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Research on Sandy Soils from Oltenia Plain and Their Cultivation

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Abstract

Sandy soils from Oltenia Plain occupies the largest area in the country, about 209.400 ha and are situated on terraces of the Danube, the Jiu and Olt River and west Oltenia Plain. The primary material of the origin of the sand in the south Oltenia is the Carpathians South of Olt and Jiu, the differences consisting of the amount somewhat less coarse sand by the Danube, rich in calcium carbonate thereof as compared to the sand and sandy soils from Left Jiu. The territory between Olt, Jiu, and Danube consists of two distinct areas: one field Leu-Rotunda, located in southeastern Oltenia. This field is a continuation of the surface of the plateau levatinului Piedmont. The second area is formed by terraces Olt, Jiu and Danube. This area has the absolute altitude between 110-140 m with slopes to the east and south. As such relief formations have shown sandy dunes and interdune form. Dunes had heights of 5-15 m and 100-500 m width were interdune. Area with sandy soils in southern Oltenia is crossed by a river system, represented by the Danube River to the south, Olt River to the east and west Jiu River. Plant growth and development of the sandy, is related to the presence of water, which has a decisive role. Low rainfall, high temperatures and Austru wind, warm and dry, make sands of Oltenia sometimes take the form of semi-desert. From an textural, in most cases, the percentage of coarse sand is higher and the lower sand on the dune and the interdune increase both the proportion of sand and the clay. In Oltenia Plain appear dominant cernisols represented by typical chernozems, calcic chernozems, cambic chernozems, gleyic chernozems and argic chernozems, which are added some luvisols of type reddish preluvosols and typical luvosols and some typical eutricambosols. Not missing hidrisols nor salsodisols, and in floodplains and terraces predominate protisols with distric psamosols and eutric aluviosols. Lately, as a result of pedoameliorative measures, such as shaping and

leveling, were essential changes in both the forms of relief, and the main physical and chemical properties, disappearing dunes due to mobilization on higher ground sand and depositing the material in interdune. Excavated and deposited quantities of sand are varied both in terms of origin and physic and chemical properties. Production potential is medium. Requires to stem deflation, the increase in organic matter in the soil and especially in the areas set (level model), the fertilization and maintaining forest cover.

Keywords: sandy soils, Oltenia Plain, production potential, fertilization, maintaining forest cover

1. Introduction

These sandy soils are located terraces Danube between Jiu, Olt and West Oltenia Plain. Sandy soils located to the left of Jiu looms next town Craiova and continue north of the Danube, between Bechet and Corabia. Sands of Jiu and Olt differ in origin from the right Jiu being formed from materials brought Jiu and then reworked by wind. The total area of the sandy soils from Oltenia is about 209.400 ha (Table 1).

Table 1. Sandy soils surfaces of southern Oltenia (ha)

Zone	System	County	Sand	Sandy soils	Total
1. Drincea Plain	Crivina-Vânju Mare	Mehedinţi	8,1	42,0	50,1
	Izvoare-Cujmir	Mehedinţi	0,3	3,2	3,5
	Irrigated	Mehedinţi	3,2	-	3,2
	Total		**11,6**	**45,2**	**56,8**
2.Calafat-Bistreţ-Băilești	Cetate-Galicea	Dolj	-	4,0	4,0
	Calafat-Băileşti	Dolj	2,2	17,0	19,2
	Calafat-Ciuperceni	Dolj	1,2	2,5	3,7
	Bistreţ-Nedeia		1,5	1,0	2,5
	Irrigated	Dolj	10,4	15,7	26,1
	Total	Dolj	**15,3**	**40,2**	**55,5**
3. Left Jiu	Sadova-Corabia	Dolj	22,4	23,7	46,1
	Terasa Corabia	Olt	4,0	3,7	7,7
		Olt	0,4	2,0	2,4
		Dolj	6,9	30,1	37,0
	Irrigated	Olt	1,2	2,7	**3,9**
	Total		**34,9**	**62,2**	**97,1**
TOTAL			**61,8**	**147,6**	**209,4**

Sandy soils in southern Oltenia is characterized by a high content of coarse sand (50-70%), some clay and dust (2-8%).Granulometric composition is different dunes and interdune. Dune physical clay content is between 5.8 to 8.4% and more than 90% of coarse sand and fine sand,

and in interdune physical clay content reached 12.1% or 15.8% and the proportion of coarse sand and fine drops to 75-80%.

