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SOME ASPECTS OF GENESIS, DISTRIBUTION AND AMELIORATION OF SALINE SOILS FROM THE BRAILA PLAIN

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Abstract

In Romania, saline soils occur in the low-lying accumulative plains with arid climate and deficient water drainage. In the Braila Plain, the saline soils show a zonal distribution on the East-West direction and occupy 5% of the land surface. Here soils and groundwater with the highest concentrations of salts, especially chlorides and sulphates are to be found. Their occurrence is favoured by the arid climate, accumulative land forms, shallow groundwater, low gradient of groundwater flow.

There are two types of salts accumulation: continental-phreatic and lacustrian, within each type being several mechanisms of migration and accumulation of salts specific for various local conditions in which this process takes place.

For a better agricultural use of land resources of the Braila Plain, progressive soil desalination is necessary. A drainage system located in areas with saline soils has to maintain groundwater table levels below the critical depth of salinization.

INTRODUCTION

One of the main concern of today's soil specialists is to prevent and combat soil degradation processes, which can be natural or anthropogenic.

One of these processes, rather widespread in this more or less arid plain, is the soil salinization with harmful effects on agricultural production. Extending irrigation in poorly drained fields increased the risk of soil salinization even more.

One of the main aim of research on saline soils is the knowledge of specific occurrence and characteristics of these soils, the factors favouring them and the growth conditions for plants, in order to establish amelioration measures and to define the most appropriate management technologies.

MATERIAL AND METHODS

To highlight aspects of the genesis, distribution and amelioration of saline soils from Braila Plain (Northern Baragan), both literature alongside with own observations, field and laboratory analyses and their interpretation were used.

RESULTS AND DISCUSSION

Saline soils (salsodisols) occupy in Romania an area of approximately 614,000 ha (table 1), occurring in low lying accumulative plains with arid climate and deficient natural drainage.

The Braila Plain is a part of the Romanian Lower Danube Plain and belongs to Northern Baragan, it is known as a geographic subunit with large areas of saline soils and groundwater with high mineralization. It represents the eastern part of the Buzau-Calmatui interfluve and is bounded by Calmatui river plain (valley) to the south, eastward by the Danube valley, northward by the Buzau valley and westward by the Buzau floodplain which continues south with Buzoel valley (between Faurei and North Ulmu), [1, 8, 9, 10].

In the Braila Plain (northern Baragan) soils distribution exhibits a zonal character on the East-West direction: Vermic Calcaro-Calcic Chernozems, characteristic for the Danube terrace, pass toward West in Vermic Calcic Chernozems, then in Haplic Chernozems.

Saline soils occur locally in poorly drained low lying areas of interfluve and occupies 5% of the surface. In this unit, there are large amounts of salts in soils and groundwater, and among the accumulated salts large quantities of chlorides and sulphates are to be found.

The accumulation of salts in groundwater and soil depends on several factors: climate, lithology, hydrogeology, geomorphology, natural vegetation etc.

Generally, in arid and semiarid areas, the climate, saline rocks or the landform have the dominant role in this process. In these areas, mineralizated groundwater, salts bearing rocks and saline and hyposodic soils occur when the groundwater level is high, internal drainage of the soil weak or even absent, and potential evapotranspiration exceeds rainfall amount.

Occurrence of saline soil in the Braila Plain is due to the existence of large areas in which there are met a number of local conditions. Besides on a relatively dry climate, favouring the accumulation of salts in soil and groundwater, high annual average temperatures (9 - 11^{0}C) and particularly very dry and hot summers, cause a large potential evapotranspiration (700 mm) which significantly exceeds the average annual rainfall (400 - 650 mm) and results in a moisture deficit (50 - 300 mm); during the summer time evapotranspiration exceeds several times the average rainfall, which in areas with shallow groundwater creates the possibility of a large quantities of water to evaporate.

Table 1

Area of salt affected soils in Romania [7]

Geographic region	Total area 10^3 (ha)	Soils							
		Saline		Afected		Total		Potential saline	
		10^3 ha	%	10^3 ha	%	10^3 ha	%	10^3 ha	%
Romanian Plain	5,228.70 (100%)	70.25	1.35	130.35	2.49	200.60	3.84	611	11.69
Western plain	2,841.30 (100%)	69.75	2.45	105.25	3.71	175.00	6.16	400	14.08
Moldova	2,510.30 (100%)	31.60	1.26	82.40	3.28	114.00	4.54	135	5.38
Transylvania	4,816.40 (100%)	1.60	0.03	18.80	0.39	20.40	0.42	30	0.62
Dobrogea	1,557.00 (100%)	35.50	2.28	68.50	4.40	104.00	6.68	45	2.89
TOTAL	**16,953.700 (100%)**	**208.70**	**1.23**	**405.30**	**3.39**	**614.00**	**4.62**	**1221**	**7.20**

The accumulation of salts in the soil takes place - as already mentioned - only under certain local relief and hydrological conditions. Landforms favouring the development of this process in the Braila Plain (a flat, low terrace plain, poorly drained and unfragmented) are generally negative microrelief forms: lower parts of the unfragmented or weak fragmented interfluves, or unfloodable river plains, lower terraces, subsidence areas, old river beds valleys, lake shores, especially of the brackish ones; contact areas between two different landforms (terrace - flood plain, high terrace - low terrace).

