Vol. 4, No. 8 August 2014 ISSN 2225-7217
ARPN Journal of Science and Technology
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http://www.ejournalofscience.org

Effect of Salinity on Germination and Early Seedling Growth of Chickpea (Cicer Arietinum L)

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ABSTRACT

Salinity is one of the major stresses especially in arid and semiarid regions which severely affected seed germination, early growth stages and consequently crop production .This research was carried out in order to test the effects of different salinity levels on seed germination and early seedling growth of chickpea (*Cicer arietinum* L.).Pot experiment was conducted using completely randomized design in four replications in May 2014 at Faculty of forestry sciences nursery. University of Zalingei, Sudan. Experimental treatments includes 4 levels of Na Cl concentrations (0, 0.5, 1.0 and 1.5%).Results showed that the number of germinated seeds, germination percentage ,plumule length ,radical length, and heaviest wet and dry seedling weights were higher in the control treatment. High salinity level (1.5%) reduced germination percentage significantly ($p \leq 0.05$).Maximum germination percentage (98%) was observed in the control treatment and the minimum (58%) was found with 1.5% Na Cl concentration. Seedling length decreased with increasing NaCl concentration. The differences were highly significant ($p \leq 0.01$).The reduction in seedling length were 44%,13.5% and 2.7% for 1.5,1.0 and 0.5% Na Cl concentration relative to control. Seedling fresh and dry weights followed the same trend of seedling length that shoot fresh and dry weights reduced with increasing salinity level, high salinity (1.5%) resulted in highly significant reduction($p \leq 0.01$) in both parameters measured . Although, fresh and dry weights were decreased but the differences when compared the control with 0.5% and1.0% were not significant .high salinity (1.5%) decreased fresh weight by39%, While, dry weight reduction was 44.8% relative to the control.

Keywords: *chickpea, germination, salinity, seedling growth.*

1. INTRODUCTION

Salinity is one of the major environmental factors that lead to deterioration of agricultural land and reduction in crop productivity worldwide. It is one of the major stresses especially in arid and semiarid regions, it impairs seed germination, reduces nodule formation and reduce crop yield [11]. Chickpea is salt sensitive and its yield is seriously reduced particularly by chloride salinity [15].The effects of salinity on chickpea are wide ranging, which varies from germination to vegetative stage and tolerance of chickpea for salinity differs from genotype to another [4 ; 3and 12]. [6] reported that the Na Cl content influenced seed germination and concentrations above 50mol.m^3 decreased germination and seedling growth .Similar findings were recorded by [17] that salinity had significant effect on seed germination and seedling dry weight .[1]found that salt concentration has significant effect on seed germination and seedling growth parameters ,these characters decreased significantly with increasing salt concentration from 2 - 20 dsm-1.Result of experiment conducted by [13]showed no effect of Na Cl treatment was observed on frequency of germination ;however ,a drastic decrease in early seedling growth was recorded at increase Na Cl concentration. Effect of salinity stress on germination and seedling growth in different crops were tested by many workers, [5] studied salinity stress in common bean, and he found that all the examined parameters were decreased with increasing Na Cl concentration, except mean germination time. When,[16] reported that salinity significantly delayed germination and germination counts at 300-400 Na Cl. seedling emergence ,fresh and dry mass of both shoots and roots as well as seed yield also decreased with increasing salinity .The percentage and speed of germination , plumule length , radical length and heaviest wet and dry seedling weight were higher in control treatment [14].Similar results with different crops were reported by many researchers [2 ; 19 and 20]. The present study was conducted to investigate the effects of salinity on the germination and early seedling growth of chickpea.

