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WATER HOLDING CAPACITY OF SOIL FROM MOLDAVIAN PRUT RIVER BANK - DETERMINATIONS IN LABORATORY CONDITIONS

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Abstract

The degradation phenomena of river bank after afforestation still persists. The tree stands were established in 1998, and 1999. The method used for river bank stability was to establish tree stands mixed with unplanted stripes. The aim of research is to determine the water holding capacity of soil, due to the related events regarding water in soil. The phenomena of water moving through hydrophilic porous materials are conditional for land properties. Due to the aspect of mixed afforestation method, it was observed a difference opposite with expectations: water hold capacity should be very good (higher than 50% of dry soil weight) in tree stands. The mean of water holding capacity, determined in laboratory conditions, for soil located at the edge of tree stand is 19.47% of dry soil weight, and for soil located in the unplanted stripe is 30.53% of dry soil weight.

Key words*: dry soil weight, edge effect, unplanted stripe, tree stand.*

INTRODUCTION

In spring of 1998, and 1999, it was proposed a stand establishment for Moldavian Prut river bank stability. The proposed solution was to establish unplanted stripes mixed with tree stands, and until 2003 they were also carried out various planting interventions.
In 2016, the studied area still shows river bank degradation phenomena. The hypothesis of the study is to determine if there is an edge effect regarding water holding capacity of the soil, which occurs at the boundary of the two habitats: unplanted stripes and tree stands.
The studies of water in respect of porous materials are important for understanding water as a factor which condition land properties (Chirita et al., 1967). Also, water in relation with soil represents a factor which determines soil erosion (Motoc, 1963; Dirja, 2000).
The water holding capacity is influenced by mechanic characteristics, structure and texture of soil (Budoi et al., 1965).
A method to prevent soil erosion and land degradation, with ecological benefits, is afforestation (Traci and Costin, 1966).

MATERIALS AND METHODS

Figure 1. Site location: Moldavian Prut River Bank
Latitude: 47°59'N; Longitude: 27°10'E

Figure 2. Soil profile - Moldavian Prut River Bank: soil profile at the edge of tree stand

Figure 3. Soil profile - Moldavian Prut River Bank: soil profile in unplanted stripes with 60% vegetation cover

Water holding capacity was determined in laboratory conditions. The soil samples were collected from two sites after a soil profile was opened for each site (Figure 2 and Figure 3).

Figure 4. Soil put for drying after field sampling

Soil samples were collected in October 2016. They were let dry at room temperature (Figure 4), and after one week they were put in drying stove for 8 hours, at a temperature of 105oC. The soil samples were grid into fine powder using a mortar and pestle. The powder was sieved to obtain fine powder with diameter lower than 0.25 mm.

It was weight 10 g of fine powder with diameter of minerals < 0.25 mm using a weighing balance with precision of e=0.1g/0.1ct and d=0.01g/0.1ct. The 10 g of fine powder were transferred in glasses with volume of 50 cm3.

The water was dropped on fine powder using a pipette with an accuracy of 0.1 ml.

The statistical analysis was conducted for the quantity of water used to saturate the samples.

The values were calculated using the formula after Brici and Lepsi method (presented in Luca et al., 2013):

$$WHC = \frac{C_n \cdot 100}{M} \cdot k$$

where:

WHC – water hold capacity [% of dry soil weight];

Cn – water quantity used to saturate the soil samples [ml];

M – soil weight [g];

k – 0.43, experimental coefficient.

Note: k – aftersoil factor, which includes particle size of the soils, organic matter content, soil structure and profile permeability).

RESULTS AND DISCUSSIONS

In Figure 4 is presented the variation of mean values determined for each site regarding water holding capacity.

The values determined in laboratory conditions were statistical analysed (Table 1).

Table 1 shows the values of F computed for each factor and for interaction between the two factors.

The location of soil sampling have F values higher than theoretical values for p=5% and p=1%.

Analysing the influence of site location (Table 2) was determined a difference of 11.05 % of dry soil weight between the mean values of water holding capacity.

