Universidade Federal Rural do Semi-Árido
Pró-Reitoria de Pesquisa e Pós-Graduação
https://periodicos.ufersa.edu.br/index.php/caatinga

ISSN 0100-316X (impresso)
ISSN 1983-2125 (online)
http://dx.doi.org/10.1590/1983-21252022v35n319rc

CYTOKININ AND AUXIN INFLUENCE ON GROWTH AND QUALITY OF WATERMELON IRRIGATED WITH SALINE WATER[1]

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ABSTRACT – Watermelon has great economic relevance, but edaphoclimatic factors and inadequate management have favored the salinization of the water used for irrigation, which is a limiting factor for the growth and production of the crop. However, it is considered that the use of growth regulators belonging to the group of cytokinins and auxins may contribute to the development and yield of crops, even under adverse conditions such as salinity. Thus, the objective was to evaluate the influence of cytokinin and auxin proportions on the growth and quality of watermelon irrigated with saline water. The experimental design was completely randomized, with four replicates and 5 x 2 factorial, referring to five proportions of growth regulators (0/100; 25/75; 50/50; 75/25 and 100/0%) corresponding to concentrations of 1.0 and 10.0 mg L^{-1} of forchlorfenuron (CPPU)/ indoleacetic acid (IAA), and two salinity levels, one composed of water without adding salt (0.3 dS m^{-1}) and the other with 2.0 dS m^{-1} electrical conductivity. The proportions of cytokinin and auxin influenced the growth and quality of watermelon subjected to salinity in irrigation water. The 25/75% (CPPU/IAA) proportion favored smaller decreases in leaf area and total dry mass under a saline condition of 2.0 dS m^{-1}. For fresh and dry fruit mass, the 75/25% (CPPU/IAA) proportion favored smaller reductions. Fruit firmness and soluble solids were favored by the proportions 25/75 and 50/50% (CPPU/IAA) at EC of 2.0 dS m^{-1}. Acidity was only influenced by the proportion of 50/50% (CPPU/IAA) between the electrical conductivity levels.

Keywords: *Citrullus lanatus* L. Growth regulators. Plant production. Salinization.

INFLUÊNCIA DA CITOCININA E AUXINA NO CRESCIMENTO E QUALIDADE DA MELANCIA IRRIGADA COM ÁGUA SALINA

RESUMO – A melancia apresenta grande relevância econômica, no entanto, fatores edafoclimáticos e manejo inadequado vem favorecendo a salinização da água utilizada para irrigação, sendo este um fator limitante para o crescimento e produção da cultura. Contudo, considera-se que a utilização de reguladores de crescimento pertencentes ao grupo das citocininas e auxinas, pode contribuir para o desenvolvimento e produtividade das lavouras, mesmo em condições adversas como a salinidade. Assim, objetivou-se avaliar a influência de proporções de citocinina e auxina no crescimento e na qualidade de melancia irrigada com água salina. O delineamento experimental foi inteiramente casualizado, com quatro repetições e fatorial 5 x 2, sendo cinco proporções de reguladores de crescimento (0/100; 25/75; 50/50; 75/25 e 100/0%) correspondentes às concentrações 1,0 e 10,0 mg L^{-1} de forchlorfenuron CPPU / ácido indolacético (IAA), e dois níveis de salinidade, um composto da água sem adição de sal (0,3 dS m^{-1}) e outro com condutividade elétrica de 2,0 dS m^{-1}. As proporções de citocinina e auxina influenciaram no crescimento e qualidade de melancia submetida à salinidade na água de irrigação. A proporção 25/75% (CPPU/IAA) favoreceu menores decréscimos na área foliar e na massa seca total em condição salina de 2,0 dS m^{-1}. Para massa fresca e seca do fruto, a proporção 75/25% (CPPU/IAA) favoreceu menores reduções. A firmeza do fruto e os sólidos solúveis foram favorecidos pelas proporções 25/75 e 50/50% (CPPU/IAA) em EC de 2.0 dS m^{-1}. A acidez só foi influenciada pela proporção de 50/50% (CPPU/IAA) entre os níveis de condutividade elétrica.

Palavras-chave: *Citrullus lanatus* L. Reguladores de crescimento. Produção de plantas. Salinização.

