

Response of Groundnut (*Arachis hypogaea* L.) Genotypes to Irrigation with Magnetized Saline Water

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ABSTRACT

A study was conducted at Etay Elbaroud Research Station, Agriculture Research Center, MALR, Egypt, to investigate the effect of magnetic saline irrigation water on growth of two groundnut genotypes. The experiment was carried out in randomized complete block design in a split-split-plot arrangement with three replicates. The main plot represented by four salt concentrations (0, 25, 50 and 100 mM NaCl), the sub-plot was two groundnut genotypes (Giza 6 and N.C.) and the sub-subplot was two treatments (with or without magnetized irrigation solution). Seeds were sown in pots containing 0.5 Kg pre-washed quartz sand and irrigated three times per week by adding 100 mL of irrigation solution consisting of base nutrient solution and the salt level exposed to with or without a magnetic field, to each pot. After three weeks from sowing the whole plants were collected. The results indicated that increasing salt stress decreased the all growth parameters and shoot/root ratio on fresh and dry weight basis of the two groundnut genotype. However, moisture content of whole plant, shoots and roots were increased with increasing salt stress. Electrolytes leakage generally decreased with increasing salt stress. Chlorophyll *a*, *b* and total chlorophyll content increased at high level of salt stress (100 mM NaCl). The N.C. genotype was more sensitive to salinity than the Giza 6 genotype for most growth attributes. The magnetized saline irrigation water had no significant effect on alleviation of salt stress to the two groundnut genotypes.

Keywords: Salt stress, groundnut, magnetic water, electrolytes leakage, chlorophyll content.

INTRODUCTION

Salinity in soil or water is one of the major abiotic stress especially in arid and semi- arid regions and can severely limit crop production (Shannon, 1998). It is an ever-increasing problem throughout the world and imposes major constraints to food production (Hasegawa *et al.*, 2000; Tester and Davenport, 2003). Globally, nearly 100 million hectares of land is affected by salinity which accounts for 6-7% of the total arable land (Munns and James, 2003). Two million feddans in Egypt suffer from salinization problems (FAO, 2007). It has negative affect on plants through three components: osmotic, nutrition's and toxic stresses (Läuchli and Epstein, 1990; Munns, 1993). When plants are exposed

to salinity, growth and fruits tend to decline, with consequent reduction in the economic outcome. The use of saline water in cultivation, especially scarcity regions requires innovative and sustainable research, and an appropriate transfer of technologies. There is a vital need to use the magnetic field during irrigation with saline water.

Numerous studies have been carried out to investigate the effects of magnetic fields on the biological systems. Magnetized water is obtained by passing the water through the permanent magnets or through the electro-magnetic installed in/on a feed pipeline. As documented in the literature, there are some beneficial effects of magnetic field treatments either the pre-sowing seed treatment or irrigation with magnetized water. Magnetic field improves plant growth characteristics (Mostafazadeh-Fard *et al.*, 2011; Radhakrishnan and Kumari, 2012), influence on the chemical composition of plants (Radhakrishnan and Kumari, 2012). A magnetic treatment of saline and recycled water prior to irrigation of celery, peas and snow peas slightly increases the biomass production and yield per unit water application, for celery and snow peas, as compared to irrigation with untreated water (Maheshwari and Grewal, 2009). However, it was not clear if these findings were connected to the salinity. Therefore, more studies on this issue are required for further verification and interpretation of this phenomenon.

Groundnut (*Arachis hypogaea* L.) is considered one of the most important edible oil crops in Egypt, due to its seeds have high nutritive value. In addition to the seed oil importance for industrial purposes, it contains about 50% oil, 25-30% protein, 20% carbohydrates and 5% fibers. Groundnut is classified as moderately sensitive crop to salinity (Ayers and Westcot, 1985). Hence, this research was conducted to study the extent to which the salt stress of two groundnut genotypes could be alleviated by exposing the saline irrigation water to a magnetic field.

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MATERIALS AND METHODS

A pot experiment, using sand culture technique under field conditions, was carried out during summer season 2020 at Etay Elbaroud Research Station, El Beheira Governorate, Ministry of Agriculture and Land Reclamation (MALR), Agriculture Research Center, Giza, Egypt to investigate the response of two groundnut (*Arachis hypogaea* L.) genotypes (Giza 6 and N.C.) obtained from Agriculture Research Center, Ministry of Agriculture and Land Reclamation (MALR), Egypt.

To irrigation with saline water exposed to or without a magnetic field. A randomized complete block design in a split-split-plot array with three replicates was used. The main plot was four salt concentrations (0, 25, 50 and 100 mM NaCl), the sub-plot was two groundnut genotypes (Giza 6 and N.C.) and the sub-subplot was two treatment (with or without magnetized irrigation solution).

