THE DYNAMICS OF BIOCENOTICS INDICES OF THE SOIL IN THE FOREST ECOSYSTEM, "CODRII" RESERVATION

DINAMICA UNOR INDICI BIOCENOTICI AI SOLULUI ÎN ECOSISTEMUL FORESTIER, REZERVAȚIA "CODRII"

COJUHARI Tamara [1], VRABIE Tatiana[1], KRIVOV Ludmila[1], KOTERNEAK Ana-Maria[1], ANGHEL Liubovi[1]
e-mail: cojuhari_tamara@mail.ru

Abstract. *This paper represents a stage of long-term research in which we highlight the dynamics of humus, soil reaction indexes and hydrolytic acidity. During vegetation period, as a result of research in 3 types of forest it was established: territorial distribution of humus shows essential variations depending on the type of soil, vegetation type and depth. The typical gray clay forest soil over clay-sandy loam (oak with hornbeam forest, A) and brown clay soil over deeply gleyed clay (durmast oak with linden and ash forest, B) are much more supplied with organic matter, which in the 0-40 cm layers falls within the limits of 1.1-8.5%, 0.9-8.6% and 0.3-3.5% in the brown sandy loam soil over clay-sand (beech with durmast oak forest, C). The dynamics of the* pH_{H2O}*,* pH_{KCl} *indices, hydrolytic acidity is determined by the soil type, depth and floral indices. Soil of forest A in layers 0-60 cm, characterized by neutral to weak acid* pH_{H2O}*,* pH_{KCl} *to moderately acidic, low-medium hydrolytic acidity; Forest soil B is weak acid for* pH_{KCl} *and neutral-weak acid for* pH_{H2O}*, hydrolytic acidity is low. The forest soil C is more acidic and has higher hydrolytic acidity.*
Key words: biocenosis, forest type, humus dynamics, soil pH, hydrolytic acidity

Rezumat. *Lucrarea dată prezintă o etapă a cercetărilor de lungă durată în care evidențiem dinamica humusului, indicilor de reacție a solul şi acidității hidrolitice. În rezultatul cercetărilor în 3 tipuri de pădure, în perioada de vegetație s-a stabilit că repartiția teritorială a humusului indică variații esențiale în funcție de tipul de sol, tipul de vegetație şi adâncime. Solul cenuşiu tipic lutos pe lut-argilă (pădurea de stejar cu carpen, A) şi brun lutos pe lut adânc gleizat (pădurea de gorun cu tei şi frasin, B) sunt mult mai aprovizionate cu materie organică, care în straturile 0-40 cm se încadrează corespunzător în limitele 1,1-8,5 %, 0,9-8,6% şi 0,3-3,5% în solul brun tipic luto-nisipos pe lut-nisip (pădurea de fag cu gorun, C). Dinamica indicilor* pH_{H2O}*,* pH_{KCl}*, aciditatea hidrolitică, în cea mai măsură sunt determinate de tipul de sol, adâncime şi indicii floristici. Solul pădurii A în straturile 0-60 cm, se caracterizează cu reacția* pH_{H2O} *de la neutru la slab acidă,* pH_{KCl} *până la moderat acidă, valori mici-mijlocii ale acidității hidrolitice; solul pădurii B este slab acid pentru* pH_{KCl} *şi neutru-slab acid pentru* pH_{H2O}*, aciditatea hidrolitică este mică; solul pădurii C este mai acid şi deține valori mai mari ale acidității hidrolitice.*
Cuvinte cheie: biocenoză, tip de pădure, dinamica humusului, pH-ul solului, aciditatea hidrolitică

[1] National Museum of Ethnography and Natural History, Chisinau, Republic of Moldova

INTRODUCTION

It is known that the formation of the erbaceous layer is determined by biotic and abiotic factors. Due to the fact that the grassy species form small ecological niches, their spatial distribution is mostly favored by the dynamics of soil regimes. In the previous papers the main ecological indicators were simultaneously analyzed in the soil in profiles and semi-profiles (hydrici, physicochemical, minerals, including nutrition) and plants (structure and composition of the arboretums, floristic and numerical diversity, organic mass, Nutritive) (Cojuhari *et al.*, 2002, 2009, 2016, 2017; Grati *et al.*, 2012; Vrabie and Cojuhari, 2015).

