

Vegetable ash as attenuate of saline stress in peanut (*Arachis hypogaea* L.)

ABSTRACT

Aims: This work was developed with the aim to evaluate the development of irrigated peanut with salt water and application of vegetable ash doses.

Study design: The experiment installed was in a completely randomized design, in a 5x4 factorial scheme, with five replicates.

Place and Duration of Study: The experiment was conducted between January and April 2015, in a greenhouse of the Federal University of Paraíba, in Bananeiras, PB, Brazil.

Methodology: Peanut seeds, cultivar BR-1 were planted in pots (5 dm³). Irrigation with different electrical conductivities of irrigation water (0.5, 1.5, 2.5, 3.5 and 4.5 dS m⁻¹) was used 20 days after emergence until the end of the cultivation and the four doses of vegetable ash (0, 1.5, 2.5 and 3.5 g kg⁻¹ soil) were applied at the beginning of the crop. Were evaluated: plant height, leaf area index, root length, number of pods, number of branches, number of seeds, root dry matter, shoot, pods and seeds and total chlorophyll.

Results: The use of saline water influenced all variables analyzed in peanut regardless of the use of vegetal ash.

Conclusion: The use of vegetable ash was not efficient as an attenuating agent of the deleterious effect of irrigation water salinity on peanut.

Keywords: Fertilization; water quality; salinity.

1. INTRODUCTION

Peanut (*Arachis hypogaea* L.) is one of the most cultivated oilseed crops in the world, showing great economic and social importance to many farmers living in the semi-arid regions of the planet [1]. In the year 2016 the world production of peanut was 36 million tons, obtained in 23 million hectares [2].

The salinity of water is one of the most abiotic factors that contribute to the reduction of growth and development of cultivated plants and its effect is more prominent in the arid and semi-arid regions. High salt concentrations, in addition to reducing the potential for water use, can cause toxic effects on plants, leading to functional disturbances and metabolic damage [3].

The responses to the plants subjected to saline stress comprise changes in metabolism and growth, as in biochemical and physiological processes. Thus, the plant needs to adjust to survive under adverse conditions, and may require adaptation processes in the absorption, transport and distribution of ions, in addition to the compartment of mineral nutrients in the cells. These changes can be expressed in plant morphology, growth and physiology and consequently in crop productivity [4].

The peanut tolerates irrigation with water with electrical conductivity of up to 3.3 dS m⁻¹, without losses in yield [5]. In the literature, several studies on the effect of water salinity on the crop are found [6,7,8]. These authors found that increased salinity of irrigation water significantly reduced the development of peanut crop.

Faced with this problem, many researches have been carried out to attenuate the effects of saline stress in several crops, with emphasis in the use of alternative sources of nutrients such as vegetable ash. It may contain essential nutrients such as K, P, Ca, Mg and Si that are directly related to the increase of plant resistance to abiotic stresses [9]. Some authors have already reported beneficial effects of potassium, silicon and phosphorus nutrients as attenuators of salt stress [10,11,12]. In view of the above, this work was developed with the objective of evaluating the cultivation of peanut (*Arachis hypogaea* L.) irrigated with salt water and application of vegetable ash doses.

2. MATERIAL AND METHODS

The experiment was conducted in a protected environment (greenhouse) between January and April 2015 in the Agriculture sector of the Center for Social and Agricultural Human Sciences (CSAHS) of the Federal University of Paraíba (UFPB) in Bananeiras, PB, a municipal district inserted in the micro-region of the Brejo Paraibano, located by the geographical coordinates 6° 45 '00 "of South latitude, 35° 38' 00" of West longitude of Greenwich and 520 m high.

The experimental design was completely randomized 5x4 with factorial scheme consisting of five electrical conductivities of irrigation water (ECw - 0.5, 1.5, 2.5, 3.5 and 4.5 dS m⁻¹) and four doses of vegetable ash (VA - 0.0, 1.5, 2.5 and 3.5 g kg⁻¹ of soil) with five replicates, totaling 100 experimental units.

