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Use of Salines Waters and Biofertilizers in Quality of the Seedlings From *Passiflora edulis* Evaluated by the Dry Phytomass

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Abstract

The objective of this study was to evaluate the effects of the biofertilizers (common and enriched) in substrate irrigated with saline waters on the quality of the seedlings evaluated by the phytomass from yellow Passiflora edullis. In this sense, an experiment was carried in a greenhouse at the Center of Agricultural Sciences and Biodiversity CCAB/UFCA, Crato-CE, from October/2017 to March/2018. The substrate used was a material of the first 20 cm to depth of a Red Yellow Latosol. The experimental design was completely randomized in a factorial scheme of type 5 × 3, with three replications, referring to the electrical conductivity values of the irrigation water: 0.5; 1.0; 2.0; 3.0 and 4.0 dS m^{-1}, in the soil without the bovine biofertilizer; in treatments with common biofertilizer and, evaluated in the soil with enriched biofertilizer, conditioned in black polyethylene bags with it a maximum capacity of 5.0 kg, totaling 60 treatments. The fermented bovine biofertilizer after dilution in non-saline and non-chlorinated water (0.5 dS m^{-1}), in the proportion of 1:3, was applied only once to 10% of the substrate volume, two days before sowing. The salinity increase of the irrigation water affected negatively the phytomass production, but with less intensity in the treatments with enriched biofertilizer. The enriched and common biofertilizer provided higher growth and consequently higher phytomass production of passion fruit seedlings in relation to the soil without the respective input, independently of the level of salinity of irrigation water.

Keywords: *Passiflora edulis* F. Flavicarpa Deg, organic input, sanilization

1. Introduction

The yellow passion fruit (*Passiflora edulis* f. Sims, Flavicarpa Deg.), which is also called the sour passion fruit, is a species originated from Tropical America, with more than 150 species native to Brazil, intensely cultivated in countries of tropical and subtropical climate, which corresponds to about 98% of productivity in Brazil (Agrianual, 2016). For the rural producer small, the passion fruit it´s a culture that represents great economic importance, to be it presents a source of profit during the year and because of it your good adaptability for the fruit market *in natura* (Faleiro, Farias Neto, & Ribeiro Júnior, 2008; Meletti, 2011; Souza et al., 2018).

In Brazil, the area affected by the saline stress corresponds to 5% of the total area and 33% of the world's soils are degraded or in process of erosion, salinization, compaction, acidification and contamination are among the main problems (FAO, 2015). In this case, it contributes to the great obstacle to crop productivity, especially on the Northhest of Brazil or in semi-arid areas around the world, where the irrigation system occurs mainly by sprinkling or drip irrigation and low-quality water. Under high saline conditions, the expansion of these areas naturally compromised, in the irrigated perimeters of the Brazilian Northeast constitutes economic and social disorders to the semi-arid region where the production system depends of irrigation and every day new production areas are installed to attend the growing food demand (Yang et al., 2011; Medeiros et al., 2016).

The rational use of water in irrigated agriculture has been a recurrent discussion along the last decades, especially with respect to water quality (Ayers & Westcot, 1999; Silva et al., 2007; Anami, Sampaio, Suszek, Gomes, & Queiroz, 2008). The water use with high salt content results in the salinization of agricultural soils, causing disturbances and altering the chemical nature in these soils, besides to limiting the development of the crops (Mesquita et al., 2015; Sá, Silva, Brito, & Figueiredo, 2015; Ribeiro, Dantas, Mathias, & Pelacaci, 2017; Oliveira et al., 2017).

The saline water has hampered agricultural activity both by the direct effects on the plant and by its accumulation in the superficial layers of the soil. The effects of salinity are related to the decrease of the osmotic potential, reducing the availability of water to the plants, at the toxic effect of specific ions, such as NaCl ions, and, to the nutritional effect (Epstein & Bloom, 2006; Munns & Tester, 2008). The saline stress, according to Silveira et al. (2012), is related to two types of effects: the osmotic and the ionic. The first effects caused by the excess salts are of a biophysical nature, standing out at the osmotic effects, restricting the transport of water. As they saline ions accumulate excessively on the cytosol of the cells will arise toxicity problems (toxic or ionic phase) in the plants exposed to the salinity (Taiz & Zeiger, 2013).

