

## CRESCIMENTO INICIAL DE CULTIVARES DE GERGELIM SOB ESTRESSE SALINO

MARIA JARDEANE LOPES PEREIRA<sup>1</sup>; GEOVANA FERREIRA GOES<sup>2</sup>; JULIANO JOSÉ CÓ<sup>3</sup>; SAMUEL DE OLIVEIRA SANTOS<sup>4</sup> E GEOCLEBER GOMES DE SOUSA<sup>5</sup>

<sup>1</sup>Instituto de Desenvolvimento Rural - IDR, Universidade da Integração Internacional da Lusofonia Afro-Brasileira-UNILAB, (Avenida da Abolição, 3, centro, 62.790-000, Redenção/CE); Brasil, E-mail: jardeanelopes290@gmail.com; (0009-0000-6111-5889)

<sup>2</sup>Departamento de Engenharia Agrícola, Universidade Federal do Ceará-UFC, (Av. Mister Hull, s/n, Pici, 60455-760, Fortaleza/CE, Brasil); Brasil, E-mail: ggoes64@gmail.com; (0000-0002-1699-1537).

<sup>3</sup>Instituto de Desenvolvimento Rural - IDR, Universidade da Integração Internacional da Lusofonia Afro-Brasileira-UNILAB, (Avenida da Abolição, 3, centro, 62.790-000, Redenção/CE); Brasil, E-mail: julianog@aluno.unilab.edu.br; (0009-0001-0243-1504).

<sup>4</sup>Departamento de Engenharia Agrícola, Universidade Federal do Ceará-UFC, (Av. Mister Hull, s/n, Pici, 60455-760, Fortaleza/CE); Brasil, E-mail: samueloliveira1111@gmail.com; (0000-0002-1057-8274).

<sup>5</sup>Instituto de Desenvolvimento Rural - IDR, Universidade da Integração Internacional da Lusofonia Afro-Brasileira-UNILAB, (Avenida da Abolição, 3, centro, 62.790-000, Redenção/CE, Brasil); Brasil, E-mail: sousagg@unilab.edu.br; (0000-0002-1466-6458).

### 1 RESUMO

A irrigação com água salobra é um desafio para o desenvolvimento inicial das culturas agrícolas. Deste modo, objetivou-se avaliar os efeitos do estresse salino na emergência, crescimento e biomassa de cultivares de gergelim. A pesquisa foi realizada na Unidade de Produção de Mudas das Auroras, vinculada à Universidade da Integração Internacional da Lusofonia Afro-Brasileira, Redenção, Ceará. O delineamento utilizado foi inteiramente casualizado, com 5 repetições em esquema fatorial 3 x 5, sendo o primeiro fator três cultivares de gergelim (C1= BRS Seda, C2= BRS Anahí e C3= BRS Morena) e o segundo fator referente a cinco condutividade elétrica da água (0,8, 1,6, 2,4, 3,2 e 4,0 dS m<sup>-1</sup>). O aumento da condutividade elétrica da água de irrigação a partir de 1,6 dS m<sup>-1</sup>, aumentou o índice de velocidade de emergência e o tempo médio de emergência, porém reduziu a velocidade média de emergência nas cultivares de gergelim. O estresse salino afeta negativamente a altura de plantas, comprimento da raiz e a massa seca da parte aérea das plântulas de gergelim, independente da cultivar. A condutividade elétrica da água de irrigação acima de 2,08 dS m<sup>-1</sup> reduziu o diâmetro do caule nas cultivares.

**Palavras-chave:** *Sesamum indicum* L., salinidade, oleaginosa.

PEREIRA, M. J. L.; GOES, G. F.; CÓ, J. J.; SANTOS, S. de O. E SOUSA, G. G. de  
INITIAL GROWTH OF SESAME CULTIVARS UNDER SALINE STRESS

## 2 ABSTRACT

Irrigation with brackish water is a challenge in the initial development of agricultural crops. Thus, the objective of this study was to evaluate the effects of saline stress on the emergence, growth and biomass of sesame cultivars. The research was carried out at the Auroras Seedling Production Unit, which is linked to the University of International Integration of Afro-Brazilian Lusophony, Redemption, Ceara. The design used was completely randomized, with 5 replications in a  $3 \times 5$  factorial scheme, with the first factor being three sesame cultivars (C1 = BRS Silk, C2 = BRS Anahí and C3 = BRS Morena) and the second factor referring to five electrical conductivities of the irrigation water (0.8, 1.6, 2.4, 3.2 and 4.0  $\text{dS m}^{-1}$ ). Increasing the electrical conductivity of the irrigation water from 1.6  $\text{dS m}^{-1}$  increased the emergence speed index and average emergence rate but reduced the average emergence rate in the sesame cultivars. Salinity stress negatively affects the plant height, root length and shoot dry mass of sesame plants, regardless of cultivar. The electrical conductivity of the irrigation water above 2.08  $\text{dS m}^{-1}$  reduced the stem diameter of the sesame cultivars.