The most important role in soil salts accumulation is played by local hydrogeological conditions represented by shallow groundwater and poor drainage [6]. There is a close relationship between these hydrogeological and relief conditions mentioned above. These landforms correspond to conditions with the lowest depth of groundwater and most deficient drainage in the Braila plain. In these areas, groundwater is approaching the surface, having a very low flowing gradient, so favouring evaporation of soil water and the accumulation of salts. Surface deposits play another important role in the salt accumulation. Areas with sandy deposits easily percolated by water, and with low capillary rise of water do not usually or seldom present saline soils, contrariwise, areas with clayey loam deposits and with good capillary ascent and with a slow movement of groundwater favour the accumulation of salts and present often saline soils; in areas of higher relief a removal of accumulated salts along with lowering the groundwater table was noticed.

Hydrographic network influences, at least partly, accumulation of salts in the plain, both by supplying groundwater table and through drainage of the dissected plain sectors. Enrichment in salts (chlorides in particular), of rivers crossing the Subcarpathians Bend and reaching the Braila Plain, mostly explains the wide availability of these salts in groundwater and soils. One could add to this explanation the rivers activity, older and more intense, from the filling-up stage of this plain with alluvial deposits, containing small amounts of salts, that following redistribution, resulted in the current pattern of salts accumulation [3]. Other influence of hydrographic network, by drainage of the plain, acts positively, taking salts from aquifer layers and lithological substrate and removing them out from the territory increasingly along with the intensification of drainage.

The process of soil salinization and that of groundwater salt eurichment are in fact a single process: the accumulation of salts in soil and groundwaters. Given the characteristic occurring in these phenomena of migration and accumulation of salts, two types of accumulation of salts [3, 4, 5] have been differentiate namely: continental-phreatic and lacustrine. Within each type there are several mechanisms for migration and accumulation of salts specific for various local conditions in which this process takes place.

Relatively high content of salts in soils and groundwater from Braila Plain and wide spread of areas with highly salinized soils lead to very difficult issues for agriculture in that region. For more efficient land use of the Braila Plain, especially in the case of irrigation, it is imperative that the soil natural hydrosalin regime and salt balance of the plain, the major cause of soluble salts accumulation, need to be fundamentally modified in order to ensure a desalinsation by driving it with much care in the desired direction [2]. This can be done only through a drainage system capable to change, in conditions without irrigation, the hidrosalin regime of areas with saline soils, making no longer possible accumulation of salts in soil by lowering the groundwater table below critical depth of salinization. Changing the hidrosalin regime of areas with saline and alkali soils could be obtained through a system of drainage ditches, whose location be grounded on knowledge of the origin of salts, the areas and conditions that favour their accumulation and the mechanisms of their migration and accumulation. Basically, the main drainage ditches network have been located within a system that may intercept the flow of groundwater before reaching the areas with conditions favourable of salts accumulation and thus to improve groundwater outflow (drainage) of aquifer layer from the area with saline soils, in order to lower the groundwater level and enchance salt discharge with water captured by the drainage system. In some cases, when the situation in the field allows, the main drainage ditches can be placed within the existing valleys, this intensifying their natural drainage.

In cases when irrigation is used in areas with saline soils, drainage system has to be provided with supple mentory drainage ditches to ensure the evacuation of water and salts.

CONCLUSIONS

1. The Braila Plain is one of the poorest drained area of the North-Eastern part of the Romanian Lower Danube Plain, with groundwater at low depth on large areas and with the high mineralization. It is characterized by a wide distribution of Calcaro-Calcic Chernozems, and Calcic Chernozems developed on loess, mostly phreatic phase. In lower areas, Chernozems are associated with Hyposalic Chernozems and Solonchaks, and here and there with salt lakes.
2. Saline soils occur locally in poorly drained low lying areas on interfluve and are characterized by large amounts of salts in soils and groundwater; among the accumulated salts large quantities of chlorides and sulphates are to be found.
3. Saline soils occurence in the Braila Plain is due to the existence of local conditions, and to relatively dry climate, favouring the accumulation of salts in soil and groundwater.

4. The processes of soil salinization of and groundwater mineralization are acting as a single process: the accumulation of salts in soil and groundwater.
5. For more efficient land use of the Braila Plain, even without irrigation, but especially in case of irrigation, it is imperative that the soil natural hydrosalin regime and salt balance of the plain, that leads to accumulation of soluble salts, have to be fundamentally modified in order to ensure a desalination the of groundwater soils and improving salts regime and driving it carefully in a desired direction.

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