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The Effect of Seed Size and Salinity on Germination and Vegetative Growth of Wheat *(Triticum aestivum* L.*)* Variety Imam

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Abstract: To investigate the effect of seed size and salinity stress on the germination and vegetative growth of wheat variety Imam, a laboratory and a pot experiment were conducted during the winter season of 2016. The experiments were conducted at the Seed Laboratory of Agronomy Department and at the Nursery, Faculty of Agriculture, University of Khartoum, (Shambat). Seed size treatments were selected on the basis of seed diameter, and were categorized into three classes of small; medium and large. Salinity concentrations were: EC0 (control); EC2 (0.24 mM NaCl L^{-1}); EC4 (0.28 mM NaCl L^{-1}); EC6 (0.39 mM NaCl L^{-1}); EC8 (0.41 mM NaCl L^{-1}) and EC10 (0.59 mM NaCl L^{-1}). The experiments were conducted using a completely randomized design with two replicates for the germination test and three replicates for the pot experiment. Data were collected on: germination percentage on the 4^{th} and 8^{th} day after planting; plant height; number of leaves per plant; leaf area; number of tillers per plant and dry matter yield. The data were statistically analyzed using ANOVA and mean separation using LSD. The results revealed that seed size class did not show significant ($p \leq 0.05$) effect on germination percent of wheat. However, salinity significantly ($p \leq 0.05$) affected germination at both readings. Small seed class registered higher germination at EC4 and EC10. For the pot experiment, the results revealed that seed size class did not have a significant ($p \leq 0.05$) effect on the studied parameters. However, better performance was observed for the large seed size class as compared to the other seed size classes. Salinity had a significant ($p \leq 0.05$) adverse effect on all measured growth parameters and reduced dry matter yield by 10.4 %, 11.7 %, 47.7% , 38.5 % and 72.2 % at EC2 and EC4, EC6, EC8 and EC10, respectively, as compared to EC0. Except for leaf number, most of the interactions between seed size and salinity were significant ($p \leq 0.05$). Further research is needed to confirm the reported effect of salinity on growth and yield of wheat variety Imam.

Key words: wheat; salinity; stress; seed size.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second largest cereal crop next to sorghum in the Sudan. Sudan produced 265.000 tons of wheat in 2014 with an average productivity of 1.95 tons/ha (Ministry of Agriculture and Forestry 2014).

Seed size is an important physical indicator of seed quality that affects vegetative growth and is frequently related to yield, market grade factors and harvest efficiency (Rukavina *et al*. 2002). Seed size influences germination, growth and biomass of the young seedling besides future crop performance (Bargali *et al*. 2009). Several investigators have reported a positive relationship between seedling vigour, improved stand establishment and higher productivity of cereal crops with plants originating from large seeds compared to those grown from smaller ones (Kaydan and Yagmur 2008).

Soil salinity is one of the major widespread abiotic stresses that limit crop growth and development and productivity of agricultural lands worldwide. Salinity also induces water deficit even in well watered soil by decreasing the osmotic potential of soil solution, thus making it difficult for roots to extract water from their surrounding media. Although wheat is rated as moderately salt tolerant, some varieties, however, are more affected by salinity than others.

The objective of this study was to investigate the effect of seed size and salinity on the germination and vegetative growth of wheat variety Imam.

MATERIALS AND METHODS

Experimental site:
The site of the experiment is at latitude 15° 40' N longitude 32°32' E and 380m above sea level. Annual rainfall ranges between 150 and 160 mm, temperature 35-40° C. The climate is semi – desert.

Seed size:
Wheat, variety Imam, with three different seed sizes was used. The seed sizes were selected on the basis of seed diameter. Accordingly, the seeds were categorized into three size classes. Small (S) (0.20–0.25cm); medium (M) (0.26–0.30cm) and large (L) class (0.31–0.38 cm).The seeds were supplied by the Seeds Testing Laboratory, Ministry of Agriculture and Forestry, Sudan.

Salinity levels:
Six salinity levels, including the control, were prepared by dissolving the respective amounts of NaCl salt in water and the salt solution was used to water the plants. The salinity levels were EC0 (control); EC2 (0.24 mM NaCl L^{-1}); EC4 (0.28 mM NaCl L^{-1}); EC6 (0.39 mM NaCl L^{-1}); EC8 (0.41 mM NaCl L^{-1}) and EC10 (0.59 mM NaCl L^{-1}).

