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Effects of saline water and potassium fertilization on photosynthetic pigments, growth and production of West Indian Cherry

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ABSTRACT

Due to the scarcity of water in the semi-arid region of Northeast Brazil, in both quantitative and qualitative terms, the use of saline water in agriculture should be considered as one alternative for irrigated agriculture. This study therefore aimed to evaluate the photosynthetic pigments, growth and production of West Indian Cherry as a function of irrigation using waters with different salinity levels and potassium (K) fertilization, after grafting. The study was carried out in drainage lysimeters under greenhouse conditions, in a eutrophic Regolithic Neosol with sandy loam texture, in the municipality of Campina Grande, PB. The experiment was set in a randomized block design, to test two levels of irrigation water electrical conductivity - ECw (0.8 and 3.8 dS m^{-1}) and four K_2O doses - KD (50, 75, 100 and 125% of recommendation), with three replicates. The dose relative to 100% corresponded to 79.2 mg K_2O kg^{-1} of soil. Irrigation with high salinity water stimulated the biosynthesis of chlorophyll *b* and carotenoids, while the chlorophyll *a* content and the growth of the cherry were reduced markedly in the post-grafting phase. The harmful effects of salinity on the total number of fruit and fresh mass of West Indian Cherry fruit were minimized with potassium fertilization.

Keywords: *Malpighia emarginata*, potassium, salt stress.

Efeito da água salina e adubação potássica nos pigmentos fotossintéticos, crescimento e produção da aceroleira

RESUMO

Diante da escassez hídrica, tanto em termos quantitativo como qualitativo, que ocorre no semiárido do Nordeste Brasileiro, o uso de água salina na agricultura deve ser considerado como uma alternativa para a agricultura irrigada. Neste contexto, desenvolveu este trabalho com o objetivo de avaliar os pigmentos fotossintéticos, o crescimento e a produção da aceroleira em função da irrigação com águas de diferentes salinidades e adubação potássica, pós-enxertia. O estudo foi conduzido em lisímetros de drenagem em condições de casa de vegetação, no

Neossolo Regolítico Eutrófico de textura franco-arenosa, no município de Campina Grande, PB. Usou-se o delineamento de blocos ao acaso, testando-se dois níveis de condutividade elétrica da água de irrigação – CEa (0,8 e 3,8 dS m^{-1}) e quatro doses de potássio – DK (50, 75; 100 e 125% da recomendação), com três repetições. A dose referente a 100% correspondeu 79,2 mg K_2O kg^{-1} de solo. A irrigação com água de elevada salinidade estimulou a biossíntese de clorofila *b* e carotenóides, enquanto o teor de clorofila *a* e o crescimento da aceroleira foram reduzidos acentuadamente, na fase pós-enxertia. Os efeitos prejudiciais da salinidade sobre o número total de frutos e massa fresca de frutos da aceroleira foram minimizados com a adubação potássica.

Palavras-chave: estresse salino, *Malpighia emarginata*, potássio.

1. INTRODUCTION

Belonging to the Malpighiaceae family, the West Indian Cherry (*Malpighia emarginata* D. C.) is a fruit native to Tropical America that stands out for its high nutritional value, especially as source of ascorbic acid, vitamin A, iron, calcium and complex-B vitamins (thiamin, riboflavin and niacin). It is consumed both fresh and processed, in the forms of juices, ice creams, jellies, syrups, liqueurs, sweets in syrup, among other products (Esashika et al., 2013).

Most West Indian Cherry orchards in Brazil are concentrated in the Northeast region, and the states of Bahia, Ceará, Paraíba and Pernambuco account for most of the national production. In this region, high temperatures, low rainfalls, irregular rainfall distribution and intense evaporation in most months of the year is common, which make the practice of irrigation indispensable to guarantee agricultural production with safety (Nobre et al., 2011; Lima et al., 2014). However, most waters used in irrigation contain relatively high contents of salts, which is one of the main obstacles for the crop production system.

With the increase of salinity in the root environment, the photosynthetic pigments, growth and production of the crops are compromised. This probably occurs due to the reduction in water absorption by plants, caused by the decrease in the osmotic potential of the soil solution, which can also lead to ionic toxicity, nutritional imbalance or both, due to the excessive accumulation of certain ions in plant tissues, especially chloride and sodium (Barroso et al., 2010; Islam et al., 2017). In addition, the use of waters with high saline concentrations can cause photoinhibition, photooxidation in the chloroplasts, inactivation of enzymes, degradation of photosynthetic pigments and lipid peroxidation of cell membranes (Ashraf and Harris, 2013).