Peanut seeds, cultivar BR-1 were used, placing four seeds in each pot at two centimeters depth. Five days after sowing (DAS) the emergence of seedlings began. After the emergence, thinning was done leaving only the most vigorous plant. The experimental units were represented by polyethylene pots with a mean capacity of 5.0 dm³, filled with 0.3 kg of gravel + 1 kg of sand + 3.7 kg of soil. The peanut plants were initially irrigated with water without restriction of use (≤0.5 dS m⁻¹), and after 20 days of emergency, the plants received on average 400 mL of water, with respective salinities. Irrigation was done by the method and drainage as needed for the crop.

Water used for irrigation came from the reservoirs of the CSAHS/UFPB with 0.5 dS m⁻¹. From this water, the salt concentrations were formulated by addition of the salt complex. For this, an instrutherm[®] microprocessed portable conductivity meter (model CD-860) was used. The ash used in the substrate was derived from firewood of algaroba plants (*Prosopis juliflora* (Sw) DC) and was placed, as the substrate was prepared in the corresponding proportions (0.0, 1.5, 2.5 and 3.5 g kg⁻¹).

Peanut plants were collected and analyzed at 95 days after sowing. The following variables were determined: plant height (PH), using millimeter, by measuring the distance between the soil surface and the apex of the plant; leaf area index (LAI) using an AccuPAR[®] linear ceptometer (model LP-80); total chlorophyll (TC), with ClorofilOG[®] portable chlorophyllometer (model CFL1030); root length (RL) with graduated ruler; number of pods per plant (NP); number of branches per plant (NB); number of seeds per plant (NS); shoot dry mass (SDM), root (RDM), pod (PDM) and seeds (SEDM). To determine dry masses, the fresh material was packed in paper bags and set to dry in an oven with forced air circulation, at a temperature of 65 °C until reaching a constant mass, being determined in a precision scale (0.001 g). Data were analyzed by t-test and, when significant, regression analysis was performed using the statistical program SISVAR version 5.6 [13].

3. RESULTS AND DISCUSSION

The electrical conductivities of irrigation water (ECw) statistically influenced the variables analyzed, as described in ANOVA (Table 1). Regarding the vegetable ash (VA) application, a significant effect was observed only for leaf area index (LAI). In relation to the interaction between the ECw x VA levels, it was verified that there was significance for plant height (PH), number of branches (NB), number of pods per plant (NP), root dry mass (RDM) and dry seed mass (DSM).

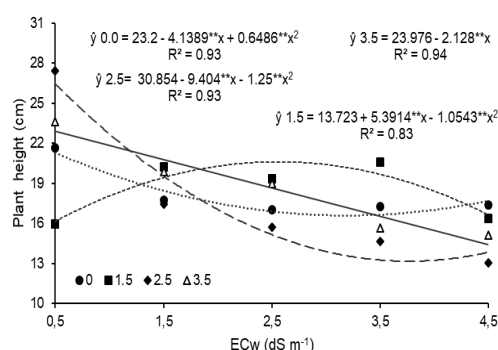
Table 1. Summary of ANOVA for plant height (PH), number of branches (NB), number of pods per plant (NP), number of seeds per plant (NS), root length (RL), total chlorophyll (TC), shoot dry mass (SDM), pod (PDM), seed (SEDM), root (RDM) and leaf area index (LAI) of peanut (*Arachis hypogaea* L.) submitted to irrigation with salt water (ECw) and application of vegetal ash (VA).

SV	DF	Mean Square					
		PH	NB	NP	NS	RL	TC
ECw	4	125.11**	22.28**	148.42**	2479.18**	57.61**	552.34**
VA	3	4.86 ^{ns}	0.77 ^{ns}	24.91 ^{ns}	112.81 ^{ns}	17.22 ^{ns}	11.54 ^{ns}
ECw * VA	12	46.48**	3.06**	20.62*	83.31*	7.85 ^{ns}	13.74 ^{ns}

Error	80	15.09	1.02	10.15	58.95	4.51	7.52
CV (%)		21.28	14.54	22.32	24.83	18.87	7.32
		SDM	PDM	SEDM	RDM	LAI	
ECw	4	93.74**	643.96**	461.81**	117.35**	1.23**	
VA	3	13.60 ^{ns}	7.08 ^{ns}	4.06 ^{ns}	14.04 ^{ns}	0.95**	
ECw * VA	12	7.44 ^{ns}	10.09 ^{ns}	9.31*	12.69*	0.52**	
Error	80	5.35	5.85	4.04	6.36	0.06	
CV (%)		22.12	22.91	27.12	31.94	23.58	

79 CV(%): Coefficient of variation; GL: Degrees of freedom; *, **: $P < 0.05$ and $P < 0.01$, respectively, and ns: not
80 significant by the F test.