Seed germination test
A laboratory experiment was conducted at the Seed Laboratory of the Agronomy Department, Faculty of Agriculture, University of Khartoum, Shambat, Sudan, in November 2016. The experiment aimed to study the influence of seed size and salinity on seed germination of wheat variety Imam.
This test was carried out in Petri dishes with two replicates for each salinity level. Twenty five seeds were sown per Petri dish for each seed size class. Seeds were grown in filter paper moistened by the saline solutions prepared by the specific needed concentrations. The test was conducted in a cold room adjusted at 20^0C. First count was recorded on the 4^{th} day and the final count was on the 8^{th} day from sowing.

$$\text{Germination \%} = \frac{\text{Number of normal seedlings}}{\text{Number of seeds planted}} \times 100$$

Pot experiment

A pot experiment was conducted at the Nursery of the Department of Horticulture, Faculty of Agriculture, University of Khartoum, Shambat, November 2016. It aimed at studying the influence of seed size and salinity on the vegetative growth of wheat.

Pots with 30 cm depth and 12 cm diameter were used for the experiment. Seven kg sun dried soil (2 clay: 1 sand) were put in each pot. The seed rate used was as recommended (119 kg ha^{-1}). The equivalent seed rate per pot of an area of 0.0706 m^2 was 0.84 g. Number of seeds per pot for large, medium and small seeds were 21, 27 and 35, respectively. The plants were watered at two days interval. The salinity treatments were applied 30 days after sowing. Fertilization with a dose equivalent to IN (95 kg urea ha^{-1}) was applied after the 20th irrigation. The experiment was laid out in a completely randomized design with three replicates.

Vegetative characters

During the growing season, observations were taken on five randomly selected plants 30; 37; 44; 51; 58 and 65 days after sowing and data were recorded on the following parameters:

Plant height

The plant height was measured from the base of the stem to the tip of the plant (*i.e.* tip of the flag leaf) using a ruler and the mean height in cm was calculated.

Number of leaves plant^{-1}

Fully expanded leaves were counted in each sample and recorded as an average of five plants pot^{-1}.

Leaf area (cm^2)

Average leaf area was determined by taking five random plants. The length and width of a leaf, in each plant was measured in (cm) and the average leaf area was calculated using the following equation;

Average leaf area = leaf length x leaf width x 0.76.

Number of tillers plant^{-1}

This was calculated as average number of productive tillers of the five tagged plants.

Dry matter yield (g)

Five plants from each pot were used to determine the dry matter weight. Plants were sun dried till constant weight and then weighed using an electric balance.

Statistical Analysis

The collected data were statistically analyzed according to Gomez and Gomez (1984) for completely randomized design. Mean separation was carried out using least significant difference method.

RESULTS

Germination percentage

The germinated seeds were counted on the 4th day (first count) and 8th day (second count) after planting. At both readings the means of this parameter were not significantly ($p \leq 0.05$) affected by seed size (Table 1). At both readings the small seed size class scored higher germination percentage compared to medium and large seed size classes. At the first reading the highest germination percent was recorded at EC4 and the lowest at EC10 for small seed size class, for medium size class the highest percentage was recorded at EC4 and the lowest at EC8 and for the large size class the highest and lowest germination percentage were recorded at EC2 and EC10, respectively. Across the seed classes the highest mean germination percentage was recorded at EC4 which did not differ significantly ($p \leq 0.05$) from that at EC2 and both were significantly ($p \leq 0.05$) higher than the mean germination percent at EC0 and EC6 which in turn were significantly ($p \leq 0.05$) higher than those at EC8 and EC10.

Table 1. Effect of seed size and salt stress on wheat germination percent on the 4th day (First count) and 8th day (Second count) after planting

	Salinity (S)				Seed Size(SS)			
	First Count				Second Count			
	S	M	L	Mean	S	M	L	Mean
EC0	70.67	69.00	70.00	69.89	75.00	70.00	86.70	77.20
EC2	89.00	82.33	95.67	89.00	95.00	85.00	97.70	92.60
EC4	95.67	90.00	90.00	91.89	96.30	94.30	98.00	96.20
EC6	79.33	83.67	62.33	75.11	85.00	90.00	63.30	79.00
EC8	70.00	50.67	52.33	57.67	75.00	70.00	60.00	68.30
EC10	57.67	52.33	51.33	53.78	65.00	59.30	51.70	58.70
Mean	77.06	71.33	70.20		81.90	78.10	76.20	
$LSD(0.05)_{ss}$		8.38				7.85		
$LSD(0.05)_{s}$				6.20				2.72
$LSD(0.05)_{sxss}$			5.71				4.71	