**Keywords:** *Sesamum indicum* L., salinity, oleaginous.

## 3 INTRODUCTION

Sesame (*S Sesamum indicum* L.) is an oleaginous species that has great socioeconomic importance, with the Northeast Region being an option for increasing its agricultural potential due to its adaptability, as its high resistance stomata in periods of low humidity reduce the transpiration process in critical periods and increase its resistance to drought. Currently, the main use of grain is in the food industry; however, other sectors, such as industry oleochemistry, are prioritized (Tenyang et al., 2017).

The use of brackish water in cultivation systems in the northeast region has been widely used by farmers because of the shortage of high-quality water (Sousa et al., 2017). Salinity can modify the metabolic and morphological structures of plants; in view of this, the addition of soluble salts to the soil solution through irrigation water in the initial stage of a crop can affect the emergence and initial development of the crop in the field due to the toxicity of the salts (Oliveira et al., 2019).

In search of the maximum

production potential of sesame crops, genetic improvement has led to the development of several varieties with distinct morphophysiological characteristics; however, few studies have evaluated the effects of saline stress on sesame cultivation in the Northeast Region of Brazil since salinity can affect emergence and modify the metabolic and morphological structure of plants (Nóbrega et al., 2018; Sousa et al., 2017). Therefore, the objective of this study was to evaluate the effects of saline stress on the emergence, initial growth and biomass of sesame cultivars (*S Sesamun indicum* L.).

## 4 MATERIALS AND METHODS

The experiment was carried out at the Auroras Seedling Production Unit (UPMA), located on the Auroras Campus linked to the University of International Integration of Lusophony Afro-Brazilian (UNILAB), Redemption/Ceara, Brazil, which is situated in the region of Brazil from Baturité, at coordinates: latitude: 4° 13' 35" S, longitude: 38° 43' 53" W. The climate of the region is type Aw', tropical rainy, very

warm, with rains predominant in the summer and autumn seasons (KÖPPEN, 1923).

The experimental design used was completely randomized (CRD), with 5 repetitions, in a  $3 \times 4$  factorial scheme. 5, where the first factor corresponded to three Sesame cultivars (C1= BRS Seda, C2= BRS Anahí and C3= BRS Morena) and the second factor corresponded to five electrical conductivities of irrigation water (0.8, 1.6, 2.4, 3.2 and 4.0 dS m<sup>-1</sup>).

Seeds of three sesame cultivars developed by Embrapa Cotton were sown in Styrofoam trays with 200 cells, each measuring 40 cm<sup>3</sup>. Each cell was sown with one seed at a depth of approximately 2 cm. The substrate used to fill the trays was prepared using a proportion (7:2:1) of arisco, sand or bovine manure, whose chemical features (Table 1) were determined according to the methodology described in Teixeira et al. (2017).

**Table 1.** Attribute chemicals of the substrate used in the node experiment.

Chemical attributes of the substrate									
MO	N	P	K	Here	Mg	In the	pH	PST	CEes
-----g kg <sup>-1</sup> -----							H <sub>2</sub> O	(%)	dS m <sup>-1</sup>
0.8	0.21	0.06	0.28	0.07	0.03	0.11	6.5	3.4	0.37

MO – Matter organic; CEes – Conductivity electrical of extract of saturation; PST – Percentage of exchangeable sodium.

The irrigation water with the lowest electrical conductivity (0.8 dS m<sup>-1</sup>) came from the unit's supply network. The brackish solutions (1.6, 2.4, 3.2 and 4.0 dS m<sup>-1</sup>) were prepared by dissolving the salts sodium chloride (NaCl), calcium chloride (CaCl<sub>2</sub>·2H<sub>2</sub>O) and chloride of magnesium (MgCl<sub>2</sub>·6H<sub>2</sub>O), following the relationship between CEa and its concentration (mmol c L<sup>-1</sup> = CE × 10) according to the Rhoades methodology of Kandiah, Mashali (2000). Irrigation was carried out manually and daily until water began to flow from the bottom of the trays (Marouelli; Braga, 2016).