81 It was observed that the height of plants was affected as the salinity increases irrigation water, except
82 for the plants that received 1.5 g kg^{-1} of ash, which maintained height of 18.98 cm. It is verified that
83 the plants submitted to the amount 2.5 g kg^{-1} of ash had a marked decrease in height with increase of
84 water salinity, decreasing from 27.44 cm in ECw from 0.5 dS m^{-1} to 14.64 cm in the ECw of 4.5 dS m^{-1}
85 (Fig. 1).



86
87 **Fig. 1. Plant height of peanut (*Arachis hypogaea* L.) submitted to irrigation with salt water and**
88 **application of vegetal ash**
89 **** $P < 0.001$**

90 Graciano et al. [4] found similar results. Research with peanut BR-1 submitted to salinities of 1.0, 3.5,
91 6.0 and 8.5 dS m^{-1} of the irrigation water, showed a negative compromise in plant height, reducing the
92 height by up to 62.4%. Costa et al. [14] showed that ECw of 4.0 dS m^{-1} affects the height values of
93 peanut plants, the difference being 28.25% when compared to the low conductivity treatment (0.8 dS m^{-1}).
94 It was observed that the plants submitted to 3.5 g kg^{-1} of ash had a linear decrease in height
95 when the amount of irrigation water salts increased, decreasing drastically from 23.4 cm in 0.5 dS m^{-1}
96 to 16.2 cm at the salinity of 4.5 dS m^{-1} . Plants that received 2.5 g kg^{-1} of ash obtained the highest
97 height when they received water of 0.5 dS m^{-1} , but as observed in the other gray doses, the height
98 was negatively affected from 1.5 dS m^{-1} of ECw in irrigation water.

99 The plants with the highest number of branches (NB) were those exposed to the control treatment (0
100 g kg^{-1} ash) and irrigated with conductivity water of 0.5 dS m^{-1} (Fig. 2). It is possible that the superiority
101 of the control treatment is related to the absence of toxic effects caused by the salinity caused by the
102 accumulation of salts in the root zone of the plants [15].

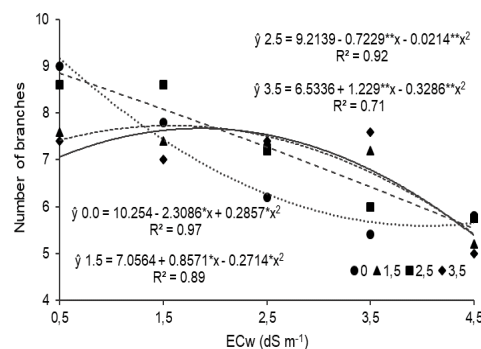


Fig. 2. Number of branches of peanut (*Arachis hypogaea* L.) submitted to irrigation with salt water and application of vegetal ash
* $P < 0.05$; ** $P < 0.001$

The numbers of branches were affected with greater intensity in the ECw of 4.5 dS m⁻¹. However, plants that received the amount 3.5 g kg⁻¹ ash at the salinity of 3.5 dS m⁻¹ achieved a higher NB value, justifying that ash application can mitigate the aggravating effects of salinity of the water the number of branches. The superiority presented by the vegetal ash confirms the suggestion of Bonfim-Silva et al. [16], revealing that this alternative fertilizer can increase soil fertility and acts as a plant growth promoter.

The amount of pods was affected by increasing salts in irrigation water (Fig. 3). The plants with the amounts of ash 1.5 and 3.5 g kg⁻¹ had higher number of pods (NP) when irrigated with water of 0.5 dS m⁻¹, however, with the increase of the conductivity to 4.5 dS m⁻¹, NP significantly decreased to less than 10 pods plant⁻¹.