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[1]Received for publication in 10/26/2021; accepted in 03/31/2022.
Paper extracted from the dissertation of the first author.
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INTRODUCTION

Watermelon (*Citrullns lanatus* L.) belongs to the family Cucurbitaceae and is considered an important vegetable crop on the world stage for having great socioeconomic and nutritional value. It is a species widely cultivated in Brazil, especially in the Northeast region, where soil and climate conditions favor its growth and production, and it can be cultivated all year round under irrigated conditions (NASCIMENTO et al., 2018).

However, the increase in demand for water reduces the availability of good quality water sources for irrigation, forcing the use of water with a relatively high concentration of salts, especially in regions with predominance of adverse weather conditions, such as high evapotranspiration and temperatures, causing the accumulation of these salts in the soil (SILVEIRA et al., 2016). The use of saline and low-quality water results in negative effects on the phenological development and yield of agricultural crops. Due to the excess of salts, osmotic stress occurs, as result of the reduction in the water potential of the soil, making it difficult for plants to absorb water and causing decreases in their growth (GHANI; AWANG; ISMAIL, 2018).

Among the alternatives to mitigate the deleterious effects of salinity is the use of growth regulators, which are synthetic compounds similar to groups of plant hormones and, when applied to plants, cause changes in their vital and structural processes, which can increase and improve their production quality (MATOS et al., 2017).

The application of regulators from the group of cytokinins and auxins has been reported to mitigate the effects of salinity in some agricultural species (LATEF; HASANUZZAMAN; ARIF, 2021; SMOLKO et al., 2021). However, the salinity response has an interspecific and antagonistic interference of several hormones, and their regulatory functions depend on their levels and locations in plants.

Plant adaptation or tolerance to salt stress involves several physiological and biochemical mechanisms. The main ones include, but are not limited to, ion homeostasis and compartmentalization, biosynthesis of osmoprotectants and compatible solutes, activation of antioxidant enzymes, synthesis of antioxidant compounds, and hormonal modulation (GUPTA; HUANG, 2014).

Under salt stress, natural endogenous cytokinin generally decreases and there is increased synthesis and accumulation of abscisic acid (ABA) (FANG; HOU; LIANG, 2021). Sun et al. (2018) state that endogenous auxin present in young and developing tissues, such as the apical parts of roots and the base of leaves, is compromised by salinity. Thus, underlying mechanisms for salinity tolerance are far from being completely understood.

In this context, the use of growth regulators from the group of cytokinins and auxins may emerge as an alternative capable of minimizing the adverse effects caused by the use of saline water in watermelon cultivation, favoring agricultural production. Therefore, the objective of this work was to evaluate the influence of two growth regulators, forchlorfenuron or [N-(2-chloro-pyridyl)-N-phenylurea] and indoleacetic acid, on the growth and quality of watermelon plants irrigated with saline water.

MATERIAL AND METHODS

The experiment was conducted in the period from June to August 2017, in greenhouse, on the premises of the Federal University of Campina Grande, in the Center for Science and Agrifood Technology located in the municipality of Pombal, Paraíba, Brazil, at the geographical coordinates 06° 46' S and 37°48' W. The climate of the region is classified according to Köppen as hot and dry semiarid (BSh type), with an average rainfall of approximately 750 mm year^{-1} and average annual evaporation of 2000 mm. The average temperature during the experimental period was 31±6 ºC, with an average relative humidity of 80±5%.

The treatments were composed of five proportions growth regulators (0/100; 25/75; 50/50; 75/25 and 100/0%) corresponding to concentrations of 1.0 and 10.0 mg L^{-1} CPPU/IAA, respectively, and two levels of salinity, one composed of water without salt addition (normal supply water) - 0.3 dS m^{-1} and another with saline water at 2.0 dS m^{-1} electrical conductivity (EC). The experimental design employed was completely randomized, with 5 x 2 factorial and four replications, totalizing 40 experimental units.