At the highest salinity level EC10 seed germination decreased salinity decresed the germination by 13 %, 17% and 19 % for the small, medium and large seed class sizes, respectively, as compared to the control EC0. This higher germination at salinity as compared to control was also found at EC2; EC4 and EC6 except for the large seed class at EC6 (Table 1). At EC8 small seed size class was similar to control but the germination of the medium and large seed classes decreased by 18% and 19%, respectively.
At the second reading the highest germination percent for the small seed size class was obtained at EC4 level and lowest germination was found at EC10 and for the large size class the highest germination was registered at EC4. At the second reading the highest mean germination percent across all seed size classes was recorded for EC4 followed by EC2 that differed significantly ($p \leq 0.05$) from EC4. The least mean germination percent was obtained at EC8 and EC10 which differed significantly ($p \leq 0.05$) from each other. The mean germination percent at EC2 and EC4 salinity levels was significantly ($p \leq 0.05$) higher than that at EC0 (control) and the latter was, significantly ($p \leq 0.05$) higher as compared to the higher salinity levels EC8 and EC10 but not EC6. As compared to the control, the germination percent increased by 10% to 24% for the different seed size classes at EC2 and EC4. At EC6 and EC8 the germination decreased only in the large seed class, while the germination of small and medium seed classes was either not affected or increased in comparison to the control. But at EC10 the germination percent for all seed size classes decreased by 10% to 35 % as compared to the control.

Plant height (cm)

Statistical analysis showed that seed size had no significant ($p \leq 0.05$) effect on plant height of wheat at all sampling times (Fig. 1). However, there were clear variations in plant height, as

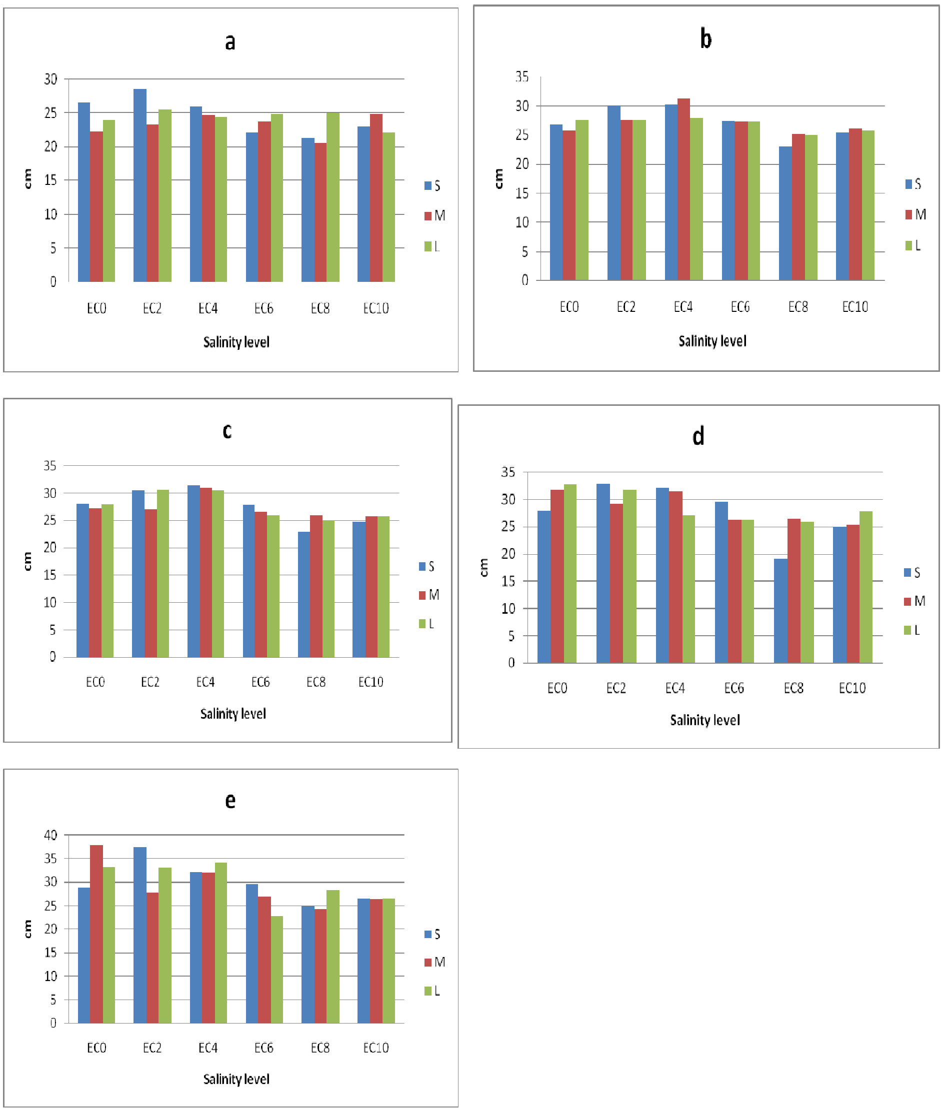


Fig.1. Effect of seed size and salinity on plant height of wheat (a) 37 DAS; (b) 44 DAS; (c) 51 DAS; (d) 58 DAS and (e) 65 DAS

affected by seed size at different sampling dates. The large seed class generally gave higher plant height values, with increasing salinity, than the medium and small size classes. The tallest plants at the highest salinity level EC10 were recorded for the large seed size at 58 days after sowing. Small seed size class recorded the tallest plants at EC2 37, 58 and 65 days after planting. Medium seed size showed the least values for this trait at EC8 37 and 65 DAS. Salinity treatments, on the other hand, significantly ($p \leq 0.05$) affected this attribute only at the last reading. The treatment EC6, EC8 and EC10 showed the same pattern but had significantly ($p \leq 0.05$) shorter plants than EC0, EC2 and EC4. The analysis of variance showed no significant differences for the interaction seed size x salinity on plant height.

