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Vol. 11(44), pp. 4470-4479, 3 November, 2016
DOI: 10.5897/AJAR2016.11568
Article Number: F034D0261473
ISSN 1991-637X
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African Journal of Agricultural Research

Full Length Research Paper

Growth indexes, production and tolerance of peanut irrigated with saline water and bovine biofertilizer

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Received 17 August, 2016; Accepted 14 October, 2016

Peanut (*Arachis hypogaea*) is one of the most cultivated oil plant worldwide since it is widely consumed as food. In this sense, this work aims to evaluate the growth, production and tolerance of peanuts under the effect of different levels of electrical conductivities in irrigation water and bovine biofertilizer. The experiment was conducted in a greenhouse located at the State University of Paraíba - Campus IV, municipality of Catolé do Rocha, Paraíba, Brazil. The experimental design was completely randomized with a factorial arrangement of 4 x 2, with six repetitions. There are two treatments: the first consisted of the combination of the electrical conductivity (ECw) of 0.5; 1.5; 3.0 and 4.5 dS m^{-1} in irrigation water and the second is the application of bovine biofertilizer (with and without). Absolute growth rates and relative plant height, stem diameter and leaf area, number of pods per plant, 100 seed weight, number of seeds per plant, seed weight, seed mass + grains, root dry mass, shoot and total and tolerance index were assessed. From the results obtained, it can be concluded that the electrical conductivity of the irrigation water from 0.5 dS m^{-1} significantly reduced the growth and production of *A. hypogaea*, however the application of bovine biofertilizer increased the results obtained.

Key words: *Arachis hypogaea* L., salinity, organic input.

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is an important plant cultivated in large scale because of the great variability of products which it originates, especially in food and oil production (Duarte et al., 2013). In addition, the culture excels in crop production because its morphological and physiological characteristics help it to adapt well to dry

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soil. In the Northeastern region of Brazil, peanut is largely grown in family farming. However, there are great risks in its cultivation, due to the low rainfall in this region, which results in water deficit and low availability of good quality water (Graciano et al., 2011).

In order to raise the productivity of crops, several factors must be met, including the irrigation water quality; and among the characteristics that determine the irrigation water quality, soluble salts or salinity concentration is one of the main factors limiting the growth and development of some crops (Bezerra et al., 2010). In addition, irrigation management is a crucial factor in the preservation of natural resources, as it negatively affects the soil and can creat soil salinity.

One of the main challenges in agricultural production today is the development of cultural management techniques that allow the use of lower quality water in agriculture, once soil salinity or water negatively affects the development of plants at different stages (Guimarães et al., 2013). Thus, the use of organic inputs, such as bovine biofertilizer can be an alternative to reduce deleterious effects of salt stress as well as to make possible the cultivation of plants in saline environments.

Several studies have shown the harmful effects of saline irrigation water on the peanut crop (Correia et al., 2009; Graciano et al.; 2011; Santos et al., 2012; Sousa et al., 2012) and other oilseeds like castor bean (Nobre et al., 2013, 2014; Santos et al., 2013; Lima et al., 2014; Sá et al., 2016;), jatropha (Oliveira et al., 2013), sunflower (Morais et al., 2011; Maciel et al., 2012), and legumes like beans (Neves et al., 2008; Garcia et al., 2010; Bezerra et al., 2010; Aydin et al., 2012). However, most studies have not shown the effect of biofertilizers as a way to mitigate the effects of salt stress on peanuts, mainly in the reproductive phase.

The positive effects of organic inputs in the recovery of saline soils have been demonstrated (El-Dardiry, 2007; Miranda et al., 2011), including bovine biofertilizer. It has a positive action by improving the soil quality in terms of aeration, dynamic air and water in soil (Mavi et al., 2012), also by the possibility of complex substances derived from the organic matter to mitigate depressive effects of water salinity on plants (Aidyn et al., 2012). Furthermore, bovine biofertilizer has a positive action, presenting in its composition many beneficial substances including humic substances which promote the reduction of the osmotic potential of soil solution and thus stimulate the uptake of water and nutrients by plants in salty environments.

This study aims to evaluate the growth, production and tolerance of peanuts under the effect of electrical conductivities in irrigation water and bovine biofertilizer.

MATERIALS AND METHODS

The experiment was conducted from September to December 2015 in the Humanities and Agricultural Sciences Center, Department of Agricultural and Exact State University of Paraíba (UEPB), Catolé do Rocha-PB, Brazil (6° 20'38 " S, 37° 44'48 "W); its altitude is 275 m. The climate of the city, according to Köppen classification, is BSW' type, that is, hot and dry steppe; its average monthly temperatures exceed 18°C throughout the year.

The experimental design was completely randomized with a factorial arrangement of 4 x 2, with six repetitions. There are two treatments: the first consisted of the combination of the electrical conductivity (ECw) of 0.5; 1.5; 3.0 and 4.5 dS m^{-1} in irrigation water and the second is the application of bovine biofertilizer (with and without). The experimental units consisted of two plants grown in pots with a capacity of 15 dm^3.

