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DOI: http://dx.doi.org/10.1590/1807-1929/agriambi.v28n1e270704 ORIGINAL ARTICLE

Production and quality of purple kohlrabi under nutrient solutions of different electrical conductivities[1]

Produção e qualidade de couve-rábano roxa sob soluções nutritivas de diferentes condutividades elétricas

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HIGHLIGHTS:
Kohlrabi is sensitive to electrical conductivity of the nutrient solution greater than 1.31 dS m^{-1}.
Vitamin C content in kohlrabi increases with salt stress provoked by nutrient solutions between 2.3 and 2.9 dS m^{-1}.
Bulb is the part of the kohlrabi plant most affected by salinity of 3.75 dS m^{-1}.

ABSTRACT: Managing electrical conductivity levels is one of the fundamentals required to obtain greater production and better quality of vegetables. The aim of this study was to evaluate the effect of electrical conductivity of the nutrient solution on the kohlrabi crop cultivated in semi-hydroponic system. A randomized block design was used with five treatments associated with the electrical conductivity of the nutrient solution (1.31, 1.71, 2.37, 2.98, and 3.75 dS m^{-1}) and four replications. The plants were harvested 78 days after transplanting and evaluated for growth, production, and postharvest quality. Nutrient solution with electrical conductivity (EC) of 1.31 dS m^{-1} promotes greater production of purple kohlrabi. The increase in EC reduced linearly most of the analyzed variables (leaf area, fresh mass of leaves, bulb and shoot, dry mass of leaves and total, bulb volume and firmness), with more significant losses for the bulb fresh mass (50.54%) and bulb volume (57.37%) variables. The use of nutrient solution with EC between 2.3 and 2.9 dS m^{-1} increased the vitamin C content and the titratable acidity.

Key words: *Brassica oleracea* Gongylodes Group, mineral nutrition, hydroponic cultivation

RESUMO: O manejo dos níveis de condutividade elétrica é um dos fundamentos necessários para se obter maior produção e melhor qualidade de hortaliças. O objetivo deste trabalho foi avaliar o efeito da condutividade elétrica da solução nutritiva na cultura da couve-rábano cultivada em sistema semi-hidropônico. O delineamento experimental foi em blocos casualizados com cinco tratamentos associados à condutividade elétrica da solução nutritiva (1,31; 1,71; 2,37; 2,98 e 3,75 dS m^{-1}) e quatro repetições. As plantas foram colhidas 78 dias após o transplante e avaliadas quanto ao crescimento, produção e qualidade pós-colheita. Solução nutritiva com condutividade elétrica (CE) de 1,31 dS m^{-1} proporciona maior produção de couve-rábano roxa. O aumento da CE reduziu linearmente a maioria das variáveis analisadas (área foliar, massa fresca de folhas, bulbos e parte aérea, massa seca de folhas e totais, volume e firmeza de bulbos), com perdas mais expressivas para as variáveis massa fresca de bulbos (50,54%) e volume de bulbos (57,37%). A utilização de solução nutritiva com CE entre 2,3 e 2,9 dS m^{-1} aumentou o teor de vitamina C e a acidez titulável.

Palavras-chave: *Brassica oleracea* Gongylodes Group, nutrição mineral, cultivo hidropônico

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Introduction

Kohlrabi (*Brassica oleracea* var. *gongylodes*), belonging to the Brassicaceae family, has bulbs rich in vitamins C, A, and K, biotin and folic acid, as well as magnesium, calcium, and selenium (Wieczorek & Jelen, 2019; Ben Sassi et al., 2021). In addition, according to these authors, its consumption bring many health benefits, mainly because they are rich in secondary metabolites, including anthocyanins, phenolic compounds, and glucosinolates important as anti-inflammatory and antidiabetic agents. It is a widely cultivated vegetable in many parts of Europe, Asia, and North America (Smychkovich & Hashemi, 2022). However, kohlrabi is still little produced and consumed in Brazil. Thus, there is a need for studies on crop management.

Growing in a hydroponic system, NFT (Nutrient Film Technique) or using substrate system, is an important technology to assess the nutritional requirements of plants since all nutrients are supplied through a nutrient solution, allowing greater control (Martinez, 2021).

Kohlrabi is classified as moderately tolerant to salinity (De Vos et al., 2019), with a threshold in terms of electrical conductivity of soil saturation extract (ECse) of 2.4 dS m^{-1}. Values above this threshold may result in significant production loss, on the order of 4.4% per unit increase in ECse. Biswas et al. (2016) observed a linear reduction in kohlrabi growth with increasing irrigation water electrical conductivity (ECw), especially with ECw greater than 3.0 dS m^{-1}. In hydroponic cultivation in coconut fiber, Oliveira et al. (2022) observed greater plant development using a nutrient solution with electrical conductivity of 2.0 dS m^{-1}.

In view of this, it is clear that there is great variability in the response of kohlrabi to salt stress, mainly regarding the cultivation system used. Several studies show that the nutritional needs of crops vary considerably, either between species or between cultivars of the same species (Oliveira et al., 2022; Ren et al., 2022).

