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Productivity in the peanut under salt stress in soil with a cover of plant mulch[1]

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ABSTRACT - Peanut cultivation in the northeast of Brazil has been badly affected by salts accumulating in the irrigation water; in this respect, the use of plant mulch is one way of mitigating salt stress. The aim of this study was to evaluate the effect of irrigation using brackish water under different mulching strategies on productivity and water use efficiency in the peanut. The experiment was carried out under field conditions in Redenção, in the state of Ceará, in a randomised block design of split-plots with five replications, in which the plots corresponded to two levels of electrical conductivity of the irrigation water (0.8 and 4.0 dS m^{-1}), and the subplots to six mulching strategies based on the phenology of the crop (MS1: mulch throughout the cycle; MS2: flowering stage; MS3: appearance of the gynophore; MS4: pod formation; MS5: final flowering stage; MS6: no mulch). The following were determined at the end of the experimental cycle: commercial, non-commercial and total number of pods, number of grains per pod, pod length and diameter, productivity and water use efficiency. Irrigation with lower-salinity water, together with mulching during the phenological stages of the peanut, affords better productive performance and greater water use efficiency. Salt stress reduced the length and diameter of the pods and had a negative effect on productivity and water use efficiency, both with and without the use of plant mulch during the phenological stages.

Key words: *Arachis hypogaea*. Production. Salinity.

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INTRODUCTION

The peanut (*Arachis hypogaea* L.) belongs to family Fabaceae, and is one of the main agricultural crops in Brazil and in other countries, being among the most important cultivated oilseeds. It is widely used in the food and cosmetic industries and in the production of biofuels, in addition to being consumed fresh (ARRUDA *et al*., 2015; ARYA; SALVE; CHAUHAN, 2015).

In 2021, production in Brazil reached 596.9 thousand kg^{-1}, with a domestic mean productivity of 3,604 kg ha^{-1}. The Northeast is the second largest consumer in the country, with a mean productivity of 796 kg ha^{-1} (COMPANHIA NACIONAL DE ABASTECIMENTO, 2022). Such results for productivity are directly related to the methods of cultivation, where rainfed systems predominate, but are aggravated by the irregular rainfall distribution, high rates of evapotranspiration, and the use of lower quality (brackish) water (CRUZ *et al*., 2021; GUILHERME *et al*., 2021; SOUSA *et al*., 2022).

In semi-arid regions such as the northeast of Brazil, using water of high electrical conductivity is, in many cases, essential to guarantee agricultural production, since these regions suffer from a shortage of good quality water and adverse weather conditions which favour the accumulation of toxic ions (Na^+ and Cl^-) in the soil solution that have a significant adverse effect on productive performance (GOES *et al*., 2021; GUILHERME *et al*., 2021).

Salt stress is one of the most limiting abiotic factors to global agricultural production due to its effects on the soil-water-plant relationship, directly reducing the osmotic potential of the soil, and triggering less water absorption by the plants, in addition to nutritional, physiological and biochemical disorders, and even phytotoxicity in the crops, leading to a reduction in the formation of photoassimilates, and consequently, in productivity (BARBOSA *et al*., 2021; LIMA *et al*., 2020; SOUSA *et al*., 2021).

One alternative that has been used to mitigate salt stress is using a ground cover of plant residue. This environmentally correct conservationist practice has the aim of reducing water evaporation and soil temperature, and maintaining humidity at acceptable levels, thereby avoiding an increase in salt concentrations (CARVALHO; RIBEIRO; GOMES, 2018; COSTA *et al*., 2021; WANG *et al*., 2018).

Studies that revealed the promising effects of plant mulch in saline environments were reported by Canjá *et al*. (2021), who saw how the damaging effects of salt stress on peanut production were mitigated, and water use efficiency was increased, when protecting the soil with a cover of sugarcane bagasse, and by Costa *et al*. (2021), who used crop residue to mitigate the effects of the salinity of the irrigation water in maize.

Given the above, the aim of this study was to evaluate the effect of irrigation using brackish water under different mulching strategies on productivity and water use efficiency in the peanut.

