

QUANTITATIVE DETERMINATION OF ECOLOGICAL INDICATORS FOR SESSILE-OAK AND BEECH FOREST SITE (FD3) ON PRELUVOSOILS, FROM THE IALOMIȚA SUBCARPATHIANS

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Abstract

The aim of this paper is to quantitatively determine the main ecological indices used in forest site evaluation of hill-area sessile, beech and mixed stands from the Ialomita Subcarpathians. Therefore, through this paper the variation of the ecological indices is analyzed for each level of site evaluation that can appear on preluvosoil, followed by a classification of ecological indices according to classes of size and favorability in relation to the ecological requirements of the analyzed species (beech and sessile-oak). Lastly, there resulted the comparative polygon of the favorability of ecological factors for the two species situated on preluvosoils, polygons that suggestively present the variation differences of the ecological factors that generate different levels of site quality for the forest sites of beech and sessile-oak. So that, by means of these polygons there has been highlighted the combined action of the ecological factors, but also which of these has a major influence on the forest site quality.

Key words: soil, site evaluation, site quality, beech, sessile oak, comparative analysis.

INTRODUCTION

The present paper intends to answer the older preoccupation of the pedologists in the forestry domain, preoccupations that underline the bond that exists between the variation of the ecological indices and the forest site quality level. In the forestry domain, the activity of determining the site quality level is still at the very beginning and is characterized by a high level of difficulty in comparison with the agricultural domain, which is especially interested in the first 30-40 cm of the soil's thickness.

In the current paper, the variation interval of the main ecological indices specific to the hill-area sessile, beech and mixed stands from the Ialomita Subcarpathians, grown on the preluvosoils is determined on the purpose of further arguing the decisions that determine forestry works.

From the very beginning it is necessary to underline the fact that in the Ialomita Subcarpathians there exist proper conditions of development for the beech and sessile oak (Târziu, 2006), which is also observed from the analysis of the forest vegetation distribution in species and productivity categories (Enache, Spârchez, 2011). Also, the lithological substratum has contributed to the formation of preluvosoils and eutricambosoils (Enache, Spârchez, 2012)

MATERIAL AND METHODS

For the accomplishment of the paper's purpose, there have been diverse methods used that have combined bibliographical research, direct observation, direct measurements, laboratory analysis, as well as methods of statistic treatment.

The research has begun from the already accepted idea by the majority of forestry specialists, according to which the indicator tree height is the most accurate forest site evaluation indicator (Rucăreanu, 1962; Giurgiu, 1972; Leahu, 1994).

On the basis of the average height and of the forest stands' age from the analyzed experimental surfaces there has been established the productivity class (Giurgiu, Drăghiciu, 2004) and indirectly, in relation to this, the forest site quality level. Therefore, the level of forest stands productivity has been assimilated with the site quality level of the specific forest site, as follows: forest stands of superior productivity level (first and second class), forest stands of medium productivity level (third class) and the forest stands of inferior productivity level (fourth and fifth class) (Pașcovschi, Leandru, 1958).

The identity between the level of forest stands productivity and the level of the forest site quality is unanimously accepted and also used by the Romanian School of forestry sites (Chirita et al., 1977), as well by the forestry ecological typology (Doniță et al., 1990). Therefore, because there are not many criteria of diagnosing the level of forestry site quality, the forest typology diagnosing currently uses the forest stands production class as a way of characterizing the level of forest site quality.

In the analysis of the physical and Phytogeographic environment of the Ialomita Subcarpathians (Enache, Spârchez, 2011), is presented the rate of the forest site types and the level of forest site qualities, as well as the

percentage distribution on forest types and productivity categories by means of which is highlighted the opportunity of using the tree height (production class) as a means of appreciation of the forest site quality, because there is a correspondence between the productivity level of the forest stands and the forest site quality.