Given the above, the present study was conducted to evaluate the effect of the electrical conductivity of the nutrient solution on kohlrabi cultivated in coconut fiber under hydroponic conditions.

Material and Methods

The experiment was carried out from February to April 2018 in a greenhouse at the Departamento de Ciências Agronômicas e Florestais (DCAF) of the Universidade Federal Rural do Semi-Árido, Mossoró, State of Rio Grande do Norte, Brazil (5º 12' 04" S; 37º 19' 38" W; mean altitude of 18 m).

The greenhouse has an area of 126 m^2, a length 18 m, a width 7 m, an upper cover of transparent light diffuser low-density polyethylene film (LDPE with 150 μm thickness, treated against ultraviolet rays.

During the experiment, daily data on maximum (Tmax), mean (Tmean), and minimum (Tmin) temperature and maximum (RHmax), mean (RHmean), and minimum (RHmin) relative humidity were collected using a digital thermohygrometer (Elitech® Brazil, model BT-3), installed inside the greenhouse. The temperature varied from 21.1 to 23.3 ºC for Tmin, 27.3 to 31.9 °C for Tmean and 27.8 to 38.1 ºC for Tmax; the relative humidity of air varied from 22.9 to 77.9% for RHmin, 48.2 to 88.6% for RHmean and 57.2 to 99.5% for RHmax.

The experiment was carried out in a randomized block design, with five treatments and four replications, testing five nutrient solutions with different nutrient concentrations (C1 - 50%, C2 - 75%, C3 - 100%, C4 - 125%, and C5 - 150%). The experimental unit was composed of six pots (3 L), which were filled with coconut fiber substrate and arranged on top of masonry bricks, thus being at 0.10 m height from the soil.

The nutrient solutions were adapted according to the recommendation of Furlani et al. (1999) for the hydroponic cultivation of leafy vegetables, in which the solution C3 (100%) contained the following fertilizer concentration per 1000 L: 750 g of calcium nitrate (15.5% N and 20% CaO), 500 g of potassium nitrate (13% N and 43% K_2O), 400 g of magnesium sulfate (11.8% S and 9% MgO), and 150 g of monoammonium phosphate (11% N and 60% P_2O_5). 30 g of Dripsol®, composed of Mg (1.1%), Zn (4.2%), B (0.85%), Fe (3.4%), Mn (3.2%), Cu (0.5%), and Mo (0.05%) were applied. To adjust the pH of the solution, between 5.5 and 6.5, solutions of 1.0 mol L^{-1} of KOH or HCl were applied.

The C3 nutrient solution contained the nutrient concentration of the standard nutrient solution. Solutions C1 and C2 were obtained by diluting C3. Solutions C4 and C5 were prepared by increasing the concentration of nutrients compared to C3.

After the addition of nutrients, the electrical conductivity (EC) of the nutrient solution for each treatment was checked, with values on the order of 1.31, 1.71, 2.37, 2.98, and 3.75 dS m^{-1} in the solutions C1, C2, C3, C4, and C5, respectively.

The seedlings of kohlrabi, cv. Purple, were produced in an expanded polystyrene tray of 128 cells, using coconut fiber substrate, by placing three seeds per cell and manually irrigating them twice a day with public-supply water (ECw = 0.5 dS m^{-1}). Germination began four days after sowing and thinning was performed at 10 days, leaving the most vigorous seedling in each cell. After thinning, the seedlings received daily fertigation using a nutrient solution (Furlani et al., 1999) diluted by 50% through a floating system.

The seedlings were transplanted into pots when they had four true leaves (at 25 days after sowing), by placing one plant in each pot containing coconut fiber. Seven days after transplanting, the seedlings were fertigated using the same nutrient solution through a drip system, and from then on, the treatments began to be applied.

Each nutrient solution was applied through an independent irrigation system composed of a PVC reservoir (60 L), electric pump, polyethylene hoses with 16 mm in diameter, 25 cm long microtube emitters, and an average flow rate of 3.5 L h^{-1}.

An open system was used, in which the drained nutrient solution was not reused. When the volume of the nutrient solution reached the minimum level for suction by the motor pumps, the residual solution was discarded. Then the reservoir was washed and filled with a new nutrient solution.

Irrigation was controlled via a digital timer (Exatron®), adopting the irrigation frequency according to the plant's needs. In the first month, the timer was scheduled to perform six daily irrigation events with a time of 1.0 min, and in the following month, the frequency increased to nine irrigation events of 1.0 min and 1.5 min, in alternation, until harvest.

The volume of solution applied was not quantified, but in each irrigation a sufficient volume was applied to leach 10% of the nutrient solution to avoid excessive accumulation of salts in the root zone.

Harvest was carried out on April 18, 2017, 78 days after sowing. Plants were collected, placed in properly identified plastic bags and transported to the UFERSA's Hydroponics Laboratory for evaluation.

