RESEARCHES REGARDING THE ZONING OF HIGH ACIDITY SOILS AND SOILS AFFECTED BY SALINISATION IN CRIŞURILOR PLAIN

Berchez Octavian*

* University of Oradea, Faculty of Environmental Protection, Gen.Magherust., no.26, 410048, Oradea, Romania, e-mail: berchez_octavian@yahoo.com

Abstract

The researches aimed at identifying and delimiting the surfaces of halomorphic soils and soils with pronounced acidity, in the area of the Crişurilor Plain and transposition on the map. By correlating field investigations with laboratory analyzes, the soil areas in the Crişurilor Plain, have been identified and determined to be affected by significant salinization and acidification. Thus, an area of 167.500 ha, occupied by soils with strong and moderate acidity, and an area of 26.804 ha occupiedby salsodisols was identified and transposed, plus other areas occupied by different soil taxonomic units affected by the salinisation process primary or secondary.

Key words: taxonomic soil unit, acidification, salinisation, alkalization, evapotranspiration

INTRODUCTION

Crişurilor Plain is situated in the north-western part of Romania, with a surface of about 3600Km², with altitudes varying between 90-180m. It presents as the western border the western border of the country, and as an eastern boundary the Crişene Hills, to the north continues with Barcăului Plain, and to the south with that of Mureş, having continuity in Hungary. Presence in the Crişurilor Plain of some low-land surfaces with groundwater 1,5 to 2 m deep and mineralized or solification material with a high content of soluble salts (calcosodic) or resulting from the disintegration of the eruptive and metamorphic rocks containing sodium, determined the orientation of the pedogenesis process in the direction of salinization and alkalization with the formation of salsodisols. Much of the soil of the Crişurilor Plain has low trophicity due to the high natural acidity or "acquired" over time, under anthropogenic influence. Thus, in the Plain Plain, about 47.2% of the soils have strong and moderate acidity.

MATERIAL AND METHODS

Determination of surfaces with soils affected by salinization and alkalinization was performed following the interpretation and correlation of field data with laboratory analyzes (ph, SB, Ah, V%, T, fixed residue, content in Cl-, SO42-, CO32-, CO3H -, Ca 2+, Mg 2+, Na +, K +, Na + exchangeable). Thus the surfaces occupied by salsodisols were identified, established and transposed on the map. The map of soils with strong and

moderate acidity was based on the performance of laboratory tests (pH, Ah, V%, CaCO3%, Sb).

RESULTS AND DISCUSSION

Identification and establishment of soils with strong and moderate acidity

For the identification and establishment of soils with strong and moderate acidity, the pH values obtained experimentally, with the ICPA rules on "Soil response estimation after pH value" were compared, soils with pH ≤ 5,8 were included in this category.

Thus, soils with strong and moderate acidity belong to soil classes (SRTS): Protisoluri, Luvisoluri, Pelisoluri and Hydrisoluri.

ProtisoluriClass

Table 1 shows the types and subtypes of soils in the Protisouriclass affected by acidity (in SRTS, WBR-SR, USDA-ST).

Table 1

Types and subtypes of soils in the Protisouri class,affected by acidity (in SRTS, WBR-SR, USDA-ST)

Type of soils SRTS	Subtype of soils SRTS	Type of soils WRB-SR	Subtype of soils WRB-SR	USDA-ST
Regosol RS	Distric-LSdi	Regosols-RS	Dystric Regosols-Rgdy	Typic Cryorthents Typic Udorthents
	Stagnic-RSst		Stagnic Regosols-RGst	Epiaquic Udorthents
	Gleizat-PSgz		Endogleyc Arenosols-ARgn	Endoaquic Udipsamments Endoaquic Ustipsaments
Aluviosol	Distric-ASdi	Fluviosols-FL	Dystric Fluvisols-FLdy	Fluventic Dystrudepts

CambisoluriClass

Table 2 shows the types and subtypes of soils in the Cambisoluriclass, affected by acidity (in SRTS, WBR-SR, USDA-ST).

