ENZYMOLOGIC STUDY UPON SOIL RESOURCES OF TROTUS VALLEY FORESTRY ECOSYSTEMS

STUDIU ENZIMATIC ASUPRA RESURSELOR DE SOL DIN ECOSISTEME FORESTIERE SITUATE PE VALEA TROTUŞULUI

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Abstract. *This paper presents the experimental pedobiological results of the analyses carried out in the oak grove perimeter of Paltinata and Heltiu-Caiuti Bacau, from the Trotus Valley, that form the core of a CEEX research contract.*

Soil resources fall into two categories – cambic soils and luvisoils. The degree of favourability of the factors and ecologic determiners (climatic and pedologic) is predominantly an average one. The pedobiological, physiologic (respiration and cellulosic potential) and enzymatic study of soil resources (catalasic, sugary, and total phosphatasic potential) for the vegetation period, within the horizon of bioaccumulation highlights an average biologic activity with a view to transforming the organic remaining and mineralization of humus.

Rezumat. *În lucrarea de faţă prezentăm rezultatele experimentale pedobiologice din pădurile de gorunete (Cvercineae) Păltinata şi Helţiu Căiuţi, Bacău, situate pe valea Trotuşului, obţinute în cadrul unui proiect de cercetare CEEX.*

Resursele de sol sunt încadrate în clasele Luvisolurişi Cambisoluri. Gradul de favorabilitate al factorilor şi determinanţilor ecologici (climatici şi pedologici) pentru gorunete este predominant mijlociu. Studiul pedobiologic şi fiziologic (potenţial de respiraţie şi celulozolitic) şi enzymatic al resurselor de sol (potenţial catalazic, zaharazic, meazic şi fosfatazic total) pentru perioada de vegetaţie la nivelul orizontului de bioacumulare evidenţiază o activitate biologică mijlocie în direcţia transformării resturilor organice şi a mineralizării humusului.

INTRODUCTION

In normal qualitative and quantitative conditions, soil constitutes an essential component of the terrestrial ecosystems, but it also represents a fundamental condition of soil functioning, since soil is a living organism and its whole activity of formation, development and evolution occurs under the action and influence of the biologic factor (Birescu, 2001, Stefanic, 1994).

Fertility represents the essential quality of soil, accounting for the presence of nutritive elements in balanced quantities that provide for plant nutrition (Cârstea, 2003). According to Jack, 1963, soil natural fertility is a biologic phenomenon, rather than a physical-chemical one. Soil is an enzymatic system, in which the accumulated enzymes, alongside the enzymes of the proliferating microorganisms, play an important contribution to plant nutrition and soil natural fertility (Birescu, 2001, Kiss and col., 1991, Stefanic and col., 1998). Soil biologic potential characterizes its fertility state as well as the influence of perturbing microbiotic agents upon soil (Ardelean and col., 2001, Drăgan-Bularda and col., 2001).

MATERIAL AND METHOD

Researching the potential of the enzymatic activity in laboratory conditions, and the level of the potential of enzymatic activity must be interpreted as level of soil population of organisms in a span of time prior to drawing soil samples (Birescu, 2001, Stefanic, 1994; Stefanic and col., 1998).

The potential of catalasic activity is assessed with the catalapmetre designed by Stefanic (1984), that measures the level of the oxygen given off during the reaction. The invertase potential is assessed by using the Stefanic method (1972), measuring the enzymatically-hydrolysed sugar content (glucose and fructose). The measic activity is assessed with the 1994 Stefanic method by means of measuring the ammonium content. The principle of assessing the soil-water activity, according to Stefanic 1999 consists in introducing glucose in a soil-water blend, with a view to combining it with the phosphate ions, enzymatically given off, thus assessing the glucose content left unused that eventually turns into phosphorus.

RESULTS AND DISCUSSIONS

The pedobiological research presented in this paper belongs to a series of complex and multidisciplinary ecological research that form the core of a CEEX research project circumscribed to an oak grove area.

The analysed natural soil resources edged by the Paltinata-Heltiu forestry ecosystems belong to luvisoils and cambic soil category. The ecologic study upon the main 20 factors and ecologic, pedologic and climatic determiners is presented in table 1.

From a quantitative point of view, we have analysed the main 8 classes of ecologic size, while, from a qualitative point of view we have analysed the main 6 classes of ecologic favourability, 5 climatic ecologic factors, 3 development pedoecologic factors, 2 space and time factors, 2 negative pedologic factors, 5 pedoecologic determiners and 3 representative synthetic indicators.

The majority of factors and ecologic determiners fit into middle ecologic and favourability class category. Mention must be made about the low values of the nutritive elements (second class small size – Heltiu forest UA 18 – lithic luvisoil and third class middle-small size – Heltiu forest UA87 stagnic districhambosoil and Paltinata UA73).