Currently, grow up the demand by acquisition of high-quality seedlings and with well-defined agronomic parameters and even in the production system of yellow passion fruit seedlings. For the production of good quality seedlings, should be adopted efficient methodologies and, if possible, low cost methodologies (Dutra, Grazziotti, Santana, & Massad, 2012). However, mainly in arid and semi-arid regions, where the water scarcity has it become a preponderant factor, the production of seedlings is carried out it using ground-water, which in most cases contains high concentrations of soluble salts, impairing the germination and the growth of them (Souza & Peres, 2016; Oliveira et al., 2017). This inconvenience can transform productive lands into unproductive lands, therefore, it requires the adoption of technologies that either minimize the salinization of the soils with the water management or that allow to produce in areas compromised by salts without large losses of agricultural income and quality of production through the use of organic inputs with positive action on the physical characteristics of the soil and in the root environment of plants (Nascimento, Medeiros, Alves, Lima, & Silva, 2015; Medeiros et al., 2016).

In this context, arise up the need for adoption of cropping technologies that attenuate the deleterious effects of salts excess in irrigation water during the whole the growing phase of the plants, principally during emergence and seedling formation. Among the technological materials employees, stand out the use biofertilizers of bovine manure (*humic substances*) where under irrigation with saline water, these inputs provide greater osmotic adjustment between the roots and the soil solution, minimizing the toxic effects of the salts in the plants (Aydin, Kant & Turan, 2012), increasing thereby the water absorption efficiency and, consequently to stimulate the plant growth (Matsi, Lithourgidis, & Barbayiannis, 2015; Oliveira et al., 2018). Studies have pointed that the use of bovine biofertilizer applied during the formation of fruit seedlings can attenuate the negative effects of irrigation with saline water (Nascimento et al., 2011).

In this sense, an experiment was conducted in a protected environment, with the objective of evaluating the effects of water salinity of irrigation and biofertilizers types (common and enriched) in substrate assessing the quality of the seedlings evaluated by the phytomass from yellow Passiflora edullis.

2. Material Studied

2.1 Characterization of Area

This work with yellow passion fruit, cultivate BRS SC1, was conducted in the period from October 2017 to March 2018, in greenhouse (protected environment), in the Center for Agrarian Sciences and Biodiversity (CASB), of the Federal University of Cariri (CCA-UFCA), in county of Crato, CE, Brazil.

The county of Crato is situated at 422 above sea level, situated under the geographical coordinates of latitude 7º23′26″ (S) and longitude of 39º36′94″ (W) of Greenwich. According to the classification of Köppen, the region's climate is of type Aw (tropical climate with dry winter season). The county of Crato has average temperature in the order of 25.10 °C. It has an average annual rainfall of 1086 mm, concentrating in the months of January to May, according Köppen and Geiger (Lima, Meireles, Oliveira, & Nascimento, 2017). The rainy season is concentrated in the period from March to June, with average rainfall of 1.400 mm per year. The average air temperature is around 23.50 °C.

2.2 Experimental Design

The treatments were distributed in a completely randomized design and in factorial scheme 5 × 3, with three replicates, referring at the salinity values of irrigation water of 0.5; 1.0; 2.0; 3.0 and 4.0 dS m^{-1}, in the treatments without biofertilizer + two types of biofertilizer: common biofertilizer and enriched chemically biofertilizer, conditioning in black polyethylene bags with a maximum capacity of 5.0 kg, totaling 60 treatments.

2.3 Preparation of Salines Waters

For obtaining of the value of electrical conductivity from each type of water used for irrigation constituted the addition of NaCl in water from CCAB/UFCA. In the preparation of the five water treatments with different saline compositions, the water used was from a local pool, of low salinity and without addition of chlorine (ECw

= 0.28 dS m^{-1}), and after that, was added NaCl in the preparation of other waters for additional irrigation of 1.0; 2.0; 3.0 and 4.0 dS m^{-1} according proceeded (Mesquita et al., 2015). For the measurements and control of the electrical conductivities of the waters, It utilized a portable digital conductivity, from model Hi98304 manufacturer Hanna.