The counts were carried out daily during the first 15 days after sowing (DAS) to quantify the effects of the treatments in the emergency, and the following variables were analyzed: percentage of emergence (FOOT), through which the seedlings were normal according to the Laboriau and Valadares (1976) methodology; emergence speed index (IVE), which was determined by the daily seedling count and adopted the methodology recommended by Maguire (1962); average emergence time

(TME), which was determined by the daily seed count according to the methodology proposed by Laboriau (1983), with results expressed in days; and average emergence speed (VME), which was determined according to the methodology proposed by Carvalho and Carvalho (2009), with results expressed in days.

At 15 DAS, 5 seedlings were collected per treatment, and the initial growth variables were analyzed: seedling height (AP, cm) and root length (CR, cm), which were measured with the help of a ruler graduated in centimeters; the diameter of the stem (A.D., mm), which was measured via a digital caliper at the base of the stem; and the dry mass of the aerial part (MSPA, g), which was measured with an analytical balance; and drying at 65 °C for 72 h until a constant dry matter value was reached.

The results obtained were subjected to analysis of variance (ANOVA), and the means of the cultivars were compared via the Tukey test, while the effect of CEa was evaluated via regression analysis via the statistical program Assistat 7.7 Beta (S

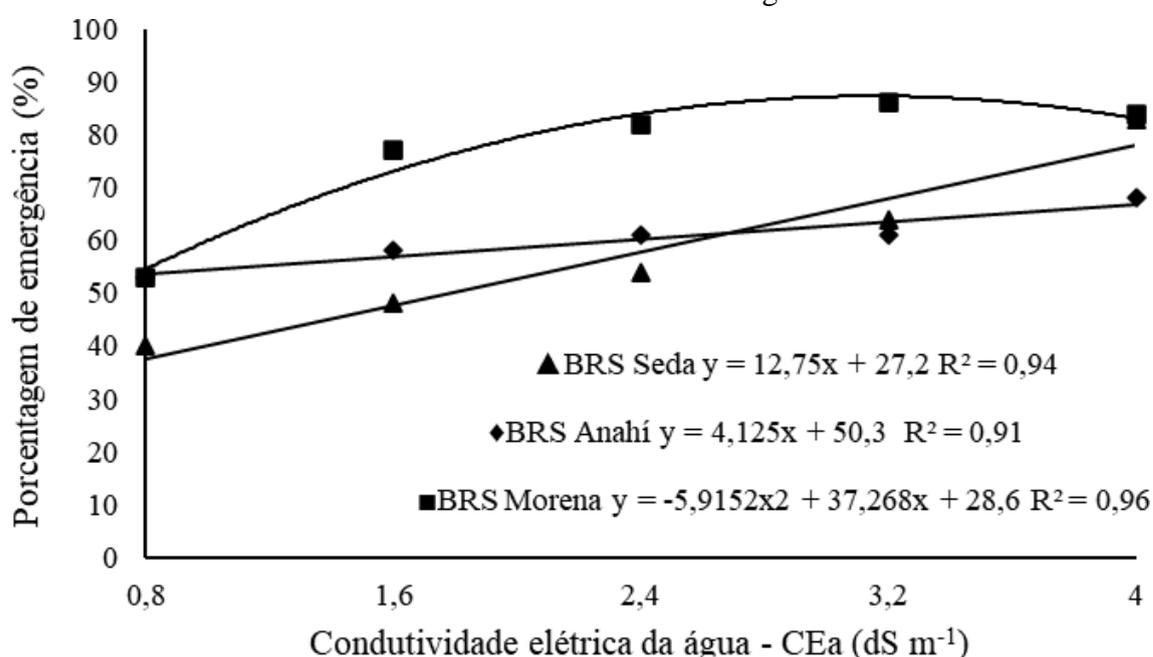
ilva; Azevedo, 2016).

## 5 RESULTS AND DISCUSSION

As shown in Figure 1, the linear regression model was better adjusted for

the BRS Seda and BRS Anahí cultivars, resulting in increases of 51.81% and 22.05% in the emergence percentage, respectively, with increasing electrical conductivity. For the cultivar BRS Morena, the quadratic polynomial model was the one that adjusted best, with a maximum value of 81.31% of the PE, referring to the electrical conductivity of the irrigation water of 3.15 dS m<sup>-1</sup>.