However, the intensity with which the salt stress affects chloroplast pigments, growth and production of the crops depends on other factors, such as species, cultivar, types of salts, stress intensity and duration, crop and irrigation management, edaphoclimatic conditions and fertilization (Munns and Tester, 2008).

Among the alternatives employed to minimize the deleterious effects caused by the high salt concentrations on plants, K fertilization stands out. Hence, studies have associated the tolerance of crops to salinity with an adequate K nutrition (Blanco et al., 2008; Gurgel et al., 2010). Potassium is essential to plants because it plays a key role in osmotic regulation and promotes the maintenance of turgor in guard cells. By increasing their osmotic potential, potassium allows these cell to absorb more water, and the adjacent cell acts as a counter cation for anion accumulation and electrogenic transport processes and, consequently, generates higher turgor pressure (Langer et al., 2004; Islam et al., 2015).

Besides being an osmoregulator, K creates an osmotic gradient that allows water movement and regulates stomatal opening and closure, playing an essential role in water saving and cell turgor, transport of carbohydrates and respiration (Shimazaki et al., 2007). Despite the importance of the West Indian Cherry crop for the Brazilian Northeast region, especially in semi-arid areas, there is a lack of studies on the interaction between water salinity and K fertilization.

In this context, this study evaluated the effects of irrigation using water of different saline levels and K fertilization on photosynthetic pigments, growth and production of West Indian Cherry, in the post-grafting stage.

2. MATERIAL AND METHODS

The research was carried out under greenhouse conditions from July 2016 to July 2017 in pots adapted as drainage lysimeters. This was done at the Center of Technology and Natural Resources of the Federal University of Campina Grande (CTRN/UFCG), located in the municipality of Campina Grande, PB, at the local geographic coordinates 7°15’18’’ S, 35°52’28’’ W and altitude of 550 m.

The experimental design was in randomized blocks, with three replicates, using a 2 x 4 factorial arrangement, and the treatments consisted of two levels of irrigation water electrical conductivity - ECw (0.8 and 3.8 dS m^{-1}) and four K_2O doses (50, 75, 100 and 125% of recommendation). The dose relative to 100% corresponded to 79.2 mg K_2O kg^{-1} of soil (Musser, 1995).

The irrigation waters with the respective ECw values were prepared through the dissolution of NaCl, $CaCl_2.2H_2O$ and $MgCl_2.6H_2O$ salts in equivalent proportion of 7:2:1, respectively, in public-supply water (ECw = 1.40 dS m^{-1}) of the municipality of Campina Grande, PB, based on the relationship between ECw and salt concentration (10*$mmol_c$ L^{-1} = ECw dS m^{-1}) according to Richards (1954). Water with ECw of 0.8 dS m^{-1} was obtained by adding rainwater (0.02 dS m^{-1}) to public-supply water.

A 4-mm-diameter drain was connected to the bottom of each lysimeter, to drain the excess of water to a container, in order to evaluate it and determine water consumption by plants. The tip of the drain inside the lysimeter was involved with a nonwoven geotextile (Bidim OP 30) to avoid obstruction by soil material.

The lysimeters were filled with a 1-kg layer of crushed stone nº 0, followed by 250 kg of an eutrophic Regolithic Neosol of sandy loam texture, properly pounded to break up clods, from the rural area of the municipality of Esperança, PB, whose chemical and physico-hydraulic characteristics were determined according to the methodologies proposed by Claessen (1997): Ca^{2+} = 9.07$cmol_c$ kg^{-1}; Mg^{2+} = 2.78 $cmol_c$ kg^{-1}; Na^+ = 1.64 $cmol_c$ kg^{-1}; K^+ = 0.23 $cmol_c$ kg^{-1}; H^+ + Al^{3+} = 8.61$cmol_c$ kg^{-1}; Al^{3+} = 0 $cmol_c$ kg^{-1}; CEC = 22.33 $cmol_c$ kg^{-1}; exchangeable sodium percentage = 7.34%; organic matter = 2.93 dag kg^{-1}; P = 39.8 mg kg^{-1}; pH in water (1:2.5) = 5.58; saturation extract electrical conductivity = 2.15 dS m^{-1}; SAR = 0.67 $(mmol\ L^{-1})^{0.5}$; sand = 659.9 g kg^{-1}; silt = 161.2 g kg^{-1}; clay = 178.9g kg^{-1}; moisture at 33.42 kPa = 25.91 dag kg^{-1}; moisture at 1519.5 kPa = 12.96 dag kg^{-1}.

