THE ROLE OF ENZYMES IN IMPROVING SOIL FERTILITY

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Abstract. *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.*

Keywords: *Chlorella vulgaris (Beyer) and Scenedesmus obliquus (Turp.), catalase, protease, polyphenoloxidase, urease and invertase.*

Introduction

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.

Main body

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 (Table 1.4.1.5.1.6). 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]. 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).

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.

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-3.

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. 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 4

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. 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 $P<0.05$.

Conclusion

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 (Fig. 3.2) 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 (Picture-1).

Catalase activity depending on soil moisture (under laboratory conditions)

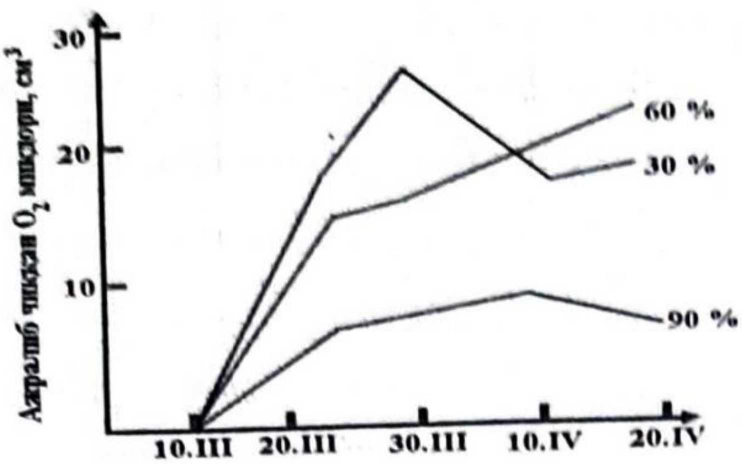

Figure 1

In addition to catalase activity, protease activity in soil was studied (picture-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%).

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