Microorganisms of the taxonomic group of irrigated meadow-alluvial soils of the Bukhara region

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Abstract. This article presents data on the effect of salinity types and levels on the total amount of bacteria, fungi and actinomycetes in alluvial soils of irrigated meadows of Bukhara region. Non-saline soils were taken as controls in this study, and analysis of activity and numbers in weakly, moderately and strongly saline soils is presented.

1 Introduction

The taxonomic groups of microorganisms include bacteria, fungi, and actinomycetes. They occupy an important place in the taxonomy of microorganisms. Almost all processes in the soil take place with their participation. Therefore, it is important to study their number and determine their activity.

Bacteria are involved in many processes that take place in the soil. With their help, a number of processes such as humification, ammonification, nitrification, denitrification are carried out. The study counted the number of bacteria on meat-peptone agar (MPA), that is bacteria growing on organic nitrogen. They are mainly ammonifiers. The number of bacteria was significantly higher in non-saline meadow alluvial soils than in meadow alluvial soils with different salinities. As the salinity level increased, the number of bacteria in grassland alluvial soils decreased[1-15]. The lowest amount of bacteria was observed in highly saline meadow alluvial soils. Bacterial populations also changed seasonally. The highest amount of bacteria was observed in the summer season. This period is the most developed period of plants, and at this time plant root secretions will have the maximum rate. This condition has a positive effect on microorganisms, including bacteria[16-29]. Therefore, the number of microorganisms, including bacteria, will be the highest in the rhizosphere and rhizosphere of plants. This condition is a consequence of the positive effect of vitamins, physiologically active substances, mono- and disaccharides contained in root extracts on microorganisms. By early spring, it will have already sprouted and root divisions will not be of significant importance. It cannot have a positive effect on

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microorganisms. The total number of bacteria is almost the same in spring and autumn, that is, no significant difference was observed. But in autumn, the number of microorganisms, that is, bacteria, was slightly higher than in spring[5,6,7,8,9,20,21,22].

2 Materials and Methods

10 g of the soil sample taken from the soil cuttings was taken and put into 90 ml of sterile distilled water and the soil suspension was prepared from the first dilution by shaking for 5 minutes. The soil suspension of the second dilution was prepared by taking 10 ml of the first dilution using a sterile pipette (in a bottle) and adding it to 90 ml of distilled water. Thus, the level of dilutions was brought up to 5 and 6 dilutions. The number of bacteria from the taxonomic groups is determined by taking 1 ml from the soil suspension at 5 dilution, the number of fungi from the soil suspension at 4 dilution, and the number of actinomycetes by taking 1 ml of the soil suspension at 6 dilution and planting them in their selective media. From the physiological group microorganisms, the fifth dilution was used to determine the number of ammonifiers, nitrate reducers, nitrogen fixers, and the fourth dilution soil suspension was used to determine the number of nitrifiers and cellulose-decomposing bacteria.

1. Number of bacteria – in Meat - peptone agar
2. Number of fungi – in Chapek environment
3. The number of actinomycetes was determined by sowing on starch-ammonia.

3 Results and Discussion

The total number of bacteria decreased from the upper layers to the lower layers in the soil profile. This decline took place quite sharply. The total number of bacteria was significantly higher in the driving (0-25) and under-driving (25-50) layers. By the next 50-80 cm layer, the total number of bacteria decreased sharply. This situation was observed in both non-saline meadow alluvial soil and saline meadow alluvial soil. This may be due to the reduction of organic matter, root secretions and oxygen in the lower layers.

At the same time, an increase in the amount of carbonates and the pH indicator in the soil profile from top to bottom has a negative effect on the growth and development of microorganisms. Bacterial numbers were higher in non-saline soils than in saline soils in all seasons and soil horizons. For example, in non-saline meadow alluvial soil, the number of bacteria in the 0-25 cm layer in spring was 23.5 million/g of soil, while in the 25-50 cm layer it was 16.6 million colony-forming unit (CFU)/g of soil, in the 50-80 cm in the layer was equal to 7.1 million CFU/g of soil. By summer, the number of bacteria in these soil horizons is 31.5, respectively; 22.7; 10.9 million CFU/g in soil, 24.8 in autumn; 18.0; It was 6.8 million CFU/g of soil. As mentioned above, in weakly saline meadow alluvial soil, these indicators are significantly lower in seasons compared to non-saline meadow alluvial soil.