Sandy soils, due to the coarse texture, have a high permeability for air and water, with a large air capacity and little capacity to retain water. Due to excessive permeability and low retention capacity, sandy soils is the phenomenon of leaching water and nutrients, registering a series of features on the implementation of irrigation and chemical fertilizers. The total porosity and sand aeration, result intense mineralization of organic matter and high temperature amplitudes up to a depth of 40 cm. Due to excessive permeability and low retention capacity, sandy soils is the phenomenon of leaching water and nutrients, registering a series of features on the implementation of irrigation and chemical fertilizers. The total porosity and sand aeration, result intense mineralization of organic matter and high temperature amplitudes up to a depth of 40 cm. Recovery sandy soils in southern Oltenia requires a specific farming system, rational and integrated with less demanding plants to soil fertility and tolerance to stress factors, to ensure profitability and environmental protection (Gheorghe et al., 2001). Cultivation of the soil with the plant requires, in particular, high doses of nitrogen in most cases lead to soil pollution by nitrates.

2. Materials and Methods

The field studies consisted of mapping and spatial reambulating the studied area on maps at 1:10.000 and 1:25.000 scale, with collection of numerous soil and groundwater samples, with observations on relief, micro-relief, parent material, climate, etc.

The basic research and mapping unit of the areas with soil zone was the soil profile, thus allowing the study of morphological characteristics of the soils. As a result, soils were classified based on intrinsic properties, namely the soil profile, taking into account diagnostic horizons and characteristics.

Soil profiles were located on the ground so that to form a network of studied points. The method of parallel routes, located almost at equal distances has been used, to cover more or less uniformly the whole working area.

The morphological description of soil profiles was done according to the Romanian System of Soil Taxonomy (SRTS, 2003, 2012), ICPA, Bucharest.

In order to establish the soils diagnosis, their morphological features have been taken into account, namely the thickness of morphological horizons, color, texture, structure, composition, adhesion, etc.

Soil samples were taken from genetic horizons both in modified and unchanged settings.

The analytical methods used for determination of chemical:

Determination of particle size fractions:

- pipette method fraction ≤ 0, 002 mm;

- wet sieving method for fractions 0.002 to 0.2 mm and dried fractions > 0.2 mm. The results are expressed as a percentage of the remaining material after the pretreatment.

Organic matter (humus) determined by volumetric method Walkley - Black wet oxidation after the change Gogoașă (Stoica et al., 1986).

Total Nitrogen (Nt): Kjeldahl method disintegration H_2SO_4 at 350 °C, a catalyst of potassium sulfate and copper sulfate.

Phosphorus accessible (P mobile): method-Riehm-Domingo and dosed with colorimetric molybdenum blue method after Murphy-Riley (reduction with ascorbic acid).

Potassium (K mobile) accessible: after extraction method Egner-Riehm-Domingo and determination by flame photometry.

pH: potenţiometric, determined the combined glass electrode and a calomel, in aqueous suspension the soil/water ratio of 1/2, 5.

The base saturation degree (V%) and total cation exchange capacity (T me/100 g soil), by calculation.

Sum of bases (SB): extraction using 0.05 n hydrochloric acid (Kappen-Schofield-Chiriță method).

Total cation exchange capacity (T me/100 g soil) was determined with the following formula: T (me /100 g soil) = SB + Ah

Interpretation of the results has been submitted in accordance with "Methodology developing soil studies", ICPA Bucharest, 1987, provided for in current legislation on the subject.

Map making materials were used following map: Romanian soil map, scale 1:200.000, sheet Turnu Măgurele, Romania geomorphological map, scale 1: 500.000, Groundwater depth map, scale 1:500.00. Thus, those maps were scanned, then the images were vectorized. He data were then processed using CorelDRAW. For each map, the computer result in a "polygon layer" mapping each polygon representing a territorial unit. Cartographic data validation was done by overlapping polygons layer the source data. Each territorial mapping unit, were entered as attributes: soil genetic unit, the surface texture, the parent material, pedogenetic processes and the relief.

3. Results and Discussions

The territory between Olt, Jiu, and Danube consists of two distinct areas: one field Leu-Rotunda, located in southeastern Oltenia. This field is a continuation of the surface of the Levantine from Getic Piedmont. The second zone is formed by terraces Olt, Jiu and Danube (Figure 1).