**Figure 1.** Percentage of emergence (PE) in sesame cultivars (*Sesamum indicum* L.) as a function of different electrical conductivities of irrigation water.



The three cultivars presented satisfactory performance in terms of the percentage of emergence with increasing amounts of salt in the irrigation water, which is possibly related to the process of acclimatization of these cultivars to salinity. In addition to their genetic characteristics, biochemists and metabolism mechanisms enable adequate seedling emergence (Silveira and al., 2016). Praxedes et al. (2020) evaluated the tolerance of seedlings of 23 varieties of cowpea (*Vigna unguiculata* (L.) Walp.) to saline stress and reported promising behavior in terms of the percentage of seedling emergence with increasing

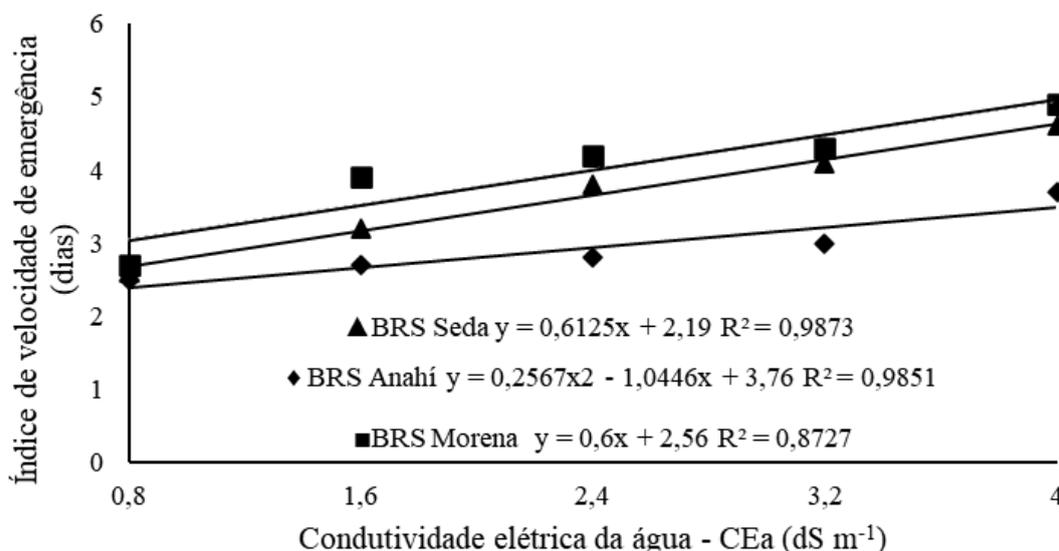
electrical conductivity of the irrigation water.

The emergence speed index variable (Figure 2) showed a linear relationship with the three cultivars, with increases of 76.92%, 48.00% and 81.48% for the BRS Silk, BRS Anahi and BRS Brunette cultivars, respectively, when the plants were irrigated with relatively high-salinity water (4 dS m<sup>-1</sup>). Studying the effects of salinity in sorghum (*Sorghum bicolor* (L.) Moench) culture, Sousa et al. (2020) reported that, under saline stress, plants can increase their metabolic activities, with the purpose of osmotic homeostasis, increasing the speed of

emergence. These results contrast with those of Santos et al. (2018), who evaluated zucchini genotypes (*Cucurbita pepo* L.)