Table 1. Effect of salinity on the bacterial count of irrigated meadow alluvial soils, million CFU/g soil

Soil horizons, cm	Seasons		
	In spring	**In summer**	**In spring**
Non-saline			
0-25	23,5	31,5	24,8
25-50	16,6	22,7	18,0
50-80	7,1	10,9	6,8

Weakly saline			
0-25	20,3	24,8	20,5
25-50	14,5	19,3	14,0
50-80	5,3	6,2	5,5
Moderately saline			
0-25	11,4	14,7	7,5
25-50	7,8	10,3	5,3
50-80	2,8	4,6	2,1
Strongly saline			
0-25	7,6	11,4	6,3
25-50	4,2	6,1	3,4
50-80	1,1	1,8	0,8
S_x%	4,66	4,69	3,27
$HCP_{0,5}$	1,37	1,85	0,91

This means that increasing the concentration of salts, increasing the amount of harmful and toxic salts will have a negative effect on bacteria. For example, in weak saline meadow alluvial soil, the number of bacteria in spring is 0-25; 20.3 in 25-50 and 50-80 cm layers, respectively; 14.5; 5.3 million CFU/g in soil, this indicator is 24.8 in summer; 19.3; 6.2 million CFU/g in soil, and 20.5 in autumn; 14.0; It was equal to 5.5 million CFU/g of soil (Table 1). With increasing salinity, the number of bacteria decreased significantly in all studied seasons and soil horizons. When the salinity level increases, not only the amount of harmful ions such as sodium, magnesium and chloride increases, but also the percentage increases. This has a negative effect on the growth and development of bacteria, causing their number to decrease. In moderately and highly saline meadow alluvial soil, the increase in the amount of salts in autumn had a stronger negative effect on the number of bacteria. As a result, the number of bacteria in autumn was lower than in spring. Because in spring, water-soluble salts, especially chlorides, are washed into the lower layers of the soil, and their concentration in the upper layers decreases. For example, the average saline meadow alluvial soil has a bacterial count of 0-25 in spring; 25-50; 11.4, respectively, in 50-80 cm soil layers; 7.8; 2.8 million CFU/g of soil, this indicator was 14.7, respectively, in these soil layers in summer; 10.3; 4.6 million CFU/g in soil, 7.5 in autumn; 5.3; 2.1 million CFU/g of soil was determined (Table 1). A stronger decrease in the number of bacteria was observed in highly saline meadow alluvial soil, which occurred in all seasons. For example, in highly saline meadow alluvial soil, the number of bacteria in spring is 0-25; 25-50; 7.6, respectively, in layers of 50-80 cm; 4.2; 1.1 million CFU/g of soil was in the soil, this indicator was 11.4 in summer; 6.1; 1.8 million CFU/g of soil, 6.3 in autumn; 3.4; It was 0.8 million CFU/g of soil (Table 1). Therefore, the number of bacteria growing on meat-peptone agar (MPA) decreases dramatically with increasing soil salinity and flour levels. Slowing down of the humification process in saline soils indicates that the activity of microorganisms participating in this process has decreased under conditions of soil salinity. Bacteria play an important role in them. At the same time, as a result of this, the lack of humus in the saline soil has a negative effect on the number of bacteria, causing them to form in small numbers. In saline soil, the high alkalinity of the environment reaction (pH) leads to a decrease in the number of bacteria. If we take into account that bacteria are involved in a wide variety of microbiological processes in the soil and that they constitute the main part of microorganisms, we understand that the role of bacteria in the soil is very high. These bacteria are mainly ammonifiers that decompose organic residues, and they are important in the formation of humus in the soil and its filling with ammonium. Therefore, improvement of reclamation of saline soils based on salinity level and chemistry is important for the growth and development of bacteria. In this case, the number of bacteria increases and the activity of microbiological processes is restored.