The water used for irrigation showed an electrical conductivity of 1 dS m^{-1}. The water analysis was carried out by the Irrigation and Salinity Laboratory (LIS) of the Center for Technology and Natural Resources of the Federal University of Campina Grande – UFCG. It had the following chemical characteristics: pH (H_2O) = 7.53; Ca^{2+} = 2.30 $cmol_c dm^{-3}$; Mg^{2+} = 1.56 $cmol_c dm^{-3}$; Na = 4.00 $cmol_c dm^{-3}$; K^+ = 0.02 $cmol_c dm^{-3}$; chloride = 3.90 $cmol_c dm^{-3}$; carbonate = 0.57 $cmol_c dm^{-3}$; bicarbonate = 3.85 $cmol_c dm^{-3}$; RAS = 2.88 $(mmol_c l^{-1})^{1/2}$.

A soil classified as Fluvent sandy clay loam texture was used. Samples were collected from 0-20 cm layer in native area located on the campus of UEPB. The soil sample used for filling the polyethylene vessel was removed and a subsample was chemically analyzed. The following characteristics were obtained: Ca^{2+} = 4.63 $cmol_c dm^{-3}$; Mg^{2+} = 2.39 $cmol_c dm^{-3}$; Na^+ = 0.30 $cmol_c dm^{-3}$; K^+ = 0.76 $cmol_c dm^{-3}$; SB = 8.08 $cmol_c dm^{-3}$; H^+ = 0.00 $cmol_c dm^{-3}$; Al^{3+} = 0.00 $cmol_c dm^{-3}$; cation exchange capacity = 8.08 and organic matter = 1.88 g kg^{-1}.

The biofertilizer was obtained by anaerobic fermentation, that is, in a hermetically sealed environment. To release methane at one end of a thin hose, the upper base of each digester was coupled and the other end was immersed in a container of water. For the preparation of biofertilizer we used 70 kg of manure from dairy cows and 120 L of water; 5 kg of sugar and 5 L of milk were added to speed up the metabolism of the bacteria (Silva et al., 2012).

The biofertilizer was applied 15 days after emergence at 10% of the volume of the vessels, and later in 15 - day interval, 6 applications were made. Prior to application, the biofertilizer was subjected to screening and filtering process to reduce the risk of clogging of the sieve watering holes. The biofertilizer was analyzed and had the following chemical characteristics (Table 1).

The different levels of electrical conductivity of water (ECw) were obtained by the addition of sodium chloride (NaCl) water from the local supply system according to Rhoades et al. (2000), and the quantity of salts (Q) was determined by the following equation: Q (mg L^{-1}) = ECw x 640, wherein ECw (dS m^{-1}) is the desired value of electric conductivity. Water chosen as control - S_1 (0.5 dS m^{-1}) stems from an Amazonas well of supply, located near the experimental area UEPB. Treatments with the different electrical conductivities of irrigation water began 15 days after emergence and until harvest.

Seeds were sown directly into pots with 3 in each pot. They emerged in 15 days, and were thinned to only the strongest plant. The growth of peanut was assessed at 30, 70 and 90 days after sowing (DAS) by measuring height of the plant, number of leaves, stem diameter and leaf area. From the monthly average values of plant height, stem diameter and leaf area, their respective absolute growth rate (AGR), relative growth rates (RGR) and shoot root ratio were calculated according to Benincasa (2003).

At 90 DAS during harvest, the number of pods per plant, 100 seed weight, number of seeds per plant, seed weight, seed mass + grains were also evaluated. In addition, there were also evaluated the dry mass of root, shoot and total dry mass. The dry matter of root, stem, shoot and total were determined after fresh weight was obtained for approximately 48h. They were circulated in air at 60°C

Table 1. Chemical attributes of liquid biofertilizers used in the experiment. Catolé do Rocha-PB, UEPB 2015.

Chemical properties	Obtained values
pH	4.68
EC (dS m^{-1})	4.70
Nitrogen (%)	1.00
Phosphorus (mg dm^{-3})	296.20
Potassium ($cmol_c dm^{-3}$)	0.71
Calcium ($cmol_c dm^{-3}$)	3.75
Magnesium ($cmol_c dm^{-3}$)	3.30
Sodium ($cmol_c dm^{-3}$)	1.14
Sulfur ($cmol_c dm^{-3}$)	14.45

