# THE INFLUENCE OF SOME STAGNOLUVOSOLS CHARACTERISTICS ON THE PRODUCTIVITY OF *QUERCUS CERRIS* AND *QUERCUS FRAINETTO* STANDS FROM O.S. FĂGET, D.S. TIMIŞ.

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***Abstract.*** *It is a well-known fact that the West part of Romania presents good climatic-edaphic conditions for the ecological requests of Turkey oak (Quercus cerris) and Hungarian oak (Quercus frainetto). As such, the two species offer large productions and good quality of wood. The present paper intends to analyze only the forests that belong to the hill Turkey oak - Hungarian oak stands of superior productivity types, namely 7 forest management units from 3 production units from the forest district. The main purpose of this paper is to prepare stational datasheets for these forests with a focus on the characteristics of stagnoluvosols on which these species grow in correlation with their requests. After a presentation of the climatic conditions, the edaphic conditions were studied and soil profiles were situated in each forest management plan. Samples were then gathered and analyzed. Further analyses were realized for 4 forest management plans in order to establish the potential trophicity. Ecological factors and determiners were also analyzed and were then framed on size and species favorability categories. The ecological datasheet contains the size categories and favorability categories for all the ecological factors. Their synergetic effects have as result a superior quality type of station. Even though the luvosols are considered soils with a lower trophicity, some qualities of the studied soils (such as the large physiological thickness, the very large edaphic volume, the humus percentage and distribution on horizons, the high content of total nitrogen) lead to a potentially high trophicity.*

***Key words:*** *luvosols, trophicity, edaphic volume.*

## INTRODUCTION

The forest station or the biotope represents the birthplace of biocenosis, the forest's inorganic part or subsystem or the ecosystem's physical environment. The forest station is composed of relief elements, bedrock or parental material elements and the soil elements.

In comparison with the biocenosis, the forest station has a larger permanence and a stronger autonomy in the ecosystem (3). Even though the biocenosis disappears, the station still remains. As an ecological unit (ecotype), the station is characterized by climatic (local climate) and edaphic criteria.

Certain systems that contribute to the ecological peculiarity of the station can result by combining the parts of the station. They are mainly climatic and edaphic systems (thermal system, trophicity system, humidity system etc.). Based on the ecologic specific, each station has a certain capacity for sustaining a certain biocenosis, named phytocenosis aptitude. This allows the existence of a certain type of vegetation and a certain productivity potential.

The Turkey oak (*Quercus cerris* L.) and the Hungarian oak (*Quercus frainetto* Ten.) are two *Quercus* species that have a large capacity for vegetating on compact, earthen and hardly penetrable soils.

The present article intends to analyze the manner in which the edaphic ecological factors act together with other ecological factors and create a type of forest station of superior bonity for *Turkey oak* - *Hungarian oak* stands.

Both species are well developed on soils with a lower trophicity. However, the Turkey oak is more demanding with the nitrogen supply in comparison with the mobile phosphorus and mobile potassium ones. In the west part of the country, both species have very favorable growth and development conditions. For example, Turkey oak forest stands with superior productivity register 50% from the occupied area in the west part of the country and only 15% in the south part. The idea of creating zonal production tables for the two species was also taken into consideration.

## MATERIAL AND METHODS

The investigations were realized in the area of Faget forest district, Timis country forest administration. The purpose of the investigations was to establish the correlation between the ecological requirements of Turkey oak and Hungarian oak species and the climatic and edaphic conditions that have led to a superior stand productivity. As such, only stands from the "Superior productivity hill *Turkey oak* - *Hungarian oak* stands" type were visited together with the type of station in which they grow. Research was thus made in 7 compartments (u.a.) from 4 production units (U.P.) from the above mentioned forest district.

The first part of the project was dedicated to a physical-geographical characterization of the area by using bibliographical data and the district's forest management plans. Soil profiles were realized for each u.a. and samples were gathered for analyses. The profiles were situated so that they correspond to the average characteristics of the relief (slope, exposition), vegetation, flora etc. The soils potential trophicity was determined and calculated for 4 profiles by using the formula proposed by C.D. Chirita (1):

$$Tp = \Sigma tp = H \cdot d \cdot V \cdot 0{,}1 \cdot rv \cdot Da \qquad (1)$$

where H is the humus percentage reported to the volume, d is the horizon thickness in dm, V is the base saturation degree at pH = 8,3, $r_v$ is the ratio between the slick soil (without roots and skeleton) volume and the soils total volume and Da is the bulk density. The multiplication with 0,1 is made so that values too large for Tp and tp shouldn't be obtained.