Another taxonomic group is fungi. They are aerobic microorganisms that thrive in an oxygen environment. The number of fungi in the soil is much less than the number of bacteria and actinomycetes. Fungi are the first to go to new organic waste and begin to break it down and create conditions for other types of microorganisms. Therefore, fungi love organic matter, and soil rich in organic matter will have a high number of saprophytic fungi. In the study, the number of fungi is determined by cultivation in Chapek medium. The number of fungi was higher in the non-saline meadow alluvial soil than in the saline meadow alluvial soil. This situation was observed in all studied seasons and all soil horizons. Fungal numbers were highest in summer in saline and non-saline soils. This is due to favorable conditions for microorganisms, including fungi, in the plant rhizosphere and rhizoplane. By summer, plant root secretions increase significantly and their composition becomes more diverse. This has a positive effect on the growth of fungi. By the fall, root secretions decrease sharply, or even stop. This leads to a decrease in the number of fungi. In non-saline meadow alluvial soils and in meadow alluvial soils with varying salinity, the number of fungi significantly decreased from top to bottom along the soil profile. The main role in this is played by the sharp decrease of oxygen in the soil air from top to bottom in the soil profile. At the same time, the fact that the remains of plants and roots are mainly collected in the upper layer, and their presence in the lower layers has a negative effect on the number of fungi. For example, the number of fungi in weak saline meadow alluvial soil is 0-25 in spring; 25-50; 35.5, respectively, in the soil layer of 50-80 cm; 23.4; 6.0 thousand CFU/g was in the soil, this indicator is 42.9 corresponding to the layers presented in summer; 31.5; 9.7 thousand CFU/g of soil, respectively 34.6 in autumn; 21.7; 6.6 thousand CFU/g of soil was observed (Figure 4.1.2). Therefore, root exudates can increase the number of fungi even in the background of low salinity, and the decrease in the number of fungi even in the low salinity level leads to a decrease in the processes involving fungi in these soils. This has a negative effect on soil fertility.

Table 2. Effect of salinity on fungal counts of irrigated grassland alluvial soils, thousand CFU/g soil

Soil horizons, cm	Seasons		
	In spring	In summer	In autumn
None-saline			
0-25	40,17	50,6	41,5
25-50	27,1	37,8	30,3
50-80	6,5	12,3	14,8
Weakly saline			
0-25	35,5	42,9	34,6
25-50	23,4	31,5	21,7
50-80	6,0	9,7	6,6
Moderately saline			
0-25	20,3	26,8	17,7
25-50	15,6	20,4	13,2
50-80	3,0	5,3	2,5
Strongly saline			
0-25	15,2	19,2	13,2
25-50	8,3	10,7	7,0

50-80	1,4	2,0	1,0
S_x%	3,51	3,88	3,82
$HCP_{0,5}$	1,17	2,51	1,88

The decrease in the number of fungi in the soil increased with increasing salinity. The number of fungi in moderately and strongly saline meadow alluvial soils decreased dramatically in all seasons and soil layers. The number of fungi was the lowest in the highly saline meadow alluvial soil. Therefore, an excessive increase in the amount of soluble salts in water will drastically reduce the number of fungi. At the same time, the recovery of salts in moderate and strongly saline meadow alluvial soil in autumn had a negative effect on the number of fungi. As a result, the number of fungi in the soil at these salinity levels was significantly lower in autumn than in spring. For example, in moderately saline meadow alluvial soil, the number of fungi was significantly lower in autumn than in spring. For example, 0-25 in spring on moderately saline meadow alluvial soil; 25-50; The number of fungi in 50-80 cm layers is 20.3, respectively; 15.6; If 3.0 thousand CFU/g was in the soil, this indicator was 26.8 in accordance with the above-mentioned soil horizons in the summer season; 20.4; 5.3 thousand CFU/g of soil in autumn, respectively 17.7; 13.2; It was 2.5 thousand CFU/g of soil (Table 2).

As a result of strong salinity, the number of fungi further decreased and had a minimum indicator. For example, in a highly saline meadow alluvial soil, the number of fungi in the spring is 0-25; 25-50; 15.2, respectively, in layers of 50-80 cm; 8.3; 1.4 thousand CFU/g was in the soil, and in the summer season, this indicator was 19.2, corresponding to the soil horizons; 10.7; 2.0 thousand CFU/g of soil, 13.2 respectively in autumn; 7.0; 1.0 thousand CFU/g of soil was observed (Table 2).

An indicator of environmental response towards lower layers and salinity, i.e. increasing pH and increasing soil alkalinity, had a dramatic effect on the number of fungi. Because along the soil profile from top to bottom, the pN index increases and the alkalinity increases. This situation was observed in both non-saline meadow alluvial soil and meadow alluvial soil with varying degrees of salinity.

