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BROWNISH-PODZOLIC GLEIED SOILS OF PRE-CARPATHIANS IN WRB SYSTEM

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The basic diagnostic properties of Brownish-podzolic soils have been analyzed according to requirements of World Reference base for soil resources. The soil has been revealed to belong to Reference soil group Albeluvisol.

Keywords: classification of soils Brownish-podzolic soils, diagnostics, Albeluvisols

Introduction. New (second) edition of World Reference base for soil resources – WRB [5] was accepted in 2006. Since 1980 the International Union of soil sciences worked at creation of universal soils classification system.

WRB was developed as a correlation tool between the scientists interested in soils and the earth, and it should serve as a general denominator by means of which national systems of soils classification can be comparable and correlated. It is important to underline, that materials for WRB are received from soil scientists of many countries of the world. In the ideological relation this system origins from a legend of a FAO/UNESCO soil map of the world and at present time it is working soils classification in many countries and it replaces national classifications in a number of the countries. Some of them include elements of WRB. Acquaintance of soil scientists of our country with WRB is at an urgent necessity. The first steps [3] have been already made for this purpose. Actually the correlation process of the soils named after the national nomenclature, with WRB should be the following step. The same work developed all over the world, the part of them is presented in this bulletin. It is especially important to carry out a detailed correlation of soils with difficult genesis, the understanding of what often remains disputable even among soil scientists of one country. One of such soils is brownish-podzolic (often gleied) soil.

Object and methods. Object of our researches is the brownish-podzolic soil which occupies the considerable areas on Pre-Carpathians and Trans-Carpathians (fig. 1).

Genesis and properties of Pre-Carpathians brownish-podzolic soils were investigated throughout 1985-2007 by the scientists of Soil Science Department of Chernivtsi national university [1]. 15 cuts are analyzed only under wood vegetation. The cut pawned near the village Ispas, Vizhnitsia region, Chernivtsi area, is the most typical. Samples of soil were selected from each of genetic horizons. The properties defined in them are the following: colour by Munsell, texture by a pipette method, contents of organic carbon by Tyurin (oxidation by potassium dichromate in sulphuric acid), pH – in KCl extract by potentiometry, coefficient of linear expansion – by recipe of Soil Survey Laboratory Methods Manual [2], amorphous iron (Feox) and amorphous aluminium (Alox) in an oxalate acids extract (pH 3), physico-chemical properties – by standard methods. The indexation of genetic horizons was carried out both by the Ukrainian system and by WRB system.

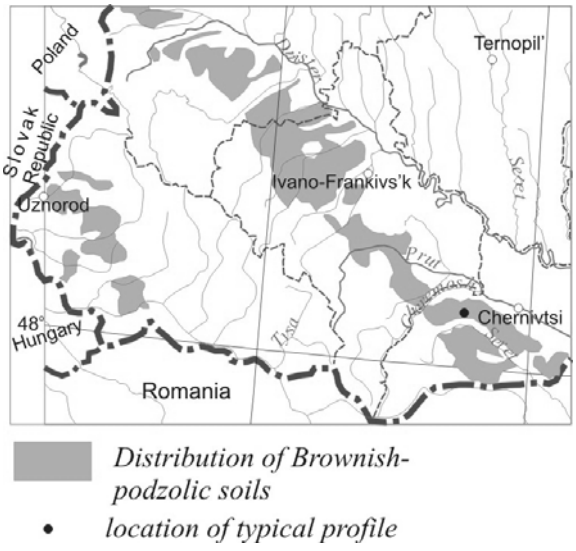

Fig. 1. Distribution of brownish-podzolic soils in the Carpathians mountain-wood province

Fig. 2. The soil profile

Results and their discussion. The morphological constitution of investigated soil is represented in fig. 2. The cut is pawned in a mixed forest. The grassy cover is developed poorly.

Ho (O) – a wood litter, 4 cm depth.

He(gl) (Aeg) – humic-eluvial horizon, 18 cm depth, gleied, medium-loamy texture, crumb-nutty structure, small iron-manganese concretions, appreciable boundary.

Ehgl (Eg) – eluvial horizon, greyish-whitish, 23 cm depth, heavy loam, slight platy structure, iron-manganese concretion, gradual boundary.

Eigl (Eвg) – eluvial-illuvial horizon (fragipen), 30 cm depth, non-uniform colour, heavy loam, blocky-crumb structure, iron-manganese concretion, gradual boundary.

Igl (Btg) – illuvial, 42 cm depth, non-uniform brownish-glaucous-ochre colour, heavy loam, dense, large-blocky structure, gradual boundary.

Pgl (Cg) – parent material at a depth lower than 115 cm.

By the morphological characteristic a given soil first of all considerably differs in presence of albeluvic tonguing, which are brightly shown in depth 43-73 cm. The term "albeluvic tonguing" (from Latin albus, white, and eluere, to wash out) stands for a penetration clay- and Fe-depleted material into argic (clay-illuvial) horizon. Often they are formed on surfaces of the peds. The basic diagnostic criteria of albeluvic tonguing are the following. They have colouring of eluvial albic horizon and its structure. Tonguing should be deeper, than wide, occupy more than 10 % of volume of the top 10 cm or the quarter (but not less) of argic horizon, and their width should be more than 10 mm in clay loam and silty argic horizons. Distribution of textural fractions must show that the coarser textured horizon is overlying the argic horizon. Morphological features of investigated brownish-podzolic soil completely coincide with the definition of albeluvic tonguing.