Seeds of the watermelon hybrid 'Quetzali', Sandia species of Syngenta® from the group of mini watermelons, were sown in pots with capacity of 2L filled with Golden Mix® coconut fiber for agricultural use and commercial substrate Tropstrato HT Hortaliças® in the proportion of 3:1. The chemical attributes of the substrate components were: pH in H_2O (1:2.5) = 6.50; EC= 0.10 dS m^{-1}; P= 16.0 mg dm^{-3}; K = 1.29 cmol$_c$ dm^{-3}; Na = 0.12 cmol$_c$ dm^{-3}; Ca = 2.0 cmol$_c$ dm^{-3}; Mg = 2.5 cmol$_c$ dm^{-3}; Al = 0.0 cmol$_c$ dm^{-3} and H + Al = 0.3 cmol$_c$ dm^{-3}. Four seeds were sown per pot and, when the stage of three true leaves was reached, thinning was done, leaving only the most vigorous plant. The treatments were used for the first time in an initial experiment to determine the most influential ones, which were used for this study.

Irrigation was performed daily, being determined by drainage lysimetry, considering leaching fraction of 10%. The volume of water applied was determined according to the initial field capacity. Only the undrained volume was applied during the entire course of the experiment, keeping the soil always near field capacity. During the first 15 days after sowing (DAS), the plants were irrigated with normal water. After this period, they were exposed to treatments and the normal supply water was replaced by nutrient solution of Hoagland and Arnon (1950) with 75% of its total strength to meet the nutritional needs of plants (Table 1).

The saline treatment 2.0 dS m^{-1} was made by adding sodium chloride (NaCl) to supply water, with chemical characteristics described in Table 2. Conductivity was checked using a portable conductivity meter (model CON 200, Oakton®, Canada) for later chloride application. The proportions were applied the next day after application of the saline treatment, at once: IAA was foliar applied, with the aid of a manual sprayer (Compression Sprayer model, flow rate of 0.5 L/min, W-MAX Wurth®, Japan) inside a closed chamber, and the CPPU was applied directly to the substrate.

Table 1. Concentrations of nutrients in the nutrient solution of Hoagland and Arnon (1950).

Nutrients	N	P	K	Ca	Mg	S	Fe	Mn	B	Cu	Zn	Mo
						mmol L^{-1}						
Concentrations	15	1	6	5	2	2	0.05	0.01	0.05	0.003	0.0008	0.001

Table 2. Chemical analysis of the supply water used in irrigation.

	EC	pH	K^+	Ca^{2+}	Mg^{2+}	Na^+	SO_4^{2}	CO_3^{2-}	HCO_3^-	Cl^-	SAR
Water	dS m^{-1}				....(mmol$_c$ L^{-1})..						(mmol L^{-1})$^{0.5}$
	0.3	7.0	0.3	0.2	0.6	1.4	0.2	0.0	0.8	1.3	2.21

Note: pH= hydrogen potential; EC= Electrical conductivity; K^+= potassium; Ca^{2+}= Calcium; Mg^{2+}= Magnesium; Na^+= Sodium; SO_4^{2-} = Sulfate; CO_3^{2-} = Carbonate; HCO_3^- = Bicarbonate; Cl^- = Chlorine; SAR= Sodium adsorption ratio.

At 44 days of exposure to the treatments, the following variables were analyzed: Leaf area (LA), by correlating the obtained dry mass of eight leaf discs of known area (11.28 cm²) taken from the intermediate region; total dry mass (TDM), obtained by summing the dry mass of the aerial part (leaves and branches) and root; fresh fruit mass (FFM), obtained by the average weight of fruits; dry fruit mass (DFM), obtained after drying the plant material in an oven with air circulation and renewal at 70 °C for 72 hours, with the results expressed in g per plant, as well as for TDM; pulp firmness (PF), obtained dividing the fruit longitudinally and performing three readings in the equatorial region of each half of the fruit, one in the center and two on the sides, using a texturometer (41050 model, Fruit Hardness Tester®, Germany), with 2.0 mm penetration depth (TA pointer 8/1000), speed of 2.0 mm s^{-1}, with the results expressed in Newtons (N); soluble solids (SS), evaluated directly in the homogenized pulp, with reading in digital refractometer (PR model – 100, Palette Atago Co., LTD, Japan), expressed as a percentage (AOAC, 2005); titratable acidity (TA), determined according to methodology recommended by the Institute Adolfo Lutz (IAL, 2008), using 5 ml of homogenized pulp and diluted with 50 ml of distilled water, followed by titration with standardized 0.1 N NaOH solution, using as an indicator the turning point of phenolphthalein, with the results expressed in g of citric acid 100 mL^{-1} sample.

