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CORRELATIONS BETWEEN THE ACTIVITY OF SOIL ENZYMES AND THEIR AGROCHEMICAL PROPERTIES

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Abstract
This article analyzes the enzymatic relationships between the enzymatic activity of irrigated serozem-meadow soils of various degrees of salinity and their agrochemical properties, common in the Khavast district. The data obtained showed that due to the unfavorable climatic conditions in the research area, varying degrees of soil salinity and low organic matter content, a low degree of enzymatic activity is observed.
The highest rates of enzymatic activity were observed in the upper, humus-rich layers of the soil profile, while in the lower layers there was a significant weakening of enzymatic activity. It was found that enzyme activity consistently decreases as salinity increases. A higher correlation was observed between enzyme activity and humus at r = 0.78–0.98, with a total nitrogen content at r = 0.87–0.98, and with a phosphorus content at r = 0.80–0.96.

Keywords: Soil, enzymatic activity, humus, total nitrogen, total phosphorus, correlation, salinization, irrigated serozem-meadow soils.

Introduction

The biological and biochemical processes of soils that ensure soil fertility are directly determined by the activity of enzymes. Enzymatic activity is a sensitive

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indicator of the biological state of soils and characterizes the intensity, as well as the course of biochemical processes occurring in the soil.

There are different points of view on the concept of biological activity of the soil. D. G. Zvyagintsev asserts that biological activity characterizes the properties of the soil, its microbiological, physiological, biochemical properties and their condition [1].

The biological activity of the soil phyto-, zoo - and microbiocenoses form an integral system with waste products (humus and enzymes) and abiotic components of the soil environment (granulometric composition, structural elements, physical and water properties, pH, etc.). However, anthropogenic factors (fertilization, land development, heavy metals and pesticides) have a significant impact on its change [2].

All biological processes related to the formation of energy and substances in the soil are carried out by enzymes and play an important role in the mobilization of plant nutrition elements. Enzymes also characterize the intensity and direction of important biochemical processes associated with the synthesis and decomposition of humus, hydrolysis of organic compounds and the redox regime of the soil [3,11,13].

As a result of enzymatic processes in the soil, nutrient compounds that are difficult for plants to digest turn into forms that are easily absorbed by plants and microorganisms. Consequently, in turn, the formation of soil fertility is inextricably linked to the course of enzymatic processes.

The activity of soil enzymes-the type of soil depends on its genesis, composition, vegetation cover, the number and type of soil microorganisms, soil and climatic conditions. In addition, many researchers note that biological activity is influenced by the physical, chemical, water-thermal properties of the soil, the amount and composition of microflora [4].

The enzymatic activity of soils is inextricably linked to the properties of the soil, one of which is the agrochemical index. The optimal level of agrochemical parameters is considered a good condition for increasing the number of soil microorganisms, as well as for plant growth. The biological activity of the soil is

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significantly influenced by its physical properties: mechanical composition, density, state of structure, porosity, and others. Many researchers have noted in the course of research that soils with heavy mechanical composition have higher enzymatic activity than soils with light mechanical composition [5,6,7].

The investigations conducted by L.A.Gafurova et al. in various regions of Uzbekistan, it has been shown that the degree of soil degradation has a significant impact on its biological activity, including enzymatic activity and the number of microorganisms. During the studies, the enzymatic activity in the studied areas showed seasonal dynamics depending on the time of year and varied depending on soil types and salinity levels. Correlations between soil properties and biological activity have also been identified based on the results obtained [8,12].

The process of salinization negatively affects all the properties of the soil, including its biological activity. It is manifested by a decrease in enzymatic activity, a decrease in the number of microorganisms and humus. Also, under the influence of salinity, the ability of the soil to retain water decreases and the process of decomposition of organic substances slows down.

The investigations conducted by I.M. Gabbasova and her colleagues have shown that salinity levels have different effects on enzyme activity. The results of the study showed that oxidoreductase enzymes are more resistant to the salinity process compared to hydrolytic enzymes and have relatively stable activity even at higher salinity levels [9].

The activity of catalase is influenced by soil properties such as the amount of organic matter, soil temperature, the number of microorganisms, clay minerals and pH. Many researchers directly relate catalase activity to the amount of humus in the soil. A change in the humus content in the soil profile leads to an increase or decrease in catalase activity [10].

The group of phenol oxidases includes the enzymes peroxidase and polyphenol oxidase. Enzymes belonging to this group are fully involved simultaneously in the conversion of organic substances in the soil into humus and increase their mobility.

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Object and methods of the research

The irrigated serozem-meadow soils of the Khavast district of the Syrdarya region were chosen as the object of the research.

