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Posted Date: 21 March 2024

doi: 10.20944/preprints202403.1123.v1

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Abstract: Nitrogen fertilization can provide greater nutritional support and mitigate salt stress in the millet crop. The aim of this study was to evaluate the physiological responses and agronomic performance of millet crops subjected to nitrogen fertilization and irrigation water salinity. The study was carried out in a greenhouse, using a completely randomized design in a 5 x 2 factorial scheme, with 4 replications, with five doses of nitrogen (40; 60; 80; 100 and 120 kg ha-1 of N) and two levels of electrical conductivity of the irrigation water: 0.3 and 4.0 dS m-1. We concluded that salt stress increased leaf sodium levels and had a negative impact on stalk dry mass and panicle dry, leaf gas exchange, mineral element concentrations (K, P and Ca), and water use efficiency. The use of lower salinity water associated with increased nitrogen fertilization provides greater stalk dry mass and panicle dry, photosynthesis, water use efficiency, chlorophyll index, leaf potassium concentration, and biomass production. Salt stress negatively affected transpiration, stomatal conductance, leaf P and Ca levels, and increased leaf sodium levels as nitrogen fertilization increased in millet plants grown under pot conditions. These results can be used to create a strategy to reduce the negative impact of salt stress associated with the nutrition of millet plants, using nitrogen fertilization.

Keywords: nitrogen; *Penissetum glaucum* L.; salinity; plant nutrition; photosynthesis

1. Introduction

Millet (*Penissetum glaucum* L.) is an annual forage crop belonging to the Poaceae botanical family and originally from the African continent. It can be used for human and animal food (forage and grains) due to its nutritional composition. When compared to other forage plants, millet has simple cultivation, low production costs and greater tolerance to water deficit. This crop is also an alternative

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for conservation soil management systems such as no-till, used in crop rotation and succession, as well as having low soil fertility requirements [1–3].

In many regions of the world, the use of irrigation is the only way to guarantee agricultural production safely, especially in tropical regions with hot, dry or sub-humid climates [4]. However, the water resources available for irrigating crops have become increasingly scarce, and there is competition with the consumption of populations and other economic activities. in the semi-arid Northeast of Brazil In addition, in many regions, including Northeast Brazil, some water sources, especially those of underground origin, have a high concentration of soluble salts, which often represent the only source for irrigation [4–6].

Salinity is one of the main abiotic factors that negatively affects crop productivity and can severely affect agricultural production. High concentrations of soluble salts and high Na+ saturation are commonly observed in soils in arid and semi-arid regions, or in regions where soils have imperfect drainage conditions [7,8]. In these regions, agricultural production is limited by water scarcity, high soil salinity and low fertility [9,10].

The application of mineral fertilizers is an important practice for promoting crop development and production. To ensure high yields, producers make intensive use of fertilizers, especially nitrogen fertilizers [10–12], which is an essential macronutrient for plant growth, development, and productivity [13]. However, although N is one of the nutrients most absorbed by the millet crop, care must be taken not to supply it in excess, since excessive doses of N reduce root growth, the harvest index and favor the growth of the vegetative part [14,15]

However, in saline environments, the ionic interactions that affect the viability, absorption and transport of nutrients are highly complex, mainly due to the differences in concentration and ionic composition, where there is a greater accumulation of Na+ and Cl- ions, which can limit the absorption of N, P, K, Ca and Mg [16–18].

In view of the above, the objective was to evaluate the physiological responses and agronomic performance of the millet crop subjected to nitrogen fertilization and irrigation water salinity.

2. Materials and Methods

2.1. Location and Characterization of the Experimental Area

The experiment was carried out during the dry season (September to November 2020), in the experimental area of the Auroras Seedling Production Unit (UPMA), belonging to the University of the International Integration of Afro-Brazilian Lusophony (UNILAB), Redenção, Ceará, Brazil. The city is located at a latitude of 04º13’33”S, longitude of 38º43’50”W, with an average altitude of 88m. The region has a sub-humid and hot climate, with rainfall predominating in the summer and fall seasons. The meteorological data during the period of the experiment (September to November 2020) were monitored by a Data logger (HOBO® U12-012 Temp/RH/Light/Ext) (Figure 1). The total rainfall during this period was only 18 mm.

