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THE ROLE OF ENZYMES IN IMPROVING SOIL FERTILITY

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In the article, it is fully explained that the activity of catalase, protease, peroxidase enzymes in the soil under the influence of green microalgae can increase soil fertility in irrigated meadow alluvial soil.

Currently, the increase in the demand for food is caused by the increase in the number of people, the reduction of cultivated areas, the destruction of the soil structure due to the use of the same monoculture for several years, as well as the increase in the level of salinity of the soil due to the proximity of flood water. In addition, as a result of non-compliance with the correct agrotechnical rules in irrigation and land use, the activity of catalase, protease, peroxidase enzymes in the soil decreased sharply. This led to a decrease in soil fertility.

In order to increase soil fertility, they were compared with mineral fertilizers by creating optimal methods of rapid propagation of strains of green microalgae belonging to the species Chlorella vulgaris (Beyer) and Scenedesmus obliquus (Turp.) and determining the effectiveness of their use in the pre-sowing treatment of seeds in the irrigated, moderately saline meadow alluvial soils of Bukhara region, as well as the dynamics of fermentative and microbiological processes.

Table 1 shows the activity of catalase enzyme on days 7 and 15 in soil samples given green microalgae and mineral fertilizers in irrigated meadow soil, where catalase activity in the initial soil was 1.90 in 100g and catalase activity increased by 2.16 within 7 days. As this process continued, activity was observed to be 4.01 within 15 days. In the experiment using green microalgae suspension, catalase activity increased by 3.2 ml/mg O_2, and during 15 days, this indicator increased to 4.95. It was observed that the activity of catalase in the soil increased slightly when mineral fertilizers were added to the soil together with the suspension of green microalgae in the amount of 50%.

So, the activity of catalase, the main representative of enzymes involved in the process of oxidation and reduction in the soil, is directly dependent on the content of the substances applied to the soil.

Table 1. Activity of catalase enzyme under the influence of green microalgae and mineral fertilizers in irrigated meadow soil

№	Experiment	Catalase in mg/O_2 released in 100g of soil for 3 minutes	Catalase in mg/O_2 released in 100g of soil for 5 minutes
	Days	7 days	15 days
1	Initial soil (control)	$1,90^{+}_{-}0,06$	
2	Soil + NPK	$2,16^{+}_{-}0,04$	$4,01^{+}_{-}0,03$
3	Soil + green microalgae	$3,19^{+}_{-}0,08$	$4,95^{+}_{-}0,06$
4	Soil+green microalgae+NPK50%	$2,94^{+}_{-}0,05$	$4,55^{+}_{-}0,05$

Note: the underlined values are the control variant at R<0.05 (reliably different from the initial soil value)

Changes in soil enzymes, applied fertilizers are closely related to soil and environmental conditions. A difference in the dependence of enzyme activity on the composition of fertilizers was also expressed in scientific works [Galstyan, 1963, 1965; Mishustin, Petrova, 1966: Vernichko, 1980].

Table 2. Protease activity in irrigated meadow alluvial soil

№	Experiment	Prothesis activity, on the basis of mg NH_2 in 1g of soil
1	Soil + NRK (100 %)	0,310±0,003
2	Soil + green microalgae + NRK (50 %)	0,590±0,007
3	Soil + biomass + NRK (50 %)	0,720±0,09
4	Soil + plant residue + green microalgae + NRK (50%)	0,910±0,01

Note: the underlined values are significantly different from the value of the control option (soil + NPK) at P<0.05.

Experiments carried out in the conditions of Bukhara region showed that when complete mineral fertilizers were used, the protease activity in 1 g of soil sample corresponded to the amount of 0.310 mg/ amino nitrogen, and mineral fertilizers to microalgae and when used with the addition of gits, these indicators are equal to 0.590-0.720 mg/ amino nitrogen. If the composition of the applied fertilizers is further enriched, if the plant content and mineral fertilizers are added to the suspension of green microalgae, it is possible to see a further increase in the activity of the protease enzyme in irrigated soils (Table 2).

In the irrigated meadow alluvial soil, plant residues have the characteristic of rapid decomposition, and the oxidation involved in the initial stage of decomposition (their peroxidase) and later synthesis depends on the activity of polyphenoloxidase, especially When green microalgae are mixed with mineral fertilizers, the activity of these enzymes increases, as shown in Table 4.