Five seeds of every groundnut genotype were sown in plastic pot (12 cm inside diameter and 9 cm depth with holes in the bottom for drainage) containing 0.5 kg pre-washed quartz sand of size fraction between 0.25 and 1 mm (Hewitt, 1966). Each pot was irrigated three times per week with 100 mL of nutrient solution treated with or without magnetic, which contains both one-tenth strength modified Hoagland and Arnon nutrient solution (Hewitt, 1966), and the tested salt concentrations (0, 25, 50 or 100 mM NaCl). The magnetized irrigation solution has been exposed to magnetic field by passing through a magnetic device supplied by Nefertari Biomagnetic Company before the application to the pot. The concentrations of macronutrients in the base solution were 16.87, 8.47, 11.92, 29.99, 12.00, 4.78, and 6.38 mg L⁻¹ for N-NO₃, N-NH₄, P, K, Ca, Mg, and S, respectively. The concentrations of micronutrients in the base solution were 0.50, 0.11, 0.05, 0.01, 0.01 and 0.005 mg L⁻¹ for Fe, Mn, B, Zn, Cu and Mo, respectively. After 10 days from sowing, the plants were thinned to three plants per pot.

After three weeks from sowing, the whole plants were collected, washed by distilled water, and then separated into shoots and roots. The fresh weight of shoots and roots, shoot height, and root length were measured. Half gram of a fresh leaf tissue from the fully expanded leaf extracted in 10 mL of 80% acetone during seven days in the dark to determine the chlorophyll content using the methods of Arnon (1949) and Coombs *et al.* (1987). The absorbance of the extract was measured using a spectrophotometer (Model Spectronic 21D) at 645 and 663 nm to determine the content of chlorophyll a and b, respectively. Total chlorophyll was calculated by adding chlorophyll a and b. Chlorophyll a and b content in milligrams of

chlorophyll per gram of leaf tissue was calculated according to Arnon (1949) using the following formulae:

$$\text{mg chl.a/g fresh leaf tissue} = 12.7(D_{663}) - 2.69(D_{645}) \times V / (1000 \times W)$$

$$\text{mg chl.b/g fresh leaf tissue} = 22.9(D_{645}) - 4.68(D_{663}) \times V / (1000 \times W)$$

Where D = Absorbance at wavelength 645 or 663 nm

V = Volume (ml) of the ethanol extract

W = Fresh weight of leaf tissue

Electrolyte leakage was used to assess membrane permeability according to Dkhil and Denden (2012). The fresh leaf uniform size discs were cut (1 cm²) and put in closed test tubes containing 10 ml of distilled water and incubated at room temperature for 24 h and subsequently electrical conductivity of the solution (EC₁) was recorded. The samples were then autoclaved at 120 °C for 20 min and the final electrical conductivity (EC₂) was obtained after cooling the solution to room temperature. The Electrolyte leakage was calculated as EC₁/EC₂ and expressed as percentage.

The plant samples were then dried at 70°C for 48 hours till constant weight and the dry weight of shoots and roots were measured. The moisture content as a percentage of the whole plant, shoots, and roots were obtained by (fresh weight – dry weight)/ fresh weight *100. The shoot/root ratio on fresh and dry weight basis of the whole plant, shoots, and roots were calculated. The relative decrease expressed as: (control – treatment) / control * 100 of most parameters was calculated.

The analysis of variance was calculated using the CoStat 6.311 Statistical Analysis Software (CoStat, 2005) and the differences are identified among means by Fisher's Least Significant Difference (LSD) test at 0.05 probability level.

RESULTS AND DISCUSSION

Plant weight

Whole Plant: The whole plant weight is an important parameter determining the plant growth. The whole plant fresh weight of the two groundnut genotypes decreased significantly with increasing salt concentrations (Table 1). There were significant differences among groundnut genotypes with respect to the whole plant fresh weight under salt stress. Also, there were significant differences between the interaction of salinity and groundnut genotypes on the whole plant fresh weight (Fig. 1). The relative decreases in whole plant fresh weight of Giza 6 with increasing salinity were -1.1, 28.8, and 69.8 % for 25, 50, and 100 mM NaCl levels, respectively as compared to the control (0 mM NaCl) with mean relative decrease 32.5 %, while, the relative decreases of N.C were 20.5, 25.9,

and 77.8 % for 25, 50, and 100 mM NaCl levels, respectively with mean relative decrease 41.4 %. On the other hand, there were no significant differences between magnetic treatments and between salinity X

magnetic, genotypes X magnetic and salinity X genotypes X magnetic interactions on the whole plant fresh weight.

