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LIFE SCIENCE AND BIOMEDICINE
NOVEL-RESULT
SUPPLEMENTARY-RESULT

Salinity decreases transpiration of sorghum plants

Miguel Julio Machado Guimarães[1,*], Welson Lima Simões[2], Juliane Rafaele Alves Barros[3] and Lilia Gomes Willadino[4]

[1]Programa de Pós-Graduação em Engenharia Agrícola, Universidade Federal do Vale do São Francisco, Juazeiro, BA, Brazil., [2]Embrapa Semiárido, Petrolina, PE, Brazil., [3]Programa de Pós-Graduação em Recursos Genéticos Vegetais, Universidade Estadual da Bahia, Feira de Santana, Bahia, Brazil., and [4]Departamento de Biologia, Universidade Federal Rural de Pernambuco, Recife, PE, Brazil.
*Corresponding author: Email: mjmguimaraes@hotmail.com

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Abstract
Growing in a saline environment causes changes in important physiological processes that are directly related to plant growth and development. In this study we evaluated the effect of salinity on transpiration of sorghum plants in semi-arid conditions and found that the highest rates of transpiration were observed in the hottest hours of the day, between 10 a.m. and 3 p.m., with plants subjected to the saline environment having their transpiration reduced by up to 70% when compared to the non-saline environment. This behavior can be reflected in reductions in plant growth and development due to reduced water absorption by the roots, consequently causing an imbalance of nutrients in the plant due to low absorption rate and competition between nutrients and salts in the preferred routes of absorption in the roots.

Keywords: water consumption; semi-arid conditions; salinity; *Sorghum bicolor* (L.) Moench

Introduction

Salinity is one of the most severe environmental stresses and the responses given by plants are diverse. These are reflected in physiological variables (stomach conductance, rate of perspiration and photosynthesis) (Freire et al., 2014), biometrics (height, leaf area, biomass production) (Guimarães et al., 2019), biochemistry (antioxidant enzymes) (Barbosa et al., 2014). *Sorghum bicolor* (L.) Moench is a crop species that presents C4 mechanism, and is one of the most versatile and efficient species in terms of photosynthetic mechanism (Berenguer & Faci, 2001). This contributes to its greater resistance to adverse conditions. The tolerance of plants to salinity is associated with the development of mechanisms that contribute to minimize salt stress. Theses mechanisms have different energy costs for the plants, which negatively affect plant gas exchange, and consequently plant growth and development (Hassanein et al., 2010).

Objective

The objective of the present study was to evaluate the influence of saline water irrigation on the transpiration of sorghum (*Sorghum bicolor* (L.) Moench) plants under semi-arid conditions.

Methods

The study was conducted in a controlled environment in the semi-arid region of Brazil. During the experiment period the average relative humidity was 48.72% and the temperature around 26.86 °C. The

maximum evapotranspiration observed was 7.28, with an average of 6.03 mm day^{-1}. Sorghum seeds (*Sorghum bicolor* (L.) Moench), Ponta Negra variety, were seeded in 25 plastic pots of 20 dm^3, filled with medium-textured soil, totalizing five repetitions per treatment. The plants were submitted to irrigation with the following salinity levels: 0.0; 1.5; 3.0; 6.0 and 12.0 dS m^{-1}. For irrigation management, weight lysimeters were installed with an electronic data collection system that recorded the weight of the pots every 15 minutes. Irrigation was performed by applying a leaching fraction of 15% to prevent the accumulation of salts in the soil. At 60 days after seeding the total leaf area of the plants was determined. Transpiration was determined from the weight differences recorded in the weight lysimeters.

Results

There was a linear reduction of the total leaf area of the plants with an increase in the salinity of the water used for irrigation, which contributed to lower perspiration values of the plants submitted to the higher salinity levels. It was observed that specific transpiration (represented by the ratio of transpired water volume per square meter of leaf area) decreased with the increase in salinity (Fig. 1), evidencing the effect of salts on the gas exchange of sorghum plants. Plants submitted to higher salinity levels generally presented lower transpiration values at all times evaluated. The highest values of transpiration were observed in the range of 10 a.m. to 3 p.m. (Fig. 2), being in accordance with the climatic data of the region,