Table 2

The types and subtypes of soils in the Cambisoluriclass, affected by acidity (in SRTS, WBR-SR, USDA-ST)

Type of soils SRTS	Subtype of soils SRTS	Type of soils WRB-SR	Subtype of soils WRB-SR	USDA-ST
Eutri-cambosol-EU	Tipic-ECti	Eutric Cambisols-CM	Eutric Cambisols-CMeu	Typic Eutrocryepts Typic Etrudepts
	Vertic-ECvs		Eutri-vertic Cambisols-CMvr-eu	Vertic Etrudepts Vertic Haplustepts
	Gleic-ECgc		Gleyi-eutric Cambisols-CMeu-gl	Endoaquic Etrudepts
	Stagnic-ECst		Stagni-eutric Cambisols-Cmeu-st	Endoaquic Etrudepts

Luvisoluri Class

Table 3 shows the types and subtypes of soils in the Luvisoluriclass affected by acidity (in SRTS, WBR-SR, USDA-ST).

Table 3

The types and subtypes of soils in the Luvisoluri class affected by acidity (in SRTS, WBR-SR, USDA-ST)

Type of soils SRTS	Subtype of soils SRTS	Type of soils WRB-SR	Subtype of soils WRB-SR	USDA-ST
Preluvosol-EL	Tipic-ELti	Luvisols-LV	Haplic Luvisols-LVha	Typic Hapludalfs Typic Haplustalfs Inceptic Hapludalfs
	Roşcat-ELrs		Chromic Luvisols-LVvr	Typic Haplustalfs
	Vertic-ELvs		Vertic Luvisols-LVvs	Vertic Hapludalfs Vertic Haplustalfs
	Stagnic-ELst		Stagnic Luvisols-LVst	Epiaquic Hapludalfs
	Gleic-ELgc		Gleyic Luvisols-LVgl	Epiaquic Hapludalfs
Luvosol-LV	Tipic-LVti	Luvisols-LV	Haplic Luvisols-LVha	Typic Hapludalfs
	Roşcat-LVrs		Chromic Luvisols-LVar	Udic Hapludalfs
	Vertic-LVvr		Vertic Luvisols-LVve	Vertic Hapludalfs Vertic Haplustalfs
	Albic-LVab		Albic Luvisols-LVab	Gllosic Haplustalfs
	Stagnic-LVst		Stagnic Luvisols-LVst	Epiaquic Hapludalfs
	Gleic-LVgc		GleycLuvisols-LVgl	Epiaquic Hapludalfs

PelisoluriClass

Table 4 shows the types and subtypes of soils in the Pelisoluriclass affected by acidity (in SRTS, WBR-SR, USDA-ST).

Table 4

The types and subtypes of soils in the Pelisoluriclassaffected by acidity (in SRTS, WBR-SR, USDA-ST)

Type of soils SRTS	Subtype of soils SRTS	Type of soils WRB-SR	Subtype of soils WRB-SR	USDA-ST
Vertosol-VS	Tipic-VSti	Vertisols-VR	Pellic Vertosols- VRpe Haplic Vertosols- VRha	Typic Hapluderts Typic Haplusterts
	Stagnic-VSst		Stagni-pellic-Vertosols-VRpe-st	Epiaquic Hapluderts Epiaquic-chromic Hapluderts
	Gleic-VSgc		Gleyi-pellic- Vertosols-VRpe-gc Gleyi-chromic-Vertosols-VRcr-gc	Endoaquic Hapluderts Endoaquic Haplusterts Endoaquic-chromic Hapluderts

HidrisoluriClass

Table 5 shows the types and subtypes of soils in the Hidrisoluri class affected by acidity (in SRTS, WBR-SR, USDA-ST).

Table 5

The types and subtypes of soils in the Hidrisoluri class, affected by acidity (in SRTS, WBR-SR, USDA-ST)

Type of soils SRTS	Subtype ofsoils SRTS	Type of soils WRB-SR	Subtype of soils WRB-SR	USDA-ST
Stagnosol-ST	Tipic-STti	Luvisols-LV Cambisols-CM	Stagnic Cambisols Stagnic Luvisols-LVst	Typic Epiaquepts Typic Epiaqualfs
	Luvic-STlv		Stagnic Luvisols-LVst	Typic Epiaqualfs
	Albic-STal		Stagni-albic Luvisols-LVal-st	Typic Glossaqualfs
Gleiosol GS	Distric-GSdi	Gleisols-GL	Dystric Gleysols-GLdy	Typic Endoquepts-calcic class /phase
	Aluvic-GSal		Fluvic Gleysols-GLfv	Fluviaquentic Endoaquepts
	Cambic-GScb		Haplic Gleysols-GLha	Typic Endoaquepts

Following the overlapping of the soils maps with strong and moderate acidity with the administrative territorial maps, the area of spreading these soils in the Crişurilor Plain (Table 6) could be determined.