MATERIAL AND METHODS

The experiment was conducted from August to November 2021 in an experimental area on the Piroás Experimental Farm (FEP) of the University for the International Integration of Afro-Brazilian Portuguese (UNILAB), in Barra Nova (04°13’25” S, 38°43’49” W, average altitude of 240 m), in the district of Redenção, microregion of Maciço de Baturité, in the state of Ceará. The climate of the region is type BSh’, with very high temperatures and rainfall predominantly during the summer and autumn (ALVARES *et al*., 2013).

An accumulated rainfall of 34.5 mm was recorded during the experimental period. The air temperature (maximum and minimum) and relative humidity recorded during the experiment are shown in Figure 1.

The soil in the area is classified as a red-yellow Argisol with a sandy-loam texture (SANTOS *et al*., 2018). Before installing the experiment, soil samples were collected and sent to the laboratory to determine the chemical attributes, shown in Table 1, following the methodology described in Teixeira *et al*. (2017).

The adopted design was of randomised blocks (DBC) in a split-plot scheme, with five replications, where the plots corresponded to two levels of electrical conductivity of the irrigation water (ECw: water supply of 0.8 ds m^{-1}, and saline solution of 4.0 dS m^{-1}), and the subplots to different mulching strategies related to the phenological stages of the crop (MS1: mulch throughout the cycle; MS2: flowering stage - 25 DAS; MS3: appearance of the gynophore - 36 DAS; MS4: pod formation - 47 DAS; MS5: final flowering stage - 65 DAS; MS6: no mulch).

Seeds of the BR-1 cultivar from the Valencia group were used, obtained from the germplasm bank of Embrapa Algodão; these have a red colour and are round in shape, with pods having from three to four seeds. Sowing was carried out manually, adopting four seeds per hole, at a spacing of 1.0 m × 0.3 m between the rows and plants, respectively.

Fertilisation was based on the initial chemical analysis of the soil (Table 1) and used organic sources (tanned cattle manure and a biofertiliser of poultry manure), following the recommendation of Fernandes (1993), and comprised 15 kg ha^{-1} N, 62.5 kg ha^{-1} P_2O_5 and 50 kg ha^{-1} K_2O. The chemical characteristics of the organic sources were determined as per the methodology of Teixeira *et al*. (2017), and are shown in Table 2.

The NPK values present in the soil and organic sources were verified (Tables 1 and 2) in order to meet the need for nutrient supplementation of the crop. For the established stand of 33,333.33 plants ha^{-1}, the maximum nutrient dosage per $plant^{-1}$ $cycle^{-1}$ was: 0.45 g N, 1.87 g P_2O_5 and 1.5 g K_2O, respectively. Based on the need for nutrient supplementation and the amount of NPK shown in Table 2, the applied amounts of organic fertiliser are shown in Table 3.

Ten days after sowing (DAS), with the plant stand established, thinning was carried out leaving one plant per hole. At the same time, the different treatments began, irrigating with brackish water and applying the mulch as per each of the adopted strategies. The material used consisted of spontaneous-crop residue from the experimental area, which was applied to the area surrounding the plants (layer of 10 cm).

The water supply (0.8 dS m^{-1}) was used to prepare the saline solution (4 dS m^{-1}), dissolving sodium chloride (NaCl), calcium chloride ($CaCl_2.2H_2O$) and magnesium chloride ($MgCl_2.6H_2O$) at a ratio of 7:2:1 (RHOADES; KANDIAH; MASHALI, 2000) and maintaining the ratio between the ECw and its molar concentration ($mmol_c$ L^{-1} = EC × 10) (RICHARDS, 1954).