This work is a continuation of these research and proposes the analysis of the spatial variations of ecopedological indices - humus, soil pH and hydrolytic acidity as indices that determine optimal conditions in the supply of plants with nutrients. These results can contribute to: tracking pedocenter processes in natural systems that are more stable to environmental factors; The soil-plant relationships presented in spatial and temporal dynamics can be used as authentic materials in ecological, pedological, botanical, forestry monitoring. For this reason, for greater clarity, we present the analytical results in the tables.

MATERIALS AND METHODS

Based on the long-term research carried out in three representative biocoenoses of the Rezervatia Codrii, namely: common oak with hornbeam forest on typical gray clay forest soils over clay-sandy loam (A); durmast oak with linden and ash forest on brown clay soil over deeply gleyed clay (B); beech with durmast oak forest on brown sandy loam soil over clay-sand (C), as a continuation the characterization of the ecological indices named above in the spatial and seasonal dynamics of 2001, in each association included in forest biocenoses, established biocoenoses, as a forest type based on ecosystem methodology. Forest types and associations were determined by doc. Şabanov G. according to the classification of 3 Vegetation of the Republic of Moldova (Postolache, 1995). The determination of the species was carried out according to the determinant T. Gheideman, 1986, by G. Şabanov and T. Cojuhari. Determinations in soil were performed according to traditional methods (Аринушкина, 1970): humus-method Nichitin; current acidity, pH_{H20} - potentiometric; exchangeable acidity, pH_{KCl} - potassium chloride; hydrolytic acidity, H + - Cappen method; the vegetation homogeneity index according to the Sorensen method; Mathematical statistics - according to the method of Gorea S., 1986.

RESULTS AND DISCUSSIONS

Climate. After the stationary separation, the arbors from the studied territory belong to the deciduous forests. The thermal condition of the area is characterized by average annual temperatures of 8.7 °C -9 °C and annual average precipitation of about 510-525 mm. Taking into account the small differences of altitude and the general position of the slopes in the territory, one climatic level separates the slope, plateaus and valleys. There is a close correlation between climatic and filo-climatic level, the natural setting vegetation being made under the simultaneous action of the physico-geographic factors and the biotic factors. Temperature and atmospheric precipitation were determined on the basis of the meteorological points established within each research area (the meteorological station of the Rezervatia "Codrii"). In order to assess the climate correlation - the productivity process revealed variations in temperature and precipitation indices, also from the previous periods, which formed the basis of organic mass building.

Temperature. The results of temperature investigations in the biocenoses studied for the years 2000-2001 have shown similar results for all types of forests as these are located at fairly small distances. Some differences are due to the location of land at different heights above sea level. We highlight the maximum and minimum temperature indices in the annual dynamics (2000-2001), as extreme factors that determine plant adaptation to habitat. Maximum temperature: point 1 (hornbeam oak forest) - 33°C; 32°C; Point 2 (durmast oak with linden and ash forest) - 30°C; 32°C; Point 3 (beech with durmast oak forest) – 33 °C; 34 °C. Minimum temperature - point 1 - -12; -16 °C; Point 2 - -11 °C; -14°C; Point 3-13 °C; -13°C.

Monthly and decade-long amplitude indices are essentially lower. Highest temperature variation are followed in : March, April and October, which indicated higher oscillations for point 3, lower for point 2. However, these differences are insignificant in determining the growth and development of plants. We note that the temperature regime is favorable for plant growth and development in all surveillance sectors (fig. 1). Annual values are shown in table 1.

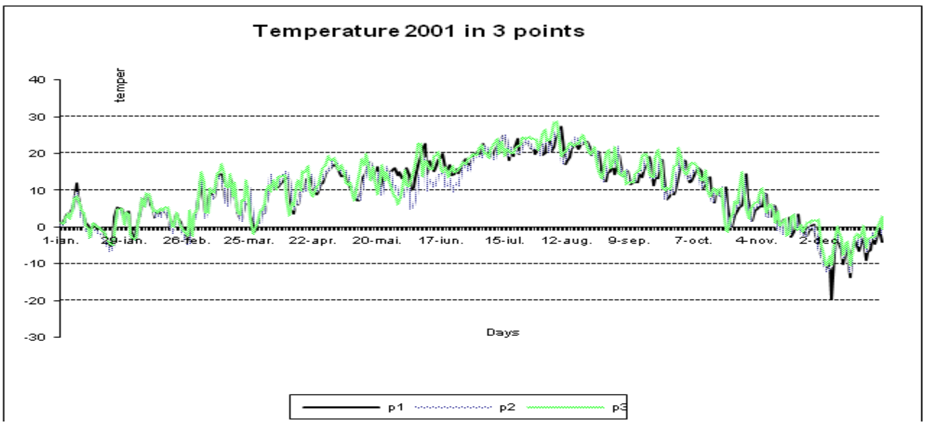

Fig.1 Annual values of temperature index

Table 1

Mean annual values of temperature regime in investigated areas (2001)