The plants were evaluated for the following variables: number of leaves (NL), leaf fresh mass (LFM), bulb fresh mass (BFM), shoot fresh mass (SFM), bulb volume (BV), leaf dry mass (LDM), root dry mass (RDM), bulb dry mass (BDM), total dry mass (TDM), leaf area (LA), specific leaf area (SLA), and leaf area ratio (LAR).

The number of leaves was determined shortly after harvest by counting the leaves that showed green color and disregarding yellow and/or dry leaves.

Shoot fresh mass, leaf fresh mass, and bulb fresh mass were obtained immediately after harvest by determining their weight on a precision digital scale (0.01 g).

Bulb volume was obtained by the method of water displacement in a measuring cylinder (1000 mL) containing water up to the level of 500 mL, where the bulbs were immersed, and the result was given by the difference between the final volume and the initial volume of water. Bulb volume was expressed in cm^3.

For dry mass determination, the samples were placed in previously identified paper bags and dried in a forced air circulation oven at 65 °C (± 1) for 72 hours. After drying, measurements of root dry mass, shoot dry mass, and bulb dry mass were taken by weighing on a precision digital scale (0.01 g), and their sum was used to obtain the total dry mass.

Leaf area was determined through the disc method, by collecting samples of ten 50-mm-diameter leaf discs from each treatment, in each replicate (Souza et al., 2012), and calculated as shown in Eq. 1:

$$LA = \frac{DA \times LDM}{DDM} \tag{1}$$

where:
LA - leaf area (cm^2 per plant);
DA - disc area (cm^2 disc);
LDM - leaf dry mass (g per plant); and,
DDM - disc dry mass (g per plant).

Specific leaf area was determined by the ratio between leaf area and leaf dry mass, by Eq. 2:

$$SLA = \frac{LA}{LDM} \tag{2}$$

where:
SLA - specific leaf area (cm^2 per g of LDM);
LA - leaf area (cm^2 per plant); and,
LDM - leaf dry mass (g per plant).

Leaf area ratio was determined by the ratio between leaf area and total dry mass, according to Eq. 3:

$$LAR = \frac{LA}{TDM} \tag{3}$$

where:
LAR - leaf area ratio (cm^2 per g of TDM);
LA - leaf area (cm^2 per plant); and,
TDM - total dry mass (g per plant).

Quality analyses were performed at the Postharvest Laboratory of UFERSA, where the following bulb parameters were evaluated:

Bulb firmness (FIRM): obtained using an analog penetrometer with 8-mm-diameter tip and penetration of 5 mm, and the results of these readings were obtained in pound and then converted to Newton (1 N = 4.45 lb).

The samples were crushed in a domestic blender and then the quantities necessary for each analysis were collected.

pH: determined using a benchtop pH meter in samples containing 10 g of kohlrabi pulp, mixed with 100 mL of distilled water.

Soluble solids (SS): determined using a digital refractometer, PR-100 Palette model (Atago Co., Ltd., Japan), with results expressed in °Brix.

Titratable acidity (TA): determined according to analytical standard of IAL (1985), by the titration method, using 10 g of pulp diluted in 100 mL of distilled water. Volumetric procedure: the burette of 50 mL was filled with 0.02 N sodium hydroxide (NaOH), and 3 to 4 drops of phenolphthalein were added to the sample (10 g of juice), which was titrated with NaOH until the color became slightly pink.

Vitamin C (Vit C): determined according to Strohecker & Henning (1967), using a 10 g sample of the crushed material, diluted to 100 mL of oxalic acid, followed by the collection of a 5 mL aliquot and addition of 45 mL of water. Titration was performed with 2,6-diclorofenolindofenol (0.094 mg mL^{-1}) until it achieved a pinkish color.

The SS/TA ratio was determined by the division of the variables SS and TA.

The obtained data were subjected to analyses of variance by F test, and the variables that showed significant response were analyzed by regression analysis, using SISVAR software (Ferreira, 2019).

Results and Discussion

According to the analysis of variance, the variables leaf area (LA), leaves fresh mass (LFM), bulb volume (BV), leaf dry mass (LDM), root dry mass (RDM), bulb dry mass (BDM), and total dry mass (TDM) were affected by the treatments applied ($p \leq 0.01$), as well as bulb fresh mass

Table 1. Summary of F-test for number of leaves (NL), leaf area (LA), leaf fresh mass (LFM), bulb fresh mass (BFM), shoot fresh mass (SFM), bulb volume (BV), leaf dry mass (LDM), root dry mass (RDM), bulb dry mass (BDM), and total dry mass (TDM), specific leaf area (SLA), and leaf area ratio (LAR) of purple kohlrabi fertigated with nutrient solutions of different electrical conductivities (ECns)

SV	DF	F-test											
		NL	LA	LFM	BFM	SFM	BV	LDM	RDM	BDM	TDM	SLA	LAR
ECns	4	ns	**	**	*	*	**	**	**	**	**	ns	ns
Blocks	3	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV		15.21	13.44	15.22	10.77	15.63	15.55	14.25	11.87	16.44	12.14	15.75	17.47

SV - Source of variation; DF - Degrees of freedom; ECns - Electrical conductivity of nutrient solutions; CV - Coefficient of variation; *, **, and ns - Significant at $p \leq 0.05$ and, and not significant, respectively, by F test

(BFM) and shoot fresh mass (SFM) ($p \leq 0.05$). There was no significant effect ($p > 0.05$) of the electrical conductivity of nutrient solutions (ECns) on the number of leaves (NL), specific leaf area (SLA), and leaf area ratio (LAR) (Table 1).