Number of leaves per plant

There were no significant ($p \leq 0.05$) differences in number of leaves per plant due to seed size (Fig. 2). The small seed size class, however, recorded the highest number of leaves at EC2 at 58 and 65 DAS. Salinity significantly ($p \leq 0.05$) affected this parameter at 65 DAS reading, where EC0, EC2 and EC4 were almost similar, but had significantly ($p \leq 0.05$) more leaves than EC6, EC8 and EC10 (Fig. 2). The interaction of seed size x salinity also had no significant effect on leaf number per plant.

Leaf area per plant (cm^2)

Analysis of variance revealed that leaf area of wheat was not significantly ($p \leq 0.05$) affected by seed size (Fig. 3). The highest leaf area was recorded for the medium seed size class at EC4 salinity level followed by the small seed size class at EC2 salinity level. Salinity levels and the interaction seed size x salinity significantly ($p \leq 0.05$) affected leaf area, where increased salinity levels decreased leaf area and the least values were recorded at EC10 level across all seed size classes. The treatments EC0, EC2 and EC4 gave significantly ($p \leq 0.05$) larger leaf area than the other higher salinity levels (Fig. 3).

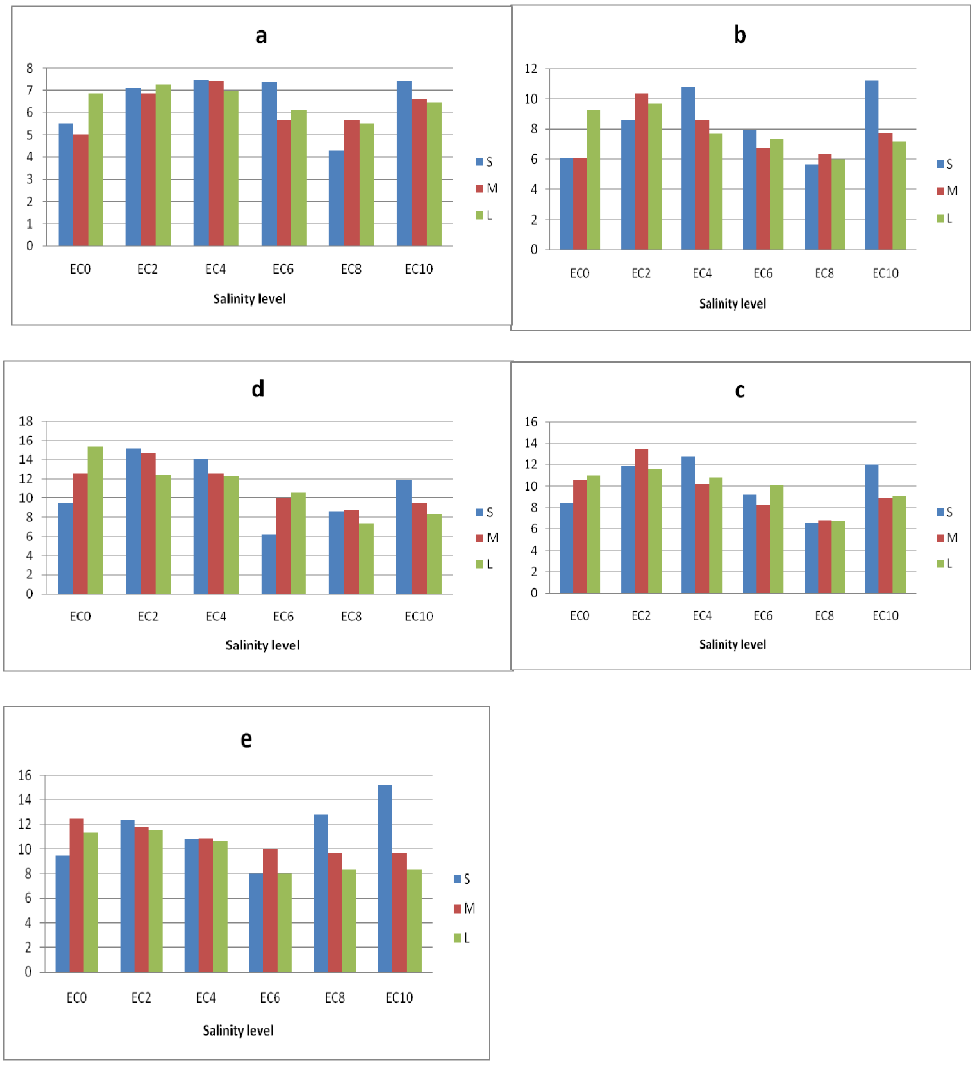
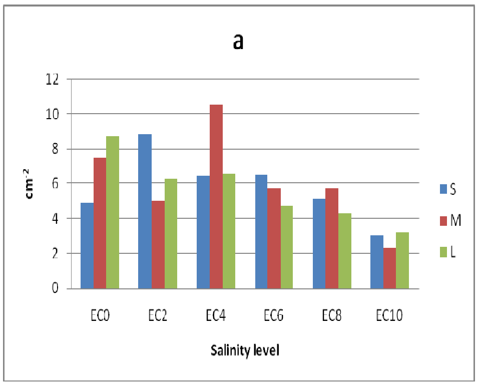