The location for these four profiles was chosen near an average sized tree in order to estimate the percentage occupied by the roots (9). After the analysis of climatic and edaphic data, the ecological datasheet for the station type was realized. The datasheet presents the ecological factors size class and their favorability classes for the researched species.

## RESULTS AND DISCUSSIONS

The researched area took into consideration the forests from O.S. Faget, an area framed by Lipova hills. In these hills the soils are developed on parental sedimentary materials. Under the sediments part there are Paleozoic crystalline shale (4). The altitudes are gathered between 170 and 230 m (see Table 1) and the slopes have a slight inclination.

The hot and humid climate is formed under the main influence of west oceanic wind masses and south Mediterranean ones and is thus situated in the Koppen C.f.b.x.- west piedmont province. Based on the Romanian monograph, B.p.2. it is a moderately continental hill climate from the forest district with an average annual temperature of 10.5˚C.

The start of the bioactive period (with temperatures over 0˚C) is situated in the interval 21.02 - 01.03, whereas the end of this period is 11.12 - 21.12. The vegetation period (with temperatures over 10˚C) starts in the interval 11.04 - 21.04 and ends in 11.10- 21.10.

The average annual precipitation are of 662,6 mm with two maximums, one during late spring and the other at the beginning of autumn. The potential (annual) evapotranspiration is of 550 mm, lower than the average annual precipitation quantity.

The main wind directions are NV-SV. They don't register a higher frequency than 17-19% and their intensity isn't higher than 10-15 m/s, so they don't damage to the forest vegetation.

Soils with different characteristics and different soil fertility have thus evolved in the diverse natural conditions of Lipova hills. On the entire surface of this area approximately 36 soil subtypes were identified and framed in 17 soil types (5).

The investigations detailed in this article were concentrated on Turkey oak and Hungarian oak forests situated in the 731.1. forest type ("Hill *Turkey oak - Hungarian oak* stands") and in the 6.1.4.3. stand type ("Hill *Quercus* (sessile oak stands) and stagnoluvosols high edaphic hill mixed hardwood stands (Bs) with *Carex pilosa*").

*Table 1*

Soil profile location in O.S. Faget

| Nr. crt. | U.P., u.a. | Altitude (m) | Expo-sition | Forest type | Station type | Compo-sition | Producti-vity class | Age (years) |
|---|---|---|---|---|---|---|---|---|
| 1. | I, 43 B | 190-240 | SV | 731.1 | 6.1.4.3. | 6Ce 4Gî | 2 | 80 |
| 2. | I, 76 B | 190-230 | SE | 731.1. | 6.1.4.3. | 5Ce 5Gî | 2 | 80 |
| 3. | II, 36 C | 180-260 | V | 731.1. | 6.1.4.3. | 5Ce 4Gî 1Dt | 1 | 55 |
| 4. | II, 38 | 190-240 | V | 731.1 | 6.1.4.3 | 5Ce 4Gî 1Dt | 2 | 50 |
| 5. | II, 56 B | 180-230 | V | 731.1 | 6.1.4.3 | 7Ce 3Gî | 2 | 60 |
| 6. | II, 193 | 170-230 | V | 731.1 | 6.1.4.3 | 6Ce 4 Gî | 2 | 110 |
| 7. | IV, 71C | 240 | SE | 731.1 | 6.1.4.3 | 7Ce 3Gî | 2 | 110 |

Seven soil profiles were situated (see table 1) and the result of the chemical analysis is presented in table number 2.

