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Research Report Open Access

Growth, Yield and Seed Nutritional Composition of Groundnut (*Arachis hypogaea* LINN) under Elevated Level of Soil Salinity

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Abstract A field experiment was conducted to investigate the effect of salinity on growth, yield and nutritional composition of *Arachis hypogaea* L. (groundnut) to evaluate its tolerance level. Plants were irrigated with 0 (control), 25, 50, 100, 150 and 200 mM NaCl solution. Mortality 30% and 50% occurred only at 150 and 200 mM concentrations respectively. Salinity significantly reduced shoot length, collar diameter, leaf area, root length and relative growth rate (RGR). Number of leaves, branches, roots, primary branches and root nodules/plant declined with increasing NaCl concentration. Fresh and dry mass of plant parts were significantly lower under saline soil than in control, which culminated in reduced total biomass. Leaf total chlorophyll decreased significantly from 100 mM NaCl to higher concentrations. Plants grown in saline soil had slightly higher root: shoot ratio than in control. Yield parameters decreased with increasing salt concentration except number of seeds/pod. Number of pods/plant differed from control significantly except at 25 and 50 mM NaCl. Pods produced at 200 mM lacked seeds. Salinity reduced seed mineral content except phosphorus (P), while percentage sodium (Na) increased with increasing salinity. Cl^- and Na^+ accumulated in the seeds of salt-treated plants, which resulted in elevated level of percentage ash. Percentage fibre was not affected while carbohydrate, protein and lipid were reduced by soil salinity but at a non-significant level. Arachis hypogaea can tolerate and produce reasonable yield up to 50 mM NaCl concentration, but not fit for soil above 150 mM NaCl.

Keywords Fabaceae; Salinity stress; Growth; Yield; Proximate composition; Tolerance

Introduction

Arachis hypogaea L. (groundnut) belongs to the family *Fabaceae*. It is an annual herbaceous plant growing 30-50 cm tall. The leaves are opposite pinnate with four leaflets, each leaflet is about 1-7 cm long and 1-3 cm broad. The flowers are a typical pea flower in shape, 2-4 cm across, yellow with reddish veining. Its pods are 3-7 cm long containing 1-4 seeds. According to FAO (2004), groundnut is the 13th most important food crop of the world, the world's 4th most important source of edible oil and 3rd most important source of vegetable protein. Its seeds contain high quality edible oil (50%), easily digestible protein (25%) and carbohydrate (20%). It is grown on 26.4 million ha worldwide with a total production of 36.1 million metric tons, and an average productivity of 1.4 metric tons/ha. Globally, 50% of groundnut produced is used for oil extraction, 37% for confectionery use and 12% for seed purpose. Its haulms (vegetative plant part) also provide excellent hay for feeding livestock. However, its production has a downward trend over the years due mainly to environmental factors (FAO 2004).

Soil salinity is one of the most serious environmental factors limiting crop growth and production in the arid and semi-arid regions, with about 23% of the world's cultivated lands being saline (Khan and Duke, 2001). The increased salinization of arable land is expected to have global effects, resulting in 30% land loss within the next 25 years (Wang et al. 2012). Therefore, the

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effort to select salt tolerant plants is becoming an option to minimize the negative impact of salinity on food production and bear remarkable importance for sustainable agriculture. Salinity affects plant growth and development by imposing osmotic stress on plants, causing specific ion (Na^+) toxicity, affecting activity of major cytosolic enzymes by disturbing intracellular potassium homeostasis, and causing oxidative stress in plant cells (Munns et al., 2006). To select salt-tolerant plant species, considerable research work has been conducted on the effect of salinity on different growth characters of different crops worldwide (Cha-Um et al., 2011; Nasser, 2012; Moradi and Zauareh, 2013; Zeinoalbedin, 2012). This research is therefore aimed at investigating growth, yield and seed nutritional composition of *A. hypogaea* under soil salinity to evaluate its level of tolerance to salinity.