In the present study, rootstocks consisted of native West Indian Cherry seedlings from the EMBRAPA Tropical Agroindustry, in Pacajus-CE. At transplantation, the seedlings were 240 days old. During the acclimatization period in the greenhouse, the West Indian Cherry plants were irrigated using water of low salinity level (0.8 dS m^{-1}). ‘BRS 366 Jaburu’ was used as scion variety. This cultivar stands out for its high yield (57 t ha^{-1}), which favors the production of vitamin C (2,648 mg $100g^{-1}$), with height of approximately 1.87 m and crown diameter of 2.18 m. The fruits are shiny when ripe, exhibiting mean weight of 4 to 5 g in unripe stage, adequate to obtain vitamin C, and 6 to 7 g after ripening.

Before transplanting the seedlings, soil moisture was increased until reaching field capacity, using the respective water of each treatment. After transplanting, irrigation was daily performed by applying a water volume to maintain soil moisture close to field capacity in each lysimeter. The applied volume was determined according to the water requirement of the plants, estimated through the water balance: applied volume minus volume drained in the previous irrigation, plus a leaching fraction of 0.10.

Fertilization with phosphorus and nitrogen was performed according to the recommendation of Musser (1995), applying 180 and 95.4 mg kg^{-1} of P_2O_5 and N, respectively, in the form of single superphosphate and urea. Phosphorus was entirely applied as basal fertilization. To meet probable deficiencies of micronutrients, the West Indian Cherry plants received the application of 5 L of solution containing 1.5 g L^{-1} of ubyfol [(N (15%); P_2O_5 (15%); K_2O (15%); Ca (1%); Mg (1.4%); S (2.7%); Zn (0.5%); B (0.05%); Fe (0.5%); Mn (0.05%); Cu (0.5%); Mo (0.02%)].

The effects of the different saline levels and K doses on the contents of chlorophylls *a* (Chl *a*) and *b* (Chl *b*), carotenoids (Car) and growth were evaluated based on stem diameter of the rootstock (Rootstock SD) and scion variety (Scion SD), at 300 days after transplanting.

The contents of chlorophyll *a* and *b* (g m^{-2}) were determined according to the laboratory method proposed by Arnon (1949), using samples of 5 discs of the blade of the third mature leaf from the apex. The extracts were used to determine the contents of chlorophyll and carotenoids in the solutions through spectrophotometer at the absorbance wavelength (ABS) (470, 646 and 663 nm), using the following equations: Chlorophyll *a* (Chl *a*) = 12.21 ABS_{663} – 2.81 ABS_{646}; Chlorophyll *b* (Chl *b*) = 20.13 ABS_{646} – 5.03 ABS_{663}; Total carotenoids (Car) = (1000 ABS_{470} – 1.82 Cl *a*–85.02 Cl *b*)/198. The values obtained for the contents of chlorophyll *a*, *b*, and carotenoids in the leaves were expressed in µm cm^{-2}.

Rootstock stem diameter was measured at height of 5 cm from the base of the plant, while scion stem diameter was measured 3 cm above the grafting line. Harvest started at 180 DAS and was quantified based on total number of fruits (TNF), total fruit fresh weight (FFW) and fruit mean weight (FMW).

The data were subjected to analysis of variance by F test and, when significant, test of comparison of means (Tukey test at 0.05 probability level) was applied to the water salinity levels, while regression analyses was applied to the factor K_2O doses, using the statistical program SISVAR-ESAL (Ferreira, 2011).

3. RESULTS AND DISCUSSION

According to the summary of the analysis of variance (Table 1), there was significant effect of the water salinity levels on all studied variables. Potassium doses and the interaction between the factors saline levels and K_2O doses (SL x KD) caused significant effect only on the variables total number of fruits and total fruit fresh weight.