*Table 2*

Analytical data

| Profile no. | U.P. u.a. | Hori-zon | Level (cm) | Humidi ty (%) | pH | Hum us (%) | SB (me%) | SH (me %) | Total capacit y (me %) | V (me%) | Nt (g %) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | U.P.I u.a.43 B | Ao | 0-15 | 3,85 | 5,55 | 3,41 | 13,77 | 14,38 | 18,15 | 53,26 | 0,636 |
| | | Elw | 15-37 | 3,33 | 4,75 | 2,33 | 14,48 | 14,76 | 29,24 | 49,51 | 0,119 |
| | | Btw1 | 37-74 | 4,54 | 4,78 | 1,59 | 16,33 | 13,35 | 29,68 | 55,03 | 0,082 |
| | | Btw2 | 74-104 | 3,59 | 5,44 | 0,98 | 17,57 | 11,67 | 29,24 | 60,08 | 0,050 |
| 2 | U.P.I, u.a.76 B | Ao | 0-18 | 3,03 | 4,88 | 5,02 | 18,81 | 14,53 | 33,34 | 56,41 | 0,257 |
| | | Elw | 18-43 | 4,52 | 4,71 | 1,47 | 17,98 | 14,02 | 32,00 | 56,20 | 0,075 |
| | | Btw1 | 43-86 | 5,51 | 5,07 | 0,73 | 22,31 | 17,24 | 38,55 | 56,41 | 0,038 |
| | | Btw2 | 86-120 | 5,07 | 5,75 | 0,61 | 24,78 | 21,47 | 46,25 | 58,58 | 0,031 |
| 3 | U.P.II u.a. 36 C | Ao | 0-20 | 4,56 | 4,95 | 5,46 | 15,37 | 14,03 | 29,40 | 52,27 | 0,280 |
| | | El | 20-35 | 5,02 | 5,17 | 2,51 | 11,74 | 15,74 | 26,75 | 41,11 | 0,129 |
| | | Btw | 35-65 | 7,22 | 5,29 | 1,01 | 18,54 | 8,32 | 26,85 | 69,03 | 0,052 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | U.P.II u.a. 38 | Ao | 0-8 | 3,49 | 5,67 | 5,38 | 18,24 | 9,79 | 28,03 | 55,71 | 0,276 |
| | | Elw | 8-33 | 2,52 | 4,66 | 3,66 | 12,59 | 11,15 | 23,72 | 52,99 | 0,187 |
| | | Btw1 | 33-43 | 3,65 | 4,04 | 2,04 | 16,07 | 15,72 | 31,79 | 50,56 | 0,105 |
| | | Btw2 | 43-100 | 5,40 | 4,83 | 1,83 | 10,30 | 9,66 | 19,97 | 51,60 | 0,094 |
| 5 | U.P.II u.a. 56 B | Ao | 0-16 | 3,51 | 4,80 | 4,78 | 13,47 | 11,85 | 25,32 | 53,20 | 0,520 |
| | | Elw | 16-40 | 3,37 | 4,80 | 1,66 | 10,56 | 9,79 | 20,35 | 50,88 | 0,087 |
| | | Btw | 40-65 | 4,37 | 4,56 | 0,23 | 14,30 | 13,19 | 27,49 | 52,03 | 0,065 |
| 6 | U.P.II u.a. 193 B | Ao | 0-12 | 3,43 | 4,95 | 2,87 | 14,35 | 11,14 | 25,49 | 56,30 | 0,280 |
| | | Elw | 12-25 | 3,96 | 4,90 | 2,33 | 8,70 | 9,56 | 18,26 | 47,65 | 0,230 |
| | | Btw1 | 25-41 | 4,50 | 5,25 | 2,33 | 18,26 | 7,72 | 25,98 | 70,28 | 0,200 |
| | | Btw2 | 41-82 | 5,60 | 5,60 | 1,60 | 20,44 | 4,84 | 25,28 | 80,85 | 0,150 |
| | | Btw3 | 82-190 | 5,00 | 6,68 | 1,00 | 22,61 | 2,55 | 25,16 | 89,86 | 0,050 |
| 7 | U.P.I V u.a.71 C | Ao | 0-5 | 6,45 | 5,04 | 3,39 | 13,47 | 16,54 | 30,01 | 66,93 | 0,635 |
| | | El | 5-20 | 6,49 | 4,43 | 2,55 | 8,22 | 13,23 | 19,45 | 31,99 | 0,131 |
| | | Btw | 20-95 | 4,52 | 4,78 | 0,84 | 14,01 | 8,82 | 28,83 | 44,28 | 0,043 |