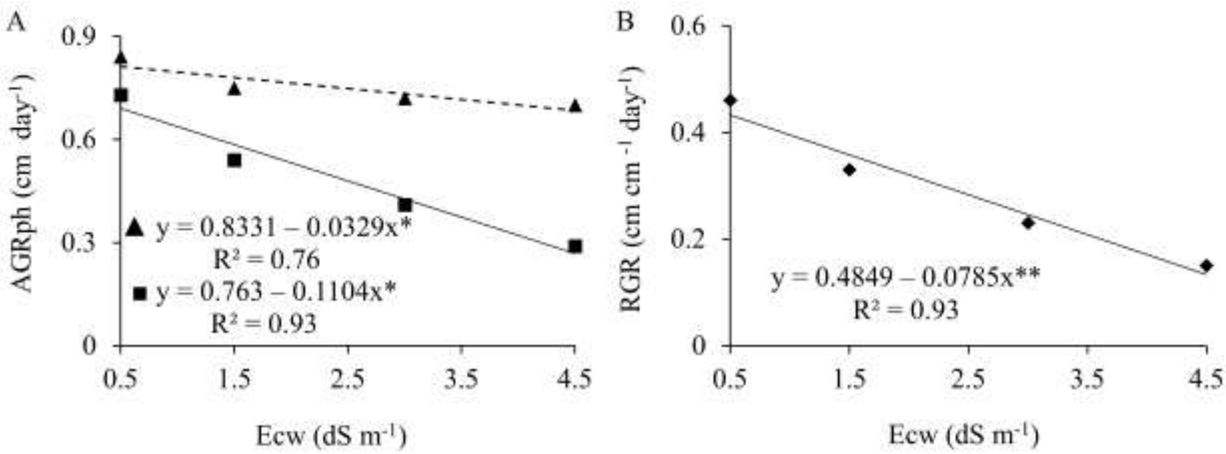

Figure 1. Absolute growth rate - AGRph (A) at 30 to 70 days after sowing (DAS) and relative - RGRph (B) high peanut under the effect of electrical conductivity irrigation water (▲) and without (■) bovine biofertilizer.

until a constant weight was obtained. Then they were weighed on a precision scale of 0.0001. The total dry matter production data were used to calculate the percentages partitioned between vegetative organs and the rate of salinity tolerance, comparing the data from saline treatments with the control (ECw = 0.5 dS m^{-1}) according to the methodology of Aquino et al. (2007).

Data were evaluated by analysis of variance of F test at 0.05 and 0.01 probability; and for significance, there was linear and quadratic polynomial regression analysis using the statistical software SISVAR 5.0 (Ferreira, 2011).

RESULTS AND DISCUSSION

There was a significant effect of electrical conductivity in irrigation water (ECw) on all variables except for the relative growth rate of plant height (RGRph) at 70 to 90 DAS; absolute growth rate (AGRsd) and relative growth rate (RGRsd) at 70 to 90 DAS. The biofertilizer was only significantly effective on the absolute growth rate in the plant height (AGRph) at 70 to 90 DAS.There was noticed a significant effect of ECw x bovine biofertilizer interaction on AGRph and RGRsd variables at 30-70 DAS and on AGRph at 70 to 90 DAS.

The ECw negatively influenced the absolute growth rate of the plant height (AGRph) at 30to 70 DAS, showing a decrease of 0.0329 cm day^{-1} when the plants received bovine biofertilizers; when without bovine biofertilizer was not applied, there was a reduction of 0.1104 cm day^{-1} (Figure 1A). It was also observed that most AGRph was obtained in plants irrigated with water of 0.5 dS m^{-1} at 0.84 cm day^{-1} and bovine biofertilizer; there was lower AGRph when the plants were irrigated with water of 4.5 dS m^{-1} and when bovine biofertilizer was not applied. This occurred at a rate of 0.29 cm day^{-1}.

For the relative growth rate of plant height (RGRph), linear decrease of 0.0785 cm cm^{-1} day^{-1} per unit

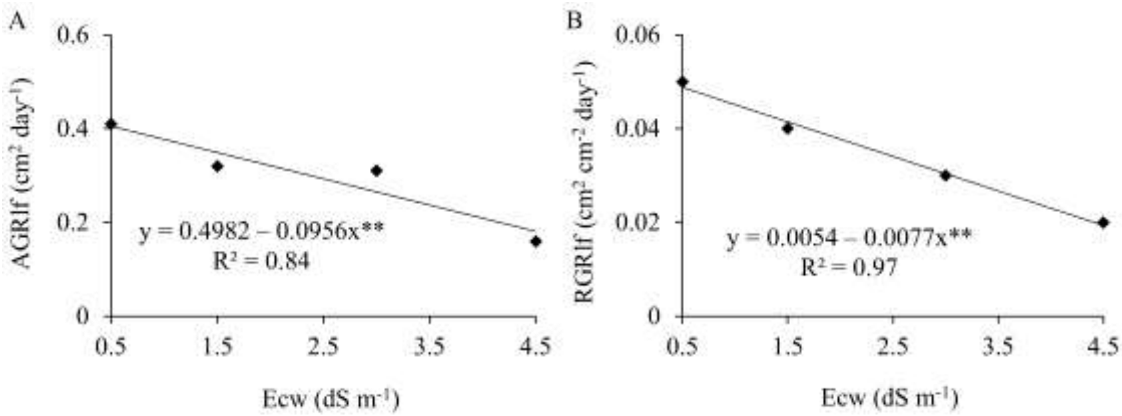

Figure 2. Absolute growth rate - AGRlf (A) and relative - RGRlf (B) of peanuts leaf area under the effect of electrical conductivity of irrigation water in the period 30-70 days after sowing (DAS).

increased ECw at 30-60 DAS. The largest RGRph was obtained when the plants were irrigated with water of 0.5 dS m^{-1}; its value was 0.46 cm^{-1} day^{-1} cm, while the lowest was 0.15 cm RGRph cm^{-1} day^{-1} when the plants were irrigated with water of 4.5 dS m^{-1} (Figure 1B).