Meteorological conditions	Point 1.		Point 2		Point 3	
	Veg.per.	Year	Veg.per.	Year	Veg.per.	Year
Number of days with t 5° C	229	247	227	244	229	264
Number of days with positive temperatures	1	56	0	63	3	59
Sum of mean daily positive temperatures	3349	3403	3270.4	3383.1	3527.6	3687.3
Sum of mean daily negative temperatures	1.3	186.3	0	241.6	4	158.7

Rainfall. Weather data precipitations were collected at the meteorological station of the rezervatia „Codrii”. From 1999 – 2001 were noticed rainfall values corresponding to the normative index for Moldova – 662.9 mm (576.5 – 495.6 accordingly). Considering plants water supply from soil reserve, most frequently accummulated in autumn-winter, sometimes in early spring. It was found that in november-december of the previous year and in january-february of 2001, precipitations has accumulated as a result of rains and snow, 184.2 mm and 144.4 mm. Precipitations in the year of study proved to be quite favorable – 506.0 mm, in march - may – 143.0 mm. Summer precipitations (163.6 mm) has been marked by strong rainfalls on June 5th (72.7 mm), in autumn exceeded summer by 110.7 mm. The variation of rainfalls contributed to the growth and development of herbaceous layer.

Characteristics of vegetation and soils

The three forest types, chosen as stationary, belong to the European ecosystem – hardwood forest and differ according to composition, structure, specific and numerical range.

The vegetation of the hornbeam oak forest (forest A) belongs to *Quercetum* (*Quercus robur*), with two associations (900 m2 of territorial rehearsals for each type of forest) *Carpineto-Quercetum and Fraxineto-Quercetum*. The vegetation of the durmast linden and ash forest (forest B), also belongs to *Quercetum* with a single *Fraxineto-Quercetum* association; the vegetation of beech with durmast oak forest (forest C) belongs to *Fagetum* (*Fagus sylvatica*) including two vegetal associations - *Carpineto-Fagetum* and *Querceto-Fagetum*, described in previous works (Cojuhari *et al.,* 2009; Grati *et al.,* 2012).

Here are some floristic aspects of ecological importance, without including a more detailed description of later research fields.

Oak with hornbeam forest is highlighted by *Quercus robur, Quercus petraea* followed by Tilia cordata, Fraxinus excelsior, Ulmus minor and Acer campestre, all belonging to 7 genera and 6 families.

The layer of shrubs is poorly developed, predominantly consisting of horn (Cornus mas) with hawthorn and wayfarer elements.

The herb layer includes 59 species of herbaceous vascular plants (55 and 42 corresponding to the years 2000 and 2009), belonging to 47 genera (45 and 36) of 21 families (21 and 19) and a wood species (*Hedera helix*) of which *Asparagus Convallaria majalis, Corydalis bulbosa (cava)* and *Corydalis marschalliana*, are characterized by Negru (2007) as rare species because of constantly diminishing populations, under the influence of anthropogenic factors.

Typical gray clay forest soil over clay-sandy loam is characterized by low eluvial and iluvial horizons. Reaction of the mildly acidic soil at the surface is maintained throughout the profile (strongly acidic in the Ae horizon), the concentration of humus is more intense at the surface, suddenly decreasing in the eluvial horizon. Saturation level at basic layer is high. This soil has an optimal structural capacity.

Phytocenosis corresponding to **durmast oak with linden and ash forest** (B), is marked by wooden species like *Quercus petraea, Tilia cordata, Fraxinus excelsior, Acer campestre, Ulmus minor, Sorbus torminalis*, belonging to 6 families and 6 genera. The subsurface layer is well developed and consists of a single species - Cornus mas. Natural regeneration is marked by the emergence of Quercus robur and Acer campestre seedlings. The herb layer consists of 36 species included in 32 genera and 20 families, of which climbing wooden species *Hedera helix* (Cojuhari *et al.*, 2009; Grati *et al.*, 2012).

