ANALYSIS OF HUMIDITY, ELECTRICAL CONDUCTIVITY AND PH IN SALINIZED SOILS OF IRRIGATED PERIMETER CURU-RECUPERAÇÃO, PENTECOSTE-CE

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SUMMARY: Soil salinization in the Brazilian Northeast occurs and develops rapidly, making them unsuitable for the cultivation of most agricultural species. We aim to evaluate the parameters humidity, electrical conductivity and PH in soils of irrigated perimeter Curú-Recuperação, Pentecoste-CE. There were 49 plots, divided into 6 blocks. In each plot, soil samples were collected, forming a sample composed of plot. Subsequently, the samples were dried, smashed and sieved. Determination of conductivity designed with a 1:1 solution of soil and distilled water, from pH determination with a 2.5:1 solution of the same constituents. Wet weight and dry weightwere also determined for the calculation of soil moisture. The parameter of electrical conductivity showed a significant increase of the rainy season to the dry season (between 120% and 370%), showing the influence of the characteristics of the semiarid in the process of soil salinization, since the soil moisture is directly related to the volume and distribution of rainfall. The process of salinization is alive in areas of the irrigated perimeter, being necessary works to recover it.

KEYWORDS: Salinization, Semiarid, Soils

ANÁLISE DE UMIDADE, CONDUTIVIDADE ELÉTRICA E pH EM SOLOS SALINIZADOS DO PERÍMETRO IRRIGADO CURÚ-RECUPERAÇÃO, PENTECOSTE-CE.

RESUMO: A salinização dos solos no Nordeste brasileiro ocorre e se desenvolve rapidamente tornando esses inadequados para o cultivo da maioria das espécies agrícolas. Objetivamos avaliar os parâmetros de umidade, condutividade elétrica (CE) e pH de solos salinizados no perímetro irrigado Curú-Recuperação, Pentecoste-CE. Foram marcadas 49 parcelas, divididas

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em 6 blocos. Em cada parcela foram feitas coletas de solo, formando uma amostra composta por parcela. Posteriormente, as amostras foram secadas, destorroadas e peneiradas. A determinação da CE foi realizada com uma solução 1:1 de solo e água destilada, enquanto a determinação do pH com uma solução 2,5:1 dos mesmos constituintes. Foram determinados também os pesos úmidos e secos para cálculo da umidade. O parâmetro CE mostrou um aumento da quadra chuvosa para a estação seca (entre 120% e 370%), enquanto que a umidade do solo sofreu um decréscimo (entre 147 % e 200%), mostrando a influência das características do semiárido no processo de salinização dos solos, visto que a umidade do solo está diretamente relacionada com o regime das chuvas. O processo de salinização encontra-se vivo em áreas do perímetro irrigado, sendo necessários trabalhos para recuperá-lo.

PALAVRAS-CHAVE: Salinização, Semiárido, Solos

INTRODUCTION

Soils affected by salts, known as halomorphic or saline and sodic soils, are soils that develop under inexact drainage conditions, where it is characterized by the presence of soluble salts, exchangeable sodium or both, in layers close to the surface. When the concentration of salts is high, it can damage the crop yield, thus considered a salinized soil (Ribeiro, 2010; Major & Sales, 2010). The principle of the problem of salinity implies in the soil formation itself, where it is a product of the weathering of rocks (Ribeiro et al., 2003, Ribeiro et al., 2009). The most common sources of soil salts are surface and groundwater, because the concentration is dependent on the soil salts content where the waters have been in contact (Santos, 1997; Nazário et al., 2010).

Soils generally have a dilute solution of salts in which, by being infiltrated by the roots, they promote the mineral nutrition of the plants. These soluble salts are largely equivalent in various forms to the Na^+, Ca^{++} and Mg^{++} cations and the Cl^- and $SO4^{2-}$ anions. K^+ cation and anions HCO^{-3}, $CO3^-$, $NO3^-$ usually occur at low concentrations (Munns & Tester, 2008). The excessive rates of these ions can increase the reduction in the osmotic potential of the soil solution, consequently an increase in the electrical conductivity (EC), so that for a soil to be considered saline it must present an EC of its saturated extract superior to 4.0 $dS.m^{-1}$ (Richards, 1974; Kotuby-Amacher et al., 2000).