Table 1. Main effects of salinity concentrations, genotypes and magnetic on fresh and dry weights of whole plants, shoots and roots and shoot/root ratio of groundnut

Treatment	Fresh weight (g plant ⁻¹)			Dry weight (g plant ⁻¹)			Shoot/Root Ratio	
	Whole	Shoot	Root	Whole	Shoot	Root	Fresh Weight	Dry Weight
Salinity conc. (mM NaCl)								
0	4.66 ^a	3.38 ^a	1.28 ^a	0.71 ^a	0.45 ^a	0.26 ^a	2.69 ^a	1.80 ^b
25	4.26 ^a	2.76 ^b	1.51 ^a	0.52 ^b	0.37 ^b	0.15 ^b	1.92 ^b	2.48 ^a
50	3.38 ^b	2.08 ^c	1.29 ^a	0.39 ^c	0.26 ^c	0.13 ^b	1.63 ^c	2.04 ^b
100	1.24 ^c	0.81 ^d	0.44 ^b	0.12 ^d	0.08 ^d	0.04 ^c	2.06 ^b	1.99 ^b
LSD _{0.05}	0.69	0.43	0.30	0.08	0.05	0.04	0.27	0.44
Genotypes								
Giza 6	3.92 ^a	2.58 ^a	1.34 ^a	0.49 ^a	0.33 ^a	0.17 ^a	1.99 ^b	2.07
NC	2.85 ^b	1.93 ^b	0.92 ^b	0.38 ^b	0.25 ^b	0.13 ^b	2.16 ^a	2.08
LSD _{0.05}	0.30	0.17	0.14	0.03	0.02	0.01	0.15	ns
Magnetic								
without	3.33	2.25	1.09	0.42	0.28	0.14	2.12	1.95
with	3.44	2.26	1.17	0.45	0.30	0.15	2.02	2.21
LSD _{0.05}	ns	ns	ns	ns	ns	ns	ns	ns

ns: Not significant.

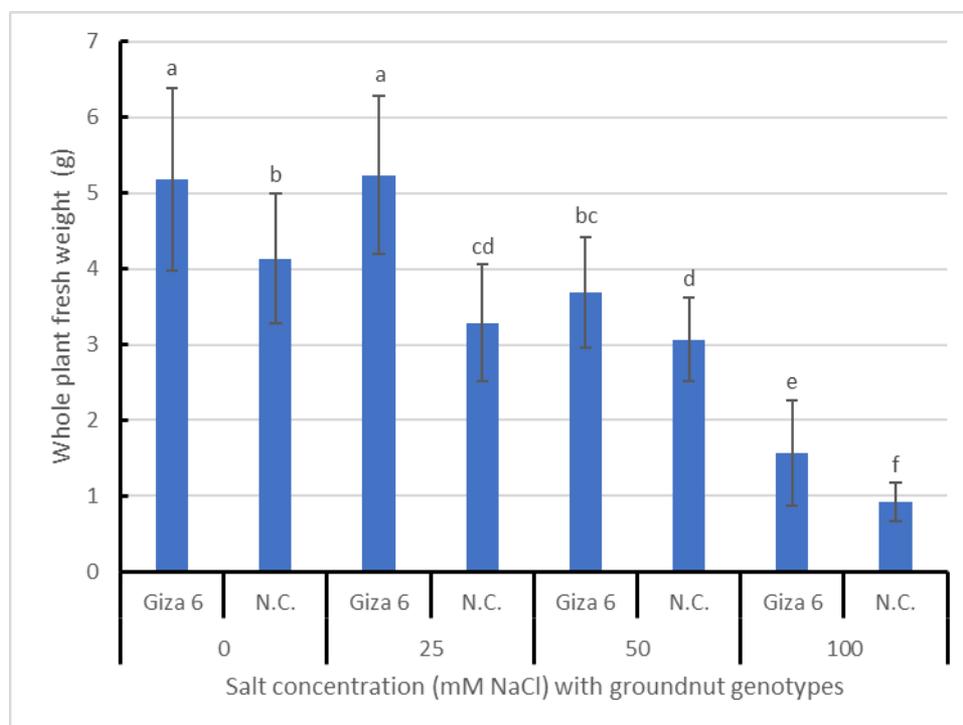


Fig. 1. Means of whole plant fresh weight of the two groundnut genotypes as affected by salinity concentrations

Whole plant dry weight of the two groundnut genotypes significantly decreased under Salt stress (Table 1). There were significant differences among groundnut genotypes with respect to the whole plant dry weight under salt stress. While there were no significant differences between the interaction of salinity and groundnut genotypes on the whole plant dry weight. The relative decreases in whole plant dry weight of Giza 6 with increasing salinity were 23.1, 45.7, and 79.2 % for 25, 50, and 100 mM NaCl levels, respectively with mean relative decrease 49.3 %, while, the relative decreases of N.C were 31.9, 43.6, and 86.9 % for 25, 50, and 100 mM NaCl levels, respectively with mean relative decrease 54.1 %. This mean that the N.C genotype was more sensitive to salt stress than Giza 6. There were no significant differences between magnetic treatments and between salinity X magnetic, genotypes X magnetic and salinity X genotypes X magnetic interaction on the whole plant dry weight.