Figure 1 - Maximum and minimum temperature and relative humidity during the experimental period

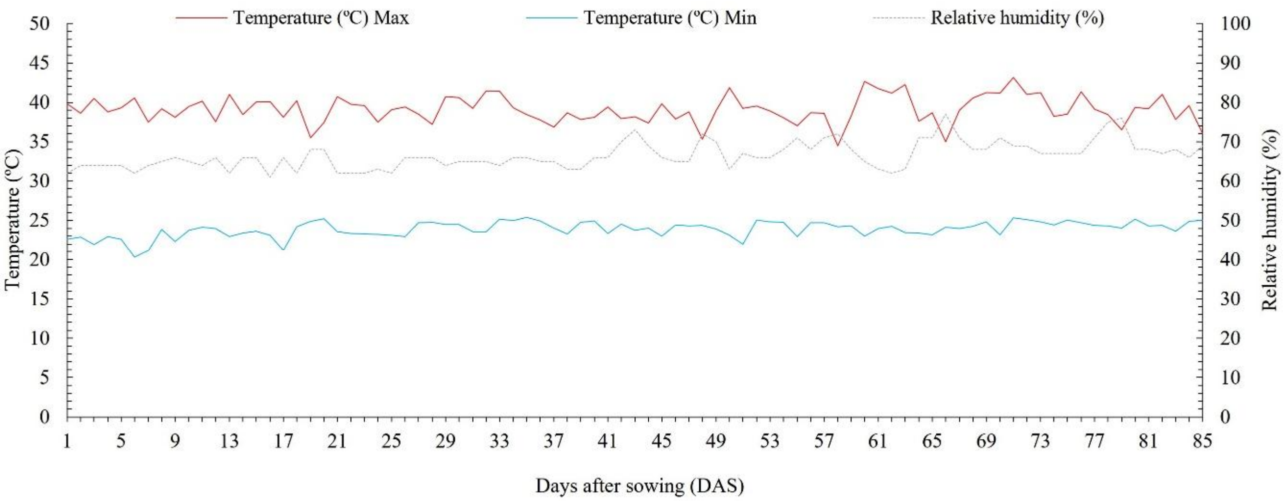


Table 1 - Chemical characteristics before starting the treatments

OM¹	N	P	K^+	Ca^{2+}	Mg^{2+}	Na^+	$H^+ + Al^{3+}$	SB²	ESP³	ECe⁴	pH
g kg^{-1}		mg kg^{-1}	---------------------------- $cmol_c$ kg^{-1} ----------------------------						%	dS m^{-1}	H2O
15.00	0.22	0.90	0.11	5.3	6.5	0.17	0.85	12.08	1.41	0.70	6.12

¹OM - Organic matter; ²SB – Sum of bases; ³ESP - Exchangeable sodium percentage; ⁴ ECe - Electrical conductivity of the saturated soil extract

Table 2 - Chemical characterisation of the organic fertilisers used in the experiment

Organic Source	N	P	K^+
		g L^{-1}	
Cattle manure	0.96	0.47	0.59
Poultry biofertiliser	3.9	0.33	2.5

Table 3 - Amount of organic fertiliser applied to the peanut

Organic Source	Applied Amount
Cattle manure	2.0 kg plant^{-1}
Poultry biofertiliser	6.0 g L^{-1} plant^{-1}

For irrigation, self-compensating drippers with a flow rate of 8 L h^{-1} and a distribution uniformity coefficient (DUC) of approximately 93% were used, spaced 0.3 m between plants. Irrigation management was estimated daily from the reference evapotranspiration (ETo), using data from a Class A evaporimeter pan located close to the experimental area. The potential crop evapotranspiration (PETc) was determined as per Bernardo *et al.* (2019), using Equation 1:

$$PETc = ETo \times Kc \tag{1}$$

where:

PETc - potential crop evapotranspiration (mm day^{-1}); ETo - reference evapotranspiration, estimated using a Class A pan (mm day^{-1}); Kc – crop coefficient.

The accumulated irrigation depth throughout the experimental cycle was determined from the PETc, equal to 532 mm. The following crop coefficients (Kc) were adopted: 0.45 (establishment and vegetative development stage up to 45 DAS), 0.70 (flowering and pod formation from 46 to 55 DAS), and 0.90 (maturation stage from 56 to 90 DAS), as per Silva and Amaral, (2008). An irrigation frequency of two days was adopted, and the time of each irrigation event was determined as per Equation 2:

$$Ti = \frac{PETc \times Sp}{Ei \times q} \times 60 \tag{2}$$

where:

Ti - irrigation time (min); PETc - crop evapotranspiration (mm); Sp - spacing between drippers; Ei - Irrigation efficiency (0.93); q - flow rate (L h^{-1}).