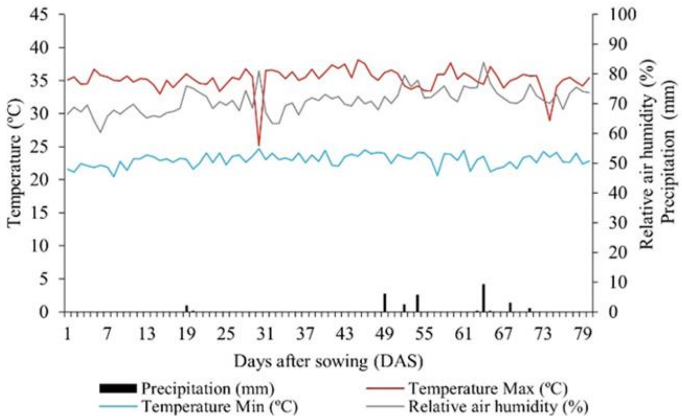

Figure 1. Mean values of maximum (Max) and minimum (Min) temperatures, rainfall, and relative air humidity observed during the experimental period.

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2.2. Experimental Design and Treatments

The experimental design used was entirely randomized in a 5 x 2 factorial scheme, with 4 replications, with the first factor referring to five doses of nitrogen (40; 60; 80; 100 and 120 kg ha $^{-1}$ of N); and the second factor corresponding to two electrical conductivities of the irrigation water (ECw): 0.5 and 4.0 dS m $^{-1}$.

2.3. Plant Material and Fertilization

The crop used was millet (Pennisetum glaucum L.), cultivar BRS-1501, sown in rows (five per pot), using an average of 45 seeds to ensure a minimum plant stand in each experimental unit. Thinning was carried out 15 days after emergence, leaving three plants per pot.

Mineral fertilization was recommended by [19] with 120 kg ha $^{-1}$ of N, 30 kg ha $^{-1}$ of P_2O_5 and 40 kg ha $^{-1}$ of K_2O. For pot fertilization purposes, a stand of 10,000 plants ha $^{-1}$ was considered, where each pot received 3.0 g of P_2O_5 and 4.0 g of K_2O, using simple superphosphate and potassium chloride, respectively. For nitrogen fertilization, a dose of 4.8, 7.2, 9.6, 12 and 14.4 g of N per pot was used, corresponding to 40, 60, 80, 100 and 120 kg ha $^{-1}$, respectively, using urea (45%). Fertilization with NPK was divided into two doses, 50% at planting and 50% at 21 days after sowing.

The pots used had a volumetric capacity of 25 L and contained a substrate made up of a mixture of arisco, sand and cattle manure in a ratio of 4:3:1, respectively. The characteristics of the substrate are described in Table 1.

Table 1. Chemical attributes of the substrate used to fill the pots.

Chemical Characteristics [1]									
O.M	N	P	Mg	K	Ca	Na	pH (in water)	ESP (%)	ECse
g kg $^{-1}$		mg Kg $^{-1}$	cmol $_c$ dm $^{-3}$						
4.34	0.26	65	1.20	0.65	1.20	0.33	6.2	7.00	1.19

MO= organic matter; PST= percentage of exchangeable sodium; CEes = electrical conductivity of the soil saturation extract.

2.4. Irrigation Management

The plants were irrigated manually with a daily watering shift and a leaching fraction corresponding to 0.15 [20], according to the drainage lysimeter methodology proposed by [21], keeping the substrate at field capacity. The volume of water applied during irrigation was determined using the equation below (Equation (1)):

$$\boldsymbol{VI = \frac{(Vp - Vd)}{(1 - LF)}}$$

Where:

VI – Volume of water to be applied in the irrigation even (mL);

Vp – Volume of water applied in the previous irrigation event (mL);

Vd – Volume of water drained (mL); and,

LF – Leaching fraction of 0.15.

To prepare the water with an electrical conductivity of 4.0 dS m $^{-1}$, the soluble salts NaCl, $CaCl_2.2H_2O$ and $MgCl_2.6H_2O$ were used in a ratio of 7:2:1 between Na, Ca and Mg, respectively, following the relationship between ECw and its concentration according to the methodology of [22]. Irrigation with the saline solution began 10 days after sowing (DAS), after the plants were established. The electrical conductivity of the water was periodically monitored using a bench conductivity meter (AZ® 806,505 pH/Cond./TDS/Salt). The water was sent for its chemical characteristics to be determined following the methodology of [23] and was classified using the methodology described by [24]. The chemical characteristics of the irrigation water are shown in Table 2.