The quantitative determination of the chemical and physical properties of the soil has been made in the Pedology Laboratory of the Faculty of Silviculture and Forest Engineering of Brasov.

In order to obtain the average value for each chemical property, that will characterize the site quality level, it has been resorted to the classification of the chemical analysis reports based on the site quality level that was indirectly determined (using the production class).

RESULTS AND DISCUSSION

Following the production class determination, the chemical analysis reports of the soil were classified on site quality levels (superior, medium and inferior), resulting in the next distribution:

- As regards the beech, the edaphic indices were analyzed for an experimental surface of superior site quality, 5 of medium site quality and 2 of inferior site quality;
- Regarding the sessile oak, the edaphic indices were analyzed for 5 experimental surfaces of superior site quality, 8 for medium site quality and there wasn't identified any experimental surface of inferior site quality;

In the purpose of highlighting the value of edaphic indices, we can see table 1 for beech and table 2 for sessile-oak stands, both situated on the preluvosoil.

Further on, the classification of the ecological indices was done on classes of size and favorability (table 3), on the basis of the average value of edaphic indicators and with the contribution of climatic indices obtained by means of using the thermal and pluviometric gradients determined for the Câmpulung Muscel, Câmpina and Târgoviste weather stations. The ecological sheets realized for both analyzed species by Stănescu et al.(1997) were used to classify the ecological indices.

Table 1

The main statistical indicators of preluvosols from beech forest sites

Chemical properties	Horizon	Statistical indices					
		Level of forest site evaluation					
		Superior		Medium		Low	
		\bar{x}	(s%)	\bar{x}	(s%)	\bar{x}	(s%)
1	2	3	4	5	6	7	8
Edaphic volume (m ³ /m ²)	Ao	0,98	-	0,58	16,22	0,46	1,55
	Bt						
Apparent density	Ao	1,46	-	1,48	14,05	1,58	6,27
	Bt						
pH _i (water)	Ao	7,66	-	5,71	12,13	6,34	6,36
	Bt	5,88	-	6,60	19,03	5,61	4,67
Humus %	Ao	8,64	-	7,56	48,04	10,55	62,87
Total nitrogen %	Ao	0,35	-	0,36	54,79	0,44	45,00
C/N	Ao	14,31	-	12,76	25,74	13,29	20,81
Exchange base, Sb, (me%)	Ao	36,40	-	20,53	44,08	27,32	22,19
	Bt	20,80	-	32,97	112,47	12,14	72,92
Exchangeable hydrogen, Sh, (me%)	Ao	4,80	-	6,14	16,46	7,16	79,80
	Bt	7,60	-	3,67	54,42	6,33	55,34
Total exchange capacity, T, (me%)	Ao	41,20	-	26,67	31,82	34,48	34,15
	Bt	28,40	-	36,64	97,11	18,47	66,90
Degree of base saturation, V (%)	Ao	88,35	-	73,71	18,57	80,94	12,42
	Bt	73,24	-	81,64	20,42	64,01	8,03
K, mg K ₂ O/100g soil	Ao	12,13	-	41,14	26,57	16,05	10,89
P, mg P ₂ O ₅ /100g soil	Ao	41,11	-	10,03	55,07	4,04	76,93

According to the ecological sheet which presents the classification of the ecological indices on classes of size and favorability, there was determined the combined action of the ecological indices for each site quality level.

In order to better visualize the influence of the ecological indices upon the level of site quality it has been resorted to the overlapping of irregular polygons of ecological factors favorability for both analyzed species. Thus, we can see very easily which of the ecological indices decisively influences the level of forest site quality (figure 1 and figure 2).

