SUGAR TOTAL SOLUBLE IN LEAVES AND ROOTS OF AFRICAN MAHOGANY UNDER SALT STRESS

Mateus Pires Barbosa[1], Leando Dias da Silva[2], Raul Antônio do Bomfim[3], Mikaela Souza Oliveira[4], Paulo Araquém Ramos Cairo[5], Matheus Ferreira Almeida[6]

ABSTRACT: The african mahogany (*Khaya senegalensis*) cultivation in recent years has been prospected in Brazil, due to intrinsic characteristics of the species such as wood quality and economic value added to the crop, which has applicability in the industry. With the distribution of crop production in the country, environments with diverse concentrations of salinity may interfere with the dry matter production of the plant. In this aspect, the objective of this work was to evaluate the effect of sodium chloride (NaCl) concentrations on total soluble sugars (SST) on roots and leaves of african mahogany young plants. The experiment was carried out in a greenhouse on the campus of the State University of Southwest Bahia-Vitória da Conquista-BA, in which the seedlings were cultivated in pots with a capacity of 15 dm³, submitted to nutrient solutions with different concentrations of NaCl (00, 20, 145, 270, 395 and 520 mM), whose concentrations corresponded to the following levels of electrical conductivity (EC): 0.0, 3.3, 15.1, 29.9, 42.6 and 53.6 dS m^{-1}). The experimental design was completely random, with six treatments and four replications, totaling 24 experimental plots. Significant differences between the salinity treatments and the control plants were verified in the leaves. However, in the roots there were differences for the EC of 3.4, 15.1 and 29.9 dS m^{-1}, where they showed higher levels of SST. For the remaining EC in roots, no significant differences were found.

KEYWORDS: abiotic stress, carbohydrate, *Khaya senegalensis*

[1] Discente em Agronomia, Departamento de Fitotecnia e Zootecnia, UESB, Estrada do Bem Querer km 04, Caixa Postal, 95, CEP 45031-900, Vitória da Conquista, BA, (77) 991405040, e-mail: mateus_pbarbosa@hotmail.com
[2] Pós-Doutorando, Programa de Pós-Graduação em Agronomia, UESB, Vitória da Conquista, BA.
[3] Discente em Agronomia, Departamento de Fitotecnia e Zootecnia, UESB, Vitória da Conquista, BA.
[4] Discente em Agronomia, Departamento de Fitotecnia e Zootecnia, UESB, Vitória da Conquista, BA.
[5] Prof. Doutor, Departamento de Fitotecnia e Zootecnia, UESB, Vitória da Conquista, BA.
[6] Discente em Agronomia, Departamento de Fitotecnia e Zootecnia, UESB, Vitória da Conquista, BA.

AÇÚCARES SOLÚVEIS TOTAIS EM FOLHAS E RAIZES DE MOGNO AFRICANO SUBMETIDAS AO ESTRESSE SALINO

RESUMO: O cultivo de mogno africano (*Khaya senegalensis*) nos últimos anos tem sido prospectado no Brasil, devido a características intrínsecas das espécies, como qualidade da madeira e valor econômico agregado à safra, com aplicabilidade na indústria. Com a distribuição da produção agrícola no país, ambientes com diversas concentrações de salinidade podem interferir na produção de matéria seca da planta. Nesse aspecto, o objetivo deste trabalho foi avaliar o efeito das concentrações de cloreto de sódio (NaCl) sobre os açúcares solúveis totais (SST) nas raízes e folhas de plantas jovens de mogno africano. O experimento foi realizado em casa de vegetação no campus da Universidade Estadual do Sudoeste da Bahia-Vitória da Conquista-BA, no qual as mudas foram cultivadas em vasos com capacidade de 15 dm^3, submetidos a soluções nutricionais com diferentes concentrações de NaCl (00, 20, 145, 270, 395 e 520 mM), cujas concentrações corresponderam aos seguintes níveis de condutividade elétrica (CE): 0,0, 3,3, 15,1, 29,9, 42,6 e 53,6 dS m^{-1}). O delineamento experimental foi inteiramente casualizado, com seis tratamentos e quatro repetições, totalizando 24 parcelas experimentais. Diferenças significativas entre tratamentos de salinidade e plantas controle foram verificadas nas folhas. No entanto, nas raízes houve diferenças para a CE de 3,4, 15,1 e 29,9 dS m^{-1}, onde apresentaram níveis mais altos de SST. Para o CE restante nas raízes, não foram encontradas diferenças significativas.

