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Biological Activity of Meadow Soils Saline with Magnesium Carbonates and Their Change under the Influence of Compost

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Abstract (Summary)

This article presents the results of experiments conducted to study the effect of composts with medium and high rates and against the background of mineral fertilizers, on the biological activity of meadow soils with carbonate-magnesium salinity, common in the middle reaches of the Zarafshan River, Zarafshan Valley. The quantitative and qualitative indicators of humus and the number of microorganisms under the influence of composts were determined. The introduction of organic fertilizers, manure and compost, increases the content of humus in the soil. Due to the rise of its contentin the soil, the number of microorganisms that mineralize organic substances of soil increases. Under the condition of a deficiency of easily mobilized organic substance in the soil, microorganisms switch to active using of the carbon of humic compounds, which leads to a decrease in the humus content.

Introduction. On low-humus soils, to enhance the activity of microorganisms, the introduction of organic fertilizers has a great importance. Meadow soil, saline with magnesium carbonates, has a high cellulolytic activity and potential nitrification capacity. The use of mineral fertilizers, manure, compost and their combinations, stimulates the development of microorganisms and activates these indicators of microbiological activity.

All types of organic substrates enhance the biological activity of the soil. Against their background, the number of main groups of microorganisms in the arable layer increases. In the first year of transformation of organic substrates, soil fungi and microorganisms using mineral nitrogen are most developed. In the second year, the development of cellulose-decomposing flora, phosphate-mobilizing microorganisms and ammonifiers are activated [4].

Under conditions of intensive farming, the potential soil fertility is closely related to the humus content and biological properties of the soil. Soils with a high humus substance have the best physical, chemical and biological features. This is due to the nature of humic substances. Their ability to persorption of nutrients available to

plants, improves water, air and nutrient modes of the soil, promotes intensive microbiological processes with optimal gas exchange [1, 3, 6].

Materials and methods

The peculiarities of the meadow soils of the experimental area are that the soils formed in the flat relief are distinguished by peculiar agrophysical and agrochemical properties. In these soils, the cemented calcareous shokhhorizonsis strongly disengaged. The formation of this horizon is associated with the consistence, temperature and depth of groundwater. Calcium carbonates accumulate in the lower horizons, while magnesium carbonates spread along the soil profile, forming carbonate-magnesium salinization. This type of salinity negatively effects on the air, water and nutrient conditions of these soils.

Field studies were carried out according to the following guidelines: determination of humus - according to Tyurin (GOST 26213-91) as modified by Central Research Institute of Agrochemical Services for Agriculture. Determination of the group and fractional structure of humus according to Tyurin as modified by Plotnikova and Ponomareva, calculation of humus reserves by calculation method, the number of bacteria in the MPA millieu; the number of fungus in Czapek'smillieu; number of actinomycetes in the SAA millieu.

Results and discussion

Humus reduces the negative effect of an excess dose of magnesium carbonate, since soil humus has an 8-10 times higher exchange capacity than the mineral part of the soil, which decreases its concentration in the soil dissolution. Carried experiments found a large difference between the number of microorganisms contained in a gram of carbonate-magnesium saline meadow soils and humus in different soil horizons (Table 1).

The growing number of microorganisms shows an increase in the intensity of microbiological processes in the upper soil horizons. The introduction of organic fertilizers leads to the rise in the biogenicity of soils with carbonate-magnesium salinity. The development of microorganisms is enhanced by the introduction of manure and compost on soils with a low humus content.

The use of high doses of mineral fertilizers, especially nitrogen fertilizers on soils poor in organic substance is often accompanied by their adverse effect on the beneficial microflora.

Table 1
The amount of microorganisms in carbonate-magnesium saline meadow soils (in thousands per 1 g of soil and per 1 g of humus)

Soil depth, cm	Amount per 1 g of soil				Amount per 1 g of humus			
	Total number of microorganisms	Bacteria	Actinomycetes	Fungus	Total number of microorganisms	Bacteria	Actinomycetes	Fungus
0-20	8300	5600	2600	20	415600	280000	134000	1000
30-40	4820	3250	1500	11	241000	162000	77700	588
50-60	2800	1890	900	6,8	140000	94600	45200	342
70-80	2508	1600	800	6,0	125400	84800	40400	300

Due to an increase in the level of nitrification and denitrification processes, which leads to the loss of nitrogen in the form of gaseous substances the use of nitrogen by plants decreases. This leads to the accumulation of nitrates and other harmful compounds in plant products, which negatively affects the quality of agricultural crops.

With the growing of the content of humus in the soil, the amount of beneficial microorganisms' increases, directing microbiological processes for the better. These transformations are influenced not only by the total humus content, but also by its group composition (Table 2).

In saline carbonate-magnesium soils, fulvic acids prevail over humic ones. Fulvic acids are considered readily soluble and more widely available humus fractions for microorganisms. The high mobility of fulvic acids is due to their relatively more pronounced acidic properties.