2.4 Physical, Chemical and as to Salinity Characterization

The substrate used was a sandy-textured Argissol Red-yellow, no-saline (Embrapa, 2013), submitted to laboratory analysis to determine the physical and chemical attributes regarding fertility and salinity indicated in Table 1, according to Embrapa (2013) and (Richards, 1954).

Table 1. Physical and chemical characterization of soil as to fertility and salinity in layer of 0-20 cm. Crato-CE, Brazil, 2018

Physical Attributes	Value	Fertility Atributes	Value	Salinity Attributes	Value
SD (g cm^{-3})	1.56	pH in water (1:2.5)	6.78	SEEC (dS m^{-1})	0.85
DP (g cm^{-3})	2.73	OM (g Kg^{-1})	12.98	pH	6.86
TP (m^3 m^{-3})	0.48	P (mg dm^{-3})	21.46	Ca^{2+} ($mmol_c$ L^{-1})	2.41
Sand (g kg^{-1})	849	K^+ (mg dm^{-3})	124	Mg^{2+} ($mmol_c$ L^{-1})	1.42
Silt (g kg^{-1})	66	Ca^{2+} ($cmol_c$ dm^{-3})	1.44	Na^+ ($mmol_c$ L^{-1})	4.42
clay (g kg^{-1})	96	Mg^{2+} ($cmol_c$ dm^{-3})	1.42	K^+ ($mmol_c$ L^{-1})	1.53
CDW (g kg^{-1})	16	Na^+ ($cmol_c$ dm^{-3})	0.77	Cl^- ($mmol_c$ L^{-1})	6.61
DF (%)	82.42	$H^+ + Al^{3+}$ ($cmol_c$ dm^{-3})	2.62	CO_3^{2-} ($mmol_c$ L^{-1})	-
DI (%)	13.56	Al^{3+} ($cmol_c$ dm^{-3})	0.00	HCO_3^- ($mmol_c$ L^{-1})	1.85
U_{cc} (g kg^{-1})	14.43	SEB ($cmol_c$ dm^{-3})	3.94	SO_4^{2-} ($mmol_c$ L^{-1})	1.14
U_{pmp} (g kg^{-1})	3.87	CEC ($cmol_c$ dm^{-3})	6.56	SAR (mmol $L^{-1})^{1/2}$	2.76
AW (g kg^{-1})	6.77	V (%)	56.77	ESP (%)	5.27

Note. SD = Soil Density; PD = Particle of Density; TP = Total porosity; CDW = Clay dispersed in water; DF = Degree of flocculation; DI = Dispersion index; U_{cc} and U_{pmp} = Respectively, humidity of the soil to the -0.01 and -1.5 Mpa; AW = Available water; OM = Organic matter; SEB = Sum of Exchangeable Bases($Na^+ + K^+ + Ca^{2+} + Mg^{2+}$); CEC = Cation exchange capacity = SB + ($H^+ + Al^{3+}$); V% = Saturation value by bases (100 × SB/CTC); SEEC = Saturation extract electric conductivity; SAR = Sodium adsorptionRelation = $Na^+ \times [(Ca^{2+} + Mg^{2+})/2]^{-1/2}$; ESP = Exchangeable SodiumPercentage (100 × Na^+/CTC).

2.5 Preparation of the Biofertilizers (Common and Enriched)

The common biofertilizer it was obtained by the anaerobic fermentation of equales parts of non-saline and non-chlorinated water with fresh bovine manure of the cows in lactating during 30 days (Melo Filho et al., 2017). The enriched biofertilizer was prepared with the same amounts of water and fresh manure as the common biofertilizer, but 2 L of molasses, 4 L of bovine milk and 2 kg of agricultural gypsum were added weekly, in a proportion of 1:2:1. To maintain the system, every 10 days a mixture was made to accelerate the microbial process and facilitate fermentation. For the maintenance of each hermetically sealed system, where the end of a 4 mm diameter hose was connected to the upper base of the biodigester and the other end immersed in a vessel with water. The agricultural gypsum used contained 26% CaO, 14.7% S and 5% moisture by matter (Leite, Diniz, Cavalcante, Gheyi, & Campos, 2010).