Data were subjected to analysis of residual normality using the Shapiro-Wilk test, homogeneity of variances using the Bartlett test, followed by analysis of variance (ANOVA) using the F test ($p \leq 0.05$), and the means were compared by Tukey test ($p \leq 0.05$). For statistical analysis we used SISVAR software version 5.6 (FERREIRA, 2014). To verify the existing relationships between the treatments and the variables analyzed, the data matrix was subjected to a Principal Component Analysis (PCA), using the FactoMineR package (Factor Analysis and Data Mining with R) in R software version 3.6.1 (R CORE TEAM, 2022).

RESULTS AND DISCUSSION

There was an influence on the interaction between the different proportions of growth regulators and salinity in the water for the variables analyzed, at $p \leq 0.01$ of probability level by the F test (Table 3), except for titratable acidity.

Table 3. Leaf area (LA), total dry mass (TDM), fresh fruit mass (FFM), dry fruit mass (DFM), pulp firmness (PF), soluble solids (SS) and titratable acidity (TA) in watermelon plants subjected to salinity and treated with different proportions of auxin and cytokinin.

S.V.	D.F.	Mean Square						
		LA	TDM	FFM	DFM	PF	SS	TA
Salt (S)	1	254746.74**	1.025386^{ns}	69699.95**	144.2560**	2.495007**	0.484000**	0.000475^{ns}
Proportions (P)	4	133352.29**	3.937299**	6702.12**	57.6826**	0.632421**	0.235625**	0.000213^{ns}
S x P	4	209084.08**	5.727791**	4106.09**	30.0442**	1.422526**	0.629625**	0.000077^{ns}
Residual	27	92.946071	0.320548	161.8579	1.435841	0.045514	0.033519	0.000119
CV (%)		0.58	4.39	2.06	2.88	3.18	2.07	8.10
Mean		1672.4626	12.8963	616.1868	41.6298	6.7007	8.82500	0.1345

Note: ** and ^{ns} significant at 1% probability level and non-significant, respectively, by the F test.
S.V. – Source of Variation, D.F. – Degrees of Freedom and C.V. – Coefficient of Variation.

The largest expansion in LA (2083.24 cm^2) was obtained with the proportion 75/25% and using the water with the lowest EC (0.3 dS m^{-1}), an increase of 26% compared to the value obtained with EC of 2.0 dS m^{-1} (Figure 1A). However, under higher EC the proportion 25/75% was the one that favored greater approximation of the maximum value obtained for this variable. As for the isolated applications of the regulators (0/100% and 100/0% CPPU/IAA, respectively), it was observed that CPPU promoted higher yields for plants under high EC compared to IAA. One of the signs of stress caused by the excess of salts is the rapid and intense reduction in the growth rate, mainly in leaf area, a response caused by the change in physiological parameters (SOUSA et al., 2019).