Fig. 2. Effect of seed size and salinity on number of leaves per plant of wheat (a) 37 DAS; (b) 44 DAS; (c) 51 DAS; (d) 58 DAS and (e) 65 DAS

Number of tillers per plant

Statistical analysis showed that seed size, salinity and their interaction had significant ($p \leq 0.05$) effect on number of wheat tillers per plant. The highest number of tillers was recorded for the small and large seed size classes at EC2 and EC4, respectively, (Table 2). The treatments EC0, EC2, EC4 and EC6 were not significantly different yet, gave significantly ($p \leq 0.05$) more tillers than EC8 and EC10 both of which recorded the least number of tillers per plant (Table 2).



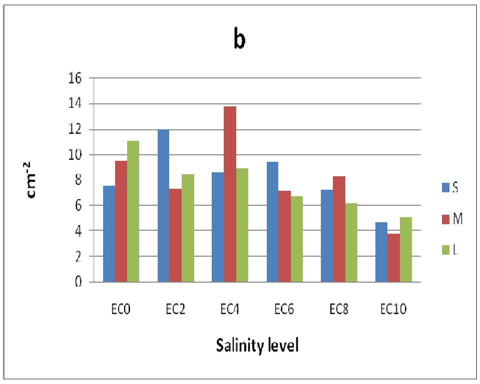


Fig. 3. Effect of seed size and salinity on leaf area of wheat (a) 51 DAS and (b) 58 DAS

Table 2. Effect of seed size and salinity on number of tillers per plant 58 DAS and dry matter yield of wheat 65 DAS

	Salinity (S)				Seed size (SS)			
	Number of tillers plant^{-1}				Dry matter (g)			
	S	M	L	Mean	S	M	L	Mean
EC0	5.33	3.80	5.23	4.79	4.03	7.03	7.47	6.18
EC2	6.23	4.07	4.63	4.98	6.03	3.97	6.67	5.56
EC4	3.80	5.63	6.23	5.22	7.27	2.80	6.30	5.46
EC6	6.10	4.43	3.77	4.77	6.10	1.67	4.93	3.23
EC8	3.77	4.43	3.33	3.84	4.03	4.27	3.10	3.80
EC10	4.23	3.33	3.13	3.57	2.03	1.33	1.73	1.70
Mean	4.91	4.28	4.39		4.92	3.51	5.03	
$LSD(0.05)_{SS}$	1.6					1.90		
$LSD(0.05)_{S}$				0.8				0.85
$LSD(0.05)_{SxSS}$		1.47					1.47	

Dry matter yield

Seed size had no significant (p ≤0.05) effect on dry matter yield of wheat (Table 2). Small and large seeds were almost similar and out-yielded medium seeds. There were significant (p ≤0.05) differences on this character among salinity treatments. The treatments EC0, EC2 and EC4 gave significantly (p ≤0.05) higher dry matter yield as compared to EC6 and EC8, all of which were significantly higher than EC10 (Table 2). The dry matter yield was significantly (p ≤0.05) affected by the interaction of seed size x salinity.

DISCUSSION

Seed size is an important physical indicator of seed quality that affects vegetative growth and crop production, whereas salinity is a widespread problem around the world and is one of the important abiotic factors that affect seed germination and vegetative growth of wheat thereby adversely affects productivity (Kaydan and Yagmur 2008).