Several studies have shown that salinity reduces absolute growth rate and relative plant height. This was observed in the culture of castor bean by Lima et al. (2014), who found that AGRph of castor bean decreased with increasing ECw, reaching a 2.47 cm day^{-1} with water of 0.3 dS m^{-1}. Nobre et al. (2014) found that RGRph had a linear increase in the order of 1.63% per unit increase in the ECw, that is, increment of 6.52% on RGRph plants irrigated with water of 4.4 dSm^{-1} as compared to the control (0.4 dS $m^{-1).}$

One of the causes of reduction in growth rate is decreased turgor of the plant, possibly by reducing the size of plants and leaves; thus plants decrease radiation gathering area, absorb less nutrients from the soil and make less CO_2 exchange with the environment. This reduces their photosynthetic potential and consequently their productivity (Ávila et al., 2007).

It was observed that the ECw exerted significant effects on absolute growth rate (AGRlf) and relative (RGRlf) of leaf area of peanut plants at 30-70 DAS, where there was reduction of 0.0956 cm² day^{-1} (Figure 2A) for AGRlf cm^2 and 0.0077 cm^{-2} day^{-1} (Figure 2B) with increasing ECw, respectively. So, the highest values (0.41 cm² day^{-1} to AGRlf and 0.05 cm² cm^{-2} day^{-1} to RGRlf) were obtained when the plants were irrigated with water of low salinity (0.5 dS m^{-1}) than those irrigated with water of 4.5 dS m^{-1}.

Santos et al. (2013) found that AGRlf of castor bean was decreased with increasing ECw. They obtained the highest AGRlf (194 cm^2 day^{-1}) under irrigation water of 0.12 dS m^{-1} and -51.4 cm^2 day^{-1} and irrigation water of high salinity (4.8 dS m^{-1}). The same authors reported that the AGRlf was not affected by the saline of irrigation water; however, it affects negatively the regression model as a function of cultivation time for 80 DAE growth rate - 0.01 cm^2 cm^{-2} day^{-1}.

The reduction in growth rate is caused by decreasing turgor, where as, small decreases in the water content and turgor can reduce growth rate or even prevent it completely (Echer et al., 2010). Furthermore, the decrease in relative growth rate of leaf area is also caused by the deleterious effect of the excess salts in the plant metabolism (Santos et al., 2013).

As the regression equation shows in Figure 3A, the model to which the best data were set was linear. In it, one can see a reduction in the absolute growth rate of stem diameter (AGRsd) (0.0072 mm day^{-1}) based on a unit increase of ECw; the maximum value obtained was 0.061 mm day^{-1} when plants were irrigated with 0.5 dSm^{-1} water. As for the relative growth rate of stem diameter (RGRsd), it can be observed a significant effect of the interaction between ECw x bovine biofertilizer. The reductions were 0.0008 mm mm^{-1} day^{-1} in plants that received biofertilizer and 0.0016 mm mm^{-1} day^{-1} without biofertilizer (Figure 3B).

Santos et al. (2013) found that AGRsd was reduced with increasing irrigation water salinity, which obtained the highest rate at 80 DAE with 4.8 dS m^{-1} getting 2.95 and 0.006 mm day^{-1} when the plants were irrigated with water of low salinity (0.12 dS m^{-1}). For RGRsd, the same authors observed a decrease during the evaluation period, regardless of the salt content of irrigation water, which obtained the highest relative growth rate in stem diameter of 0.03 mm mm^{-1} day^{-1} in irrigated plants with low salinity water (0.12 dS m^{-1}) and water of higher salinity; the growth rate of stem diameter was 0.02 mm mm^{-1} day^{-1}.

It was observed that ECw had negative influence on absolute growth rate of plant height (AGRph) at 70-90 DAS; increased water salinity decreased the AGRph

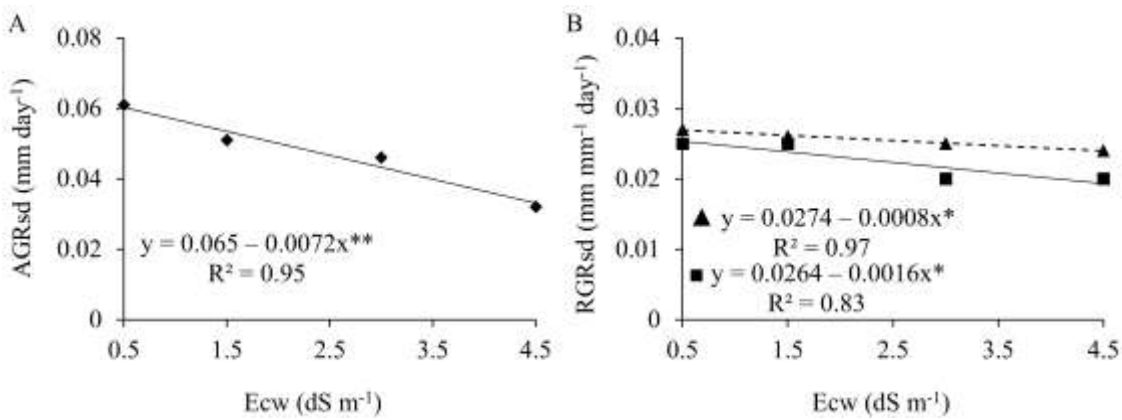

Figure 3. Absolute growth rate - AGRlf (A) and relative - RGRlf (B) diameter of peanut under the effect of electrical conductivity of stem of irrigation water with (▲) and without (■) bovine biofertilizer in the period from 30 to 70 days after sowing (DAS).