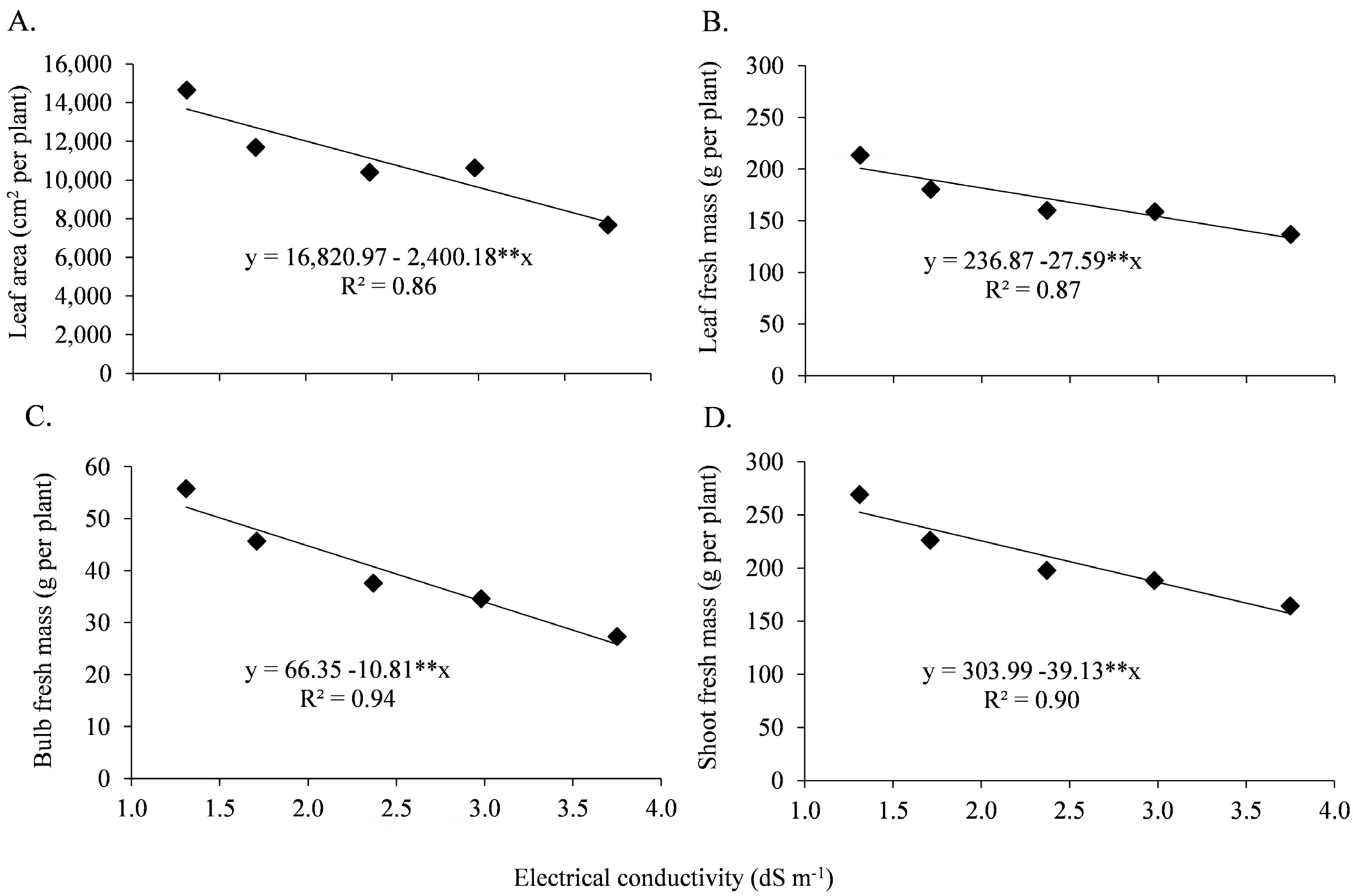
SLA expresses the thickness of the leaf blade, so the absence of response demonstrates that salinity did not affect the number of chloroplasts and the amount of photosynthetic enzymes (Urban et al., 2021). LAR expresses the leaf area available for biomass production, so the absence of significant response in the present study demonstrates that the electrical conductivities used were not sufficient to affect the photosynthetic efficiency of the plants.

