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Catalase, protease and urease activity in some types of soil

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ABSTRACT: Enzymes in the soil are closely related to the physical, chemical and biological characteristics of the soil and regulate the formation of soil fertility, organic matter, nutrient mineralization and cycling in nature. Soil contains phosphatase, urease, dehydrogenase, catalase, peroxidase, saccharase, protease, amylase, β-glucosidase, arylsulphatase and other enzymes. The purpose of the given work was estimation of catalase protease and urease activity on three different types of soil as high mountained steppe and dry steppe roughly humusified soil; mealy brown carbonated soil and mountain meadow forest soil which are common in the mountain and steppe regions of our country in correlation with soil depth and anthropogenic impacts. In all soil samples the highest enzymatic activities were detected in the depth of 0-15 cm from the soil surface. For all soil samples the enzymes activities decreased more rapidly with increasing soil depth affected to anthropogenic impacts in comparison with samples not exposed to human impacts.

Keywords: soil enzymes, catalase, protease, urease, anthropogenic impacts

INTRODUCTION

Enzymes in soils mainly come from plants, soil animals and microorganisms and connected covalently, crosslinked, copolymerized, adsorbed and included in the microcapsules of soil particles (Girish S., Ajit V., 2011). Soil enzyme activities vary seasonally and have been related to soil physico-chemical characters, microbial community structure, vegetation, disturbance and succession (Caldwell B. A. (2005). That is why soil enzymes play an important role in formation, converting and decomposition of organic matter to the plant digestible forms, decomposition of xenobiotics, involved in the nitrogen and other elements cycle and life cycling of soil microorganisms (Schaller K., 2009). Nowaday soil enzyme activities have been used as indicators in evaluation of soil quality, climate changes, destruction and toxification in ecosystems. Protease (EC 3.4.4…) in soil plays a significant role in nitrogen mineralization, more active in soils with a high water and humus content forest soils and landfills. Activity of this enzyme does not depend on microbial community of soils and expresses the biological activity of the soil. The enzyme associated with soil fertility, regulating the amount of available nitrogen in plant and plant growth. (Girish S.et al., 2011). Peroxide in soil is formed during respiration and oxidation of organic matter (Andersen D.W., Gregorich E.G., 1980). Catalase (EC 1.11.1.6) decomposes peroxide and its activity depends from organic oxygen concentration, microbe biomass, changes in CO_2, and depends from dehydrogenase, amidase, glucosidase and esterase activity in soils. Therefore an important indicator of soil fertility and aerobic microorganisms (Burns R.G., 1982). Urease (EC 3.5.1.5) activity in soils depends from organic and inorganic matter content; especially urease is very sensitive to heavy metals (Girish S.et al., 2011).

EXPERIMENTAL

Three types of soils samples were used in our study (table 1). In all soil samples moisture, soluble protein, protease, catalase and urease activities were estimated.

The moisture was estimated gravimetrically, protein contents - by the Beneduct method (Kochetov G.A., 1980), the protease activity – by Kunitz M. method, catalase - by method Bach A.N. and Zubkova S.M. and the urease activity - by the Porter L. K., methods (Purev D. Bayarmaa J., 2012). Enzymatic activities were expressed in units. 1 unit of catalase activity was taken as 1mg of hydrogen peroxide hydrolyzed by catalase of 1g soil in 1 hour, 1 unit of protease activity was taken as 1μg of tyrosine formed in 1g of soil in 1 hour and 1 unit of urease activity was taken as 1μg of urea hydrolyzed by urease of 1g soil in 1 hour.

As we see from the table 2 high in mountained steppe and dry steppe roughly humusified soil, mealy brown carbonated soil and mountain meadow forest soils the moisture content decreases to the soil depth of 1.14-2.10 times. About soluble protein content it has a tendency to decrease to the soil depth to (decreases 1,29-3 times to the soil depth). It can be seen from the calculation of the correlation coefficient (table 2). The protein content decreases from high mountained steppe and dry steppe roughly humusified soil > mountain meadow forest soil > mealy brown carbonated soils which shows that the protein content has a dependence from the soil type.