Table 2. Chemical characteristics and classification of the irrigation water used in the experiment.

ECw	Ca^{2+}	Mg^{2+}	K^+	Na^+	Cl^-	HCO_3^-	pH	SAR	Classification
dS m^{-1}	-----------------mmol$_c$ L^{-1}--------------				----mmol L^{-1}----		H_2O	(mmol$_c$ L^{-1})	
0.3	0.6	1.4	0.2	0.4	2.5	0.1	6.9	0.4	C_2S_1
4.0	8.44	10.18	2.66	20.53	33.33	1.12	7.38	7.86	C_4S_2

ECw= Electrical conductivity of water; SAR= Sodium adsorption ratio; C_2S_1= represents medium and low salinity hazard and sodicity risk; C_4S_2 = represents very high salinity and is not suitable for common irrigation, and can be used in soils with good texture and containing abundant gypsum.

2.5. Gas Exchange and Chlorophyll Index

At 76 days after sowing (DAS), readings were taken of the following physiological variables: net photosynthesis rate (*A*), transpiration (E), stomatal conductance (gs), instantaneous water use efficiency (WUE), internal CO_2 concentration (Ci) and leaf temperature (TF), using an IRGA infrared gas analyzer (LI 6400 XT from LICOR), in an open system, with an air flow of 300 mL min^{-1}, with measurements taken between 9am and 11am, on fully expanded leaves, under natural conditions of air temperature and CO_2 concentration. Relative chlorophyll index (RCI) measurements were taken on the same leaves, using the non-destructive method with a portable meter (SPAD - 502 Plus, Minolta, Japan).

2.6. Biomass Production

At 76 days after sowing (DAS), two plants were collected from each experimental unit. The plants were then separated into leaves, stalks, and roots, packed in paper bags, and placed in a forced-air oven at 65°C for 72 hours to dry and then determine the dry mass of the leaves (DML), stalk (DMS) and panicle (PDM).

2.7. Mineral Element Concentration

To assess the concentration of mineral elements, the oven-dried leaf samples were ground in a Wiley-type mill for determination. The N concentration was determined using the Kjeldahl method [25], through wet digestion, followed by steam distillation and titration to quantify NH^{4+}. The other elements (P, K, Mg, Ca and Na) were determined by dry digestion in a muffle furnace using a 1% HNO_3 solution as an extractant. A 500 mg sample of leaf tissue was placed in an electric muffle furnace and incinerated at temperatures between 500 and 550 °C. The ash resulting from the process was dissolved in nitric acid solution. The extract obtained was used to determine P, K, Mg, Ca and Na. The K and Na readings were taken by flame photometry, the P readings by molybdenum blue spectrophotometry and the Mg and Ca readings by atomic absorption spectrophotometry [26].

2.8. Data Analysis

To assess the normality of the data, the variables were subjected to the Kolmogorov-Smirnov test ($p \leq 0.05$). The data were then subjected to analysis of variance and the Tukey test to compare means ($p \leq 0.05$), using the ASSISTAT 7.7 BETA program [27].

3. Results e Discussion

3.1. Leaf Gas Exchange and Biomass Production

Based on the analysis of variance (Table 3), there was a significant interaction ($p \leq 0.01$ and $p \leq 0.05$) between the factors nitrogen doses (D) and salinity (S) for the following variables: photosynthesis (A), stomatal conductance (gs), transpiration (E), instantaneous water efficiency

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(WUE), relative chlorophyll content (RCI), dry mass of the stalk (DMS), panicle (PDM) and total (TDM). The dry mass of the leaves showed an isolated effect for nitrogen doses (p ≤ 0.01).

Table 3. Summary of the analysis of variance for the variables photosynthesis (A), stomatal conductance (gs), transpiration (E), instantaneous water efficiency (WUE), Relative chlorophyll index (RCI), dry mass of the leaves (DML), dry mass of the stalk (DMS) and panicle dry mass (PDM) in the millet crop subjected to doses of nitrogen and brackish water.