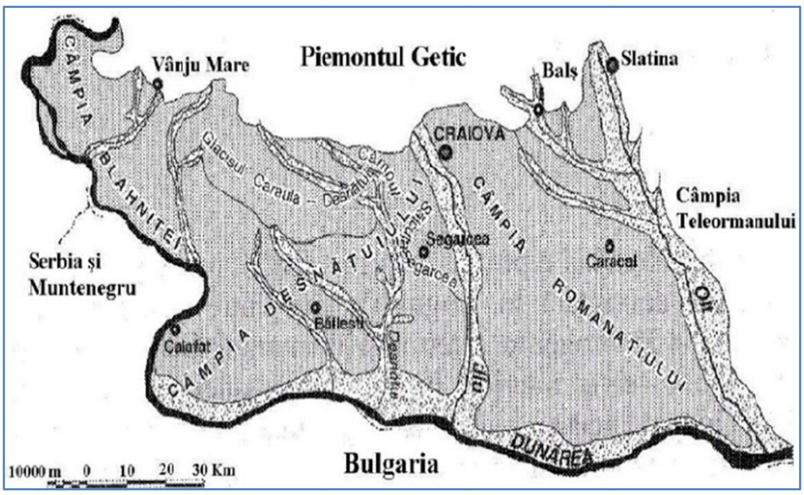

Figure 1. Relief map of the Oltenia Plain, scale 1:500.000 (Stănilă et al., 2014)

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This zone has the absolute altitude between 110-140 m with slopes to the east and south. The outline of this zone is shaped like the letter "U", with descents step towards riverbeds that gave birth.

In the west, the zone is known as "plain lower of Jiu" and 4 levels of terrace with variable height (70-85 m, 30-40 m, 15-22 m and 5-12 m), to which is added the Jiu floodplain.

In the east, the plain is limited by the Olt River, here, meeting three terraces with heights of 20-35 m, 17-21 m and 5-12 m, to which is added the Olt floodplain. The terraces are relatively flat, thin fragmented and covered with loess. These zones were covered with the dominant wind-blown sand (Figure 2).

Figure 2. Olt floodplain the locality Izlaz

Zone with sandy soils in southern Oltenia is crossed by a river system, represented by the Danube River to the south, Olt River to the east and west Jiu River (Figure 3). Danube presents five terraces, with similar age and relative altitude zone.

Figure 3. Dunărea River to Bechet

In terms of natural drainage, research carried out by Oancea and Parichi (1972), they have shown that this area has a good natural drainage, most studied being characterized by the field above 5 m depth of the ground water, except for the following areas: Celaru - Apele

Vii-Dioşti and Amărăşti, where ground water is less than 5 m deep.

In terms of territory climato-morphological ground water are at different depths. This is more than 20 m in the northern and depths (0-5 m) from influencing the soil in a greater or lesser extent, in its south (Figure 4).

Sandy soils of the Left Jiu they are placed in the climatic province Dfbx (as Koppen) having strong temperate continental, with slight mediterranean influence, characterized by a pronounced dry in the months from july to september and a surplus of rainfall in may and june.

Thus, at the southern extremity or town ship, the average annual temperature is 11,1 °C and on the northern or locality Craiova not exceed 10,8 °C.

Rainfall recorded in this zone (average 30 years) of 558.0 mm are uniformly distributed during the year and with small variations from year to year.

Plant growth and development of the sandy soils, is related to the presence of water, which has a decisive role. Low rainfall, high temperatures and wind Austru, warm and dry, make sands of Oltenia sometimes take the form of semi-desert (Figure 5).

In these conditions, the plants sweat appreciable amounts of water, often more than pumped roots in the soil, so that they end up in imbalance that occurs by wilting plants.

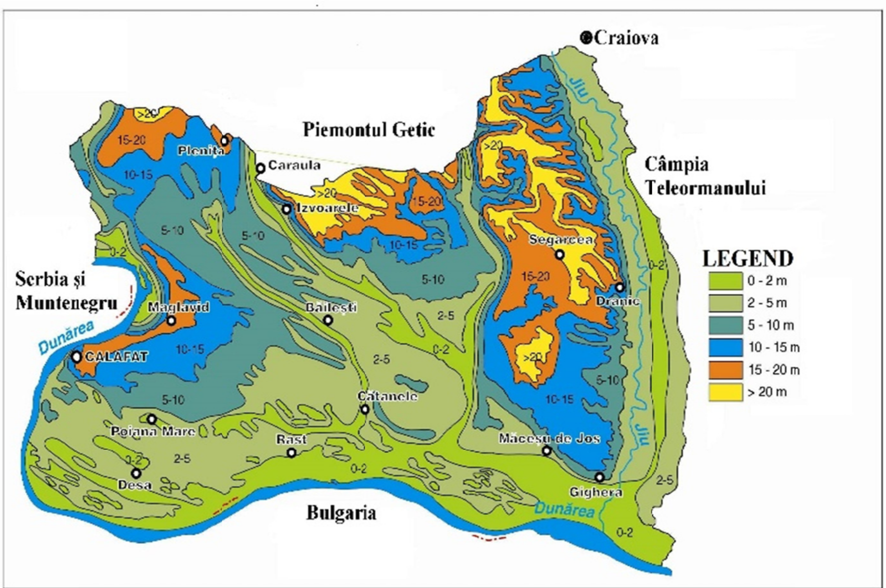

Figure 4. Map of Oltenia Plain groundwater depth, scale 1: 500.000 (Stănilă et al., 2014)

Figure 5. Relief wind in the Oltenia Plain

Their adaptation to these conditions is the reduction of perspiration, keeping constant the amount of water required (Figure 6).

