INOVAGRI International Meeting
XXVIII CONIRD
I Simpósio Latino Americano de Salinidade

DETERMINATION OF REDUCING SUGARS IN AFRICAN MAHOGANY ROOTS EXPOSED TO SALT STRESS

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ABSTRACT: The Khaya senegalensis is a species of the family Meliaceae, known as African mahogany in Brazil. Its wood is considered noble because of the similarities with Brazilian mahogany (*Swietenia macrophylla*) in terms of its physical and mechanical properties, making it a good option to meet the growing demand of noble forest products for the furniture industry. The objective of this work was to determine the content of reducing sugars in african mahogany roots exposed to saline stress. The experiment was conducted in a completely randomized design, in a greenhouse on the campus of the State University of Southwest of Bahia. Seedlings with 180 days of age were submitted to nutrient solutions with different concentrations of sodium chloride (NaCl) where they varied between 00, 145, 270, 395 and 520 mM, resulting in the electrical conductivities (EC) 3.4, 15.1, 29.9, 2.6 and 53.6 dS m^{-1}, respectively. Significant differences ($p<0.05$) were observed among saline treatments in relation to control. It is found that salinity negatively affects the EC of 3.4 dS.m-1 in mahogany plants, thus revealing an increase in reducing sugar contents.

KEYWORDS: carbohydrates, Khaya senegalensis, salinity

DETERMINAÇÃO DE AÇÚCARES REDUTORES EM RAIZES DE MOGNO AFRICANO EXPOSTAS AO ESTRESSE SALINO

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RESUMO: A *Khaya senegalensis* é uma espécie da família Meliaceae, conhecida como mogno africano no Brasil. A sua madeira é considerada nobre devido às semelhanças com a madeira do mogno brasileiro (*Swietenia macrophylla*) quanto às propriedades físicas e mecânicas, tornando-a uma boa opção para atender a demanda crescente de produtos florestais nobres para a indústria moveleira. O objetivo deste trabalho foi determinar o teor de açúcares redutores em raízes de mogno africano expostas ao estresse salino. O experimento foi conduzido em delineamento inteiramente ao acaso, em casa de vegetação no campus da Universidade Estadual do Sudoeste da Bahia. Mudas com 180 dias de idade foram submetidas a soluções nutritivas com diferentes concentrações de cloreto de sódio (NaCl) onde variaram entre 00, 145, 270 395 e 520 mM, resultando nas condutividades elétricas (CE) 3,4; 15,1; 29,9; 2,6 e 53,6 dS m-1, respectivamente. Diferenças significativas ($p<0,05$) foram verificadas entre os tratamentos salinos em relação ao controle. Verifica-se que a salinidade afetou negativamente na CE de 3,4 $dS.m^{-1}$ nas plantas de mogno, revelando assim, um aumento nos teores de açúcares redutores.

PALAVRAS-CHAVE: carboidratos, *Khaya Senegalensis*¸ salinidade

INTRODUCTION

Khaya senegalensis is of African origin belonging to the family Meliaceae, the same family of native mahogany, andiroba and cedar. Its wood is considered noble because of the similarities with the Brazilian mahogany (*Swietenia macrophylla*) wood as regards physical and mechanical properties, making it a good option to meet the growing demand of noble forest products for the furniture industry (Pinheiro et al., 2011).

Soil salinization is a problem that has been growing all over the world. It is estimated that there are about 1 to 5 billion hectares of salt-affected soils, with most of the world's irrigated areas suffering from reduced production due to excess salts in the soil (Pedrotti et al, 2015). In Brazil, the problem is verified in every country, especially in the Northeast, where approximately 25% of the irrigated areas were salinized (Pedrotti et al., 2015). According to Freire et al. (2010), the ability of plants to survive under saline conditions is important for their geographic distribution and for agriculture in the salinized regions.

It is necessary to use species that tolerate this condition and, if possible, to be able to improve the physical and chemical characteristics of this soil, which can be achieved by planting fast-growing, salinity-tolerant tree species. However, in order to be successful, it is necessary to know the effects of salinity on the development of the species to be cultivated and its degree of tolerance to this adverse condition (Freire et al., 2010).

Thus, the objective of the work was to determine the sugar content of the mahogany roots exposed to saline stress.

MATERIAL AND METHODS

The study was carried out in a greenhouse at the State University of the Southwest of Bahia (UESB), at the campus of Vitória da Conquista-BA, with coordinates 14° 53' 17" South latitude, 40° 48' 9" west longitude and 875 m altitude. According to Köppen, the municipality presents a tropical climate of altitude with summer rains and winter drought, with average annual temperature of 20ºC, being classified as *Cwb*.

The treatments were conducted in a completely randomized design with six saline treatments with four replicates, totaling 24 experimental plots. Mahogany seedlings with 180 days of age were later transferred to vessels with a capacity of 15 dm³. The plants were submitted to nutrient solutions (Hoagland & Arnon, 1950) with different concentrations of NaCl (00, 145, 270, 395 and 520 mM), resulting in the electrical conductivities 3.4, 15.1, 29.9, 26 and 53.6 dS m^{-1}, respectively, so that the values included classes from low to very high salinity. The addition of NaCl to the nutrient solution was performed every 15 days, and the electrical conductivity (EC) was measured by means of a portable conductivity meter.