Brown clay soil over deeply gleyed clay is marked by a high level of gleyzation in Bi2g horizon, the superficial layers are loose, less compact. The humus content is very high and high (11.1-5.6%), up to 32cm, deeper low and very low - 2.7-1.3%. This soil is characterized by a high level of saturation in bases, containing from high to moderate P and K, and very low N-N0_3.

The forest biocenosis being delimited in the frame of **beech with durmast oak forest** (C), covers wooden species from 3 families, 4 genera: trees - *Fagus sylvatica* and *Quercus petraea* (Fagaceae family), *Carpinus betulus* (Corilaceae family) and a climbind plant *Hedera helix* (Araliaceae family).

In the poorly developed shrub layer there are solitary specimens of *Cornus australis* and silvoforming trees - *Fagus sylvatica, Quercus petraea, which are also present in the herbaceous carpet, amongst Acer platanoides, A. campestre, Carpinus betulus, Fraxinus excelsior, Tilia cordata, Viburnum lantana, Euonymus verrucosa.*

Compositional and low specific diversityof the wooden layer is compensated by a vigorous mass of beech and durmast oak trees. The herb layer consists of 31 species corresponding to 16 families and 27 genera (Cojuhari *et al.,* 2002; 2009).

Brown sandy loam soil over clay-sand is distinguished by the more even distribution of all the analyzed indices, with slighter and homogeneous granulometric composition: the humus content at 0-50 cm, holds values within the limits of 4.6-1.4%; pH_{H2O} is within the range of 7.0-6.7; the sum of the exchangeable bases and the total cation exchange capacity supports medium values; mobile phosphorus maintains moderate and optimal, exchangeable potassium, which falls into the high value category.

In order to determine the diversity and similarity of the analyzed phytocoenoses, the Sorensen (S) homogeneity index was calculated. The specific composition of trees in the comparison of phytocenosis associations in the study is quite homogeneous, the given index is marked with values close to 1 unit. Comparing the diversity of forest types with regard to tree species: the greatest floral diversity of tree species is mentioned while comparing oak forest with hornbeam beech with durmast oak forest, durmast oak with linden and ash forest – durmast with beech forest, where S = 0.37 - 0.20 accordingly. The relations between oak and hornbeam oak forests – durmast oak with linden and ash forest have the homogeneity index S = 0.8, so both forests have a close floristic spectrum.

Table 2

Homogeneity of grassy layer, Sorensen index

Forest type	march	april	may	june	september
		richness	floristry	total	
A	0.86	0.86	0.86	0.85	0.75
B	0.95	0.95	0.63	0.79	0.98
C	0.9	0.90	0.61	0.75	0.5
		richness	floristry	mean	
A	0.73	0.63	0.71	0.67	0.53
B	0.62	0.86	0.54	0.9	0.57
C	0.40	0.70	0.53	0.71	0.5
		richness	floristry	total	
AB	0.52	0.52	0.38	0.61	0.6
BC	0.47	0.47	0.43	0.48	0.41
AC	0.64	0.64	0.60	0.75	0.7
		richness	floristry	mean	
AB	0.75	0.73	0.38	0.42	0.4
BC	0.39	0.35	0.25	0.07	0.17
AC	0.61	0.57	0.65	0.52	0.53

The floristic homogeneity of the herb layer was calculated on the basis of the total floral richness (1800 m^2) and the mean floral richness (1 m^2 areas) of the species found in each type of vegetation, which shows the similarity and divergence between them, evaluated in seasonal dynamics (tab. 2).

Comparing floristic diversity regarding types of associations we found the following:

- During the vegetation period, based on the analysis of the total floral richness of the species, it was found that the grassy layer of the hornbeam with oak forest is quite homogeneous until autumn. According to average specific richness calculation in autumn the Sorensen index (0.5) is geared towards increasing diversity.

- According to the calculation of the total floristic richness the d*urmast oak with linden and ash forest* is homogeneous, regarding spring and autumn grass species. The Sorensen index, based on the average floral richness, indicates lower values in May and September, so there is a greater diversity in both the 900 m^2 land rehearsals of the indicated forest.

- According to the calculation of the total floristic richness *beech with durmast forest* is homogeneous, regarding spring and summer grass species. In autumn, at the same time with reduction of the specific diversity of the summer species and the organic mass of the grassy layer, remain summer and autumn species which increase its diversity. Specific diversity is more pronounced in intensive work areas (medium floral richness), where soil-plant interdependencies can be more clearly observed.