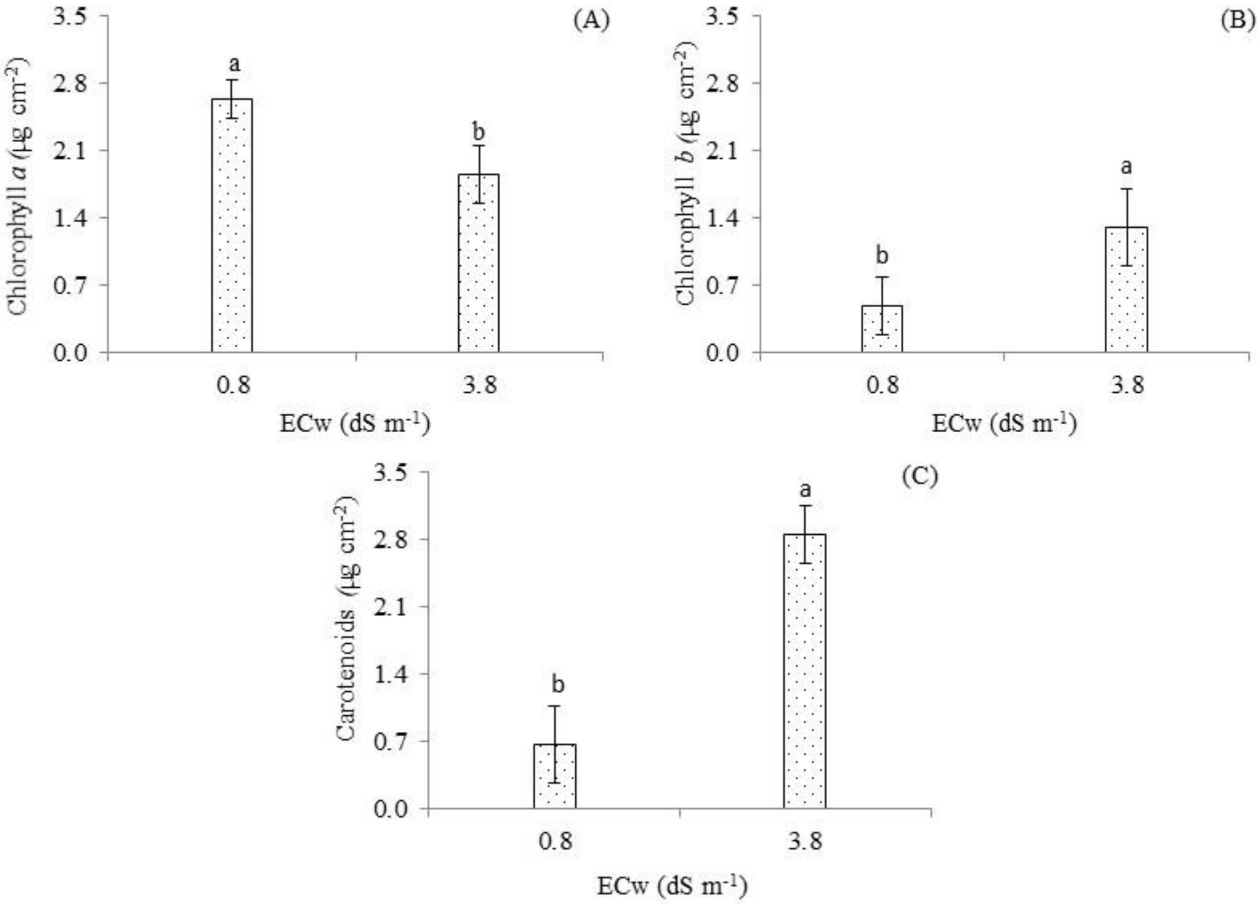
The increment in ECw levels from 0.8 to 3.8 dS m^{-1} negatively affected the photosynthetic process of the West Indian Cherry crop, a fact evidenced by the decrease in the contents of chlorophyll *a*. Based on the test of means (Figure 1A), in the West Indian Cherry plants irrigated using water of the highest ECw (3.8 dS m^{-1}), chlorophyll *a* contents decreased by 0.79 µg cm^{-2} in comparison to those subjected to the lowest saline level (0.8 dS m^{-1}). The reduction in chlorophyll *a* content (Figure 1A) in West Indian Cherry plants exposed to water salinity may have occurred due to the decrease in the synthesis of chlorophylls or due to the participation of the chlorophyllase enzyme, which degrades the molecules of this photosynthesizing pigment (Freire et al., 2013).

Table 1. Summary of the analysis of variance for the contents of chlorophyll *a* (Chl *a*) and *b* (Chl *b*), carotenoids (Car), rootstock stem diameter (Rootstock SD), scion stem diameter (Scion SD), total number of fruits (TNF), fruit mean weight (FMW) and total fruit fresh weight (FFW) of West Indian Cherry plants irrigated using waters with different salinity levels and potassium doses, at 300 days after transplanting.