Supplementary data (different from the one presented in Table 2) had to be recorded and analyzed for profiles 2, 3, 5 and 6 in order to realize the stational datasheet (Table 4). The variation limits for these elements are presented below:

*Table 3*

The variation limits of some physical-chemical characteristics for profiles 2, 3, 5, 6

| Horizon | A0 | Elw | Btw1 | Btw2 |
|---|---|---|---|---|
| Bulk density DA ($g/cm^3$) | 1,33-1,56 | 1,39-1,53 | 1,38-1,48 | 1,40-1,58 |
| Aeration porosity PA (%) | 15,1-21,1 | 19,2-22,7 | | |
| Pmobil (ppm) | 1,8-2,2 | 2,7-3,2 | 3,1-4,0 | |
| Kmobil (ppm) | 121-144 | 88-106 | | |

The following conclusions result from Table 3:

- the aeration porosity is average for the first two horizons;
- the „rv" appreciated index has an average value per profile (taking into consideration the profiles from Table 3) gathered between 0,8 and 0,85;
-the analyzed soils are very weakly supplied with mobile phosphorous and weakly supplied with mobile potassium;
- by calculating the potential trophicity for the 4 profiles, the following results were obtained:

Tp2 = 119,2
Tp 3 = 114,5
Tp5 = 135,2
Tp6 = 138,6

Based on the calculations, the soils are eutrophic (T IV = 80-140).

The useful physiologic thickness (the soil thickness in which 90% of roots are developed) is gathered between 65 and 190 cm for the 7 profiles. As such, the analyzed soils are thorough and very thorough. The useful edaphic volume varies between 90 and 95 % for the 7 profiles.

By analyzing the data from Table 2 the following conclusions have resulted:

- the soil reaction is strongly acid in the $A_0$ horizon for the 2, 3 and 4 profiles and averagely acid in the other profiles; in the El horizon the soil reaction is strongly acid with the exception of the 3 profile where it is averagely acid;
- in the A horizon the humus content is an average one and the nitrogen content is large with the exception of the 2 profile where it is average;
- the total cationic exchange capacity is average in the $A_0$ horizon with the exception of profile 1 where it is small; in the El horizon it is average for all profiles;
- the base saturation degree varies from oligomesobazic to mesobazic for all profiles;
- the exchange basis sum is small to average.

The ecological datasheet for the 6.1.4.3. station type and for the researched area was realized by taking into consideration the entire volume of data (Table 4).

*Table 4*

Ecological datasheet for 6.1.4.3. station Hill *Quercus* (sessile oak satnds) and hill mixed hardwood stands, Bs., stagnoluvosols large edaphic with *Carex pilosa*

| Factors | Ecological factors size classes | | | | | | | | Ecological factors favorable classes | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 minim | I | II | III | IV | V | E1 | E2 | Nm | Fs | S | M | R | FR |
| T m.a. | | | | | + | | | | | | | | ●○ | ●○ |
| P m.a. | | | | | + | | | | | | | | ●○ | |
| Winds | | + | | | | | | | | | | | ●○ | |
| Humidity July | | | | + | + | | | | | | | | ●○ | |
| Tp nutritive substances | | | | | + | | | | | | | | ●○ | |
| Nitrogen insurance | | | | + | | | | | | | | ●○ | | |
| Exchangeable basis | | | + | + | | | | | | | | ●○ | | |
| Acidity | | | | + | + | | | | | | | ● | ○ | |
| Summer water | | | | | + | | | | | | | ●○ | | |
| Summer consistency | | | + | | | | | | | | | ●○ | | |
| Edaphic volume | | | | | | + | | | | | | | | ●○ |
| Bioactive period length | | | | + | + | | | | | | | | ●○ | |
| Favorability | ●- Turkey oak | | | | | | | | ○ – Hungarian oak | | | | | |
| Quality | < I | | | | I | | | | M | | | Sp ●○ | | |

Where:
E1, 2 – excessive
Nm – negative favorability
Fs – very weak favorability
M – average favorability
FR – very high favorability

The correlation between the ecological factors favorability classes and the requirements of the two species result in a superior quality station reflected by the I and II production classes that are: eutrophic, euhidric towards mezohidric, summery slightly moist - moderately moist, slightly moist – FD2, sl, Bs, $T_{IV}$, $Ue_{3-2}$.

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