The diversity of species regarding the comparison of the forest types is marked with low values of the Sorensen index in AB reports in may (both cases) and may - september in the case of average specific richness; BC reports in all cases. Herbaceous layer in AC forests is homogeneous for all vegetation period, with few exceptions in summer and autumn on average floral richness calculations.

Dynamics of biocenotic indices

Humus. One of the most important item on determining soil stability. As a biocenotic component, is the main soil fertility index. Humus, as a reservoir of organic matter and minerals, creates optimal conditions for the growth and development of plants, conditioning biological, hydro, physical and chemical processes of the soil (Andrieş, 2007; Ганенко, 1987; Карпачевский, 1977, Крупеников, 1967). The character of the humus distribution in the soils of the analyzed biocenoses allows us to make a concrete assessment of each ecotope in the study of the bioproductive process, directly supplying ecological niches.

The structure and composition of humus are decisive factors in creating the soil's reaction, hydrolytic acidity, which determines the composition and the structure of the vegetation, in particular the specific and numerical indices of the grassy layer.

The dynamics of humus in terms of variation of the soil cover for each type of association and in depth was analyzed in the 0-40 cm (10 cm) layer in 24 semiprophiles, which can give more concrete indications of floral diversity during the vegetation period in the ratio with the soil cover.

The results presented have allowed us to reveal a high diversity of humus for the soils of each type of forest, ranging from very small to very high: maximum - 8.6% (state 0-10 cm) corresponds to the brown clay soil over deeply gleyed clay (durmast oak with linden and ash forest), minimal (0.30% layer (30-40 cm) layer) – brown sandy loam soil over clay-sand of beech with durmast forest.

Typical gray clay forest soil over clay-sandy loam (A) and durmast oak with linden and ash forest soil (B) are more supplied with organic substances (tab. 3). The humus content in layer 0-10 in the soils of forests A and B is in large limits, corresponding to 4.8-8.5% (average 6.3%) and 3.8% -8.6% (average 5.9%). Index variations in the soils of forests A and B within their frames are significant, which corresponds to the direct dependencies with the vegetation indices - the structure and the composition of the wood and grass layers. Starting at 20 cm depth, humus concentration decreases quite suddenly. This distribution is mostly conditioned by the accumulation of the clay fraction (Cojuhari *et al.*, 2002). The soil of oak with hornbeam forest at level 20-40 cm contains higher values than other soils.

The coefficient of variation determined for each layer and horizontally (area, forest type) includes medium and small values for the soils of the A and B forests and very small for the soil of the beech with durmast forest. Most significant variations (average one) are noted in the 0-30 cm layer of the typical gray clay forest soil over clay-sandy loam, 0-40cm of the brown clay soil over deeply gleyed clay and 10-40 cm in the brown sandy loam soil over clay-sand (tab. 3).

An obvious stability on the humus accumulation is specific for the 0-10 cm layer in each association. The analysis of the herbaceous layer during this period allowed us to reveal a direct interdependence of the humus with floral and numerical diversity indices in the analyzed $1m^2$ microparticles.

Table 3

% Humus content (% of soil dry weight) and (%) in soils of forest types A, B, C

Mean, %

Depth	**A**	**B**	**C**
0-10	6.25	5.93	2.73
10-20	3.30	3.45	1.14
20-30	2.48	2.01	0.79
30-40	1.48	1.24	0.56

Variation coefficient, %

Depth	**A**	**B**	**C**
0-10	25.68	29.90	19.90
10-20	31.97	31.14	37.28
20-30	41.39	27.14	62.00
30-40	19.47	21.13	32.83

Media, %

Depth	A	B	C
0-40	2.50	2.10	0.87

Variation coefficient, %

Depth	A	B	C
0-40	23.13	27.50	25.50

pH. Research done in natural ecosystems including forestry found that the pedocentical index dynamics, including soil pH, reflects the action of the complex of biocenotic factors on the soil.

Current acidity, pH_{H20}. of the studied soils ranged from moderately acid to neutral (tab. 4).

Typical *gray clay forest soils over clay-sandy loam* and *brown clay soil over deeply gleyed clay* on Spring and Summer period, are characterized by neutral reaction in the 0-10 cm layer and slightly acidic in herewith layers for both soils. *Brown sandy loam soil over clay-sand,* in the period indicated above, it is slightly acidic in the superficial layer 0-10 cm and moderately acid in the 10-60 cm layers. In autumn, researched soils showed that there was a decrease in the current acidity values.