In this study seed size had a significant effect on germination percentage at the 4th and 8th day from sowing. The results showed that the germination percent of the small seed class even exceeded that of the medium and large seed classes. These findings contrast with those of Cookson *et al*. (2001) who found that in wheat, seed size is positively correlated with seed vigour: larger seeds tend to produce more vigorous seedlings compared to smaller ones. However, these results are in agreement with those reported by Dar *et al*. (2002) who mentioned that small seeds to medium sized ones produced better germination and seedling vigour than those of bigger ones and cultivars with low 100 seed weight had higher germination percentage than larger seeded ones in pea (*pisum sativum* L.).

In this study the highest effect of salinity stress was recorded in large seed size class (EC10). The small seed class registered higher mean germination percent as compared to the medium and large seed classes across the different salinity levels. Small seeds germinated faster and grew higher under saline conditions and could be preferred for use in saline soils to achieve better stands. The treatments EC2 and EC4 gave significantly higher values than the other levels, whereas EC8 and EC10 gave the lowest values. This is in agreement with the results of Azini and Alam (1990) who reported a decrease in germination percentage owing to reduction in water absorption by the seed at imbibition and less seed germination by decreasing the ease with which the seeds take up water because the activities and events normally associated with germination get either delayed and /or proceed at a reduced rate. These results are in contrast with those of Basel *et al*. (2012) who showed that germination of lentil seeds was not influenced by increased salinity concentration. Ismail (2003) studying 2 lines and a cultivar of wheat observed that during germination and seedling stages, the lines could tolerate lower and moderate doses of salinity, while the germination and seedling development was completely inhibited at higher levels of salinity.

Taiz and Zeiger (2002) mentioned that high absorption of Na and Cl ions during seed germination can cause cell toxicity that finally inhibits or slows the rate of germination and thus decreases germination. According to Al-Niemi *et al*. (1992), the reduction and delay in seedling emergence occurs because of inability of seeds to overcome the osmotic stress and difficulty of water absorption for embryo expansion. Also the authors reported that salinity inhibits germination of many crops by creating greater osmotic potential outside the seed which reduces water absorption, or by ion toxicity that can inhibit physiological processes such as enzyme activity; cell division and cell differentiation. Germination and seedling development are very important for early crop establishment. Bhatti *el al*. (2004) observed that increasing salinity levels drastically affected the seedling growth.

There are two different mechanisms that enable seeds to germinate at high salt stress. Seeds can tolerate the effects of lower water potential in the soil (Allen *et al*. 1988) or they may exhibit specific tolerance to the inhibitory effect of NaCl (Rhumbaugh *et al*. 1993).

The results of this study showed no significant effects of seed size on plant height, but the large seed size class always registered better performance with increasing salinity concentrations at all sampling occasions, indicating the advantage of using larger seeds under salinity stress. Salinity significantly affected plant height and the plants at the higher salinity levels EC6; EC8 and EC10 were significantly shorter than those produced at lower salinity levels. Several researchers reported similar findings regarding the adverse effect of salinity on plant height (Elradi 2016). These results are in agreement with those of Mohammed (1988) who recorded a significant effect on plant height of wheat grown on salt affected soil. In contrast, Ahmed (1995) did not find a significant effect of salinity on this trait and explained that by the fact that frequent irrigation reduced both osmotic water potential and water stress and increased soil water potential.

There were no significant effects of seed size on the number of leaves per plant during all sampling occasions, but at the lowest salt concentration (EC2) the small seed size class recorded the highest number of leaves at most sampling dates. Salinity and the interaction with seed size significantly affected this parameter at 65 DAS; this might be due to the effect of stress, which suppresses growth and number of leaves. Salinity caused a decrease in number of leaves per plant at the higher levels. As explained by De Luca *et al*. (2001), the reason for this reduction might have been due to ion toxicity and the buildup of a high osmotic potential in soil that suppressed water absorption by the plant leading to leaf death.

Analysis of variance revealed that leaf area per plant of wheat was not significantly affected by seed size. The highest leaf area was recorded for the medium seed size class at EC4 salinity level followed by the small seed size class at EC2 salinity level. The effect of salinity and its interaction with seed size on leaf area was significant at all sampling occasions. This could be due to nutrient imbalance; an increase in Na^{+} levels will lead to a displacement of Ca^{++} from exchange sites on membrane and cell wall (Johnson, 1981). Altayeb (1991) mentioned that tolerance to high sodium could be attributed to efficient Ca^{++} transport to developing leaf blades, which is important to some physiological processes leading to effect on leaf size (Ames and Johnson 2000).

With respect to higher salt concentrations (EC6, EC8 and EC10) the lower leaf area values may be due to the damage caused by the salt. As explained by Allen *et al*. (1988) that the overall effect of salinity on plants is the eventual shrinkage of leaf size. Salinity also reduces the rate of leaf surface expansion, leading to cessation of expansion as salinity level increases. Increasing salt concentrations in leaves also causes premature senescence, reducing supply of assimilates to the growing organs, thus reducing plant growth (Munns *et al*. 2005).

