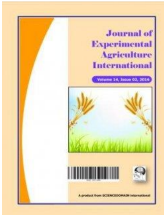

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Morphophysiology of "Crioulo" Cashew Rootstock Seedlings under Saline Water Irrigation and Potassium Silicate Doses

Reynaldo Teodoro de Fatima[1*], Reginaldo Gomes Nobre[2], Leandro de Pádua Souza[3], Geovani Soares de Lima[3], Hans Raj Gheyi[3], Evandro Manoel Silva[3], Elcimar Lopes da Silva[2] and Sabrina Gomes de Oliveira[2]

[1]Center of Agrarian Sciences, Federal University of Paraíba, Areia, Brazil.
[2]Center of Science and Agri-Food Technology, Federal University of Campina Grande, Pombal, Brazil.
[3]Academic Unit of Agricultural Engineering, Federal University of Campina Grande, Campina Grande, Brazil.

Authors' contributions

This work was carried out in collaboration between all authors. Authors RTF, RGN and LPS designed the study, participated in all the steps of conducting and writing the manuscript. Authors GSL and HRG, contribution was decisive in the correction phase, provided alternatives to enrich information work. Author EMS was responsible of the manuscript methodology. Authors ELS and SGO participated in the conduction of the experiment. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This work aimed to evaluate the effects of saline water and potassium silicate on the physiological and morphological changes of "Crioulo" cashew rootstock seedlings.
Study Design: The experimental design was the randomized block, corresponding to five levels of irrigation water electrical conductivity – ECw and five doses of potassium silicate, with four

**Corresponding author: E-mail: reynaldo.t16@gmail.com;*

replicates and two plants per plot.
Place and Duration of Study: The study was carried out in a greenhouse at the Center of Sciences and Agri-Food Technology of the Federal University of Campina Grande, Campus of Pombal – PB, Brazil, between August and November of 2017.
Methodology: The five levels of irrigation water electrical conductivity – ECw (0.3; 1.0; 1.7; 2.4 and 3.1 dS m^{-1}) were prepared by the addition of NaCl, $CaCl_2$ and $MgCl_2$, maintaining an equivalent proportion of 7:2:1, respectively, in the water from the local supply system (0.3 dS m^{-1}); the five doses of potassium silicate (0, 250, 500, 750 and 1000 mg L^{-1}) were applied on the leaves, using the commercial product Quimifol Silício, composed of 10% silicon (Si) and 10% potassium (K), completely soluble in water. The plant material was the "Crioulo" cashew genotype, adapted to semi-arid conditions, obtained from a commercial plantation area located in the municipality of Severiano Melo – RN, Brazil, and widely used in the production of rootstocks in seedling production nurseries of the region.
Results: Irrigation with 1.7 dS m-1 water causes acceptable reduction of 10% in the morphophysiology of "Crioulo" cashew rootstocks seedlings; the estimated potassium silicate dose of 524,78 mg L^{-1} led to improvements in the physiology, morphology and quality of the cashew rootstocks seedlings.
Conclusion: The "Crioulo" cashew rootstocks seedlings present moderate resistance to the salinity of the irrigation water; irrespective of salinity of irrigation water, fertilization with potassium silicate improves the morphophysiological characteristics.

Keywords: Anacardium occidentale L.; abiotic stress; fertilization management; seedling production.

1. INTRODUCTION

Cashew (*Anacardium occidentale* L.) is a tropical fruit tree native to Brazil and widely cultivated in the Northeast region of Brazil due to its adaptation to the edaphoclimatic conditions. Such situation makes this region the largest producer of cashew nut, with planted area of approximately 616,189 ha, responsible for about 98.7% of the national production, and the states of Ceará (42,597 t), Rio Grande do Norte (33,912 t) and Piauí (28,292 t) are the main cashew nut producers [1].

The economic importance of the cashew tree is mainly attributed to the industrialization of cashew nuts, aimed at export and the industrialization of the peduncle, aimed at the domestic market, where most of it is used in '*natura'* or in the production of whole juice [2,3]. In the semi-arid northeast Brazil its socio-economic importance is even more expressive, since most of the production consists of small producers, with the harvest taking place in the off-season in relation to other crops, which favors the permanence of labour in the field, and generate approximately 55,000 jobs annually [4].

Despite such high production, the yield of plantations in Northeast Brazil is considered low in comparison to other regions of the country, around 193 kg ha^{-1}, which is attributed mainly to the large genetic variability of the plant material, causing a great variation in the production of cashew nut and peduncle [5]. As an alternative, grafted seedlings have gained prominence as they make possible to use more productive genetic materials and adapted to the edaphoclimatic conditions, allowing to reproduce qualities of economic interest from the mother plant and promote early and homogeneous production [6]. Therefore, the rootstocks indication is based on the adaptation of plant material to environmental conditions and compatibility with the canopy, which directly affects productivity of orchard, because when the quality of the seedlings is affected the expression of the productive potential of even superior genotypes of cashew is limited [7].