1 Results

Soil salinity at 25, 50 and 100 mM NaCl did not affect plant survival, while mortality of 30% and 50% were obtained at 150 and 200 mM NaCl respectively (Table 1). Saline irrigation negatively affected plant growth as the growth parameters decreased with increase of NaCl concentration in the medium (Table 1). In comparison to the control, shoot length decreased, with a significant difference ($p \leq 0.05$) at 200 mM NaCl. Reduction in collar diameter was significant ($p \leq 0.05$) at 150 and 200 mM NaCl. Decrease in leaf area became significant ($p \leq 0.05$) from 50 mM NaCl, and declined remarkably at high salinity level by as much as 80.61% and 96.76% at 150 and 200 mM NaCl respectively. Plants irrigated with saline water did not differ in number of leaves and branches from those irrigated with water until at 100 mM NaCl and above. The highest reduction was obtained at 200 mM concentration with 96.28% and 86.97% for number of leaves and number of primary branches respectively. Root number in salt-treated plants did not differ significantly ($p \geq 0.05$) from those irrigated with non-saline water except at 200 mM NaCl. Salt treatment however resulted in reduced root length even at low concentration of 25 mM NaCl. This decrease did not however differ among the salt treatment levels. Saline irrigation though led to lower values for number of nodules per plant, there was no significant difference ($p \geq 0.05$) between the control and salt-treated plants. As compared to the control, soil salinity caused a significant decline ($p \leq 0.05$) in relative growth rate by as high as 87.5% and 95.83% at 150 and 200 mM NaCl respectively.

Table 1 Effect of salinity on survival and growth characteristics of groundnut (*A. hypogaea*) at 12 weeks after irrigation with different concentrations of saline water

Growth parameter	Salt concentration (mM NaCl)					
	0	25	50	100	150	200
Mortality at harvest (%)	0	0	0	0	30	50
Shoot length (cm)	14.80^{a}	12.10^{a}	12.80^{a}	9.54^{ab}	6.76^{ab}	1.26^{c}
Collar diameter (cm)	4.73^{a}	3.72^{a}	3.47^{a}	2.67^{ab}	1.76^{b}	0.25^{c}
Leaf area (cm^2)	15.11^{a}	10.25^{ab}	7.81^{b}	5.86^{b}	2.93^{c}	0.49^{d}
Leaves/plant	172.20^{a}	148.00^{ab}	153.60^{ab}	99.00^{b}	49.60^{c}	6.40^{d}
Primary branches/plant	4.60^{a}	3.80^{ab}	3.80^{ab}	2.60^{bc}	2.60^{bc}	0.60^{d}
Roots/plant	10.74^{a}	7.81^{ab}	6.34^{ab}	5.89^{ab}	5.86^{ab}	3.90^{b}
Root length (cm)	12.68^{a}	8.78^{b}	8.30^{b}	5.86^{b}	6.34^{b}	4.88^{b}
Number of nodules/plant	13.66^{a}	10.28^{a}	9.27^{a}	5.86^{ab}	5.37^{ab}	3.41^{ab}
Relative growth rate (mgg-1 dry mass)	0.024^{a}	0.014^{b}	0.015^{b}	0.012^{b}	0.003^{c}	0.001^{c}

Note: Each value is a mean of 5 replicates. For each parameter, means with the same letter(s) [in superscript] in the same row are not significantly different at $P \geqslant 0.05$ (Tukey HSD)

Fresh and dry mass values of leaf stem and root decreased with increasing salt concentration (Table 2). Decrease in root mass became significant ($p \leq 0.05$) at salinity above 100 mM NaCl as compared to the plants exposed to non-saline water treatment. Leaf mass reduction was significant ($p \leq 0.05$) even at low concentration of 25 mM. However, root mass of plants treated with salty water did not differ significantly

($p \geq 0.05$) from the control until at 150 mM NaCl concentration. Saline water application caused a steady decline in the moisture content of plant parts but one way ANOVA revealed that the values did not differ significantly ($p \geq 0.05$) when compared to the control (Table 2).