Table 1. Soil samples

Type of soil	Place of sample collection	Soil	Collection point	Height, m
High mountained steppe and dry steppe roughly humusified soil	Ulaanbaatar city, Chingeltei, Zurkh Uul	Not affected with human impact	N 48^{0}00, 9162`, E 106$^0$85, 9761`	1560
	Ulaanbaatar city, Chingeltei, Zurkh Uul	Affected with human impact	N 48^{0}01, 0597` E 106$^0$86, 2165`	1527
Mealy brown carbonated soil	Bulgan aimag, Dashinchilen sum	Not affected with human impact	N 47^{0}47, 672`, E 103$^0$57, 795`	1135
	Bulgan aimag, Dashinchilen sum	Affected with human impact	N 47^{0}50, 441`, E 104$^0$35, 474`	1076
Mountain meadow forest soil	Khentii aimag, Batshireet sum	Not affected with human impact	N 47 î53'04'' E 106 î55'04.6''	1268
	Khentii aimag, Batshireet sum	Affected with human impact	48 î41'48.8'' 110 î12'06.8''	1126

RESULTS AND DISCUSSION

Samples of three different types of soil as high mountained steppe and dry steppe roughly humusified soil; mealy brown carbonated soil and mountain meadow forest soil with and without human impact were collected from the depth of 0-7, 7-15 and 15-25 cm from the soil surface in June 2011 and used in our study. In all samples moisture, protein content, the protease, catalase and urease activities were estimated. Results are summarized in tables 2, 3 and 4.

From the table 3 we can see that the activity of estimated enzymes have a dependence from the soil depth. In all soil samples estimated enzymes have the highest activity at a depth of 0-15 cm from the soil surface. Rapid decreasing trend for estimated enzymes activities with increasing depth of soil for all soil samples affected to human impacts in comparison with samples not exposed to human impacts were observed (table 3).

Table 2. Soil moisture and soluble protein content

Type of soil	Soil	Soil depth, cm	Moisture, %	Protein content, %	Correlation coefficient (soil depth/ protein)
High mountained steppe and dry steppe roughly humusified soil	Not affected with human impact	0-7	21.60±0.60	0,96	-0.975
		7-15	21.96±0.78	0,54	
		15-25	20.12±2.50	0,35	
	Affected with human impact	0-7	18.60±0.96	0,47	-0.282
		7-15	13.24±0.86	0,29	
		15-25	11.46±1.12	0,28	
Mealy brown carbonated soil	Not affected with human impact	0-7	0.59±0.06	0,33	-0.912
		7-15	2.17±0.01	0,19	
		15-25	1.90±0.20	0,16	
	Affected with human impact	0-7	1.58±0.42	0,35	-0.884
		7-15	3.56±0.38	0,19	
		15-25	2.71±0.73	0,16	
Mountain meadow forest soil	Not affected with human impact	0-7	9.04±1.77	0,69	-0.992
		7-15	8.20±0.13	0,57	
		15-25	7.64±0.23	0,32	
	Affected with human impact	0-7	7.29±1.08	1,33	-0.999
		7-15	8.30±0.57	1,04	
		15-25	7.99±0.52	0,73	

Table 4. Correlation coefficient

Soil	Protein/ protease	Protein/ catalase	Protein/ urease
Not affected	-0,727	0,420	-0,901
Affected	-0,815	-0,278	-0,204
Not affected	-0,693	0,991	0,939
Affected	0,995	0,992	0,915
Not affected	0,954	-0,513	0,973
Affected	0,980	0,919	0,994

For estimated enzymes the correlation coefficient with soluble protein content was calculated. It shows of existing of a direct and inverse relationship of studied enzyme activities to soluble protein in the soils (table 4).

CONCLUSIONS

1. Soil moisture and soluble protein content has a tendency to decrease to the soil depth.
2. All soil samples show the highest enzymatic activities in the depth of 0-15 cm from the soil surface.
3. Studied enzyme activities have a direct and inverse relationship to the content of soluble protein in the soils.
4. The enzymes activity decreased more rapidly with increasing depth of soil for all soil samples affected to human impacts in comparison with samples not exposed to human impacts.

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