At the end of the experimental cycle (85 DAS) the pods were collected from each working plot and left to dry for 15 days in a protected environment to constant weight. After this period, at 100 DAS, the following variables were determined: number of commercial pods (NCP, in units), by counting the fully formed pods; number of non-commercial pods (NNCP, in units), including those with no seeds; total number of pods (TNP, in units), by a direct count of the pods per plant; pod length (PL, in mm) and pod diameter (PD, in mm), measuring the longitudinal and transverse diameters, respectively, using a digital calliper; pod weight (PW, g), using a 0.01 g precision balance; productivity (PROD) expressed in kg ha^{-1}; and water use efficiency (WUE, in kg ha^{-1} mm^{-1}), from the ratio between the total applied irrigation depth and productivity.

To assess normality, the data were submitted to the Kolmogorov-Smirnov test ($p \leq 0.05$). After verifying normality, the data were submitted to analysis of variance, and when significant by F-test, were submitted to Tukey's test ($p \leq 0.05$), using the Assistat 7.7 Beta software (SILVA; AZEVEDO, 2016).

RESULTS AND DISCUSSION

It can be seen from a summary of the analysis of variance (Table 4) that the interaction of the factors under study (electrical conductivity of the irrigation water × mulching strategies) significantly influenced the number of commercial pods (NCP) and the total number of pods (TNP) at 1% probability, and pod weight (PW), productivity (PROD) and water use efficiency (WUE) at 5% probability. Pod length (PL), pod diameter (PD) and the number of non-commercial pods (NNCP) showed a significant influence (at 1% and 5% probability) for ECw only.

It can be seen from Figure 2 that the number of commercial pods was higher when irrigating with lower-salinity water (0.8 dS m^{-1}) regardless of the mulching strategy, showing statistical superiority compared to the use of water of 4 dS m^{-1}. Furthermore, there was a significant difference between the strategies only when using the water of lower conductivity, highlighting the association of the MS1 strategy (mulch throughout the cycle) with higher values (55 commercial pods); whereas MS5 (mulch from the flowering stage - 65 DAS) showed lower values, with an average of 28 commercial pods.

This result shows that using lower-salinity water throughout the phenological cycle of the crop afforded greater ability to form viable pods. This process can also be influenced by various factors, from morphological characteristics and climate conditions, to the type and form of fertilisation, in addition to the type and/or presence of mulch (RAMAKRISHNA *et al*., 2006; SANTOS, 2000; SOUSA *et al*., 2021).

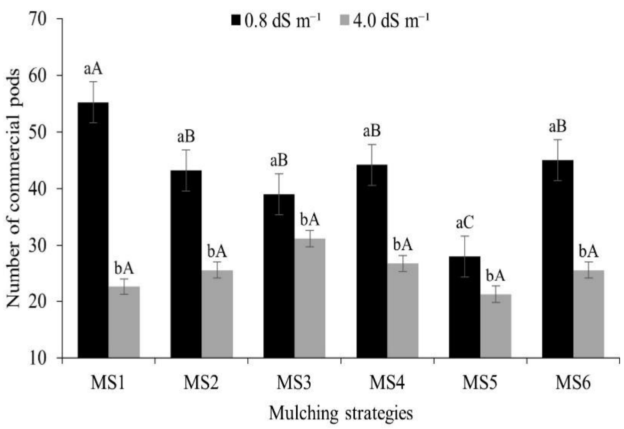
On the other hand, salt stress imposes adverse conditions related to morphophysiological processes, affecting net CO_2 assimilation and causing early leaf

Table 4 - Summary of the analysis of variance and mean values for the variables number of commercial pods (NCP), number of non-commercial pods (NNCP), total number of pods (TNP), pod weight (PW), pod length (PL), pod diameter (PD), productivity (PROD) and water use efficiency (WUE) in the peanut submitted to different mulching strategies and two levels of electrical conductivity of the irrigation water