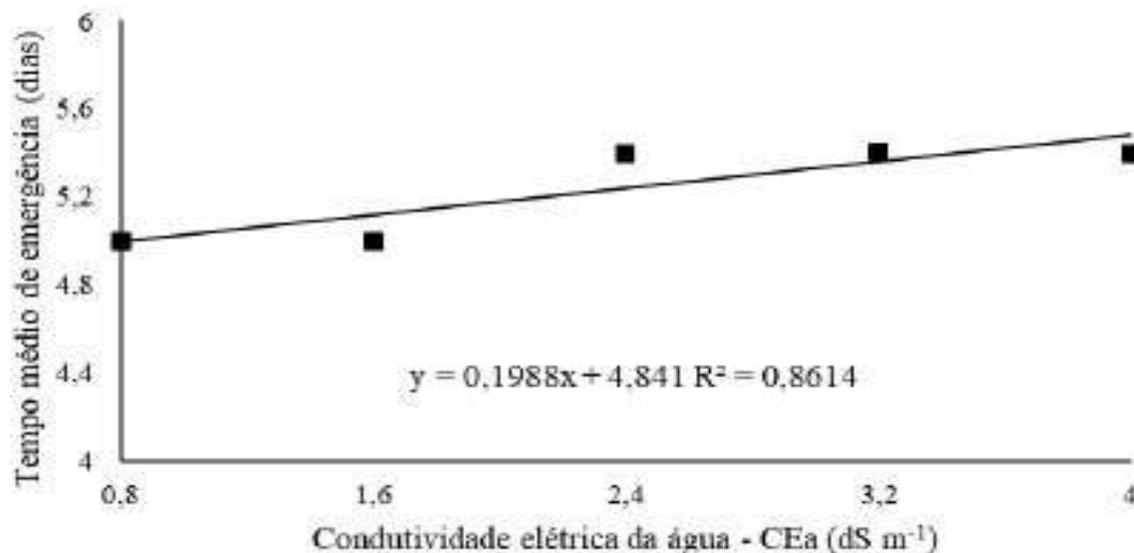
and reported a decrease in IVE with increasing salt content in the irrigation water.

**Figure 2.** Index of speed of emergence (IVE) in cultivars of sesame (*S Sesamum indicum* L.) depending on different electrical conductivities of irrigation water.



For the mean emergence time (Figure 3), the linear regression model provided better adjustment, resulting in an increase of 9.90% in the TME with increasing salinity from the water. The delay in emergence can be influenced by the reduction in the osmotic potential of the substrate solution, which is caused by the increase in the concentration of soluble salts, which interferes with water availability and consequently in the absorption of water by the seeds, delaying the emergence of seedlings (Sousa et al. , 2020).

**Figure 3.** Time average of emergence (TME) as a function of different conductivity irrigation water electrical systems.



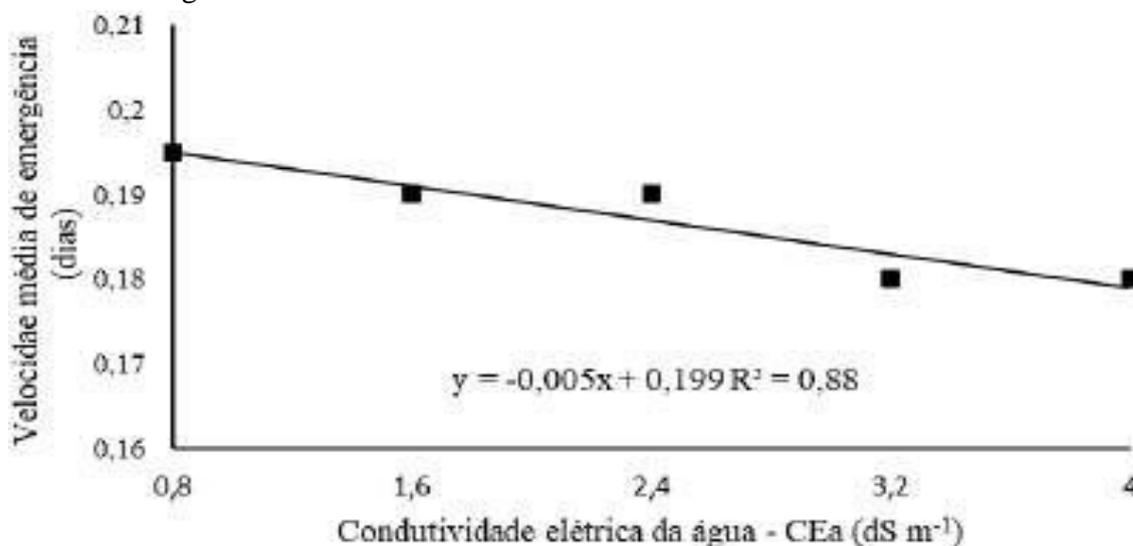
Similarly, Ceita et al. (2020), when evaluating the emergence of fava bean (P.

*lunatus* L.) seedlings irrigated with water from different levels of salinity, reported similar results, where an increase in water ECa delayed seedling emergence.

With respect to the average speed of emergency (Figure 4), the regression model better adjusted the linear decrease, causing a reduction of 7.69% with increasing

electrical conductivity of the water. This result is possibly related to the increase in the concentration of  $\text{In}^+$  and  $\text{Cl}^-$  ions in the irrigation water, which reduces the speed of absorption of water by seeds, interfering with the metabolic and biochemical processes involved in emergence (Freire et al., 2018).