SF	DF	Medium Square							
		A	gs	E	WUE	RCI	DML	DMS	PDM
Doses of N (D)	4	5.65**	0.01158**	0.597**	1.51*	359.44**	62.15**	311.15**	356.35**
Salinity (S)	1	40.17**	0.03600**	2.148**	0.083ns	77.17*	14.40ns	286.22**	184.90ns
Interaction (D x S)	4	3.89*	0.00658**	0.339**	2.27**	164.48**	35.65ns	314.22**	268.65**
Residue	30	1.4	0.0007	0.033	0.43	12.01	14.53	28.67	57.03
Total	39								
CV (%)	-	11.88	15.24	8.16	14.64	8.03	30.26	23.77	19.9

SF = source of variation; DF - Degrees of freedom; CV = coefficient of variation; 'ns' not significant; (*) significant by F test at 5%; (**) significant by F test at 1%*.

The photosynthetic rate increased as the nitrogen dose increased in plants irrigated with 0.5 dS m-1 water. However, when irrigation water of 4.0 dS m-1 was used, there was a decrease when comparing the highest and lowest doses of nitrogen (Figure 2A).

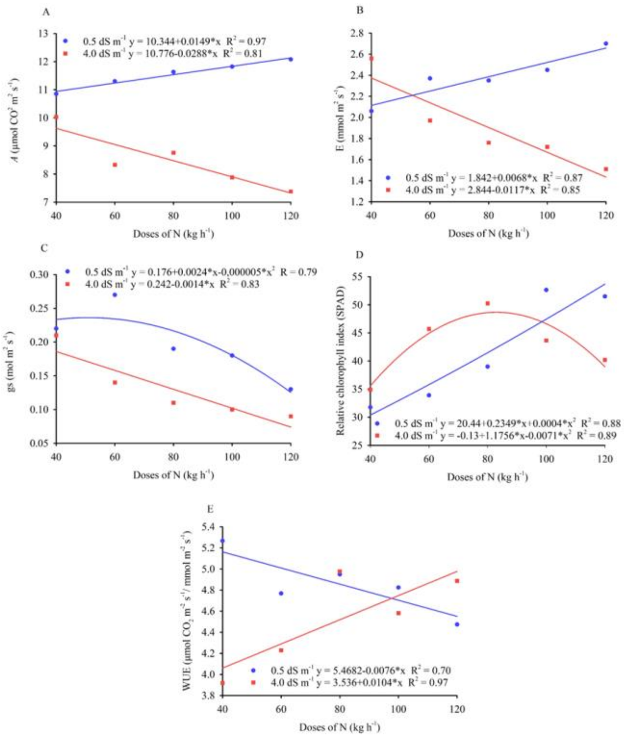

Figure 2. Photosynthetic rate (A), transpiration (B), stomatal conductance (C), Reltive chlorophyll index (D) and water use efficiency (E) in millet plants as a function of different doses of nitrogen and the electrical conductivity of the irrigation water.

Increasing the amount of N fertilizer applied tends to prolong the longevity of functional leaves and increases chlorophyll content, thus improving photosynthetic capacity [28]. In our study, it was

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found that increasing the dose of N intensified the effect of salt stress on CO^2 assimilation compared to control plants. This indicates that the increase in nitrogen concentration under conditions of salt stress may have caused a nutritional imbalance, impairing the absorption of other essential nutrients for photosynthesis such as Mg $^{2+,}$ as well as leading to the accumulation of Na+ and/or Cl- ions in the chloroplasts, affecting the biochemical and photochemical processes involved in photosynthesis [29,30].

[31] showed that nitrogen fertilizations of 60 and 120 kg ha-1 provide greater photosynthesis, transpiration, stomatal conductance, and internal CO^2 concentration in millet plants using lower salinity water throughout the cycle or using brackish water from 30 and 45 days after sowing. On the other hand, [12] found no interaction between salinity and N doses in the corn crop.

The transpiration of the millet plants (Figure 2B) increased linearly in the water with the lowest salinity (0.5 dS m-1) and decreased in the water with the highest salinity (4.0 dS m-1) as the doses of nitrogen increased, respectively, although the values were always higher in the control plants. Transpiration is correlated with stomatal conductance, which also decreased with salinity and as the dose of N increased (Figure 2C). Increasing the dose of nitrogen in the soil intensifies the osmotic effect, especially in the saline treatment, thus reducing the gradient of water potential between the soil and the plant roots and decreasing stomatal conductance, transpiration rate and water absorption by the plants [32–34].