Saline or sodic soils have a higher occurrence in arid and semi-arid regions, due to water deficit, preventing satisfactory leaching, as well as high evaporation rates, and for the same reasons they are scarce in wetlands (Chapman, 1975; Zerai et al., 2010). About 50% of all northeastern territory is considered semi-arid, where salinity is linked to sodicity, which negatively influences agricultural and livestock production, so that, in exorbitant situations, crop cultivation in general becomes impracticable (Medeiros et al., 2012).

Saline stress interferes with plant development, as it reduces the osmotic potential of the soil solution, decreasing the availability of water and / or the accumulation of ions in plant tissues, which can generate ionic toxicity, nutritional deficiency or both (Tester & Davenport, 2003).). In addition, stress may also interfere with soil microbial biomass maintenance and biochemical processes that are essential for the regulation of organic matter in the soil (Rietz & Haynes, 2003, Tripathi et al., 2006; Yuan et al., 2007). Taking into account that the prediction of human population increase is 6.1 billion in 2001, to 9.3 billion in 2050, food formation has to rise so that food security be guaranteed (Flowers, 2004).

Thus, the restructuring and rehabilitation of salinized soils is indispensable, both for the issue of the ecological balance of the sites and for the economy of the countries that present the problem, aiming at the reorganization of the cultivation system (Melo et al., 2008; Tavares Filho Et al., 2012). In view of the above, this work aimed to evaluate the parameters CE, pH and soil humidity of a salinized area of the irrigated perimeter Curu-Recuperação, in Pentecoste-CE.

MATERIAL AND METHODS

Description of the experimental área

The present research was carried out from May / 2016 to December / 2016, with collections in the rainy season and during the dry period in the region, in the D-core of the Curu-Recuperação Irrigated Perimeter in Pentecoste-CE. The climate according to the Koppen classification corresponds to the type Aw', hot and with low precipitation, with irregular rains concentrated in the months of February to May, conferring semiarid characteristics. The average annual rainfall is 817.7 mm, and the average annual evaporation is 1.474 mm, which generates a pronounced water deficit. The annual average temperature is around 26.8 ° C and average air relative humidity is 73.7%.

According to DNOCS (1976), the origin of the area occurred through alluvial or alluvial-colluvial sediments, of varied nature, causing phases stratified genetically unrelated to each other, and posed without preferential position of stratum. Alluvial soils, also called Fluvic Neosoils, are found scattered along the Canindé, Caxitoré and Curu rivers. In relation to the texture of the soils, they become smoother closer to the river beds and more intense as they approach the crystalline.

Collect and preparation of samples

A total of 49 permanent plots were randomly assigned to the experimental area, divided into 6 blocks. Within the plots, a square of PVC of 1x1m size was randomly placed, and at the vertices were marked the places where the collections would be made for soil analysis (EC, pH and humidity). The samples were taken at the four corners of the PVC square, at a depth of 0-20 cm to form a composite soil sample. Some of the soil samples were stored in hermetically sealed metal pots so that they did not gain or lose moisture. The other part of the samples was stored in properly identified plastic bags.

Samples analysis

The soil samples of the metal pots were measured and then dried in a forced aeration oven at 65 ° C to constant weight. The composite samples of the plastic bags were dried outdoors, smashed and sieved. For determination of electrical conductivity and pH, 50 mg of soil was diluted in 50 ml of distilled water and 25 mg of soil in 10 ml of water, respectively. The solutions obtained from the dilutions were decanted for 24 hours for electrical conductivity and one hour for pH. Measurements were then made using conductivity meter and potentiometer.