Table 2 Effect of salinity on biomass accumulation in groundnut (*A. hypogaea*) at 12 weeks after irrigation with different concentrations of saline water

	Plant part	Salt concentration (mM NaCl)					
		0	25	50	100	150	200
Fresh	Leaf	6.37^{a}	3.67^{b}	3.39^{b}	2.13^{bc}	1.28^{bc}	1.19^{bc}
mass (g)	Stem	10.04^{a}	7.9^{ab}	7.64^{ab}	6.24^{ab}	2.35^{c}	1.56^{c}
	Root	7.11^{a}	5.33^{ab}	6.54^{ab}	5.01^{ab}	2.54^{c}	1.39^{c}
Dry	Leaf	1.53^{a}	1.04^{b}	0.97^{b}	0.58^{bc}	0.43^{bc}	0.41^{bc}
mass (g)	Stem	3.83^{a}	3.19^{a}	3.17^{a}	2.77^{ab}	0.96^{b}	0.65^{b}
	Root	2.02^{a}	1.6^{b}	1.91^{b}	1.46^{b}	0.81^{c}	0.42^{c}
Moisture	Leaf	0.78^{a}	0.72^{a}	0.71^{a}	0.73^{a}	0.67^{a}	0.65^{a}
Content (%)	Stem	0.62^{a}	0.60^{a}	0.59^{a}	0.56^{a}	0.59^{a}	0.58^{a}
	Root	0.73^{a}	0.71^{a}	0.71^{a}	0.71^{a}	0.69^{a}	0.69^{a}

Note: Each value is a mean of 5 replicates. For each parameter, means with the same letter(s) [in superscript] in the same row are not significantly different at $P \geqslant 0.05$ (Tukey HSD)

In addition, the values of total biomass in plants irrigated with saline water were significantly ($p \leq 0.05$) lower than that of the control, by as much as 70.09% and 80.24% at 150 and 200 mM NaCl respectively (Figure 1). Root: shoot ratio of plants exposed to soil salinity did not differ significantly ($p \geq 0.05$) but slightly increased over the control (Figure 1). Chlorophyll content declined significantly ($p \leq 0.05$) over control due to application of salt, the reduction being highest at 200 mM NaCl (Figure 2).

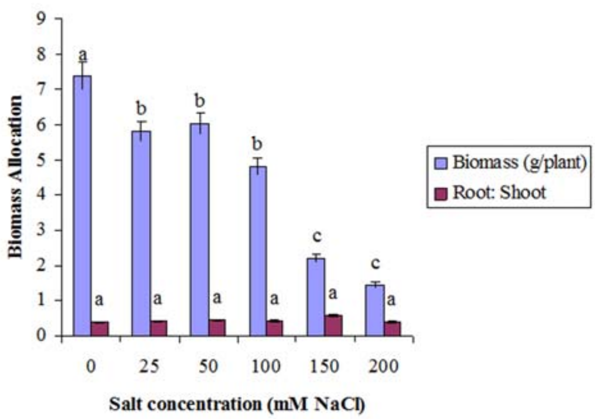

Figure 1 Effect of salinity on biomass (g) and Root: Shoot ratio of groundnut (*A. hypogaea*) at 12 weeks after irrigation with different concentrations of saline water

Note: Bars are mean of 5 replicates + SE. Bars with the same letter are not significantly different at $P \geq 0.05$ (Turkey HSD)

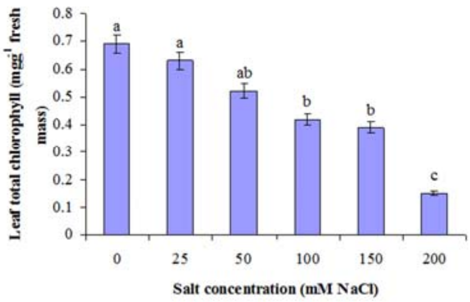

Figure 2 Effect of salinity on leaf total chlorophyll content (mgg-1 fresh mass) of groundnut (*A. hypogaea*) at 12 weeks after irrigation with different concentrations of saline water