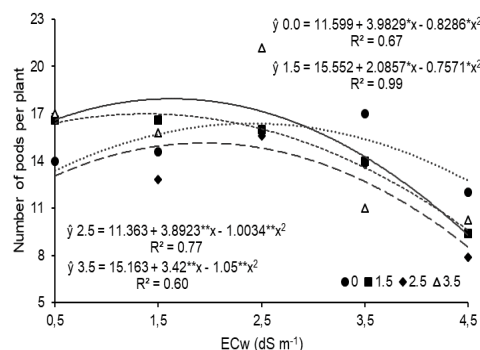
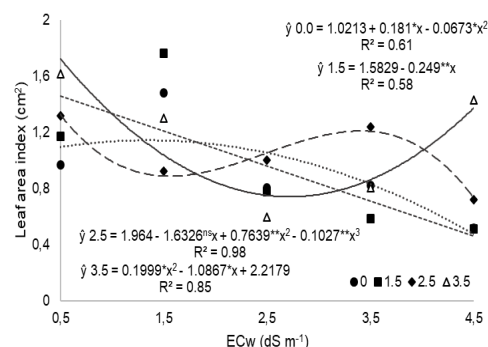


Fig. 3. Number of pods of peanut (*Arachis hypogaea* L.) submitted to irrigation with salt water and application of vegetal ash
* $P < 0.05$; ** $P < 0.001$

Plants which did not receive ash (0 g kg⁻¹) had better response to NP, presenting 13 pods plant⁻¹, even irrigated with salinity water of 4.5 dS m⁻¹. The addition of ash did not influence the number of pods in the conductivity treatment 4.5 dS m⁻¹. Sofiatti et al. [17] observed different results, studying the effect of wood ash and sewage sludge on cotton, found that the number of fruits was positively affected by the increase of wood ash.

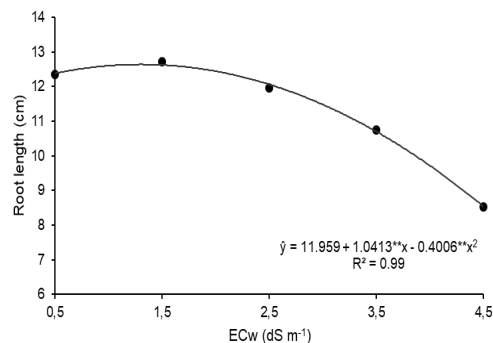
Fig. 4 shows the significant difference between treatments, especially when the water saline content are high. Plants that had the amounts of ash 0.0, 1.5 and 2.5 g kg⁻¹ added on the substrate and exposed to salinity of 0.5 dS m⁻¹ and obtained practically the same values of Leaf Area Index (LAI). However, from the salinity of 2.5 dS m⁻¹ the LAI values decrease drastically. However, the plants that received the amount 3.5 g kg⁻¹ of ash reached a higher value of LAI (1.8 cm²), which maintained the LAI of 1.5 cm² even when submitted to salinity of 4.5 dS m⁻¹, justifying that the application of 3.5 g kg⁻¹ of ash can mitigate the aggravating effects of irrigation water salinity on leaf area of peanut plants. The lowest LAI values were identified in the treatment of 4.5 dS m⁻¹, ranging from 0.5 to 0.8 cm² for the plants that received the amounts of ash 0.0, 1.5 and 2.5 g kg⁻¹. Sousa et al. (2014), identified a

135 decrease in the leaf area of the peanut plants, maintained under different salinities in the presence
136 and absence of bovine biofertilizer.



137
138 **Fig. 4. Leaf area index of peanut (*Arachis hypogaea* L.) submitted to irrigation with salt water**
139 **and application of vegetal ash**
140 *** $P < 0.05$; ** $P < 0.001$; $^{ns} P > 0.05$**

141 Fig. 5 shows that the root length of the peanut plants was affected as the salinity of the irrigation
142 water was increased. The highest value was observed in the ECw of 1.5 dS m⁻¹ (12.7 cm) and the
143 lowest in the ECw of 4.5 dS m⁻¹ (8.5 cm), representing a decrease of 49.4%.