Statistical analysis

The averages were calculated per block for all parameters, followed by Analysis of Variance and Tukey's test, with the aid of the SAEF / UFV program, which aimed to evaluate the heterogeneity of the area, as well as the seasonal effect.

RESULTS AND DISCUSSION

The pH results, both in the rainy season and in the dry season, showed a higher alkalinity (Figure 1). From the rainy season to the dry season there was an increase in the pH of blocks 1 and 2, while a decrease in the values of blocks 3, 4, 5 and 6 could be observed. Rainfall averages were between 6.88 and 7.78 ($p = 0.222$), while the dry season averages were from 6.61 to 7.44 with statistical difference ($p = 0.018$) observed between blocks 1 and 2, 4 and 5 and 5 and 6.

It was verified that soil moisture decreased significantly from the rainy season to the dry season ($p < 0.001$), verified in all blocks (Figure 2). This decrease occurs due to the concentration of rainfall between February and May (Bezerra, 2006), making the soil stay for a long period without receiving water from the rains and exposed to the high rate of evaporation.

The electrical conductivity increased significantly between the rainy season and the dry season ($p < 0.001$), however, the increase was only significant in blocks 1 and 2 (Figure 3). The average values of the rainy season varied between 0.31 $dS.m^{-1}$ to 10.66 $dS.m^{-1}$, while dry season averages ranged from 0.88 $dS.m^{-1}$ to 51.31 $dS.m^{-1}$.

According to the classification of halomorphic soils proposed by the USSL Staff (1954), the soil of blocks 1 and 2 are considered saline soils with a saline-sodic character, with CE ≥ $dS.m^{-1}$ and pH ≤ 8.5, also known as Solonchak-Solonetzico in the old classification systems (Camargo et al., 1987). The soil of blocks 3, 4 and 5, although not considered salinized in the most commonly used classification systems, because they have a CE < 4 $dS.m^{-1}$ (Richards, 1974; Kotuby-Amacher et al., 2000, EMBRAPA, 2013), may cause a decrease in the yield of common crops in the northeastern semi-arid region, such as melon, sweet pepper, beans, sweet potatoes, potatoes and onions (Bezerra, 2006). More rigidly, the soil of these blocks can be classified as slightly saline (DNOCS, 1976) (Table 1).

Salinization in the irrigated perimeter soil could have been avoided if some practices had been adopted. Only irrigate soils with good drainage or, in the case of semi-arid regions, implement an underground drainage system are examples of recommended practices to avoid soil salinization (Batista et al., 1999). Sales et al. (2004) obtained a reduction in soil salinity in the analysis of an underground drainage system in a vineyard area in Ceará, where before the drainage installation the electrical conductivity reached values up to 10 $dS.m^{-1}$.

Although it is a more expensive system, the practice of using drip irrigation as an irrigation system is another mitigating practice. In this system, because the watering intervals are smaller, keeping the soil wetter for longer, the concentration of the soil solution is lower than in systems such as gravity and sprinkling (Bezerra, 2006).

In order to reverse the process of salinization of these soils, besides the installation of the practices mentioned above, other techniques may be applied. In the case of slightly saline blocks, periodic flooding of the soil can be adopted, while for saline-sodic blocks, in addition to flooding, the application of calcium correctives is recommended, since with the washing of this soil the percentage of exchangeable soil will increase and may become the soil unstable and have its structure destroyed (Batista, 1999).

Complementary practices, such as phytoremediation by phytoextraction, which consists in the ability of plants to concentrate elements and compounds extracted from the environment and metabolize it in their tissues, can be used (Mishra & Sangwan, 2016). A viable alternative is the use of plants of the genus *Atriplex*, since these, in addition to potential phytoremaster, have a forage interest, such as *Atriplex nummularia* that has physiological characteristics related to tolerance both salinity and drought, showing affinity in the phytoremediation process of soils of the northeastern semi-arid region (Qadir et al., 2007; Mattos, 2009).

CONCLUSION

The soil of the experimental area in the irrigated perimeter is largely salinized or in salinization process, being necessary the implementation of practices aimed at recovering this soil and makes it productive again.

