# THE TROPHICITY OF THE LUVISOILS UNDER THE INFLUENCE OF FORESTRY VEGETATION FROM TINCA FOREST DISTRICT, U.P. II SITITELEC, BIHOR COUNTY

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***Abstract:*** *For the soil quality assessment of qualitative point of view it imposes the characterization of physical, chemical and biological properties of soil corroborates with ecological elements of zonal and local specific. Trophicity it's an important characteristic of forestry resorts. The trophy potential of non – degraded natural ecosystems can be explained by the potential global trophicity index. The objective of the presented work is to show the influence of forest vegetation, represented by red oak old (Quercus rubra) of 42 year, 77 year old sessile oak (Quercus petraea), and 62 year old oak (Quercus robur) tree on the potential trophicity index of the luvisoils from the area of Tinca Forest District, U.P. II Sititelec. If in the first three horizons the soil is included in silty clay loam sub-class, under red oak and silty loam under sessile oak and oak trees, on the base of profiles, in the Btw2 horizon will pass from the medium clayey loam to the loamy clay both under red oak and oak trees. The estimated values of bulk density are included between 1,30 and 1,33 g/cm$^3$ in the bioaccumulation horizon $A_o$ for all soil profiles and respectively 1,38 and 1,40 g/cm$^3$ in $Btw_2$ clay accumulation horizons, the biggest values being registered on stagnic luvosoil profile, under oak trees. The humus quantity in the first horizon of bioaccumulation Ao is higher in case of sessile oak than in case of red oak or oak tree, with 2,53 % and respectively 2,90 %. The corrected potential triphicity index values became of 77.94 under sessile oak and of 65,55 under red oak, on the haplic luvosoils and respectively of 80,03 under oak forest, on luvosol. In spite of the fact that the differences between the values of trophicity index of the three profiles are not essential, the trophicity characterization of these is different. If the characterisation of profile 1 and 2, under sessile oak and red oak (haplic luvosoils) is mesotrophic soil, (T III trophicity class) the characterization of profile 3, under oak forest became eutrophic soil (T IV trophicity class).*

***Key words:*** *trophicity, potential trophicity index, forestry soil, luvisoils;*

## INTRODUCTION

In the 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 notion of soil quality, relative new notion is easier to understand but is very hard to define the needed ways for its quantitative estimation. The soil quality is defines through a synthetic index that takes in consideration the intrinsic, one's own characters of soil and of the interdependence relations between ecological factors that offer the information about the trophy potential of soil. (BIREESCU L. and al., 2008)

For the soil quality assessment of qualitative point of view it imposes the characterization of physical, chemical and biological properties of soil corroborates with ecological elements of zonal and local specific. (MAUSBACH J.M., 1996; KARLEN D.L., and al., 1997; CARTER M.R., 2002; GRANT D.A., 2002).

The growth and production of biomass of trees and stands according to soil's capacity of supply with water and with nutritional elements, namely soil's trophicity. Soil's trophicity depends not only on the fund of available nutritional elements but also on the available water and the soil's favorability for root system development. (CHIRIȚĂ C., 1964; TÂRZIU D.R., 2006;).

Trophicity it's an important characteristic of forestry resorts. The trophy potential of non – degraded natural ecosystems can be explained by the potential global trophicity index. (CHIRIȚĂ C., 1974).

The objective of the presented work is to show the influence of forest vegetation, represented by red oak old (*Quercus rubra*) of 42 year, 77 year old sessile oak *(Quercus petraea)*, and 62 year old oak (*Quercus robur*) tree on the potential trophicity index of the luvisoils from the area of Tinca Forest District, U.P. II Sititelec.

The soil is laid on a relatively flat surface with little waves, with an altitude of 140 - 160 m, this is a reason why the luvosoils presents stagnic properties, on the superior part of the profile.