Source of variation	DF	Mean squares							
		Chl *a*	Chl *b*	Car	Rootstock SD	Scion SD	TNF	FMW	FFW
Saline levels (SL)	1	3.77*	4.04*	28.17**	44.22*	17.22*	15150.37**	8.16*	524172.70**
K doses (KD)	3	0.06ns	0.91ns	0.32ns	3.09ns	4.88ns	467.37*	0.78ns	33072.55*
Linear regression	1	0.05ns	2.26*	0.0002ns	8.91ns	7.38ns	35.20ns	0.16ns	6914.64ns
Quadratic regression	1	0.13ns	0.47ns	0.51ns	0.006ns	3.42ns	0.04ns	0.38ns	18818.80*
Interaction SL*KD	3	0.30ns	1.19ns	0.33ns	2.59ns	0.50ns	388.37*	1.36ns	11637.27*
Blocks	2	0.03ns	0.22ns	0.26ns	1.48ns	0.30ns	58.50ns	0.18ns	2704.53ns
Residual	14	0.28	0.18	0.46	4.19	2.15	45.92	0.53	2369.37
CV (%)		13.76	16.79	18.77	7.57	8.75	17.66	10.10	19.83

ns, **, * respectively not significant, significant at $p < 0.01$ and $p < 0.05$.

Carlin et al. (2012) mention that the reduction in chlorophyll biosynthesis can be a form of adaptation to the stress condition to which the crop was subjected, aiming at energy saving and lower light energy capture to avoid oxidative stress, possibly resulting from photooxidation of the pigments, which damage the plants by oxidizing membrane lipids, proteins and nucleic acids. In addition, the decrease in chlorophyll *a* content of the West Indian Cherry observed in this study in plants cultivated at the highest saline level (3.8 dS m^{-1}) may be a strategy to conserve energy and absorb less light energy and consequently decrease flow of electrons to the electron transfer chain, thus avoiding eventual photooxidative stresses (Silva et al., 2016). During this process, the energy absorbed at the reaction centers (photosystem I and II) oxidize the water to oxygen to produce ATP and reduce $NADP^+$ to NADPH. These substrates are used later in the Calvin & Benson cycle to produce sugars and / or carbon chains for biosynthetic routes (Casaroli et al., 2007). Thus, as photosynthesis forms the basis of the production of a crop, the absorption and use of the light energy by the plants reflect directly on the crop production (Freire et al., 2013). Reduction in the contents of photosynthesizing pigments have been observed in various species cultivated under salt-stress conditions, such as passion fruit (Freire et al., 2013) and guava (Silva et al., 2017).



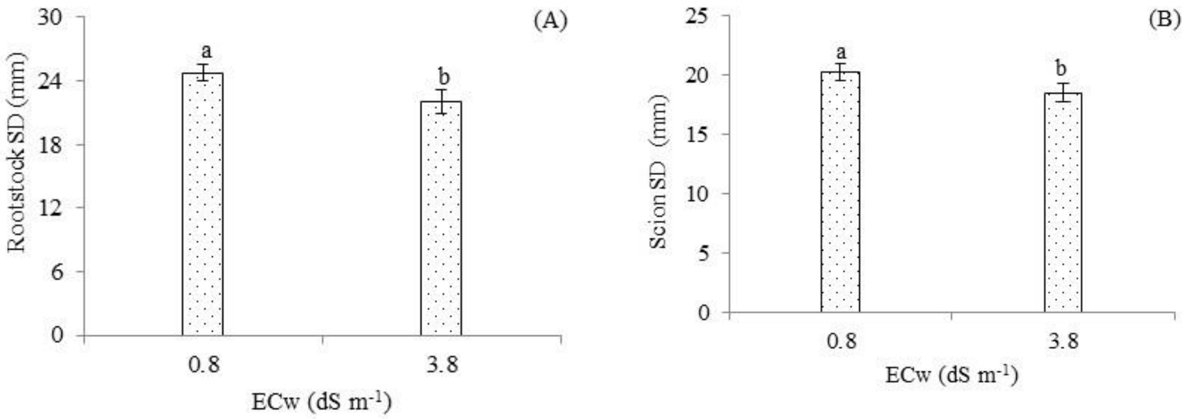
Bars represent mean standard error (n=3). Means followed by different letters indicate difference between treatments by Tukey's test, $p < 0.05$.

Figure 1. Contents of chlorophyll *a* (A), chlorophyll *b* (B) and carotenoids (C) in West Indian Cherry plants as a function of irrigation water salinity - ECw, at 300 days after transplanting.