Shoot: Shoot fresh weight of the two groundnut genotypes decreased significantly with increasing NaCl concentration (Table 1). There were significant differences between groundnut genotypes with respect to shoot fresh weight under salt stress. Also, there were significant differences with respect to shoot fresh weight between the interaction of salt stress and groundnut genotypes (Fig. 2). The relative decreases in shoot fresh weight of Giza 6 with increasing salinity were 12.6, 39.7, and 74.1 % for 25, 50, and 100 mM NaCl levels, respectively with mean relative decrease

42.1 %, while, the relative decreases of N.C were 25.7, 36.6, and 78.7 % for 25, 50, and 100 mM NaCl levels, respectively with mean relative decrease 47.0 %. On the other hand, there were no significant differences between magnetic treatments and between salinity X magnetic, genotypes X magnetic and salinity X genotypes X magnetic interactions on the shoot fresh weight.

Shoot dry weight of groundnut genotypes significantly decreased due to salt stress (Table 1). Also, there were significant differences between the two studied groundnut genotypes with respect to shoot dry weight under salt stress. However, no significant effect of magnetic treatment and of all the interaction levels between the treatments on shoot dry weight.

Roots: Root fresh weight of groundnut genotypes significantly decreased with increasing salt stress (Table 1). There were significant differences between groundnut genotypes with respect to root fresh weight under salt stress. Also, there were significant differences with respect to root fresh weight between the interaction of salt stress and groundnut genotypes (Fig. 3). The relative decreases in root fresh weight of Giza 6 with increasing salinity were -37.9, -0.2, and 58.4 % for 25, 50, and 100 mM NaCl levels, respectively with mean relative decrease 6.7 %, while, the relative decreases of N.C were 7.4, -1.5, and 75.3 % for 25, 50, and 100 mM NaCl levels, respectively with mean relative decrease 27.0 %.

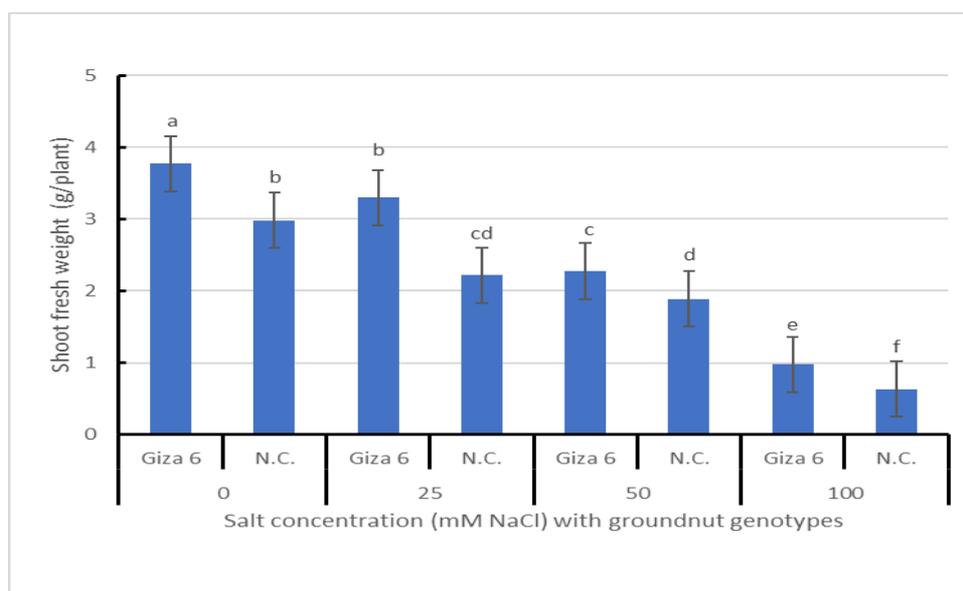


Fig. 2. Means of shoot fresh weight of the two groundnut genotypes as affected by salinity concentrations