The type of herbal flora, after Beldie and Chiriță, 1964 is: *Agrostis stolonifera* and other guiding plants (frequent accompanying) are: *Molimia coerulea, Galium palustre, Lysimachia nummularia, Festuca pratensis, Canapaenula patula, Lichuis flos-cuculi, Calamagrostis epiglios, Hieracium sp., Myorotis scorpiodes, Polygonum hydropiper, Lycopus europaeus, Carex hirta* and *Veronica officinalis.*

Former researches about soil evolution from the Forest District Tinca area, U.P. 3 Gepiş under the influence of sessile oak forest in the last 40 years it has registered some changes of physico chemical properties compared to those from the profile under Douglas forest in 70 years. (KÁTAI et al., 2007; SABĂU and MOȚIU 2008; MOȚIU P.T. et al., 2010;)

## MATERIAL AND METHODS

In order to reach the proposed objective, on the luvisoils from U.P. II Sititelec, Tinca Forest District were opened three soil profiles, until the depth of 1 m, one in the 130 parcel, occupied by 77 year old sessile oak (Profile no.1) the second in the 139 parcel, occupied by 42 year old red oak (Profile no.2) and the other one in the 3B parcel, occupied by 62 year old oak tree, on a distance between the profiles of approximately 2 km. (Figure 1).

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.).

In order to appreciate soil's trophicity it has been used the potential global trophicity index, calculated with the relation settled by Chiriță C., 1964:

$$Itp = \sum_{i=1}^{n} Itp_i = \sum_{i=1}^{n} H_i \cdot d_i \cdot V_i \cdot 0{,}1 \cdot rv_i \cdot DA_i; \qquad [1.]$$

where:

H - humus content (%) from horizon i;

d – Thickness (dm) of i horizon;

V – The degree of basic saturation (%) of horizon i;

0, 1 – derogation coefficient in order not to reach high index values;

rv – the ration between edaphic amount (soil without skeleton and roots) and the amount of soil from horizon i;

DA – bulk density from horizon i;

The analyses of the soil were made by the „County Office for Pedological and Agrochemical Studies Oradea" in accordance to the „Methodology of Elaborate Pedological

Studies” – The Research Institute for Pedology and Agro chemistry, Bucharest.

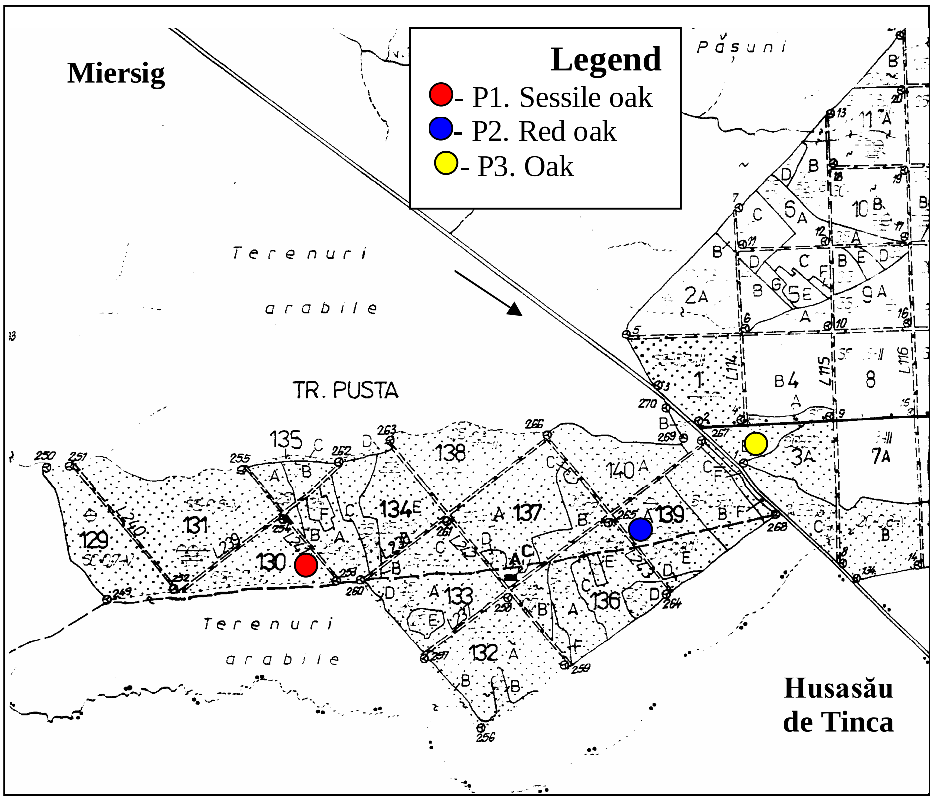


Figure1. Emplacement of the soil profiles

## RESULTS AND DISCUSSIONS

After the Romanian Taxonomy Soil System, 2002, the tree profiles analyzed was joined in luvisols class, the soil types of the two first profiles are stagnic haplic luvosoil and the third is stagnic luvosoil.