The impact of the different doses of nitrogen and the electrical conductivity of the irrigation water on the relative chlorophyll index (Figure 2D) differed from the results observed for leaf gas exchange. The IRC increased linearly in the leaves of plants irrigated with low salinity water (0.5 dS m^{-1}), comparing the highest and lowest doses of N applied. However, in water with higher salinity (4.0 dS m^{-1}), there was a quadratic effect, with the maximum IRC value being observed at a dose of 82.78 kg ha^{-1} of N. In addition, the RCI values were higher in plants under saline stress compared to the control plants, except for the highest doses of N. The increase in the relative chlorophyll index in plants irrigated with high-salinity water is possibly related to a process of acclimatization to saline stress and the crop’s environment, in order to ensure photosynthetic rates in line with physiological and growth needs [35]. In non-stressed plants, the increase in chlorophyll concentration usually translates into greener leaves and improved photosynthetic capacity, which can result in better plant growth and development [36].

The increase in nitrogen doses associated with the use of lower salinity water linearly reduced the instantaneous efficiency of irrigation water use but increased it when irrigated with higher salinity water (Figure 3E). Saline stress reduces plant gas exchange and therefore instantaneous water use efficiency, which is the result of the relationship between photosynthesis and transpiration, where stress translates into reduced water consumption by plants [37]

Research carried out by [31] on the same millet cultivar fertilized with 50 and 100% of the recommended dosage and irrigated with brackish water from the 30th, 45th and 65th days onwards, found no mitigating effect of nitrogen fertilization on water use efficiency. On the other hand, [38] found similar results to this study. These same authors, when assessing the effect of nitrogen fertilization on the eggplant crop, obtained a higher water use efficiency of 6.34 (μmol CO^2 mmol H2O m^{-2} s^{-1}) for a dosage of 250 Kg ha^{-1} of N, at the lowest electrical conductivity of the water.

Increasing the doses of nitrogen in the substrate had a linear effect on the dry leaf mass, with a maximum increase of 68% when comparing the lowest and highest doses of N (Figure 4A). The positive influence of increasing doses of nitrogen in the substrate may be related to the effect of the nutrient on the transport of assimilates from the source to the drain, enabling greater dry matter accumulation [39].

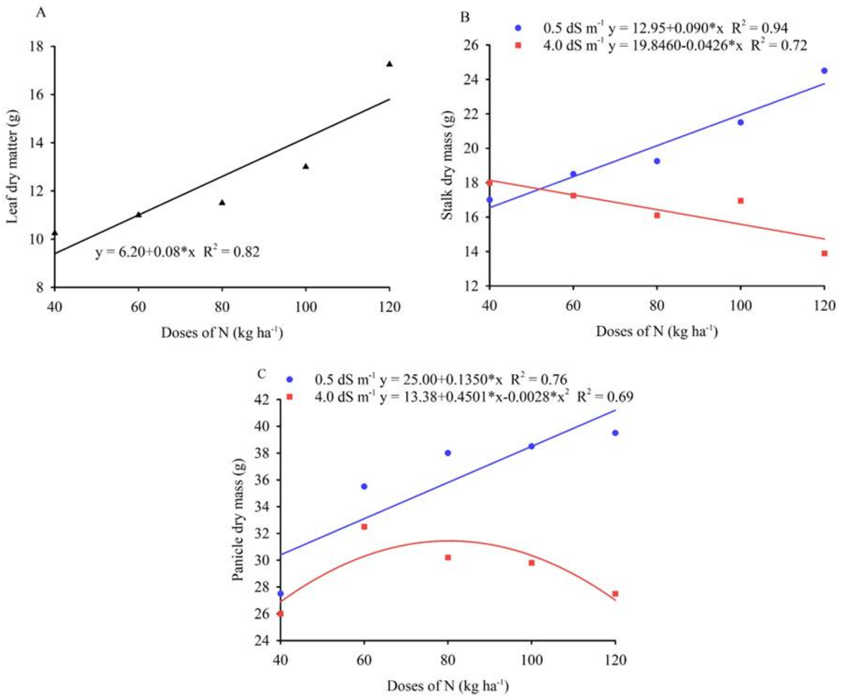

Figure 4. Leaf dry mass (A), stalk dry mass (B), and panicle dry mass (C) in millet plants as a function of nitrogen doses and electrical conductivities of the irrigation water.