144 **Fig. 5. Effect of electrical conductivity of irrigation water in the root length of peanut (*Arachis***
145 ***hypogaea* L.)**
146 **** $P < 0.001$**
147

148 The electrical conductivity of 4.5 dS m⁻¹ caused a decrease in the length of the roots of the peanut,
149 which determines that the cultivar does not tolerate high salt levels in irrigated water, causing root
150 atrophy of the excess salts. , the high concentration of salts in the cells provoke the unbalance of the
151 biochemical reactions and physiological alterations, consequently being able to worsen
152 circumstantially in the growth of the tissues [15]. The decrease in the root length of the plants irrigated
153 with saline water may also be interconnected with the increase of soil osmotic pressure, implying a
154 greater difficulty for the plant to absorb water and reach the process of cell division and stretching
155 [20].

156 It is observed that the number of seeds per plant was affected as the salinity of irrigation water was
157 elevated (Fig. 6). The maximum value of seeds / plant was 40.8 and the minimum of 14.4, found in
158 the salinities of 0.5 and 4.5 dS m⁻¹, respectively, representing a decrease of 183.3%. These results
159 corroborate with those found by Gomes et al. [18] who worked with the same crop and showed that
160 the increase of salinity interferes negatively in the number of seeds produced. The high concentration
161 of salts in the soil solution impairs the absorption of nutrients, causing abnormalities in plant
162 metabolism, directly influencing the production of the crops [19].

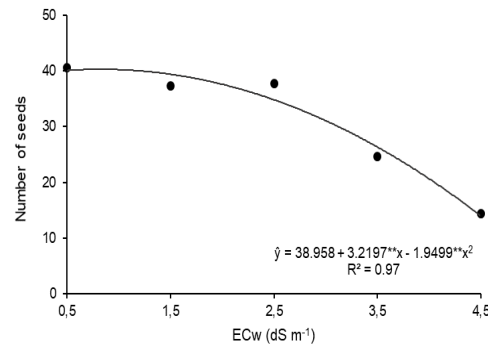


Fig. 6. Effect of electrical conductivity of irrigation water in the number of seeds of peanut (*Arachis hypogaea* L.)
** $P < 0.001$

The total chlorophyll index (TC) decreased as the salt concentration was elevated, the maximum value was 42.6 and the minimum of 31 FCI, found in the salinities of 0.5 and 3.5 dS m⁻¹, respectively (Fig. 7). In researches carried out by Santos et al. [7], these authors point out that the chlorophyll content was linearly affected by the increase in the mean electrical conductivity of the soil saturation extract, proving the sensitivity of the crop to high levels of salts in the water. Also according to these authors, the decrease of chlorophyll indices may be related to the disorganization of the cells and the degradation of the chlorophylls by NaCl, reducing their synthesis. Consequently, the radiation rate can be affected and there is interference in productivity.

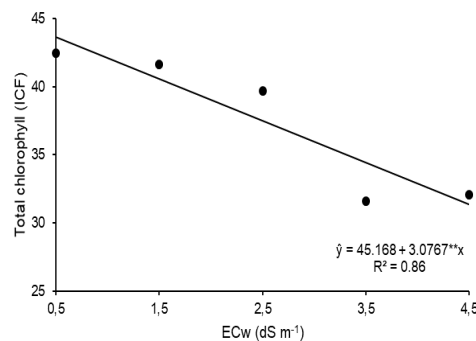


Fig. 7. Effect of electrical conductivity of irrigation water in the total chlorophyll of peanut (*Arachis hypogaea* L.)
** $P < 0.001$

All biomass variables were significantly reduced when the plants were submitted to saline stress (Fig. 8A-B and 9A-B). This is a classic response that was verified in other studies when plants are submitted to saline stress [7,21,22]. These results are associated with the salinity effects of irrigation water on the physiology of the plant, promoting metabolic disorders, mainly in relation to the absorption of water and soil nutrients and the reduction of leaf area, which implies a smaller surface area photosynthesizing and, consequently, low yield of the crop [6].

