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INFLUENCE OF THE DEGREE OF SALINITY ON THE MICROBIOLOGICAL ACTIVITY OF THE MEADOW-ALLUVIAL SOIL OF THE BUKHARA OASIS

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Abstract:

The article is devoted to the study of the effect of salinization of meadow-alluvial soils on the number of taxonomic and physiological groups of microorganisms. When the content of water-soluble salts in the meadow-alluvial soil deteriorates the conditions for the reproduction of microorganisms, which is reflected in their numbers. The salt mode of meadow-alluvial soil changes greatly in medium and highly degrees of salinization. Therefore, the number of taxonomic and physiological groups of microorganisms was the smallest in the mean and highly salinization meadow-alluvial soils. On highly saline meadow-alluvial soils, the concentration of the soil solution reaches the greatest indicator that negatively acting on the number of microorganisms. Therefore, on highly saline meadow-alluvial soils, the number of bacteria, mushrooms, actinomycetes, nitrogen fixers, ammonifiers, nitrifiers, nitrate reductants and cellulose-decomposing bacteria. The number of microorganisms was influenced by the depth of the horizons. Down the soil profile the number of microorganisms of all groups was significantly reduced in the deepest soil horizon (50-80 cm) was the smallest. This may be due to a decrease in the content of humus and oxygen as it deepens in the soil. The decrease in aerobic microorganisms in this direction was sharper. The number of taxonomic and physiological groups of microorganisms is significantly affected by the seasons. In irrigated meadow-alluvial soils in the summer in agroeconomic of cotton and other cultures, the number of microorganisms was larger than in spring or autumn. In autumn, the soil salinity is enhanced and achieves the worst state. Therefore, in the middle and strong degrees of salinization in the fall, the number of microorganisms was the smallest.

Keywords: Irrigated soils, meadow-alluvial, salinization, microorganisms, quantity.

INTRODUCTION.

Microbiological activity is of great importance in the formation of soil fertility and its nutritional regime [1,2,3]. Because due to microbiological processes, nutrients for plants are continuously formed, the soil shows its buffering capacity and maintains homeostasis. Consequently, microorganisms participating in all processes of the soil make it a dynamic system, where it will be possible to live microorganisms, soil organisms and grow plants [4].

At the same time, various factors, including soil obstruction, affect microorganisms and their activity. An increase in the content of water-soluble salts in the soil, increasing the concentration of the soil solution, has a negative effect on the number and activity of various taxonomic and physiological groups of microorganisms.

Since, among the meadow-alluvial soils of the Bukhara oasis, there are soils with various degrees and types of salinity, and therefore the study of the effect of salinity on microbiological activity is of great importance. The study of the microbiological activity of meadow-alluvial soils of the Bukhara oasis was carried out by some researchers [5,6,7,8,9,10]. These works show how microbiological activity changes depending on various factors. But in these works little attention is paid to the effect of salts on microorganisms.

With an increase in the concentration of water-soluble salts in the soil, the microbiological activity of the soil decreases [5,6,7], which negatively affects the agrochemical and agrophysical properties of the soil.

In this case, the processes of humus formation, ammonification and nitrification are disrupted. In addition, the types of salinization are important. Soda, chloride and sodium salinization is considered especially dangerous for

microorganisms. When the soil is alkalized, structures are destroyed, the soil is compacted, the air and water properties of the soil deteriorate, which creates an unfavorable condition in the soil for microorganisms.

Therefore, by creating favorable conditions for various groups of microorganisms, it is possible to optimize the processes, to increase the fertility of the soil, to improve the properties.

The purpose of the research. Study of the influence of types and degree of salinity on the microbiological activity of meadow-alluvial soils of the Bukhara oasis. At the same time, the microbiological activity of non-saline, weakly, moderately and highly saline meadow alluvial soils is comparatively evaluated. At the same time, the effect of salinity chemistry is being studied, i.e., chlorides, sulfates, soda, sodium and magnesium for microorganisms.

MATERIAL AND RESEARCH METHODS.