SV	DF	Mean Square							
		NCP	NNCP	TNP	PW	PL	PD	PROD	WUE
Blocks	4	44.32^{ns}	5.43^{ns}	59.58^{ns}	209.20^{ns}	8.63^{ns}	0.39^{ns}	85941.43^{ns}	0.36^{ns}
ECw (A)	1	4369.07**	21.60*	3776.27**	3530.65**	336.26**	2.46**	1471100.73**	6.80**
Residual (A)	4	37.98	1.31	39.18	79.01	10.69	0.07	61547.58	0.30
MS (B)	5	220.63**	6.27^{ns}	228.11**	107.23^{ns}	4.48^{ns}	0.16^{ns}	88198.24^{ns}	1.12**
Residual (B)	40	28.55	1.02	31.78	107.84	3.97	0.17	52593.29	0.23
ECw x MS	5	211.31**	1.0^{ns}	209.03**	292.42*	6.80^{ns}	0.31^{ns}	138541.83*	0.75*
CV - A (%)	-	18.11	26.82	16.12	22.39	10.63	2.24	25.71	27.01
CV - B (%)	-	15.70	18.05	14.52	26.50	6.48	3.44	23.77	24.06
		-	-	-	g	mm	mm	kg ha^{-1}	kg ha^{-1} mm^{-1}
0.8 dS m^{-1}		42.57	4.20 b	46.77	44.11	33.14 a	12.35 a	1121.47	2.37
4.0 dS m^{-1}		25.50	5.40 a	30.90	28.77	28.41 b	11.94 b	808.29	1.69

SV - Source of variation; DF - Degrees of freedom; CV (%) - Coefficient of variation; *, **, ns - Significant at $p \leq 0.05$, $p \leq 0.01$ and not significant, respectively; ECw – Electrical conductivity of water; MS – Mulching strategies. Mean values followed by the same lowercase letter do not differ statistically by Tukey's test ($p \leq 0.05$)

Figure 2 - Number of commercial pods in the peanut submitted to different mulching strategies and two levels of electrical conductivity of the irrigation water



Lowercase letters compare the mean values of the ECw levels in each mulching strategy, and uppercase letters compare the mean values of the different mulching strategies at the same level of ECw by Tukey's test ($p \leq 0.05$). MS1: mulch throughout the cycle; MS2: flowering stage - 25 DAS; MS3: appearance of the gynophore - 36 DAS; MS4: pod formation - 47 DAS; MS5: final flowering stage - 65 DAS; MS6: no mulch

senescence, reducing photosynthetic capacity due to the reduction in leaf area, generating less production, and compartmentalising photoassimilates, which results in less ability to form viable pods, even when protecting the soil (CANJÁ *et al*., 2021; KHATRI; RATHORE, 2022). Sun *et al*. (2018), however, emphasise that temperature and soil moisture are determining factors of pod formation in the peanut. From this perspective, the absence of stress and the presence of mulch, with its capacity to minimise the effects of climate variation and maintain soil moisture, may have afforded better conditions for pod formation when applied throughout the crop cycle, compared to the other strategies.

Working with the peanut (BR-1 genotype) under irrigation with brackish water and using sugarcane bagasse to protect the soil, Canjá *et al*. (2021) saw a reduction of 13.54% in the number of commercial pods with an increase in the ECw from 0.9 to 5 dS m^{-1}, even when using plant mulch. Similar to the present study, Sun *et al*. (2018), using biodegradable film to protect the soil when cultivating the peanut, saw a reduction of 46.66% in mature (commercial) pods from the absence of any ground cover.

As shown in Table 3, the number of non-commercial pods was greater after irrigation with water of 4.0 dS m^{-1}, presenting a mean value 22% higher than obtained using lower-salinity water.

Salt stress inhibited the formation of commercial pods (full pods, completely formed, with no apparent physical damage and with completely formed grains) caused by an increase in the abortion rate of pods under formation, resulting in a larger number of pods of no commercial value due to morphophysiological and nutritional disorders imposed by increases in the electrical conductivity of the water (CRUZ *et al*., 2021; GOES, *et al*., 2021).

An increase in the number of non-commercial pods was also seen by Canjá *et al*. (2021), who identified a 10% increase in non-commercial pods when irrigating the peanut with brackish water of 5 dS m^{-1} compared to the lower salinity 0.9 dS m^{-1}.