To determine the reducing sugar content (SR), roots were collected after the end of the experiment (120 days after treatment) and dried in a forced circulation oven (65 ± 5°C) until reaching a constant mass. After drying, the samples were crushed in a knife mill and then stored for further analysis. Was weighed 0.2 g of dry roots to obtain the extract. For this, in 15 mL of buffer solution 0.1 M potassium phosphate were used as extractor. The total volume was divided into three equal volumes for three 45 minute centrifuges at 2.500 rpm. The supernatant was collected for quantification of SR by the dinitrosalicyclic acid method (DNS), as described by Miller (1959). The method consisted in the addition of a 0.6 mL aliquot of the extract to 0.5 mL of DNS and 0.4 mL of deionized water, totalizing a reaction volume of 1.5 mL, which was submitted to the water bath, 100°C for five minutes. After cooling to room temperature, 3.5 mL of deionized water was added, making up to 5.0 mL. The reading was then carried out in a spectrophotometer at 540 nm.

The data were subjected to analysis of variance by the F test at 5% probability and the averages compared by the Tukey test at 5% probability.

RESULTS AND DISCUSSION

There were significant differences ($p < 0.05$) between the treatments, except for the conductivities 15.1, 29.9 and 2.6 dS m^{-1} (Figure 1). According to Sousa et al. (2010), analyzing the content of reducing sugars in *Jatropha curcas* did not obtain significant differences for four treatments. In the literature, accumulation of osmotically compatible organic compounds under stress conditions has been reported, reflecting the ability of some species to osmotically adjust to adverse conditions.

However, salinity may cause an imbalance between carbohydrate and nitrogen compounds (Silva et al., 2010). By analyzing the conductivity 3.4 dS m^{-1}, treatment with NaCl was relatively superior to the control. According to Sousa et al. (2012), reducing sugars were increased in plants under saline stresses. And this increase may be related to several factors. Bezerra et al. (2003) state that photosynthetic activity is less sensitive to saline stress than growth, which promotes an extra photoassimilate production that is not readily used by the plant and consequently accumulates as a compatible solute.

For the electrical conductivity of 53.6 dS m^{-1}, it is observed that this level of salinity already begins to interfere in the processes of the plant. Salinity negatively affects the photosynthetic assimilation of CO_2 and decreases growth, and consequently, plant productivity. SR are part of the non-structural sugars whose contents environmental variations and injuries suffered by plants are sensitive.

They are sugars used to evaluate plant responses to stress conditions (Bennett et al., 2005). According to Freire et al. (2010), this high concentration of solutes in the solution of the soil causes a water deficit by reducing the osmotic potential, affecting the root absorption capacity of the plant and consequently its metabolism, besides the direct effect of the ions, causing nutritional disturbance of the plant, thus hindering its development. It is believed that concentrations above the ideal trigger several biochemical reactions of perception and expression of genes linked to the stress modulator factor (presence of ions, osmotic potential, changes in turgescence pressure).

Then, to verify the modifications of the plants, involving protein synthesis and hormonal balance. It is believed that these two processes are responsible for the visual symptomatology of ionic toxicity such as foliar chlorosis (chlorophyll degradation) and appearance of necrotic points in the leaf limb (symptoms of apoptosis or cell death) (Silveira et al., 2010).

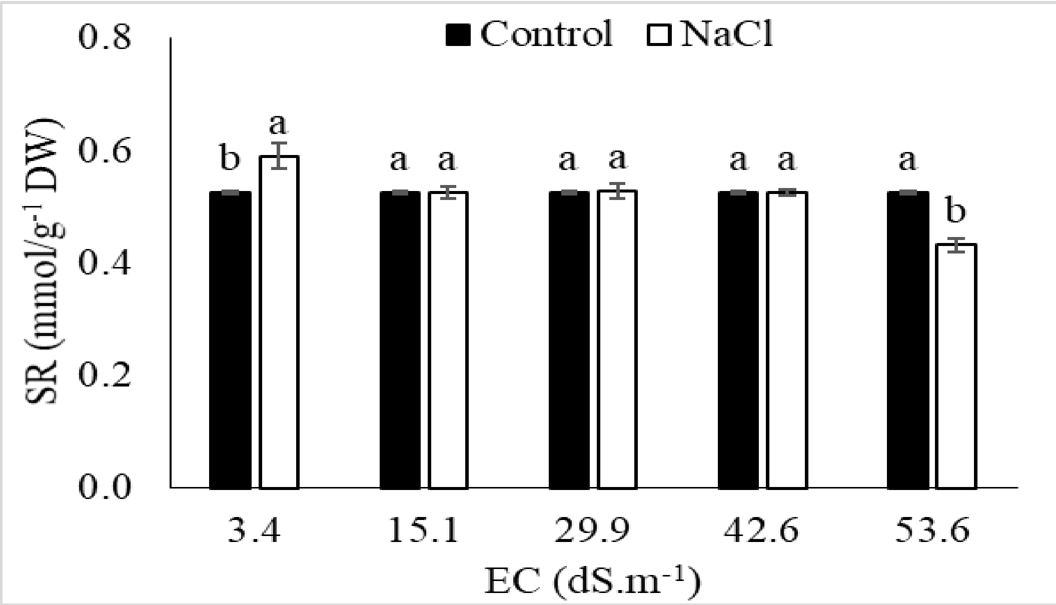

Figure 1. Reducing sugar content (SR) in african mahogany roots exposed to saline stress at 120 DAT. The columns are averages of 4 replicates and the bars represent the standard error of the mean. Lowercase letters indicate a comparison between the effects of control plants and NaCl treatments by the Tukey test ($p < 0.05$).

CONCLUSIONS

Salinity is an important factor in the growth and development of the plant because it affects several biochemical processes until it reaches the final product. Thus, the reducing sugars content in african mahogany roots was modified according to their concentration.

ACKNOWLEDGEMENTS

To UESB for granting scholarship to the first author. To CNPq, FAPESB and CAPES for the PNPD scholarship.

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