Therefore, producing quality seedlings is a decisive step for a successful process, but it has been limited by the long periods of drought which force seedling production nurseries to use waters with high concentrations of salts in irrigation, thus limiting rootstock quality by saline stress [8]. This occurs because the excess salts disturb the physiological and biochemical functions of the plants, causing reductions in the absorption of water and transport of the essential mineral elements, besides providing the accumulation of toxic elements, limiting the development of the plant [9].

To mitigate the effects caused by salts, fertilization techniques such as potassium fertilization have stood out, because potassium participates in various biological processes in plant cells, such as enzymatic activation, respiration, photosynthesis and competition with toxic elements, besides enhancing water balance [10,11]. Besides that, there is also the absorption of silicon, which lessens the toxic effects induced by the excess Na^+ in the cell compartments and increases the antioxidant defense capacity in various plant species, by enhancing the activity of enzymes associated with plant defense mechanism [12].

In this context, this study aimed to evaluate the effects of saline water and potassium silicate on the physiological and morphological changes of "Crioulo" cashew rootstocks seedlings.

2. MATERIALS AND METHODS

2.1 Location of the Experiment

The study was carried out in a greenhouse at the Center of Sciences and Agri-Food Technology of the Federal University of Campina Grande, Campus of Pombal – PB, Brazil, at the geographic coordinates 6º48'16'' S and 37º49'15" W, and altitude of 174 m.

2.2 Description of Treatments

The experiment was set in a randomized block design, with treatments arranged in a 5 x 5 factorial scheme, corresponding to five levels of irrigation water electrical conductivity – ECw (0.3; 1.0; 1.7; 2.4 and 3.1 dS m^{-1}) and five doses of potassium silicate (0, 250, 500, 750 and 1000 mg L^{-1}) applied through spraying on the leaves, with four replicates and two plants per plot.

Solutions of different salinity levels were prepared by the addition of NaCl, $CaCl_2$ and $MgCl_2$, maintaining an equivalent proportion of 7:2:1, respectively, in the water from the local supply system (0.3 dS m^{-1}). This proportion is commonly found in waters used for irrigation in the Northeast region [13]. Saline levels were selected based on Sousa et al. [14].

The source of potassium silicate was the commercial product Quimifol Silício, composed of 10% silicon (Si) and 10% potassium (K), completely soluble in water. Due to the scarcity of studies using potassium silicate in seedlings, the doses were based on the K recommendation for experiments in pots, 150 mg of K dm^{-3}, proposed by Novais et al. [15].

2.3 Production of Rootstocks

The plant material was the "Crioulo" cashew genotype, adapted to semi-arid conditions, obtained from a commercial plantation area located in the municipality of Severiano Melo – RN, and widely used in the production of rootstock seedlings in nurseries of the region for its rusticity.

Sowing was performed on August 29, 2017, in polyethylene bags with capacity for 1150 mL, perforated at the bottom to allow free drainage. One seed was planted in each bag and the substrate was maintained at field capacity using public-supply water (ECw of 0.3 dS m^{-1}) along the period of germination and emergence of seedlings. The bags were placed on a metal bench, at 0.8 m height from the soil.

The bags were filled with substrate composed of 85% soil, 10% fine sand and 5% aged bovine manure. The physical and chemical characteristics of substrate used are presented in Table 1, determined according to the methodologies proposed by Claessen [16].

Table 1. Chemical and physical characteristics of the substrate used in the experiment

.... Chemical characteristics								
pH	**ECse**	**P**	**K^+**	**Na^+**	**Ca^{2+}**	**Mg^{2+}**	**Al^{3+}**	**$H + Al^{3+}$**
$CaCl_2$ 1:2,5	dS m^{-1}	mg dm^{-3}	.... $cmol_c$ dm^{-3}					
7.41	1.21	15,40	0.43	1.17	7.80	1.70	0.00	0.00

.... Physical characteristics						
Sand	**Silt**	**Clay**	**AD**	**DP**	**Total porosity**	**Textural class**
.... g kg^{-1}			..... kg dm^{-3}...		**%**	
778	136	76	1.48	2.86	48	Sandy loam

pH – hydrogen potential, Ca^{2+} and Mg^{2+} extracted with 1 M KCl at pH 7.0; Na+ and K^+ extracted using 1 M NH_4OAc at pH 7.0; Al^{3+}+H^+ extracted using 0.5 M CaOAc pH 7.0; ECse – electrical conductivity of the saturation extract; AD - apparent density; DP –particle density.