At the edge of trees stand the mean value of water holding capacity was 19.47 % of dry soil weight and in the unplanted stripes was determined a value of 30.53 % of dry soil weight. The difference is statistically: distinct significant.

According with Obrejanu and Puiu (1972; p. 192), the water holding capacity at the edge of tree stand is unsatisfactory (lower than 25% of dry soil weight), but for unplanted stripe is satisfactory (between 20-30% of dry soil weight), and overall, this trend of satisfactory regarding water holding capacity is maintained (Figure 6).

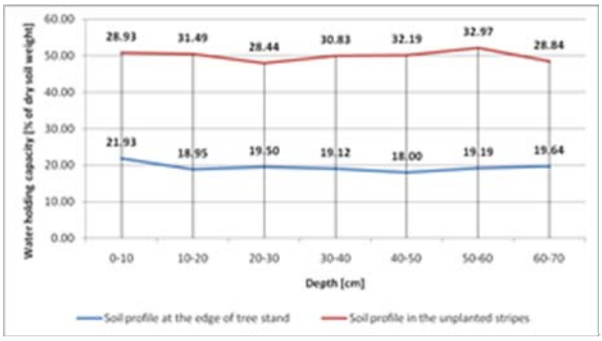

Figure 5. Variation of water holding capacity (% of dry soil weight) for soil profile opened at the edge of tree stand (blue line) and in unplanted stripes (red line)

Table 1.The analysis of variance for bifactorial observations with vegetation cover location and soil sampling depth

Source of variance	SS	df	MS	F	p
Factor A - location	1282.518	1	1282.518	716.615	>18.51 ; 98.58
Factor B - depth	18.271	6	3.045	0.312	<2.51; 3.67
Interaction AxB	66.280	6	11.046	1.131	<2.51; 3.67
Total	1619.985	41			

Note: SS – sum of squares; df – degrees of freedom; MS – mean of square; F – Test (statistics); p – significance for p – 5%; 1%.

Table 2. Statistical analysis of influence of soil sampling location

Variant	Water holding capacity [% of dry soil weight]	Differences [% of dry soil weight]	Significance
Edge of trees stand	19.47	-	-
Unplanted stripe	30.53	11.05	**
		$p_{5\%}$	1.78
		$p_{1\%}$	4.10
		$p_{0.1\%}$	13.05

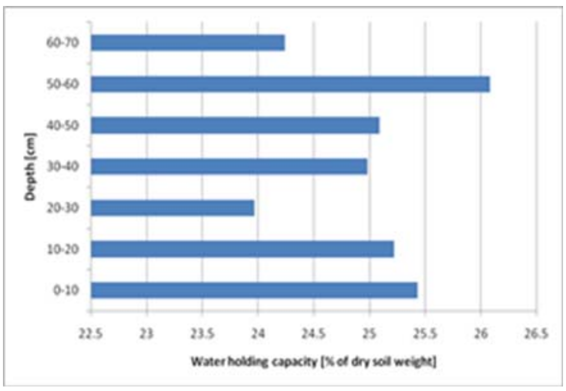

Figure 6. The water holding capacity ranging on soil profile depth

CONCLUSIONS

The analysis of variance shows that the location of soil sampling influences water holding capacity of soils.
The depth of profile layers does not influence the water holding capacity.
The differences computed for the same depth (0-10 cm) are statistical significant. Water holding capacity in unplanted stripe is higher with 7% of dry soil weight.
The differences computed for the following depths: 10-20 cm, 30-40 cm, 40-50 cm, and 50-60 cm are very statistical significant, ranging from 11.71% of dry soil weight to 14.19% of dry soil weight.
The differences computed for 20-30 cm, and 60-70 cm are statistical distinct significant.
The soil profile at the edge of tree stand is deeper than the soil profile of unplanted stripe with 30 cm. The determinations water holding capacity at the 70-100 cm depth (tree stand) showed a very high variability, ranging from 18.49 to 46.30 % of dry soil weight (within replications).

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