Table 3. Peroxidase activity in soil samples (in 100 g soil/ mg purpurgaalin)

№	Experiment	Preoxidase	
Days		7 day	15 day
1.	Soil + NRK	3,84±0,08	3,02±0,04
2.	Soil + green microalgae + NRK	4,40±0,09	4,37±0,06
3.	Soil + plant residue + green microalgae + NRK (50%)	5,25±0,01	5,10±0,08

Note: the underlined values are significantly different from the value of the control option (Soil) at RF 0,5 <P0,05 from the control option (Soil + NRK).

Table 4. Activity of soil and polyphenoloxidase enzyme in experimental samples (in 100 g soil/ mg purpurgaalin)

№	Experiment	Polifenoloksidaza	
Days		7 day	15 day
1.	Soil + NRK (control)	8,99±0,11	7,69±0,09
2.	Soil + green microalgae + NRK (50%)	11,95±0,15	10,89±0,12
3.	Soil + plant residue + green microalgae + NRK (50%)	12,64±0,19	11,90±0,08

Note: The underlined values are significantly different from the control option (soil + NPK) at R<0.05.

The peroxidase enzyme, which is involved in the formation and rapid decomposition of humus, which has a complex composition and is considered a very important substance in irrigated grassland soil, plays an important role [1]. This opinion was also reflected in our experiences. That is, the activity of peroxidase and polyphenoloxidase enzymes in the soil with full mineral fertilizers is 100 g. 3.0-7.7 mg of purpugallin in dry soil for 15 days, and 5.1-11.9 mg of purpugallin when green microalgae are added to this soil together with mineral fertilizers observed. Therefore, the decomposition and synthesis of humus, which is an organic substance in irrigated soil, depends on the activity of enzymes.

The activity of catalase, protease, preoxidase and polyphenoloxidase was determined in laboratory conditions for 15 days. After three months, it was observed that the activity of microorganisms and enzymes increased in the samples of the bridge, but it was observed that the activity of catalysis did not change in the variant when the fertilizer was not applied. Urease and invertase activity significantly changed. It was determined that the activity of catalase increased by 2-3 times in 60-90 days when green microcuts and mineral fertilizer were given to the soil (Table 5).

Table 5. Enzyme activity in irrigated grassland soil under the influence of green microalgae

№	Experiment	Days	Enzymes, M ± m		
			Enzymes, M ± m Catalase, O_2 released in 3 minutes, mg/g	Urease, N released in 24 hours from 1g of soil, mg	Intervase, glucose produced in 1g of soil, in 24 hours, mg
1.	Initial soil (control)	-	11,95±0,04	0,21±0,010	0,6±0,02
2.	Unfertilized soil	30 60 90	1,15±0,02 0,99±0,01 1,09±0,01	0,19±0,01 0,12±0,01 0,95±0,01	0,10±0,01 0,07±0,004 0,20±0,01
3.	Soil + green microalgae + NRK (50 %)	30 60 90	0,17±0,01 2,09±0,02 3,99±0,02	0,26±0,01 0,39±0,02 0,45±0,02	0,15±0,011 0,27±0,01 0,51±0,02

Note: Underlined values are control variant (significantly different from primary soil value) at P<0.05.

It was observed that catalase activity almost did not change during 90 days of the experiments without fertilizer. It was established that the activity of urease and intervase enzymes changed significantly in the 90-day experiment compared to the 30-day experiment. During the experiment, it was found that catalase activity increased by 2-3 times during 60-90 days, compared to 30 days, when full mineral fertilizers were used in Utloki soil with microalgae. An increase in the activity of enzymes, especially urease and invertase activity, plays a key role in the process of rapid decomposition of organic matter in the soil and transition to a form that can be assimilated by plants. It is known from the literature that the activity of invertase and urease enzymes directly depends on the amount of organic matter in the soil [2, 3]. Together with the activity of enzymes, it was shown that changes in the total number of microorganisms in the experimental options planted in these periods (Table 6) depend on the composition of the fertilizers used.