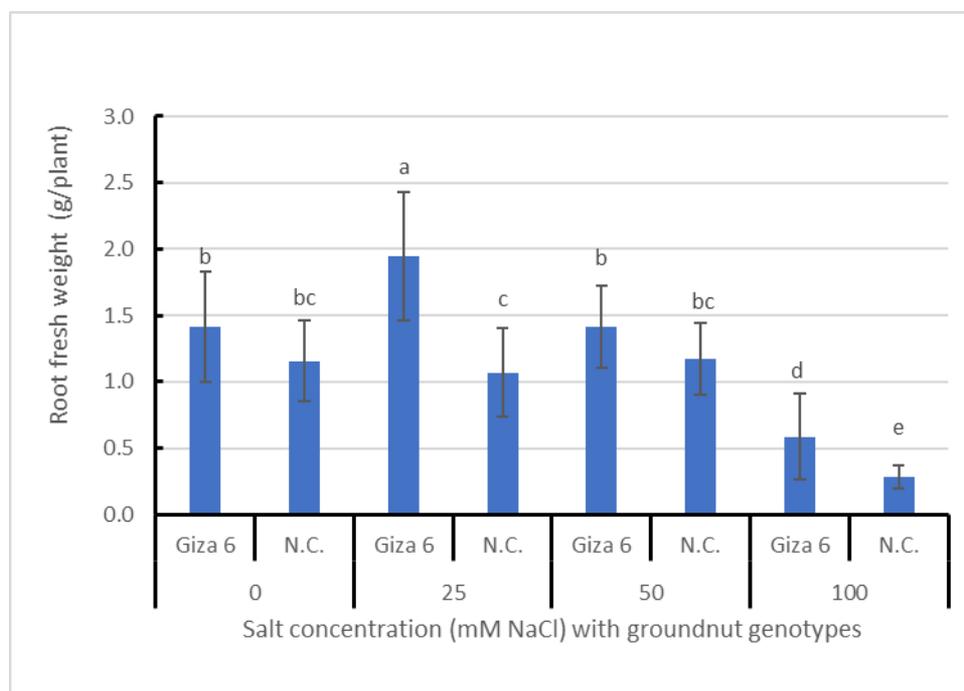


Fig. 3. Means of root fresh weight of the two groundnut genotypes as affected by salinity concentrations

Root dry weight of groundnut genotypes significantly decreased due to salt stress (Table 1). Moreover, there were significant differences between groundnut genotypes with respect to root dry weight under salt stress. On the other hand, no significant differences were observed between magnetic treatments and between all the interaction levels of these treatments, on root dry weight.

These results are in accordance with the already published results which reported that increasing salt concentration negatively affects the root and shoot development (Farhoudi *et al.*, 2015; Saad-Allah, 2015). The reduction of plant growth under salt stress may either be due to excessive ions, Na^+ and Cl^- accumulation in the plant tissues (Yousef and Al-Saadawi, 1997). High foliar concentration of Na^+ ion can reduce CO_2 assimilation because of ionic toxicity (Cachorro *et al.*, 1993). Also, due to generation of osmotic stress leading to reduce in water absorbance by plant and cell division and differentiation (Nikee *et al.*, 2014). It has been reported that saline condition significantly reduced net photosynthetic rates, increased energy losses for salt exclusion mechanism, largely decreased uptake of nutrient and finally reduced plant growth (Seemann and Sharkey, 1986). While the effect of magnetic on the growth under salt stress the results were disagree with those reported by Gao *et al.* (2017) on cotton seedlings.

Shoot/Root ratio: The shoot/root ratio, on fresh weight basis, significantly decreased under salt stress, while,

the shoot/root ratio, on dry weight basis, significantly increased at 25 mM NaCl only (Table 1). Also, there were significant differences between groundnut genotypes and salt salinity levels X magnetic interaction in shoot/root ratio on fresh weight basis. Where the highest value was 2.74 to Giza 6 at 0 mM NaCl and the lowest value was 1.62 to Giza 6 at 50 mM NaCl. While there were no significant differences of the other factors and different interactions on shoot/root ratio on fresh and dry weight basis. It could be concluded that the magnitude of reduction of root growth was greater than that of shoot under salinity stress. This indicates that roots of the studied groundnut genotypes are more sensitive to salinity stress than shoots. It is also, clear that the higher values of shoot/root ratio on dry weight basis than on fresh weight basis could be due to lower moisture content in shoots than in roots. These results agree with that obtained by Abdelraouf and Elgarhy (2017) who observed that the roots growth of soybean genotypes and broad bean cultivars were more adversely affected by salinity than the shoots.

Shoot length

Shoot length of groundnut genotypes significantly decreased with increasing salt stress (Table 2). Also, there were significant effect for salinity levels X magnetic interaction on shoot length. On the other hand, there were no significant effects of genotypes, magnetic factors and other different levels of interactions on shoot length. These results agree with those reported by

Aydişakir *et al.* (2015) and Saad-Allah (2015) and disagree with those reported by Aly *et al.* (2015).

Root length

The root length of groundnut genotypes significantly decreased with increasing salinity levels (Table 2). Also, there were significant differences between groundnut genotypes and between the interaction of salinity levels and magnetic on the root length. However, there were no significant effect of magnetic factor and between the other levels of interactions on the root length. These results agree with those obtained by Aydişakir *et al.* (2015) and Saad-Allah (2015). The reason that the roots and shoots length are affected negatively by salt stress could be due to the fact that cytokinesis and cell expansion are inhibited and toxic effect of salts. Additionally, the increase in hormones that hinder the growth and decrease in hormones that stimulate growth can cause shorter roots and shoots lengths (Taiz and Zeiger 1998). High salinity may inhibit root and plant elongation due to slowing down the water uptake by the plant may be another reason for this decrease (Werner and Finkelstein 1995).

