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Fertility Of Soils In The Middle River Of The Zarafshan River And Changes In Its Microflora

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Annotation
This work analyzes soil fertility and changes in the microflora of the middle reaches of the Zarafshan River, as well as the impact of decisions made by the President of the Republic of Uzbekistan on these processes. The study examined the main soil types of the region, their physicochemical properties, humus content, and microbiological activity.
It also highlights the importance of agrotechnical, agrochemical, and agro-reclamation measures aimed at increasing soil fertility, including the use of organic fertilizers, sowing green manure crops, the introduction of crop rotation, and modern irrigation methods. Based on presidential decrees, measures taken to prevent soil degradation, increase humus content, and restore soil microflora were analyzed.
Keywords: Zarafshan River, soil fertility, soil microflora, humus, land degradation, organic fertilizers, green manure crops, crop rotation, soil biological activity, sierozems, alluvial soils, salinization, irrigated lands.

Introduction. Nowadays, the efficient use of agricultural land in the Republic of Uzbekistan, as well as the preservation and enhancement of soil fertility, is one of the important directions of state policy. In particular, increasing the fertility of irrigated serozem and alluvial soils located in the middle reaches of the Zarafshan River and restoring their biological activity, including microflora, is one of the most pressing issues.

In recent years, the President of the Republic of Uzbekistan has adopted a number of resolutions aimed at increasing soil fertility, preventing land degradation, and improving its agromeliorative condition [1; 1-15-p].

Resolution № PP-71 dated February 13, 2024, "On measures to combat the degradation of agricultural land, increase the amount of humus in the soil, and enhance its fertility," is of great importance in increasing soil fertility.

Microbiological processes and microorganisms occurring in the soil are of great importance in increasing soil fertility [1; 1-15-б 2; 15-30-p].

According to data, soil microorganisms include bacteria, actinomycetes, and fungi, of which about 70 % are bacteria, about 27–30 % are actinomycetes, and approximately 1–3 % are fungi.

If the agrophysical and water-physical properties of the soil are within normal ranges, the movement of microorganisms in it activates, resulting in an increase in soil fertility. Therefore, knowledge of soil microflora and biology, as well as the assessment of various agrotechnological measures, is very important issue. In particular, the use of green manure on fields cleared of cotton in the short-rotation cotton-grain crop rotation affects not only the agrophysical properties of the soil but also all vital processes occurring in the plant and the microbiological activity of the soil; therefore, its study is one of the most pressing issues.

Research Methods. Research was conducted using standard methods generally accepted in soil science, including field, laboratory, and cameral analysis. These include: «Methods of agrochemical, agrophysical and microbiological research

and irrigated soil of cotton areas» created by CSSPCARI scientists; «Methods for studying the physical properties of soils and grounds» by A.F.Vadyunina, Z.A.Korchagina; «Guidelines for conducting chemical and agrophysical soil analyses during land monitoring» developed by the scientists of the Research Institute of Soil Science and Agrochemistry; and « Instructions on conducting soil surveys and drawing up soil maps for the maintenance of the state land cadastre » by R.Kuziev and others; as well as comparative-geographic and laboratory-analytical methods. Mathematical-statistical analysis of the obtained data was calculated using the «Microsoft Excel» program by the dispersion method (B.A.Dospexov).

Results. Given the importance of the problem, the influence of green manure crop species on the soil microflora of the experimental field was studied, and the results of the microbiological analysis are presented.

In the soils of the experimental field, the number of bacteria after sideration at the beginning of the growing season were close to each other in all variants, averaging 4.43–7.26 million bacteria per 1 g of soil over two years. During this time, it was established that the number of bacteria in the soil was influenced by the biomass left by the siderates in the soil. For example, in the experiment, the number of bacteria at the beginning and end of the cotton growing season decreased from 4.43 million to 4.32 million units per 1 g of soil in the control variant without green manure, while in the variant with mixed peas

Furthermore, based on the analysis, it was established that the number of bacteria in the soils of the experimental field was 1.60–2.98 million units higher than the initial amount at the end of the growing season in the variants using green manure. In the experimental field, the number of bacteria was highest in the pea + rapeseed variant (7.30 million units per 1 g of soil).

At the beginning of the growing season, in the control variant (1 g of soil), there were an average of 1.18 million actinomycetes over two years; in the variants using sideration (peas, rapeseed, peas + rapeseed), this figure was 1.53; 1.28; 1.56 million units. The number of actinomycetes in the soils of the experimental field increased by 0.1–0.36 million units compared to the control variant with an increase in plant biomass, i.e., an increase in soil moisture.

At the end of the growing season, in the control variant without siderate, the number of actinomycetes averaged 1.20 million units, while in the variants using siderates, their number was 0.12–0.48 million units higher than in the control. At the same time, the number of actinomycetes in the pea + rapeseed variant was 0.48 million more than in the control. However, if the number of actinomycetes is compared at the beginning and end of the growing season, these indicators will certainly be higher than the initial amount.

At the beginning of the growing season, the number of fungi in the control variant averaged 20.2 thousand units per 1 g of soil over two years. As the biomass accumulated in the soil increased, the number of fungi in the soil increased by 21.2–24.5 thousand units compared to the control variant.

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Table 1. Influence of soil microflora (0-40 cm), 2019–2020.

T/p	Experiment options	At the beginning of vegetation			At the end of vegetation		
		bacterial, mln/g in soil	actinomycetes, million/g of soil	fungal items, thsd/g	bacterial, mln/g in soil	actinomy-sets, million/g of soil	fungal items, thsd/g
1.	Control-free	4,43	1,18	20,2	4,32	1,20	20,9
4.	Peas	6,12	1,53	42,6	6,24	1,60	43,3
8.	Rapeseed	5,83	1,28	41,4	5,92	1,32	42,5
9.	Peas + Rapeseed	7,26	1,56	44,7	7,30	1,68	45,2

At the end of the growing season, the amount of fungi in the soil composition in the control variant was 20.9 thousand/g, which was on average 21.6–24.3 thousand more than in the variants using green manure.