The dry mass of the stalk (Figure 4B) and the panicle (Figure 4C), when irrigated with low-salinity water, showed increasing linear responses with increasing nitrogen doses in the substrate. On the other hand, plants irrigated with brackish water (4.0 dS m^{-1}) showed a linear decrease in stalk dry mass with increasing N dose, while panicle dry mass presented a maximum estimated value of 31.47 g for a dose of 80.37 kg ha^{-1} of N. These results indicate that the cultivation of millet plants under high nitrogen doses and irrigated with brackish water intensifies the deleterious effects of salts on biomass production.

On the other hand, the plants irrigated with brackish water (4.0 dS m^{-1}) showed a better fit to the quadratic polynomial model, in which the dry mass of the stalk, panicle and total had maximum estimated values of 35.59; 42.04 and 117.09 g for the doses 83.84; 82.63; 79.32 Kg ha^{-1} of N. These results possibly indicate that growing millet plants under high nitrogen doses and irrigated with brackish water intensifies the deleterious effects of salts on dry mass accumulation.

[40] found that adding NaCl to the irrigation solution significantly reduced leaf growth, in terms of dry weight, by 11% and 7% when the plants were fertilized with NO3- and NH4+, respectively. Similar to the results found in this study, [41] and [42] found an increase in the dry mass of the aerial part as a result of the increase in nitrogen doses in cotton and corn plants, respectively.

A study carried out by [31] with saline stress and nitrogen fertilization at 50 and 100% of the recommended dose in the millet crop, reported that there was no effect similar to that of this research. These same authors found that the use of brackish water from 30 days after sowing did not negatively affect leaf biomass. They differed from the use of water with lower salinity, with greater biomass with water of 4.0 dS m^{-1} in plants fertilized with 100% of the nitrogen dose. On the other hand, [43] showed a similar trend to this study, where plants under saline stress promoted greater stalk accumulation. For panicle mass, [44] evaluated the use of high salinity water associated with 100% of the recommended dose in millet cultivation and found similarity to this study.

3.2. Leaf Concentration of Nutrients

The leaf potassium content showed an isolated effect for irrigation water, while the other nutrients were influenced by the interaction of the factors studied at a significance level of $p \leq 0.01$ and $p \leq 0.05$ by the F test (Table 4).

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Table 4. Summary of the analysis of variance for the content of nitrogen (N), phosphorus (P), calcium (Ca), magnesium (Mg) sodium (Na) and leaf potassium (K) in millet plants under doses of nitrogen in the substrate and irrigated with different electrical conductivities of the irrigation water.

SV	DF	Medium Square					
		N	P	Ca	Mg	Na	K
Doses of N (D)	4	239,33**	0,48**	2,44**	5,06**	2,84**	1,62 ns
Salinity (S)	1	101,06**	1,06**	6,81**	2,63**	11,07**	41,57**
Interaction D x S	4	49,92**	0,35**	1,58**	1,70**	2,44**	5,91 ns
Residue		4,63	0,81	0,32	0,15	0,13	3,35
CV (%)		7,65	17,12	11,52	7,98	33,97	13,48

SF = source of variation; DF - Degrees of freedom; CV = coefficient of variation; 'ns' not significant; (*) significant by F test at 5%; (**) significant by F test at 1%*.

The leaf N content (Figure 5A) increased linearly with the increase in N doses in the control plants. On the other hand, the leaf N content in the plants irrigated with brackish water (4.0 dS m-1) responded in quadratic form, with a maximum value of 31.8 g kg-1 at a dose of 90.13 kg ha-1 of N.