Table 6

Soils in Crişurilor Plain with strong and moderate acidity on soil classes and types, and administrative-territorial units (according to SRTS)

Class of soils	Type of soils SRTS	Type of soils WRB-SR	spread
PROTISOLURI (PRO)	Regosol (RS)	Regosols-RS	The old terraces of the rivers
	Aluviosol (AS)	Fluviosols-FL	Sântandrei, Oradea, Tăut, Talpeş, Batăr, Apateu, Ciumeghiu, Boiu, Avram Iancu, Tămaşda, Chiorac, Păuşa, Miersig, Craiva, Coroi.
CAMBISOLURI (CAM)	Eutricambosol (EC)	Eutric Cambisols-CM	Sântandrei, Salonta, Oradea, Parhida, Niuved, Arpăşel, Tulca, Batăr, Tăut, Mădăras, Ineu, Chereluş, Vaida, Hodoş, Sântimbreu, Gepiu, Homorog, Gurbediu
LUVISOLURI (LUV)	Preluvosol (EL)	Luvisols-LV	Sepreuş, Mişca, Zerindu Mic, Tămaşda, Ghiorac, Tinca, Chişineu Criş, Seleuş, Ineu, Nădab, Chereluş, Şicula, Sintea Mică, Biharia, Oradea, Miersig, Bicaci, Gurbediu.
	Luvosol (LV)	Luvisols-LV	Mişca, Sepruş, Zerindu Mic, Ghiorac, Apateu, Tămaşda, Sălard, Cauaceu, Hodoş, Sântimbreu, Vaida, Sânmartin, Cihei, Apateu, Chişirig, Leş, Păuşa, Gepiu, Miersig, Ianoşda, Husasău de Tinca, Căuşad, Gurbediu, Oradea, Ucuriş, Căuşad, Usag, Craiva, Vasile Goldiş, Călacea, Crişu Negru, Avram Iancu.
	Planosol (PL)	Luvisols-LV	They are spread in complex with luvosols
PELISOLURI (PEL)	Vertosol (VS)	Vertisols-VR	Zerindu Mic, Apateu, Sepreuş, Vărşad, Moroda, Pilu, Cintei, Sintea Mică, Zărand, Nădab, Zerind, Talpoş, Avram Iancu, Vasile Goldiş.
HIDRISOLURI (HID)	Gleiosol (GS)	Luvisols-LV Cambisols-CM	Borş, Santău Mic, Santău Mare, Toboliu, Sântion, Mihai Bravu, Parhida, Inand, Satu Nou, Tămăşeu, Tulca, Ghiorac, Cefa, Inand, Homorog, Salonta, Ciumeghiu, Avram Iancu, Biharia.
	Stagnosol (SG)	Gleisols-GL	Girişu de Criş, Talpoş, Ghiorac, Tămaşda, Zerindu Mic, Vânători, Sepreuş, Oradea, Sânmartin, Cihei, Chişirid, Apateu, Păuşa, Gepiu, Ianoşda, Miersig, Gurbediu, Husasău de Tinca, Bicaci, Gurbediu, Inand, Vasile Goldiş, Avram Iancu, Coroi, Tălmaci, Soşag, Berechiu.

In Table 7 are presented the physical and chemical properties of a Albic luvosol, (Albic Luvisols WRB-SR-1998, Glossic Hapludalfts USDA-ST-1999), Miersig locality.