2.6 Chemical Characterization of Water and of the Biofertilizers (Common and Enriched)

The chemical composition of irrigation water and of the two types of biofertilizers in the liquid form was made using the methodologies suggested by Richards (1954). Before application of the organic input, each type of biofertilizer was diluted in water in the proportion of 1:3, applied once, two days before of the sowing, in the volume equivalent at 10% of the substrate volume (3.5 L). The chemical composition of water for irrigation and fertilizers in liquid form are showed in Table 2, this was based on the methodologies suggested by Richards (1954), these analyzes were made in laboratory of analytical central, Federal University of Cariri/Campus of Juazeiro do Norte-CE.

Table 2. Characterization of irrigation water, of the common and enrichedbiofertilizer with milk, molasses and agricultural gypsum. Crato-CE, Brazil, 2018

Componentes	Water	Biofertilizer	
		Common	Enriched
EC (dS m^{-1})	0.59	3.68	6.25
SAR (mmol $L^{-1})^{1/2}$	2.63	1.53	2.30
Ca^{2+} ($mmol_c$ L^{-1})	1.37	9.35	21.42
Mg^{2+} ($mmol_c$ L^{-1})	0.83	7.51	14.82
Na^+ ($mmol_c$ L^{-1})	2.56	3.42	9.21
K^+ ($mmol_c$ L^{-1})	0.19	11.54	16.41
Cl^- ($mmol_c$ L^{-1})	2.28	20.12	25.92
HCO_3^- ($mmol_c$ L^{-1})	0.45	6.02	8.82
CO_3^{2-} ($mmol_c$ L^{-1})	0.00	0.00	0.00
SO_4^{2-} ($mmol_c$ L^{-1})	0.76	6.18	15.32
Classification	C_1S_1	C_4S_1	C_4S_1

Note. EC = Electric conductivity; SAR = Sodium adsorption ratio = $Na^+ \times [(Ca^{2+} + Mg^{2+})/2)]^{-1}$.

At the sowing were placed five seeds of the yellow passion fruits in each experimental unit with 93% viability. At the 15 days after emergence, was done the thinning of the seedlings, maintaining the most vigorous and the irrigation with each saline level was accomplished daily in a volume established according to the water requirement of the culture, ranging from 0.15 to 0.35 L of water until the end of the experiment, respecting the conditions of the soil field capacity.

2.7 Variables Analyzed at the End of the Experiment

At the end of the experiment, at 180 DAE (days after emergence), the following morphological parameters were evaluated: dickson quality index, root length, using a graduated ruler; root area through leaf disc weights proposed by Mielke, Hoffmann, Endres and Fachinello (1995) and Nascimento et al. (2011), using a well with a known area (1.0 cm^2), where leaf discs of the basal, medial and apical portions were highlighted. The root area was estimated through the known area of leaves discs (KALD) featured of leaf discs weight (LDW) and total of leaf weight (TLW), all analyzed in analytical balance. The total leaf area was estimated applying the following formula: AF = PTF × ACD/PDF.

For the quantification of dry matter, the seedlings were cut close to the soil, and soon after, were removed carefully all roots, stems and root. Then, were subjected to the washing process with distilled water for withdrawal of soil excess and dried to remove excess water. The separates parts (root, stem and leaves) was added in a safe place, in the nutrition's laboratory of soil at the UFCA. After, was measured the fresh matter of each one of the plants organs in digital precision balance. Posteriorly, the dry vegetable material (root + leaves) was obtained after oven in kiln-drying with forced air circulation at a temperature of 65 °C up to constant matter. After the drying, was obtained dry matter in digital electronic balance with of 0.01 g.

The morphological parameters of the seedlings and their relationships used in the evaluating the results were: height of aerial part (HAP), stem diameter (SD), total dry matter (TDM), dry matter of aerial part (DMAP), dry matter of roots (DMR), relation between the height of aerial part and dry matter of aerial part, relation between dry matter of aerial part (DMAP) and dry matter of root (DBR) and dickson quality index (DQI), as it also proceeded Mesquita et al. (2015), in Indian neem seedlings (*Azadiracta indica* A. Juss), Marana, Miglioranza & Fonseca (2015) in the seedlings of Jaracatiá (*Jacaratia spinosa*) and Silva et al. (2018) in the culture of the yellow passion fruits (*Passiflora edullis* L.).

