RABANET CULTURE SUBMITTED TO DIFFERENT LEVELS OF SALINITY

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ABSTRACT: The objective of the present study was to evaluate radish production at different levels of salinity. The experiment had seven levels of irrigation water salinity (water with natural salinity, 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 dS.m^{-1} at 25ºC), The slides being applied according to the crop evapotranspiration daily. The experimental design was completely randomized blocks with 3 replicates, each plot consisted of one pot with 12 L capacity, containing three radish plants. The application of different levels of salinity influenced in a significant way the variables analyzed in this experiment.

KEYWORDS: Salinity; leaching fraction; irrigation management

CULTURA DO RABANETE SUBMETIDO A DIFERENTES NÍVEIS DE SALINIDADE

RESUMO: O objetivo do presente estudo foi avaliar a produção do rabanete em diferentes níveis de salinidade. O experimento teve sete níveis de salinidade da água de irrigação (água com salinidade natural; 1,0; 2,0; 3,0; 4,0; 5,0 e 6,0 dS.m-1, a 25ºC), sendo as lâminas aplicadas de acordo com a evapotranspiração da cultura diariamente. O delineamento experimental foi de blocos inteiramente casualisados e com 3 repetições, sendo que cada parcela foi constituída por um vaso, com capacidade de 12 L, contendo três plantas de rabanete. A aplicação de diferentes níveis de salinidade influenciou de forma significativa as variáveis analisadas neste experimento.

PALAVRAS-CHAVE: Salinidade; fração de lixiviação; manejo da irrigação

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INTRODUCTION

The radish (Raphanus sativus L.) is a plant of the brassicacea family, being small, not exceeding 30 cm in height (CAMARGO et al., 2007). Still it presents little tradition in the commercial production, but it has attractive nutritional aspects and with a fast cycle of production, becoming attractive and with great potential of growth. Because of its rapid development, the radish needs high levels of soil fertility, requiring high amounts of nutrients in a short period of time. (COUTINHO NETO et al., 2010).

The northeast has favorable conditions for the production of oleraceous, Such as the frequency of heat, high luminosity and low relative humidity of the air, thus, irrigation is an essential instrument for the commercial production of the vegetables however, its use in the region still lacks studies to show a significant potential, requiring better control as to the amount of water to be applied, the frequency and the critical moment of irrigation (SOUSA et al., 2010). The inviability duo to crop sensitivity to the salinity of ater and soil highlights the need for research that minimizes the impact of harmful effects, since it is generally the only form of irrigation in semi-arid regions.

As vegetables species tolerate a salinity up to a certain threshold (salinity threshold) without compromising its development and production (ALENCAR et al. 2003). According to Tester & Davenport. (2003), The salinity reduces the osmotic potential, reflecting in the decrease of the water absorption by the plants and compromising the physiological processes; thus, the plants may present morphophysiological modifications in order to increase their tolerance to salinity, especially the reduction of the leaf area due to the decrease in the volume of cells.

Bregonci et al. (2008), when the radish was subjected to water stress in different phases, it was observed that the crop is poorly resistant to lack of water, and the results indicated that there was a 50% reduction in root diameter and dry matter. Acoording to Oliveira et al. (2010), the radish is moderately sensitive to salinity and expresses its adaptability according to its threshold, reducing the leaf area according to the saline concentration.

In view of the problems that afflict the culture, the purpose of this work was to evaluate several levels of salinity in water, in order to identify the tolerance salinity level of the radish culture.

MATERIAL AND METHODS

The study was carried out at the Federal University of Sergipe - UFS, located in the central portion of the physiographic region of Sergipe State Coast, 15 km from Aracaju, at the geographic coordinates of 10º 55 '27 "south latitude and 37º 12' 01" Of longitude west, with an altitude of 46 meters. In greenhouse, in the Department of Agronomic Engineering.