Similar to NCP, it can be seen that for the total number of pods (Figure 3A), irrigation with water of higher salinity, regardless of the time the mulch was applied, caused a reduction of 54%, 36%, 17%, 33%, 23% and 29% for each strategy (MS1, MS2, MS3, MS4, MS5 and MS6), respectively.

In this study, the reduction caused by salt stress may be related to the inherent increase in salt concentration, a result of irrigating with water of inferior quality (brackish) having a negative effect on the emission of reproductive branches, especially related to osmotic and nutritional disorders due to the reduction in water absorption and, consequently, of nutrients, causing a water and nutritional deficit in the peanut under salt stress (SILVA *et al*., 2022; SOUSA *et al*., 2022). Another factor related to the reduced total number of pods may be a result of the crop under adverse conditions investing most of its metabolic activity in stress survival mechanisms, which is a decisive factor for low production parameters (KHATRI; RATHORE, 2022).

A reduction in the total number of pods for increases in the salinity of the irrigation water was reported by Cruz *et al*. (2021) when evaluating the use of saline water applied continuously. The same authors saw a reduction from 46.5 to 29.1 pods per plant, equal to a percentage difference of 37.4%.

Pod weight was significantly reduced with the increase in ECw, regardless of the time the mulch was applied, with different reductions for the different mulching strategies: MS1 - 22.11 g, MS2 - 12.96 g, MS3 - 12.96 g, MS4 - 15.61, MS5 - 11.43 g and MS6 - 23.36 g, between the lowest and highest saline levels (Figure 3B).

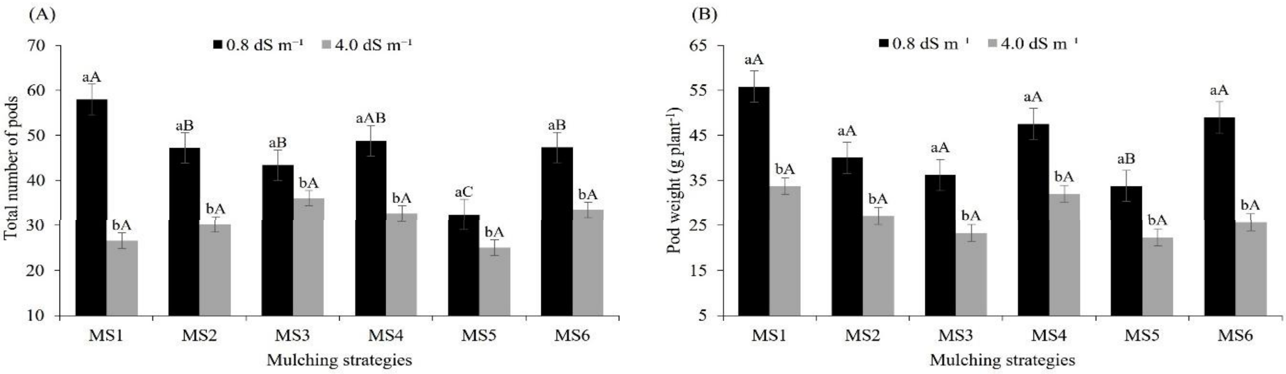
Pod weight followed a similar trend to that of TNP, i.e. the lower-salinity water afforded greater pod weight compared to the higher-salinity water for each of the mulching strategies. Salt stress not only reduces pod formation, but also reduces grain filling, possibly due to the harmful effect of the high salt concentration interfering in the water flow of the plant and in the translocation of photoassimilates and essential elements such as potassium (BARBOSA *et al*., 2021; CANJÁ *et al*., 2021; SILVA *et al*., 2022), even when protecting the soil; it is therefore clear that the mulch was not able to minimise the impacts of salt stress during the pod-filling stage.

Goes *et al*. (2021) found a similar trend to that of this study: pod weight in the peanut was significantly reduced when subjected to a water salinity of 4 dS m^{-1}. When irrigating the peanut with increasing levels of salinity (0.2 to 6.4 dS m^{-1}), Cruz *et al*. (2021) saw a linear reduction in pod weight of 0.66 g per plant for each unit increase in conductivity.