With the datas obtained from dry matter, it was calculated the dry matter of aerial part and total, the relation height of aerial part/collector diameter, the relation between height of aerial part/production of dry matter of aerial part, the relationship between the production dry matter of root/production of dry matter of arerial part its has a variable that measures the quality of seedlings for the field, called of dickson quality index (DQI) according with (Dickson, Leal, & Hosner, 1960):

$$DQI = \frac{DTMP}{\frac{HP}{SD} + \frac{RDMP}{PADMP}} \quad (1)$$

Where, DTMP = Total dry matter production (g); HP = Height of the aerial part (cm); SD = Stem diameter (mm); RDMP = Root dry matter production (g); PADMP = Part aerea of dry matter production (g).

The dickson quality index is mentioned as an promising integrated morphological measure and indicated as a good indicator of the seedlings quality, considering for its calculation, the robustness and the balance of the phytomass distribution, being weighted several important parameters (Lisboa et al., 2014).

2.6 Statistical Analysis

The results were submitted to analysis of variance by the "F" test, and when significant, the salinity levels of the water were submitted to the Polynomial Regression analysis, while the biofertilizers and the yellow passion fruits were compared by the Tukey ($p < 0.05$) (Banzatto & Kronka, 2008). For the data processing, the free version of the SISVAR software was used 5.6, Build 86-DEX-UFL Alivre (Ferreira, 2011).

3. Results and Discussion

The statistical analysis revealed significant effects of the interaction of water salinity and biofertilizers on root length and root area of the yellow passion fruit, indicating that the actions of these independent factors exerted positive effects on the growth and development of this Passifloraceae (Figure 1).

In the absence of biofertilizer (●),the substrates of the yellow passion fruit seedlings had their root length increased from 13.40 to up 18.14 cm in the salinity threshold of 1.96 dS m^{-1} (Figure 1A). This behavior of the seedlings may be related to the process of inhibition of the root system as a strategy to avoid direct contact of the deleterious effect of the salts. According to Taiz et al. (2017), this inhibition of the growth caused by the salinity is due to the osmotic effect, which promotes the physiological drought, as well as causes the toxic effect, resulting from the concentration of ions in the protoplasm.

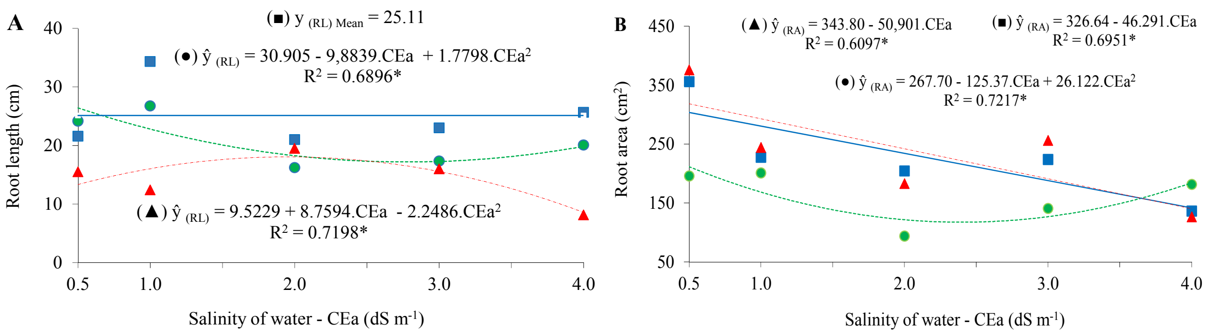

Figure 1. Root length (A) and root area (B) of passion fruit seedlings evaluated on the substrate without bovine biofertilizer (●), with common biofertilizer (■) and with enriched biofertilizer (▲) in function of the salinity of irrigation water. Crato-CE, 2018

Because, the salinity tolerance, either even so relatively low in the majority of the cultivated species, can occur with great genetic variability not only among species, but also among cultivars within a species such as that occurring in this study (Ponte et al., 2011).