The soil used was collected from the arable layer of the Experimental Farm area of UFS and placed to dry in the open air, dismantled, passed through a 5 mm mesh sieve, homogenized and placed in the pots. It had the following chemical characteristics: pH (CaCl2) = 5.1; M.O. = 18.7 g dm-3; P = 4.4 mg dm-3; K = 13.8 mmol, dm-3; Ca = 1.39 mmolc dm-3; Mg = 0.89 mmol dm-3; H + Al = 4.04 mmolc dm-3; SB = 2.34 mmol, dm-3; Al = 0.20 mmol dm-3; Na = 4.9 mg / dm -3, CTC = 6.38 mmol dm-3; V = 37%. A correction of acidity was carried out, with application of 19g of dolomitic limestone per pot, and fertilization with NPK according to the recommendation for cultivation.

The treatments were started after ten days, this being the period of stability of the plants. After the period, treatments were continued. Salinized waters were prepared by adding 390 mg / g sodium and 30 mg / g iodine salt to the water of the UFS local supply system. The experimental design was a completely randomized blocks with 7 levels of salinity (0,4; 1; 2; 3; 4; 5; 6 dS m-1) T1, T2, T3, T4, T5, T6, T7 and with 3 replicates, each plot consisted of one pot with 12 L capacity and three radish plants.

Irrigation management was carried out based on crop and reference evapotranspiration, and irrigation times were calculated in a spreadsheet using Kc values at the different stages of the crop. The meteorological data for the determination of the reference evapotranspiration were obtained through meteorological stations of the National Institute of Meteorology (INMET), located in Aracaju - SE.

For the estimation of reference evapotranspiration - ETo in the daily scale, the Penman-Monteith model adapted by Allen et al. (1989), given by Equation 1:

$$ETo = \frac{0{,}4082\Delta(R_n - G) + \gamma^* \frac{900}{T + 273} u_2(e_s - e_a)}{\Delta + \gamma^*(1 + 0{,}34\, u_2)} \qquad (1)$$

where: ETo - reference evapotranspiration (mm d^{-1}); Δ - slope of the saturation vapor pressure curve (kPa ° C^{-1}); γ * - psychrometric constant = 0.063 kPa ° C^{-1}; R n - surface radiation balance (MJ m^{-2} d^{-1}); G - heat flow in soil (MJ m^{-2} d^{-1}); T - average air temperature (° C); U_2 - wind speed measured at 2 meters height (m s^{-1}); es - vapor saturation pressure (kPa); and - steam partial pressure (kPa); (And s - and a) - vapor saturation deficit (kPa).

For the calculation of crop evapotranspiration, Equation 2 was used:

$$ETc = ETo * Kc \qquad (2)$$

where: Kc – crop coefficient; ETc - crop evapotranspiration (mm); ETo – reference evapotranspiration.

At the end of the cropping cycle, 35 days after sowing, an evaluation of each experimental unit was carried out, the data of diameter, length and weight of the bulb were collected for statistical analysis using a pachymeter and digital scale, considering in each plot the mean value Of the three plants of each of each pot.

The results were submitted to the analysis of variance, with effects ranging, according to their significance, the means compared by the F and Tukey tests at the 5% probability level, using the ASSISTAT statistical program (Silva & Azevedo, 2002). The choice of the regression model was made based on the model of greater degree significant by the test F.

RESULTS AND DISCUSSION

The summary of the variance analysis and the observed averages for the growth variables cited in Table 1, in evaluations were performed at the thirty-fifth day after sowing (DAS). The analyzed variables were significantly influenced by the different electrical conductivities at 5% of significance and 1% of probability, by the Tukey test.

The diameter and length and weight of the bulb presented an adjustment to the quadratic regression model as can be observed in figures 1, 2 and 3. The diameter and length showed a linear reduction according to the increase in salinity levels (Figure 1-DB And 2-CB). The observed values corroborate with Ferro et al. (2015) evaluating salinity levels of 0.14 (control), 2.14; 4.14 and 6.14 dS m^{-1}, which also had a reduction with increasing salt concentration, with a higher decrease in the highest salinity level (6.14 dS m^{-1}).