PALAVRAS-CHAVE: manejo da irrigação, Blaney e Criddle, Penman-Montheith

INTRODUCTION

The forest sector in Brazil has been developing in search of better sustainability with a focus on soil management, pulp production to supply the industry and commercialization of wood, increasing reforestation rates and avoiding the deforestation of native preservation woods environmental (IBÁ, 2017).

The planting of african mahogany in Brazil has been growing on a commercial scale, due to the large size, quality of the wood and the high economic value added to the crop. Its wood is used for shipbuilding, furniture manufacturing, flooring, interior and exterior decoration (PINHEIRO et al., 2011).

Areas with salt concentrations increase considerably with deforestation and irrigation management. Saline stress can influence the physiological development of plants and may vary according to plant phenotype, genotype and tissue identity, thus presenting different responses in plant physiology (Willadino & Camara, 2010). One of the effects of excess salts on the plant is osmotic stress, which causes disturbances in water relations, changes in nutrient absorption, loss of turgor and accumulation of toxic ions.

Impacts of water deficit on physiological processes generally increase stomatal resistance, reducing transpiration and therefore the supply of CO_2 for the photosynthesis process. (SANTANA et al., 2015). Therefore, knowledge of the physiological and biochemical mechanisms involved with all levels of plant responses to water deficit generates great interest (SLAMA et al., 2007).

However, the responses to this stress occur through innumerable physiological processes, such as compartmentalization, osmotic adjustment, accumulation of compatible osmolytes, selective absorption and salt excretion (Nepomuceno et al., 2001; Willadino & Camara, 2010). Due to few studies on salinity and its effects on the physiology of african mahogany, the objective of this work was to evaluate the effect of salt concentrations on total soluble sugars in roots and leaves of african mahogany plants.

MATERIAL AND METHODS

The experiment was carried out in a greenhouse on the campus of the State University of Southwest Bahia-Vitória da Conquista-BA with coordinates: 14° 51' 53" South, 40° 50' 13" West. According to Köppen and Geiger the climate classification is *Cwb*. With average temperature of 20 °C and average annual precipitation of 712 mm. African mahogany seedlings were grown in pots with a capacity of 15 dm^3, submitted to nutritional solutions according to Hoagland e Arnon (1950) with different concentrations of NaCl (00, 20, 145, 270, 395 and 520 mM), whose concentrations corresponded to the following levels of electrical conductivity (EC): 0.0, 3.3, 15.1, 29.9, 42.6 and 53.6 dS m^{-1}).

The experimental design was completely random, with six treatments and four replications, totaling 24 experimental plots. For the extraction of total soluble sugars (SST), 15 mL of 0.1M potassium phosphate buffer solution were used as extractors for each 200 mg of homogenized and comminuted dry matter.

The total volume of the extractor was divided into three equal volumes, to achieve three centrifugation 30 minutes at 4000 rpm. The supernatant was collected as an extract and quantification of SST was performed by the anthrone method, as described in Yemm & Willis (1954). 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 between the control and sodium chloride (NaCl) concentration in leaf tissue (Figure 1), thus demonstrating a higher total soluble sugar content (SST) in the control. Amorim Filho et al. (2010), also verified that the content of soluble sugars in adult cashew plants was higher in plants not submitted to saline concentrations. This decrease in SST levels may be associated with cellular ion imbalance, resulting in osmotic stress that significantly reduces membrane permeability, growth and production.

Therefore, this ionic effect causes a nutrient imbalance and reduction of the photosynthetic rates, causing reduction in carbohydrates supplied by photosynthesis important for cell growth (Hanny & Bahaa, 2016). The values of SST in roots showed a significant difference for treatments with electric conductivities (EC) of 3.4, 15.1 and 29.9 dS m^{-1}, showing a higher content in plants submitted to NaCl concentrations. However, for EC treatments of 42.6 and 53.6 dS m^{-1}, there were no significant differences (Figure 2).