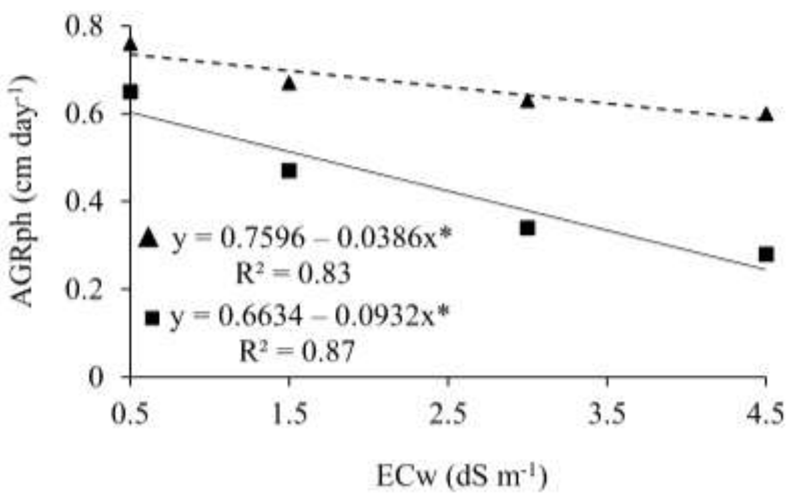

Figure 4. Absolute growth rate of plant height - AGRph peanuts in the electrical conductivity effect of plant irrigation water with (▲) and without (■) bovine biofertilizer in the period 70-90 days after sowing (DAS).

0.0386 and 0.0932 cm day^{-1} per unit increase of ECw on the treated plants with and without bovine biofertilizer, respectively. However, in irrigation water of low salinity (0.5 dS m^{-1}), plants that received bovine biofertilizer were superior in the results obtained (0.76 cm day^{-1}); while in irrigation water with high salinity (4.5 dS m^{-1}) and without bovine biofertilizer, lower values (0.28 cm day^{-1}) were noticed (Figure 4).

One of the deleterious effects of salinity is the reduction of plant growth. Therefore, one of the parameters used to evaluate the effects of salinity is the growth rate of the plant's ability to tolerate this stress (Correia et al., 2009; Garcia et al., 2010). Furthermore, salinity inhibits the growth of the plant height, stem diameter, leaf area, causing negative effects on absolute growth rate of each of the respective variables (Santos et al., 2013).

ECw exerted significant effects on absolute growth rate (AGRlf) and relative (RGRlf) of peanut leaf area at 70-90 DAS; there was a reduction with increasing ECw in the order of 0.0075 cm² day^{-1} (Figure 5A) for AGRlf and 0.0074 cm² cm² day^{-1} (Figure 5B) for AGRlf. When the peanut plant was subjected to ECw of 4.5 dS m$^{-1,}$ its AGRlf and RGRlf were lower compared to plants irrigated with low saline water (0.5 dS m^{-1}).

One of the parameters used to evaluate the effects of salt stress and plant capacity to overcome salinity is the growth rate and biomass production, since plant growth processes are particularly sensitive to salts (Morais et al.,

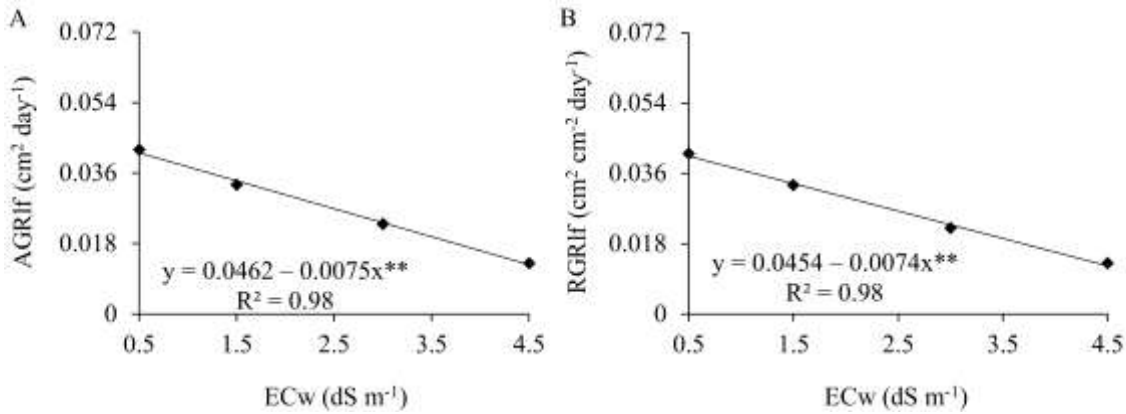

Figure 5. Absolute growth rate - AGRlf (A) and relative - RGRlf (B) of leaf area peanuts under the effect of electrical conductivity of irrigation water in the period 70-90 days after sowing (DAS).