2.4 Application of Treatments

Application of saline solutions began at 30 days after sowing (DAS), manually, through daily irrigations. The applied volume was determined through drainage lysimetry, by daily providing the evapotranspired water volume to bring the soil to field capacity, equivalent to difference between the applied volume and the volume drained in the previous irrigation. Every 15 days, a leaching fraction of 0.10 was also applied, based on the volume applied in this period, to reduce salt accumulation in the substrate.

Potassium silicate fertilization began at 31 DAS, split into weekly foliar applications, for five weeks, performed in the late afternoon using sprayers. Eight liters of solution were used for each dose of potassium silicate, applying a total volume of 200 mL per plant.

Phytosanitary control was performed along with sowing, by applying a sulfur-based product, registered for the crop and characterized by fast initial action and short persistence. Weeding was carried out always when necessary, to control the incidence of invasive plants which could damage the crop.

2.5 Variables Analyzed

At 55 DAS an LCPro+ infrared gas analyzer (IRGA) was used to measure gas exchanges in the cashew rootstock seedlings, based on leaf transpiration (E), intercellular CO_2 concentration (Ci), stomatal conductance (gs) and CO_2 assimilation rate (A), and these data were used to calculate water use efficiency (WUE = A/E). Gas exchange measurements were performed from 7:00 to 9:00 a.m. in a fully expanded mature leaf, using artificial light source with intensity of 1200 MJ m^{-2} s^{-1} and CO_2 from the atmosphere at 2.5 m height.

Treatment effects on plant growth were evaluated by measuring, from 35 to 75 DAS, the absolute growth rates (AGR) in plant height (AGR_{PH}) and stem diameter (AGR_{SD}). The absolute growth rate was determined using the methodology proposed by Benincasa [17], according to Equation 1:

$$\mathrm{AGR} = \frac{(\mathrm{A}_2 - \mathrm{A}_1)}{(\mathrm{t}_2 - \mathrm{t}_1)} \qquad (1)$$

where: AGR = absolute growth rate; A_2 = plant growth at time t_2; A_1 = plant growth at time t_1; and $t_2 - t_1$ = time difference between measurements.

At 75 DAS, plants were separated into stems, leaves and roots, placed in paper bags to dry in a forced-air oven at 65 ºC until constant weight, and weighed on precision scale (0.01 g) to obtain shoot dry phytomass – SDP (leaf dry phytomass + stem dry phytomass) and total dry phytomass – TDP (SDP + root dry phytomass).

Rootstock quality was assessed by the Dickson quality index (DQI) for seedlings, using the formula of Dickson et al. [18], according to Equation 2.

$$\mathrm{DQI} = \frac{(\mathrm{TDP})}{(\mathrm{PH/SD}) + (\mathrm{SDP/RDP})} \qquad (2)$$

where: DQI = Dickson quality index; PH = plant height (cm); SD = stem diameter (mm); TDP = total dry phytomass (g); SDP = shoot dry phytomass (g); and RDP = root dry phytomass (g).

2.6 Statistical Analysis

The variables were subjected to analysis of variance by F test (0.01 and 0.05 probability levels) and, in cases of significant effect, linear and quadratic polynomial regressions were applied, using the statistical program SISVAR [19]. Regression models were chosen based on the best fit considering the coefficient of determination (R^2) and a probable biological explanation.

3. RESULTS AND DISCUSSION

According to the summary of analysis of variance (Table 2), irrigation water salinity and potassium silicate doses had significant effect on stomatal conductance, intercellular CO_2 concentration and CO_2 assimilation rate. For transpiration, there was only significant effect of irrigation water salinity, whereas potassium silicate doses had effect on water use efficiency. Apart from that, the interaction between irrigation water salinity and potassium silicate doses had no significant effect on "Crioulo" cashew rootstock seedlings at 55 DAS for any of the studied variables.

Stomatal conductance (gs) was the parameter most affected by irrigation water salinity (Fig. 1A), with linear reduction of about 15.16% per unit increase in ECw, resulting in total decrease of 42.45% in the gs of plants subjected to irrigation with ECw of 3.1 dS m^{-1}, compared with those irrigated with the lowest saline level (0.3 dS m^{-1}). This is related to stomatal closure, which reduces water vapor exit and CO_2 diffusion to carboxylation sites, leading to decrement in intracellular CO_2 concentration and subsequent reduction in net photosynthesis [20].

Potassium silicate doses caused a quadratic polynomial effect (Fig. 1B) and the estimated dose of 625 mg L^{-1} led to a 25.54% increment in stomatal conductance compared with the rootstock seedling which received no foliar application of potassium silicate. This is explained by stomatal regulation, promoted by the increase in the availability of potassium and silicon, which act in the control of stomatal opening and closure [20].