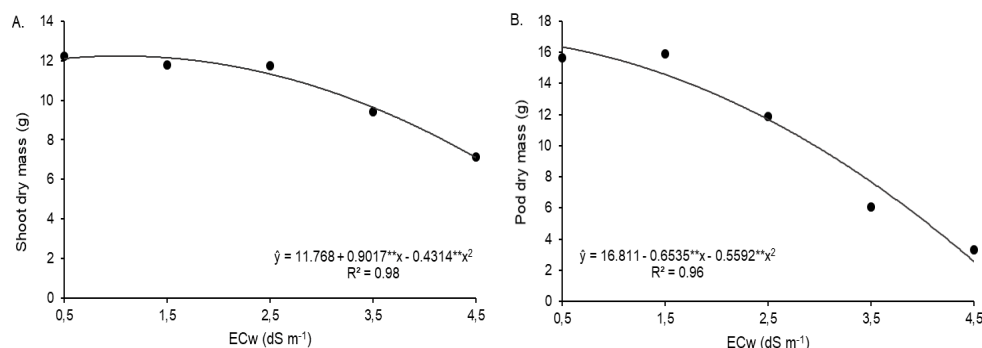


Fig. 8. Effect of electrical conductivity of irrigation water in the shoot dry mass (A) and in the pod dry mass (B) of peanut (*Arachis hypogaea* L.)
**** $P < 0.001$**

The shoot dry mass (SDM) was affected as the salinity of irrigation water increased from 2.5 dS m⁻¹. It is observed that there was a significant reduction of 41.8% when irrigated with water with ECw of 4.5 dS m⁻¹ (Fig. 8A). These decreases agree with Sousa et al. (2014) when reporting that the increase in the saline concentration of the irrigation water progressively decreases the biomass production in peanuts. Graciano et al. [4] argue that the reduction of the growth parameters of the crop may be related to the restriction of the osmotic potential of the soil solution due to the increase of the high levels of salinity.

Fig. 8B shows a negative effect on the dry mass pod (DPM), when the salt content is high, and the highest dry matter deposition was found in the treatments of 0.5 dS m⁻¹ and 1.5 dS m⁻¹. Plants kept under the salinity of 4.5 dS m⁻¹ obtained the lowest MSV value, demonstrating the sensitivity of the culture to the higher salts. Prazeres et al. [23] working with string beans under saline irrigation and potassium fertilization, identified a reduction in dry biomass of the pods from the salinity of 2.2 dS m⁻¹.

Seed dry mass (SEDM) was affected drastically with salinity increase of the irrigated water (Fig. 9A). The highest value of SEDM was observed in plants that received the amount of ash 2.5 g kg⁻¹ when subjected to the salinity of 0.5 dS m⁻¹, adjusting linearly decreasingly from the increase of ECw. This may be associated with the osmotic potential of the soil solution that makes it difficult for the plant to absorb water. Santos et al. [7] also observed a reduction in this variable with the increase of irrigation water salinity.

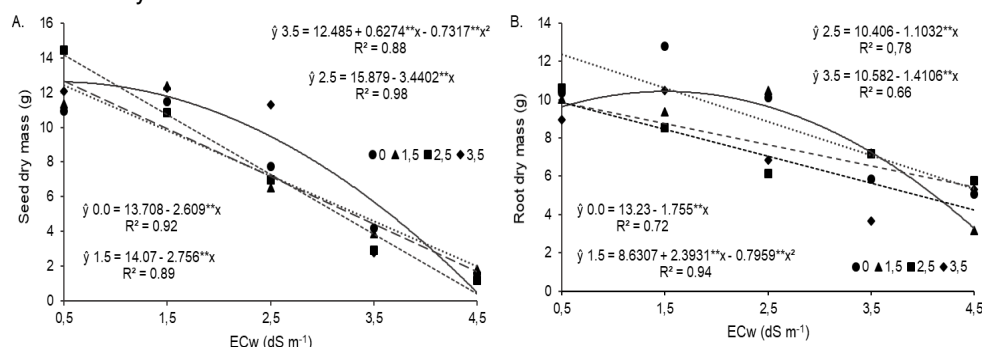


Fig. 9. Seed dry mass (A) and root dry mass (B) of peanut (*Arachis hypogaea* L.) submitted to irrigation with salt water and application of vegetal ash
**** $P < 0.001$**