Using a key to WRB reference soils groups [5] the soil investigated was defined as belonging to reference group of Albeluvisols. By the definition these soils having a clay illuviation horizon with an irregular or broken top boundary within 1 m from the surface, result in tonguings of bleached soil material into the illuvial horizon. The Albeluvisols profile structure is the following: the thin, dark surface horizon is placed over subsurface albic horizon that tongues into the basic brown argic horizon.

It is necessary to analyze the character of eluvial and illuvial horizons more detailed, and also a complex of soils properties (table 1) for taxonomy acknowledgement to reference group of Albeluvisols.

The character of eluvial horizon is defined by a complex of its properties. The horizon albic (from Latin albus, white) – subsurface horizon of light colouring from which clay and free iron oxides have been removed, or in which the last are segregated to such degree, that colour of horizon is defined by colour of sandy and silt particles, instead of coating them [4]. It usually has poorly expressed structure or its insufficient development. Albic horizons are coarser textured, than the bottom horizons. However, if spodic (iron-illuvial) horizon lies below, these differences can be insufficient. A lot of albic horizons are associated with the raised humidifying and have attributes of reducing conditions. Albic horizon is characterised by different variants of Munsell colour. One of colour variants in a moist condition is value 5 and a chroma less than 3; that corresponds to colour of eluvial horizon of the investigated soils. Depth of horizon should be not less than 1 cm. Thus, horizon Ehgl (Eg) is an albic horizon by diagnostic attributes.

Horizons albic present in several reference soils groups, for example, Podzols which differ from Albeluvisols in presence of a subsurface spodic horizon. Therefore the analysis of nature and character of illuvial horizon is important for diagnostics of investigated brownish-podzolic soils. For Albeluvisols, as it was specified above, the illuvial argic horizon is typical. Horizon argic (from Latin argilla, white clay) is subsurface horizon with much higher content of clay,

than in the overlying horizon. The textural differentiation of profile in this case is mostly caused by clay illuvial accumulation [4].

1. The basic properties of brownish-podzolic gleied soil

Horizon	Depth, cm	Sand	Silt	Clay	OC*, %	pH KCl	HA*	EB*	CEC*	Al exch.*	BS*, %
		%					cmol/kg^{-1}				
He(gl) (Aeg)	4-18	18,5	69,7	11,8	1,6	4,4	11,7	12,3	29	3,3	42
Ehgl (Eg)	18-43	16,7	68,1	15,2	0,8	4,3	9,3	6,6	17	3,2	38
EIgl (EBg)	43-73	23,2	56,2	20,6	0,6	4,0	6,3	12,1	25	3,9	49
Igl (Btg)	73-115	19,7	53,5	26,8	0,4	4,0	4,6	9,5	16	2,9	61

Horizon	Minerals, %		Munsell colour (moist)	Rate clay : total clay	Total clay, %	Texture	COLE*	$Al_o + {}^1/_2Fe_o$
	montmoril-lonite	chlorite						
He(gl) (Aeg)	50	6		0,33	36,3	silty loam		1,12
Ehgl (Eg)	38	5	5 YR 7/1	0,38	40,01	silty loam		1,58
EIgl (EBg)	49	8		0,47	43,91	silty loam		-
Igl (Btg)	45	5	5 YR 6/6	0,55	48,82	silty-clay loam	0,64	1,46

**Hydrolytic acidity – HA, Cation Exchange Capacity – CEC, Organic Carbon – OC, Coefficient of linear extensibility – COLE, Exchangeable Al – Alexch , Exchangeable Bases – EB, Base Saturation – BS*

The horizon argic has a texture of loamy sand or finer and more than 8 % of clay in fine earth fraction. It should contain more physical clay, than the top, coarse by texture, horizon. And if the overlying horizon contains more than 40 % of total clay in fine earth fraction (as the investigated soil), the argic horizon must contain at least 8 % more clay. The clay films covering walls of the pores or clay films on the surfaces of soil aggregates should be visualized in this horizon. The coefficient of linear expansion (COLE) is 0.04 or higher, the ratio of fine clay to total clay in argic horizon 1.2 times (or more) higher, than the ratio in top coarser textured horizon, which is caused by illuviation mainly of fine parts of clay. The increase in clay content occurs within vertical distance not less than 30 cm (to exclude a diagnostic property "Abrupt textural change", which is typical for Stagnosols). The horizon should have thickness of one-tenth or more of the sums of the thicknesses of all overlying horizons. Thus, the illuvial horizon of investigated brownish-podzolic soil completely corresponds to argic horizon by the diagnostic attributes.

Illuvial horizon cannot be recognized as spodic because there is no accumulation of amorphous iron in it. Value Alox+1/2Feox in spodic horizon must be twice as big, as in overlying eluvial horizon, that is why it is not observed in brownish-podzolic soil. Since the humus illuviation does not occur in this horizon, it is not a sombric horizon either.