Despite the substantial reduction in stomatal opening, the intercellular CO_2 concentration (*Ci*) (Fig. 2A) decreased by only 2.13% per unit increase in irrigation water electrical conductivity, reaching a total reduction of 12.77 μmol of CO_2 m^{-2} s^{-1} (6%) between the highest and lowest ECw levels (3.1 and 0.3 dS m^{-1}, respectively). This fact demonstrates that CO_2 demand for photochemical processes was not significantly damaged by stomatal closure.

Potassium silicate doses caused a quadratic effect on *Ci* (Fig. 2B), with the best results at the dose of 530 mg L^{-1} (214.999 μmol of CO_2 m^{-2} s^{-1}), 8.65% higher than that of plants under no foliar application of the product. This is related to the increase in stomatal conductance at the potassium silicate doses, promoting greater CO_2 entry through stomatal opening.

Table 2. Summary of analysis of variance for the physiological variables stomatal conductance (gs), intercellular CO_2 concentration (Ci), CO_2 assimilation rate (A), leaf transpiration rate (E) and water use efficiency (WUE) in "Crioulo" cashew rootstock seedlings subjected to saline water irrigation and potassium silicate doses at 55 days after sowing (DAS).

Source of variation	DF	Mean squares				
		gs	***Ci***	***A***	***E***	***WUE***
Saline levels (SL)	4	0.0057^{**}	507.2^{*}	20.80^{**}	0.63^{**}	0.302^{ns}
Linear regression	1	0.015^{**}	1529.6^{**}	39.00^{**}	2.17^{**}	0.05^{ns}
Quadratic regression	1	0.004^{**}	139.24^{ns}	16.00^{**}	0.04^{ns}	0.02^{ns}
Potassium silicate (PS)	4	0.0013^{**}	876.3^{**}	8.78^{**}	0.05^{ns}	0.354^{**}
Linear regression	1	0.0016^{*}	2.40^{ns}	0.93^{ns}	0.05^{ns}	0.295^{*}
Quadratic regression	1	0.0012^{*}	3320^{**}	33.93^{**}	0.11^{ns}	0.97^{**}
Interaction (SL*PS)	16	0.0006^{ns}	345.54^{ns}	4.40^{ns}	0.15^{ns}	0.352^{ns}
Blocks	2	0.0004^{ns}	282.24^{ns}	0.12^{ns}	0.12^{ns}	0.19^{ns}
CV (%)		26.75	6.33	11.18	16.41	8.41

*** P<0.01; * P<0.05; ^{ns}P>0.05*

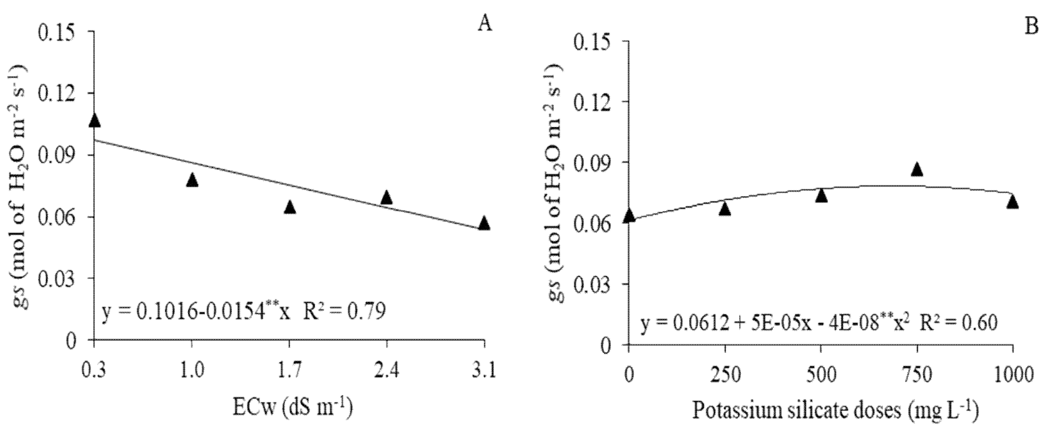

Fig. 1. Isolated effect of irrigation water electrical conductivity (A) and potassium silicate doses (B) on stomatal conductance – gs in "Crioulo" cashew rootstock seedlings at 55 DAS.
*** P<0.01*