Field and laboratory investigations have been conducted according to generally accepted standard methods. During the research, the enzymes belonging to the group of oxidoreductases - peroxidase and polyphenol oxidase - were determined by the A.Sh.Galstyan method, and the catalase enzyme was determined by the Kruglova and Paromenskaya gasometric method. Correlations between diagnostic indicators of soil fertility and biological activity were also analyzed using the software Statgraphics Center XVII.

The results obtained and their analysis

As it is known that the enzyme catalase is one of the most stable and widely used enzymes in nature and plays an important role in the redox process occurring in the soil.

Even during our research, the highest catalase activity rates occurred in the upper humus layers of the soil profile, while its activity weakened in the lower layers. It is shown that the enzyme catalase is one of the most stable and widely used enzymes in nature and plays an important role in acidic soils.

Catalase activity was 3.3-3.8 cubic cm O_2 in spring in slightly saline soils, 2.0-2.8 cubic cm O_2 in summer and 2.2-3.3 cubic cm O_2 in autumn in 1 g of soil for 1 minute.

In medium saline irrigated serozem-meadow soils, catalase activity was 2.0-2.4 cubic cm O_2 in spring, 1.1-1.6 cubic cm O_2 in summer, and 1.3-1.8 cubic cm O_2 in autumn in 1 g of soil for 1 minute.

The least catalase activity occurred in highly saline soils of irrigated serozem-meadow soils. Catalase activity in these soils was 1.3-1.8 cubic cm O_2 in spring, 0.6-1.0 cubic cm O_2 in summer, and by autumn this indicator was 0.8-1.3 cubic cm O_2 per 1 g of soil per 1 minute (Fig.1).

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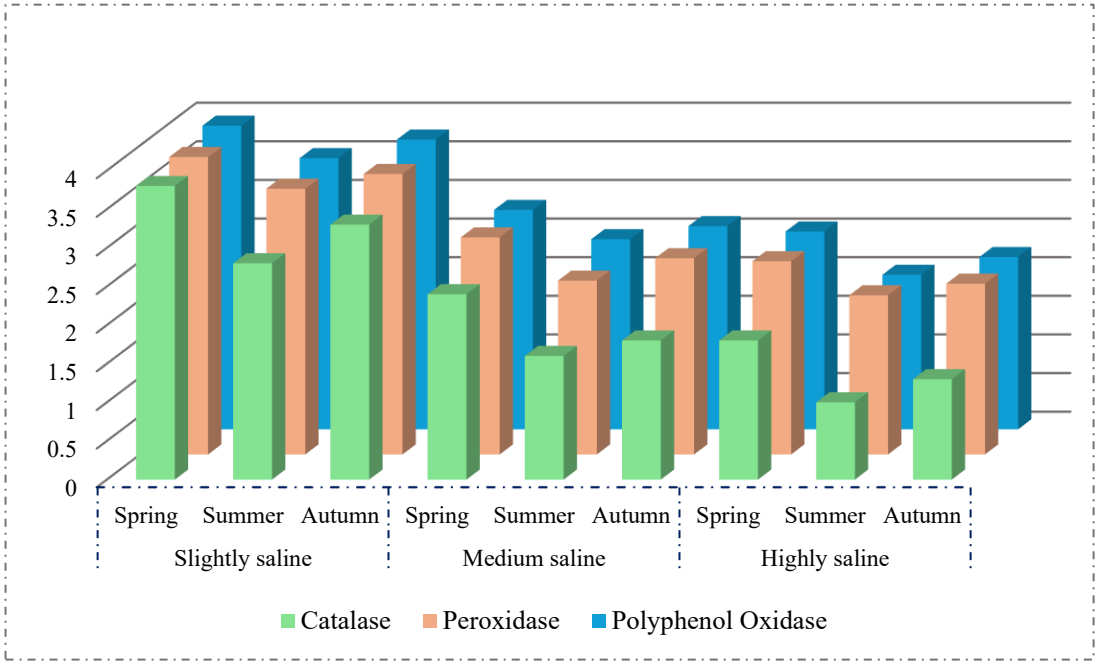

Figure 1. Seasonal dynamics of soil enzymatic activity in the studied area (Catalase-cubic cm O_2 1g per1minute; Peroxidase and polyphenol oxidase-purpurgallin mg 100 /30 minutes)

The weakening of catalase activity in highly saline soils is explained by the low content of organic substances in the soil and the high content of water-soluble salts. In addition, a decrease in catalase activity in the soil profile from the upper to the lower layers is associated with a decrease in humus content and porosity, as well as an increase in soil density.

The activity of the enzyme peroxidase and polyphenol oxidase in irrigated serozem-meadow soils showed relatively high rates in slightly saline soils. The enzyme peroxidase was 3.43-3.85 mg in spring, 3.10-3.50 mg in summer, and 3.16-3.63 mg of purpurgallin /30 minutes per 100 g of soil in autumn. The enzyme polyphenol oxidase, on the other hand, contained 3.50-3.93 mg in spring, 3.10-3.67 mg in summer, and 3.31-3.75 mg of purpurgallin /30 minutes per 100 g of soil in autumn.