According to the variation coefficient, changes at the soil type and subtype level, during the vegetation period indicate minimal and moderate values. Seasonal and deep variations for each type of forest are noted in the low and very high values (tab. 5).

Table 4

Current acidity, pH_{H2O}

Depth, cm	Forest	Spring	Summer	Autumn
0-10	A	7.0	6.8	7.3
	B	6.9	7.1	7.3
	C	6.1	6.3	6.6
10-20	A	6.3	6.4	6.5
	B	6.8	6.9	7.0
	C	5.2	5.5	6.1
20-30	A	6.1	6.4	6.6
	B	6.7	6.7	6.9
	C	5.4	5.7	5.9
30-40	A	6.2	6.3	6.2
	B	6.6	6.5	6.8
	C	5.7	6.0	5.9
40-50	A	6.1		
	B	6.6		
	C	5.8		
50-60	A	6.1		
	B	6.9		
	C	6.0		

Table 5

Variation coefficient, pH_{H2O}%

Depth, cm	Forest	Spring	Summer	Autumn
0-10	A	4.3	2.9	4.9
	B	5.2	3.9	5.6
	C	11.6	9.7	10.5
10-20	A	9.3	2.7	11.3
	B	2.2	1.3	6.7
	C	6.8	15.9	12.6
20-30	A	7.2	4.5	8.8
	B	5.0	6.8	7.7
	C	8.7	14.2	6.9
30-40	A	6.1	5.0	7.6
	B	10.6	14.5	9.2
	C	11.5	13.2	10.6
40-50	A	11.4		
	B	10.1		
	C	12.4		
50-60	A	14.2		
	B	12.3		
	C	13.7		

pH_{KCl} exchangeable acidity. During the vegetation period, exchangeable acidity is characterized by a fairly large amplitude of the pHK1 values in the analyzed soils. During vegetation period, oak with hornbeam forest is highlighted on the surface with neutral reaction, in a moderately acidic depth, with an exception in the 10-20 cm layer in spring. Durmast oak with linden and ash forest soil is characterized by a neutral reaction in the layer 0-10 cm (10-20 cm in summer) and slightly acidic in the adjacent ones throughout the vegetation period. (tab. 5). Exchangeable acidity in beech with durmast soil forest is classified from low acid to strongly acid, being conditioned by eluvial-iluvial processes and also accumulation and distribution of vegetal rubbish.

Table 5

Exchangeable acidity, pH_{KCl}

Depth, cm	Forest	Spring	Summer	Autumn
0-10	A	6.5	6.3	6.3
	B	6.4	6.6	6.3
	C	5.2	4.9	5.4
10-20	A	5.3	4.9	5.0
	B	6.0	6.2	5.9
	C	4.1	4.0	4.7
20-30	A	4.9	4.6	4.9
	B	5.7	5.5	5.5
	C	4.2	4.1	4.1
30-40	A	4.8	4.5	4.4
	B	5.5	5.2	5.4
	C	4.4	4.2	4.2
40-50	A	4.8		
	B	5.4		
	C	4.5		
50-60	A	4.8		
	B	5.7		
	C	4.7		

The variation coefficient (tab. 6) receives lower values on surface and deeper layers of A and B forest soils, except for the 30-40 cm layer of B forest, in summer and autumn. The soil of the forest C in all layers contains average values, with differences in the 10-20cm and 20-30cm layers, small variations during the spring period.

Table 6

Variation coefficient, pH_{KCl}, %

Depth, cm	Forest	Spring	Summer	Autumn
0-10	A	4.8	4.9	4.9
	B	7.0	6.1	6.1
	C	15.9	20.0	20.0
10-20	A	16.0	8.4	8.4
	B	4.0	3.5	3.5
	C	8.5	21.8	21.8
20-30	A	12.5	12.3	12.3
	B	9.8	20.4	20.4
	C	7.5	21.6	21.6
30-40	A	11.1	10.6	10.6
	B	18.9	28.4	28.4
	C	11.8	18.8	18.8
40-50	A	16.3		
	B	14.0		
	C	13.5		
50-60	A	16.6		
	B	16.4		
	C	15.6		

Hydrolytic acidity, H +. Changing hydrogen values are the expression of the extent to which the colloidal soil complex contains H +. The results presented (tab. 7) show very small limits of the value classes regarding the distribution of the given index: oak with hornbeam forest soil denotes small and medium values of hydrolytic acidity (2.3-4.3 me / 100g soil); beech with durmast forest soil also shows medium values (3.6-5.8 me / 100g soil); small for the soil of gouna forests with ash and ash (summer and autumn in the layer 0-10cm, very small); low values for durmast oak with linden and ash forest soil (in summer and autumn on 0-10 cm layer, very low).

