Activity of peroxidase and polyphenoloxidase, as a diagnostic index of the intensity of the processes of humus formation in arid soils

[1]Kadirova Dilrabo Abdukarimovna, [2]Gafurova Lazizakhon Akramovna

[1]Senior lecturer of Department of Agro chemistry and Soil science,
Tashkent State Agrarian University, Tashkent, Uzbekistan.
[2]Professor of Department of Soil science,
National University of Uzbekistan, Tashkent, Uzbekistan
Email – dilrabo_qodirova@rambler.ru

***Abstract*:** *In this article given the results of the influence of degradation processes on the activity of peroxidase and polyphenoloxidase of the main types and subtypes of soils in the Surkhandarya Valley, which are widespread in horizontal and vertical zoning of the region.*

Key Words: *mountain and foothill soils, irrigated soils, desert soils, erosion, salinity, degree erosion and salinity, activity of peroxidase and polyphenol oxidase.*

1. INTRODUCTION:

Enzymatic activity is an obligatory component of soil, which possesses unique properties. Biochemical transformations in soil, which determine its fertility, are largely determined by the intensity and orientation of the enzymatic processes. The indices of enzymatic soil activity are widely used in solving diagnostic and indication issues of soil science, the dynamics of nutrient content in soil and mineral nutrition of plants, and the evaluation of the effectiveness of fertilizer systems. All biological processes associated with the transformation of substances and energy in soil occur with the participation of enzymes, that play an important role in mobilizing the elements of plant nutrients. They also determine the intensity and direction of the most important biochemical processes associated with the synthesis and decomposition of humus, the hydrolysis of organic compounds and the oxidation-reduction regime in soil [7].

Based on the above data, a special attention is paid to the study of the activity of some oxidation-reduction enzymes that participate in the basic processes of soil formation, and to their change under the influence of erosion and salinity.

2. MATERIALS AND METHODS:

The objects of the study are the main types and subtypes of soils of the Surkhandarya Valley, which are widespread in horizontal and vertical zoning of the region. The activity of the studied soil enzymes is determined by the methods of soil enzymology, described by F.Kh.Khaziev.

3. RESULTS AND DISCUSSION:

Enzymes – oxy-reductases are involved in transformation reactions of organic and inorganic substances in soil. Many outstanding researchers have carried out the studies of these enzymes [2, 4, 6, 9]. Phenol-oxidases play a key role in the processes of humus formation, they have a protective effect on soil, decomposing various xenobiotics, participate in multi-stage decomposition and synthesis of organic compounds of the aromatic series [5].

Among soil phenoloxidases are peroxidase and polyphenol oxidase enzymes. It is assumed that polyphenol oxidase and peroxidase can serve as indicators of the intensity of humus formation processes of organic matter decomposing in soil [7].

Considering the important role of phenoloxidase in the synthesis and mineralization of humus substances, we have studied the effect of erosion and salinity processes on the activity of these enzymes in soils located in vertical and horizontal zoning conditions. Investigated soils have different activity of enzymes depending on the degradation, hydrothermal regimes and their microbiological activity.

The results have shown that in the studied mountain and foothill soils peroxidase and polyphenoloxidase activity changes depending on the degree of erosion, slope exposure and soil-forming rocks, as shown in other studies too [1]. The activity of the studied enzymes decreases from the upper horizons to the lower horizons, from northern to southern exposures, from washed over soils to unwashed and washed away soils.

In the investigated dark sierozems on tertiary sediments, the highest activity of peroxidase and polyphenol oxidase in the upper layer in accordance with humus content is 1,38-1,55, more in dark sierozems, in loess - 3,41-4,80 mg of purpurgaline per 100 g of soil for 24 hours (Figure 1).