The pods of plants irrigated with higher-salinity water (4 dS m^{-1}) were reduced in length by 16.78% in relation to those irrigated with the water of lower conductivity (0.8 dS m^{-1}), where the mean values for length were 34.14 and 28.41 mm, respectively (Table 3).

This reduction under salt stress can be considered an alternative way of minimising the absorption of saline water, especially Na^+ and Cl^-, since salinity can result in a low osmotic potential, a reduction in the relative water content, and extend the productive aspects (LIMA *et al*., 2014, 2020). Studies by Goes *et al*.

Figure 3 - Total number of pods (A) and pod weight (B) in the peanut submitted to different mulching strategies and two levels of electrical conductivity of the irrigation water



Lowercase letters compare the mean values of the ECw levels in each mulching strategy, and uppercase letters compare the mean values of the different mulching strategies at the same level of ECw by Tukey's test ($p \leq 0.05$). MS1: mulch throughout the cycle; MS2: flowering stage - 25 DAS; MS3: appearance of the gynophore - 36 DAS; MS4: pod formation - 47 DAS; MS5: final flowering stage - 65 DAS; MS6: no mulch

(2021), working with the peanut under irrigation with brackish water of 4.0 dS m^{-1}, corroborate the results of the present study, i.e. irrigation water of greater electrical conductivity caused a reduction in pod length in the peanut.

Similar to pod length, pod diameter was also slightly reduced with the increase in electrical conductivity of the irrigation water, with mean values of 12.35 and 11.94 mm for 0.8 and 4 dS m^{-1} respectively, equal to a reduction of 3.32% (Table 3).

Biochemical, physiological, morphological and anatomical changes in response to the presence of salts in the irrigation water tend to occur as a strategy for acclimatising the plant to the submitted stress conditions, including influencing the formation of pods, as well as a reduction in their diameter (GUILHERME *et al*., 2021; KHATRI; RATHORE, 2022). Guilherme *et al*. (2021), working with the peanut under salt stress (ECw: 4.0 dS m^{-1}), found a reduction in pod diameter due to irrigating with saline water.

Regardless of when the mulch was applied, productivity in the peanut was significantly reduced with the increase in the electrical conductivity of the irrigation water from 0.8 to 4 dS m^{-1}, showing a mean reduction of 34% from the lowest to the highest conductivity. However, the highest productivity (1,431.87 kg ha^{-1}) was obtained with the water of the lowest conductivity associated with MS1. On the other hand, the treatment using higher-salinity water with no mulching resulted in lower productivity (619.49 kg ha^{-1}).

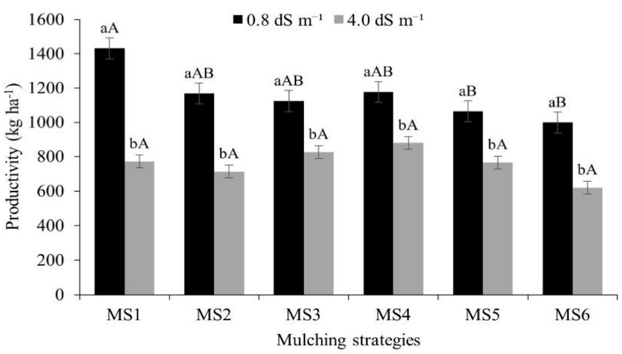
According to Companhia Nacional de Abastecimento (2022), the productivity data from this study are below the average for the state of Ceará (1,158 kg ha^{-1}) and for the country (3,604 kg ha^{-1}). This performance is possibly related to the salt stress imposed on the crop and the fertiliser used (organic), i.e. under these conditions, the crop was unable to express its maximum genetic potential.

It can be seen that, due to the adaptation mechanisms employed, salt stress had a similar negative effect in the presence and absence of plant mulch; the plants under these conditions tend to expend metabolic energy in an attempt to adapt to the increase in salinity. Furthermore, a high level of salinity reduces the absorption of water and of essential nutrients, with a direct effect on productivity, as reported by Costa *et al*. (2021) and Sousa *et al*. (2022). A reduction in productivity with an increase in the electrical conductivity of the irrigation water was also found by Goes *et al*. (2021), working with the peanut irrigated with water of increasing salinity (1 and 4 dS m^{-1}).

