THE INFLUENCE OF DOUGLAS FOREST ON SOME PHYSICAL AND CHEMICAL PROPERTIES OF A STAGNIC LUVISOIL

INFLUENȚA PĂDURII DE DUGLAS ASUPRA UNOR PROPRIETĂȚI FIZICO-CHIMICE ALE UNUI LUVOSOL STAGNIC

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Abstract: *The main objective of this work is studying the evolution of some physical-chemical properties of the stagnic luvisoils under the long term influence of the forest vegetation, respective 40 year old Douglas forest (Pseudotsuga menziesii) and 70 year old Sessile oak (Quercus petraea).*
The folic unhydromorf O horizons, present on the surface of analyzed soil profiles, has under the Sessile oak a content of 37,02 % humus and 21,47 % of organic carbon while under Douglas 29,8 % and 16,87 %.
The different evolution of the chemical properties of stagnic luvisoils is due to organic matter from folianeous horizons, more acid under Douglas.
Because of environmental conditions, more aggressive under Douglas forest, as a result to increase of acidity, it produces an intensification of disintegration and deterioration processes, materialized through the growth of clay content and the reduction of dust content.

Rezumat: *Principalul obiectiv al acestei lucrări este studiul evoluției unor proprietăți fizico-chimice ale luvosolurilor stagnice sub influența îndelungată a vegetației forestiere, respectiv, pădure de Duglas (Pseudosuga menziesii) în vârstă de 40 de ani şi Gorun (Quercus petraea) de 70 de ani.*
Orizontul O folic nehidromorf, prezent la suprafața profilelor de sol analizate, are sub Gorun un conținut de humus de 37,02 % şi de carbon organic de 21,47 %, pe când sub Duglas numai 29,8 % şi respective 16,87 %.
Evoluția diferită a proprietăților chimice ale luvosolurior stagnice se datorează materiei organice din orizontul folic, mai acidă sub Duglas.
Datorită condițiilor de mediu, mai agresive sub pădurea de Duglas, ca urmare a creşterii acidității, s-a produs o creştere a intensității proceselor de dezagregare şi alterare, materializate prin creşterea conținutului de argilă şi reducerea conținutului de praf.

Key words**:** stagnic luvisoil, *Douglas, Sessile oak, folic horizon, clay, dust;*
Cuvinte cheie: ***luvosol stagnic****, duglas, gorun, orizont folic, argilă, praf;*

INTRODUCTION

The soil, the representative of pedosphere, the layer formed in time under the influence of pedogenetic factors, on the surface of lithosphere is interposing between this and the biosphere, hydrosphere and atmosphere. Among all these spheres of global environmental system are existing mutual influences.

In case of relations between the pedosphere and biosphere, the most important relation of interdependence is represented by the fact that the soil represents the natural support, assures water and nutritious elements necessary for growth and development of vegetation, while the biosphere, through the quantity and quality of organic matter distributed on the surface and depth of soil, influences the quantity, quality and distribution of humus in the profile's depth.

The objective of the presented work is to show the influence of forest vegetation, represented by 40 year old Douglas and 70 year old Sessile oak, on the chemical properties of an epihipostagnic luvisoils from the area of Tinca Forest District, U.P. 3 Gepis.

The soil is laid on a relatively flat surface with little waves, with an altitude of 280 m; this is a reason why it presents stagnic properties, on the superior part of the profile.

The herbal flora from the forest is represented by: ***Genista tinctoria - Poa nemoralis*** and other guiding plants of the excess humidity.

MATERIALS AND METHOD

In order to reach the proposed objective, on the epihipostagnic luvisoils from U.P. 3 Gepis were opened two soil profiles, in October 2007, until the depth of 1 m, one in the 38 F parcel, occupied by 40 year old Douglas (Profile no.1) and the other one in the 38 B parcel, occupied by 70 year old Sessile oak (Profile no.2) on a distance of approximately 30 m between the profiles.

After the delimitation of horizons there were crapped samples from each horizon inducing the following characteristics: texture, reaction (pH H_2O), hydrolytic acidity (Ah), the sum of bases (SB), saturation degree in bases (V %), humus (H %), total nitrogen (N %), phosphor (P p.p.m.) and mobile potassium (K p.p.m.).