Analyzing the percent of particle-size distribution sand, dust and clay for the three studied profiles we mention the fact that for all profiles the percent of clay increasing starting from the surface until the basis of the profile, except the transition horizon AoBtw of luvosol under red oak and the luvic horizon of eluviation Elw of haplic luvosol under the oak trees. (Table 1.)

In case of sand, we can see the same tendency of decreasing under red oak ad oak trees, while under sessile oak the percent of sand increase on transition horizon.

On the profile of haplic luvosol under sessile oak the dust have a decreasing tendency, except the first horizon of clay accumulation Btw1. The percent of dust, in the case of haplic luvosol under red oak has an increasing tendency, starting from the surface until the depth of profile, when in Btw2 horizon decrease. The same increasing tendency of dust can be remarked on the profile of luvosoil, under the oak trees, except the two horizons of clay accumulation Btw1 and Btw2.

*Table 1.*

The particle-size distribution (texture soil) of the luvisoils from Tinca Forest District, U.P. II Sititelec

| No. of profile | Forestry vegetation | Horizon | Coarse sand | Fine sand | Particle-size distribution (%) | | | Soil textural sub-class |
|---|---|---|---|---|---|---|---|---|
| | | | (%) | | Sand | Dust | Clay | |
| 1. | Sessile oak | Ao | 1,3 | 34,3 | 35,6 | 41,1 | 23,3 | Silty loam |
| | | AoBtw | 2,2 | 40,1 | 42,3 | 33,8 | 23,9 | Silty loam |
| | | Btw1 | 2,7 | 32,7 | 35,4 | 35,9 | 28,7 | Silty loam |
| | | Btw2 | 2,5 | 26,1 | 28,6 | 31,8 | 39,6 | Medium clayey loam |
| 2. | Red oak | Ao | 2,4 | 28,4 | 30,8 | 33,9 | 35,3 | Silty clay loam |
| | | AoBtw | 2,0 | 28,5 | 30,5 | 34,9 | 34,6 | Silty clay loam |
| | | Btw1 | 2,2 | 24,8 | 27,0 | 36,8 | 36,2 | Silty clay loam |
| | | Btw2 | 1,1 | 24,9 | 26,0 | 26,1 | 47,9 | Loamy clay |
| 3. | Oak | Ao | 2,4 | 34,5 | 36,9 | 34,6 | 28,5 | Silty loam |
| | | Elw | 3,5 | 32,5 | 36,0 | 37,8 | 26,5 | Silty loam |
| | | ElwBtw | 1,5 | 31,2 | 32,7 | 38,6 | 28,7 | Silty loam |
| | | Btw1 | 5,2 | 32,3 | 37,5 | 34,6 | 27,9 | Silty loam |
| | | Btw2 | 1,1 | 26,7 | 27,8 | 26,0 | 46,2 | Loamy clay |

Due to the strong increasing of fine particle percent and the clay levigation of stagnic haplic luvosol under red oak, in those 43 years, there appeared structure modifications in textural sub-classes. If in the first three horizons the soil is included in silty clay loam sub-class, under red oak and silty loam under sessile oak and oak trees, on the base of profiles, in the Btw2 horizon will pass from the medium clayey loam to the loamy clay both under red oak and oak trees.

The bulk density values were estimated according to the textural classes of horizon soil with the help of triangular diagram CANARACHE A., 1990 (Table 2.).