Working with the same genetic material as in the present study (genotype BR-1), Canjá *et al*. (2021), obtained a similar response for productivity, i.e. a reduction from irrigating with brackish water (5 dS m^{-1}), whether the soil was protected or not with plant mulch (sugarcane bagasse).

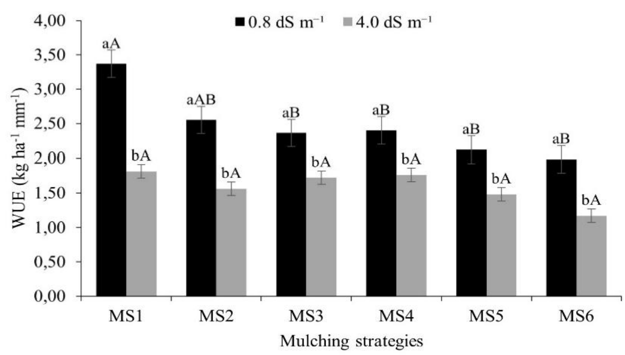
Water use efficiency in the peanut was greater using soil protection throughout the cycle and irrigating with lower-salinity water (0.8 dS m^{-1}), with an increase of 2.2 kg ha^{-1} mm^{-1} compared to the lowest efficiency obtained (MS6 × ECw: 4 dS m$_{-1}$). It can still be seen that the increase in ECw afforded a similar reduction in WUE for each of the mulching strategies, with no significant differences (Figure 5).

Figure 4 - Productivity in the peanut submitted to different mulching strategies and two levels of electrical conductivity of the irrigation water



Lowercase letters compare the mean values of the ECw levels in each mulching strategy, and uppercase letters compare the mean values of the different mulching strategies at the same level of ECw by Tukey's test ($p \leq 0.05$). MS1: mulch throughout the cycle; MS2: flowering stage - 25 DAS; MS3: appearance of the gynophore - 36 DAS; MS4: pod formation - 47 DAS; MS5: final flowering stage - 65 DAS; MS6: no mulch

Figure 5 - Water use efficiency in the peanut submitted to different mulching strategies and two levels of electrical conductivity of the irrigation water



Lowercase letters compare the mean values of the ECw levels in each mulching strategy, and uppercase letters compare the mean values of the different mulching strategies at the same level of ECw by Tukey's test ($p \leq 0.05$). MS1: mulch throughout the cycle; MS2: flowering stage - 25 DAS; MS3: appearance of the gynophore - 36 DAS; MS4: pod formation - 47 DAS; MS5: final flowering stage - 65 DAS; MS6: no mulch

The presence of mulch throughout the cycle resulted in greater efficiency, e.g. the sooner the mulch was applied, the greater the ability to use water more efficiently for production, especially in relation to the ability for continuous water maintenance and reducing losses from evaporation when protecting the soil (WANG *et al*., 2018).

From the reductions found, it can be seen that the negative effects of salinity were significant on both production and water use efficiency regardless of the mulching strategy employed, demonstrating the harmful effects of salinity, possibly associated with a reduction in osmotic potential. As a result, the plant absorbs less water due to the low suction pressure for overcoming the osmotic pressure (BARBOSA *et al*., 2021; SOUSA *et al*., 2021), capturing fewer essential nutrients for maintaining production. In addition, the similarity of WUE between strategies under salt stress shows that the residue of spontaneous crops may not contribute to the dilution of salts in the root zone.

In contrast to the results obtained in the present study, Canjá *et al*. (2021), cultivating the BR-1 peanut in pots, obtained greater WUE under irrigation with saline water (5 dS m^{-1}) and mulch, being 26.5% higher compared to the absence of mulch of plant origin.

CONCLUSIONS

1. Irrigation with lower salinity water together with mulching during the different phenological stages of the peanut affords better performance in terms of productivity and water use efficiency;

2. Salt stress had a negative effect on the number of commercial pods, the number of total pods, pod weight, productivity and water use efficiency in the peanut both with and without mulching during the various phenological stages;

3. The use of higher-salinity water reduced pod length and pod diameter in the peanut.

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