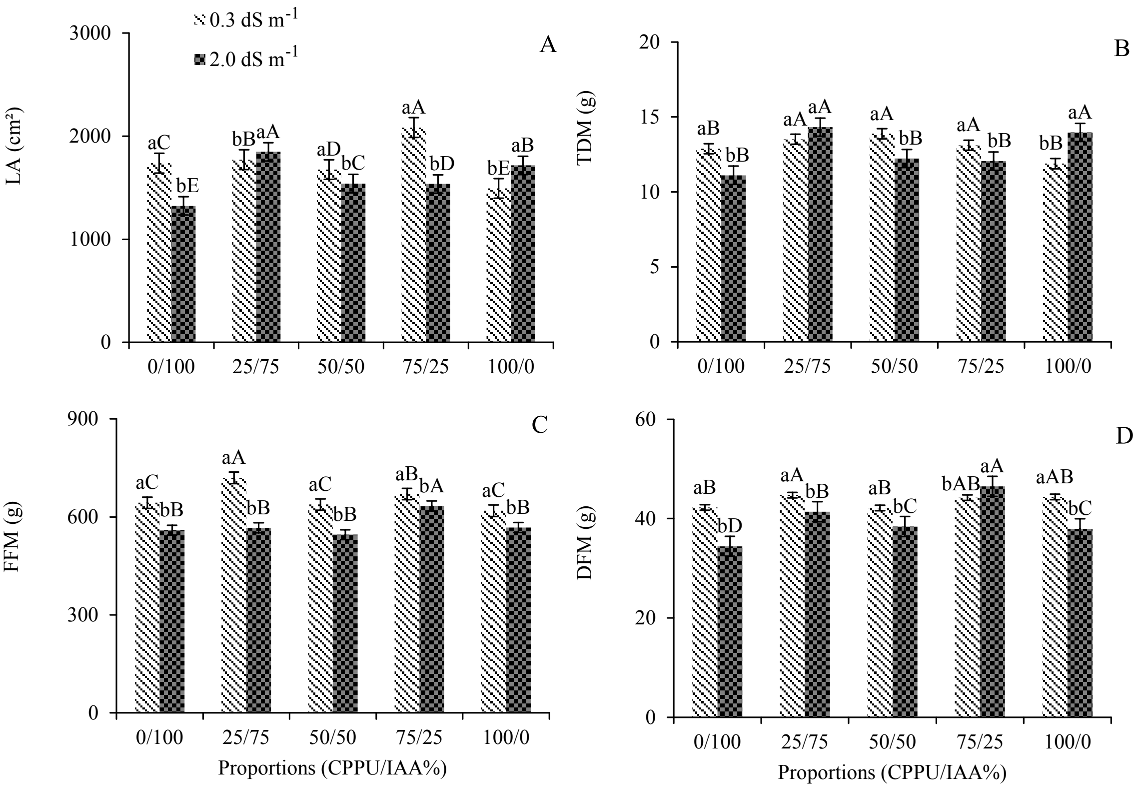


Figure 1. Leaf area (LA, A), total dry mass (TDM, B), fresh fruit mass (FFM, C) and dry fruit mass (DFM, D) of Quetzali watermelon plants, subjected to two salinity levels (0.3 and 2.0 dS m^{-1}, respectively) and five proportions of growth regulators (CPPU/IAA). Letters on the bars indicate significant differences tested by the Tukey test ($p \leq 0.05$). Lowercase letters refer to salinity levels and uppercase letters refer to the proportions of growth regulators.

For TDM, a similar behavior was found between the treatments 25/75, 50/50 and 75/25% when the plants were irrigated with normal water, while at a salinity level of 2.0 dS m^{-1}, they obtained greater accumulated mass (14.32 g) with the proportion 25/75% (Figure 1B). In relation to isolated applications, the 100/0% treatment promoted an increase of 14.89% under saline condition when compared to those irrigated using water with EC of 0.3 dS m^{-1}. Mass reduction due to increased salinity was also observed by Dantas et al. (2018). However, as seen in this work, depending on the proportion of regulators used, the plant tends to decrease mass losses due to increased salinity in the irrigation water. These results indicate that with the hormonal introduction there was a better adaptation of the plant to salinity, since growth was not drastically impaired, justified by metabolic homeostasis (preservation of normal functions).

According to Bielach, Hrtyan and Tognetti (2017), plants develop mechanisms that allow rapid recognition, distinction and response to unfavorable external factors, such as salinity, and the relationship between reactive oxygen species (ROS). The increase of auxins and cytokinins allows adjusting plant development and growth, like a pre-adaptive factor, triggering morphological changes necessary to prevent the negative effects of stress on the plant's physiology.

As for FFM, all treatments promoted better yields in plants irrigated with water of 0.3 dS m^{-1} compared to the use of 2.0 dS m^{-1} (Figure 1C). However, the proportion 75/25% was the one that provided promoted greater gains (634 g) for this variable under saline condition. This result is not different from that observed for dry fruit mass, with a noticeable increase compared to the level of 0.3 dS m^{-1}, showing that the proportion of 25/75% promotes better growth of the fruit considering higher levels of salts in the irrigation water (Figure 1D).

According to Wani et al. (2016), in plants under stress, the increased cytokinin content causes the reduction of abscisic acid, leading to an increase in the cytokinin/ABA proportion. It is observed that with an increase in cytokinin there is an increase in the accumulation of phytomass up to a certain concentration, possibly due to the reduction in the action of ABA, not causing stomatal closure under these conditions; in other words, the plant continues its photosynthetic and transpiratory activity even subjected to a higher salt concentration.

Iqbal and Ashraf (2013), when studying the influence of synthetic auxin on the performance and yield of wheat under salt stress, found that it can increase hormonal homeostasis, as well as the rate of CO_2 assimilation, which results in better growth and confers tolerance to salinity.