The increase in ECns linearly reduced the leaf area (LA), leading to a loss of 2,400.2 cm^2 per unit increase in ECns, with LA decreasing from 13,676.73 to 7,820.29 cm^2 at ECns of 1.31 and 3.75 dS m^{-1}, respectively, resulting in a total loss of 42.82% (Figure 1A).

Thus, it can be observed that the negative effect of the highest ECns on LA was due to the reduction in leaf blade expansion since it did not affect the production of new leaves. Other authors have also found a reduction in the leaf area of kohlrabi in response to the increase in electrical conductivity, caused either by the addition of NaCl in the irrigation water (Osman & Salin, 2016) or by the increase in nutrient concentration in the nutrient solution (Oliveira et al., 2022).

The reduction of leaf area probably stems from the decrease in cell volume because reductions in leaf area and photosynthesis contribute, in a certain way, to the adaptation of the crop to salinity. Reduction of leaf area under water stress can be a survival mechanism that enables water conservation due to the smaller transpiration area of the plants (Ali et al., 2022).

These negative results can be attributed to the increase of salt concentration in the substrate, which negatively acts



** - Significant at $p \leq 0.01$ by F test

Figure 1. Leaf area (A), leaf fresh mass (B), bulb fresh mass (C), and shoot fresh mass (D) of purple kohlrabi fertigated with nutrient solutions of different electrical conductivities

on the physiological process, reducing water absorption by roots, inhibiting meristematic activity, cell elongation, and consequently reducing plant growth and development (Chen et al., 2022; Ji et al., 2022; Rivera et al., 2022).

Increasing nutrient concentration in the nutrient solution linearly reduced leaf fresh mass (LFM), bulb fresh mass (BFM), and shoot fresh mass (SFM) (Figures 1B, C, and D), with losses of 27.60, 10.81, and 39.13 g per plant per unit increase in ECns, resulting in total reductions of 33.54, 50.54, and 37.78% for LFM, BFM, and SFM, respectively, at the highest ECns (3.75 dS m^{-1}), compared to the values obtained at the lowest ECns (1.31 dS m^{-1}), equal to 200.69, 52.19, and 252.73 g per plant for LFM, BFM, and SFM, respectively.

Thus, it can be noted that the parameter BFM was more sensitive to salinity than LFM, confirming the results reported by Biswas et al. (2016), which can be attributed to the higher water content in the bulb.

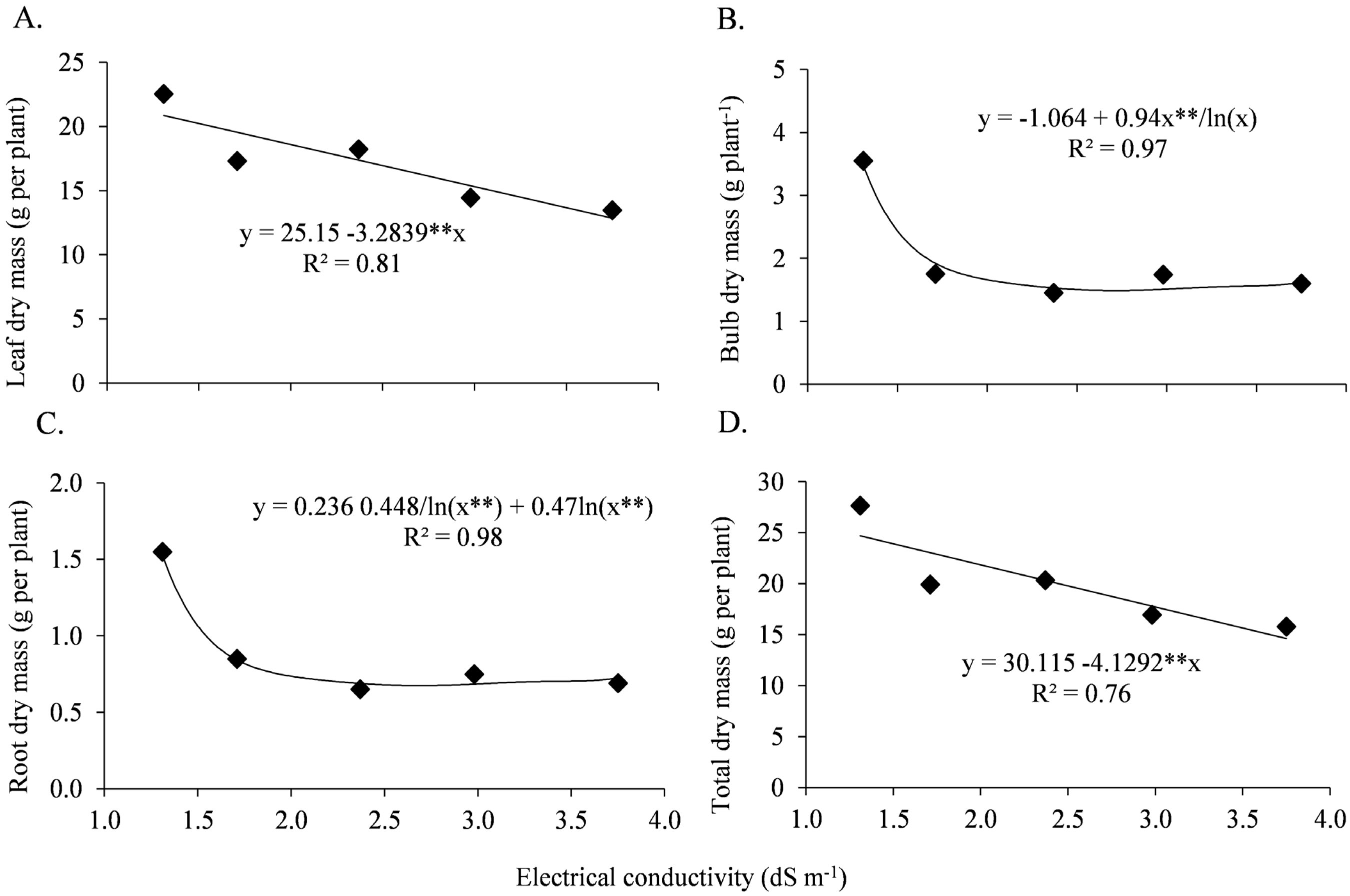
The reduction in bulb fresh mass observed at the highest ECns may have occurred in response to the higher electrical conductivity of the nutrient solution, agreeing with the results reported by Biswas et al. (2016) and Osman & Salim (2016), who also reported a reduction in the development of kohlrabi bulb as a response to salinity.