Moisture content

The whole plant, shoots, and roots moisture contents of groundnut genotypes significantly increased with increasing salinity levels (Table 2). The magnetic factor affected significantly the shoots and roots moisture content. There were significant effects of interaction between salinity levels and genotypes on moisture contents of whole plant (Fig. 4), shoots and roots. Moreover, the salinity levels and magnetic interaction

had significant effect on whole plant and shoots moisture contents and genotypes and magnetic interaction had significant on whole plant and roots moisture contents. On the other hand, there were no significant differences between groundnut genotypes with respect to moisture content in the whole plant, shoots, and roots. There were also no significant differences between salinity levels X genotypes X magnetic interaction with respect to moisture content in the whole plant, shoots, and roots.

It is clear that the groundnut plants resisted the adverse effects of salt stress by succulence, which mean the plant increased the shoot and root fresh mass by increasing the moisture content more than the biomass production. These results are in agreement with those reported by Abdelraouf (2017), and Abdelraouf and Elgarhy (2017).

Electrolytes leakage

Salt stress generally decreased significantly membrane damage where the leakage of electrolytes from the leaf cells were decreased by increasing salt stress of the two groundnut genotypes (Table 3). NC genotype was significantly lesser membrane damaged than Giza 6. Also, magnetized water significantly decreased membrane damage of the two groundnut genotypes. On the other hand, there were no significant differences between all interaction levels of these factors on membrane damage of groundnut genotypes. The effect of salinity on moisture content results are partially agreement with those reported by Dkhil and Denden (2012) and Jeyaprabha *et al.*, (2016).

Table 2. Main effects of salinity concentrations, genotypes and magnetic on the shoot length, root length and moisture contents of groundnut genotypes.

Treatment	Shoot length (cm)	Root length (cm)	Moisture content (%)		
			Whole plant	Shoot	Root
Salinity conc. (mM NaCl)					
0	19.6 ^a	10.7 ^a	84.7 ^d	86.6 ^c	79.8 ^b
25	16.7 ^b	9.5 ^b	87.6 ^c	86.6 ^c	89.4 ^a
50	13.7 ^c	9.2 ^b	88.4 ^b	87.6 ^b	89.6 ^a
100	7.6 ^d	5.6 ^c	90.4 ^a	90.4 ^a	90.1 ^a
LSD _{0.05}	2.0	1.1	0.7	0.8	2.5
Genotypes					
Giza 6	14.8	9.1 ^a	87.8	87.7	87.5
NC	14.0	8.3 ^b	87.7	87.9	87.0
LSD _{0.05}	ns	0.3	ns	ns	ns
Magnetic					
without	14.7	8.8	87.7	88.0 ^a	86.6 ^b
with	14.0	8.7	87.8	87.6 ^b	87.9 ^a
LSD _{0.05}	ns	ns	ns	0.4	1.0

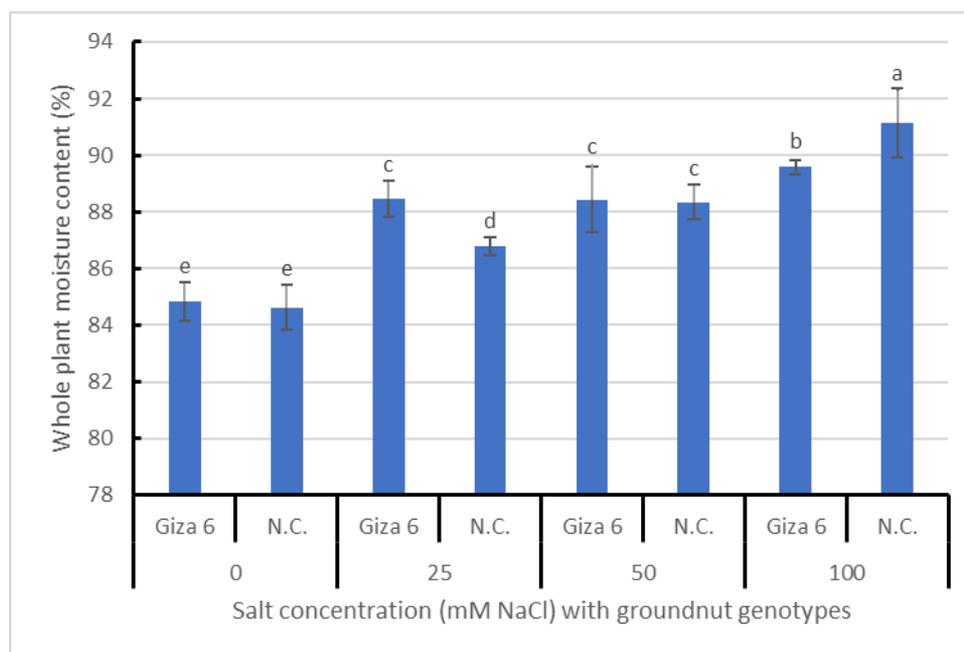


Fig. 4. The interaction between salinity concentrations and the two groundnut genotypes on whole plant moisture content

