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EDAPHIC CONDITIONS IN MOST COMMON TYPES OF OAK FORESTS AFFECTED BY DRYING*

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SUMMARY: We evaluated the edaphic conditions in three most common types of oak forests affected by different degree of drying. According to Soil Map of Vojvodina Province R 1:50000 meadow black soil was indicated as a dominant systemic soil unit. Content of silt+clay fraction was above 60%, and two major textural classes were loam and clayey loam. The content of hardly available water was the highest in all types of forests with the most prominent drying process (ranging from 21,65 to 24,13%). Chemical soil properties varied only slightly, and the most prominent deviations were related to the content and ratio of carbon and nitrogen. The above mentioned characteristics indicated the need for further monitoring in the common oak stands.

Key words: *Quercus robur, site conditions, forest types, monitoring.*

INTRODUCTION

English oak (Quercus robur L.) is the dominant tree species of natural forests in the area of flat Srem, and it is linked to a hygrophilic oak-Alno – Quercion roboris forests. The stands are highly productive, and preserved stands in the flat Srem are considered the most valuable forests in Serbia, as in Europe (Thomas et al. 2002). The appearance of a trend toward oak drying in the forest area of Srem imposed the obligation of monitoring the intensisty of drying, both at the time of forest inventory and at implementing the forest managament plans (Medarević et. al 2009), as well as to require mobility of competent scientists and experts to resolve this matter.

Dubravac and Dekanic (2009) mentioned that the middle-aged stands are the most

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prone to stem drying, and that the most intense drying happens in forests communities of English oak in lower positions. Drying of English oak forests causes deterioration of hydrology regimes, microclimate changes, deterioration of soil biological components, which alltogether affects the numerous changes in micro-ecosystem (Pilaš et al., 2007; Dubravac and Dekanić, 2009, Bittner et al., 2010). Ecological preconditions must be created prior to reforestation in order to rejuvenate such surfaces with forest trees of which the stand was previously made (Q. robur and F. angustifolia). In a conceptual framework of the impact of factors in this study (Dubravac and Dekanic, 2009) the analysis of a part of the factors such as soil and water regime will be run, since the regime of flood water wetting, and the level of ground water depends on the fine variations in micro-relief in the alluvial plain of the plain rivers, while the agricultural production is often limited by quantity and temporal distribution of precipitation (Benka et al. 2010).

Great area under English oak forests in the alluvial plain of Sava river is out of the influence of flood waters, which causes the changes in habitat conditions. From that reason determination of edaphic conditions was done in the forests affected by different degrees of drying.

MATERIAL AND METHODS

The study sample plots are situated in defended part of alluvial plain of Sava near Morovic in nine oak forests stands. Depending on the micro-relief conditions, soil profiles were opened for the study of soil morphology and soil samples were taken for the laboratory analysis. Particle size composition (%) was determined by the international B-pipette method with the preparation in sodium pyrophosphate. Soil particle classification in the particle size composition was based on Atterberg's classification. Water retentions at Rv0.1 b and Rv0.33b (% mass) were determined in Pressure plate extractor and water retention Rv6.25b (% mass) was determined by Richards pressure membrane and differential mercury regulator. Available water capacity (Kvk) (% mass) was calculated as the difference between Rv0.33b and Rv6.25b by the formula Kvk = Rv0.33b – Rv6.25b,. Chemical characteristics were determined by the following methods: humus (%) by Turin's method, modification by Symakov; CaCO3 (%) volumetric method, by Scheibler unit calcimeter; pH in H2O electrometric method with combined electrode on Radiometer pH meter; C and N on CHN analyzer; total contents of Ca, K and Mg on AAS extracted with HNO3.

The trial was conducted in three types of forests that make up about 65% representation of all forest types in Srem region. In this stands are observed weak, moderate and strong drying process.

71 (IV2) – Forest of pedunculate oak and ash (Fraxino-Querceto roboris typicum) on drier varieties of hydromorphic black soil (humosemigley), Jović et al. (1994)

73 (IV4) – Forest of pedunculate oak and ash with common maple and tartar maple and rich shrub layer (Fraxineto Quercetum roboris aceretosum) on the driest varieties of hydromorphic soils and meadow black soils with the signs of lessivage (humosemigley to eugley with signs of lessivage), Jović et al. (1994)

111 (VI3) – Forest of pedunculate oak, hornbeam and ash in floodplain (Carpino-Fraxino-Quercetum roboris inundatum) on alluvial brown soil, Jović et al. (1994)

RESULTS

The most frequent type of soil is meadow black soil in loess i.e. loess-alluvium (table 1). Maximum carbonate content did not exceed 11,7% (Table 2).