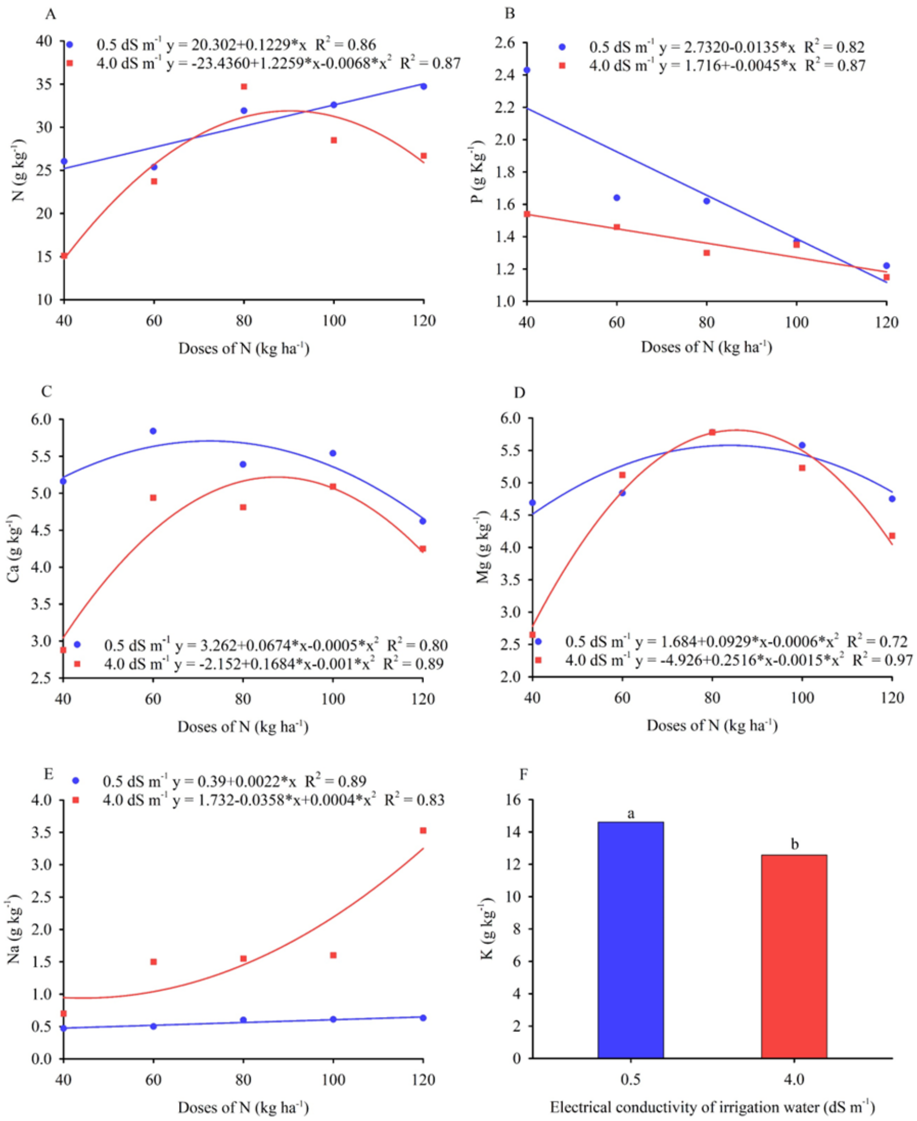

Figure 5. Leaf nitrogen (A), phosphorus (B), calcium (C), magnesium (D), sodium (E) content in millet plants as a function of the interaction between nitrogen doses in the substrate and electrical

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conductivities of the irrigation water and leaf potassium (F) content in millet plants as a function of different electrical conductivities of the irrigation water.

Averages followed by the same lowercase letters in the same electrical conductivity of the water do not differ significantly by the Tukey test ($p \leq 0.05$).

In saline environments there is an antagonism between Cl^- and NO_3^- which causes deleterious effects on the absorption and translocation of nitrogen to plant structures [45], which was demonstrated from the dose of 90.13 kg ha^{-1} of N. These results indicate that millet plants, when they receive the maximum recommended nitrogen fertilization, may develop a mechanism to use N for proline synthesis and resistance to saline stress [46].

Contrary to the results obtained in this study, [47] when irrigating the maize crop with brackish water (3.0 dS m^{-1}), found no effect of nitrogen fertilization with 100% of the recommended dose on leaf content, i.e.**,** there was no effect of the interaction between the nutrient and salt stress factors.

Regardless of the salt concentrations in the irrigation water, increasing the doses of N in the substrate led to a reduction in the leaf P content of millet plants (Figure 5B). The reductions, according to the regression analyses, represented 5.04 and 1.8% per unit increase in the doses of N in the substrate for ECw 0.3 and 4.0 dS m^{-1}, respectively.