Note: Bars are mean of 5 replicates + SE. Bars with the same letter are not significantly different at $P \geq 0.05$ (Turkey HSD)

Yield parameters were negatively affected by saline irrigation as they decreased with increasing NaCl concentration except number of seeds/pod (Table 3). Reduction in number of pods/plant differed but not significant ($p \geq 0.05$) at 25 and 50 mM NaCl but at higher concentrations. Pods contained seeds at all treatment levels except 200 mM NaCl. The number of seeds/plant and seed yield following similar trend as the difference became significant ($p \leq 0.05$) from 50 mM NaCl. The values of 100 seed mass was significantly higher ($p \leq 0.05$) at the control treatment than in plants subjected to soil salinity, which declined as salt concentration increased. When compared to the control, mineral content in the seeds of plants under saline soil decreased except phosphorus (P) while percentage sodium (Na) increased with increasing salinity (Table 4).

Table 3 Effect of salinity on yield characteristics of groundnut (*A. hypogaea*) at 12 weeks after irrigation with different concentrations of saline water

Yield parameter	Salt concentration (mM NaCl)					
	0	25	50	100	150	200
Number of pods/plant	15.12[a]	9.76[ab]	7.32[ab]	5.86[bc]	4.39[bc]	1.49[d]
Number of seeds/pod	3.11[a]	3.24[a]	3.01[a]	2.86[ab]	2.93[ab]	-
Number of seeds/plant	47.01[a]	31.73[ab]	23.01[b]	16.82[b]	12.96[c]	-
Pod yield (g/plant)	17.80[a]	13.08[b]	12.91[b]	11.90[b]	2.85[c]	0.37[d]
Seed yield (g/plant)	13.21[a]	8.6[ab]	5.37[b]	4.1b[b]	2.64[c]	-
100 seed mass (g)	29.09[a]	24.03[b]	21.37[b]	18.46[b]	15.52[b]	-

Note: Each value is a mean of 5 replicates. For each parameter, means with the same letter(s) [in superscript] in the same row are not significantly different at P ≥ 0.05 (Tukey HSD)

Table 4 Effect of salinity on nutritional and proximate composition of groundnut (*A. hypogaea*) at 12 weeks after irrigation with different concentrations of saline water

Nutritional and proximate composition	Salt concentration (mM NaCl)					
	0	25	50	100	150	200
N (%)	3.15[a]	3.09[a]	2.98[a]	3.08[a]	2.78[a]	-
P (%)	0.35[a]	0.38[a]	0.31[a]	0.37[a]	0.30[a]	-
K (%)	0.26[a]	0.22[b]	0.21[b]	0.20[b]	0.20[b]	-
Ca (%)	0.23[a]	0.19[b]	0.16[b]	0.19[b]	0.13[b]	-
Mg (%)	0.79[a]	0.44[b]	0.40[b]	0.25[b]	0.26[b]	-
Na (%)	0.047[b]	0.703[a]	0.934[a]	0.955[a]	0.927[a]	-
Ash (%)	2.94[a]	4.89[ab]	5.88[ab]	6.83[ab]	8.85[ab]	-
Fibre (%)	3.06[a]	3.09[a]	3.05[a]	3.09[a]	3.06[a]	-
Protein (%)	19.69[a]	19.31[a]	18.63[a]	18.25[a]	17.38[a]	-
Lipid (%)	39.47[a]	38.79[a]	38.54[a]	36.91[a]	36.47[a]	-
Carbohydrate (%)	37.84[a]	36.92[a]	36.57[a]	34.87[a]	34.22[a]	-
Cl^- (mg/kg)	12780[a]	17040[b]	17750[b]	20590[c]	22600[c]	
Na^+ (mg/kg)	465.00[a]	706.80[b]	846.30[b]	1032.00[c]	1074.20[c]	-

Note: Each value is a mean of 5 replicates. For each parameter, means with the same letter(s) [in superscript] in the same row are not significantly different at P ≥ 0.05 (Tukey HSD)

Percentage ash increased under salinity but not significantly different ($p \geq 0.05$) when compared with control. Percentage fibre was not affected while carbohydrate, protein and lipid were reduced by soil salinity but not at a significant level ($p \geq 0.05$) (Table 4). The accumulation of both Cl^- and Na^+ was obtained in the seeds of plants growth in saline soil.