The weight of the Bulbs (Figure 3-PB) was linearly reduced with increasing salt levels, being observed a larger decrease for the higher salinity level (6 dS m^{-1}). The fresh mass reduction of the Bulb due to the salinity levels used is associated to the fact that the high concentration of NaCl in the substrate causes a significant reduction in the growth parameters of the plants (GHOULAM et al., 2002).

The electrical conductivity increase in the irrigation water linearly reduced to, the fresh bulb weight, the diameter and the length of the bulb. Bulb is one of the most important variables for evaluating plants in saline stress, because the characteristics provide important information about the response of plants to stress conditions (JAMIL & RHA, 2004).

A negative response of radish culture to salinity was also found by Marcelis and Hooijdonk (1999), who evaluated the radish crop development at different saline levels (1, 2, 4, 9 and 13 dS m-1), and verified the maximum development of the plants with salinity of the soil in the range of 2 to 4 dS m-1, with significant reductions of leaf area and in the phytomass accumulation of shoot and roots. The highest tolerance of the radish crop, observed by these authors, may have been due to the composition of the solution used, since the different saline levels were obtained by the addition of different fertilizers, resulting, thus, in higher nutrients concentration available to the plants.

Similar results to this study were observed by Dias et al. (2012) in the yellow passion fruit crop, where according to these authors, the fresh weight decreased with the different electrical conductivities increase of the irrigation water. On the other hand, Santos et al. (2012) did not obtain significant responses of saline stress in plants of pitangueira cultivated in soil with humus.

Another similar result to this study was observed by Jamil et al. (2007), who studying radish plants irrigated with high salinity water (5.47 dS m-1) observed a decrease in leaf area values at 15 DAS. Similarly, Oliveira et al. (2010), showed the same result in radish plants under saline stress.

According to Flowers (2004), in saline stress conditions, the plants close the stomata to reduce transpiration, resulting in a photosynthetic rate reduction, and this morphophysiological alteration may be one of the main causes in the growth decrease of the species under these conditions. Another possible cause for reduced plant development parameters observed in this work may be related to a possible nutritional imbalance of the plants caused by higher salinities (TAIZ and ZEIGER, 2004), as observed by Abdelrahman (1987) and Yildrim et al. (2008) for radish culture. Some authors also found nutritional imbalance due to salinity for other crops, such as eggplant (BOSCO et al., 2009) and melon (MEDEIROS et al., 2008), among other crops of agronomic interest.

CONCLUSION

The diameter, length and weight of the bulb were influenced by the saline concentration, decreased with increasing doseof saline, being observed a greater loss in concentration of 6 dS m^{-1}.

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Table 1. Summary of variance analysis and averages for bulb diameter (DB), bulb length (CB) and bulb weight (PB).

TREATMENTS	CB	DB	PB
T1	60,32[a]	40,48a	47,58[a]
T2	56,38ab	37,97ab	43,21[a]
T3	52,44ab	35,46ab	35,46ab
T4	48,50bc	32,95ab	32,95ab
T5	44,55bc	30,44ab	30,44ab
T6	40,61c	27,92b	27,92b
T7	36,67c	25,41b	25,41b
CV (%)	7,85	12,91	11,96

* Values followed by the same letter do not differ statistically at 5% significance by Tukey's test.