For the content of chlorophyll *b* (Figure 1B), according to the test of comparison of means, West Indian Cherry plants subjected to the highest ECw (3.8 dS m^{-1}) statistically showed the highest value of Chl *b*, compared with those irrigated using water of 0.8 dS m^{-1}. In addition, according to the data presented in Figure 1B, as water salinity increased from 0.8 to 3.8 dS m^{-1}, there was an increment in the chlorophyll *b* content of 0.82 µg cm^{-2} (on average, 2.67 times higher). The increment in chlorophyll *b* content, with the increase in the saline level of the irrigation water, is probably a physiological defense process of the plants against the photooxidation to consequently avoid a reduction in photosynthetic efficiency (Silva et al., 2014). Contrary to the results of the present study, Silva et al. (2017) observed reduction in the chlorophyll *b* content due to the increment in irrigation water salinity, evaluating the effects of irrigation water salinity (ECw: 0.3 to 3.5 dS m^{-1}) on the photosynthetic pigments of guava, cv. Paluma, at 190 days after sowing.

As observed for Chl *b* (Figure 1B), the content of carotenoids was also significantly influenced by irrigation water salinity. According to the test of means (Figure 1C), the Car content of West Indian Cherry plants irrigated using water with highest saline level (3.8 dS m^{-1}) significantly and quantitatively differed, with increments of 2.17 µg cm^{-2} between plants subjected to ECw of 3.8 dS m^{-1} and those subjected to 0.8 dS m^{-1}. Hence, it can be inferred from the results obtained for contents of carotenoids that West Indian Cherry plants cultivated with the highest saline level had greater protection against photooxidation, and consequently lower damages in the photosynthetic membranes. On this topic, Falk and Munné-Bosch (2010) point out that carotenoids perform the function of antioxidant agents and can regulate the activity of enzymes and endoproteinases, protecting lipid membranes of the chlorophyll molecule from the oxidative stress caused by the salt stress.

Rootstock stem diameter in West Indian Cherry plants irrigated with ECw of 0.8 dS m^{-1} significantly differed in comparison to those irrigated using water of 3.8 dS m^{-1}. According to the data presented in Figure 2A, there was a decrease of 2.72 mm in the Rootstock SD of plants subjected to ECw of 3.8 dS m^{-1}, compared with those subjected to 0.8 dS m^{-1}. The negative effects of salinity on Rootstock SD are due to the increase in the osmotic pressure in the root environment and to the restriction of water flow from soil to plants (Freitas et al., 2013), consequently promoting a deviation of energy resulting from the higher osmotic effect outside the root. Hence, the reduction in Rootstock SD may be a consequence of the high metabolic cost for the accumulation of sugars, organic acids and ions in the vacuole, energy that could be used for plant growth (Santos et al., 2012).



Bars represent mean standard error (n=3). Means followed by different letters indicate difference between treatments by Tukey's test, $p < 0.05$.

Figure 2. Rootstock stem diameter - Rootstock SD (A) and scion stem diameter - Scion SD (B) of West Indian Cherry plants as a function of irrigation water salinity - ECw, at 300 days after transplanting.

For stem diameter of the scion variety, according to the test of means (Figure 2B), plants subjected to irrigation with ECw of 0.8 dS m^{-1} showed a statistically higher value compared with those cultivated with water of 3.8 dS m^{-1}. Comparing the mean values of Scion SD (Figure 2B) of plants under ECw of 0.8 dS m^{-1} and those subjected to the higher saline level (3.8 dS m^{-1}), there were increments of the order of 8.39%. Based on a joint analysis of Rootstock SD and Scion SD, according to the data in Figure 2A and 2B, the stem diameter of the scion variety was less sensitive to the variation in the levels of irrigation water salinity, although for both variables the salt stress affected plant growth.

Gurgel et al. (2003), studying the influence of irrigation with saline water (ECw from 0.5 to 5.5 dS m^{-1}) on the West Indian Cherry crop in the rootstock formation stage (90 days after emergence), observed greater reduction in stem diameter (38.46%) in plants subjected to ECw of 5.5 dS m^{-1} in comparison to those under 0.5 dS m^{-1}.