**Figure 4.** Mean emergence velocity (MEV) as a function of different electrical conductivities of irrigation water

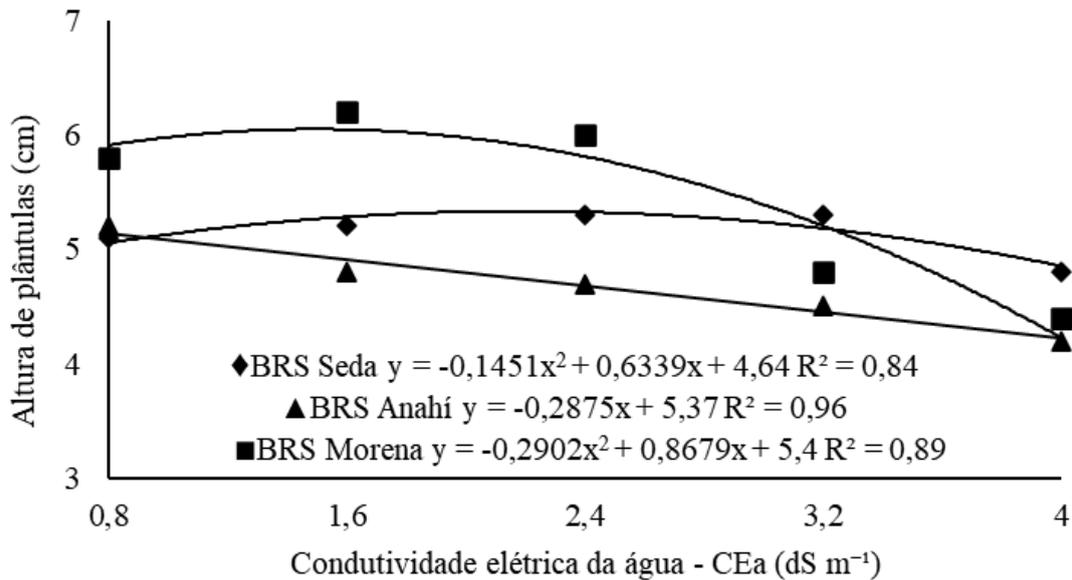


Sousa et al. (2023) evaluated variables of emergence from a watermelon (*Citrullus lanatus*) culture under saline stress and reported a reduction in the average emergence speed with increasing electrical conductivity of the water.

With respect to seedling height, for the cultivars BRS Morena and BRS Seda, the model that best fit was the quadratic polynomial, with a maximum value of 6.2

cm at a CEa of 1.6 dS m<sup>-1</sup> and 5.33 cm at a CEa of 2.4 dS m<sup>-1</sup>, respectively. The ECa of the cultivar BRS Anahi decreased linearly with increasing irrigation amount (Figure 5). The reduction in height with increasing electrical conductivity of irrigation water can be explained by the fact that water with a high concentration of salt decreases the potential for cell turgor, affecting growth (Sousa et al. , 2021b).

**Figure 5.** Height of seedlings (APs) of sesame (*S Sesamum indicum* L.) cultivars as a function of different electrical conductivities of irrigation water.

