THE CUMULATIVE PARTICLE SIZE DISTRIBUTION CURVES IN ULTRAMAFIC SOILS OF ALBANIA

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Abstract *. The aim of the study is to determine the most representative cumulative particle-size distribution curves for some typical* ***mafic soils*** *in Albania, and by them, replacing the soil textural triangles for a more realistic texture assessment and practical usage. That is the reason why it was a number of three various textural soils picked up of Albania for being considered in the study. The pipette method was applied to measure the relative participation of clay silt and sand particles and all of this was described in a manual book given under references.The particle sizes range comprised the three well-known classifications of soil particles in the most part of them: USDA, ISSS, and Katschinski, considering the three ones as the most widespread and prevailing classifications. The* ***mafic soils*** *under investigation, spread in Albania, were grouped in three sections, each of them representing respectively the* ***heavy***, ***medium***, *and* ***light*** *soils from the textural viewpoint.The regression analysis was applied to determine the best mathematical function fitting the distribution of relative participation in percentages of particles of various sizes. The results were that the best fit for the three groups is a semi logarithmic function, because it provided the highest coefficient of regression (determination). The very high regression coefficients, close to 1, and also, the precondition described as the soil under investigation should be well graded, created the possibility to replace the soil textural triangles by the indicated cumulative particle-size distribution curves, avoiding the arbitrary characteristics the textural triangles show.*

Key words*: agroecosystem component, soil, texture, ultramafic soils, cumulative particle-size distribution curve, textural triangle classification.*

INTRODUCTION

Based on numerous studies made by various scientists which have argued that arbitrary boundaries of soil structure classes, based on a relative combination of soil particle

Table 1. Site of Heavy, Medium, Light Mafic Soils

	Heavy Mafic soil	**Medium Mafic soil**	
Pedon	**Site**	**Pedon**	**Site**
6	Korce (EXP Station AUK)	**4**	Radanj (Kolonjë)
7	Maliq (Korce)	**14**	Kolaj (Burrel)
8	Fushe Kruje	**30**	Markatomaj (Lezhë)
9	Vidhas (Elbasan)		
12	Dukagjin (Kukes)	**Light Mafic soil**	
18	Tren (Korçë)	**Pedon**	**Site**
19	Dishnice (Korce)	**5**	Dvoran (Korçë)
20	Bucimas (Pogradec)	**27**	Laç, (Kurbin)
21	Cervence (Pogradec)	**28**	Melgushë,Shkodër
22	Lin fshat (Pogradec)	**29**	Oblikë, Shkodër

size, such as clay, silt and sand, may be avoided if the texture triangle is replaced by distribution curves (HILLEL 1980). The same argument applies to mafic soils. Some others demonstrated that, for the same textural class of each textural triangle, a number of different cumulative particle-size distribution curves could be found (HILLEL 1980 , 1998, 2003, SKAGGS 2001). This clearly shows the arbitrary and not realistic status of soil triangles in textural assessment of a given soil. Since then, many efforts are done in two directions. **First**, ways were found to use the cumulative particle-size distribution curves for transforming one textural classification were determined or system to another one (ROUSSEVA 1997, SHEIN 2008, WARD 2012). **Second**, determining hydraulic properties of soils by using the cumulative particle-size distribution curves was already known (DONG , PATTON, 2015, ARYA , LEIJ, SHOUSE, VAN GENUCHTEN, 1999, SKAGGS, ARYA, MOHANTY, 2001).

According to the studies which are made many years ago untill today, regarding to the that arbitrary boundaries of soil structure classes in Albania we noticed that no attempt has been made to replace textural triangle from the cumulative particle-size distribution curves (LEKAJ, GJONGECAJ, 2016).

MATERIAL AND METHODS

The mafic soils to be analyzed were picked in order to represent as realistically as it is possible the three respective soil characterizations: heavy, medium and light ones. We chose

Table 2, a,b,c. The % of Mg in different Soils Depth(cm) for the Heavy, Medium and Light Mafic ***Soil***

Table 2.a	**Heavy Mafic soil**									
Depth(cm)	**Pedon 6**	**Pedon 7**	**Pedon 8**	**Pedon 9**	**Pedon 12**	**Pedon 18**	**Pedon 19**	**Pedon 20**	**Pedon 21**	**Pedon 22**
Soil	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**
0-13	7.10	9.60	4.70	3.60	5.10	2.10	6.30	1.50	6.60	13.00
13-28	7.70	9.50	6.00	3.60	4.70	2.20	7.90	2.30	5.70	13.60
28-48	8.50	9.10	8.30	5.50	8.50	2.40	12.50	6.00	6.70	15.10
48-74	8.00	7.80	12.70	11.20	24.70	2.70	20.30	4.60	11.60	18.90
74-97	10.50	8.30	15.60	6.70	27.40	1.70	20.10	5.70	11.10	25.00
97-110	10.20	2.30	13.70	9.80		4.80	8.80	5.10	10.30	47.60
110-116	9.30	4.50	12.60			7.30	7.50	3.80		34.00
116-132	11	7	11.9			5.8		4		
132-140	10									
140-173	12.10									
173-210	7.80									
Average	***9.29***	***7.20***	***10.69***	***6.73***	***14.08***	***3.63***	***11.91***	***4.06***	***8.67***	***23.89***