Table 2

The content of humus, nitrogen and the qualitative consistence of humus in Carbonate-magnesium saline meadow soils

Soil horizon cm	Humus, %	Total nitrogen, %	C / N	Group composition of humus, %				Hydrolysable/ non-hydrolysable	$C_{гк}:C_{фк}$
				Humic acids	Fulvic acids	∑ of humic and fulvic acids	Unusable residue		
0-20	1,19	0,116	8,4	22,48	25,03	47,51	52,49	0,90	0,90
30-40	0,98	0,071	8,0	15,03	25,98	41,01	58,99	0,69	0,58
50-60	0,57	0,056	6,8	17,61	32,39	50,00	50,00	1,00	0,54
70-80	0,51	0,128	7,0	17,88	29,25	57,13	42,87	1,35	0,61

Composts, enriching the soil with organic substances, create favorable conditions for the growth and development of microorganisms. In our studies, the number of bacteria (million/ha of soil), fungi (thousand/haof soil) and actinomycetes (million/haof soil) was determined from the taxonomic groups of microorganisms. Actinomycetes are less vigorous soil ammonifier. In the control variant without fertilizers, the number of microorganisms was bacteria 16 million/ha, fungi 26 thousand/haand actinomycetes 11 million/haof soil. In the second variant, when 20 t/ha of manure was applied under the fall winter - 28 million/haof soil, 63 thousand/haand 16 million/g of soil. In the third option with an increased rate of manure (40 t/ha) - 33 million/ha, 65 thousand/haand 21 million/haof soil. In the fourth option with an average compost rate (20 t/ha) - 29 million/ha, 63 thousand/haand 16 million/hasoil, in the fifth variant with an increased compost rate (40 t/ha) - 35 million/ha, 68 thousand/haand 22 million/haof soil, respectively. In the variants of joint application of various types and doses of organic fertilizers together with mineral fertilizers: 20 t/ha manure + N200P150K100; 40 t/ha manure + N200P150K100; 20 t/ha compost + N200P150K100; 40 t/ha compost + N200P150K100. The amount of microorganisms has significantly increased due to the enrichment of the soil with microorganisms applied with organic fertilizers and the intake of nutrients readily available to microorganisms in the form of mineral fertilizers. In these variants, the amount of bacteria was 68, 74, 71, and 78 million/g of soil; fungus- 74, 80, 75 and 84 thousand/haof soil; actinomycetes - 33, 38, 35 and 40 million/haof soil, respectively. In the variant with the introduction of

only mineral fertilizers (N200P150K100), the number of microorganisms was inferior to the variants of combined application of organic and mineral fertilizers and prevailed over the control variant - without fertilizers and variants with the introduction of various types and doses of organic fertilizers (figure - 1).

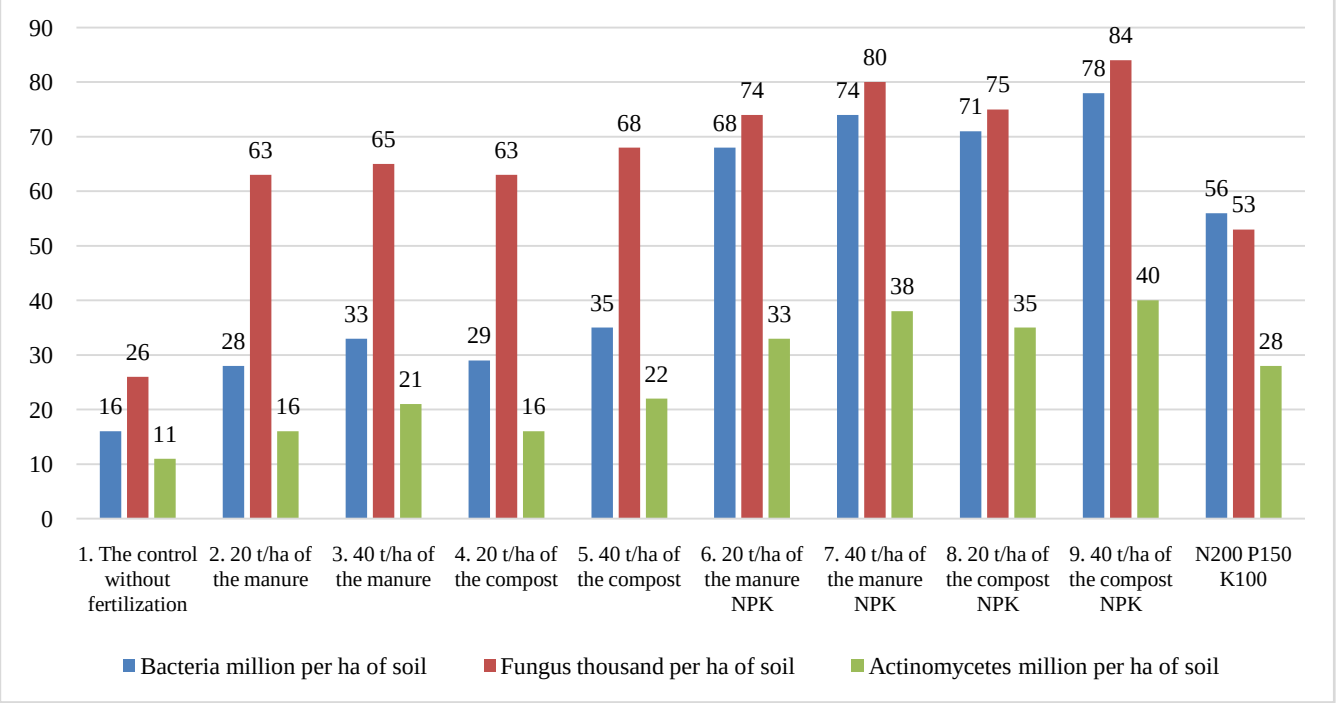

Figure - 1. **Influence of composts on taxonomic groups of microorganisms in meadow soils saline with magnesium carbonates**

Conclusion

Thus, in the conditions of active anthropogenic use of agricultural land, unfavorable conditions have been created for microbiological processes of humus formation. This led to the widespread development of global processes of humus degradation and a decrease in the natural soil fertility, especially with a deep expression in saline soils. On soils with low humus content, it is not possible to obtain noticeable harvests of cultivated crops without applying scientifically based technologies to increase effective fertility.

Currently, with small supplies of manure, composts redound to the enrichment of the soil not only with nutrients, but also with microflora, combining the action of mineral and organic fertilizers, which makes it possible to improve the unfavorable agrophysical and agrochemical facilities of saline soils.

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