Analyzing the root length of the seedlings in the soil with common biofertilizer (■), this variables response were reduced with the increase of electrical conductivity of water (ECw), where it was observed that as you increased the ECw, there was a unit decrease of 3.61; 4.57 and 1.03 cm for each value unit of the electrical conductivity of the irrigation water, evaluated at 180 DAE, respectively (Figure 1A).

This reduction in the root system is due to the direct effects of the ions toxicity or indirect effects of the saline ions present in the soil, causing osmotic imbalances to plants (García, Alcántara, & Fernández, 2011). These data's in consonance with Cavalcante et al. (2010) verified that the excess of sodium salts entails a series of losses in the chemical and physical properties of the soil, whereas consequently, causes the reduction in the growth and in some situations the death of the cultivated plants.

The increase of the water salinity levels reduced the growth of root length during the formation of the yellow passion fruit seedlings, restricting independently of the application of organic inputs (common and enriched), but with superiority to the treatments that received the enriched organic input provided before sowing (Figure 1A).

Although the dispersion high of the datas, in function of the stress caused by the salinity of the waters, the enriched biofertilizer (▲) did not adjust the none them mathematical model, but, even so, it promoted a longer root length of the seedlings in relation to the soil without and with a common organic input, respectively, with average value of 25.11 cm. These datas are in accordance with Cavalcante et al. (2009), who verified superiority in the root development of yellow passion fruit seedlings on substrate fertigated with biofertilizer (■) and irrigated with saline waters.

The root area of the seedlings of passion fruits suffered with the increase of ECw, where it was observed that as you increased the ECw, there was a percentage loss of 15.08, 114.51 and 127.06%, at 180 DAE (Figure 1B), of the seedlings of passion fruits treated without the organic input, with common and enriched biofertilizer, respectively. The greater expansion root of plants in the soil with biofertilizer (■), is generally, is a response to the better physical condition provided to the substrate by the humus substances (Abdel-Latef et al., 2011), as well as, at the higher accumulation of organic solutes such as soluble carbohydrates and other substances as proline in the plants raising the capacity of osmotic adjustment (Sucre et al., 2011).

The energy spent by the plant to absorb water in a saline soil is higher than that to absorb water from a solution without salts. This reduction in the leaf area development in relation to root growth would reduce the plant's water use, thus allowing a higher concentration of salts in the soil, damaging the metabolic activities of plants (Taiz & Zeiger, 2013). According to Taiz et al. (2017), this inhibition of the growth caused by the salinity is due to the osmotic effect, which promotes the physiological drought, as well as causes the toxic effect, resulting from the concentration of ions in the protoplasm.

It was observed that the increase in ECw effects exercised significant on the dickson quality index (DQI) and, according with to the regression equation, the model to which the datas had or presented better adjustments in R^2, that is, adjusted was quadratic in all situations studied. The irrigation with water up to 4.0 dS m^{-1} reduced quadratically, the diskson quality index, reaching the lowest value of 0.67, which corresponded to a decrease of 163.43%, per unit increase in ECw to salinity threshold of 2.28 dS m^{-1}, in the soil without the organic input (Figure 2A). These data are lower than those presented by Melo Filho et al. (2017), when studying the quality index of dickson of Pitomba seedlings (*Talisia esculenta*) under different electrical conductivities of irrigation water. These authors verified a drastic percentage drop of up to 173.17% dickson quality index of these seedlings in the salinity threshold of 4.5 dS m^{-1}.

According to the criterion of Hunt et al. (1990), the DQI less than 0.2 indicates seedlings not considered of good final quality to be established in the field and the higher the DQI value, better will be the seedling quality. In this sense, the treatments that did not receive the fermented organic compound with the lowest dickson quality index (DQI) in the order of 0.67, at the threshold salinity of 2.28 dS m^{-1}, the yellow passion fruit seedlings are with superior quality suitable for the transplanting, demonstrating robustness and performance in the field. The tendency of the plants to increase their yields after the minimum point would be a biological natural response of the plants against the adversity or saline stress, in the saline environment.