So, salinization of meadow alluvial soils with a high content of harmful and toxic salts, increasing salinity significantly reduces the number of fungi in the soil in all seasons and soil horizons. The negative effect of water-soluble salts on the number of fungi was most pronounced in autumn. This is due to the increase in the amount of water-soluble salts in the soil in autumn. The depth of the soil layer also has a strong negative effect on the number of fungi compared to the number of bacteria. This is explained by the extreme sensitivity of fungi to oxygen compared to bacteria. At the same time, the activity of fungi is highly dependent on organic matter. Lack of organic matter has a strong negative effect on fungi. This condition is strongly manifested in the 50-80 cm layer. Because the amount of oxygen and organic matter in the 50-80 cm layer decreases dramatically, creating unfavorable conditions for the activity of fungi. The low number of fungi in saline soils may also be related to low mineral nitrogen in the soil. Therefore, the decrease in the number of fungi in saline soil is influenced by several negative factors caused by salinity.

Actinomycetes are one of the taxonomic groups of microorganisms. This type of microorganisms takes an active part in soil processes. Among them, there are many antagonists of disease-causing microorganisms. They secrete different antibiotics. At the same time, it actively participates in the humus formation process. In the conditions of the Bukhara oasis, the exposure of meadow alluvial soil to salinity had a negative effect on actinomycetes. The number of actinomycetes was significantly reduced in the saline meadow alluvial soil compared to the non-saline meadow alluvial soil. Therefore, increasing the amount of water-soluble salts in the soil has a negative effect on the number of actinomycetes. In this case, especially when the level of salinity increases, the increase in the amount and percentage of harmful and toxic salts in the soil leads to a decrease in the number of actinomycetes in the soil. Such salts are formed in large quantities when sodium and magnesium chloride ions increase in soil water absorption.

In non-saline meadow alluvial soil, the number of actinomycetes was the highest in summer. This is due to the creation of favorable conditions for microorganisms, including actinomycetes, in the soil in summer. Because by this period, humidity is optimized due to irrigation, and the temperature in the biocenosis of plants that have grown tall is more suitable for microorganisms. Mineral fertilizers have a positive effect on the growth of actinomycetes by increasing soil fertility. In such conditions, the growth and development of plants will be accelerated. This increases the release of plant root secretions. At this time, the root is in its best development period and spreads strongly to all sides of the soil. It has a positive effect on microorganisms, including the number of actinomycetes. At the same time, increasing the number of small roots that have died in the soil has a positive effect on the development of actinomycetes. This situation was observed both in non-saline meadow alluvial soil and in meadow alluvial soil with varying degrees of salinity. In non-saline meadow alluvial soil, the number of actinomycetes was slightly higher in autumn than in spring. This situation may be related to a significant increase in plant roots and surface remains that died in the fall. Because organic residues have a positive effect on microorganisms, including the number of actinomycetes. For example, in non-saline meadow alluvial soil, the number of actinomycetes in the spring is 0-25 of the soil; 25-50; 6.2, respectively, in layers of 50-80 cm; 4.7; 2.2 million CFU/g of soil, this figure is 7.4 in the summer season, corresponding to the above-mentioned layers; 6.0; 3.2 million CFU/g in soil, 6.5 in autumn; 5.1; 2.4 million CFU/g of soil was found (Table 3). In the non-saline meadow alluvial soil, the number of actinomycetes decreased sharply from top to bottom along the soil profile and had the smallest value in the 50-80 cm layer. When the soil became salinized, that is, in weakly saline meadow alluvial soil, the number of actinomycetes decreased compared to non-saline meadow alluvial soil. Such a decrease in the number of actinomycetes in weakly saline meadow alluvial soil was observed in all studied seasons and soil layers. The number of actinomycetes also reached the highest value in the summer in the weakly saline meadow alluvial soil. In spring, the number of actinomycetes was slightly higher than in autumn, but this difference in the number of actinomycetes was not convincing. Therefore, slightly higher than normal water-soluble salts in weakly saline meadow alluvial soil also have a negative effect on the number of actinomycetes. In this case, instead of increasing the concentration of salts, the increase of harmful and toxic salts, chloride, sodium, and magnesium ions in water-soluble salts has a more negative effect on the number of actinomycetes. The number of actinomycetes decreased sharply from top to bottom along the soil profile.