Regarding the quality of watermelon fruits, it was found that pulp firmness was influenced by the association of the regulators, as well as the salinity in the water (Figure 2). In the treatment without adding salts in the water, the best proportion was 0/100%, equivalent to 7.5 N firmness, but not differing significantly from the proportions 25/75 and 50/50% with water of 2.0 dS m^{-1}, corresponding to 7.11 and 6.99 N, respectively, of firmness. In the other treatments, however, there was a reduction in firmness with an increase in salts in the irrigation water. Salinity reduces the firmness of the fruits, due to the greater activity of hydrolytic enzymes in the cell wall structure, caused by the prolongation in the period of vegetative development and point of harvest of the fruits.

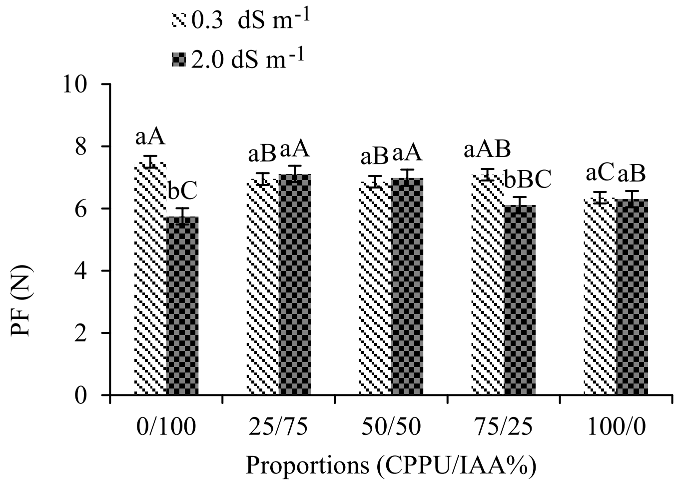


Figure 2. Pulp firmness of Quetzali watermelon plants, subjected to two salinity levels (0.3 and 2.0 dS m^{-1}) and five proportions of growth regulators (CPPU/IAA). Letters on the bars indicate significant differences tested by the Tukey test ($p \leq 0.05$). Lowercase letters refer to salinity levels and uppercase letters refer to the proportions of growth regulators.

PF, in addition to being an attribute related to the aroma and flavor of the fruits, is essential in their postharvest life, promoting greater resistance to fruit transport, from handling the harvest to selling it to the final consumer. According to Taiz et al. (2017), the production of cytokinins in the roots and their transport to the aerial part are inhibited by salt stress, accelerating senescence. Therefore, the application of the cytokinin regulator may have supplied this deficiency and even implied mechanisms of defense and adaptation, which promoted similar standards of fruit quality.

According to Oliveira et al. (2016), the application of cytokinin-based products can alter not only the reproductive components, but also the metabolism of the fruits. Thus, it is important to evaluate components that characterize fruit quality such as soluble solids and acidity.

The content of SS in this study was higher in most treatments with saline water, 0/100, 25/75, 50/50%, CPPU/IAA (Figure 3A). The highest SS was obtained with 25/75% (CPPU/IAA), equivalent to 9.20% in fruits from plants irrigated with water of 2.0 dS m^{-1}. It is common to use saline water to increase sugar in fruits, as reported by Costa et al. (2013), who found that the increase in the salinity levels of irrigation water from 2.77 to 4.91 dS m^{-1} increased the SS values by 3.58 and 5.08%, respectively. The authors also report that the increase in the salinity levels of the irrigation water reduced the water absorption by the plant, resulting in a higher concentration of SS in the fruit.