The analyses of the soil were made at the Office for Pedological and Agrochemical Studies Bihor, Oradea, in accordance to the Methodology of I.C.P.A. Bucharest.

RESULTS AND DISCUSSION

The folic horizon O of unhydromorf organic matter accumulation, represented mainly by litter it has a thickness of 3 cm in both cases, having a difference through their moderate acid reaction under Douglas, pH = 5.4 and respectively soft acid pH = 6.15 under Sessile oak. The content of humus and organic carbon is larger under Sessile oak, 37.02 % and 21.47 % than under Douglas 29.08 % and respectively 16.87 %.

Analyzing the contents distribution of humus in the depth of those two analyzed profiles it is remarked that for both profiles the content of humus is higher in horizon O and reduced reversed proportional with the profile's depth (Figure 1).

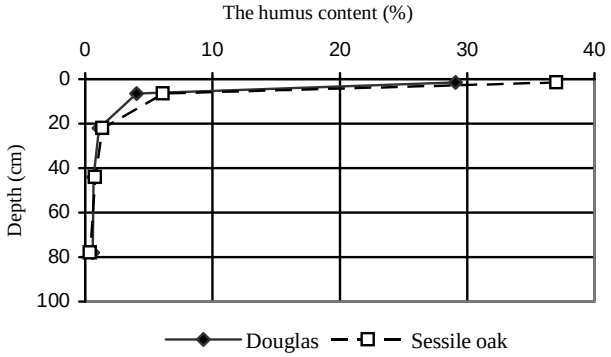

Figure 1. Humus content variations (%) with depth

The content of humus, in the depth of the two analyzed profiles it is higher in case of Holm forest than under Douglas, with values between 11.94 % in folic horizon and 0.14 % in ElwBtw transition horizon. An exception is made in case of Btw horizon, where the content of humus is higher with 0.18 % under Douglas than under Holm.

As a result of long term influence of organic matter from folic horizon there had been recorded differences between the soil reactions determined on the horizons of the two studied profiles, between – 0.75 pH units in horizon O and + 0.30 pH units in bioaccumulation of organic matter Ao (Table 1.).

Table 1

Soil reaction modifications due to forest vegetation

Horizon	Depth (cm)	pH H_2O		
		Profile no.1. Douglas	Profile no. 2. Sessile oak	Differences
O	0 – 3	5.40	6.15	-0.75
Ao	3 – 10	5.05	4.75	+0.30
Elw	11 – 32	4.90	5.00	-0.10
ElwBtw	33 – 56	5.00	5.10	-0.10
Btw	57 – 100	5.10	5.20	-0.10

If in the surface horizon the reaction under Douglas is moderate/strong acid (pH = 5.05) it is strongly acid under Sessile oak (pH = 4.75). Immediately under bioaccumulation horizon reaction differences indicate a growth of 0.1 pH units for all horizons until profile bases represented by the argic Btw horizon.

So, in case of profile no.1 the reaction is highly acid in eluvial luvic Elw horizons and of ElwBtw transition in order to become moderately acid on eluvial argic Btw horizon. For profile no.2 the reaction remains highly acid in Elw horizon too in order to pass in moderately acid domain for ElwBtw and Btw horizons (Figure 2.).

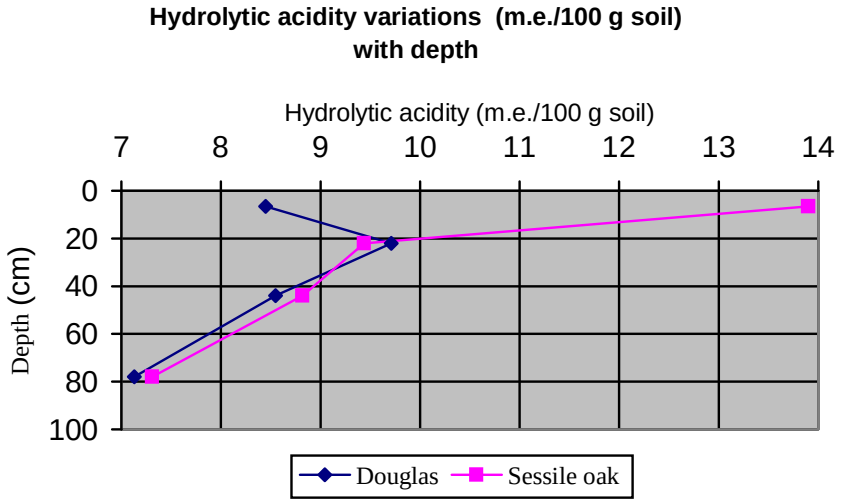

Figure 2. Hydrolytic acidity variations (m. e./100g soil) with depth

Although the resulted humus from the Sessile oak litter is in bigger quantities and superior quality, with a lower percent of fulvic acids and a higher pH than in case of Douglas, the reaction of Ao bioaccumulation horizon under Sessile oak profile is more acid than in case of Douglas.