Table 3. The main effects of salinity levels, genotypes and magnetic on Electrolytes leakage and Photosynthetic pigments of groundnut genotypes

Treatment	Electrolytes leakage (%)	Photosynthetic pigments (mg/g Fresh Weight)			Chl. a/Chl. b ratio
		Chl. a	Chl. b	Total Chl.	
Salinity conc. (mM NaCl)					
0	64.7 ^a	0.84 ^b	0.40 ^b	1.24 ^b	2.16
25	71.0 ^a	0.80 ^b	0.40 ^b	1.20 ^b	2.06
50	63.6 ^a	0.79 ^b	0.40 ^b	1.19 ^b	2.22
100	36.9 ^b	1.22 ^a	0.68 ^a	1.91 ^a	1.86
LSD _{0.05}	12.2	0.17	0.07	0.19	ns
Genotypes					
Giza 6	64.9 ^a	0.86	0.43 ^b	1.29 ^b	2.11
NC	53.3 ^b	0.97	0.51 ^a	1.47 ^a	2.04
LSD _{0.05}	9.3	ns	0.06	0.12	ns
Magnetic					
without	67.3 ^a	0.88	0.49	1.37	1.91 ^b
with	50.9 ^b	0.94	0.45	1.39	2.24 ^a
LSD _{0.05}	11.7	ns	ns	ns	0.29

Chlorophyll content

Increasing salt stress generally significantly decreased chlorophyll a, b and total chlorophyll content of the two groundnut genotypes studied, except at 100 mM NaCl, but had no significant effect on chlorophyll a / chlorophyll b ratio (Table 3). There were also, significant differences between groundnut genotypes for chlorophyll b and total chlorophyll content and there were significant differences between the interaction of

salinity levels and groundnut genotypes for total chlorophyll content (Fig. 5) and chlorophyll a, and b. Magnetic treatments had no significant effect on chlorophyll a, b and total chlorophyll content, but had significant effect on chl. a / chl. b ratio.

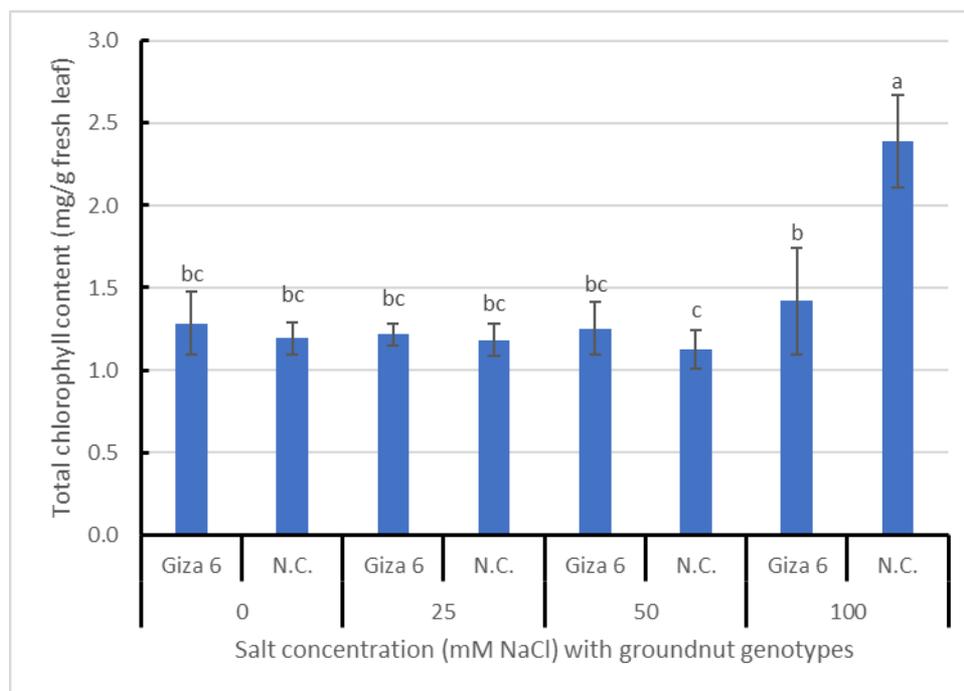


Fig. 5. The interaction between salinity concentrations and the two groundnut genotypes on total chlorophyll content