The root dry mass (RDM) of the peanut plants were negatively affected as the salt contents were increased (Fig. 9B). Plants that did not receive ash (0 g kg⁻¹) had the highest accumulation of dry matter in the root, however, the MSR values were decreased as the water salinity was increased. Studies performed by Diniz Neto et al. [10] evidenced that the dry mass of the root of oiticica (*Licania rigida* Benth.) seedlings irrigated with saline water and fertilized with potassium was reduced with the increase of salts in irrigated water.

218 4. CONCLUSION

- 219 • The use of saline water influenced all variables analyzed in the peanut (*Arachis hypogaea* L.)
 220 crop regardless of the use of vegetal ash;
 221 • The use of vegetable ash was not efficient as an attenuating agent of the deleterious effect of
 222 irrigated water salinity in the peanut crop.

224 REFERENCES

- 225
 226 1. Varshney RK, Pandey MK, Janila P, Nigam SN, Sudini H, Gowda MVC, et al. Marker-assisted
 227 introgression of a QTL region to improve rust resistance in three elite and popular varieties of
 228 peanut (*Arachis hypogaea* L.). Theor and Appl Genetics. 2014;127(8):1771-1781.
 229 doi: 10.1007/s00122-014-2338-3
 230 2. Fao Food and Agriculture Organization of the United Nations. Statistics at Fao. Rome:
 231 Fao Publications; 2017
 232 3. Santos SM, Paiva ALR, Silva VF. Qualidade da água em b́aragem subterrânea no
 233 semiárido Rev Bras Agricult Irrigada 2016; 10 (3): 651-662. Portuguese
 234 <http://dx.doi.org/10.7127/rbai.v10n300394>
 235 4. Graciano ESA, Nogueira JMC, Lima DRM, Pacheco CM, Santos RC. Crescimento e
 236 capacidade fotosintética of the cultivar in the process of BR1 soy conduits of
 237 salinidade. Rev Brasil de Eng Agric e Ambiental 2011; 15 (8): 794-800. Portuguese.
 238 5. Ayers RS, Westcot DW. A qualificatio de agricultura agricultura 2th ed. Campina
 239 Grande: UFPB, FAO; 1999. Portuguese.
 240 6. Correia KG, Fernandes PD, Gheyi HR, Nobre RG, Santos TS. Crescimento,
 241 producers of the fluorecence of the fluorecence of clonic acid from the condoções
 242 of the researchers. Rev Ciência Agronômica. 2009; 40 (4): 514-521. Portuguese.
 243 7. Santos DB, Ferreira PA, Oliveira FG, Batista RO, Costa AC, Cano AO Produce and
 244 parasite fisiológicos do amendoim have fun Idesia 2012; 30 (2): 69-74 Portuguese.
 245 8. Sousa GG, Lima FA, Gomes KR, Viana TVA, Costa FRB, Azevedo BM, et al.
 246 Irrigação com água salina na cultura do amendoim agnos biofertilizante bovino
 247 Nativa 2014; 2 (2): 89-94. Portuguese.
 248 9. Lemes ES Aplicação de cinza da casca de arroz, via solo, como fonte de silício i
 249 arrozado sob estresse salino. 2013. 68 f. Dissertação (Mestrado em Ciência e
 250 Tecnologia de Sementes) - Universidade Federal de Pelotas, Pelotas, 2013.
 251 Portuguese.
 252 10. Diniz Neto MA, Silva IF, Cavalcante LF, Diniz BLMT, Silva JCA, Silva EC. Mudanças de
 253 oitica cigarettes are no alcohol in the biofertiliser bovino e potassium. Rev Brasil de
 254 Eng Agric e Ambiental 2014; 18 (1): 10-18. Portuguese.
 255 11. Castellanos CIS, Rosa MP, Deuner C, Bohn A, Barros ACSA, Meneghello GE. A
 256 casualty of the casualty of the casualty of a coconut foam: The quality of the genesis
 257 of the production of cinnamon and fiberglass products Rev Ciênc Agrárias 2016; 39
 258 (1): 95-104. Portuguese. <http://dx.doi.org/10.19084/RCA15011>
 259 12. Sá FVS, Ferreira Neto M, Lima YB, Paiva EP, Gheyi HR, Dias NS. Initial
 260 development of cowpea plants under salt and phosphate fertilization. Rev Amb Água
 261 2017;12(3):405-415. <http://dx.doi.org/10.4136/ambi-agua.2070>
 262 13. Ferreira DF. Sisvar: A computer statistical analysis system. Ciência e
 263 Agrotecnologia. 2011; 35 (7): 1039-1042. <http://dx.doi.org/10.1590/S1413-70542011000600001>
 264 14. Costa FRB, Gomes KB, Sousa GG, Azevedo BM, Monteiro FJF, Viana TVA.
 265 Crescimento inicial do not affect the amount of water sold in the city's suburbs. Rev
 266 Brasil de Agric Irrigada 2014; 8 (6): 466-475. Portuguese [https //: 10.7127 /](https://doi.org/10.7127/rbai.v8n600260)
 267 [rbai.v8n600260](https://doi.org/10.7127/rbai.v8n600260)
 268 15. Taiz Law, Jaze A, Moller Im, Murphy A. Physiology in Physiology 6th ed. Porto
 269 Alegre, Ross: Artmade, 17. Portuguese.
 270