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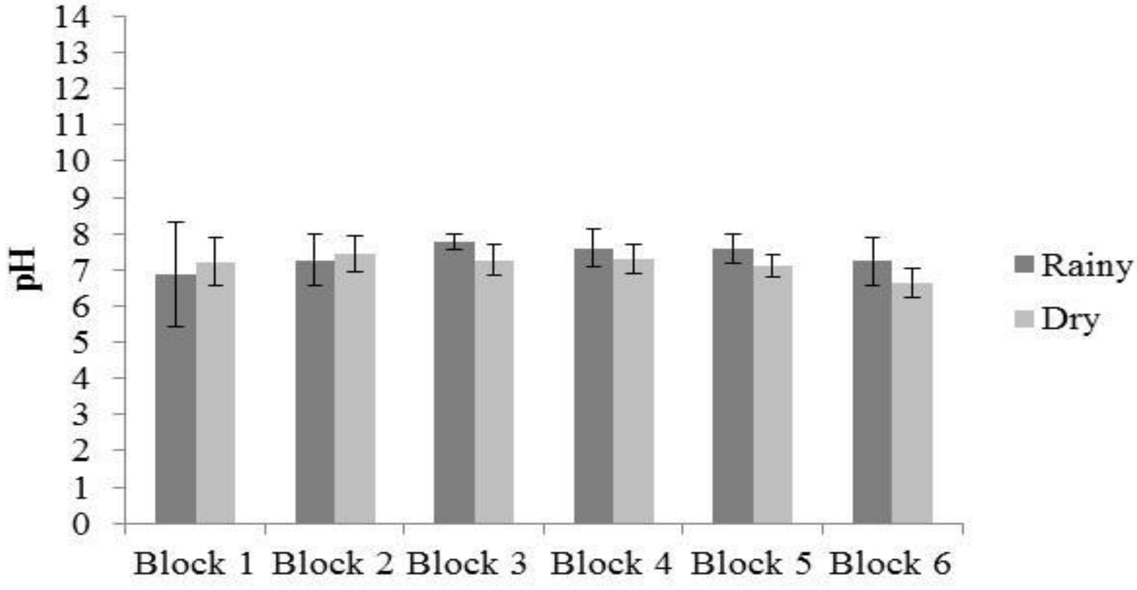

Figure 1. Soil pH values of the experimental area in the irrigated perimeter Curu-Recuperação, Pentecoste-CE, in two seasons (rainy and dry).