Table 7

Physical and Chemical Properties of a Albic Luvisols (Albic Luvisols WRB-SR-1998, Glossic Hapludalfts USDA-ST-1999), Miersig locality

Horizons	**Ao**	**Ea**	**EB**	**Bt**
Depths (cm)	**0-22**	**22-35**	**35-60**	**60-90**
Coarse sand% (2-0,2 mm)	**3,3**	**3,5**	**3,8**	**1,6**
Fine sand% (0.2-0.02 mm)	**34,4**	**33,5**	**31,1**	**23,6**
Dust% (0.02-0.002 mm)	**38,7**	**40,4**	**28,5**	**25,5**
Clay% (less than 0.002 mm)	**23,6**	**22,6**	**36,6**	**49,3**
Texture	**LP**	**LP**	**TT**	**AL**
Ph in water	**4,90**	**4,85**	**4,90**	**4,95**
Humus%	**2,40**	**1,76**	**-**	**-**
Total nitrogen (ppm)	**0.125**	**0,080**	**-**	**-**
Mobile Phosphorus (ppm)	**12**	**8**		
Mobile potassium (ppm)	**100**	**60**		
Hydrolytic acidity (me / 100 g soil)	**5,1**	**4,7**	**5,5**	**7,2**
Bases (me / 100 g soil)	**11,3**	**9,7**	**15,6**	**21,6**
Degree of saturation in bases	**54,9**	**55,4**	**62,9**	**64,0**

Identification and determination of the areas occupied by salinized soils and alkaline soils

The identification and establishment of soil taxonomic units that are affected by salinisation and alkalization was carried out in accordance with the Romanian Soil Taxonomy System, SRTS-2012 +.

These soils are spread in the Crişurilor Plain area, important areas, meet in the Joasă Plain, between Zărand - Socodor - Grăniceri, in the Chişineu Criş area, Salonta area and between Marhaz and Sânicolau Român. Salinisation is due to the presence of mineralized groundwater (> 3g / l soluble salts) at critical or subcritical depths.Salinisation is due to the presence of mineralized groundwater (with a content> 3g / l soluble salts) at critical or subcritical depth.The type of salinisation is sodium sulfate and sodium-chloro-sulphate. Only on a small part of these soils salinisation is due to the parental material, and there are cases of secondary salinization in the west and southwest of the plain.Table 8 presents the physical and chemical properties of Cambisols - Mollic-gleyi-endosalic Cambisols (WRB-SR-1998), Humic Eutrodepts, Aquic Haplustepts (USDA-ST-1999)from Sântion

Table 8

The physical and chemical properties of Cambisols - Mollic-gleyi-endosalic Cambisols (WRB-SR-1998), Humic Eutrodepts, Aquic Haplustepts (USDA-ST-1999) from Sântion

Horizons	**Am_1**	**Am_2**	**ABacsc**	**Bvacsc**	**BCGoscac**
Depths (cm)	**0-28**	**28-52**	**52-66**	**66-95**	**95-120**
Coarse sand% (2-0,2 mm)	**0,9**	**0,4**	**0,2**	**0,7**	**1,3**
Fine sand% (0.2-0.02 mm)	**21,8**	**18,1**	**18,8**	**23,7**	**31,7**
Dust% (0.02-0.002 mm)	**25,5**	**21,1**	**20,6**	**21,4**	**19,0**
Clay% (less than 0.002 mm)	**51,8**	**60,4**	**60,4**	**54,2**	**48,0**
Texture	**AL**	**AL**	**AL**	**AL**	**AL**
Ph in water	**6,50**	**7,75**	**8,05**	**8,15**	**8,80**
Carbonates%	**-**	**0,04**	**0,04**	**0,09**	**0,21**
Humus%	**5,11**	**2,25**	**-**	**-**	**-**
Total nitrogen%	**0,255**	**0,113**	**-**	**-**	**-**
Mobile Phosphorus (ppm)	**11**	**2**	**-**	**-**	**-**
Mobile potassium (ppm)	**140**	**80**	**-**	**-**	**-**
Bases (me / 100 g soil)	**29,2**	**-**	**-**	**-**	**-**
Exchangeable (me / 100 g soil)	**-**	**-**	**-**	**-**	**2,06**
Nechangeable (% of T)	**-**	**-**	**-**	**-**	**11,2**
Hydrolytic acidity (me / 100 g soil)	**1,3**	**-**	**-**	**-**	**-**
Degree of saturation in bases	**95,7**	**-**	**-**	**-**	**-**
Fixed residue	**-**	**0,144**	**0,292**	**0,592**	**0,217**
Humus reserve (t / ha)	**306**	**-**	**-**	**-**	**-**
Cl- (me / 100 g of soil)	**-**	**0,90**	**0,60**	**1,00**	**1,10**
SO4,2- (me / 100 g of sol)	**-**	**0,38**	**1,85**	**3,84**	**7,10**
CO 3,2- (me / 100 g of salt)	**-**	**0,24**	**0,00**	**0,00**	**0,00**
CO 3 H- (me / 100 g sol)	**-**	**1,38**	**0,54**	**0,59**	**0,69**
Ca2 + (me / 100 g sol)	**-**	**0,21**	**0,43**	**0,31**	**0,87**
Mg2 + (me / 100 g sol)	**-**	**0,45**	**0,31**	**0,74**	**1,00**
Na & lt; + & gt; (me / 100 g sol)	**-**	**2,20**	**2,35**	**4,50**	**7,08**
K + (me / 100 g sol)	**-**	**0,05**	**0,03**	**0,01**	**0,01**