When analyzing dry mass accumulation, it was found that leaf dry mass (Figure 2A) and total dry mass (Figure 2D) were linearly reduced by 3.28 and 4.13 g per plant, respectively, per unit increase in the electrical conductivity of the nutrient solution, resulting in total losses of 37.93 and 40.55% with the nutrient solution of highest ECns (3.75 dS m^{-1}), compared to values obtained at the lowest ECns (1.31 dS m^{-1}). For bulb dry mass (Figure 2B) and root dry mass (Figure 2C), the highest values were obtained at ECns of 1.31 dS m^{-1}, being 3.49 and 1.55 g per plant, respectively. There were reductions only for the use of nutrient solution up to electrical conductivity of 2.72 dS m^{-1} (1.49 g per plant) and 2.65 dS m^{-1} (0.68 g per plant), which led to losses of 57.35 and 44.74%, while the values remained constant at the other ECns levels for both variables (Figure 2B and C).

Similar results were observed by other authors when evaluating the production of kohlrabi under saline conditions (Biswas et al., 2016; Osman & Salim, 2016), who also found a significant reduction in dry mass accumulation because of the increased salinity.

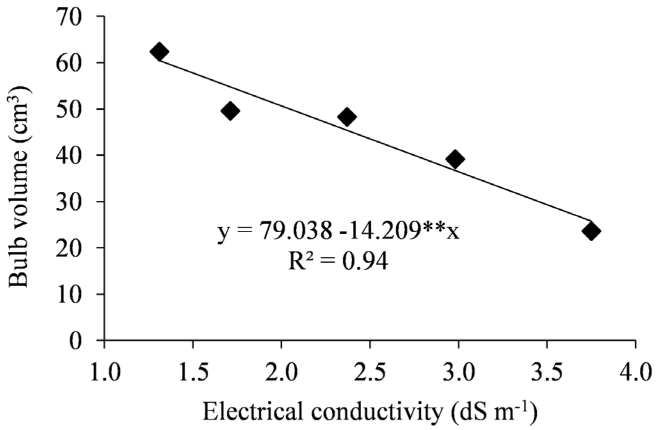
Salinity can affect plant growth because a reduction in the soil's osmotic potential decreases water and nutrient availability (Gonzáles et al., 2021). In order to balance it, plants decrease their osmotic potential, which is their strategy of adaptation to salt stress, reducing photosynthetic activities and, consequently, biomass production.

The increase of nutrient solution concentration linearly and negatively affected bulb volume (BV); its highest value (60.42 cm^3) occurred at a salinity of 1.31 dS m^{-1} and reduced at the rate of 14.21 cm^3 per unit increase in electrical conductivity, with the lowest BV obtained at salinity of 3.75 dS m^{-1} (25.75 cm^3), equivalent to a total reduction of 57.37% (Figure 3).



** - Significant at $p \leq 0.01$ by F test

Figure 2. Leaf dry mass (A), bulb dry mass (B), root dry mass (C), and total dry mass (D) of purple kohlrabi fertigated with nutrient solutions of different electrical conductivities



** - Significant at $p \leq 0.01$ by F test

Figure 3. Bulb volume of purple kohlrabi fertigated with nutrient solutions of different electrical conductivities

The reduction in bulb volume (BV) occurred due to the high ECns in the most concentrated nutrient solution, confirming the results reported by Biswas et al. (2016), who observed a reduction in bulb size in plants subjected to salt stress. This reduction occurred because high salt concentrations reduce the osmotic potential in the solution of the substrate used, reducing the availability of water to plants (Lu & Fricke, 2023).