The object of the study was the meadow-alluvial soils of the Bukhara oasis with various degrees of salinity. For this, expeditionary studies were carried out, where soil cuts were made in meadow-alluvial soils with various degrees of salinity. For microbiological analyzes, soil samples were taken from horizons 0-25; 25-50; 50-80 cm. In these soil samples, the number of bacteria, fungi, actinomycetes, ammonifiers, nitrifiers, nitrate reducers, nitrogen fixers, cellulose-decomposing bacteria was determined. Bacteria and ammonifiers were determined on meat-peptone agar (MPA), mushrooms - on Czapek's medium, actinomycetes - KAA (starch-ammonium agar), nitrifiers - among Vinogradskiy, nitrate reducers - among Giltai, nitrogen fixers - on Ashby's medium, aerobic cellulose - on Hutchinson's environment.

To determine the degree and type of salinity, a chemical analysis of the water extract of the soil was carried out, where the content of carbonates, bicarbonates, chlorides, sulfates, calcium, magnesium, sodium and potassium ions was determined.

Soil sampling and chemical as well as microbiological analysis were carried out on the basis of methodological guidelines such as "Methods of agrochemical, agrophysical and microbiological research in irrigated cotton areas",

"Guidelines for the chemical analysis of soils" (E.V. Arinushkina), "Guidelines for chemical analyzes of soils during land monitoring", "Methods of microbiological research and determination of trace elements" [11,12,13].

RESEARCH RESULTS AND DISCUSSION.

In the Bukhara oasis, meadow-alluvial soils with varying degrees of salinity are very common. Low and medium saline meadow-alluvial soils are widespread. Non-saline and highly saline meadow-alluvial soils are found to a lesser extent. Chlorides and sulfates are involved in salinization. As the degree of salinity in the water extract of meadow-alluvial soils increases, the concentration and proportion of magnesium and sodium cations increases, which worsens the ionic composition of the water extract. Consequently, an increase in the concentration of water-soluble salts is accompanied by an increase in the proportion of harmful and dangerous ions for microorganisms and plants.

Thus, meadow-alluvial soils with different degrees of salinity differ not only in the general concentration of water-soluble salts, but also in the ionic composition of these salts. All this affects the number of taxonomic and physiological groups of microorganisms, as well as their activity.

The results of microbiological analyzes of soils show that the number of bacteria in non-saline soils is higher than in saline meadow-alluvial soils (Table 1). This is observed in all studied soil horizons of the soil. With an increase in the degree of salinity, the number of bacteria decreases and the lowest number of bacteria is observed in highly saline meadow-alluvial soils.

A decrease in the number of bacteria occurs noticeably in medium and highly saline soils as compared to non-saline soils. The decrease in the number of bacteria in slightly saline soils is less noticeable. A decrease in the number of bacteria during soil salinization was observed in all seasons - in spring, summer and autumn.

But at the same time, the number of bacteria was greatest in the summer. This is due to the activity of plant roots, where root secretions have a positive effect on the development of microorganisms, incl. bacteria. In all types of salinity, the number of bacteria decreased down the soil profile, this was especially noticeable in the soil layer 50–80 cm (Table 1). Consequently, an increase in the concentration of water-soluble salts in the soil has a negative effect on the number of bacteria.

This may be due to an increase in the osmotic pressure of the soil solution, which creates an unfavorable condition for bacteria. An increase in the concentration and proportion of chloride ions, sodium and potassium in the soil solution further enhances the negative effect of high salt concentrations.

Table 1.
Influence of the degree of salinity on the number of taxonomic groups of microorganisms on irrigated meadow - alluvial soils.