Table 9 presents the physical and chemical properties of a Gleic Solonets (WRB-SR-1998), Typical Natraqualfts (USDA-ST-1999), Zerind

Table 9

The physical and chemical properties of a Gleic Solonets (WRB-SR-1998), Typical Natraqualfts (USDA-ST-1999), Zerind

Horizons	**Aosc**	**Elnasc**	**Btnasc**	**B/CGonasc**	**CGonasc**
Depths (cm)	0-17	17-39	39-56	56-82	82-120
Coarse sand% (2-0,2 mm)	2,50	2,20	1,20	0,80	1,60
Fine sand% (0.2-0.02 mm)	46,20	39,90	43,70	42,40	43,70
Dust% (0.02-0.002 mm)	24,40	22,00	20,80	25,10	19,90
Physical clay% (less than 0.01 mm)	26,90	35,90	34,30	31,70	34,80
Texture	LL	TT	TT	LL	LL
carbonates	0,10	2,70	2,90	25,80	21,20
Ph in water	8,05	9,60	9,60	9,65	9,30
Humus	2,35	1,13	-	-	-
Total nitrogen%	0,118	0,057	-	-	-
Mobile Phosphorus (ppm)	2,0	1,0	-	-	-
Mobile potassium (ppm)	140	160	-	-	-
Soluble salts% (1: 5)	178	252	346	316	173
Cl- (me / 100 g, sol)	0,41	0,63	0,66	0,65	0,64
SO42- (me / 100 g, sol)	0,41	0,96	2,06	2,2	0,63
Na + changeable (% of T)	9,53	26,3	30,13	50,29	20,99

In Table 10 are presented the types and subtypes of Salsodisoluri class soils identified in the study area (in SRTS, WBR-SR, USDA-ST). Large areas of soils affected by salinisation belong to the taxonomic class and Protisols, Cernisols, Luvisols and Cambisols (SRTS)

Table 10

Types and subtypes of soils in the Salsodisoluri class (SRTS), identified in the study area (in SRTS, WBR-SR, USDA-ST)

Type of soils SRTS	Subtype of soils SRTS	Type of soils WRB-SR	Subtype of soils WRB-SR	USDA-ST
Solonceac-SC	Tipic-SCti	Solonchaks-SC	Haplic Solonchaks-SCha	Typic Haplosalids
	Calcaric-SCka		Calcaric-Haplic Solonchaks-Scha-ca	Typic Haplosalids-phase calcareous
	Molic-SCmo		Mollic Solonchaks-SCmo	Typic Haplosalids
Soloneț SN	Tipic-SNti	Solonetz-SN	Haplic Solonetz -SNha	Aquic Natrustalfs Aquic Natrudalfs
	Molic-SNmo		Mollic Solonetz-SNha	Aquic Natrustolls Aquic Natrudolls
	Luvic-SNlv		Haplic Solonetz -SNha	Aquic Natrudalfs
	Calcaric-SNka		Haplic Solonetz -SNha	Aquic Natrustalfs

By overlapping the maps on which the soils affected by salinization are represented, with the administrative territorial maps, the area of spreading these soils has been established in the Crişurilor Plain.