Table 6. Microalgae abundance and respiration as influenced by green microalgae in an irrigated alluvial soil

№	Experiment	Days	Total amount of microorganisms (thousand cells per 1g of soil, cultured), M ± m			
			Amon	Oligonite-rophils	Fungi	SO_2 separated in 100g of soil, mg
1.	Primary ground (control)	-	100±2,01	16±4,0	3±0,07	11,4±0,3
2.	Unfertilized soil	30 60 90	360±2,10 530±3,00 1490±1,90	11±0,3 7±0,2 9±0,25	9,9±0,4 8±0,2 10±0,3	20,1±1,0 19,5±1,1 14,9±0,60
3.	Soil + green microalgae + NRK (50 %)	30 60 90	7100±12,0 75110±90,0 814±4,0	1950±30 7500±67 4100±49	18±0,99 29±0,30 37±0,40	31,0±0,8 26,9±0,6 25,6±0,4

Note: Underlined values are control variant (significantly different from primary soil value) at P<0.05.

Therefore, when using complete mineral Fertilizers together with green microalgae compared to the previous option, the total number of ammonify increased by 7-8 times. It is worth noting that the amount of oligonitrophils increased 5-6 times in the experimental variants compared to the sample soil. During the first 30 days of this soil sample, its respiration rate was high. However, in the following days, the soil respiration decreased strongly. This can be explained by the increase in the proportion of small-sized particles in the composition of the soil microaggregate, which can be explained by the inactivation of its respiration. getting dressed.

It was observed in the experiment that the respiration of the soil depends not only on the composition of various fertilizers, but also on the moisture retention of the soil. In their research, many scientists have come to the conclusion that the activity of soil respiration and enzymes depends on the composition of fertilizers given to the soil. The experiment carried out in laboratory conditions showed that on the 1st and 2nd days of March, the release of SO_2 from the soil increased to a high level, while on the third ten days this indicator reached 100 g showed that 29 mg/SO_2 was released in soil over 24 h. This process was observed at 30% soil moisture. However, on the 10th day of April, the release of SO_2 decreased by 18%, and on the 20th day of this month, it began to rise rapidly. A gradual increase of SO, in the soil was observed at 60% humidity. However, at 90% humidity, it was observed that the respiration of the soil decreased sharply.

In spring, the activity of enzymes and the influence of humidity were studied in the period and conditions where soil respiration depends on its moisture level. In particular, the activity of catalase enzymes was observed to increase at 30% and 60% soil moisture (Figure 1.).

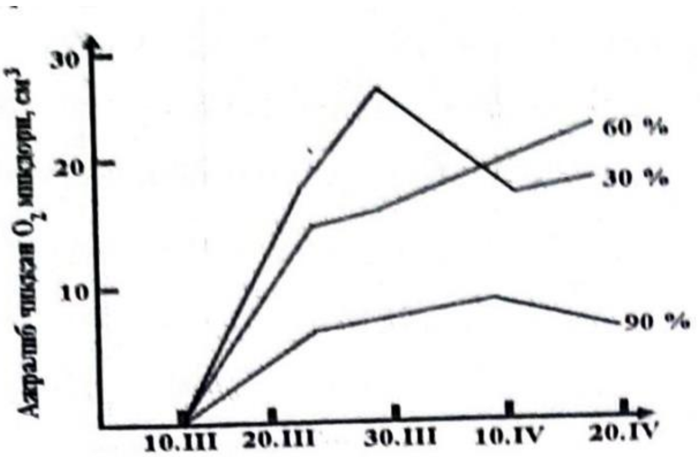

Figure 1. Catalase activity depending on soil moisture (under laboratory conditions)

In addition to catalase activity, protease activity in soil was studied (Figure 2.). According to the obtained data, protease activity increased from the 10th to the last days of March, while in April, these indicators were observed to increase uniformly. However, at 90% humidity, it was observed that the protease activity decreased dramatically. So, the normal respiration of the soil and the increase in the activity of enzymes give good results at 30 and 60% soil moisture level. A sharp decrease in biological activities was observed in soil with a high level of moisture (90%).