The interaction between magnetic X genotype had significant effect on chlorophyll b content and chl. a / chl. b ratio. The highest value of chl. b was 0.51 to NC with magnetic and the lowest value was 0.38 to Giza 6 with magnetic, while, the highest value of chl. a/chl. b was 2.49 to Giza 6 with magnetic and the lowest value was 1.73 to Giza 6 without magnetic. However, the interaction between magnetic X genotype had no significant effect on chlorophyll a and total chlorophyll content. The third interaction of salt levels X genotypes X magnetic had significant effect on chl. a / chl. b ratio but had no significant effect on chlorophyll a, b and total chlorophyll content. The highest value of chl. a/chl. b was 3.08 to Giza 6 with magnetic at 50 mM NaCl and the lowest value was 1.19 to Giza 6 without magnetic at 50 mM NaCl.

Similar results are obtained by El-Rodeny and EL-Okkiah (2012). The observed reduction in chlorophyll content under NaCl stress could be attributed to the destruction of chlorophyll pigments and the instability of the pigment protein complex (Saad-Allah, 2015). It is also attributed to the interference of the salt ions with the synthesis of proteins, the structural component of chlorophyll, rather than the breakdown of chlorophyll (Jaleel et al., 2008). The increased pigment at high salt concentration (100 mMNaCl) has previously been attributed to decreasing leaf growth in response to

salinity stress (García-Sánchez *et al.*, 2002). Pandolfi *et al.* (2012) suggested that stress may trigger a set of physiological alterations enabling the plants to withstand severe salinity. As was observed in our results, high salinity stress (100 mMNaCl) tended to enhance the chlorophyll a, b and total chlorophyll content (Table 3). These results were agreement with those reported by Shah *et al.*, 2017. The results of the effect of magnetic on chlorophyll pigment were disagreement with those reported by Al-Khazan *et al.*, 2011.

CONCLUSION

Increasing salinity stress decreased all growth parameters, shoot/root ratio on fresh and dry weight basis and electrolytes leakage of the two groundnut genotypes at seedling stage. However, chlorophyll content and moisture content of whole plant, shoots and roots were increased with increasing salt stress. The N.C. genotype was more sensitive to salinity than the Giza 6 genotype for most growth attributes. The magnetized saline irrigation water had no significant effect on alleviation of the salt stress on the two groundnut genotypes.

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الملخص العربي

استجابة تراكيب وراثية مختلفة من الفول السوداني للري بمياه مالحة ممغنطة

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لكل أصيص. بعد ثلاثة أسابيع من الزراعة، تم حصاد النباتات بالكامل. أشارت النتائج إلى أن زيادة الإجهاد الملحي قلل من جميع قياسات النمو ونسبة المجموع الخضري/ الجذري على أساس الوزن الطازج والجاف لكل التراكيب الوراثية من الفول السوداني. إلا أنه قد زاد المحتوى الرطوبي للنبات الكامل والمجموع الخضري والجذور مع زيادة إجهاد الملح. انخفض تسرب الإلكتروليتات بشكل عام مع زيادة الإجهاد الملحي. زاد الكلوروفيل أ، ب ومحتوى الكلوروفيل الكلي عند المستوى العالي من إجهاد الملح (١٠٠ ملي كلوريد الصوديوم). كان التركيب الوراثي N.C. أكثر حساسية للملح من الصنف جيزة ٦ لمعظم سمات النمو. لم يكن لمياه الري المالحة الممغنطة تأثيراً معنوياً على تخفيف تأثير الإجهاد الملحي على كل من التركيب الوراثيين المختبرين من الفول السوداني.

أجريت هذه الدراسة في محطة بحوث إيتاي البارود، مركز البحوث الزراعية، وزارة الزراعة، مصر، أثناء الموسم الصيفي ٢٠٢٠، للتحقق من تأثير مياه الري المالحة المعرضة للمعالجة المغناطيسية على نمو تركيبين وراثيين من الفول السوداني. نفذت التجربة في تصميم قطاعات عشوائية كاملة في مصفوفة منشقة مرتين بثلاثة مكررات. كانت القطع الرئيسية ممثلة بأربعة تركيزات للملح (٠، ٢٥، ٥٠ و ١٠٠ ملليمول كلوريد صوديوم)، وكانت القطع الفرعية عبارة عن تركيبين وراثيين من الفول السوداني (جيزة ٦ و N.C.) وكانت القطع تحت الفرعية عبارة عن معاملتين (الري بمحلول ري ممغنط أو بدون ممغنط). زرعت البذور في أصص تحتوي على ٠.٥ كجم من رمل الكوارتز المغسول مسبقاً وتم ريها ثلاث مرات في الأسبوع عن طريق إضافة ١٠٠ مل من محلول الري المكون من محلول مغذي أساسي ومستوى الملح المعرض أو غير المعرض لمجال مغناطيسي (محلول عادي)