Bulb firmness (FIRM) and soluble solids/titratable acidity ratio (SS/TA) were significantly affected by electrical conductivity of the nutrient solution ($p \leq 0.05$), as well as titratable acidity (TA) and vitamin C (Vit C) content ($p \leq 0.01$) (Table 2). Soluble solids (SS) content and hydrogen ion potential (pH) were not affected by the applied treatments ($p > 0.05$) (Table 2).

In the literature, few studies have reported the effect of nutrient solutions on the pH of kohlrabi bulbs, but it is possible to find studies evaluating the quality of bulbs under storage conditions, indicating, after harvest, pH around 6.39 (Heo et al., 2021), a value close to that observed in the present study.

For the soluble solids content, other authors (Heo et al., 2021) found mean SS values from 8.31 °Brix, so the values obtained in this study are close to those found in the literature. The absence of a significant effect may have occurred because there was no difference in the water content in the bulb of this cultivar, which ranged from 93.6 to 96.1%.

Bulb firmness (FIRM) was linearly reduced in response to the increase in the electrical conductivity of the nutrient solution, showing reduction of 3.037 N per unit increase in ECns, with values ranging from 28.47 to 21.06 N, at the electrical conductivities of 1.31 and 3.75 dS m^{-1}, respectively, resulting in a total reduction of 26.03% (Figure 4A).

Table 2. Summary of F-test for soluble solids (SS), hydrogen potential (pH), bulb firmness (FIRM), titratable acidity (TA), vitamin C (Vit C), and soluble solids/titratable acidity ratio (SS/TA) of purple kohlrabi fertigated with nutrient solutions of different electrical conductivities

SV	DF	F-test					
		SS	pH	FIRM	TA	Vit C	SS/TA
ECns	4	ns	ns	**	*	*	**
Blocks	3	ns	ns	ns	ns	ns	ns
CV		14.35	3.44	10.85	12.42	13.62	10.87

SV - Source of variation; DF - Degrees of freedom; ECns - Electric conductivity of nutrient solutions; CV - Coefficient of variation; *; **, and ns - Significant at $p \leq 0.05$ and 0.01, and not significant, respectively, by F test

Osman & Salim (2016) found a reduction in the bulb firmness of kohlrabi plants grown under salt stress; in addition, these authors found that there is a negative correlation between bulb size and firmness. A reduction in bulb firmness in response to salt stress was observed by Venâncio et al. (2022) in onions due to a reduction in the membrane stability index in leaf and bulb tissues. Salinity decreases the deposition of calcium pectate and calcium phosphate in tissues, which limits cell wall development and hence reduces the firmness (Ullah et al., 2020).

For the variables titratable acidity (TA) and vitamin C (Vit C), there were quadratic responses (Figures 4B and C), for which the highest values were obtained at ECns of 2.32 and 2.91 dS m^{-1}, with maximum values of 0.71% (TA) and 47.28 mg $100g^{-1}$ of fresh mass (Vit C). It is also observed that the Vit C content showed a higher response to nutrient solutions, with a gain of 36.41% compared to that obtained at electrical conductivity of 1.31 dS m^{-1} (34.41 mg $100g^{-1}$ of fresh mass) (Figure 4B), while TA increased by 18.65% (Figure 4C).