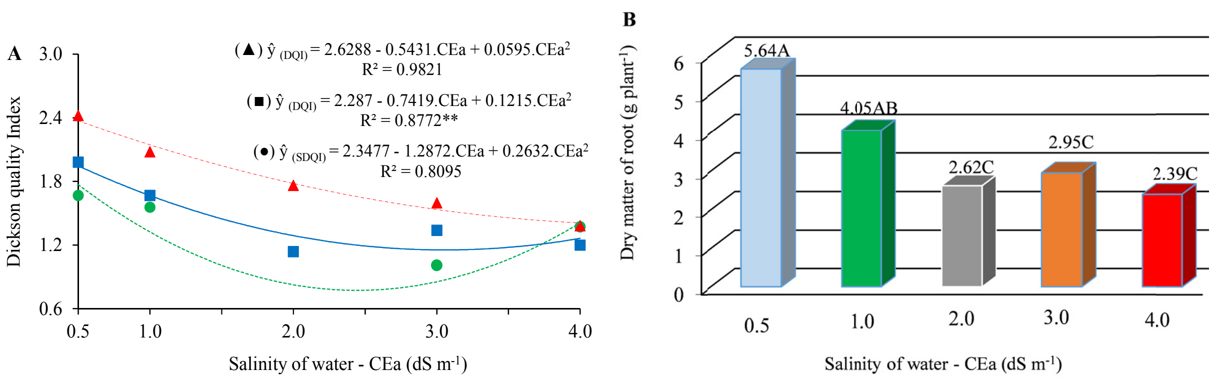

Figure 2. Dickson quality Index (A) and dry matter of root (B) of the yellow passion fruit seedlings treated in the soil without bovine biofertilizer (●), in the presence of common biofertilizer (■) and with enriched biofertilizer (▲) to the detriment of the salinity of irrigation water. Crato-CE, 2018

When comparing the values of the dickson quality index (DQI) for the soil with common and enriched biofertilizers (Figure 2A), Its note a superiority expressive in the behavior of the seedlings, however, the drastic inhibition of the plants caused by the salts was reported in all situations, except in the treatments with common organic compound (■), as of the threshold salinity 3.0 dS m^{-1}, that is, the saline stress reduced significantly the quality of the seedlings evaluated by the DQI parameter 2.36 to 1.53 (0.5 and 4.0 dS m^{-1}, respectively) due to the direct effects of ionic ions or indirect effects of the saline ions present in the soil, causing osmotic imbalances to the plants (García, Alcántara, & Fernández, 2011). These datas are superior to those presented by Mesquita et al. (2015), verified that the excess of sodium salts entails a series of losses in the chemical and physical properties of the soil, which, consequently, causes a percentage reduction of 83.34% in the growth and quality of the neem seedlings (*Azadirachta indica*).

By Figure 2A, the model to which the datas referring to the dickson quality index if adjusted in the treatments with enriched biofertilizer (▲) was the quadratic model, with R^2 equivalent to 87.22%, indicating a decrease in the quality of the seedlings through the process of inhibition in the order of 1.94 to 1.13 (0.5 and 4.0 dS m^{-1}, respectively), due to direct effects of ionic ions or indirect effects of saline ions present in the soil, causing osmotic imbalances to plants (García, Alcántara, & Fernández, 2011).

Carneiro et al. (2007) confirmed that the height of the aerial part combined with the diameter of the collection is one of the most important morphological parameters to estimate the growth of seedlings after the final planting in the field. Mesquita et al. (2015) working with neem seedlings (*Azadirachta indica*) and Diniz Neto et al. (2014) evaluating Oiticica seedlings (*Licania rigida* Benth.), Also observed that high salinity levels decrease the DQI of this plant.

Based in the (Figure 2B), the results of the root dry matter of the passion fruit seedlings, were not statistically significant for the interaction effect type the salinity × biofertilizers. However, the seedlings succeeded catch up the mean values of 5.64 and 4.05 grams of root dry matter, at the lowest salinity levels, 0.5 and 1.0 dS m^{-1}, respectively.