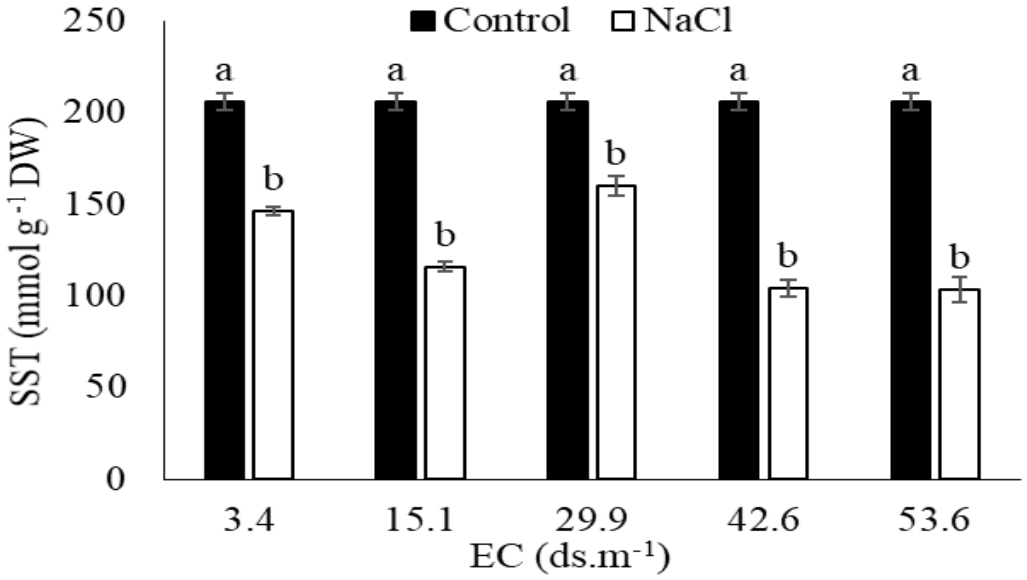

Figure 1. Total soluble sugars (SST) in leaves of african mahogany submitted to saline stress at 120 DAT. The columns are averages of 4 replicates and the bars represent the standard error of the mean. Lowercase letters indicate a comparison between the effects of control plants and NaCl treatments by the Tukey test ($p < 0.05$).