Statistical analysis showed that salinity and interaction with seed size had significant effect on number of wheat tillers per plant. At the lowest salinity level EC2, the small size seed class produced the highest number of tillers while the large size seed class gave the highest number of tillers at EC4. Significant differences between salinity treatments were found *i.e.* the tiller number per plant decreased with increasing salinity levels. These results are supported by those of Iqbal (2003) who evaluated the effects of constant and variable salinity on spring wheat. He found that salinity significantly decreased the number of tillers, leaf area, shoot and root dry weight per plant, where these parameters were always higher at variable than at constant salinity.

Salinity is defined as the total concentration of soluble salt in water and soil and represents serious environmental problem that causes osmotic stress, and reduction in plant growth and development (Yohannes and Abraha 2013). Salinity reduces the ability of plants to absorb water which results in growth reduction, also salts accumulation in leaves causing injury in leaf cells, further reducing growth, thereby directly affecting crop production (Munns 2005). The results of this study showed significant effects of salinity and interaction of seed size and salinity on dry matter yield of wheat. The salinity levels affected dry yield significantly. This is only to be expected as salinity adversely affected all growth parameters, as discussed earlier, and therefore resulted in a negative impact on dry matter yield. Several authors reported similar findings (Elradi 2016).

In this study, salinity adversely affected germination and vegetative growth parameters of wheat variety Imam indicating a low tolerance for salinity. Further research is needed to investigate the effect of salinity on growth and yield of wheat variety Imam grown in saline soils.

REFERENCES

Ahmed, A.B. (1995). *Impact of Soil Water Management on Salt Leaching and Forage Sorghum Growth in Shambat Soil*. M.Sc. thesis (Agric.), Faculty of Agriculture, University of Khartoum, Sudan.

Altayeb, O.E. (1991). *Effect of Sowing Methods and Fertilization on the Productivity of Fodder Sorghum in a Saline-Sodic Soil*. M.Sc. thesis (Agric.), Faculty of Agriculture, University of Khartoum, Sudan.

Allen, S.G., Dobrenz, A.K., and Bartels, P.G. **(**1988**).** Physiological response of salt-tolerant and non-tolerant alfalfa to salinity during germination. *Crop Science* 20, 1004-1008.

AL-Niemi,T.S.; Campbell, W.F. and Rumbaugh, M.D. (1992). Response of alfalfa cultivars to salinity during germination and post germination growth. *Crop Science* 32, 979-980.

Ames, M. and Johnson W.S. (2000). A Review of Factors Affecting Plant Growth. *University of Nevada, Reno*. U.S.A.

Azini, A.R. and Alam, S.M. (1990). Effect of salt stress on germination, growth, leaf anatomy and mineral elements composition of wheat cultivars. *Acta Plant Physi*ology 12(3), 215-224.

Bargali. S.S.; Bargali. K. Singh; Ghosh, L. and lakhera, M.L. (2009). *Acacia nilotica* based traditional agro forestry system: effect on paddy crop and management. *Curr. Science* 96, 581-587.

Basel, N.; Zaher, B. and Sameer, A. (2012). Effect of Irrigation with Sea Water on Germination and Growth of Lentil (*Lens culinaris* Medic). *Water Resource and Protection* 4, 307-310. *http://dx.doi.org/10.4236/jwarp.2012.45033. Published Online May 2012 (http://www.SciRP.org/journal/jwarp)*

Bhatti, M.A., Zulfiqur, A., Allah, B., and Jamall A.R. (2004). Screening of wheat lines for salinity tolerance. *International Journal of Agricultural Biology* 6(4), 627-628.

Cookson,W.R.; Rowarth, J.S. and Sedcole, J.R. (2001). Seed vigour in perennial ryegrass (*Lolium perenni* L.): Effect and cause. *Seed Science and Technology* 29, 255-270.

Dar, F.A.; Gera N. and Gera, (2002). Effect of seed grading on germination pattern of some multi-purpose tree species of Jammu Region. *Indian Forestry* 128, 509-512.

De Luca, M.; Garcia, S.L.; Grunberge, K.;, Salgado, M.; Cordoba, A.; Luna, C.; Ortega, L. and Rodriguez, A. (2001). Physiological causes for decreased productivity under high salinity in boma, a tetraploid Chloris gayana cultivar. *Australian Journal of Agricultural Research* 52, 903-910.

Elradi, S.B. (2016). Effect of irrigation with saline water on the performance of three forage maize (*Zea mays* L.) Hybrids. M.Sc. thesis (Agric.), Faculty of Agriculture, University of Khartoum, Sudan.

Gomez, K.A. and Gomez, A.A. (1984). *Statistical procedures for Agricultural Research*. 2nd edition. John Willey and Sons Inc. New York.