Table 7

Hydrolytic acidity H^+, me/100g soil

Depth, cm	Forest	Spring	Summer	Autumn
0-10	A	2.1	2.3	2.3
	B	2.1	1.7	1.7
	C	4.1	4.1	4.1
10-20	A	3.9	4.3	4.3
	B	2.1	2.2	2.2
	C	5.8	5.8	5.8
20-30	A	4.0	4.3	4.3
	B	2.3	2.8	2.8
	C	4.7	5.2	5.2
30-40	A	3.2	4.1	4.1
	B	2.4	3.5	3.5
	C	4.0	4.7	4.7
40-50	A	3.4		
	B	2.6		
	C	4.1		
50-60	A	3.6		
	B	2.5		
	C	3.6		

Table 8

Variation coefficient H^+, %

Depth, cm	Forest	Spring	Summer	Autumn
0-10	A	28.3	33.2	66.1
	B	50.4	58.3	41.3
	C	50.5	47.2	65.2
10-20	A	46.3	21.7	46.6
	B	26.9	9.7	34.0
	C	34.7	39.8	67.7
20-30	A	34.7	29.3	46.9
	B	48.1	72.5	37.4
	C	51.0	59.79	40.64
30-40	A	23.4	23.9	34.2
	B	69.0	87.9	45.7
	C	68.3	66.7	50.8
40-50	A	54.6		
	B	81.0		
	C	69.1		
50-60	A	62.1		
	B	87.3		
	C	71.9		

The distribution of H + values in depth is not homogeneous for the typical gray clay forest soil over clay-sandy loam (A). Although the limits of H + values are rather small, seasonal variations in depths, in vegetal associations and forest types (tab. 8), indicate high values for variation coefficient in all layers.

CONCLUSIONS

1. The climatic conditions in the indicated year and in the autumn of the previous year were quite favorable for vegetation growth and development. Essential differences in the analyzed biotopes were not recorded. The temperature and water reserves accumulation in the soil have facilitated the maintenance of pedogenetic processes regarding organic matter accumulation indices, soil reaction, in rather slow dynamic regimes.

2. Typical gray clay forest over clay-sandy loam soil (A) and brown clay soil over deeply gleyed clay (B) are much more supplied with organic matter, compared to brown sandy loam soil over clay – sand (C). The minimum and maximum humus values fall within the range of 1.1-8.5%, 0.9-8.6%, 0.3-3.5%. The variation coefficient of variation includes medium and high values in the 10-40 cm layers, depending on the type of association (forest type) confirming direct dependence on vegetation indices - the structure and composition of woody and herbaceous layers.

3. The actual acidity of the studied soils pH_{H20} is characterized by neutral to low acid values for A and B forest soils and low acid to moderate acid for C forest soil. According to the variation coefficient, during the vegetation period, the current acidity variations at the soil type and subtype level indicate minimal and moderate values. Seasonal and deep variations for each type of forest are set within the limits of small and very high values.

4. During the vegetation period, exchangeable acidity is characterized by a fairly large amplitude of the pH K_1 values in the brown sandy loam over clay-sand soil (from low acidity to high acidity) and typical gray clay forest soil over clay-sandy loam (neutral-moderately acidic reaction), lower for brown clay soil over deeply gleyed clay. The 0-20 cm superficial layers of forest soil A and B denote smaller variations in pH $_{KCL}$. In depth the variation coefficient shows average values. C forest soil shows large variation in all layers, except spring period in 0-20 cm layer. The vegetation of the A and B forest is similar, the coefficient of homogeneity Sorensen is 0.8. The diversity of the flora, referring to the vegetation ratios in the AC and BC forests, conditions the temporal and spatial variations of the pedocenotic indices compared to the AB ratio.