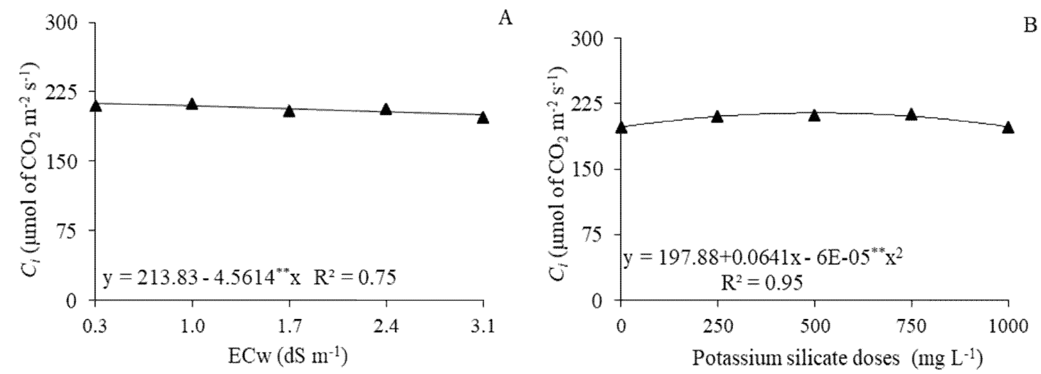

Fig. 2. Isolated effect of irrigation water electrical conductivity (A) and potassium silicate doses (B) on intercellular CO_2 concentration – Ci in "Crioulo" cashew rootstock seedling at 55 DAS.
*** P<0.01*

Regarding CO_2 assimilation rate (A) as a function of irrigation water salinity (Fig. 3A), as ECw increased there was a reduction in CO_2 assimilation and the maximum value of 8.10 μmol of CO_2 m^{-2} s^{-1} was found at ECw of 0.3 dS m^{-1}. This type of behavior demonstrates that the decrease in photosynthesis is due not only to the reduction in stomatal opening, but also to the imbalance between production and removal of reactive oxygen species (ROS) generated during photosynthesis, causing metabolic alterations that culminate in oxidative damages such as lipid peroxidation, damages in cell membranes and degradation of proteins [21].

CO_2 assimilation rate showed a quadratic response as a function of the potassium silicate doses (Fig. 3B), and the dose of 567 mg L^{-1} led to maximum value (7.46 μmol of CO_2 m^{-2} s^{-1}), which is 34.66% higher than that for plants under control treatment (dose 0) with potassium silicate (5.54 μmol of CO_2 m^{-2} s^{-1}). This result is due to the rise in K/N ratio in cashew rootstock leaves and increase in antioxidant enzymes by the silicon, which reduced the effect of sodium on the plant and, consequently, the nutritional imbalance, improving the photosynthetic processes [22,23].

A decreasing linear response was found for leaf transpiration rate, which diminished by 8.24% per unit increase in ECw (Fig. 4A). At electrical conductivity of 3.1 dS m^{-1}, this decline reached 23.08%, resulting in a reduction of 0.48 mmol of H_2O m^{-2} s^{-1} in transpiration when compared with plants under 0.3 dS m^{-1} salinity level. This strategy may be related to an alternative to avoid the absorption of saline water by the plant, because it will maintain a lower sap flow and, consequently, lower absorption of toxic ions [11].

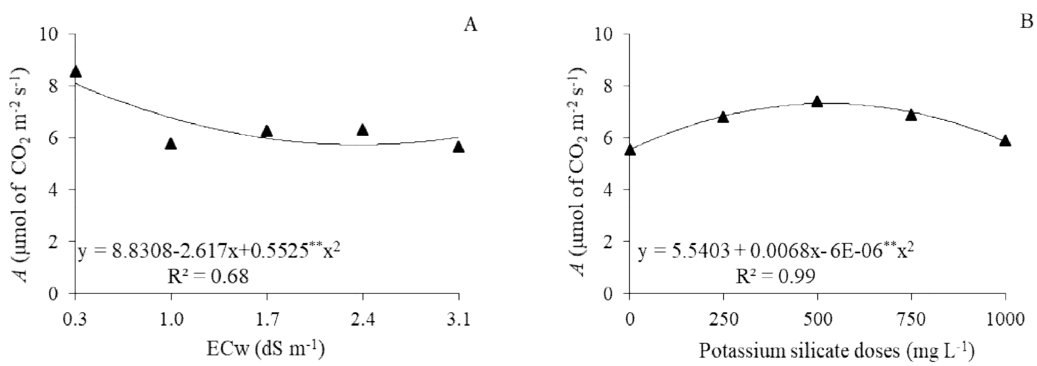

Fig. 3. Isolated effect of irrigation water electrical conductivity (A) and potassium silicate doses (B) on CO_2 assimilation rate – A in "Crioulo" cashew rootstock at 55 DAS.
*** P<0.01*