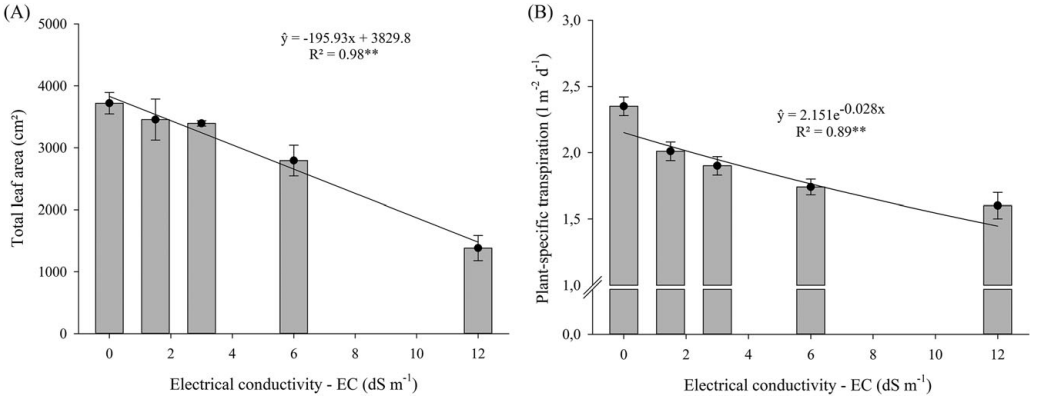

Figure 1. Total leaf area (A) and plant-specific transpiration (B) of sorghum submitted to salinity levels. Error bars with standard deviation. (**) Significant regression coefficient with $p < 0.01$.

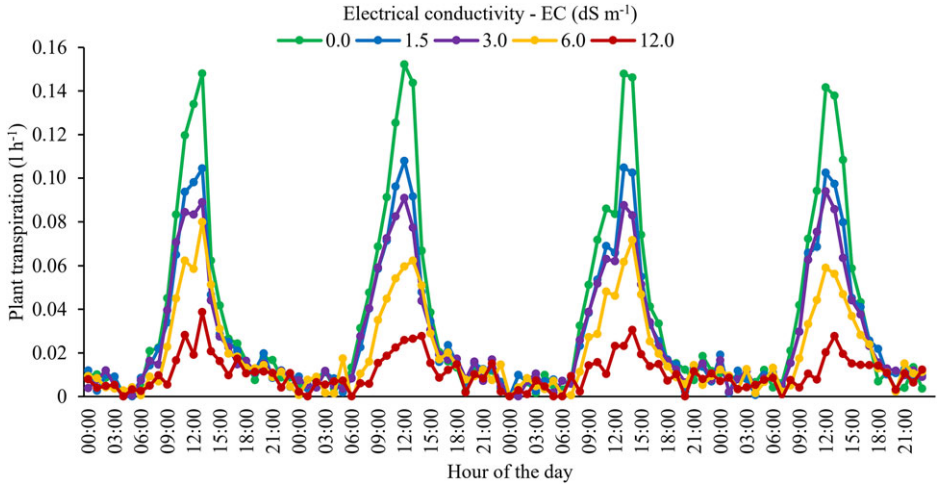

Figure 2. Daily variation of transpiration of sorghum submitted to salinity levels.

which presents higher temperatures in the range that the highest transpiration was registered, considering that one of the main functions of transpiration is the regulation of plant temperature.

Discussions

Reductions in gas exchange of plants subjected to saline environments are associated with the osmotic effect on plant metabolism (Silva et al., 2013). Studies with fodder sorghum have shown that the continuous use of water with salinity above the threshold of the crop reduces the rate of transpiration due to partial closure of the stomata (Coelho et al., 2018). Liu et al. (2015) reported a direct influence of salinity on the water and photosynthetic relationships of sorghum leaves. Heidari (2009) reported that the potential for negative water in sorghum leaves affected by salt resulted in reduced transpiration of the evaluated plants, corroborating with the data presented in this study.

Conclusions

The present results indicate that the salinity of irrigation water has strong interference with transpiration of sorghum plants. The reductions in transpiration observed in this work may reflect in reductions in plant growth and development, since transpiration is a physiological process that encompasses the passage of water through the entire body of the plant, from its absorption at the roots to evaporation at the surface of the leaves through the stomata, having a direct relationship with the absorption and distribution of nutrients in the plant.

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Author Contributions. WLS and LGW conceived the study. MJMG conducted data collection, performed statistical analyses. MJMG and JRAB wrote the article.

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Conflicts of Interest. All authors declare no conflicts of interest.