Iqbal, R.M. (2003). Effect of constant and changing salinity environment on different growth parameters in spring wheat. *Asian Journal of Plant Science* 2(15\16), 1112-1117.

Iqbal, R.M. (2010). Leaf extension growth of wheat grown under NaCl and Na_2SO_4 salinity. Asian Journal of Plant Science 2 (15/16), 1092-1996.

Johnson, C.B. (1981). *Physiological Processes Limiting Plant Productivity*. 1st edition. William Clowes. London, Great Britain.

Kaydan, D. and Yagmur (2008). Germination, seedling growth and relative water content of shoot in different seed sizes of triticale under osmotic stress of water and NaCl. *African Journal of Biotechnology* 7, 2862-2868.

Ministry of Agriculture and Forestry, Statistics Division (2014). Khartoum, Sudan

Mohammed, A.B.A. (1988)**.** *Effect of Irrigation and Fertilization on Wheat (Triticum astivum) L. Growth on Salt Affected Soil.* M.Sc. Thesis (Agric.), Faculty of Agriculture, University of Khartoum, Sudan.

Munns, R. (2005). Genes and salt tolerance: bringing them together. *New Phytology* 167, 645-663.

Rukavina, H.I.; Kolak, H.S. and Satovic, Z. (2002). Seed size, yield and harvest characteristics of three Croatian spring malting barley. *Die Bodenkunde* 53, 9-12.

Rumbaugh, M.D.; Johnson, D.A. and Pendery, B.M. (1993). Germination inhibition of alfalfa by two-component salt mixtures. *Crop Science* 35, 1046-1050.

Taiz, L. and Zeiger, E. (2002). *Plant Physiology*. 3rd Ed. Sinauer Associates Inc. Sunder Land.

Yohannes, G. and Abraha, B. (2013). The role of seed priming in improving seed germination and seedling growth of maize (*Zea mays* L.) under salt stress at laboratory conditions. *African Journal of Biotechnology* 12 (46), 6484-6490.

تأثيرحجم البذرة والملوحةعلي الإنبات والنموالخضري لمحصول القمح الصنف إمام

هنادى إبراهيم الدسوقى وعلياء حياتي الشيخ

قسم المحاصيل الحقلية- كلية الزراعة- جامعة الخرطوم- السودان

المستخلص: لدراسة تأثير حجم البذرة والملوحة علي الإنبات والنمو الخضري لنباتات محصول القمح (الصنف إمام) , أجريت تجربة معملية وتجربة أصص خلال الموسم الشتوي 2016. أجريت التجارب بمعمل البذور كلية الزراعة، قسم المحاصيل الحقلية، ومشتل كلية الزراعة ، جامعة الخرطوم ،شمبات. إختيرت معاملات حجم البذرة علي أساس قطر البذرة وعليه، قسمت أحجام البذور الي ثلاثة أقسام وهي: الصغيرة; المتوسطة والكبيرة. و كانت تراكيز الملوحة (EC0)الشاهد EC2; (0.24 mM) NaCl L^{-1}); EC4 (0.28 mM NaCl L^{-1}); EC6 (0.39 mM NaCl L^{-1}); EC8 (0.41 mM NaCl L^{-1}) ; EC10 (0.59 mM NaCl L^{-1}). صممت التجارب بإستخدام التصميم كامل العشوائية بمكررين لتجربة إختبار الإنبات وثلاثة مكررات لتجربة الاصص. تم جمع بيانات عن: نسبة الإنبات فى اليوم الرابع واليوم الثامن بعد الزراعة; طول النبات; عدد الاوراق في النبات; مساحة الورقة; عدد الخلف في النبات و وزن المادة الجافة. أظهرت النتائج أن حجم البذور لم يؤثرمعنويا علي نسبة الإنبات بينما كان للملوحة تأثير معنوي علي نسبة الإنبات فى القرائتين سجلت البذور صغيرة الحجم أعلى نسبة إنبات عند مستويات الملوحة EC4و EC10. بالنسبة لتجربة الاصص أظهرت النتائج أن حجم البذور لم يؤثرمعنويا علي كل الصفاة التي درست إلا أن البذور ذات الحجم الكبير أظهرت أداء افضل مقارنة بأحجام البذور الأخرى. كان للملوحة تأثير معنوي سالب علي كل صفاة النمو التي قيست، كما ادت الي إنخفاض إنتاجية المادة الجافة بنسة 10.4%،11.7%، 47.7%، 38.5 % و 72.2 % عند المستويات EC2; EC4; EC6; EC8وEC10 علي التوالي مقارنة بالشاهد. يجب إجراء المزيد من البحوث لتأكيد النتائج عن تأثير الملوحة على إنبات ونمو محصول القمح الصنف (امام) .