- 271 16. Bonfim-Silva EM, Cabral CEA, Silva TJA, Moreira JCF, Carvalho JCS. Cinza vegetal:
272 características produtivas e teor de clorofila do capim-marandu. Biosc Journal 2013;
273 29 (5): 1215-1225. Portuguese.
- 274 17. Sofiatti V, Lima RLS, Goldfarb M, Beltrão NEM. Cinza de madeira e foto de
275 nutrientes para o crescimento do algodoeiro Rev Biol Ciências da Terra 2007; 7 (1):
276 144-152. Portuguese.
- 277 18. Gomes TMA, Reis LS, Moura PAA, Nascimento RLR Manejo da irrigations are used
278 in the production of a saliva (Archeas hypogea L.) and are available in various fields.
279 In: IX Jornada de ensino, pesquisa e extensão 3., Recife Anais da IX Jornada de
280 ensino, pesquisa e extensão, 2009. Portuguese.
- 281 19. Schossler TR, Machado DM, Zuffo AM, Andrade FR, Piauilino AC. Salinidade:
282 efeitos na fisiologia and nutrients of mineral plants Enc Biosfera 2012; 8 (15): 1563-
283 1578. Portuguese.
- 284 20. Dias ND, Blanco FF. Efeitos dos sais no solo e na planta In: Gheyi HR, Dias NS,
285 Lacerda CF. Manejo's Best of the Agriculture: Estudos BASICOS and Appliances
286 Fortaleza: Instituto Nacional de Ciência e Tecnologia and Salinidade p.129-140,
287 2010. Portuguese.
- 288 21. Medeiros DC, Medeiros JF, Dias PMS, Barbosa MAG, Lima KS. Produced by Pele
289 de Sapo, the 'Medellín' cultivates two different varieties of food. Rev Ciênc Agron
290 2011; 42 (3) 628-634. Portuguese.
- 291 22. Maciel MP, Soares TM, Gheyi HR, Rezende EPL, Oliveira GXS. Producer of the
292 girassol ornamental comic acid salmon in the hipproponica NFT. Rev Brasil de Eng
293 Agric e Ambiental 2012; 16 (2): 165-172. Portuguese.
- 294 23. Prazeres SS, Lacerda CF, Barbosa FEL, Amorim AV, Araujo ICS, Cavalcante LF.
295 Crescimento e trocas gasoline in the planting of the plant, and then the coconut oil
296 and potato dosage. Rev Agr @ ambiente. 2015; 9 (2) 111-118. Portuguese.