When the sodium content is high in relation to the other cations, it can be adsorbed by the exchange complex and, in this case, the clay particles can be dispersed, and the soil loses its structure, becoming impermeable (Holanda Filho et al., 2011). Thus, the dissolved salts in the soil solution promote changes in the physiological processes of the cultures, with consequent reduction in their root growth and their production of photoassimilates.

The highest gains in dry matter of area part (DMAP) and total dry matter (TDM) were obtained in seedlings irrigated with water of lower salinity (0.5 dS m^{-1}) with 19.81 g (DMAP) and 25.22 g (TDM) and lower gain in matter in saline irrigation of 4.0 dS m^{-1} 6.44 g (DMAP) and 7.61 g (TDM). The ECw negatively influenced aerial dry matter (DMAP) and total dry matter (TDM) of the yellow passion fruit seedlings, according to the regression equation (Figure 3). This can be explained by the fact that the NaCl negatively affects the synthesis and translocation of hormones from roots to the part aere, which results in loss of dry matter (Melo Filho et al., 2017). This response of the plants at saline stress may be a protection response of the plants after this behavior or saline stress.

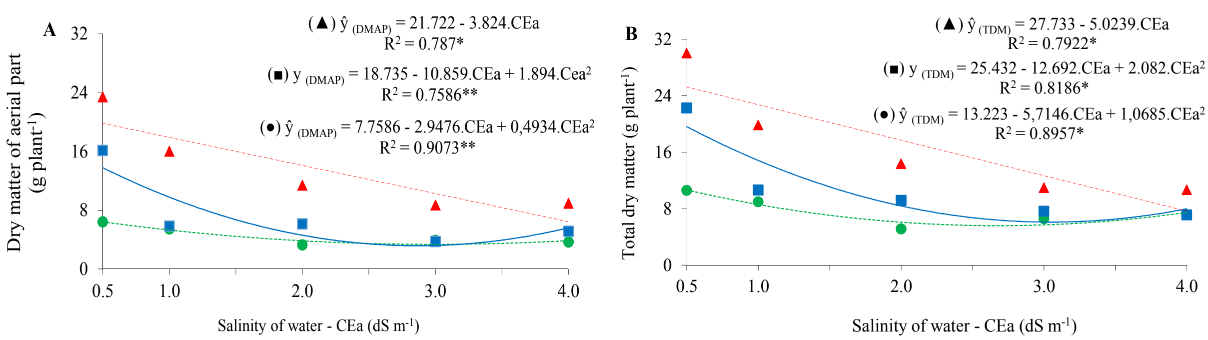

Figure 3. Dry matter of part area (DBPA) and total dry matter (TDB) of the yellow passion fruit seedlings evaluated on the substrate without bovine biofertilizer (●), in the presence of common biofertilizer (■) and with enriched biofertilizer (▲) in function of the salinity of irrigation water. Crato-CE, 2018

The sodium excess favors the nutritional imbalance, triggering toxicity, which affects morphological processes (growth, root expansion) and physiological (respiration, CO_2 fixation), resulting in lower growth rate and matter allocation (Cavalcante et al., 2010).

The salinity affected the growth of the seedlings, especially in the initial phase of growth, as observed in yellow passion fruit seedlings (Mesquita, Rebequi, Cavalcante, & Souto, 2012), papaya (Sá, Silva, Brito, & Figueiredo, 2015) and oiticica (Diniz Neto et al., 2014). This is due to the fact that the saline stress limits the photosynthetic rate and the stomatal conductance, which consequently decreases the rate of CO_2 assimilation, compromising plant growth (Freire et al., 2014; Melo Filho et al., 2017).

4. Conclusions

The irrigation with saline waters affected the morphology and quality of the yellow passion fruit seedlings (*Passiflora edullis*), there is, the length of the root and leaf area of the yellow passion fruit seedlings were higher in the substrates with the enriched biofertilizer.

The enriched biofertilizer has a positive action in reducing of the deleterious effects of irrigation saline water in relation to the soil with common input and in the treatments without the organic compound, thus providing, more vigorous yellow passion fruit seedlings.

Evaluating the growth and development of seedlings, both biofertilizers attenuated and provided greater phytomass production and seedling quality.

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