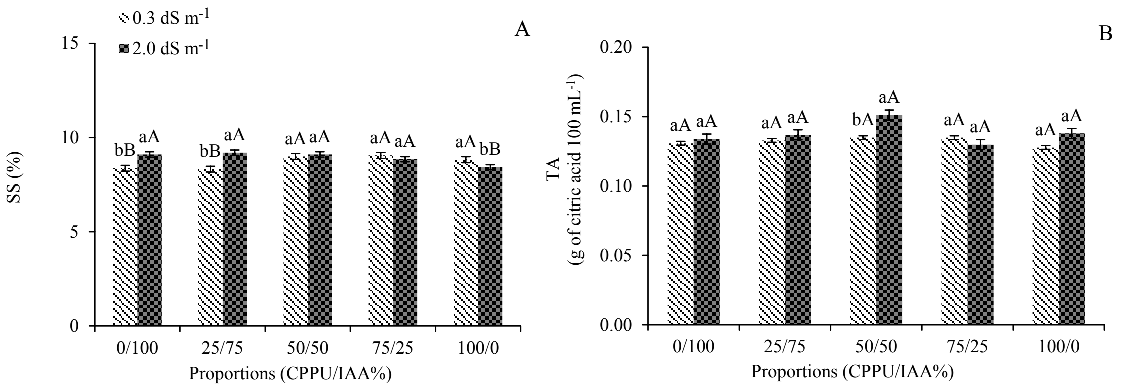


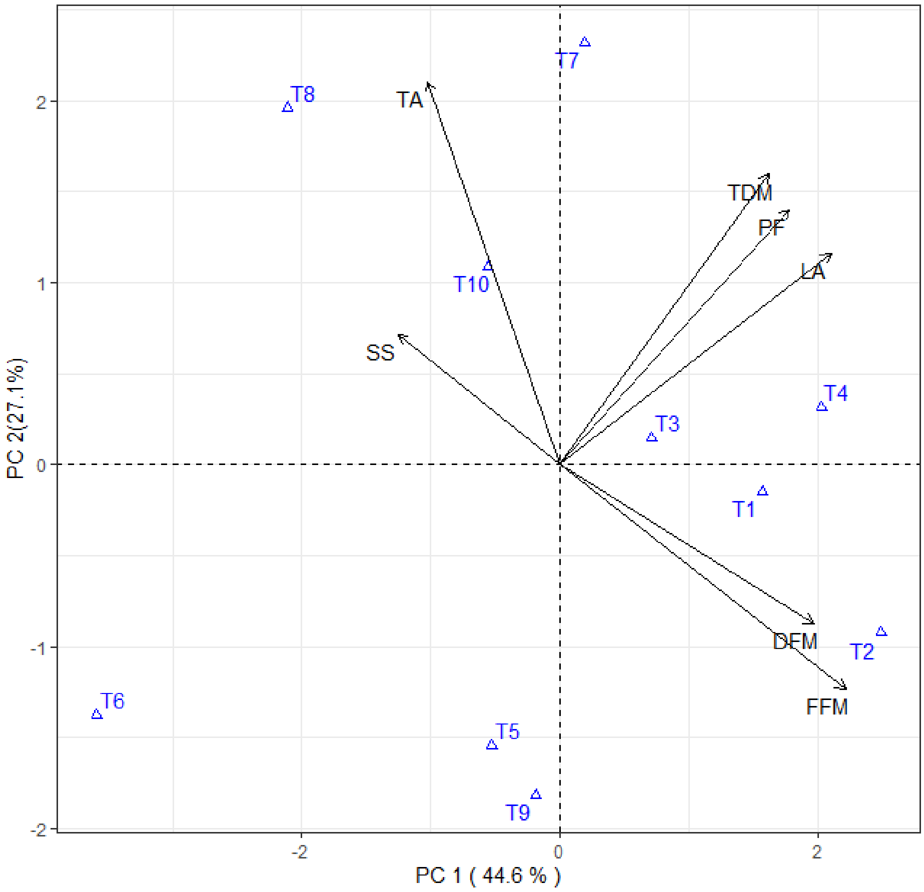
Figure 3. Soluble solids (SS, A) and titratable acidity (TA, B) of Quetzali watermelon plants, subjected to two salinity levels (0.3 and 2.0 dS m^{-1}) and five proportions of growth regulators (CPPU/IAA). Letters on the bars indicate significant differences tested by the Tukey test ($p \leq 0.05$). Lowercase letters refer to salinity levels and uppercase letters refer to the proportions of growth regulators.

The minimum content of soluble solids recommended for watermelon is 10%, but Martins et al. (2013) found values similar to those observed this work in Quetzali watermelon. The lowest levels of SS were found at the concentrations of 0/100 and 100/0% (CPPU/IAA), non-saline and saline, respectively. High levels of SS in watermelon fruits are quite desirable since this index is a very important parameter in the acceptance of the product by the consumer market (DANTAS et al., 2013). Thus, the use of only one plant regulator at high concentration does not have a beneficial effect if compared to the existing synergy between them.