5. Researched soils show low value limits of H+: 2.3-4.3 me/100g for A forest soil, 1.7- 3.5 me/100g soil (B) and 3,6-5,8 me/100g soil (C), which frames into low-medium values for A and C soils; low (1.7-3.5 me/100g soil) for B forest soil, escept 0-10 cm layer, which in summer and autumn has a very low H+ value. The dynamics of hydrolytic acidity is an index that guides the natural eluvial-iluvial processes, contributes to the ecosystem stability, reflected in the soil and vegetation parameters.

***Acknowledgments**: Thanks for the consultations provided by Prof. I. Krupenicov, doc. Šabanov Galina, doc. Smirnova Olga., doc. Filipciuc V. and "Soros" Foundation for the financial support granted during this period.*

REFERENCES

1. **Andrieş S., 2007**- *Optimizarea regimurilor nutritive ale solurilor şi productivitatea plantelor de cultură*. Pontos, Chişinău, 374 p.
2. **Cojuhari T., Jardan N., Sturza N., 2009** – *Cercetări privind starea ecologică a florei erbacee în biocenozele de supraveghere din Rezervația „Codrii”* . În: Buletin Ştiinţific. Revistă de Etnografie, Ştiințele Naturii şi Muzeologie. Ştiințele Naturii. Nr. 10 (23). Chişinău, p. 6-19.
3. **Cojuhari T., Dediu I., Stratulat P. et al**., **2002** – *Schimbările sezoniere ale ecosistemului forestier sub aspectul potențialului productiv* În: Fiziologia şi biochimia plantelor la început de mileniu: realizări şi perspective. Materialele Congresului II al Societății de Fiziologie şi Biochimie Vegetală din Republica Moldova. Chişinău, p. 114-128.
4. **Cojuhari T., Vrabie T., Pană S**. **2009 -** *Manganul (Mn) şi molibdenul (Mo) în solul şi plantele de pădure*. În: Buletin Ştiinţific. Revistă de Etnografie, Ştiințele Naturii şi Muzeologie. Ştiințele Naturii. Nr. 22 (35). Chişinău, p. 96-110.
5. **Cojuhari T., Vrabie T., Pana S., Koterneak P., 2016** - *Calcium end magnezium in plands and soils, „Codri” Rezervation*. În : Jurnal of Botany, Vol. VIII, nr. 1 (12), Chişinău, p. 121-130.
6. **Cojuhari T., Vrabie T., Pana S., Maslov E., 2017** - *Nutritive elements (P, K) in typical forest biocenoses, reserve "Codrii"*. International Scientific Sympozium „Conservation of plant diversity” 5th edition, !-3 June 2017. Botanical Garden of ASM. Chişinău, Republic of Moldova, p.128
7. **Grati V., Krupenikov I., Cojuhari T., Roşca Z**., **2012** - *Caracteristici ale solurilor din biocenozele de supraveghere din rezervația „Codrii*”. În: Lucrările Conferinței ştiințifice cu participare internațională „Eficiența utilizării şi problemele protejării solurilor. 28-29 iunie, 2012”. Chişinău, p. 126-137.
8. **Postolache Gh**., **1995** - *Vegetația Republicii Moldova***.** Ştiința, Chişinău, 332 p.
9. **Vrabie T., Cojuhari T**., **2015** - *Azotul în solul şi plantele ierboase de pădure, rezervația „Codrii”. Aspecte statistice*. În: Lucrările Conferinței ştiințifice a tineretului studios dedicată Zilei Internaționale a Studenților cu participare internațională, 13 noiembrie, 2015 „Homo sapiens şi raporturile dintre sistemele naturale şi factorii de mediu”. Chişinău, p. 100-109.
10. **Аринушкина Е.В., 1970** - *Руководство по химическому анализу почв*. МГУ, Москва, 487 с.
11. **Ганенко В.П.,1987** - *Гумус почв Молдавии и его трансформация при их сельскохозяйственном использовании*. Академия наук Азербадж. ССР, Баку, 21с.
12. **Гейдеман Т., 1986** - *Определитель высших растений Молдавской ССР*. Штиинца, Кишинев, 636 с.
13. **Горя С., 1978** - *Алгоритмы математической обработке результатов исследований*. Штиинца, Кишинев, с. 21-22.
14. **Карпачевский Л., 1977** - *Динамика свойств почвы*. М.,. 170 с.
15. **Крупеников И.А., 1967** - *Черноземы Молдавии*. Из-во « Картя молдовеняскэ», Кишинэу, 428 с.