Figure 6. *Portulaca oleracea* on eutric psamosols in the Dăbuleni Field

The natural state of sand and sandy soils left Jiu followed by step planning their zone requiring treatment edaphic factor differently.

From an textural, in most cases, the percentage of coarse sand is higher, and the lower sand on the dune, and the interdune increase both the proportion of sand and the clay.

Based on the results, Stănilă et al., 2012 established correlations between the field capacity and the clay content, the hygroscopic coefficient and moisture equivalent.

The chemical properties of the dune shows the differences between the formations to those of interdune, the difference being only the order of magnitude.

These variations are closely related to the particle size composition of which is different on the two relief formations.

The texture is sand dune and sandy-loam in interdune, which explains the different nutrient supply on two forms of relief (Table 2).

Table 2. The physico-chemical properties of the sandy soils of southern Oltenia

Landform	pH (H_2O)	SB (me/100 g sol)	T (me/100 g sol)	V %	Humus %	Total Nitrogen (Nt%)	Total phosphorus (P_2O_5 %)	Assimilable phosphorus P_2O_5 per 100 g soil	Assimilable potassium K_2O per 100 g soil
Dune	6,1	2,26	3,22	70,1	0,48	0,023	0,036	2,7	12,7
	6,5	2,77	2,33	74,2	0,46	0,023	0,041	1,3	13,4
	6,5	2,06	2,65	77,7	0,37	0,01	0,028	1,0	14,2
	6,6	2,56	3,10	82,5	0,20	-	0,024	0,9	10,4
	6,6	2,66	3,20	83,1	0,05	-	0,021	0,7	9,9
Interdune	6,1	3,98	5,23	76,0	1,21	0,064	0,050	4,3	13,8
	6,4	4,58	5,76	79,5	1,10	0,052	0,036	1,2	14,9
	6,5	3,47	4,22	82,2	0,73	0,017	0,030	0,7	16,6
	6,6	3,27	3,82	85,8	0,40	-	0,021	0,7	15,7
	9,6	2,66	3,30	80,6	0,06	-	0,010	0,5	15,6
Interdune	6,6	7,48	0,76	85,3	1,90	0,083	0,078	6,8	14,8
	6,6	8,75	10,11	86,0	1,84	0,084	0,074	6,9	13,2
	6,7	8,80	9,60	91,6	1,23	-	-	-	-
	6,9	9,17	9,91	92,5	0,65	-	-	-	-
	7,2	9,83	10,07	97,6	0,20	-	-	-	-

The reaction soil is slightly acid to neutral (pH 6.1 to 7.2) in the Oltenia Plain. In terms of content of humus, sandy soils contain from 0.05 to 0.48% of humus dune, compared with 0.20 to 1.90% by interdune. They are poorly supplied with nutrients (N, P, K) and has reduced biological activity.

The natural state of sandy soils left Jiu followed by step planning their zone requiring treatment edaphic factor differently.

From an textural, in most cases, the percentage of coarse sand is higher, and the lower sand on the dune, and the interdune increase both the proportion of sand and the clay.

Based on the results, Stănilă et al., 2012 established correlations between the field capacity and the clay content, the hygroscopic coefficient and moisture equivalent.

The chemical properties of the dune shows the differences between the formations to those of interdune, the difference being only the order of magnitude.

A distance of about 30-35 km from the Danube to the north the absolute altitude of the relief increases by up to 125 m is achieved transition from typical chernozems (loess and loess sediments formed) on the lower terrace of the Danube to cambic chernozems, argic chernozems up to reddish preluvosols. On account established some massive sand located on several alignments developed a wide range of soils comprising the eutric psamosols up to reddish preluvosols and water at a shallow favored the appearance of hidrisols or salsodisols.

As results from the soil map (Figure 7) the territory of Jiu-Danube plain dominant appear cernisols represented by typical chernozems, calcaric chernozems, cambic chernozems, gleiyc chernozems and argic chernozems, which are added some luvisols type reddish preluvosols and typical luvosols and some typical eutricambosols. Not missing hidrisols nor salsodisols, and in floodplains and terraces predominate protisols with dystric psamosols and eutric aluviosols.