2 Materials and Method

2.1 Field preparation and experimental set up

The study was conducted at the agriculture farm beside the screen house of Plant Science and Biotechnology Department, Adekunle Ajasin University, Akungba Akoko, Ondo State, Nigeria (7°37'N latitude, 5°44'E Longitude and 100 m above the mean sea level). The soil was an agricultural field soil with 5.60 pH, 6.19% clay, 4.29% silt, 89.7% sand, 2.89% C, 0.14% N, 9.02 mg/100 g P, 6.24 mg/100g Ca, 1.84 mg/100 g Mg, 0.34 mg/100 g Na, 0.23 mg/100 K, 0.20 mg/100 g H and 8.86 mg/100g CEC. The field was prepared for sowing by manual tillage. Dried seeds of *A. hypogeae* commonly grown in the area were obtained from the Agricultural Development

Programme (ADP) office at Ondo State, Nigeria. The crop was raised following recommended agronomic practices. Seeds were hand-planted in rows in early October 2013. The experiment had six treatments of soil salinity levels: 0 (control), 25, 50, 100, 150 and 200 mM NaCl. Twenty days after seedling emergence, plants were thinned to one plant every 45 cm. Salt treatment commenced 30 days after seedling emergence and was carried out once a week from 9:00 to 10:00 on each day for 12 weeks. Irrigation was done at the root zone of the plant to ensure that the relative level of soil salinity would be the primary cause of any observed effect rather than combined effect of soil and air-borne salinity. The different saline solutions were prepared in plastic kegs just before each treatment by dissolving weighed amount of commercially available salt in tap water to make 25, 50, 100, 150, and 200 mM NaCl solution, while tap water served as the control. Prior to beginning salt treatments, five plants grown in the experimental site but not for the experiment were randomly selected for the determination of initial growth parameters. Plants were irrigated at the root zone by gradual 25 mM increments at 2-day intervals to reach the maximum salinity level of 200 mM NaCl after 14 days (Khan et al., 2000). This was to prevent osmotic shock. The experiment was carried out during summer (October 2013 -February 2014), thus the plants received low inputs from natural rainfall besides those provided by the artificial rain treatments. Plants were irrigated with excess water by saturating the soil with water once a week to avoid salt build-up in the soil above the treatment levels (Khan et al., 2000). Survival, yield and seed nutritional composition were determined.

2.2 Survival and growth determination

Plant survival was monitored till the end of the experiment (12 weeks after treatment), which was equivalent to 114 days after sowing. Shoot length, leaf area and collar diameter were measured with meter rule, leaf area meter (LI-COR 300 model) and digital vernier caliper (model 0-200 mm) respectively. The leaves and primary branches on individual plants were counted. At maturity, plants were destructively harvested and partitioned into leaves, stems, roots and pods. Monolith samples were washed on pinboards to measure root length, root number and number of nodules. Root: shoot ratio (root mass/shoot mass) and the relative growth rate (RGR) = (ln mass2-ln mass1)/ time were estimated.

2.3 Moisture and total chlorophyll content determination

Leaf total chlorophyll was extracted with 80% acetone following the method of Arnon (1945) and calculated with the formula: $(20.2 \times D_{645} + 8.02 \times D_{663}) \times (50/1000) \times (100/5) \times ½$, where D = absorbance. Moisture content was calculated with the commonly used formula: [(fresh mass– dry mass)/dry mass] × 100.

2.4 Yield measurement

Fresh plant pods were sun dried at harvest. Number of pods/plant, seeds/pod, seeds/plant, pod yield, seed yield and 100 seed mass were recorded.