Total content of silt+clay ranged from 52,8 to 78,5 % (table 3), and textural class ranged from loam to clayey-loam depending on the content of this fraction (Table 2). Loamy textural class was determined in the most cases in the humus-accumulative horizon, while prevailing fraction in deeper profile layers was clay to clayey-loam.

Table 1. Soil types
Tabela 1. Tipovi zemljišta

Soil type Tipovi zemlji- šta	IV2	IV4	VI3
Weak / Slab	Meadow black soil on loess-alluvium Livadska crnica na lesoalu -vijumu	Meadow black soil on loess / Livadska crnica na lesu	Meadow black soil on loess Livadska crnica na lesu
Mode- rate / Srednji	Riparian black soil on loess-alluvium Ritska crnica na lesoalu-vijumu	Meadow black soil on loess-alluvium Livadska crnica na lesoalu-vijumu	Meadow black soil on loess-alluvium Livadska crnica na lesoalu-vijumu
Strong / Jak	Meadow black soil on loess-alluvium Livadska crnica na lesoalu -vijumu	Meadow black soil with fossil horizon Pogrebe-na ritska crnica	Meadow black soil on loess-alluvium Livadska crnica na lesoalu-vijumu

Table 2. Textural class
Tabela 2. Teksturna klasa

Text- ural class Tekst- urna klasa	IV2	IV4	VI3
Weak / Slab	Loam / Ilovača	Loam / Ilovača	Loam / Ilovača
	Clayey loam / Glino-vita ilovača	Loam / Ilovača	Loam / Ilovača
Mode rate / Srednji	Loam / Ilovača	Loam / Ilovača	Silty loam / Praš-kasta ilovača
	Clayey loam / Glino-vita ilovača	Clayey loam / Glino-vita ilovača	Clayey loam / Glino-vita ilovača
Strong / Jak	Silty loam / Praša-sta. ilovača	Loam / Ilovača	Silty loam / Praška-sta ilovača
	Silty loam / Praška-sta ilovača	Clayey loam / Glino-vita ilovača	Clayey loam / Glino-vita ilovača

Content of easily available water in the profile ranged from 75,87 to 86,59% (table 5). The largest quantity of easily available water was recorded for low drying intensity, while the highest content of hardly available water was related to soils with the highest degree of drying (Table 6). The content determined in these soils ranged from 21,65 do 24,13%.

Table 3. Contents of silt+clay %
Tabela 3. Sadržaj praha+gline

Contents of silt+clay Sadržaj praha+gline	IV2	IV4	VI3
Weak / Slab	63,2	54,8	60,9
	64,8	52,8	54,7
Moderate / Srednji	68,1	54,0	78,9
	66,4	75,9	70,5
Strong / Jak	74,4	67,4	71,6
	73,3	78,5	70,0

Table 4. Contents of C/N ratio
Tabela 4. Odnos C/N

C/N ratio Odnos C/N	IV2	IV4	VI3
Weak / Slab	10,6	13,6	17,9
Moderate Srednji	13,5	10,72	22,46
Strong / Jak	8,32	9,76	12,43
	0,83	0,00	0,00

Table 5. The ammount of water R0.1b-R6,25b
Tabela 5. Količina vode R0.1b-R6,25b

Ammount of water m^3/ ha; % *Količina vode m^3/ha; %*	IV_2	IV_4	VI_3
Weak / *Slab*	2772,55	3356,28	2604,42
	84,00	86,59	82,42
Moderate / *Srednji*	2613,68	2585,52	3172,40
	80,21	76,30	80,96
Strong / *Jak*	2237,72	2373,60	2952,59
	75,87	76,02	78,35

Table 6. The ammount of water R6.25b-R15b
Tabela 6. Količina vode R6.25b-R15b

Ammount of water m^3/ ha; % *Količina vode m^3/ha; %*	IV_2	IV_4	VI_3
Weak / *Slab*	528,06	519,64	555,36
	16,00	13,41	17,58
Moderate / *Srednji*	644,80	803,00	746,26
	19,79	23,70	19,04
Strong / *Jak*	711,56	748,80	815,93
	24,13	23,98	21,65

Quantity of carbon was the smallest in forests with low drying intensity and it ranged from 2,26 to 3,93% (table 7). The similar trend was observed for nitrogen content in the soil (Table 8).