[48] describe that plants adapt to nutrient levels by altering their gene expression profile, i.e.**,** they modulate nutrient absorption and metabolism in order to process and adapt to environmental conditions. [47] found an isolated effect for ECw levels and N doses on leaf P content in maize, where they found a reduction with increasing ECw and a higher concentration in plants that did not receive fertilization.

Figure 5C, shows that the ECw equations as a function of the increase in N doses in the substrate best fitted the polynomial model and behaved similarly for the leaf Ca content in millet plants. For water with a low salt concentration (0.3 dS m^{-1}), there was an estimated maximum value of 5.53 g kg^{-1} of Ca for a dose of 67.40 Kg ha^{-1} of N. In plants irrigated with brackish water (4.0 dS m^{-1}), there was an estimated maximum value of leaf Ca of 4.93 g kg^{-1} for a dose of 84.20 Kg ha^{-1} of N.

The increase in N doses increased the Ca content in millet leaves in a saline environment, being slightly higher than the control treatment at doses close to 100% of the recommended dose. The millet plants may have developed an antioxidant mechanism driven by the increase in N to tolerate toxic ions such as Na^+ [47,49], or even increased the exchange capacity of the roots in saline environments and favored greater absorption of bivalent ions such as Ca^+ and Mg^+ [50]. [40] studied the interactive effects of salinity and forms of nitrogen on plant growth, photosynthesis and osmotic adjustment in maize and found that there was an increase in the concentration of Ca^{2+} in the presence of NaCl in the nutrient solution regardless of the N source.

With regard to the leaf Mg content in the millet crop (Figure 5D), it was found that the accumulation of Mg showed an approximate response range, regardless of the ECw and doses of N in the substrate, but with the control being superior close to the recommended dose. A similar trend was observed by Sousa et al. (2022), who recorded an increase in leaf Mg content in maize leaves irrigated with brackish water and fertilized with 50% of the N recommendation. One of the main side effects of salinity is to cause nutritional deficiency, but balancing the nutritional status (N, P, K+, Mg2+ and Ca2+) and this adverse effect can be partially corrected through fertilizer management [51].

As can be seen in Figure 5E, the leaf Na content increased in the irrigation water, with the lowest salinity water (0.3 dS m^{-1}) showing the smallest increase compared to the plants irrigated with the highest salinity water. The results show that the increase in N doses in the substrate boosted the accumulation of leaf Na content in millet plants. In addition, the supply of N may have contributed to the synthesis of compatible solute compounds (proline and glycine-betaine), consequently adjusting the osmotic potential of the cytoplasm **[31,52]**. Similar effects were found by [40] in corn. These same authors observed an increase in leaf Na content in plants under salt stress and fertilized with 100% of the nitrogen fertilizer.

For leaf K content as a function of ECw (Figure 5F), the mean comparison test shows that millet plants irrigated with low salinity water (0.3 dS m^{-1}) were statistically superior to plants irrigated with brackish water (4.0 dS m^{-1}). High concentrations of Na can affect the integrity of root cell membranes by replacing Ca+ ions and disrupting the selectivity of transporters, affecting the absorption of K ions and translocation to the aerial part [53].

In line with the present study,[54] found that there was a reduction in leaf K content in the maize crop as the ECw increased. On the other hand,[55] found that there was no significant effect on the K content in the aerial part of the Sorghum bicolor crop, however, plants that were being grown under high soil and water salinity and without leaching showed a decrease in the K content in the root.

5. Conclusions

We concluded that salt stress increased leaf sodium levels and had a negative impact on stalk dry mass and panicle dry, leaf gas exchange, mineral element concentrations (K, P and Ca), and water use efficiency. The use of lower salinity water associated with increased nitrogen fertilization provides greater stalk dry mass and panicle dry, photosynthesis, water use efficiency, chlorophyll index, leaf potassium concentration, and biomass production.

Salt stress negatively affected transpiration, stomatal conductance, leaf P and Ca levels, and increased leaf sodium levels as nitrogen fertilization increased in millet plants grown under pot conditions. These results can be used to create a strategy to reduce the negative impact of salt stress associated with the nutrition of millet plants, using nitrogen fertilization.

Acknowledgments: Acknowledgments are due to the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

Conflicts of Interest: The authors declare to be no conflicts of interest.

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