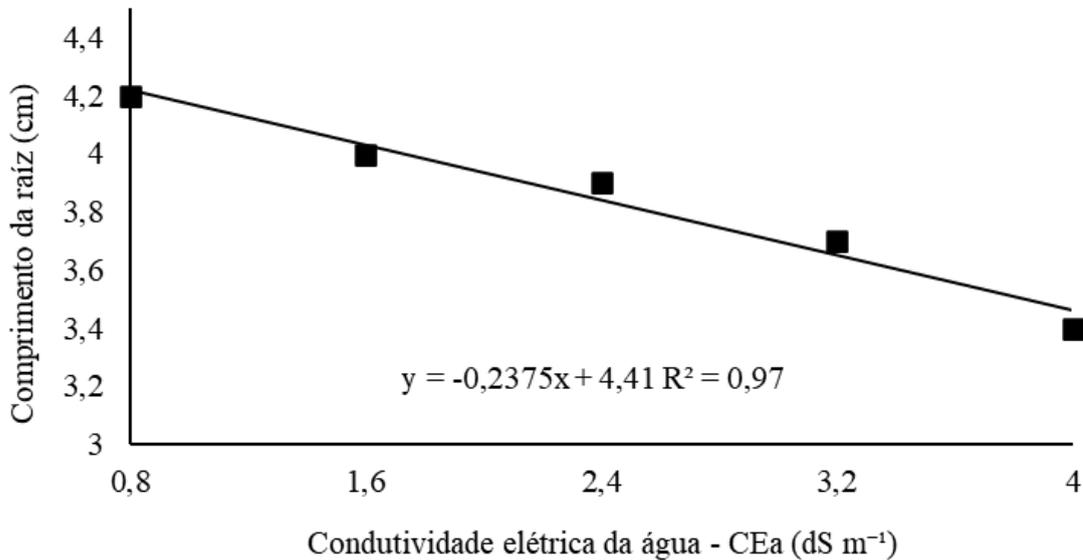


Cordão et al. (2020), working with the BRS Seda cultivar, reported a decrease in seedling growth with increasing salinity, with reductions of 22.03, 58.00, 75.33 and 94.11% in electrical conductivities of 1.2 dS m<sup>-1</sup>, 1.8 dS m<sup>-1</sup>, 2.4 dS m<sup>-1</sup> and 3.0 dS m<sup>-1</sup>, respectively.

The root length decreased linearly by approximately 5.3% with increasing conductivity. electrical water for irrigation (Figure 6). The reduction in the root system

with increasing salinity is related to water restrictions imposed by saline stress due to osmotic imbalances, causing toxicity and disturbances in natural nutrients and, consequently, less root development (Lessa et al., 2022). Similarly, Ramos et al. (2022) reported a reduction in the length of the roots of passion fruit (*P. edulis* Sims) when subjected to high concentrations of salt, which highlights the sensitivity of these plants to saline stress.

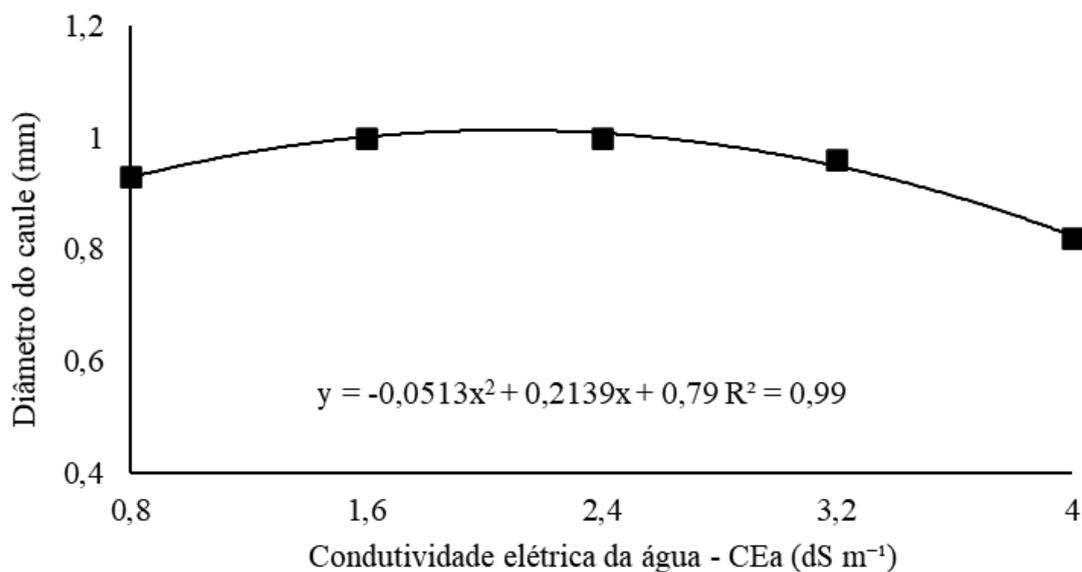
**Figure 6.** Length from the source (CR) as a function of different electrical conductivities from the irrigation water.



For stem diameter, a quadratic response was observed as a function of increasing salinity. from the irrigation water, with a maximum value of 1.01 mm at a CEa of 2.08 dS m<sup>-1</sup> (Figure 7). The decrease with increasing water salinity may be related to morphological changes due to the increase in the concentration of salts in

the irrigation water, causing water and nutritional imbalances. In addition, the exacerbated metabolic expenditure due to the acclimatization process triggers a series of ionic changes, thus affecting the development of seedlings (Sousa et al., 2023).

