Saline soils in the Baixada Maranhense: A case study in Maranhão state, Brazil

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INTRODUCTION

The Baixada Maranhense region is located in northeastern Brazil in Maranhão state. It is a seasonally flooded interior plain of 6.266 km². It comprises hydrophilic floodplain fields, intermittent lakes, halophilic mangroves, mangrove swamps, muddy tidal plains. Solonetz are the dominant salt-affected soils. The main land use systems are extensive livestock and shrimp farming.

The plant available water (PAW) in saline soils are restricted to high osmotic potential caused by the high concentration of salts in the soil solution. The osmotic potential is often neglected.

The main goal of this study is to show the characteristics of two saline soils and the contents of PAW to crop sustainable production.

METHODOLOGY

This study was conducted in northeastern Brazil in Maranhão (MA) state, Brazil.

Two soil profiles are selected and classified using the Brazilian Soil System of Classification (Santos et al., 2018) and the World Reference Base Soil (WRB, 2015): Vertissolo Hidromórfico Sálico which corresponds in WRB to a Katogypsic Vertisol (saline soil) – (03° 00' 24,7" S e 44° 21' 30,8" W); and Gleissolo Sálico Sódico which corresponds to a Katovertic Pantogleyic Epigeoabruptic Solonetz (saline sodic soil) - 03° 22' 37,0" S e 44° 51' 16,4" W.

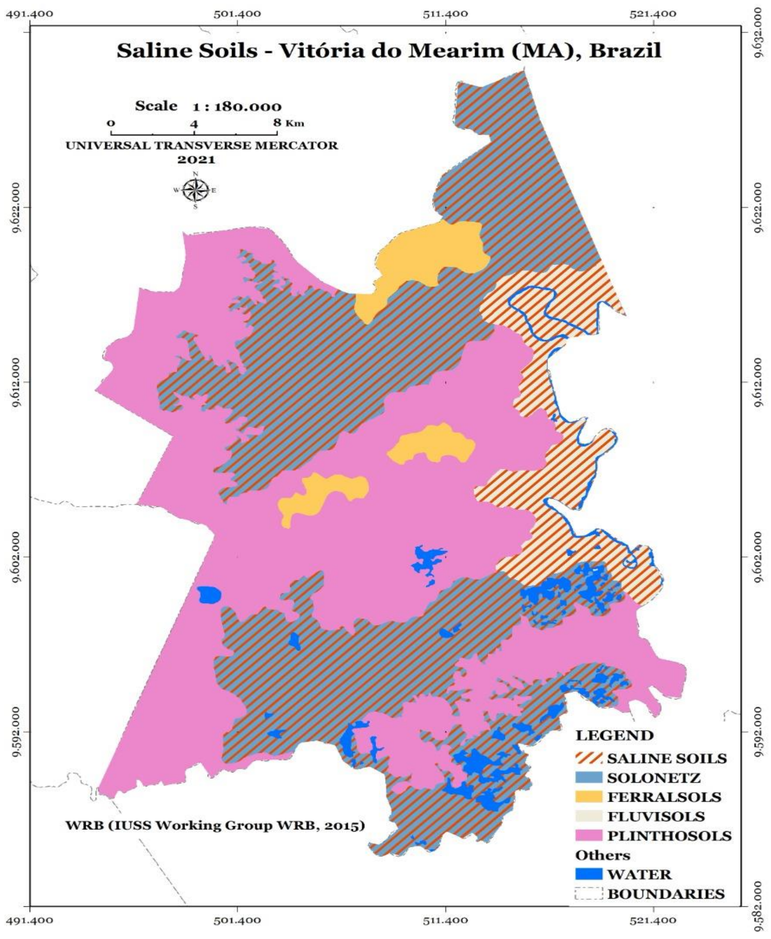

Fig 1. Map of the Saline soils in Vitória do Mearim - XIII RCC- Maranhão, Brazil.

The chemical, physical and mineralogical characterization of these profiles are in Oliveira et al. (2020). Plant available water (PAW) was estimated by subtraction of the volumetric soil moisture in 6, 10, and 33 kPa (field capacity) from the moisture at the permanent wilting point - 1500 kPa (Teixeira et al. 2020).

RESULTS

The Solonetz profile studied has a predominance of the fine sand and silt fractions with smectite.