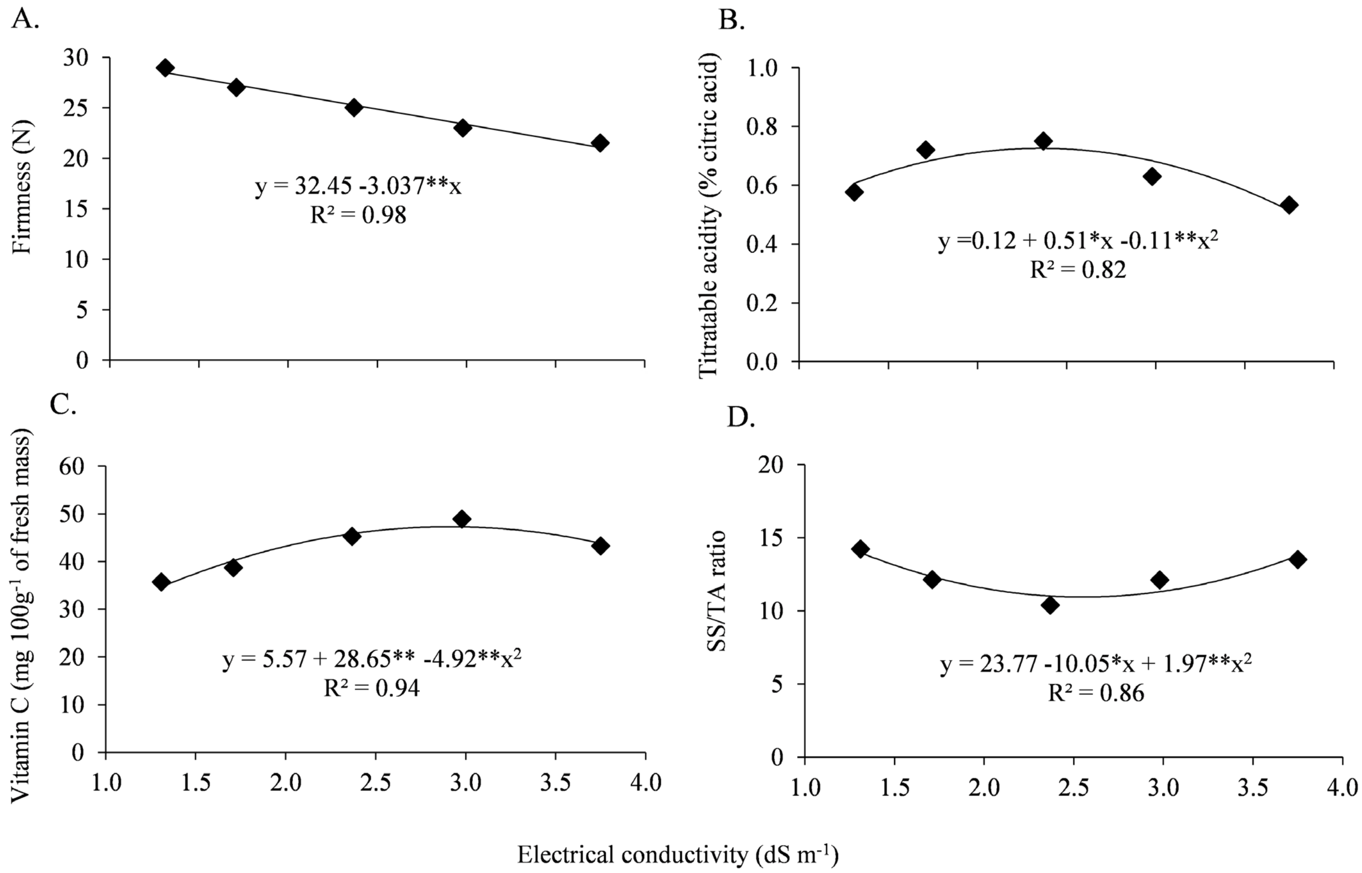
The presence of acidity in the pulp is an important characteristic to maintain the organoleptic balance, giving the feeling of freshness and improving the post-harvest quality (Ó et al., 2021). The most acidic products are naturally more stable in terms of deterioration and the relative proportion of organic acids present in fruits and vegetables (García et al., 2021).

The vitamin C contents observed in the present study are close to those obtained by Oliveira et al. (2022), who observed highest content (57.40 mg $100g^{-1}$ of fresh mass) at the highest EC of the nutrient solution, 3.75 dS m^{-1}, in white kohlrabi.

Studies conducted with other crops show that vitamin C content tends to increase in response to increased salinity of the nutrient solution, for instance with lettuce (Carillo et al., 2020), amaranthus (Sarker & Oba, 2019), and tomato (Oliveira et al., 2022). This information is of great importance, as ascorbic acid, a precursor of vitamin C, can contribute to prolonging the shelf life of the product and sustain its nutraceutical value by conferring antioxidant properties (Carillo et al., 2020; Zandi & Schnug, 2022).

The highest value for the SS/TA ratio (13.98) was obtained at the lowest electrical conductivity (1.31 dS m^{-1}) and decreased with the increase in salinity of the nutrient solution up to the level of 2.55 dS m^{-1} (10.95), resulting in a reduction of 21.69%. From ECns of 2.55 dS m^{-1}, the increase in ECns caused an elevation in the SS/TA ratio; at the highest level (3.75 dS m^{-1}), it attained the value of 13.78 (Figure 4D).

The SS/TA ratio is used as a criterion for evaluating the taste of the product, as it indicates the degree of balance between the contents of sugars and organic acids, so the balance between these two variables is the factor that gives the product the characteristic of more or less attractive flavor (García et al., 2021).



**, * - Significant at p ≤ 0.01 and p ≤ 0.01, respectively, by F test

Figure 4. Bulb firmness (A), titratable acidity (B), vitamin C (C), and soluble solids/titratable acidity ratio (D) of purple kohlrabi fertigated with nutrient solutions of different electrical conductivities

Conclusions

1. Nutrient solution with electrical conductivity (EC) of 1.31 dS m^{-1} promotes greater production of purple kohlrabi.

2. The increase in EC reduced linearly most of the analyzed variables (leaf area, fresh mass of leaves, bulb and shoot, dry mass of leaves and total, bulb volume and firmness), with more significant losses for the bulb fresh mass (50.54%) and bulb volume (57.37%) variables.

3. The use of nutrient solution with EC between 2.3 and 2.9 dS m^{-1} increased the vitamin C content and the titratable acidity.

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