Table 2.b	**Medium Mafic soil**		
Depth(cm)	**Pedon 4**	**Pedon 14**	**Pedon 30**
Soil	**Mg**	**Mg**	**Mg**
0-28	15.50	12.8	12.9
28-49	16.00	18.8	13.1
49-69	20.90	21.5	14.8
69-95	20.90	22.4	16.9
95-119		23.1	19.7
119-142		23.5	17.1
142-170			20.4
Average	***18.33***	***20.35***	***16.41***

Table 2.c	**Light Mafic soil**			
Depth(cm)	**Pedon 5**	**Pedon 27**	**Pedon 28**	**Pedon 29**
Soil	**Mg**	**Mg**	**Mg**	**Mg**
0-19	5.00	10.2	3.80	2.20
19-42	6.30	15.1	4.30	3.20
42-68	6.40	19.1	4.90	5.60
68-97	6.60	24.7	3.00	4.30
97-128	11.40	26.2	7.10	4.70
128-153	9.70	22.5	9.30	4.30
153-175			4.70	4.40
Average	***7.57***	***19.63***	***5.30***	***4.10***

seventeen of different texture mafic soils in Albania (Zdruli 1997) , were divided into three different groups, based on the clay, silt and sand fraction (%), classified as heavy soils (Pedon: 6, 7, 8, 9, 12, 18, 19, 20, 21, 22); as medium soils (Pedon: 4, 14, 30) and as light soils (Pedon: 5, 27, 28, 29) (Table 1). They are selected according to the magnitude of Mg and the place of occurrence in the ultrabasic area of Albania (Table 2. a, b, c).

The naming of soils is done using the USDA textural triangle system. The limit sizes of the particles were chosen from the most known textural systems: ISSS, USDA, Katschinski (Rousseva, 1997). For example, the "< 0.001" means all particles with the size less than 0.001 mm; and "<0.002" means all the particles with the size less than 0.002 mm, including those with the size less than 0.001 mm as well. The ultrabasic mapping of Albania provides the distribution of mafic soils where the database were taken (Figure 1).

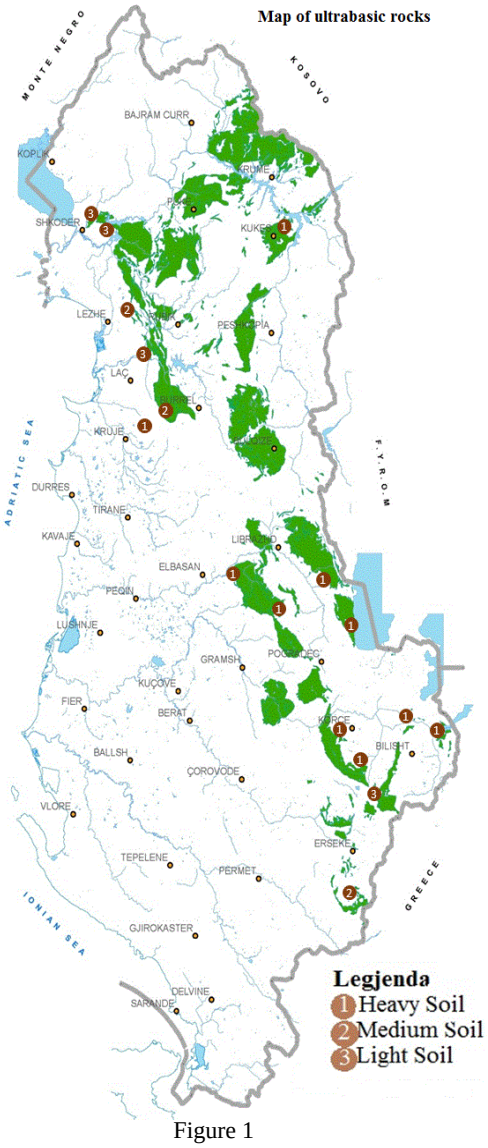


Figure 1

RESULTS AND DISCUSSIONS

The data on texture for the three groups of mafic soils (*heavy, light, medium)* are presented in the following tables 1. Founded in various places in Albania, where the soils are analyzed in different depths soorted percentage.