2011). Reductions in relative growth rate of leaf area are mainly due to the effect of excess salts on plant metabolism (Santos et al., 2013).

ECw has significant effect on the variables; bovine biofertilizer had a significant effect on seed weight and tolerance index. There was also significant effect of ECw x B interaction on the variables, number of pods, weight of 100 seeds (W100S), number of seeds, seed mass and index of tolerance (IT).

It is shown in Figure 6A that the number of pods was reduced by increasing ECw; plants irrigated with water of 4.5 dS m^{-1} without bovine biofertilizer (6.5 pods) had low values; while maximum value (25.5 pods) was obtained when the plants were irrigated with low salinity water (0.5 dS m^{-1}) under bovine biofertilizer. For number of seeds (Figure 6B), the irrigation water of 4.5 dS m^{-1} linearly decreased this parameter; the lowest values of 20 seeds were obtained from the plants treated without bovine biofertilizer, and the largest number of seeds (54.5) was obtained in plants irrigated with water of 0.5 dS m^{-1} and treated with bovine biofertilizer (Figure 6B).

Correia et al. (2009) found that salinity significantly affects the number of peanut fruits, with a total reduction of 36% in higher salinity irrigation water (ECw = 6.0 dS m^{-1}). Salt stress reduces plant growth, causing a decrease in osmotic potential and/or excessive accumulation of ions in the plasma and may induce ionic toxicity, nutritional imbalance or both. Thus, in order for the plants to adapt, the size of the leaves, transpiration surface and the exposed area to capture radiation were reduced. Thus, lower plants have less transpiration capacity, less potential to absorp nutrients from the soil solution and lower CO_2 exchange with the environment. This reduces their photosynthetic potential, and as a result, a lower plant productivity is noticed (Garcia et al., 2010).

Due to the presence of humic substances in bovine biofertilizer, as humic acids, a higher grain yield was registered when plants were treated with organic feedstock, since these substances increase cell division; and the permeability of cell membranes thus provides greater absorption of water and nutrients for plants exposed to salt stress and increased production of fruits (Khaled and Fawy, 2011).

Plants grown under saline water are likely to originate from seeds with low physiological quality. However, studies show that it does not happen often. It is essential for these data, since producers living in regions with a shortage of good quality water can use saline water for irrigation (Dantas et al., 2015). Moreover, the application of organic inputs, such as bovine biofertilizer can increase water retention capacity, soil aggregation and reduce bulk density (Mgbeze and Abu, 2010).

ECw negatively influenced the weight of 100 seeds (W100S) and seed mass of peanut plant. The regression equations show the data are linear, indicating a decrease of 4.05 g 8 48 g in 100 seed weight (Figure 7A) on the treated plants with and without biofertilizer, respectively and 2.96 and 4.68 g in seed weight (Figure 7B) in plants treated with and without biofertilizer, respectively. The biggest gains in W100S and seeds mass occurred in plants irrigated with low salinity water (0.5 dS m^{-1}), with 74.3 (W100S) and 63.75 g seeds mass.

Correia et al. (2009) found that the weight of 10 seeds had a total decrease of 78.3% in ECw 6.0 dS m^{-1} in peanuts. The same authors associated these results to the deleterious effects of irrigation water salinity on the physiology of the plant. It promoted metabolic disorders, especially in relation to the absorption of water and nutrients from the soil, reduced leaf area, resulting in less photosynthetic surface area and lower crop yield. In the case of bean seeds, Neves et al. (2008) observed that irrigation with saline water (ECw 5.0 dS m^{-1}) started after germination and until the end of the bean cycle it did not influence the weight of 100 seeds.

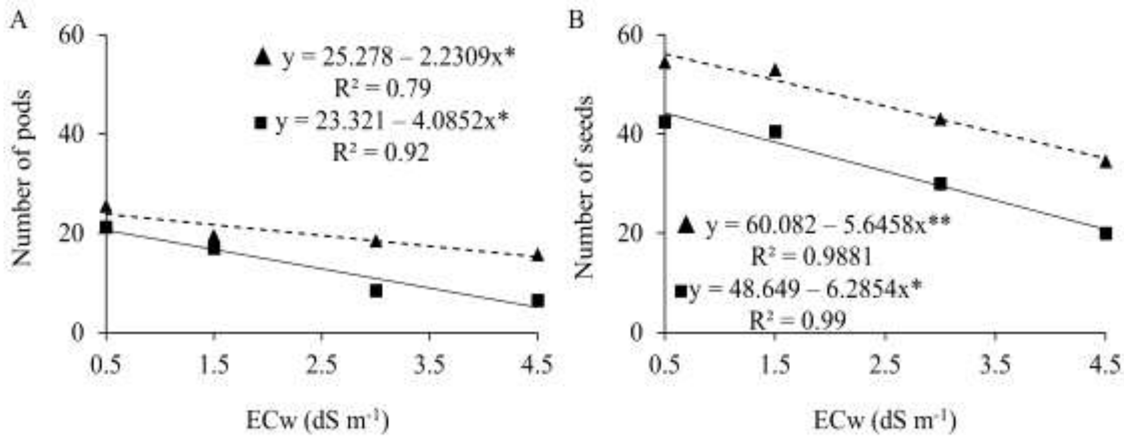

Figure 6. Number of pods (A) and seeds (B) under the effect of peanut electrical conductivity of the irrigation water with (▲) or without (■) bovine biofertilizer.