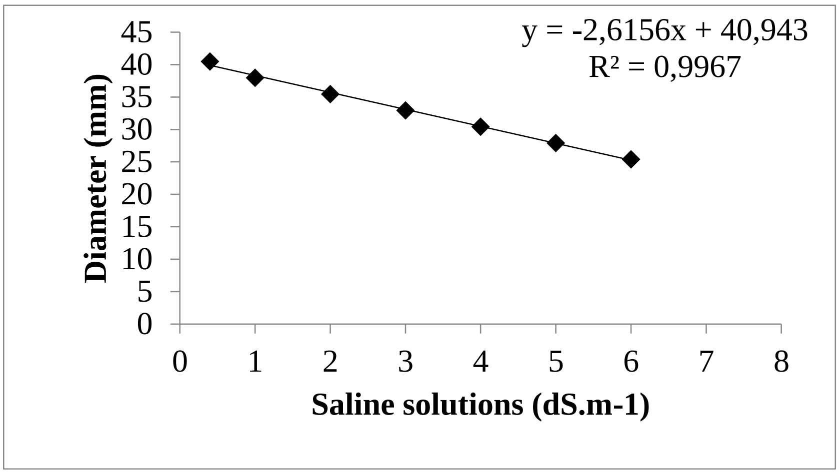

Figure 1. - Bulb diameter - DB of radish according to different saline solutions, 30 days after sowing (DAS).

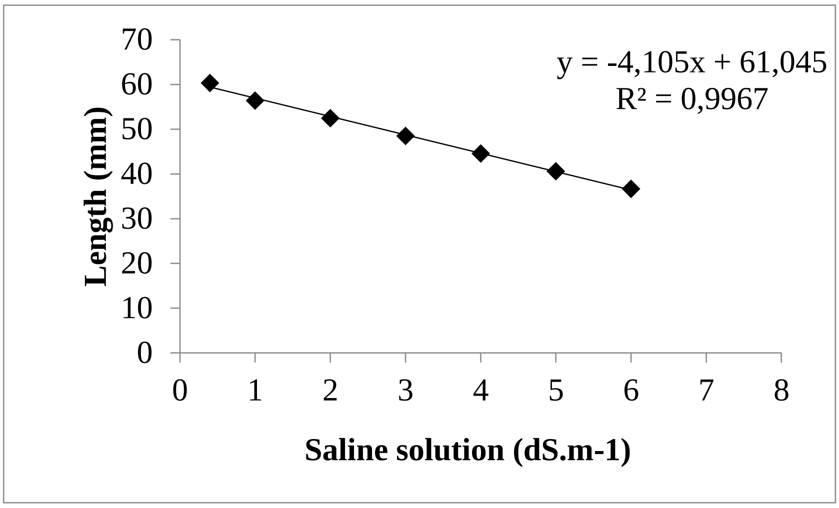

Figure 2. Bulb length - CB of radish according to different saline solutions, 30 days after sowing (DAS).

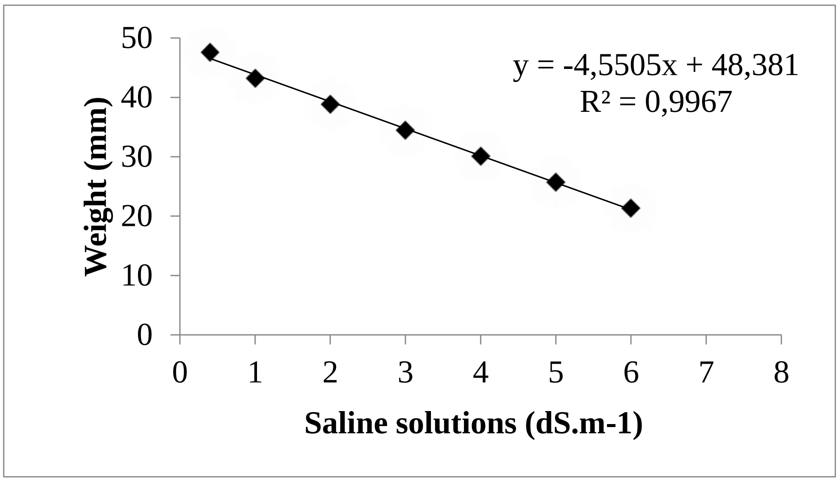

Figure 3. Bulb weight- PB of the radish according to the different saline solutions, after 30 days of sowing (DAS).