*Table 2.*

Estimated values of bulk density (g/cm$^3$) (after CANARACHE A., 1990)

| No. of profile | Forestry vegetation | Horizon | Size composition (%) | | | Fine sand/ Coarse sand | Variation interval DA | Bulk density (g/cm$^3$) |
|---|---|---|---|---|---|---|---|---|
| | | | Sand | Dust | Clay | | | |
| 1. | Sessile oak | Ao | 35,6 | 41,1 | 23,3 | 26,4 | 1,24 – 1,46 | 1,30 |
| | | AoBtw | 42,3 | 33,8 | 23,9 | 18,2 | 1,24 – 1,46 | 1,31 |
| | | Btw1 | 35,4 | 35,9 | 28,7 | 12,1 | 1,24 – 1,46 | 1,32 |
| | | Btw2 | 28,6 | 31,8 | 39,6 | 10,4 | 1,17 – 1,52 | 1,38 |
| 2. | Red oak | Ao | 30,8 | 33,9 | 35,3 | 11,8 | 1,12 – 1,55 | 1,33 |
| | | AoBtw | 30,5 | 34,9 | 34,6 | 14,3 | 1,12 – 1,55 | 1,34 |
| | | Btw1 | 27,0 | 36,8 | 36,2 | 11,3 | 1,12 – 1,55 | 1,35 |
| | | Btw2 | 26,0 | 26,1 | 47,9 | 22,6 | 1,05 – 1,46 | 1,40 |
| 3. | Oak | Ao | 36,9 | 34,6 | 28,5 | 14,4 | 1,24 – 1,46 | 1,30 |
| | | Elw | 36,0 | 37,8 | 26,5 | 9,3 | 1,24 – 1,46 | 1,28 |
| | | ElwBtw | 32,7 | 38,6 | 28,7 | 20,8 | 1,24 – 1,46 | 1,31 |
| | | Btw1 | 37,5 | 34,6 | 27,9 | 6,2 | 1,24 – 1,46 | 1,32 |
| | | Btw2 | 27,8 | 26,0 | 46,2 | 24,3 | 1,05 – 1,46 | 1,39 |

The estimated values of bulk density are included between 1,30 and 1,33 g/cm$^3$ in the bioaccumulation horizon $A_o$ for all soil profiles and respectively 1,38 and 1,40 g/cm$^3$ in $Btw_2$ clay accumulation horizons, the biggest values being registered on stagnic luvosoil profile, under oak trees.

The humus quantity in the first horizon of bioaccumulation Ao is higher in case of sessile oak than in case of red oak or oak tree, with 2,53 % and respectively 2,90 %. This evolution of humus content remains identically on the base of profile but the smaller content is registered under red oak. (Figure 2.).

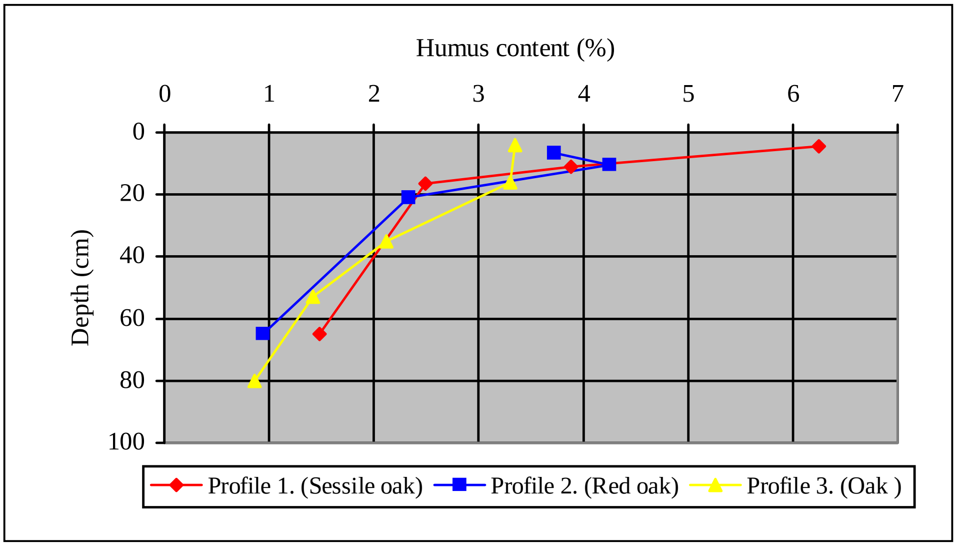


Figure 2. The humus content

Analyzing the contents distribution of humus in the depth of those three analyzed profiles it is remarked that for all profiles the content of humus is higher in horizon O and reduced reversed proportional with the profile's depth.