Table 1

The ecological specific card of some cvercinee forest ecopedotypes from Trotuş valley

Ecological factors	Measure classes of ecological factors								Favourability classes of ecological factors					
	0…m	I	II	III	IV	V	E_1	E_2	N…m	FS	S	M	R	FR
RAISING FACTORS														
Natrium total			●	○X							○●	X		
Phosphorus mobile			●	○X							○●	X		
K (K_2O)			●	○X							○●	X		
CLIMATICAL ECOLOGICAL FACTORS														
Annual medium temperature (T^oC)					○●X									○●X
Annual medium rain (Pmm)				○●X								○●X		
Windy regime (Vt)				○●X								○●X		
Summer rain (Pe)			○●X								○●X			
Summer air relative humidity (Uer)			○●X								○●X			
ECOLOGICAL FACTORS SPACE-TIME														
Edaphyc volume (Ve)				○●X								○●X		
Bioactive period length					○●X									○●X
NEGATIVE ECOLOGICAL FACTORS														
Alkalinity - Acidity			○●X										○●X	

Summer consistency							○●X			○●X					
ECOLOGICAL DETERMINANTS															
Humus		●	○	X						●	○	X			
Texture				○●X								○●X			
Aeration porosity			○●X							○●X					
Soil reaction				○●x							○●	X			
Base status			●	○X							○●	X			
SYNTHETICALLY BIOLOGICAL INDEX															
Biological activity			●	○X						●	x	○			Favourability
SYNTHETICALLY PEDOLOGICAL INDEX															
Potential trophicity			○	●	x					●	○	x			
Effective trophicity			○●	x						●	○	x			

○Paltinata UPV; UA 73 (Iuvosol stagnic litic);
● Heltiu UPVI; UA 18 (Iuvosol litic);
x Heltiu UPVI; UA 78 (districambosol stagnic)

Climatic factors during the aestival season record low rainfall levels, and high atmospheric humidity that account for a low favourability level. The same aestival season is characterised by low values of soil aeration, degree of saturation with bases, humus content, soil reaction and biologic activity.

Forest soil acidity, low aeration, reduced level of edaphic humus determine a account for low parameters of enzymatic potential, humification and mineralization processes of organic remainings. The level of enzymatic potential in the 3 ecotypes presented in this paper was assessed in the bio-active area of 0-60 cm. One notices average values during the first 20 cm that halve at a depth of 40 cm, and reach a percentage of 30% at 60 cm depth. The enzymatic potential records lower values in the Heltiu UPVI, UA18 ecosystem – lithic luvisoil and low towards average values in the Heltiu UPVI, UA87 ecosystem – stagnic districhambosoil and Paltinata UA73.

Table 2

The enzymatic activity potential of soil resources in some cvercinee forester ecosystems from Trotuş valley

Forester ecopedotop	Depth (cm)	Catalasis cmc 02/ 100 g SU	Zaharasis mg glucose/ 100 g SU	Ureasis mg NH_4/ 100 g SU	Phosphates Mg P/ 100 g SU
Paltinata UPV: UA73 Luvosol stagnic litic	0- 20	275	819	8,12	3,28
	20- 40	141	372	1,69	1,16
	40-60	100	103	0,73	0,41
Heltiu UPVI; UA 18 Luvosol litic	0- 20	181	691	6,52	2,43
	20- 40	106	151	2,32	0,99
	40-60	56	74	1,01	0,33
Heltiu UPVI; UA78 districambosol stagnic	0- 20	201	554	5,85	1,93
	20- 40	88	162	2,67	0,61
	40-60	39	105	1,35	0,27

Thus, the catalasic potential records low values on the 0-60 cm interval, that rank between 275-100cmc02/100g SU in the Paltinata UA73 ecosystems, 181-56cmc02 in the Heltiu UPVI, UA18, and 201-39cmc02 in the Heltiu UPVI, UA87 ecosystem.

The level of sugary potential records low values due to anaerobic processes that diminish the mineral and organic matter. The lowest values of the sugary potential is recorded by the Heltiu UPVI, UA18 ecosystem, ranking between 554-105 mg glucose/100 g SU. Slightly higher values, but still ranking low towards average characterise the other two analysed forestry ecosystems (691-74 mg glucose in the Heltiu UA18 ecopedotype and 819-103 mg glucose in the Paltinata UA73 forest). The ureasic potential reaches low towards average values:

recording lower values in the Heltiu UPVI, UA87 – 5.85-1.35 NH4/100 g. SU, in strict correlation with low humus and nutrients content. The total phosphatic potential is low, correlated as it is with the local edaphoclimatic peculiarities of the three analysed forests, the lowest values (1.93-0.27 mgP (0-60cm) belonging to the Heltiu UPVI, UA87 forest, while the other two ecosystems record similar values, slightly higher (0-20cm).

CONCLUSSIONS

High acidity of soil resources together with a deficient aero-hydric regime and low edaphic volume lower, stress and limit the biologic, enzymatic activities within the local ecologic context.

The bio-pedo-climatic peculiarities provide an average favourability for the oak groves of the analysed perimeters.

Low levels of enzymatic potential (catalasic, measic, sugary and total phosphatic) are recorded by the first 20 cm, just to drop to some 50% at the depth of 40 cm and to 30% at a depth of 60 cm.

Low values of the enzymatic potential, during the vegetation period, determine a reduced speed of transformation of organic remaining (via acid and predominantly anaerobic phenomena).

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