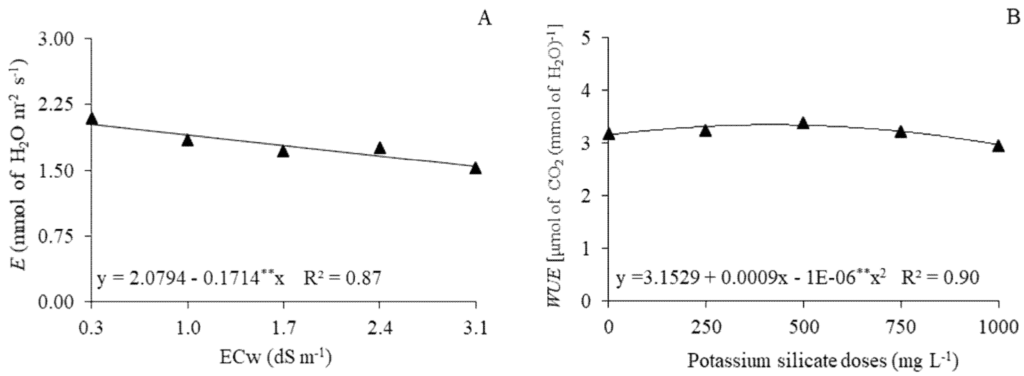

Fig. 4. Isolated effects of irrigation water electrical conductivity on leaf transpiration rate – E (A) and of potassium silicate doses on water use efficiency – WUE (B) in "Crioulo" cashew rootstock seedlings at 55 DAS.

*** P<0.01*

For water use efficiency, potassium silicate applications on "Crioulo" cashew rootstock seedlings led to a quadratic effect according to the regression equation (Fig. 4B), with maximum point at the estimated dose of 450 mg L^{-1}, thus increasing water use efficiency by 6.48% compared with plants under no application of the product. Such fact may be related to the formation of a cuticle-silica double layer in the stomata, which reduces transpiration and water demand by plants [23].

Based on the results of the analysis of variance (Table 3), irrigation water salinity and potassium silicate doses had significant effect on all variables studied (absolute growth rates in plant height and stem diameter; shoot and total dry phytomass; and Dickson quality index) at 75 DAS. Nonetheless, there was no significant effect of the interaction between factors on these variables.

The absolute growth rate in plant height (AGR_{PH}) fitted best to a decreasing linear model as a function of the salinity levels (Fig. 5A), with reduction of 7.19% per unit increase in ECw. The ECw of 3.1 dS m^{-1} led to a reduction of 20.13% (0.106 cm day^{-1}) in comparison to plants subjected to ECw of 0.3 dS m^{-1}. Freire et al. [24] attribute these reductions to the effects of salts on cell turgor pressure, which reduces water content in the tissues, resulting in decrease of cell wall expansion, causing decline in plant growth.

Table 3. Summary of analysis of variance for absolute growth rates in plant height (AGR_{PH}) and stem diameter (AGR_{SD}), shoot dry phytomass (SDP), total dry phytomass (TDP) and Dickson quality index (DQI) of "Crioulo" cashew rootstock seedlings subjected to saline water irrigation and potassium silicate doses, at 75 days after sowing (DAS).

Source of variation	DF	Mean squares				
		AGR_{PH}	AGR_{SD}	SDP	TDP	DQI
Saline levels (SL)	4	0.0522^{**}	0.00039^{**}	2.43^{**}	4.086^{**}	0.030^{**}
Linear regression	1	0.1410^{**}	0.00117^{**}	7.99^{**}	15.59^{**}	0.074^{**}
Quadratic regression	1	0.0370^{**}	0.00008^{ns}	0.04^{ns}	0.009^{ns}	0.002^{ns}
Potassium silicate (PS)	4	0.0179^{**}	0.00008^{*}	1.52^{**}	2.174^{*}	0.021^{*}
Linear regression	1	0.0121^{ns}	0.00006^{ns}	0.15^{ns}	0.158^{ns}	0.031^{*}
Quadratic regression	1	0.0486^{**}	0.00026^{**}	5.55^{**}	7.812^{**}	0.048^{*}
Interaction (SL*PS)	16	0.0090^{ns}	0.00004^{ns}	0.21^{ns}	0.561^{ns}	0.004^{ns}
Blocks	2	0.0134^{*}	0.00002^{ns}	0.33^{ns}	2.187^{*}	0.0001^{ns}
CV (%)		14.06	15.91	10.90	13.23	15.14