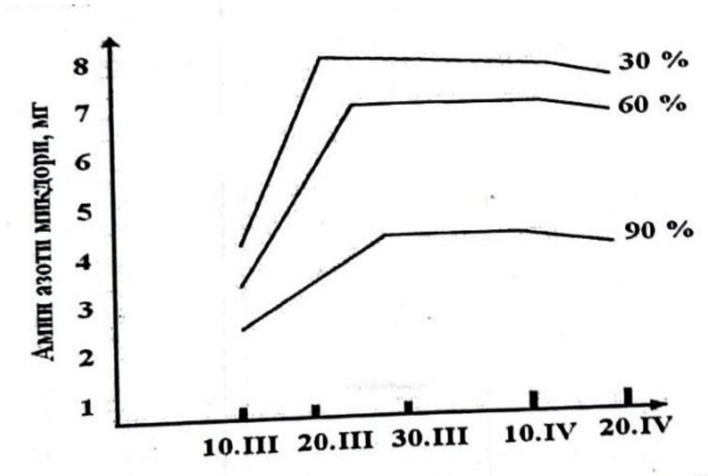

Figure 2. Protease activity based on soil moisture (under laboratory conditions)

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CREATION OF MELIORATIVE MAPS OF THE LOCATION AND MINERALIZATION OF LEACH WATERS IN THE VEGETATION SEASON IN IRRIGATED AREAS IN BUKHARA REGION USING ArcGis AND ArcMap SOFTWARE

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This article presents information on the land areas in the districts of Bukhara province, the location level and mineralization of underground water during the vegetation period of the land, and it is used to create reclamation maps using ArcGis and ArcMap programs and collect analytical data of farm land areas. work, land reclamation cadastre, technical devices needed to create a land reclamation map, hydrochemical laboratory analyzes of water taken three times a year, i.e. on March 1, July 1, and September 1, are entered into the ArcMap program through GPS device location coordinates. , a map of groundwater mineralization during the vegetation season of the irrigated areas is prepared, as well as the depth of the underground groundwater level is determined by areas, and suggestions are made for the necessary agrotechnical activities and the placement of agricultural crops. scientific research works are being carried out.

The Bukhara region is located in the central part of the Kyzylkum desert, it is bordered by the Republic of Turkmenistan to the northwest, Kashkadarya region to the southeast, Navoi region to the northwest, Khorezm region and the Republic of Karakalpakstan to the northeast. It is located in the lower and middle part of the penis. The main part of the land area consists of barrens and pastures.

Bukhara region was established on January 15, 1938. The area is 4 million 193705 hectares, of which 20909 hectares (0.5%) are parks, 2674186 hectares (63.77%) are pastures, 205616 hectares (4.9%) are forests and 1002295 hectares (23.9%) are other land areas. makes up the remaining 6.9 percent of land areas are abandoned (zalez) lands. The irrigated land area is 276309 hectares, 30034 hectares in Bukhara district, 21515 hectares in Vobkent district, 32982 hectares in Jondor district, 18771 hectares in Kogon district, 21521 hectares in Olot district, 22776 hectares in Peshko district, 27221 hectares in Romitan district, 19126 hectares in Shafirkon district. It is 26,466 hectares in Karakol district, 19,308 hectares in Qarovulbazar district and 27,007 hectares in Gijduvan district [1, 2, 4].

The soil consists mainly of meadow-alluvial, brownish-gray and desert sandy soils. The climate is continental dry, precipitation is 110-140 mm per year, frost-free days are 246-272, useful effective temperature is 2430-2690 degrees C. Precipitation is mainly observed in winter and spring seasons.

The regional center is the city of Bukhara.The main water source for the Bukhara region is the "Amu Darya" basin, and the main waterways that meet the water needs of the irrigated lands are the I-II turn of the "Amu-Bukhara" machine canal and the "Amu-Korakul" canal.

In addition to these, "Quyi-Mozor", "Todakol" and "Shorkol" water reservoirs are additional water sources for the region. Also, mainly in the spring months of the year, the water coming from the "Zarafshan" river is also used to meet the water needs of the region [3, 5-7].

In addition, the hydrographic network of the region consists of a large number of irrigation facilities, a collector and its networks. The main reclamation networks in the province are: "Central-Bukhara", "Shimaliy", "Parallel", "Dengizkol", "Tashkuduq", "Parsankol" and "Ogitma" reservoirs.

The climate of the region is continental, and the air temperature changes sharply throughout the year. Summer is hot and dry, and winter is short and cold. About 60 percent of the annual rainfall is from January to the end of April. The wind, which is the main factor of climate in the region, blows almost all year round, the direction of the wind is mainly south and south-east. In some cases, the wind speed is 20-26 meters per second. In the conditions of the Bukhara region, the above-mentioned features of the climate, i.e. dry air and very hot summer months, very little rainfall, underground water with a lot of mineral salts near the surface of the earth slightly accelerates evaporation, the amount of water used for transpiration increases, which in turn leads to re-salination of lands prone to salinity.