This phenomenon could be explained through a long term period of 70 years during which the luvisoil was influenced by organic matter specific to Sessile oak, which is an even more quantity and a better quality still lightly acid.

For the same type of soil in case of which in the first 30 years the rests of organic matter were specific to Sessile oak the pH evolution it was the same, modifications being noted in the last 40 years when the soil was planted with Douglas.

After Douglas plantation the humus quantity with a moderate acid reaction was reduced, but the acidification process of Ao horizon continued. Taking into account that the pH differences of organic matter are small, 0,75 units, the organic matter quantity under Sessile oak is bigger and the resulted humus is less disseminated in the profile's depth, can consider that speed of acidification process remained the same in the last 40 years. However the organic matter given by Douglas is more reduced regarding quantity and inferior quality, and a big part of this is washed under the depth of Ao horizon, also determines a process of acidification, but the speed is more reduced.

The modification of chemical properties of stagnic luvisoil under Douglas, produced in the last 40 years had influenced the modification of physical characteristics of soil.

Analyzing the percent-participation of granulometric clay, dust and sand fractions for the two studied profiles we mention the fact that for both profiles the percent of clay is rising starting from the surface until the basis of the profile (Figure 3.)

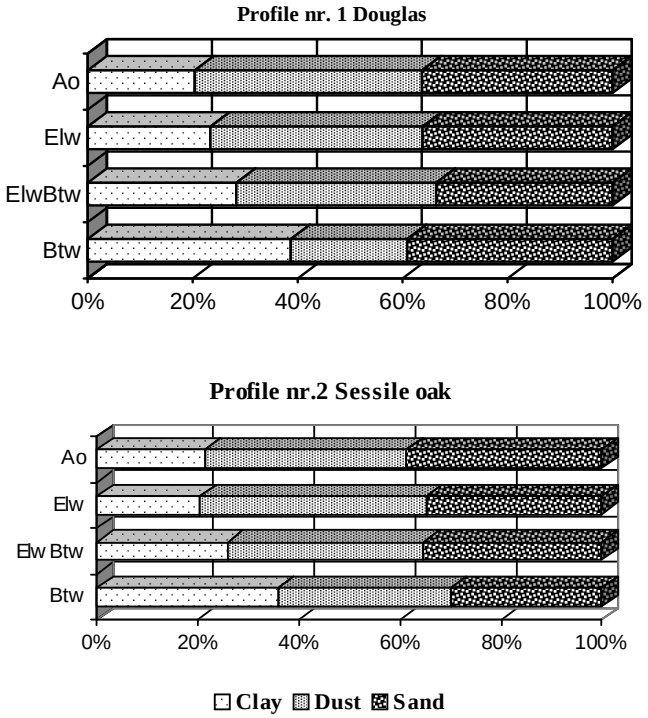

Figure 3. The comparative analysis of the granulometric composition for stagnic luvisoil occupied by Douglas and sessile oak

The percent of dust, in case of luvisoil under Douglas has a decreasing tendency, starting from the surface until the depth, decreasing that is less evident in case of the profile under Holm.

In case of sand, we can see the same tendency of decreasing under Holm, while under Douglas the percents are close in the first two horizons Ao and Elw, it is reduced to the ElwBtw transition horizon so as the level of argic Btw horizon to overpass the content on the surface of profile.

The difference between the clay content of the two profiles of analyzed soil indicates the fact that the bioaccumulation horizon produces a meaningless decreasing of clay content, 1,0% in the profile under Douglas than under Holm (Table 2.).