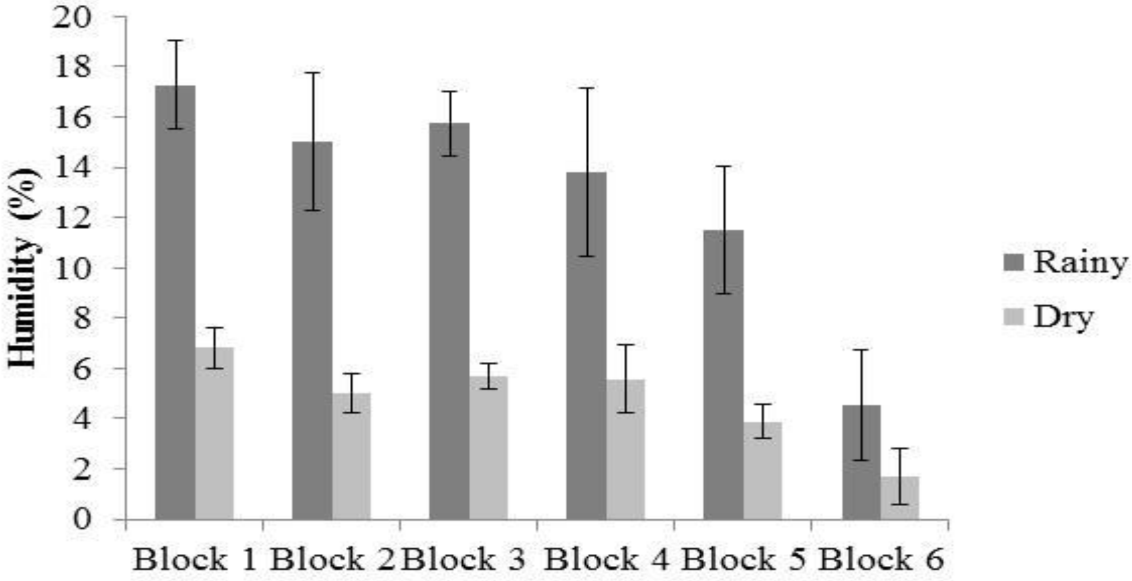

Figure 2. Soil humidity values of the experimental area in the irrigated perimeter Curu-Recuperação, Pentecoste-CE, in two seasons of the year (rainy and dry).

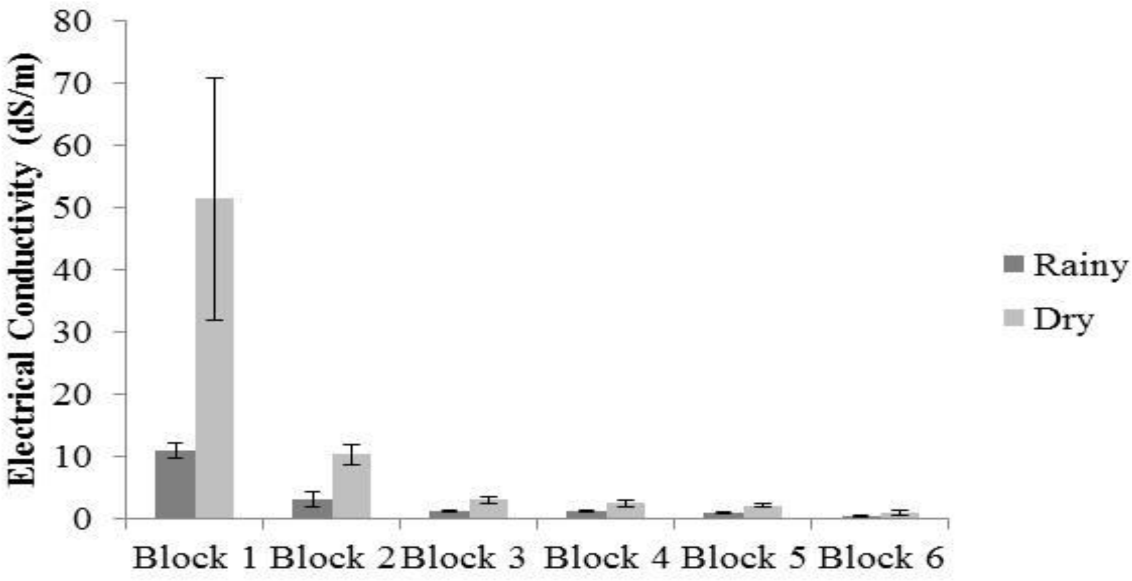

Figure 3. Electric soil conductivity values of the experimental area in the irrigated perimeter Curu-Recuperação, Pentecoste-CE, in two seasons of the year (rainy and dry).

Table 1. Soil classification, by block, of the experimental area in the irrigated perimeter Curu-Recuperação, Pentecoste-CE.

Block	Humidity (%)		pH		EC (dS.m^{-1})		Classification
	Rainy	Dry	Rainy	Dry	Rainy	Dry	
1	17,27	6,83	6,88	7,23	10,88	51,31	Saline-sodic
2	15,03	5,00	7,26	7,44	3,01	10,22	Saline-sodic
3	15,74	5,70	7,78	7,25	1,12	3,00	Slightly saline
4	13,80	5,58	7,60	7,30	1,06	2,35	Slightly saline
5	11,50	3,90	7,59	7,10	0,85	2,00	Slightly saline
6	4,53	1,69	7,24	6,61	0,31	0,88	Normal