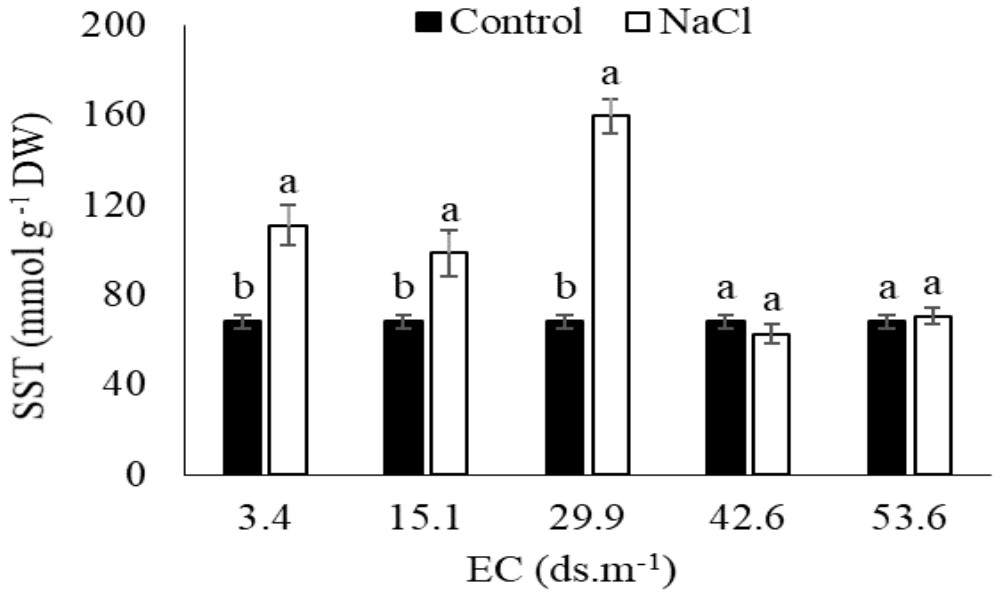

Figure 2. Total soluble sugars (SST) in African mahogany roots submitted to saline stress at 120 DAT. The columns are averages of 4 replicates and the bars represent the standard error of the mean. Lower case letters indicate a comparison between the effects of control plants and treatments with NaCl by the Tukey test ($p < 0.05$).

CONCLUSIONS

Salinity had a negative effect on the african mahogany plants, with the roots being affected by the leaves, which were more affected by the increase in the SST content in the EC of 3.4, 15.1 and 29.9 $dS.m^{-1}$.

ACKNOWLEDGEMENTS

To CNPq, FAPESB, CAPES and UESB.

BIBLIOGRAPHIC REFERENCES

AMORIM FILHO, A.V;, E.G; BEZERRA, M.A; PRISCO, J.T; E LACERDA, C.F. Respostas fisiológicas de plantas adultas de cajueiro anão precoce à salinidade. **Revista Ciência Agronômica**, v. 41, n. 1, p. 113-121, 2010.

ARNOLD, R. *Khaya senegalensis*– current use from its natural range and its potential in Sri Lanka and elsewhere in Asia. In: **Prospects for high-value hardwood timber plantations in the 'dry' tropics of Northern Australia**. Proceedings of a Workshop held in Mareeba. Mareeba: Department of Primary Industries and Fisheries, 2004, p. 1-8.

HANY, S.O.; BAHAA, B.M.S. Influence of exogenous application of some phytoprotectants on growth, yield and pod quality of snap bean under NaCl salinity. **Annals of Agricultural Science**, v. 61, n. 1, p. 1-13, 2016.

HOAGLAND, D.R.; ARNON, D. I. The water culture method for growing plants without soils. Berkeley**: California Agricultural Experimental Station**, 347p., 1950.

IBÁ. Indústria Brasileira de Árvores. Relatório 2017. Disponível em: <https://www.iba.org/datafiles/publicacoes/pdf/iba-relatorioanual2017.pdf>. Acesso em: 25 maio de 2019.

NEPOMUCENO, A.L.; NEUMAIER, N.; FARIAS, J.R.B.; OYA, T. Tolerância à seca em plantas: mecanismos fisiológicos e moleculares. **Biotecnologia Ciência e Desenvolvimento**, v.23, p.12-18, 2001.

PINHEIRO, A.L, COUTO, L, PINHEIRO, D.T, BRUNETTA, J.M.F.C. Ecologia, silvicultura e tecnologia de utilização dos mognos-africanos (*Khaya* spp.). Viçosa, MG: **Sociedade Brasileira de Agrossilvicultura**, p. 102, 2011.

SANTANA, T.A.; OLIVEIRA, P.S.; SILVA, L.D.; LAVIOLA, B.G.; ALMEIDA, A-A.F.; GOMES, F.P. Water use efficiency and consumption in different Brazilian genotypes of *Jatropha curcas* L. subjected to soil water deficit. **Biomass & Bioenergy** 75: 119-125, 2015.

SLAMA, I.; GHNAYA, T.; HESSINI, K.; MESSEDI, D.; SAVOURÉ, A.; ABDELLY, C. Comparative study of the effects of mannitol and PEG osmotic stress on growth and solute accumulation in *Sesuvium portulacastrum*. **Environmetal Experimental Botany**, 61:10-17, 2007.

WILLADINO, L.E.; CAMARA, T.R. Tolerância das plantas à salinidade: aspectos fisiológicos e bioquímicos. **Enciclopédia Biosfera**, v. 6, n. 11, p., 2010.

YEMM, E.W.; COCCKING, E.C. The determination of amino acid with ninhydrin. **Analyst**, v. 80 p. 209-213, 1955.