The degree of basic saturation is superior in case of profile under oak tree compared to that under sessile oak and red oak. The biggest difference it's registered in the Btw clay accumulation horizon (Figure 3.).

The values of the degree's saturation in bases are, under sessile oak between 57,18 % and 64,54 %, under red oak between 52,54 % and 64,32 %, being very close on the two profiles of haplic luvosoil, while on the luvosoil profile, under the oak tree it increases to 53.57 – 79,29 %.

The potential global trophicity index (Itp) was calculated on the horizons components of three analysed soil profiles, the value of each profile was obtained by cumulating the values corresponding to the component profiles. (Table 3.)

The ratio rV, between the edaphic amount represented by soil amount, less than the soil occupied by skeleton and the amount of tree roots and the amount of the analyzed soil was appreciated of 0,9.

The potential trophicity index Itp have the values between 110,02 under red oak (profile 2.) and 149,07 under sessile oak (profile 1.) the both being placed on haplic luvosoil. The potential trophicity index registered on the luvosoil (profile 3.) is of 141,58.

Due to the fact that at the surface's profile 1, in the first 10 cm, on Ao horizon the content of humus is bigger than 6 %, and its type is moderate acid moder, the potential trophicity index Itp is corrected with the correction coefficient about 0,6.

Taking in consideration that all soil profiles presents, at the base, surface water gleyzation, the potential trophicity index for these horizons must reduce using the correction coefficient of 0,5.

In these conditions, the corrected potential triphicity index values became of 77.94 under sessile oak (profile 1.) and of 65,55 under red oak (profile 2.) on the haplic luvosoils and respectively of 80,03 under oak forest (profile 3.) on luvosol.

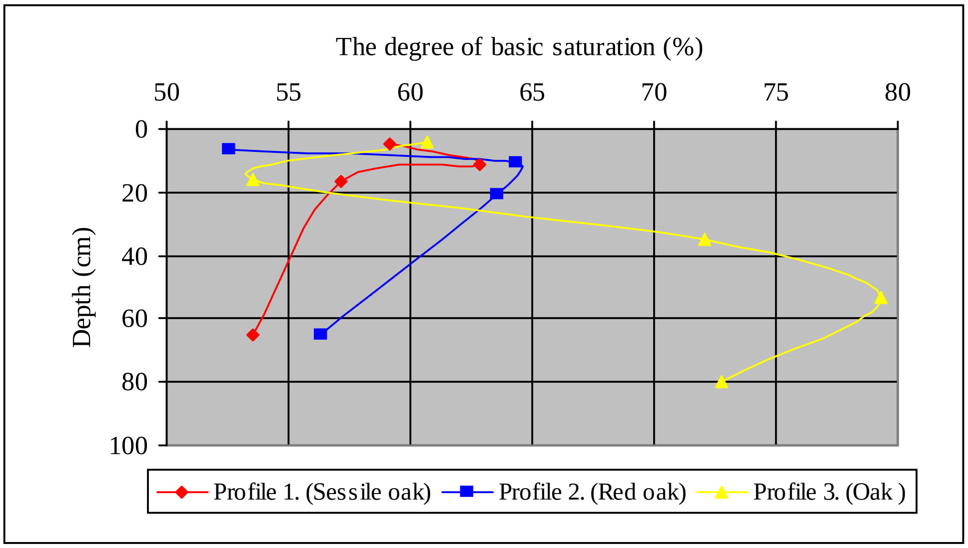


Figure 3. The degree of basic saturation V(%)