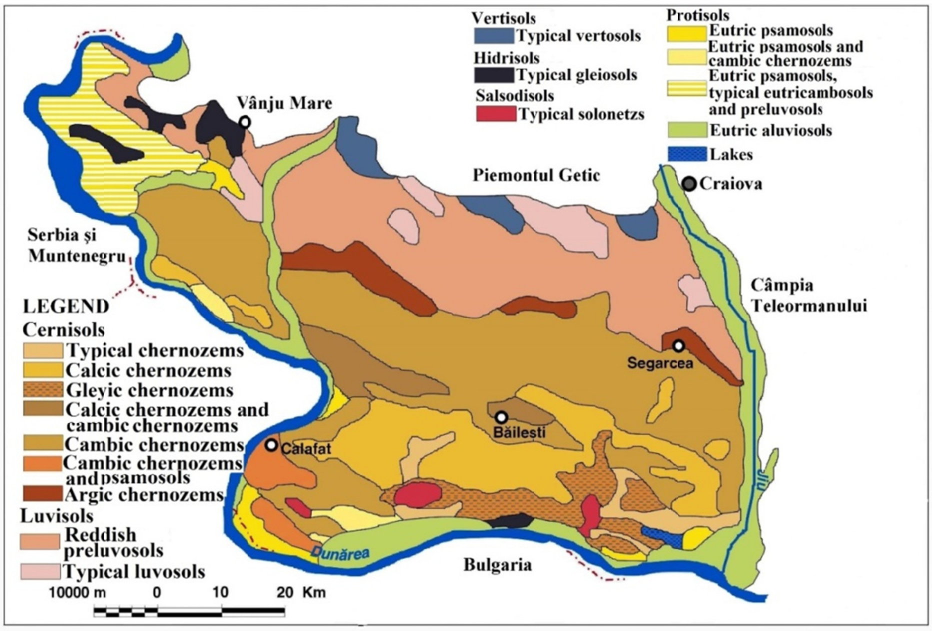

Figure 7. Map soils of Oltenia Plain, scale 1: 500.000 (Stănilă et al., 2014)

Lately, as a result of soil meliorative measures carried such as shaping and leveling, significant changes have occurred both in the forms of relief, and the main physical and chemical properties, disappeared after the mobilization of sand dunes on high places and depositing the material in interdune.

Excavated and deposited quantities of sand are varied both in terms of origin and physico-chemical properties. The solutions adopted were aimed at creating a land modeling as uniform, allowing mechanization, fertilization and irrigation rational.

4. Conclusions

Sandy soils of low fertility Oltenia Plain due to low content of humus and nutrients, and because they are subjected to wind erosion.

They are used with good results for vines (Figure 8), the fruit (peach, apricot tree, cherry), of grain legumes (beans, pea, lupine), technical plants (tobacco, sunflower, potato) (Figure 9), vegetables (tomato, cucumber, onion, cabbage, watermelons, melons) (Figure 10, 11, 12), forage crops (sorghum, vetch, alfalfa, maize, maize sillage, wheat) (Figure 13) and various medicinal plants (Figure 14).

Spring warming is easier, sandy soils make it possible to obtain early crops.

To protect and improve these soils requires special measures. Thus, for stopping deflation recommended the establishment of the locust curtains (*Robinia pseudoacacia)* (Figure 15), fences of twigs, or the use of chemical substances (based on polyvinyl alcohol) forming a protective film on the surface of the field and contribute to soil structure. Also, irrigation have important role in the stability of soils, as well as vegetation.

Figure 8. *Vitis vinifera (*vine) on eutric psamosols in the Dăbuleni Field

Figure 9. *Ipomoea batatas* (sweet potato) on eutric psamosols in the Dăbuleni Field

Figure 10. *Brassica oleracea* (cabbage) on eutric psamosols in the Dăbuleni Field

Figure 11. *Citrullus lanatus (*watermelon) on eutric psamosols in the Dăbuleni Field

Figure 12. *Cucumis melo* (melon) on eutric psamosols in the Dăbuleni Field

Figure 13. *Triticum aestivum (*wheat) on eutric psamosols in the Dăbuleni Field

Figure 14. *Lavandula angustifolia* on eutric psamosols in the Dăbuleni Field

Figure 15. Protection of the locust curtains (*Robinia pseudoacacia*) in the Dăbuleni Field

Important role in increasing fertility it has massive incorporation of manure (20-30 t/ha), the application of chemical fertilizers with nitrogen, phosphorus and potassium, as the use of green manure (white lupine, pea, rye).

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Conflict of interest

We declare that we have no conflict of interest.

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