As soil salinity increases, the number of microorganisms, in particular, actinomycetes, decreases further in meadow alluvial soils. Therefore, the number of actinomycetes was the lowest in medium and especially highly saline meadow alluvial soil. This is due to the sharp increase in the amount of water-soluble salts in these soils, the strong increase in the osmotic pressure of the soil solution, creating unfavorable conditions for actinomycetes. In moderately and highly saline meadow alluvial soil, the number of actinomycetes was the highest in summer. In autumn, the number of actinomycetes showed the lowest level. In the spring, the number of actinomycetes was intermediate. A sharp decrease in the number of actinomycetes by autumn is due to the accumulation of water-soluble salts in the soil during this period. In this case, the percentage and amount of harmful and toxic salts in the salt composition increases. It has a negative effect on actinomycetes. For example, in weakly saline meadow alluvial soil, the number of actinomycetes is 0-25 in spring; 25-50; 4.8, respectively, in layers of 50-80 cm; 4.0; 1.8 million CFU/g of soil, this indicator is 6.2, respectively, in summer; 5.3; 3.6 million CFU/g in soil, 4.4 in autumn; 3.7; 1.6 million CFU/g of soil was observed. From top to bottom along the soil profile, the number of microorganisms decreased sharply, especially when moving from the 25-50 cm layer to the 50-80 cm layer, the number of actinomycetes decreased sharply and became the least abundant in this layer. The number of actinomycetes decreased more sharply in the meadow alluvial soil with increasing salinity. This is also shown by the number of actinomycetes in moderately and strongly saline meadow alluvial soils.

Table 3. Effect of salinity on the number of actinomycetes in irrigated grassland alluvial soils, million CFU/g soil

Soil horizons, cm	Seasons		
	In spring	In summer	In spring
Non-saline			
0-25	6,2	7,4	6,5
25-50	4,7	6,0	5,1
50-80	2,2	3,2	2,4
Weakly saline			
0-25	4,8	6,2	4,4
25-50	4,0	5,3	3,7
50-80	1,8	3,6	1,6
Moderately saline			
0-25	3,1	3,8	2,8
25-50	1,4	2,0	1,1
50-80	0,8	1,0	0,6
Strongly saline			
0-25	1,8	2,2	1,5
25-50	0,8	1,1	0,6
50-80	0,5	0,9	0,3
S_x%	4,93	3,33	3,96
$HCP_{0,5}$	0,38	0,34	0,29

The lowest amount of actinomycetes was observed in alluvial soil of strongly saline meadow. In strongly saline soil, its agrophysical, agrochemical properties, water, salt, food, air and heat regimes deteriorate, which leads to the creation of unfavorable conditions for actinomycetes. In moderately and strongly saline soils, the number of actinomycetes in autumn was lower than in other seasons. For example, in moderately saline meadow alluvial soil, the number of actinomycetes in the spring is 0-25 of the soil; 25-50; 3.1, respectively, in layers of 50-80 cm; 1.4; 0.8 million CFU/g of soil, in summer these indicators are respectively 3.8; 2.0; At 1.0 million CFU/g of soil, the number of actinomycetes in autumn is 2.8; 1.1; It was 0.6 million CFU/g of soil (Table 3). The lowest number of actinomycetes was observed in highly saline meadow alluvial soil. For example, in a highly saline meadow alluvial soil, the number of actinomycetes in the spring is 0-25 of the soil; 25-50; 1.8, respectively, in layers of 50-80 cm; 0.8; 0.5 million CFU/g of soil, and this indicator is 2.2 in summer; 1.1; 0.9 million CFU/g in soil, 1.5 in autumn, respectively; 0.6; It was 0.3 million CFU/g of soil (Table 3). Therefore, the salinity of meadow alluvial soil has a negative effect on the number of actinomycetes. As the salinity level increased, the number of actinomycetes in the soil decreased.

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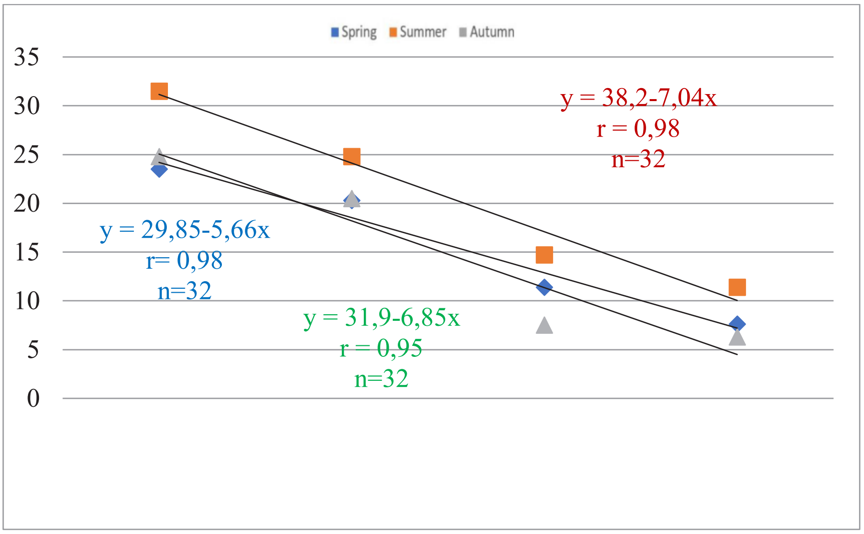