2.5 Soil and phytochemical analyses

Seed samples at each treatment were ground to fine powder using Philip model blender. The powder was re-weighed and placed in a muffle furnace set at 500℃ to determine percentage ash content. Plant samples were analyzed for nutrient and proximate composition in the Central Laboratory of The National Institute for Oil Palm Research (NIFOR), Nigeria, following the standard methods of Association of Official Analytical Chemists (AOAC 1985). Soil physicochemical parameters were also determined using the standard method.

2.6 Statistical Analysis

The experiment was a block design with 5 blocks and 2 replications per block; thus each treatment was replicated 10 times. Data were subjected to single factor ANOVA and means were separated with Tukey Honest Significant Difference (HSD) test using SPSS version 17.0 software (SPSS Inc., Chicago, IL, USA) at 95% level of significance.

3 Discussion

Soil salinity has been earlier reported to cause death in several plants; *Secale cereale* (Morant-Manceau *et al.* 2004), *Hordeum vulgare* (Atabayeva et al., 2013) and *Coriandrum sativum* (Ewase et al., 2013). This is in line with the results obtained for *A. hypogaea*. Growth reduction as obtained in *A. hypogaea* irrigated with saline water agrees with the previous findings that soil salinity resulted in a decrease in the growth of *Triticum dicoccum farrum* (Morant-Manceau et al., 2004), *Oryza sativa* (Cha-Um et al., 2011), *Vigna subterranean* (Taffouo et al., 2010), *Solanum pennellii* (Frary et al., 2010) and *Coriandrum sativum* (Ewase et al., 2013). Many nutrients have essential roles in the process of cell division and cell extension and those would cease soon after the supply were halted, especially in tissues with little nutrient storage (Alam et al., 2004). Therefore, the dominant specific reason for reduced groundnut plant growth under salt stress could be due to disturbed/imbalance nutrition.

Salinity reduced plant height in maize (Hussein et al., 2007) and *Phaseolus vulgaris* (Khadri et al., 2006), which was attributed to suppression of internode growth. According to Alam et al. (2004), it is possible that the decrease in the observed plant height was due to reduced photosynthesis, which in turn limited the supply of carbohydrate needed for growth. Stem and root growth decrease might also be by reducing turgor in expanding tissues, resulting from lowered water potential in root growth medium (Wang et al., 2012; Abou-Leila et al., 2012; Boughalleb et al., 2012). It might be due to a disturbance in mineral supply, either an excess or deficiency, induced by changes in concentrations of specific ions in the growth medium.

Hussein et al. *(*2007) detected a negative relationship between stem diameter in *Zea mays* and increasing salt concentration in water of irrigation. Ion toxicity must have injured cell membranes, increased solute leakage and led to collapse of cells thus resulting in reduction of turgor in expanding tissues as a result of lowered water potential in root growth medium (Wang et al., 2012). Leaf area has been reported to reduce in sorghum (Netondo et al., 2004), and maize (Hussein et al., 2007). James et al. (2011) observed that *Triticum turgidum* leaf elongation rates became reduced when treated with salt. This was caused by inhibition of leaf area expansion and hence, reduction of light interception. Reduced number of leaves in this study was due to leaf abscission, senescence and defoliation caused by Na^+ and Cl^- toxicity (Munns et al., 2006). Fewer leaves are as a result of decreased lateral branches bearing the leaves. Fewer leaves and reduced leaf size have direct effect on the leaf surface area available for light interception for photosynthetic activities, with consequential effect on growth (Nasser, 2012)).

Salinity led to a decreased root growth in *Abelmoschus esculentus* (Kasukabe et al., 2004), *Gossypium hirsutum* (Ibrahim et al., 2007) and *Coriandrum sativum* (Ewase et al., 2013). Reduction in root growth usually limits nutrient and water uptake with consequential effects on plant growth. The number of nodules/plants reduction in this study conforms to the earlier result of Dhanapackiam and Muhammad (2010) who said that salinity decreased nodule production in *Sesbania grandiflora*, which led to limitation of nitrogen fixing ability of the plant.