Thus, the investigated brownish-podzolic gleied soil can be referred to Albeluvisols RSG by a complex of diagnostic characteristics. However Albeluvisols often have common diagnostic horizons and properties with Luvisols and Podzols. They differ from Luvisols by presence of albeluvic tonguing. Albic Luvisols can have negligible penetrations of overlaying horizon into subsurface argic horizon, however having no size of tongues which is typical for Albeluvisols. The main difference is that eluvial horizon of Albic Luvisols is not stretched so considerably into argic horizon. In most cases tongues have the same colour, as argic horizon and are badly determined in a profile [4]. As it was specified above, spodic horizon presence in Podzols, but it is not inherent in investigated soil.

The comparison of brownish-podzolic soil properties with typical properties of Albeluvisols confirms its belonging to this reference group and explains soil formation processes. Albeluvisols formation has argilluviation (i.e. clay translocation) and elements of the processes connected with modern or paleo-periglacial climate. Albeluvic tonguing which penetrate into the compacted top part of argic horizon are the result of periglacial freeze-thaw sequencing during last glacial period.

A periodic reduction conditions are typical for Albeluvisols. As a result the stagnic colour pattern is formed usually. Stagnic properties are present in many Albeluvisols; gleyic properties happen seldom. Appreciable change of a texture from eluvial to illuvial horizon interferes with an internal drainage. Periodic overwetting of a surface layer and reduction of ferrous compounds causes strong bleaching of the eluvial horizon. It penetrates into the underlying argic horizon along root courses and cracks.

The periodic saturation with water causes segregation of iron compounds in mottles or concretions. In absence of percolation, iron remains in soil where it accumulates in discrete nodules. They are formed after periodic drying-wetting of the soil with a hysteresis between intensity of sedimentation of iron compounds in an oxidizing stage and dissolution at reducing.

Periodic leaching causes acidification of the eluvial horizon and loss of bases. Small quantity of organic substance and iron compounds in leached surface horizon explains the fact, why it has low stability of structure, low resistance to mechanical influence and why it is usually dense.

Repeated wetting and drying promotes clay disintegration. The structure of clay minerals which were at first mixed, shows pedogenetical differentiation: the quantity of montmorillonite decreases in eluvial horizon and in albeluvic tonguing where chlorites are formed (tab. 1).

The surface horizon of Albeluvisols contains usually from 1 to 10 % organic carbon, and eluvial horizon contains rarely more than 1 %, and a similar quantity presents in the illuvial horizon. Natural Albeluvisol is moderately and strongly acid; pH (KCl) ranges from 4 to 5.5. CEC is low, as well as BS, the high quantity of exchangeable aluminium is present.

The analysis of investigated soil on the second taxonomy level (level of qualifiers) has given the chance to define, that concrete soil which occurs on the territory of southern part of Pre-Carpathians, is Stagnic Cutanic Fragic Albeluvisol (Epidystric Siltic).

Horizon fragic (from Latin frangere, to break) is natural non-cemented subsurface horizon with such a structure, that roots and percolated water can move through the soil only on surfaces between peds and cracks. The horizon contains less than 0.5 % (by weight) organic carbon; it is not cemented during periodic wetting and drying; does not effervescence after interaction with 10 % HCl solution; has the depth more than 15 cm; has prismatic and(or) blocky structure. The surface of peds can have colourings and chemical characteristics of albic horizon, or meet the requirements of albeluvic tonguings. Horizon is typically loamy; dry aggregates are firm; wet aggregates are dense and very dense; wet consistence can be fragile. The prefix-qualifier cutanic means, that the soil has clay coating in some parts of argic horizon. Stagnic qualifier - the soil has reduced conditions for some time during a year within 100 cm from a surface in some parts and in more than 25 % of soil volume one or two of the following attributes: stagnic colour pattern and albic horizon. The qualifier-suffix epidystric characterises a bases saturation of less than 50 % on the depth from 20 to 50 cm from a surface. The qualifier Siltic characterizes a soil texture (silty, silty-loam, silty-clay loam or silt clay) of a layer in depth more than 30 cm within 100 cm from a surface.

Conclusions. The complex analysis of properties of brownish-podzolic gleyed soil of Pre-Carpathians has showed that this soil belongs to a reference soil group Albeluvisols. Main soil forming processes are: argilluvuation (lessivage), gleyeluviation, leaching, and formation of albeluvic tonguings. A podzolization process in its classical understanding is not typical for Albeluvisols.

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БУРУВАТО-ПІДЗОЛИСТІ ОГЛЕЄНІ ҐРУНТИ ПЕРЕДКАРПАТТЯ В СИСТЕМІ WRB

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Проаналізовані основні діагностичні властивості бурувато-підзолистих ґрунтів за вимогами Світової реферативної бази ґрунтових ресурсів. Виявлено, що ґрунт відноситься до реферативної ґрунтової групи альбелювісолей.
Ключові слова: класифікація ґрунтів, бурувато-підзолисті ґрунти, діагностика, альбелювісолі