*** P<0.01; * P<0.05; ^{ns} P>0.05*

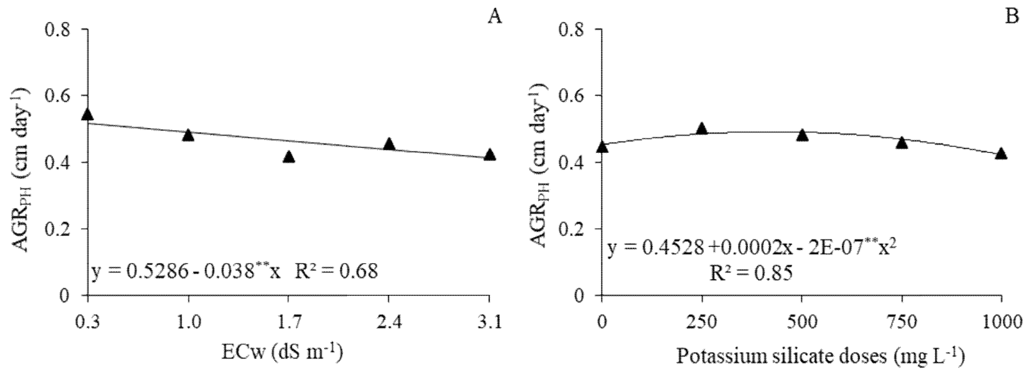

Fig. 5. Isolated effect of irrigation water electrical conductivity (A) and potassium silicate doses (B) on the absolute growth rate in plant height – AGR_{PH} in "Crioulo" cashew rootstock seedlings at 75 DAS.

***P<0.01*

AGR_{PH} was also influenced by increasing potassium and silicon fertilization and, according to the regression equation, its response was quadratic (Fig. 5B), with highest value (0.05 cm day^{-1}) at the estimated dose of 495 mg L^{-1}, which is 11.04% higher than that found in plants under no foliar application of the product. This effect is related to the photosynthetic gains of plants under foliar applications of potassium silicate, since they performed osmotic adjustment in their leaves by accumulating solutes, thus guaranteeing the maintenance of cell turgor and the consequent growth [22].

Regarding the absolute growth rate in stem diameter (AGR_{SD}) (Fig. 6A), increments in irrigation water salinity led to linear reductions of 8.51% per unit increase in ECw, which contributed to a total reduction of 0.010 mm day^{-1} (23.83%) at ECw of 3.1 dS m^{-1}, in comparison to plants irrigated with salinity level of 0.3 dS m^{-1}. Such situation was also observed by Torres et al. [8] studying the initial growth of early dwarf cashew from 10 to 70 days after germination. These authors attributed the decline caused by increased salinity to the diversion of energy substrates to processes of synthesis of organic compounds, osmotically active and necessary for compartmentalization and regulation in the transport of ions.

Regarding the factor potassium silicate doses, the best regression model for AGR_{SD} was the quadratic one (Fig. 6B), with maximum gain at the dose of 485 mg L^{-1}, which was 14.33% superior to that found in the treatment with no application of the product. This effect may be related to the stimulus caused by potassium silicate in N use by the plant, promoting increments in absorption, assimilation, nutrition and, consequently, yield [10].

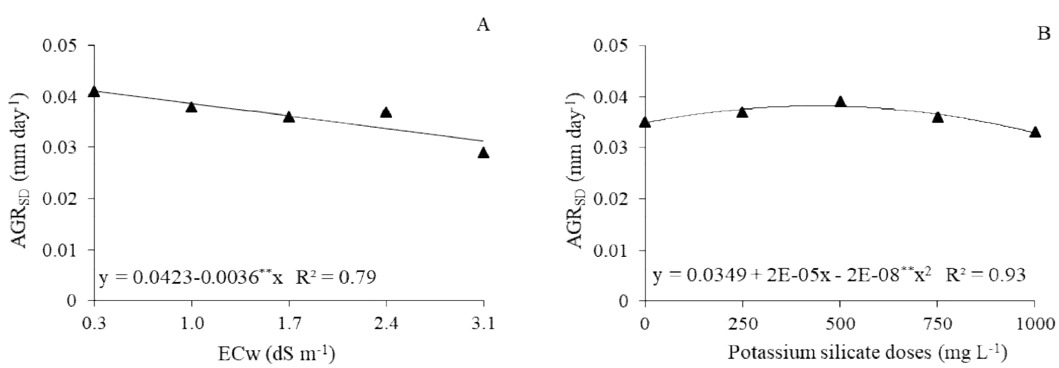

Fig. 6. Isolated effect of irrigation water electrical conductivity (A) and potassium silicate doses (B) on the absolute growth rate in stem diameter – AGR_{SD} in "Crioulo" cashew rootstock seedlings at 75 DAS

***P<0.01*

Increasing ECw levels negatively affected the phytomass production of "Crioulo" cashew rootstock seedlings (Fig. 7A), causing reductions of 5.02% and 5.48% per unit increase in ECw for shoot dry phytomass and total dry phytomass, respectively. The highest saline level led to reductions of 0.8 g (14.06%) in SDP and 1.12 g (15.39%) in TDP, compared with plants irrigated with 0.3 dS m^{-1} water. According to Taiz et al. [20] losses of phytomass accumulation in plants under saline stress result from the abscission and reduction of leaf area, due to the early senescence caused by the toxic action of the excess salts in the irrigation water.