*Table 3.*

Potential global trophicity index

| Profile | Soil type | Hori-zon | Horizon depth (dm) | Humus (%) | Saturation grade in bases V (%) | Bulk density DA ($g/cm^3$) | Itp | Correction coefficients | | Corrected Itp |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Humus type | Stagno-glay | |
| 1. Sessile oak | Haplic stagnic luvosoil | Ao | 0,9 | 6,25 | 59,15 | 1,30 | 38,93 | 0,6 | - | 23,36 |
| | | AoBtw | 0,4 | 3,88 | 62,85 | 1,31 | 11,50 | - | 0,5 | 5,75 |
| | | Btw1 | 1,7 | 2,49 | 57,18 | 1,32 | 28,75 | - | 0,5 | 14,38 |
| | | Btw2 | 7,0 | 1,48 | 53,54 | 1,38 | 68,89 | - | 0,5 | 34,45 |
| | | Summ | 10,0 | | | | 149,07 | | | 77,94 |
| 2. Red oak | Haplic stagnic luvosoil | Ao | 0,9 | 3,72 | 52,54 | 1,33 | 21,06 | - | - | 21,06 |
| | | AoBtw | 0,3 | 4,25 | 64,32 | 1,34 | 9,89 | - | 0,5 | 4,95 |
| | | Btw1 | 1,8 | 2,33 | 63,52 | 1,35 | 32,37 | - | 0,5 | 16,19 |
| | | Btw2 | 7,0 | 0,94 | 56,33 | 1,40 | 46,70 | - | 0,5 | 23,35 |
| | | Summ | 10,0 | | | | 110,02 | | | 65,55 |
| 3. Oak | Stagnic luvosoil | Ao | 0,8 | 3,35 | 60,66 | 1,30 | 19,02 | - | - | 19,02 |
| | | Elw | 1,6 | 3,30 | 53,57 | 1,28 | 32,58 | - | 0,5 | 16,29 |
| | | ElBtw | 2,2 | 2,12 | 72,08 | 1,31 | 39,94 | - | 0,5 | 19,97 |
| | | Btw1 | 1,4 | 1,42 | 79,29 | 1,32 | 18,73 | - | 0,5 | 9,37 |
| | | Btw2 | 4,0 | 0,86 | 72,76 | 1,39 | 31,31 | - | 0,5 | 15,65 |
| | | Summ | 10,0 | | | | 141,58 | | | 80,03 |

In spite of the fact that the differences between the values of trophicity index of the three profiles are not essential, the trophicity characterization of these is different. If the characterisation of profile 1 and 2, under sessile oak and red oak (haplic luvosoils) is mesotrophic soil, (T III trophicity class) the characterization of profile 3, under oak forest became eutrophic soil (T IV trophicity class).

Taking into account that the potential troficity index was corrected by the coefficients due to humus quality and of stagnogleization influence, it can be considered as effective trophicity index that characterizes the creditworthiness of resorts and the capacity of stands.

## CONCLUSIONS

The objective of the work is to show the influence of forest vegetation, represented by red oak old (*Quercus rubra*) of 42 year, 77 year old sessile oak *(Quercus petraea)*, and 62 year old oak (*Quercus robur*) forest on the potential trophicity index of the luvisoils from the area of Tinca Forest District, U.P. II Sititelec.

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The humus quantity in the first horizon of bioaccumulation Ao is higher in case of sessile oak than in case of red oak or oak tree, with 2,53 % and respectively 2,90 %.

The values of the degree's saturation in bases are, under sessile oak between 57,18 % and 64,54 %, under red oak between 52,54 % and 64,32 %, being very close on the two profiles of haplic luvosoil, while on the luvosoil profile, under the oak tree it increases to 53.57 – 79,29 %.

The potential trophicity index Itp have the values between 110,02 under red oak and 149,07 under sessile oak, the both being placed on haplic luvosoil. The potential trophicity index registered on the luvosoil is of 141,58.

After the correction of potential trophicity index with coefficients for quality humus and surface water gleyzation, the values of effective trophicity index are reduced at 65,55 – 80,03.

The characterisation after effective trophicity index of soil profiles under sessile oak and red oak indicate that the haplic luvosoils are mesotrophic soil, (T III trophicity class) and the luvosoil, under oak forest is a eutrophic soil (T IV trophicity class).

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