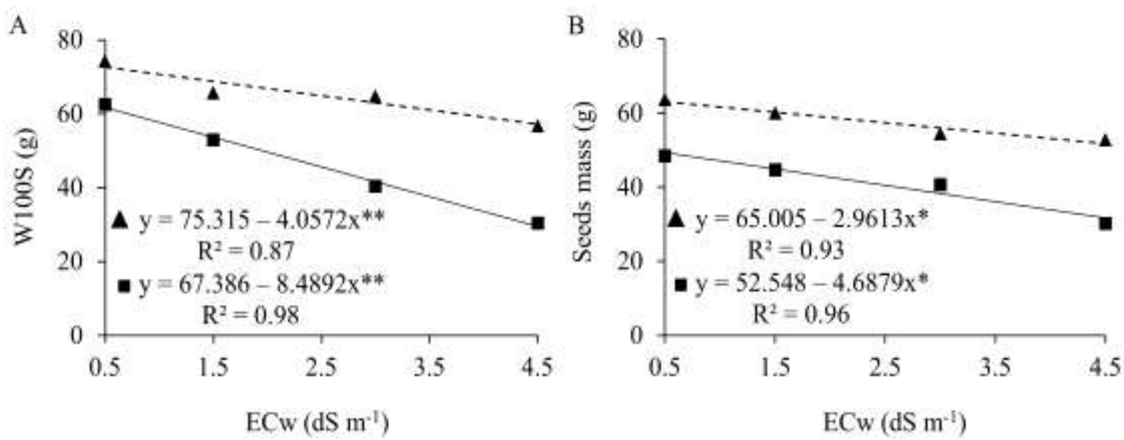

Figure 7. Weight of 100 seeds (A) and seed mass (B) of peanut under the effect of electrical conductivity of irrigation water with (▲) and without (■) bovine biofertilizer.

This increase in weight of 100 seeds and seed mass can be attributed to the beneficial action of bovine biofertilizer, as the organic feedstock operates in the physical improvement of the soil for root growth systems, as discussed by Mgbeze and Abu (2010) and Benbouali et al. (2013) and also to improve soil biological activity (Cha-Um and Kirdmanee, 2011).

It is observed that the mass of pods + grain (Figure 8A) showed a significant effect when subjected to different ECws and behaved linearly in decreasing order. It had minimum values in higher salinity levels (value 3.73 g); each unit increase in ECw levels decreased in the order of 0.55 g.

Regarding the plant dry matter (Figure 8B), a significant effect of ECw on root dry mass (RDM), shoot dry mass (SDW) and total dry mass (TDM) was registered, so that by increasing the ECw levels observed parameters decreased in the order of 1.56 g (RDM), 6.14 g (SDW) and 7.70 g (TDM). When the plants were irrigated with low salinity water (0.5 dS m^{-1}) there were shown the highest values of 14.23 g (RDM), 35.66 g (SDW) and 49.9 g (TDM) while under irrigation with high salinity (4.5 dS m^{-1}) lower values of 8.6g (RDM), 20.76 g (SDW) and 29.36 g (TDM) were observed.

The root dry mass, shoot dry weight, total dry mass and dry mass of pods + peanut kernels were reduced with increasing ECw (Santos et al., 2012). Sousa et al. (2012) studied the salt stress in peanut crop and concluded that the high concentration of salts in irrigation water reduced the root dry matter at 45 days after sowing. Graciano et al. (2011) found that root dry mass showed a significant increase of 84, 60 and 58% in plants subjected to treatments of 3.5, 6.0 and 8.5 dS m^{-1} EC, respectively, compared to control (ECw 1.0 dS m^{-1}); however, for the

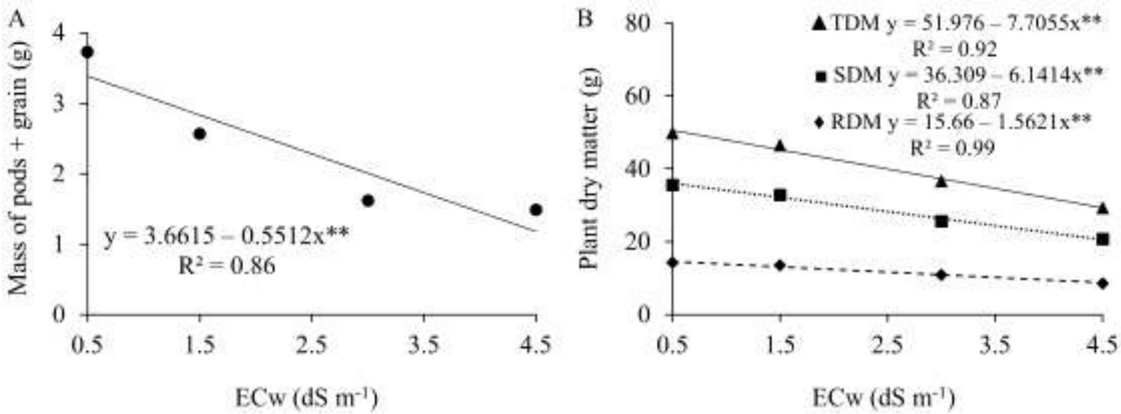

Figure 8. Pods + grain mass (A) and plant dry matter (B) of peanut under the effect of electrical conductivity of irrigation water, root dry mass (♦), shoot (■) and total (▲).