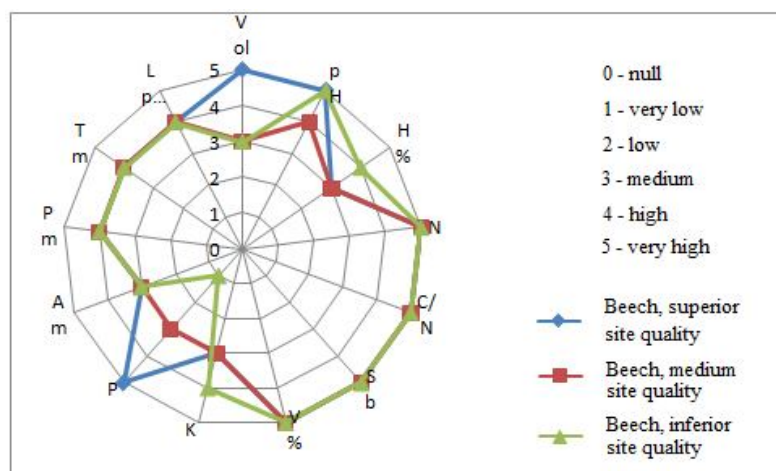


Fig.1. The comparative analysis regarding the favorability of the ecological indices for beech forest sites situated on Preluvosoils.

Table 2

The main statistical indicators of preluvosoils from sessile oak forest sites

Chemical properties	Horizon	Statistical indices					
		Level of forest site evaluation					
		Superior		Medium		Low	
		\bar{X}	(s%)	\bar{X}	(s%)	\bar{X}	(s%)
1	2	3	4	5	6	7	8
Edaphic volume (m ³ /m ²)	Ao	0,81	19,50	0,60	17,16	-	-
	Bt						
Apparent density	Ao	1,53	5,14	1,40	11,45	-	-
	Bt						
pH _i (water)	Ao	6,27	21,19	5,83	10,47	-	-
	Bt	6,05	20,66	5,70	7,77	-	-
Humus %	Ao	8,15	33,48	5,13	39,28	-	-
Total nitrogen %	Ao	0,37	25,95	0,27	39,28	-	-
C/N	Ao	13,09	24,88	11,25	17,04	-	-
Exchange base, S _b , (me%)	Ao	27,11	53,01	16,96	41,77	-	-
	Bt	35,08	97,08	14,57	39,46	-	-
Exchangeable hydrogen, S _h , (me%)	Ao	11,60	79,87	7,39	51,90	-	-
	Bt	7,84	44,27	6,20	51,54	-	-
Total exchange capacity, T, (me%)	Ao	38,72	20,54	24,35	37,77	-	-
	Bt	24,92	39,73	20,74	39,05	-	-
Degree of base saturation, V (%)	Ao	67,86	42,19	68,91	18,51	-	-
	Bt	74,60	17,86	69,71	12,19	-	-
K, mg K ₂ O/100g soil	Ao	15,00	52,28	20,78	33,00	-	-
P, mg P ₂ O ₅ /100g soil	Ao	16,81	108,44	13,40	77,81	-	-

Table 3

The ecological sheet for the forest sites situated on Preluvosoils

Ecological and decisive factors	Preluvosoils – Beech						Preluvosoils – Sessile oak					
	S.S.Q		M.S.Q		I.S.Q		S.S.Q		M.S.Q		I.S.Q	
	Classes of size and favorability											
	Size	Fav	Size	Fav	Size	Fav	Size	Fav	Size	Fav	Size	Fav
Temperature. a.a (°C)	IV	H	III	VH	IV	H	IV	VH	IV	VH	-	-
Precipitation a.a (mm)	IV	H	IV	H	IV	H	IV	VH	IV	VH	-	-
Relative humidity in july (%)	IV	H	IV	H	IV	H	IV	H	IV	H	-	-
Total N (%)	III	H	III	M	III	M	III	M	II	M	-	-
Accesible P ₂ O ₅ (mg/100g soil)	IV	VH	IV	VH	IV	VH	IV	VH	III	H	-	-
Accesible K ₂ O (mg/100g soil)	E1	VH	V	M	III	VS	E1	H	V	M	-	-
Exchange base, Sb (me/100g soil)	III	M	V	VH	IV	H	III	M	IV	VH	-	-
Acidity (pH in water)	IV	M	IV	H	III	M	V	H	III	M	-	-
Alkalinity (pH in water)	III	VH	II	VH	III	VH	II	VH	III	VH	-	-
Water. Humidity Suction (atm)	-	-	-	-	-	-	-	-	-	-	-	-
Edaphic volume	III	M	III	M	III	M	III	M	III	M	-	-
Length of the bioactive period (months)	V	VH	IV	M	II	M	IV	H	IV	M	-	-