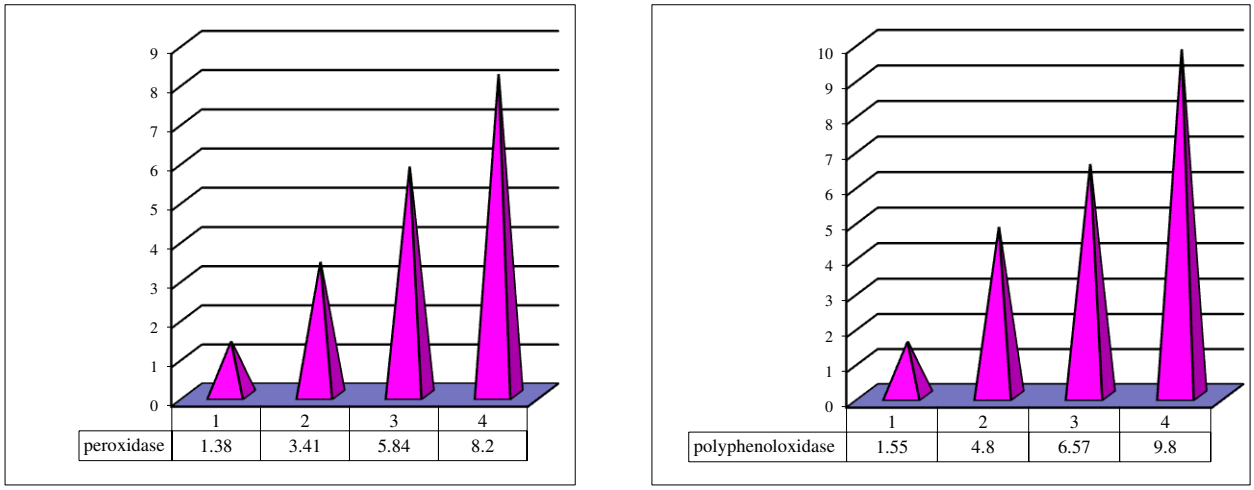

Figure 1. Activity of peroxidase and polyphenoloxidase in the upper layer of the mountain and foothill soils
1-dark sierozems formed on tertiary sediments; 2-dark sierozems formed in loess;
3- mountain-brown carbonate soils; 4- mountain-brown typical soils

In mountain brown soils, the activity of enzymes is even higher. In mountain-brown carbonate soils, the activity of peroxidase and polyphenol oxidase varies from 1.34 to 5.84 and from 1.50 –to 6.57 in the profile, in mountain-brown typical from 1.70 to 8.20 and from 2.05 to 9, 80 mg of purpurgaline per 100 g of soil for 24 hours. As a rule, soils of northern exposures have higher enzymatic activity than soils of southern exposure, and soils in different parts of the slope are characterized by different activity of peroxidase and polyphenol oxidase, depending on the degree of erosion.

Weak activity of phenoloxidases in comparison with mountain soils is observed in the investigated irrigated soils due to the irrigation terms, the vegetation cover, and the rate of humus formation processes. According to activity of phenoloxidase in irrigated soils they can be listed in the following decreasing sequence: the old-irrigated meadow> old-irrigated marsh-meadow> old-irrigated light sierozem> old-irrigated sierozem-meadow> irrigated meadow-sierozem> new-irrigated typical sierozem.

The results of studying the activity of peroxidase and polyphenoloxidase of desert saline soils have shown that slightly saline, old-irrigated meadow soils are the richest in this respect. The activity of peroxidase in the profile varies within the range of 0.70-3.68, the activity of polyphenoloxidase – from 1.56 to 5.80 mg of purpurgaline per 100 g of soil for 24 hours; followed by a slightly saline irrigated takyr-like meadow soil (1.02-3.38 and 1.26-3.02). Reduced activity of phenoloxidase is noted in the newly reclaimed deserted meadow, old-irrigated takyr-like meadow and irrigated meadow desert-sandy soils.

It was revealed that desert soils due to low content of organic matter, weak cultivation and susceptibility to salinity have a relatively low activity of these enzymes.

It is known that the determination of the activity of peroxidase and polyphenol oxidase gives the most complete idea of the direction of the processes of synthesis and decomposition of humus substances in soil. By the ratio of their activity, one can conditionally judge the coefficient of humus formation. Determination of the conditional coefficient of humus formation has shown that an increase in the activity of polyphenol oxidase, responsible for the synthesis of humus in soil, leads to an increase in the coefficient of humus formation; and an increase in peroxidase activity, responsible for decomposition of humus in soil, leads to a decrease in humus content in soils under study.

4. CONCLUSION:

Thus, the highest activity of peroxidase and polyphenol oxidase is seen in the upper layer of soil, and it decreases to the lower layers. The highest activity of these enzymes is marked near mountain soils with an increase in total microbiological activity, optimal agrophysical and agrochemical properties of soils. Next come irrigated soils; in saline soils the activity of enzymes is very low, which is associated with a change in humus content, nutrients, pH, carbonate content, gypsum content, degradation of agrophysical properties of soils, genetic peculiarities under the influence of salinization processes.

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