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In medium saline irrigated serozem-meadow soils, the enzyme peroxidase was 2.65-2.81 mg in spring, 2.25-2.45 mg in summer, and 2.36-2.54 mg of purpurgallin /30 minutes per 100 g of soil in autumn. The enzyme polyphenol oxidase, on the other hand, contained 2.68-2.84 mg in spring, 2.23-2.46 mg in summer, and 2.39-2.63 mg of purpurgallin /30 minutes per 100 g of soil in autumn.

In highly saline irrigated serozem-meadow soils, the enzyme peroxidase was 1.70-2.50 mg in spring, 1.46-2.06 mg in summer, and 1.52-2.21 mg of purpurgallin /30 minutes per 100 g of soil in autumn. The enzyme polyphenol oxidase, on the other hand, was 1.73-2.56 mg in spring, 1.43-2.00 mg in summer, and 1.56-2.23 mg of purpurgallin /30 minutes per 100 g of soil in autumn (Fig.1). It was found that the activity level of peroxidase and polyphenol oxidase enzymes in irrigated serozem-meadow soils in the investigated area varied mainly depending on the humus content in the soil and the degree of salinity.

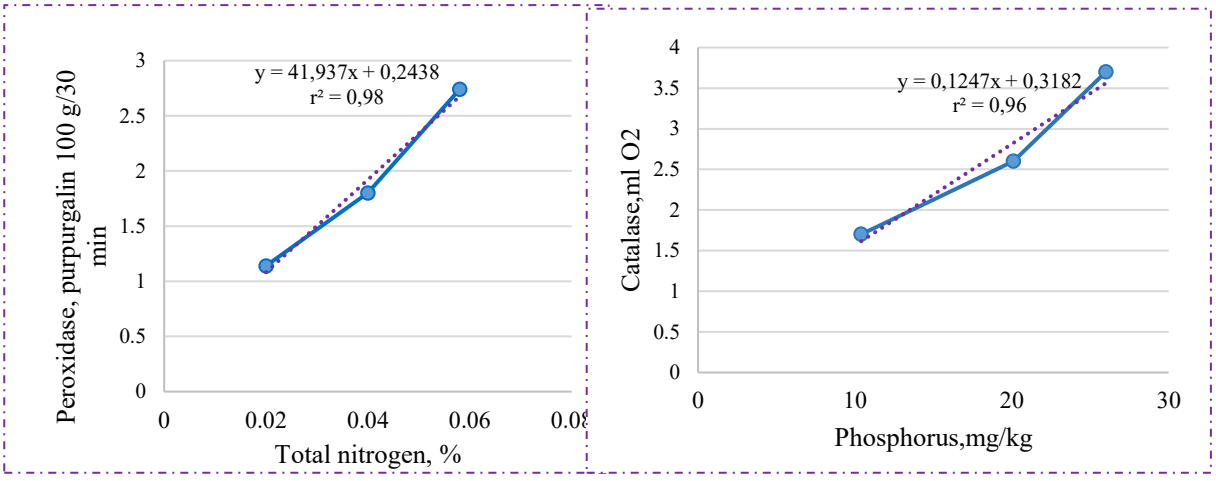

Figure 2. Correlation between biological activity of soils and their agrochemical properties

It was noted that the investigated soils have a high level of enzymatic activity in the spring season and a relatively low level of phallic activity in the summer. It

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was noticed that their seasonal change (spring, summer, autumn) depends on the intake of organic matter into the soil, changes in the number of microorganisms, soil and climatic conditions, hydrothermal regime, mechanical composition of the soil, the amount of water-soluble salts, etc.

The research also revealed correlations between the enzymatic activity of irrigated serozem-meadow soils and their agrochemical properties. The results of the study showed that there is a high degree of correlation between enzyme activity and agrochemical properties of irrigated serozem-meadow soils. In particular, it was found that the enzyme activity has a high correlation with the humus content r = 0.78–0.98, with the total nitrogen content r = 0.87–0.98 and with the phosphorus content R = 0.80–0.96.

Conclusion

It has been established that the enzymatic activity of irrigated serozem-meadow soils in the research area depends on the biological and agrochemical properties of the soil, including the content of humus, total nitrogen and phosphorus, as well as the degree of salinity. It has been observed that enzymatic activity shows seasonal changes, the highest in spring and relatively low in summer. A higher correlation was observed between enzyme activity and humus at r = 0.78–0.98, with a total nitrogen content at r = 0.87–0.98, and with a phosphorus content at r = 0.80–0.96. These data serve as a scientific basis for assessing the biological activity of the soil and increasing its fertility.

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