The reduction in the contents of photosynthetic pigments, chlorophyll *b* and carotenoids (Figure 1B and 1C) and in West Indian Cherry growth (Figure 2A and 2B) are consistent with the increment in the levels of electrical conductivity of water. Munns and Tester (2008) attributed this reduction to the alterations in the physiological and biochemical activities promoted by the content of salts present in the water, above that tolerated by the crop, because according to Ayers and Westcot (1999), the West Indian Cherry is classified as moderately sensitive to salt stress.

The chlorophyll content has a close relationship with the nitrogen content in the plant, which in turn is related to the photosynthetic capacity of the crop (Rambo et al., 2004). This relationship between the chlorophyll content and the N content is due to the fact that 50 to 70% of the total N of the leaves are constituents of enzymes that are associated to the chloroplast (Chapman and Barreto, 1997). In this context, the lower growth of the West Indian Cherry plants observed in the higher saline level may be related to the activity of the chlorophyllase enzyme, which under conditions of high salt concentration (3.8 dS m^{-1}) acts to degrade the pigment molecules (Figure 1A), promoting an increase in the synthesis of carotenoids (Figure 1C) in chloroplasts and as a consequence inhibited plant growth.

The total number of fruits was significantly ($p<0.05$) affected by the interaction between factors (SL x KD) and, according to the regression equations (Figure 3A), West Indian Cherry plants irrigated using water with ECw of 0.8 dS m^{-1} showed a quadratic behavior, and the highest TNF (81 fruits $plant^{-1}$) was obtained when plants were fertilized with K at the dose of 100% (79.2 mg kg^{-1} of K_2O). From this point on, this variable decreased and, at the highest K_2O dose, TNF was equal to 55 fruits $plant^{-1}$, i.e., 10 units more compared with plants that received 50% of the K_2O recommendation.

Regarding plants subjected to the highest saline level (3.8 dS m^{-1}), there was a linear effect, with increment in TNF of the order of 50.04% in plants fertilized with 125% of recommendation, compared with those fertilized with 50% of the K_2O recommendation. According to the results for TNF (Figure 3A) at the different ECw levels (0.8 and 3.8 dS m^{-1}), the highest reduction in West Indian Cherry production is related to the variation of water salinity. This fact may be associated with the osmotic function of these cations, because K can be partially substituted by sodium as osmotically active solute in the absorption sites in the plasmatic membrane of the roots (Taiz and Zeiger, 2013).