Section No	Soil horizons, cm	bacteria, million / g			mushrooms, thousand / g			actinomycetes, million / g		
		Seasons			Seasons			Seasons		
		Spring	Summer	Autumn	Spring	Summer	Autumn	Spring	Summer	Autumn
Unsalted										
1	0-25	23,5	31,5	24,8	40,17	50,6	41,5	6,2	7,4	6,5
	25-50	16,6	22,7	18,0	27,1	37,8	30,3	4,7	6,0	5,1
	50-80	7,1	10,9	6,8	6,5	12,3	14,8	2,2	3,2	2,4
Slightly salted										
5	0-25	20,3	24,8	20,5	35,5	42,9	34,6	4,8	6,2	4,4
	25-50	14,5	19,3	14,0	23,4	31,5	21,7	4,0	5,3	3,7
	50-80	5,3	6,2	5,5	6,0	9,7	6,6	1,8	3,6	1,6
Medium saline										
10	0-25	11,4	14,7	7,5	20,3	26,8	17,7	3,1	3,8	2,8
	25-50	7,8	10,3	5,3	15,6	20,4	13,2	1,4	2,0	1,1
	50-80	2,8	4,6	2,1	3,0	5,3	2,5	0,8	1,0	0,6
Highly salted										
17	0-25	7,6	11,4	6,3	15,2	19,2	13,2	1,8	2,2	1,5
	25-50	4,2	6,1	3,4	8,3	10,7	7,0	0,8	1,1	0,6
	50-80	1,1	1,8	0,8	1,4	2,0	1,0	0,5	0,9	0,3

The amount of mushrooms also varied depending on the degree and types of salinity. In non-saline meadow-alluvial soils, the number of fungi was greatest. With the appearance and increase of salinity, the number of fungi decreased. This trend was observed in all seasons of the study - spring, summer, autumn. Down the soil profile, the number of fungi decreases. This is especially noticeable in the 50-80cm soil layer. This may be due to the more anaerobic conditions in this horizon. Since fungi are aerobic organisms and oxygen is of great importance to them. In all degrees of salinity, the number of fungi increased in summer, when plants grew rapidly in the agrocenosis. In autumn, especially in medium and highly saline meadow alluvial soils, the amount of fungi was the smallest (Table 1). This may be due to an increase in the concentration of water-soluble salts in the soil in autumn. Consequently, an increase in the concentration of water-soluble salts contributes to a decrease in the number of fungi in meadow-alluvial soils.

Another representative of taxonomic groups is actinomycetes. The number of actinomycetes also depended on the degree of salinity of meadow-alluvial soils. In non-saline meadow-alluvial soils, the number of actinomycetes was the highest. With the appearance of salinity and an increase in the degree of salinity, the number of actinomycetes decreased. Therefore, in medium and highly saline meadow-alluvial soils, the number of actinomycetes was the smallest. The number of actinomycetes was highest in summer (Table 1). This tendency was observed in all degrees of salinization of meadow-alluvial soils. Consequently, in the rhizosphere and resoplans of cultivated plants, incl. cotton plant creates the best conditions for actinomycetes. The number of actinomycetes in all degrees of salinity decreased down the soil profile and was the smallest in the 50-80cm horizon.

In microbiological processes, physiological groups of microorganisms are of great importance. These microorganisms support microbiological processes in the soil and thus ensure the vitality of the soil. The amount of ammonifiers is involved in the ammonification processes, i.e. in the formation of ammonium from organic substances. Ammonifiers and bacteria were determined in the same among, that is, on MPA.

The number of nitriffers varied greatly depending on the concentration of water-soluble salts. Consequently, salinity, especially its high degree, strongly affects the number of nitrifying bacteria. At all degrees of salinity down the soil profile, the amount of nitrifiers decreased significantly. This is due to an increase in anaerobiosis in the lower soil horizons. Since nitrifiers are aerobic microorganisms. With an increase in the degree of salinity, the number of nitrifiers decreased and the highly saline meadow-alluvial soil was the least. The number of nitrifiers varied depending on the season. Their highest number was observed in summer, during the period of rapid development of agrocenosis plants (Table 2). Consequently, salinity has a significant effect on the amount of nitrifiers, and thus on the formation of nitrates in the soil.

Bacteria growing on nitrate nitrogen is of great importance to the soil. Since they regulate the content of nitrates in the soil. However, this has a negative impact on the efficiency of nitrogen fertilizers and plant nutrition. Soil salinization had a negative effect on the amount of nitrate reductants. With increasing salinity the number of nitrate reductants decreased, and the smallest number of them was observed in highly saline soils. This was noted in all seasons - spring, summer, autumn (Table 2). At all degrees of salinity, the largest amount of nitrate reducints was observed in summer.