Table 2

Differences of the granulometric composition of the stagnic luvisoil under the influence of Douglas and Sessile oak forest

Profile	Horizon	Granulometric composition (%)			Nf/Ng	Subclass
		Sand	Dust	Clay		
Douglas	Ao	36,3	43,3	20,4	24,9	Silty sandy loam
	Elw	36,2	40,4	23,4	20,3	Silty sandy loam
	ElwBtw	33,6	38,1	28,3	17,7	Silty sandy loam
	Btw	39,1	22,2	38,7	25,1	Medium clayey loam
Sessile oak	Ao	38,7	39,9	21,4	24,8	Silty sandy loam
	Elw	34,8	44,7	20,5	17,3	Silty sandy loam
	ElwBtw	35,4	38,7	25,9	15,1	Silty loam
	Btw	30,0	34,1	35,9	14,8	Silty clayey loam.
Diffe-rences	Ao	-2,4	+3,4	-1,0	+0,1	
	Elw	+1,4	-4,3	+2,9	+3,0	
	ElwBtw	-1,8	-0,6	+2,4	+2,6	
	Btw	+9,1	-11,9	+2,8	+10,3	

This tendency is inverted starting from the level of eluvial Elw horizon towards eluvial argic Btw, the content of clay growing under Douglas compared with the profile under Holm with values between 2,4 % and 2,9 %.

The increasing of clay percents under Douglas can be explained by the decreasing of dust percents, which have an inverted evolution. If in the Ao bioaccumulation horizon it is marked an increasing of 3.4 % under this level the decreasing of dust, comparatively with the profile under Holm, are included between 0.6 % and 11.9 %.

The differences of sand percents of the two profiles don't respect a kind of tendency; the percent content being lower under Douglas in Ao (-2,4 %) and ElwBtw (-1,8 %) horizons and higher under Holm in Elw (+ 1.4 %) and Btw (+9,1 %) horizons. If we analyze the proportion between the fine and grain it is remarked that this is higher under Douglas than under Holm with values between 0,1 % and 10,3 % which indicates the decreasing tendency of gain and increasing tendency of fine from profile under Douglas.

The increasing tendency of fine fractions from the profile under Douglas can be due to the increasing aggression of environment, as a result of increasing tendency of acidity that determines an increasing intensity of soil decomposing and alteration.

As a result of clay content percent increasing it was made a stronger structure specialization of stagnic luvisoil in case of the forest under Douglas, the structure difference index of which Idt = 1.9 is higher than in case of forest under Holm.

Due to the strong increasing of fine percent and levigation of clay of stagnic luvisoil under Douglas, in those 30 years after plantation there appeared structure modifications in subclasses. If in the first two horizons the soil is included in silty sandy loam subclass, in the ElwBtw transitional horizon will pass from the silty sandy loam to the silty loam and in the alluvial argic horizon from the medium clayey loam to the silty clayey loam.

CONCLUSIONS

Analyzing some chemical properties of an proxihipostagnic luvisols, samples taken from two profiles in a depth of 1,0 m, first from Douglas forest and the second from Sessile oak forest, for the first profile the humus quantity from O folic horizon is 29,08 % with a pH of 5,40 while in the second profile 37,02 % with a pH of 6,15.

In the Ao bioaccumulation horizon the humus content is higher with 2,09 % under Sessile oak forest than under Douglas, but the soil reaction is highly acid (pH = 4,75) for profile no.2 and moderately acid (pH = 5,05) for profile no.1.

The stronger acidity of bioaccumulation horizon under Sessile oak forest than the reaction of the same horizon under Douglas forest could be explained through the speed difference of acidification process in the last 40 years, represented by the age of Douglas.

Taking into account that the accumulated humus in Ao horizon is acid in both cases (with differences of 0,75 pH units) the speed of acidification process is directly proportional with the quantity of accumulated humus, bigger under Sessile oak and reverse proportional with the solubility of humus, higher in case of Douglas forest.

Due to environmental conditions more aggressive under Douglas, as a result of increasing acidity, it was produced an intensification of decomposing – alteration process, materialized through the increasing of clay and decreasing of dust content. The increasing tendency can be proved in case of sand because it was remarked an increasing proportion between fine and grain sand.

Although the soil structure can be hardly changed, after 30 years of Douglas forest influence, in ElwBtw transitional horizon the stagnic luvisoil will pass from the structural subclass of medium clay to dust clay and in the Btw alluvial argic horizon from medium clayey loam to silty clayey loam.

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