**Figure 7.** Diameter of the stem (A.D.) as a function of different electrical conductivities from water irrigation.

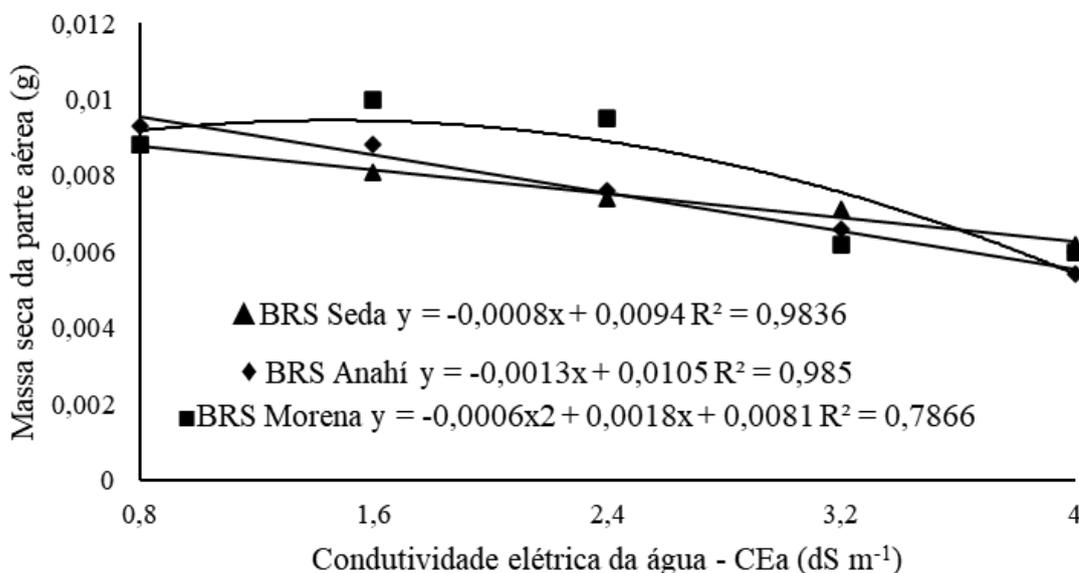


Sousa et al. (2021a) obtained results similar to those of the present study, with a reduction in stem diameter in cowpea (*Vigna unguiculata*) crops when irrigated with brackish water ( $4.0 \text{ dS m}^{-1}$ ). Similarly, Pacheco et al. (2020) reported a reduction in the diameter of the stem of sunflower (*Helianthus annuus* L.) seedlings with increasing doses of saline.

In addition to the mass drying from the aerial part from the seedling (Figure 8), the model, which was adjusted for the BRS Seda and BRS Anahí cultivars, decreased linearly. However, for the cultivar BRS Morena, it was a polynomial quadratic relationship, with a maximum value of  $0.010 \text{ g}$  and a CEa of  $1.6 \text{ dS m}^{-1}$ . The daily irrigation with water with an electrical

conductivity of  $4.0 \text{ dS m}^{-1}$  caused a reduction in the dry mass area of all the cultivars. According to studies carried out by Freire et al. (2018), the presence of salts in irrigation water can interfere with the synthesis and translocation of hormones from the source to the area of the leaf, which consequently negatively affects the metabolism of the leaf, decreasing the mass dry from the aerial parts of the seedlings. Similarly, Silva Junior, Bezerra and Silva (2021) reported similar results, where they reported significant reductions in MSPA in the interaction between increased salinity and the cowpea (*Vigna unguiculata*) cultivars BRS Tumucumaque, BRS Guariba and BRS Imponente.

**Figure 8.** Mass dry from the part aerial (MSPA) in cultivars of sesame (*S Sesamum indicum* L.) depending on different electrical conductivities of the irrigation water.



## 6 CONCLUSIONS

The increase in electrical conductivity of irrigation water from  $1.6 \text{ dS m}^{-1}$  increased the index of speed of emergence and the time average of emergence, although it reduced the average emergence speed in sesame cultivars (*S Sesamum indicum* L.).

Salinity stress negatively affects the height of plants, length from the source and dry mass of the aerial parts of sesame seedlings, regardless of cultivar.

The conductivity of the electrical water used for irrigation above  $2.08 \text{ dS m}^{-1}$  reduced the stem diameter of the sesame cultivars.

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