S.S.Q – Superior site quality, *M.S.Q* – Medium site quality, *I.S.Q* – Inferior site quality

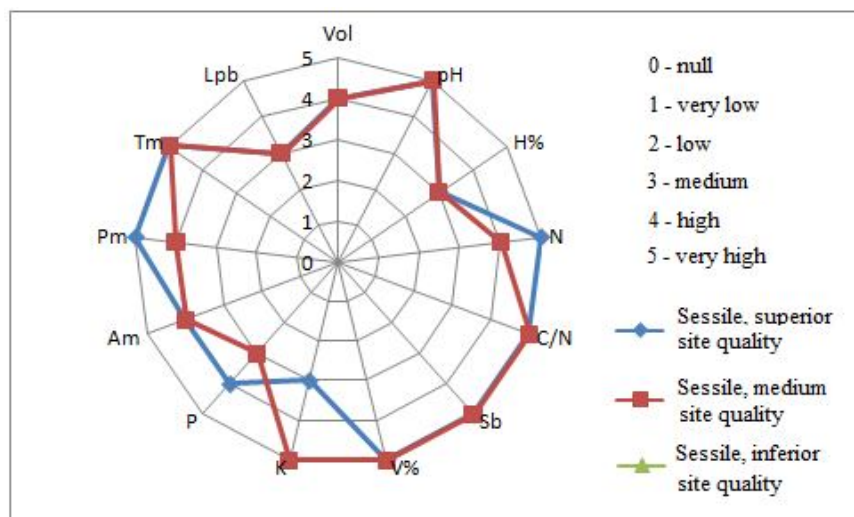


Fig.2. The comparative analysis regarding the favorability of the ecological indices for sessile oak forest sites situated on Preluvosoils

CONCLUSIONS

Following the analysis of the ecological sheet for beech located in different categories of site quality and of the first figure that illustrates the variation of ecological factors favorability on levels of site qualities, we can see that the site quality in the case of beech on preluvosoils is influenced as follows:

- Between the superior and medium site quality, the edaphic volume and the contents of accessible phosphorus exert a significant influence;
- Between the medium and inferior site quality the contents of accessible Phosphorus represents the decisive influence.

In the case of forest sites situated on preluvosoils, the Nitrogen content, the report of C/N, the amount of exchange bases, the degree of base saturation, the average altitude, the mean annual rainfall quantity and temperature are on the same level of favorability for all levels of site quality. The pH varies between high and very high favorability, but it does not influence the site quality level.

After the consultation of the ecological sheets belonging to forest sites of different site quality levels and of figure 2 that illustrates the variation of ecological factors favorability on site quality levels for sessile oak, we can see that the transition from medium site quality to superior site quality on preluvosoils is influenced by the Nitrogen content, accessible Phosphorus and by the mean annual rainfall quantity.

We can see that in the case of sessile oak, preluvosoils are capable of maintaining forest sites of superior and medium quality level.

In terms of the saturation degree in bases, preluvosoils are eubasic soils with a low acidic to a low alkaline reaction, characteristic that highly favors the growth of beech and sessile. By means of the analysis of climatic conditions we conclude that these help the humification process, contributing to the formation of an Ao horizon, intensely humiferous with mull humus forestry type, capable of supplying the two analyzed species with Nitrogen.

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