For TA (Figure 3B), it was observed that there was only a significant difference between the saline conditions, in the proportion of 50/50% (CPPU/IAA), where the highest EC led to the highest mean value of TA (0.15 g 100 mL^{-1}). The range of values for acidity found in this study is comparable to that found by Gama et al. (2013).

Principal component analysis (PCA) explained 71.7% of the original data variance in the first two axes (PC1 and PC2) (Figure 4). In axis 1, which gathered 44.6% of the explanation of the data, a significant association was observed between fresh fruit mass - FFM ($r = 0.84$; $p<0.01$), leaf area - LA ($r = 0.79$; $p<0.01$), dry fruit mass - DFM ($r = 0.74$; $p<0.05$) and pulp firmness - PF ($r = 0.67$; $p<0.05$), with higher values of these variables in treatments without salinity in the irrigation water (T1, T2, T3 and T4).

In axis 2, which gathered 27.1% of the explanation of the original variance, a significant contribution was obtained only from titratable acidity - TA ($r = 0.80$; $p<0.01$), with the highest values in the T8 (2.0 dS m^{-1} + 50/50% (CPPU/IAA)) treatment. In PCA it was also possible to observe that with the use of saline water (2.0 dS m^{-1}), the combination 25/75% (CPPU/IAA) related to T7 treatment was the one that promoted the smallest reductions in TDM, PF and LA and T9 (75/25% (CPPU/IAA)) reduced the losses of DFM and FFM in plant.



T1=0.3 dS m^{-1} + 0/100 (CPPU/IAA); T2= 0.3 dS m^{-1} + 25/75 (CPPU/IAA); T3= 0.3 dS m^{-1} + 50/50 (CPPU/IAA); T4= 0.3 dS m^{-1} + 75/25 (CPPU/IAA); T5= 0.3 dS m^{-1} + 100/0 (CPPU/IAA); T6= 2.0 dS m^{-1} + 0/100 (CPPU/IAA); T7= 2.0 dS m^{-1} + 25/75 (CPPU/IAA); T8= 2.0 dS m^{-1} + 50/50 (CPPU/IAA); T9= 2.0 dS m^{-1} + 75/25 (CPPU/IAA); T10= 2.0 dS m^{-1} + 100/0 (CPPU/IAA).

Figure 4. Principal component analysis in watermelon plants subjected to salinity and treated with different proportions of auxin and cytokinin. LA= Leaf area; TDM= total dry mass; FFM= fresh fruit mass; DFM= dry fruit mass; PF= pulp firmness; SS= soluble solids; TA= titratable acidity.

In summary, it was found that for plant growth under high EC the association of regulators corresponding to 25/75% (CPPU/IAA) was the one that alleviated deleterious effects of salinity, so that for fruit growth characteristics the 75/25% (CPPU/IAA) treatment was responsible for greater gains under increased EC. For most measures of characterization and quality of fruits under salinity condition, no significant differences were observed between the treatments 25/75% and 50/50%, with increments found for these variables. Through these considerations it is possible to affirm that the isolated use of these growth regulators, mainly auxin, does not have relevant effects under high salinity, which may be linked to the cooperative action between the two regulators. This is because both, when combined and in appropriate proportions, act synergistically in the growth and development of the plant, through the aerial part/root relationship.

According to Olatunji, Geelen and Verstraeten (2017), the balance between cytokinin and auxin interferes with plant growth and development, as observed in this study. Similar results were also reported by Santos et al. (2020) when studying the growth of pumpkin with fruiting induced by cytokinin and auxin, pointing out that the isolated use of these does not favor greater increments. Therefore, the association of cytokinin and auxin contribute to the adaptation of the plant under stress conditions, leading to smaller reductions in growth and fruit quality; however, this is intrinsically linked to an ideal hormonal balance.

CONCLUSIONS

Our results show that the proportions of cytokinin and auxin increase the tolerance of watermelon plants to salt stress, favoring smaller decreases in growth and fruit quality at EC of 2.0 dS m^{-1}.

The 25/75% proportion promoted smaller

decreases in leaf area and total dry mass under saline condition of 2.0 dS m^{-1}. For fresh and dry fruit mass, the proportion 75/25% was the one that promoted the greatest gains at EC of 2.0 dS m^{-1}. Fruit firmness and soluble solids were favored by the proportions 25/75 and 50/50% (CPPU/IAA) under saline conditions.

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