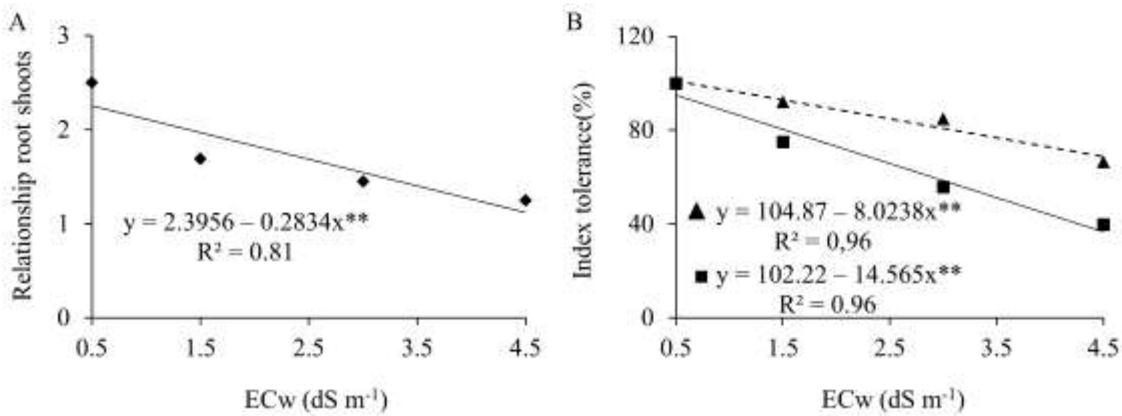

Figure 9. Relationship roots and shoots (A) and tolerance index (B) of peanut under the effect of electrical conductivity of irrigation water with (▲) and without (■) bovine biofertilizer.

total dry mass, the authors found no significant effects.

The lower production of dry mass of plants is due to the effects of salinity, reducing the availability of water to plants due to the decrease in the total water potential in the soil; and as a result, there is greater energy expenditure in plants for absorption of water (Leonardo et al., 2007). The effect of salinity on dry matter accumulation has been observed by several authors and different species of oil of agronomic interest such as sunflower (Morais et al., 2011; Maciel et al., 2012) peanut (Correia et al., 2009; Santos et al., 2012), jatropha (Oliveira et al., 2015) and castor bean (Nobre et al., 2013; Lima et al., 2014).

The same behavior of the above variables can be observed for the root shoot ratio, where the data set to decreasing linear model, down 0.28 each unit increase in the levels of ECw; the lowest values in the higher salinity identifying themselves (4.5 dS m^{-1}) with the value of 1.25 cm and the maximum value (2.5) when the plants were irrigated with water of low salinity (0.5 dS m^{-1}) (Figure 9A).

As it can be observed in Figure 9B, the peanut tolerance index decreased linearly, as the increment of ECw in which the obtained decreases from 8.02% to 14.56% per unit increase of ECw on the treated plants with and without biofertilizer bovine, respectively. Lower level of tolerance (39.75%) was observed when plants were irrigated with high salinity (4.5 dS m^{-1}) and without application of bovine biofertilizer while the highest rate of tolerance (100%) was observed in plants irrigated with low salinity (0.5 dS m^{-1}) and treated with bovine biofertilizer.

The relationship between root and shoots of groundnuts increased significantly by 75, 58 and 75% in ECw 3.5, 6.0 and 8.5 dS m^{-1} in the control, respectively (Graciano et al., 2011). Sá et al. (2016) found that increase in salinity levels caused linear reductions in salt tolerance index of all the varieties of castor bean, with 63.82% reductions to cultivate LA Guarani, 79.80, 75.51 and 77.91% for BRS Energy cultivars BRS Gabriela and IAC 028, respectively. Graciano et al. (2011) observed that peanut cv. BR1 is sensitive to salinity. However, they found that it tolerates salinity culture conditions, due to adaptation and resistance to salinity strategies such as development of root system and a small percentage of reducing shoot growth variables.

Conclusions

The electrical conductivity in the irrigation water above 0.5 dS m^{-1} negatively affects growth rate, production and tolerance of peanut. Bovine biofertilizer does not mitigate the effect of salt stress on peanuts; however, better results in growth rate, production and tolerance can be observed with the application of this input.

The interaction of electrical conductivity in the irrigation water and applying bovine biofertilizer has resulted in plant growth and a higher peanut production.

Conflict of Interests

The authors have not declared any conflict of interests.

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