Data availability. The authors confirm that the data supporting the findings of this study are available within the article and/or its supplementary materials. If additional data is required, is available from the corresponding author, [MJMG], upon reasonable request.

Supplementary Materials. To view supplementary material for this article, please visit http://dx.doi.org/10.1017/exp.2020.22.

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Peer Reviews

Reviewing editor: Dr. Richard Erickson

US Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Rd, La Crosse, Wisconsin, United States, 54603

This article has been accepted because it is deemed to be scientifically sound, has the correct controls, has appropriate methodology and is statistically valid, and met required revisions.

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Review 1: Salinity decreases transpiration of sorghum plants

Reviewer: Gilmara Moreira Oliveira

FACEPE

Date of review: 30 April 2020
Published online:

Conflict of interest statement. Reviewer declares none.

Comments to the Author: Dear all The text is clearly written and well-designed. Also the the data is valid, presented clearly and ready to be published. I would like to offer just some simple suggestions:1. Figure 1: Insert identification (e.g. A and B).2. References with three or more authors should be quoted with the first author followed by et al. in italic.

Score Card

Presentation

5.0 /5

Is the article written in clear and proper English? (30%)	5/5
Is the data presented in the most useful manner? (40%)	5/5
Does the paper cite relevant and related articles appropriately? (30%)	5/5

Context

4.8 /5

Does the title suitably represent the article? (25%)	5/5
Does the abstract correctly embody the content of the article? (25%)	5/5
Does the introduction give appropriate context? (25%)	4/5
Is the objective of the experiment clearly defined? (25%)	5/5

Analysis

Does the discussion adequately interpret the results presented? (40%)	4/5
Is the conclusion consistent with the results and discussion? (40%)	5/5
Are the limitations of the experiment as well as the contributions of the experiment clearly outlined? (20%)	5/5

doi:10.1017/exp.2020.22.pr2

Review 2: Salinity decreases transpiration of sorghum plants

Reviewer: Dr. Iug Lopes

Instituto Federal de Educação Ciência e Tecnologia Baiano, Agronomy, Salvador, Brazil, 41720-052

Date of review: 05 May 2020
Published online:

Conflict of interest statement. None.

Comments to the Author: The manuscript has international relevance, as agricultural culture is widely used and there are large regions that present soil salinity problems. Corrections must be made for the purpose of presenting numerical and statistical results. Once these corrections have been made, the article has potential for publication.The article presents a good discussion and has scientific merit. The article must be accepted after corrections.

Score Card

Presentation

3.9 /5

Is the article written in clear and proper English? (30%)	4/5
Is the data presented in the most useful manner? (40%)	3/5
Does the paper cite relevant and related articles appropriately? (30%)	5/5

Context

4.5 /5

Does the title suitably represent the article? (25%)	5/5
Does the abstract correctly embody the content of the article? (25%)	4/5
Does the introduction give appropriate context? (25%)	4/5
Is the objective of the experiment clearly defined? (25%)	5/5

Analysis

3.6 /5

Does the discussion adequately interpret the results presented? (40%)	4/5
Is the conclusion consistent with the results and discussion? (40%)	3/5
Are the limitations of the experiment as well as the contributions of the experiment clearly outlined? (20%)	4/5

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Review 3: Salinity decreases transpiration of sorghum plants

Reviewer: Dr. Jucicléia Soares da Silva

Empresa Brasileira de Pesquisa Agropecuária, Embrapa Semiárido , Rodovia BR-428, Km 152, s/n - Zona Rural , Petrolina, Pernambuco, Brazil, 56302-970

Date of review: 08 May 2020
Published online:

Conflict of interest statement. Reviewer declares none.

Comments to the Author: Artigo de grande relevância cientifica.

Score Card

Presentation

4.7 /5

Is the article written in clear and proper English? (30%)	4/5
Is the data presented in the most useful manner? (40%)	5/5
Does the paper cite relevant and related articles appropriately? (30%)	5/5

Context

5.0 /5

Does the title suitably represent the article? (25%)	5/5
Does the abstract correctly embody the content of the article? (25%)	5/5
Does the introduction give appropriate context? (25%)	5/5
Is the objective of the experiment clearly defined? (25%)	5/5

Analysis

5.0 /5

Does the discussion adequately interpret the results presented? (40%)	5/5
Is the conclusion consistent with the results and discussion? (40%)	5/5
Are the limitations of the experiment as well as the contributions of the experiment clearly outlined? (20%)	5/5