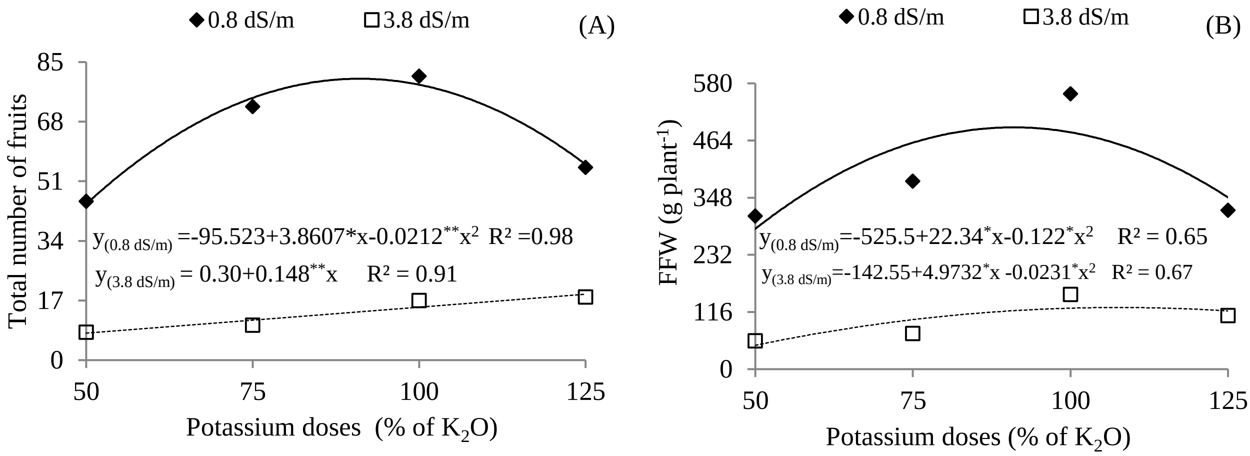


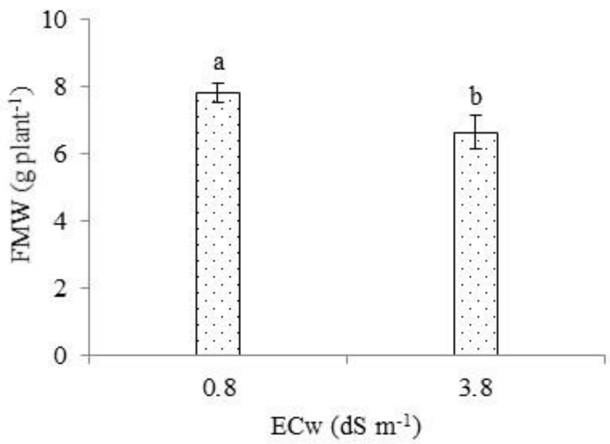
Figure 3. Total number of fruits - TNF (A) and fruit fresh weight - FFW (B) of West Indian Cherry plants as a function of the interaction between the factors water salinity levels - ECw and potassium doses.

Similarly, fruit fresh weight was also significantly influenced by the interaction between the factors water salinity levels and K doses (SL x KD). According to the regression equations (Figure 3B), the data fitted best to the quadratic model for West Indian Cherry plants cultivated with 0.8 and 3.8 dS m^{-1}, and the maximum estimated values (558.88; 151.74 g $plant^{-1}$) were obtained when the plant was subjected to K fertilization equivalent to 100% of the K_2O recommendation. As observed for TNF (Figure 3A), fruit fresh weight showed higher sensitivity to the alteration in the water salinity levels, compared with the studied K doses.

The results obtained for TNF and FFW (Figure 3A and 3B) show that although there was a decrease in these variables when ECw increased from 0.8 to 3.8 dS m^{-1}, it was observed that plants under irrigation with water of 3.8 dS m^{-1} showed a linear increase in TNF as there was a 25% increase in the potassium dose supplied. This situation was also observed for FFW (Figure 3B), where a positive response of potassium fertilization with 100% of the K_2O recommendation was observed, regardless of the salinity level of water. This fact can be attributed to the physiological functions of potassium in plant metabolism, acting osmotic and ionic homeostasis.

Thus, the high salt concentrations of the water probably inhibited K absorption by plants, which may have negatively reflected in fruit weight, due to its function in the translocation of carbohydrates. However, Gurgel et al. (2010) report that, under salt stress conditions, the increment in K doses does not always result in beneficial effects on plants; in some cases, the salinity caused by high K^+ concentrations can be even more harmful than that caused by high levels of sodium.

Regarding the mean weight of West Indian Cherry fruits, according to the test of comparison of means (Figure 4), irrigation using water with ECw of 3.8 dS m^{-1} results in lower fruit mean weight (6.66 g $plant^{-1}$), significantly differing from plants subjected to the lowest ECw level (0.8 dS m^{-1}), which showed a value of 7.83 g $plant^{-1}$. Comparing the values of plants under ECw of 3.8 dS m^{-1} and 0.8 dS m^{-1}, there were decrements of about 14.94% in the FMW.



Bars represent mean standard error (n=3). Means followed by different letters indicate difference between treatments by Tukey's test, $p < 0.05$.

Figure 4. Fruit mean weight - FMW of West Indian Cherry as a function of irrigation water salinity - ECw.

Despite the reduction in fruit mean weight due to the increment in the water salinity levels, the FMW obtained in the present study is higher than that recommended for this cultivar (4 to 5 g), as indicated by Embrapa Tropical Agroindustry. The reduction in FMW observed in the present study (Figure 3) is probably also related to the lower absorption of water and nutrients by plants, resulting from the increase in soil salinity levels, which can cause cell injury from a simple reduction in water potential, due to oxidative stress in the plant, which leads to a reduction in crop production (Lima et al., 2015).

In addition, the decrease in chlorophyll *a* cursive synthesis and the increase in carotenoid contents may have negatively influenced the growth of West Indian Cherry plants, a fact observed by reduction of the stem diameter of the rootstock (Figure 2A) and the scion (Figure 2B). Thus, the lowest growth in plants cultivated at the highest ECw level (3.8 dS m^{-1}) reflected a decline in the production components of the West Indian Cherry plant, in an evaluation performed at 300 days after transplanting.

4. CONCLUSIONS

Irrigation with high salinity water stimulates the biosynthesis of chlorophyll *b* and carotenoids, while the content of chlorophyll *a* and the growth of the West Indian Cherry plant are reduced markedly in the post-grafting phase.

The harmful effects of salinity on the total number of fruits and fresh fruit mass of the West Indian Cherry plant are minimized with potassium fertilization.

5. ACKNOWLEDGMENTS

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