This may be due to the rapid growth of plants and increased root secretions of these crops. Down the soil profile, the amount of nitrate reducers decreased, and the least amount of nitrate reductants was observed in the 50-80cm layer. Consequently, the content of aqueous solution salts substantially affects the number of nitrate reducients in meadow-alluvial soils.

Table 2.
Influence of the degree of salinity on the number of physiological groups of microorganisms on irrigated meadow-alluvial soils.

Section No	Soil horizons, cm	nitrate reducers, million / g			nitrifiers, thousand / g			nitrogen fixers, mln / g			Cellulose-decomposing microorganisms, thousand / g		
		Seasons			Seasons			Seasons			Seasons		
		Spring	Summer	Autumn	Spring	Summer	Autumn	Spring	Summer	Autumn	Spring	Summer	Autumn
Незасоленная													
1	0-25	22,6	26,0	20,5	63	72	65	28,8	32,5	26,5	615	728	635
	25-50	15,8	17,8	15,1	38	45	41	18,6	21,8	19,2	527	615	550
	50-80	8,6	10,1	8,4	2	13	10	6,2	7,6	6,5	115	185	125
Слабозасоленная													
5	0-25	20,1	24,5	8,5	55	61	57	22,7	25,7	20,3	525	610	530
	25-50	12,8	15,3	12,0	30	36	30	15,6	18,9	13,7	386	420	380
	50-80	6,3	8,4	6,0	6	10	7	4,8	5,2	3,9	78	85	75
Среднеезасоленная													
10	0-25	9,5	12,1	8,1	32	38	28	10,2	12,1	8,8	280	310	250
	25-50	7,0	9,3	6,3	20	25	17	7,3	7,8	6,2	175	200	150
	50-80	3,2	4,8	2,7	3	6	2	2,4	3,3	2,1	53	61	45
Сильнозасоленная													
17	0-25	6,0	7,5	4,8	21	27	18	6,5	7,2	5,6	145	186	120
	25-50	3,7	5,4	2,9	12	16	9	4,0	4,8	2,8	87	101	65
	50-80	2,0	3,7	1,2	1	3	0,8	1,5	1,9	0,8	25	35	20

Nitrogen fixers are of great importance in soil fertility. Free-living aerobic nitrogen-fixing agents, grown on among Ashby, essentially reacted to the content of water-soluble salts in the soil. With an increase in the concentration of salts, the amount of nitrogen fixers decreases, and in highly saline soils it was the smallest. Consequently, a high concentration of water-soluble salts negatively affects the number of nitrogen fixers (Table 2). This is observed in all seasons. However, the largest number of nitrogen fixers is observed in summer, when plants reach high growth and development. Down the soil profile, the amount of nitrogen fixers decreases and reaches the smallest amount in the 50-80cm layer.

Aerobic cellulose-decomposing bacteria is of great importance in the formation of soil fertility. The amount of cellulose-decomposing bacteria depended on the degree of salinity of meadow-alluvial soils. With an increase in the concentration of water-soluble salts, the amount of cellulose-decomposing bacteria decreased.

The lowest amount of cellulose-decomposing bacteria was observed in highly saline meadow-alluvial soils. Their highest number was in summer (Table 2). This was observed at all degrees of salinity. Down the soil profile, the number of cellulose-decomposing bacteria decreased. This may be due to a decrease in the content of humus, plant root residues, and oxygen in this direction.

Conclusion. Thus, salinization of meadow-alluvial soils of the Bukhara oasis has a negative effect on the number of taxonomic and physiological groups of microorganisms. At the same time, with an increase in the degree of salinity, the number of microorganisms decreases. The lowest number of microorganisms is observed in the layer 50-80cm. An increase in the proportion of chlorides, sodium and magnesium cations enhances the negative effect of water-soluble salts. Especially in sreno- and highly saline soils, the number of microorganisms by autumn is greatly reduced in comparison with other seasons, which is associated with an increase in salinity at this time of the year in these soils. At all degrees of salinity, the highest number of microorganisms is observed in the summer, when plants reach the best productivity, which indicates the presence of symbiosis between microorganisms and plants. To improve the microbiological activity of the meadow-alluvial soils of the Bukhara oasis, it will be necessary to reduce the salt concentration to normal levels by washing and chemical reclamation.

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