According to the regression equation (Fig. 7B), the increment in potassium silicate doses caused quadratic effect on shoot dry phytomass and total dry phytomass, with maximum values found at doses of 600 mg L^{-1} (6.57 g) for TDP and 465 mg L^{-1} (5.57 g) for SDP, i.e., 14.83% and 10.51% higher than the values found in control plants, respectively. This increase resulted from the improvements in metabolism and photosynthesis, previously observed, due to potassium silicate.

For the Dickson quality index - DQI (Fig. 8A), cashew rootstocks showed a linear reduction of 4.68% per unit increase in ECw, which led to a total reduction of 13.10% at the highest salinity level, compared with the ECw of 0.3 dS m^{-1}. Despite the substantial reduction, cashew rootstock seedlings at ECw of 3.1 dS m^{-1} still had DQI higher than 0.5, being considered as of good quality for the establishment in the field, because the DQI was higher than 0.2 [18].

Increasing doses of potassium silicate caused quadratic effect on DQI (Fig. 8B) and, according to the regression equation, maximum value of 0.63 was obtained in plants

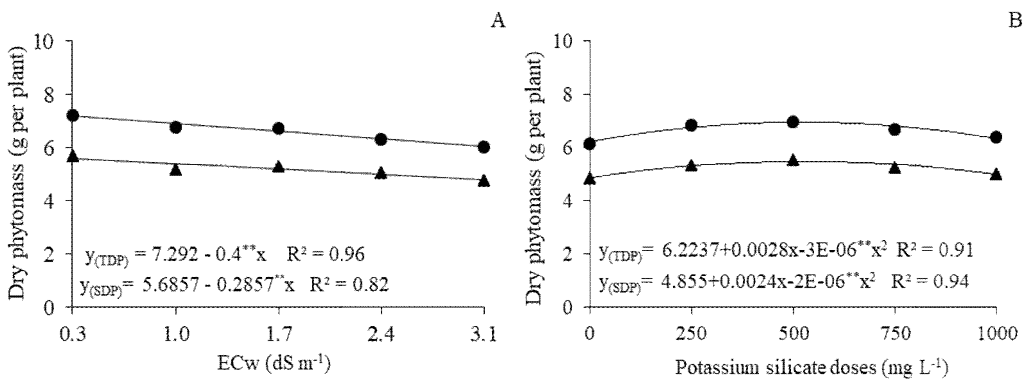

Fig. 7. Isolated effect of irrigation water electrical conductivity and potassium silicate doses on shoot dry phytomass – SDP (A) and total dry phytomass – TDP (B) of "Crioulo" cashew rootstock seedlings at 75 das.
***P<0.01*

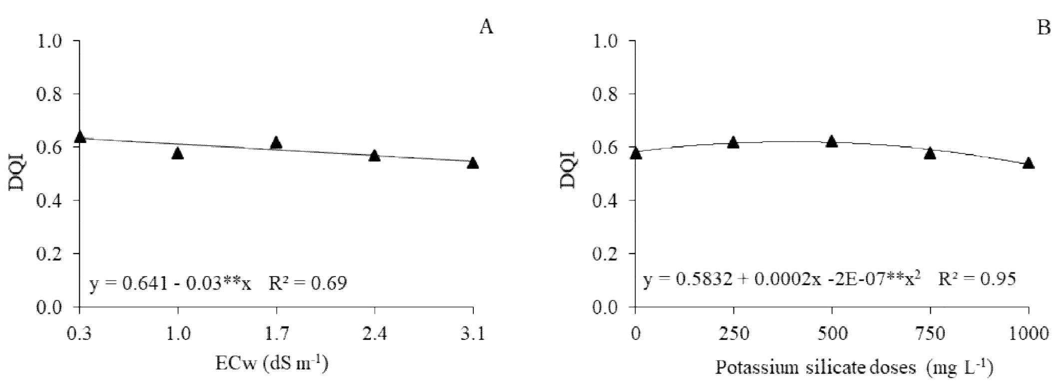

Fig. 8. Isolated effect of irrigation water electrical conductivity (A) and potassium silicate doses (B) on Dickson quality index – DQI of "Crioulo" cashew rootstock seedlings at 75 DAS.
***P<0.01*

subjected to 500 mg L^{-1}. This value was 8,57% superior to that obtained in plants under no application of the product. This result demonstrates the improvements in seedling quality caused by the silicate, since DQI calculation takes into account the robustness and balance in phytomass distribution, thus considering several important parameters.

4. CONCLUSION

Irrigation with water ECw of 1.7 dS m^{-1} causes an acceptable reduction of 10% in rootstocks morphophysiology, thus showing a moderate tolerance of cashew rootstock seedlings "Crioulo" to salinity.

The estimated dose of 524.78 mg L^{-1} of potassium silicate led to improvements in the physiology, morphology and quality of cashew rootstock seedlings, and could be used independently of the salinity of the irrigation water.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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