Table 11

Zoning of soils affected by salinisation in Crişurilor Plain (on administrative territorial units, by classes and types of soils, according to SRTS)

Type of soils SRTS	Type of soils WRB-SR	Tărian, Cheresig, Sântion, Mihai Bravu, Tămaşda, Cintei, Sintea Mică, Zărand, Grăniceri, Socodor, Ineu, Adea, Mişca, Zerind, Biharia, Hodoş, Cauaceu
Soloneţ Solonceac (SC)	Solonchaks-SC	
Soloneţ (SN)	Solonetz-SN	sectorul Zărand-Cintei-Sintea Mică, judeţul Arad.

CONCLUSIONS

The identification of soil units with trophic problems due to strong and moderate acidity or salinisation was performed at the class, type and subtype of the soil. The Romanian Soil Taxonomy System SRTS-2012 + has been used.Soil has also been transposed into international scientific systems, the World Reference Base for Soil Resource (WBR-SR-1998) and the current USDA Soil Taxonomy (USDA-ST) -1999).

In the Crişurilor Plain, the fields with strong and moderate acidity (figure 1) occupy a total area of 167,544 ha, having a wide spread in the Low Plain of Crişuri, in the localities: Tămăşeu, Biharia, Sălard, Sântandrei, Oradea, Bors, Girişul de Criş, Nojorid, Gepiu, Sânnicolau Romanian, Olcea, Mădăraş, Cefa, Salonta, Ciumeghiu, Tinca, Miersig, Avram Iancu, Socodor, Brăniceri, Pilu, Şimand, Macea, Zerind, Olari, Ineu, Beliu, Cermei, Craiva, Bocsig.

The Salsodisols (Figure 2, 3) occupy a total area of 26,804 ha, distributed as follows: in the Bihariei Plain - 55,6 ha, Bihariei Field - 32,7 ha, Cermeiului Plain - 762 ha, Borşului Plain - 1,3 ha, Parhidei Plain - 276.6 ha, Salontei Plain - 7572.4 ha, Crişului Alb Plain - 12086.7 ha, CrişuluiNegru Plain - 2128.8 ha, Ineului Plain - 2249.9 ha, plus other areas of salinic subtypes and sodium of other soils.

Knowledge of soils with strong and moderate acidity and soils affected by salinisation is a basis for solving a number of issues related to:

- obtaining and making cartograms on: soil characteristics, soil technology indicators and cartograms on production capacity
- knowledge of soils with strong and moderate acidity
- knowledge of the soils affected by salinisation

- Conservation and rational use of the land fund
- establishing the set of measures to improve soils with strong and moderate acidity
- establishing the set of measures for improving the soils affected by salinisation
- establishing the set of land improvement works for soils affected by salinisation
- establishment of the assortment of crop plants
- organization of the territory
- the correct application of differentiated agrotechnics in agricultural units
- qualification and technological characterization of land areas