Control wells serve to measure the level of seepage water every 10 days and determine mineralization in irrigated lands. Taking into account the state of land reclamation, the mechanical composition of the soil, water permeability, and the level of provision of collector-drainage networks for an area of 100-200 hectares it is recommended to build one monitoring well. Locally, pre- and post-irrigation samples are taken to check the mineralization and level of leachate in these wells.

Creation of reclamation maps in ArcGis software. Geographical information systems (GIS) is a wide-ranging field - it is widely used in reclamation maps, architecture, hydrology, geology, geography, surveying, cartography, remote sensing, land surveying, natural resource management, ecology and other fields.

Let's get acquainted with the ArcGIS program (Fig. 1), which is a component of geoinformation systems and forms its basis.

Figure 1. ArcGIS software

The establishment of a laboratory in the activity of the regional reclamation expedition and the analyzes of the composition of soil, waste and collector waters, and underground seepage water carried out in this department are of important reclamation importance and determine the planning of the further work of the expedition.

In particular, in recent years, in order to reduce the time spent on hydrochemical laboratory analysis, analysis tools created by scientists have been put into practice, resulting in accurate and high-quality analysis. The water taken from the control wells on March 1, July 1, and September 1 every year is taken to the hydrochemical laboratory. Information on water analyzed by the hydrochemical laboratory is submitted to the Department of Information Technologies and Implementation of New Equipment of the Reclamation Expedition Department.

The presented information is entered into the Arcmap program (Figure 2) and a map of the mineralization of seepage water during the vegetation season is prepared in the irrigated areas.

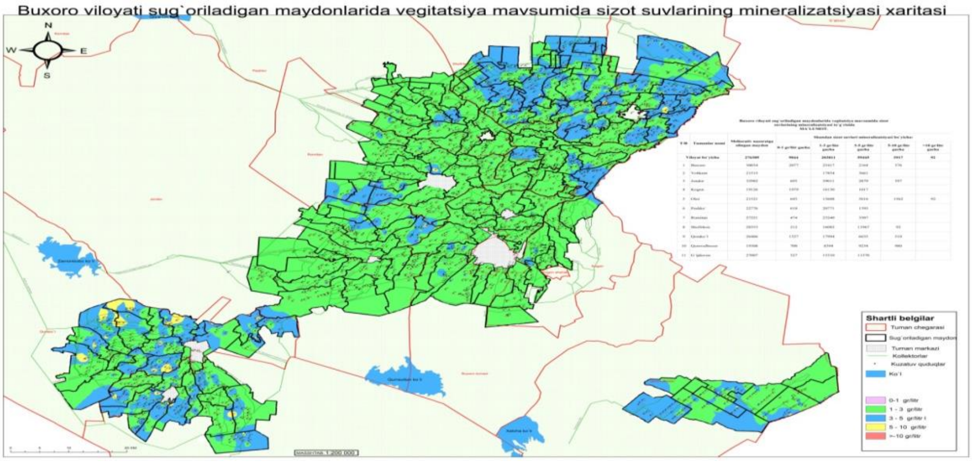

Figure 2. Bukhara Region 2022 irrigated areas map of seepage water mineralization during the vegetation season

In the irrigated areas of the Bukhara region, the mechanical structure of the soil is very complex and the soils are prone to salinity. Therefore, based on many years of experience, the characteristic period of soil salinity determination is carried out, that is, before the growing season, in the case of April 1, and after the growing season, in the case of October 1. This event, in turn, is an important factor in determining measures to improve soil fertility. For this reason:

- in the case of April 1, after the saline washing of the land, the efficiency of the salt washing event is determined, planting salt-resistant crops in the areas where its effectiveness is less after the salt washing, increasing attention to agrotechnical work and vegetation in these areas during the season, recommendations are made to land users for works related to irrigation;

- In the case of October 1, the increase in the salinity level of the soil during the growing season will be determined in the section of the contours, and recommendations on the rate of salt leaching for the next year's crop, its time and the preparation of land for salt leaching will be developed and presented to land users. will be done.

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