(See Table 1). During the statistical analysis of the relationship between green mass yields of green manure crops (peas, rapeseed, and their mixtures) and soil bacteria, it was established that there is an inverse correlation depending on the change in direction, a rectilinear correlation depending on the analytical expression, and their regression equation follows the expression y = a – bx, with a correlation coefficient equal to r<0.91. This situation is noted at the beginning of the growing season. It is evident that when plants are grown for sideration, the increase in productivity and yield is statistically proven as a result of sowing crop types in pure and mixed forms (Fig. 1).

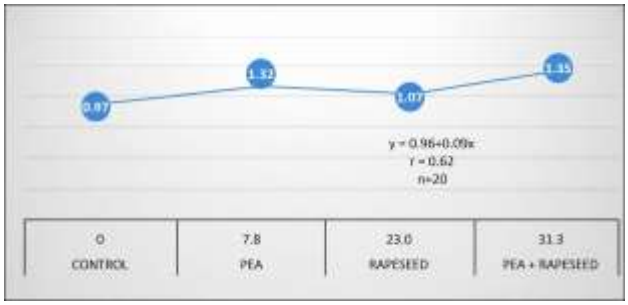

Figure 1. Dependence of the number of bacteria in the soil on the biomass of green manure crops at the beginning of the growing season.

When statistically analyzing the dependence of the number of actinomycetes on the biomass of green manure crops at the beginning of the growing season, the correlation was r=0.62. This, in turn, expresses the relationship described above (Fig. 2).

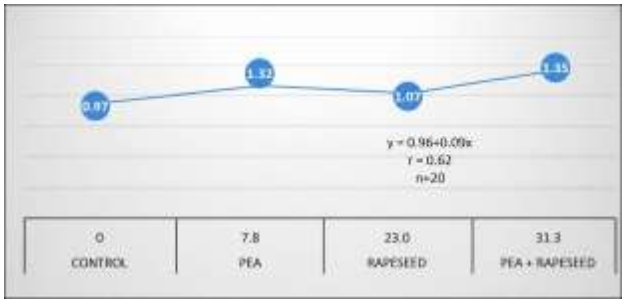

Figure 2. Dependence of the number of actinomycetes in the soil on the biomass of

green manure crops at the beginning of the growing season.

Our next statistical analysis is the dependence of the number of fungi on the biomass of green manure crops (at the beginning of the growing season). In this case, it also obeys the correlation equation y=a+bx and is equal to r=0.82. This proves once again the dependence of the number of microorganisms in the soil on organic matter, as presented in scientific sources (Fig. 3).

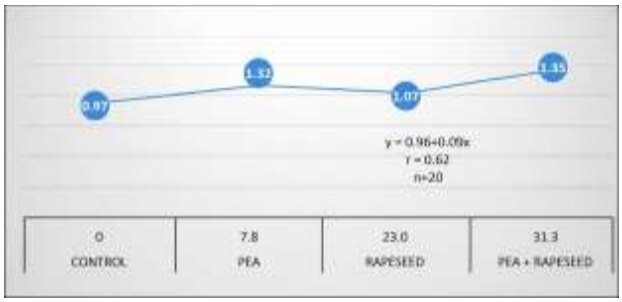

Figure 3. Dependence of the number of fungi in the soil on the biomass of green manure crops at the beginning of the growing season.

In the short-rotation cotton-grain crop rotation field, when sown in a mixture with peas and rapeseed as a siderate on areas cleared of cotton, it was observed that they had a positive effect on soil microflora; that is, at the beginning and end of the growing season (in the control variant, bacteria increased by 4.43–4.32 million/g, actinomycetes by 1.18–1.20 million/g, and fungi by 20.2–20.9 thousand/g of soil), the number of bacteria per 1 g of soil increased by 2.83–2.98 million, actinomycetes by 0.36–0.48 million, and fungi by 24.5–24.3 thousand units compared to the control variant. Due to this, the biomass of siderates decomposed in the soil quickly and in a short time. As a result, soil fertility has radically improved.

The amount of microorganisms is significantly influenced by the fall and decomposition of the green mass of plants plowed as green manure into the soil. Especially when the chemical composition of siderates is high in protein and nitrogen, the number of microorganisms is at its highest.

Thus, when plowing green manure crops in pure or mixed form, the number of microorganisms in the soil in the variants using green manure increased by 2.83–2.98 million bacteria, 0.36–0.48 million actinomycetes, and 24.5–24.3 thousand fungi per 1 g of soil compared to the control variant without green manure; its microbiological activity increased, positively affecting soil fertility, as well as the development and yield of agricultural crops.

Conclusion. When the applied green manure was ground into the soil as green manure in the first decade of April, the amount of microorganisms (bacteria, actenomycetes, fungi) in the soil at the beginning and end of the cotton growing season increased by 2.83–2.98 million/g, 0.38–0.48 million/g, and 24.3–24.5 thousand/g compared to the control variant; due to the rapid and short-term decomposition of biomass in the soil, the proportion of macroaggregates in the pea+rapis variant increased by 16.55–17.40% compared to the control at the end of the cotton growing season. As a result, it was determined that the soil bulk density decreased by 0.02 g/cm3 – 0.04 g/cm3. Research results indicate that it is possible to steadily increase land fertility by increasing biological activity in the soil and restoring the microflora. The results of this work are important for increasing efficiency in agriculture and the rational use of land resources.

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