The exchangeable sodium percent are around 30% in some horizons and the electrical conductivity is > 4 dS m^{-1} that characterize an "Sálico Sódico Gleissolo" in the Brazilian Classification.

The values of PAW ranged from the lowest value of AW33 of 1,18 mm/cm in the Apw horizon in the Vertisol to the highest AW10 of 3,45 mm/cm in the Ag horizon in the Solonetz.

Solonetz in this region is mostly saline and sodic soils, typical soils in saline mangroves. Apart from high salinity, the productivity of those eutrophic soils is restricted due to other soil factors such as iron toxicity and oxygen deficit to the roots caused by the large periods of saturation.

Table 1. Physical – hydric attributes of soils horizons profiles from Maranhão - Brazil

Horizon	Depth	Clay	Activity clay	Total porosity calculated	Available water		
					AW_6[1]	AW_{10}[2]	AW_{33}[3]
	cm	g kg^{-1}	$cmol_c$ kg^{-1}	-------% ---- --	m^3 m^{-3}		
Katogypsic Vertisol (Hypereutric, Gilgaic, Katogleyic, Humic, Katothionic, Magnesic, Katoprotosalic)							
Apv	0 - 10	716	-	0,46	0,173	0,148	0,118
Av	10 - 30	763	49,4	0,46	0,341	0,318	0,291
CAvz	30 - 77	714	62,0	0,50	0,264	0,252	0,236
Katovertic Pantogleyic Epigeoabruptic Solonetz (Epialbic, Endofluvic, Hypernatric, Magnesic, Ochric, Oxyaquic, Amphiraptic, Siltic)							
Ag	0 - 11	143	-	0,40	0,345	0,338	0,269
2Bvgzn	11 - 54	461	48,2	0,41	0,217	0,205	0,195
4Cgzn2	72 - 98	82	113,4	0,44	0,232	0,246	0,199

AW: Available water calculated by subtracting the water content at the potencial of 6, 10 and 33kPa from the water content at 1500 kPa.

Fig 2. Solonetz in Foodplain fields (Campo de Perizes) - Vitória do Mearim, Maranhão, Brazil.

CONCLUSIONS

The large areas of Solonetz have reduced agricultural aptitude. Irrigated rice plantations with tolerant varieties and to saline soil adapted pastures are among the feasible options. The PAW for salt-affected soils demands more research as the standard criterion to estimate PAW may overestimate the real available water.

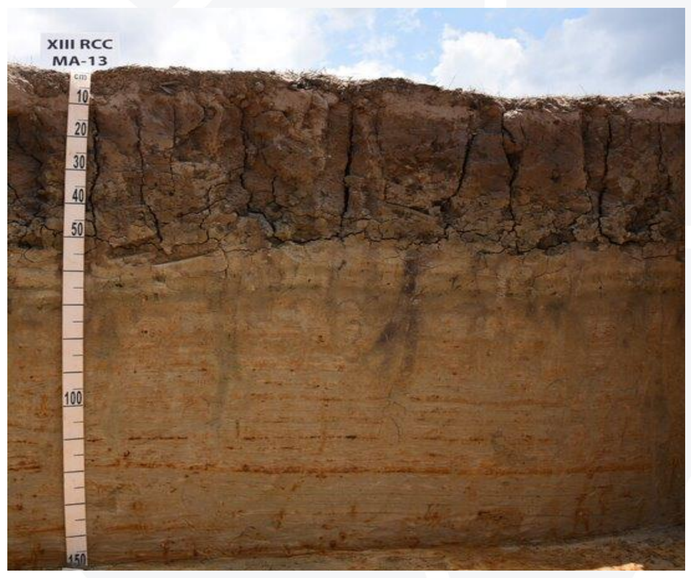

Fig 3. Soil profile of the Katovertic Pantogleyic Epigeoabruptic Solonetz in Vitória do Mearim, Maranhão, Brazil.

ACKNOWLEDGEMENTS

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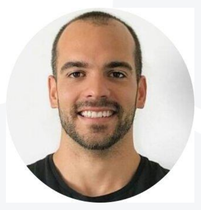
Fig 4. Participants of the Soil Correlation and Classification Meeting - XIII RCC- Maranhão, Brazil.

All Photos are credited to Sérgio Hideiti Shimizu.



We thanks Matheus Leal Neves for preparing the map(s).

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