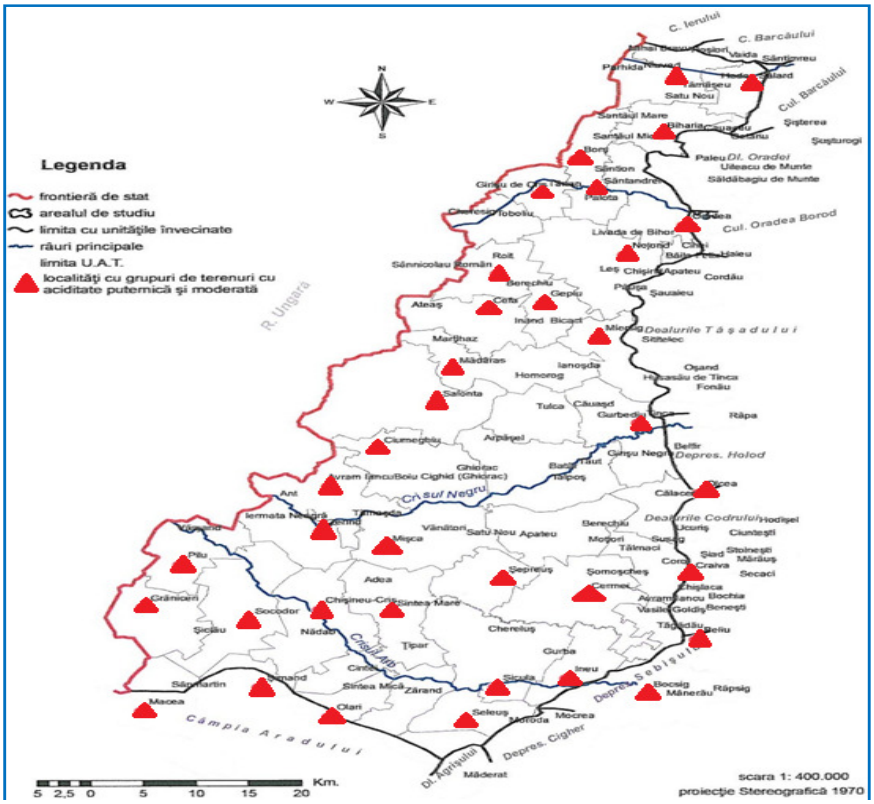

Fig. 1. The representation of lands with strong and moderate acidity

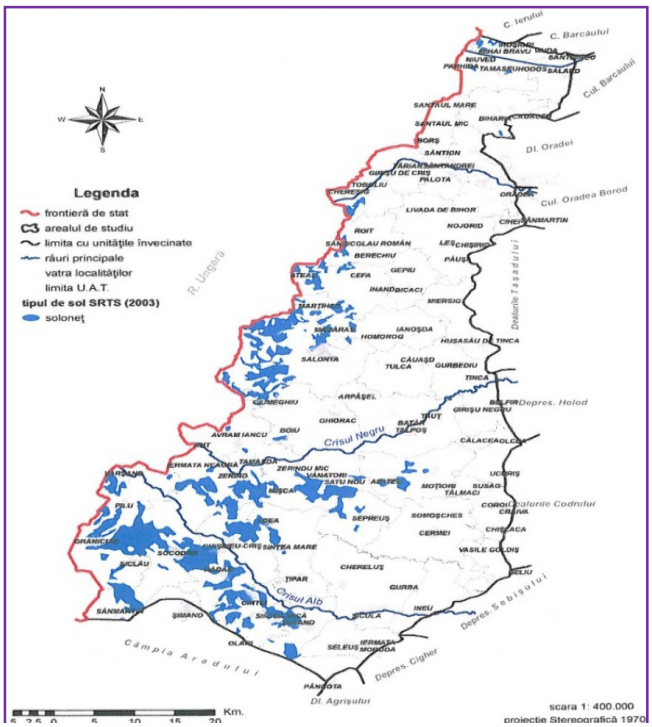

Figure 2. Representation of the distribution of halomorphic soils in the Crişurilor Plain

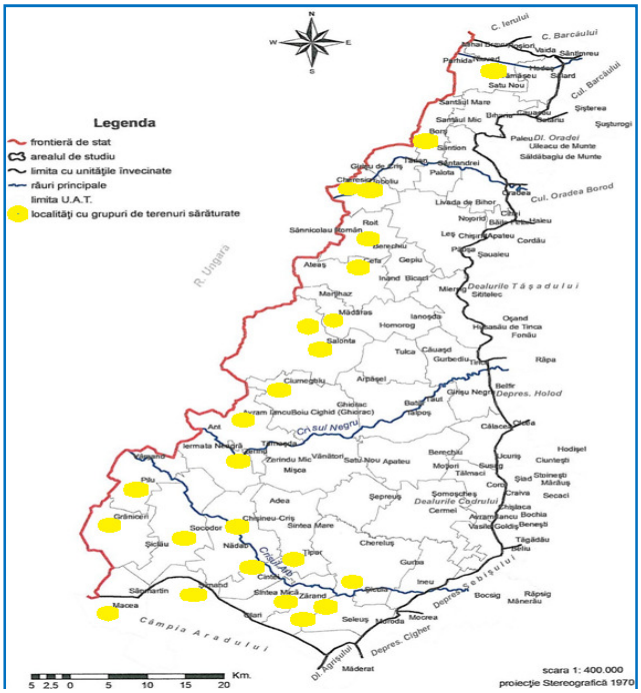

Figure 3. Representation of areas with soils affected by salinisation processes

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