layer depth (Table 1). The content of total phosphorus in non-saline soils was higher than in saline soils. A significant decrease in the content of total phosphorus was noted in saline soils. As salinity levels increased, the amount of total phosphorus in the soil decreased, with the least amount of total phosphorus in the highly saline alluvial meadow soil. For example, the amount of total phosphorus in the 0–31 cm layer of non-saline meadow-alluvial soil is 0.19%, in the 31–63 cm layer – 0.16%, in the 63–94 cm layer – 0.13%, in the 0. eleven %. layer 94-113 cm, 113 0.10% in the horizon -148 cm, 0-29 slightly saline meadow-alluvial soil; 29-49; 49-81; 81-109; The amount of total phosphorus in layers 109-140 cm is 0.17; 0.15; 0.13; 0.11; 0.09%, 0-26 moderately saline meadow soils; 26-47; 47-80; 80-105; The amount of gross phosphorus in layers of 105-137 cm is, respectively, 0.15; 0.13; 0.12; 0.11; 0.09%, 0-25 highly saline meadow-alluvial soil; 25-49; 49-79; 79-108; The amount of total phosphorus in layers 108-138 cm is 0.14; 0.12; 0.10; 0.09; observed at the level of 0.08% (Table 1). Thus, soil salinity negatively affects the amount of total phosphorus in it.

Another important nutrient is potassium. The total amount of potassium in the soil is important. No significant difference in the content of total potassium was detected between non-saline and slightly saline meadow-alluvial soils. Only in some horizons of slightly saline meadow-alluvial soil was the content of total potassium slightly higher than in non-saline soil. However, the amount of total potassium was slightly lower in meadow-alluvial medium- and highly saline soils than in non-saline meadow-alluvial soils. The content of total potassium decreased from top to bottom along the soil profile. This was observed at all salinity levels. For example, 0-31 – meadow-alluvial non-saline soil; 31-63; 63-94; 94-113; In layers 113-148 cm, the total amount of potassium is, respectively, 2.40; 2.25; 2.20; 1.97; 0-29 slightly saline meadow-alluvial soil – 1.82%; 29-49; 49-81; 81-109; The total amount of potassium in the horizons of 109-140 cm is 2.45; 2.25; 2.25; 2.0; 1.91%, 0-26 meadow-alluvial moderately saline soil; 26-47; 47-80; 80-105; In layers 105-137 cm this figure is 2.33; 2.24; 2.08; 1.88; 1.76%, 2.15, respectively, in highly saline meadow-alluvial soil; 1.96; 1.80; 1.72; amounted to 1.66% (Table 1). Therefore, the total amount of potassium is significantly lower in meadow-alluvial medium- and highly saline soils than in non-saline and slightly saline meadow-alluvial soils.

The rate and direction of microbiological processes in the soil also largely depend on the S:N ratio of carbon and nitrogen. Considering that the bulk of nitrogen in the soil is contained in organic matter, this ratio indicates that organic matter, including humus, is rich in nitrogen. The high nitrogen content in organic matter facilitates and accelerates its decomposition. There was no significant difference in S:N ratio between non-saline and saline soils. Only highly saline grassland alluvial soils had a significantly lower carbon to nitrogen ratio. In general, the carbon to nitrogen S:N ratio was significantly lower in the lower layers of saline meadow alluvial soils. In non-saline meadow-alluvial soil, this situation is not clearly visible. A high S:N ratio in the upper layers increases the stability of humus and makes it difficult for microorganisms to absorb it. The ratio of carbon to nitrogen decreased significantly only in highly saline soils, and this situation was more pronounced in the lower layers. For example, 0-31 – meadow-alluvial non-saline soil; 31-63; 63-94; 94-113; In layers 113-148 cm, the ratio of carbon and nitrogen (S:N) is 5.6, respectively; 5.2; 4.9; 5.3; If it was 5.5, then this indicator is 0-29 for slightly saline meadow-alluvial soil; 29-49; 49-81; 81-109; 5.4 in layers 109-140 cm, respectively; 5.3; 4.9; 5.0; 5.0, 0-26 meadow-alluvial soil, moderately saline; 26-47; 47-80; 80-105; 5.5 in layers 105-137 cm; 5.3; 5.3; 5.2; 5.2, 0-25 highly saline meadow-alluvial soils; 25-49; 49-79; 79-108; 5.2 respectively in layers 108-138 cm; 5.2; 5.2; 4.4; was 4.6 (Table 1). Therefore, only at high salinity levels does the S:N ratio in the soil decrease.

The amount of carbonates is also important when assessing soil fertility. Carbonates affect the soil environment (pN) and provide its alkalinity. Carbonates play an important role in converting mobile phosphorus into a form that is not absorbed by plants. In the soil, carbonate ions combine predominantly with calcium and partially with magnesium, forming calcium and magnesium carbonates.

In general, non-saline meadow alluvial soil was found to have higher carbonate content than saline meadow alluvial soil. Along with the increase in salinity, the amount of carbonates in the soil decreased. At the same time, the amount of carbonates increased from top to bottom along the soil profile. For example, 0-31 – meadow-alluvial non-saline soil; 31-63; 63-94; 94-113; The corbanate content in layers 113-148 cm is 9.15, respectively; 9.85; 10.50; 11.25; 11.88%, meadow-alluvial slightly saline soil 0-29; 29-49; 49-81; In layers 81-109; from 109-140 cm the amount of carbonates is 8.26; 8.95; 9.63; 9.91; 10.78%, 0-26 meadow-alluvial soils, moderately saline; 26-47; 47-80; 80-105; 7.85, respectively, at horizons of 105-137 cm; 8.37; 9.00; 9.42; 10.05%, 0-25% highly saline meadow-alluvial soils; 25-49; 49-79; 79-108; 7.38 respectively in layers 108-138 cm; 8.20; 8.90; 9.15; amounted to 9.61% (Table 1).

Consequently, soil salinization leads to a decrease in carbonate content, and as a consequence, carbonate content is significantly reduced in saline soils, especially in highly saline soils. This is also due to the transition of carbonates into a soluble state and leaching into the lower layers.

Thus, the amount of humus, total nitrogen, phosphorus and potassium, carbonates, and the C:N ratio in the soil changes depending on the level of soil salinity, salt content, and feather hardness. Soil salinization causes a decrease in the amount of humus, gross nitrogen and phosphorus. At the same time, in saline meadow-alluvial soils the carbonate content also decreases. A decrease in the total potassium content and C:N ratio is observed only in highly saline meadow-alluvial soil.

Depletion of humus also leads to a deterioration in the agrochemical and agrophysical properties of saline soils.

4 Conclusion

The agrochemical properties of non-saline meadow-alluvial soils, including the amount of humus and nutritional regime, significantly exceed those of saline soils. The content of total nitrogen and phosphorus is higher in non-saline meadow-alluvial soil than in differently saline meadow-alluvial soil. As a result of salinization, a decrease in the content of total potassium and the C:N ratio is observed only in highly saline meadow-alluvial soil.

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