Fig. 1. Depending on the salinity of the soil change in the number of bacteria

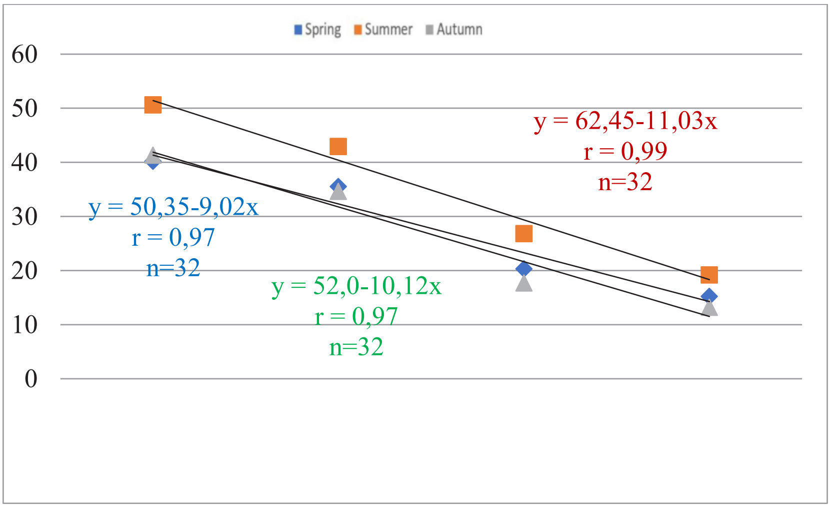

Fig. 2. Depending on the salinity of the soil change in the number of fungi

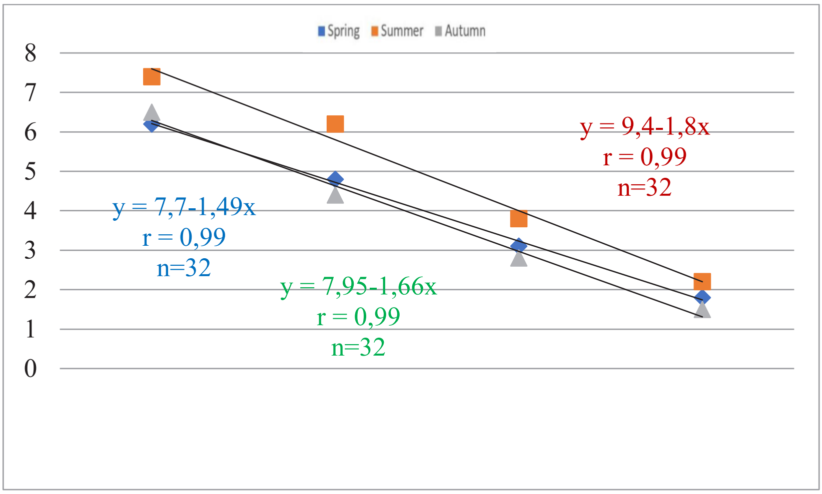

Fig. 3. Changes in the number of actinomycetes depending on soil salinity

In alluvial soils of the Bukhara oasis meadow, with increasing salinity, the number of representatives of the taxonomic group of microorganisms decreased and it had a high inverse linear correlation (R=0.95-0.98 0.99). In these soils, this relationship was expressed by the regression equation y=a-bx. This situation was observed in all seasons [1,2,3].

4 Conclusion

The number of bacteria, fungi and actinomycetes, belonging to the taxonomic group of microorganisms, is the highest in non-saline soil. Soil salinity causes a significant decrease in the number of microorganisms of the taxonomic group. As salinity increases, the number of bacteria, fungi and actinomycetes decreases dramatically. The number of microorganisms of the taxonomic group is the highest in summer. The number of microorganisms is maximum in the uppermost layer of the soil, the number of microorganisms of the taxonomic group decreases depending on the lower layers.

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