Table 7. Contents of carbon
Tabela 7. Količina ugljenika

C (%)	IV_2	IV_4	VI_3
Weak / *Slab*	3,93	2,59	2,26
Moderate/ *Srednji*	3,08	3,85	1,76
Strong / *Jak*	5,45	3,52	2,62

Table 8. Contents of nitrogen
Tabela 8. Sadržaj azota

N (%)	IV_2	IV_4	VI_3
Weak / *Slab*	0,371	0,196	0,126
Moderate/ *Srednji*	0,228	0,357	0,075
Strong / *Jak*	0,655	0,361	0,257

* in A horizon

Ratio between carbon and nitrogen revealed (Table 4) pronounced humification in the forests affected by a high degree of drying. In stands with high drying intensity this ratio ranged from 8,32 to 12,43.

The widest Ca:Mg ratio in the humus-accumulative horizon was determined for low degree of drying in forest types IV4 and VI3 (table 9). In other types of forest and for high degree of drying the ration of Ca:Mg was uniform.

Table 9. Ca/Mg ratio
Tabela 9. Odnos Ca/Mg

Ca/Mg ratio *Odnos Ca/ Mg*	IV_2	IV_4	VI_3
Weak / *Slab*	1,34	12,49	12,44
	6,03	4,04	2,52
Moderate *Srednji*	1,62	1,22	0,96
	0,79	1,01	0,87
Strong / *Jak*	1,44	1,80	1,88
	1,08	1,67	1,37

Table 10. K/Mg ratio
Tabela 10. Odnos K/Mg

K/Mg ratio *Odnos K/Mg*	IV_2	IV_4	VI_3
Weak / *Slab*	1,51	1,34	1,18
	0,89	0,24	0,25
Moderate *Srednji*	1,93	1,74	1,56
	1,12	1,53	1,34
Strong *Jak*	2,06	2,50	2,03
	1,46	1,70	1,19

It can be seen form table 10 that the widest ratio of K:Mg was the greatest for high degree of drying in all studied forest types.

DISCUSSION

The basic physical soil characteristics in the studied objects were in accordance with previous investigations in the area of Srem (Ivanišević et al., 2001). More detailed studies were dedicated to water-airy characteristics of soil. It was determined that the greatest degree of drying was recorded in the soils with the greatest quantity of hardly available water. The mentioned phenomena can be associated with the lack of additional wetting by surface waters, and insufficient wetting by ground waters. Even greater deficit of water in the soil, and thus the more pronounced drought can be expected since decreased amount of rainfall can be expected in the future (Galić et al., 2009). The consequence could be even more pronounced drying, and thus deforestation. Deforestation leads to further deterioration of water regime, and then to micro climatic changes, deterioration of biological soil characteristics, which all affects the numerous changes in micro ecosystem.

The changes in micro eco system are reflected by the content of carbon and nitrogen, as well as by the ration between carbon and nitrogen. The mentioned factors had the greatest values expressed in degrees with pronounced drying, which can be linked to the opening of the stand, and thus to faster mineralization of organic matter.

CONCLUSIONS

In this study the analysis of physical, water-airy and chemical soil characteristics in some types of English oak forest affected by different degree of drying was carried out. There were no greater changes in relation to physical soil characteristics.

The content of hardly available water was the greatest in forest with excessive drying, and the lack of additional wetting by flood waters did not provide enough water. Further drying of trees directly or indirectly linked to climatic changes can be expected in the future.

Changes to the micro ecosystem were also indicated by the content and ratio of carbon and nitrogen, and further monitoring could provide understanding of the process and the ability to mitigate the effects of forest drying.

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EDAFSKI USLOVI U TIPOVIMA ŠUMA HRASTA LUŽNJAKA ZAHVAĆENIH SUŠENJEM

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Izvod

U radu su proučeni edafski uslovi u tri najzastupljenija tipa šume hrasta lužnjaka zahvaćenih različitim stepenom sušenja. Dominantna sistematska jedinica zemljišta je bila livadska crnica. Istraživana zemljišta su sa sadržajem frakcije praha+gline preko 60% i teksturnom klasom zemljišta od ilovače do glinovite ilovače. Sadržaj teškopristupačne vode je bio najveći u svim tipovima šuma sa najizraženijim procesom sušenja (od 21,65 do 24,13%). Hemijske osobine zemljišta su sa manjom varijabilnošću, a najizražnija odstupanja su vezana za sadržaj i odnos ugljenika i azota. Navedene karakteristike ukazuju na potrebu daljeg monitoringa u sastojinama hrasta lužnjaka.

Ključne reči: *Quercus robur*, stanišni tipovi,tipovi šuma, monitoring.

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