For every pedon (soil) are found averages for clay, silt and sand. The relative contents of clay, silt and sand in the group of pedons classified as "heavy soils" expressed based on the size of the particles.

Before the regression analysis was done, the measurements range were mean determined and presented in the tables for each soil under the consideration the most known textural systems: ISSS, USDA, Katschinski.

In order to better understand the way the cumulative particle sizes expressed in percentages depend on the particle size ranges, or go along the particle size ranges, the

regression analysis were done and the results are given in the following graph, where the regression equation and the determination coefficient with the given significance are shown. Of course, the graph shown in the following figure is nothing but the cumulative particle size curve.

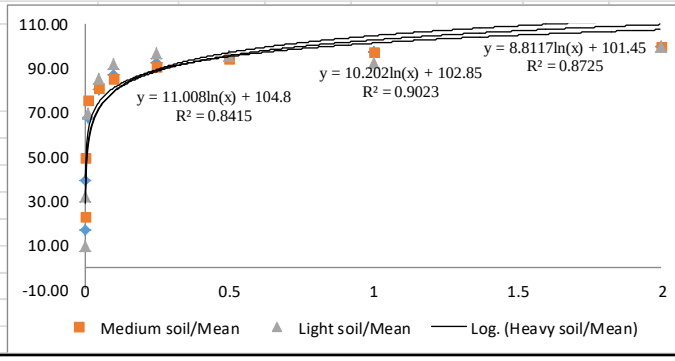
In order to have the advantage of comparison among the three cumulative particle-size distributions, placing the three of them in the same graph is necessary. The regression equation and the determination coefficient are shown in the following graphs (Figure 2, a,b). Based on the determination coefficient, we calculate the correlation coefficient that resulted respectively for heavy soils is 95%, for medium soils is 93% and for light soils 92%. This indicates are showing a very strong connection between the particle size and the progressive average expressed in percentage. So regression equations are reflectig pretty well this strong connection.

The cumulative particle sizes curve expressed in % depends on the particle size ranges in which the fraction content is.

Figure 2, a,b. The cumulative particle-size functions belonging three soil (Heavy, Medium, Light) classified respectively as clay, sandy, clay, loam and fine sandy loam;
a. Statistically elaborated. **b**. Not treated statistically.

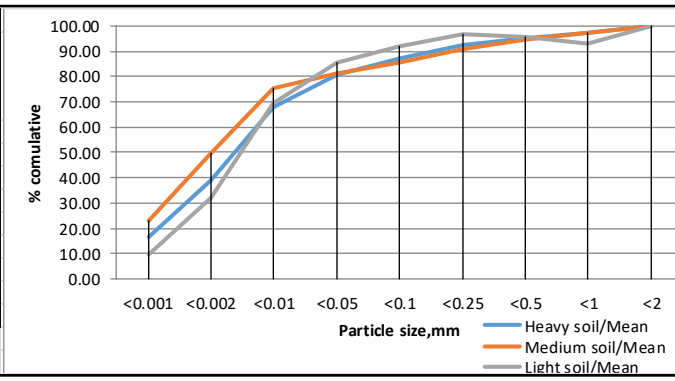
a.

Particle size fraction, mm	Heavy soil/Mean	Medium soil/Mean	Light soil/Mean
0.001	16.74	23.05	9.52
0.002	39.16	49.59	32.00
0.01	68.01	75.57	69.71
0.05	80.53	81.25	85.58
0.1	86.97	85.41	92.12
0.25	92.48	90.77	96.89
0.5	95.27	94.70	95.72
1	97.36	97.51	92.87
2	100	100	100



b.

Particle size fraction/ mm	Heavy soil/Mean	Medium soil/Mean	Light soil/Mean
<0.001	16.74	23.05	9.52
<0.002	39.16	49.59	32.00
<0.01	68.01	75.57	69.71
<0.05	80.53	81.25	85.58
<0.1	86.97	85.41	92.12
<0.25	92.48	90.77	96.89
<0.5	95.27	94.70	95.72
<1	97.36	97.51	92.87
<2	100	100	100



CONCLUSIONS

- The seventeen groups of mafic soils taken into the consideration in Albania for the cummulative particle size distrubution curves are represented by semi logarithmic functions.
- The cumulative particle-size distribution curves builted by semi logarithmic functions, can successfully replace the textural triangles, avoiding the arbitrary their nature.
- The semi-logarithmic regression functions founded are well adapted to the high definition coefficient (R^2, for each case is over 85%), based on this calculation the correlation coefficient is over 92%. This indicates are showing a very strong connection between the particle size and the progressive average expressed in percentage
- From this very good fit equations the particle size distribution curves can be used to determine the textural status of a particular mafic soil which belong to.

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