James et al. (2011) recorded a decrease in the relative growth rate of *Triticum turgidum* due to the osmotic effect of salinity. Soil salinity also caused a decline in RGR in all *Hordeum vulgare* species studied (Atabayeva et al., 2013), similar to what was obtained in *A. hypogaea*. Taffouo et al. (2010) showed that salinity led to low dry mass in *Lagenaria siceraria* plant parts. Dry and fresh weight of roots and leaves of *Medicago sativa* (Castroluna et al., 2014) in agreement with the result of this study. Low root, stem and leaf mass negatively affected total biomass (Dolatabadia et al., 2011; Atabayeva et al., 2013). Increase in root: shoot ratio value indicated that root growth was slightly more negatively affected than shoot growth, because the root was having direct contact with salt.

Salt stress can induce dehydration of plant cells through the low water potential (Frary et al., 2010; Wang et al., 2012). Once the capacity of the cell to store salts is exhausted, salts build up in the intracellular space, leading to dehydration. This might have been responsible for the reduced moisture content in *A. hypogaea* plants grown in saline soil. A decline in leaf total chlorophyll due to soil salinity has also been recorded in lentil plants (Turan et al., 2007). The reduction of leaf total chlorophyll by soil salinity was reported in many plants such as *Zea mays*, *Carthamus tinctorius*, *phaseolus vulgaris* and *Paulownia imperiallis*, which was due to increasing of destructive enzymes called chlorophyllase (Rahdari et al., 2012). Pigments system reduction is attributed to a salt induced weakening of protein-pigment-lipid complex or increased chlorophyllase enzyme activity (Turan et al., 2007). Also, inhibition of essential nutrients uptake must have led to chlorophyll reduction, because certain elements are important for normal growth and are part of chlorophyll ultrastructure (Abou-Leila et al., 2012). Also, there could inhibition of photosystem II and chlorophyll breakdown due to elevated level of salt (Nasser, 2012). Soil salinity has been shown to negatively affect yield in *Brassica napus* (Zadeh and Naeini, 2007). Decrease in pod number was associated to the increase of ABA and pollen death. They further said that the reason of seed number decrease was pod size reduction. Atabayeva et al. (2013) showed that when barley plants were exposed to salinity stress, there were many disorders in reproductive stages. It might be due to depressive effect of salinity on vegetative growth and disturbance in mineral uptake (Abou-Leila et al., 2012) and/or Na^+ and Cl^- toxicity (Munns et al., 2006). Moreover, Taffouo et al. (2010) stated that, the significant decrease of yield components under salt stress in cowpea was partly related to a significant reduction of foliar chlorophyll contents, more than 50% essential for fruit production. Zadeh and Naeini (2007) showed that, reduced nutrient in *Brassica napus* was as a result of nutrient imbalance caused by Na^+ and Cl^- accumulation in soil. Na^+ toxicity for instance has been linked with disruption of nutrient uptake (Abou-Leila et al., 2012), development of water stress, reduction of turgor and induction of oxidative cell damage. Increased ash content under salinity treatment was as a result of ion accumulation in which Na^+ and Cl^- were the major contributors. Reduced proximate composition of seeds in *A. hypogaea* is in conformity with the seed quality reduction in cherry gold plants (El-Hindi and El-Ghamry, 2005) and *Foeniculum vulgare* (Abd El-Wahab, 2006) due to the limitation of resources for normal seed development. Lipid content also reduced in *Brassica napus* due to salinity (Keshtehgar et al., 2013).

4 Conclusion

Arachis hypogaea can tolerate and produce reasonable yield up to 50 mM NaCl concentration, but not fit for soil above 150 mM NaCl. Soil salinity has negligible effect on the nutritional composition of *A. hypogaea* seeds. Irrigation of arable land with saline water has negative effect on crop growth and productivity, thus agricultural practiced that can increase salt level in soil such as irrigation with saline water and excessive use of fertilizer should be discouraged. This will prevent loss of land for agriculture and reduction in crop production.

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