2. MATERIALAS AND METHODS

Pot experiment was conducted in the faculty of forestry sciences nursery, University of Zalingei, Sudan in May 2014.The seeds of chickpea obtained from zalingei market .Purity and germination tests were done. Seeds were hand sorted to eliminate broken seeds, infected seeds, and inert materials. They were weighted for purity percentage calculation. Purity percentage = weight of pure seeds / total weight ×100.Then sorted healthy seeds were allowed to germinate in pots containing 8kg loamy soil .25 seeds were sown in every pot. The planted seeds were irrigated with the test solution for the 4 treatments (distilled water 0.0% Na Cl as control, 0.5%1%, and1.5%Na Cl) replicated 4 times in completely randomized design (CRD). The flowing parameters were studied: number of germinated seeds, germination percentage, number of leaves/plant, seedling (plumule) and root (radial) length, seedling and root fresh and dry weights. From the 5^{th} day the germinated seeds were counted daily in specific time (at early morning) .At that time, those seeds were considered germinated when the plumule was sprouted of the soil .Counting continued till there was no new germinated seeds appears (the number of the germinated seeds being constant after 10 days from sowing).Germination percentage (GP) was

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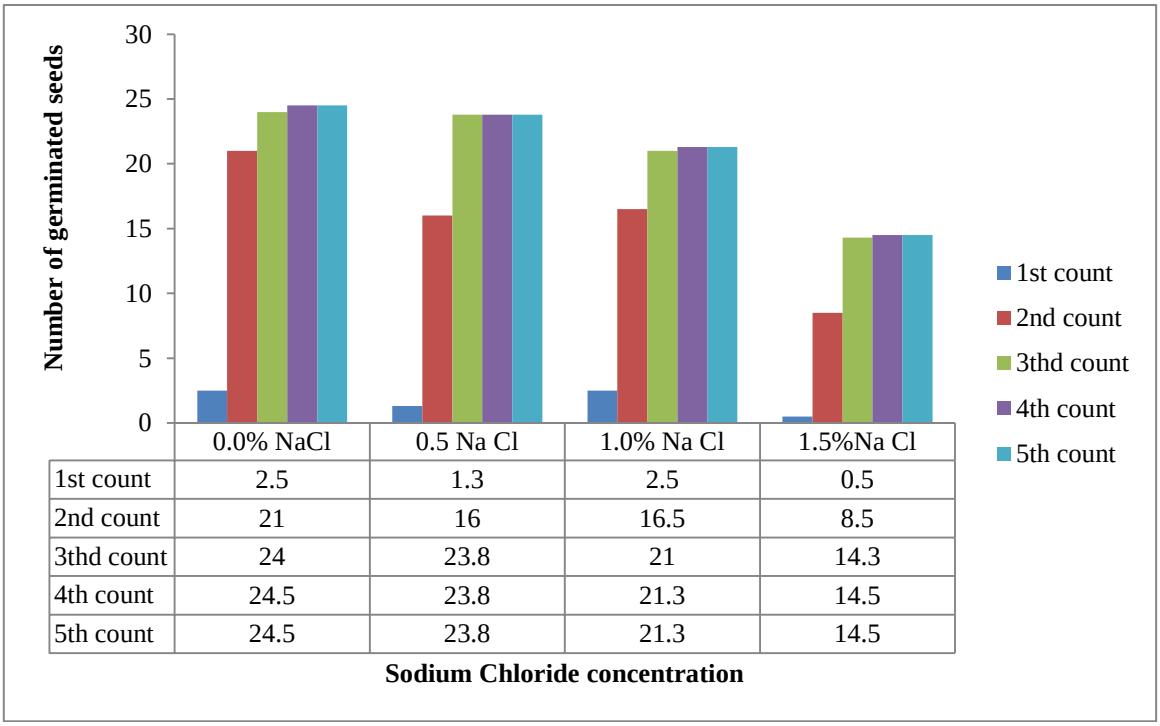
counted using the formula: GP =$N^i/N\times100$ [14]. Ni = number of germinated seeds till i^{th} day. N = total number of seeds. At the end of the experiment (10 days) 10 plants from each pot were randomly selected, their leaves were counted seedling length was measured from the soil surface to the newly grown leaf. Then they removed from the pots carefully .Radicals and plumules were separated and weighted separately to obtain shoot (plumule) and root (radical) fresh weights. In order to measure their dry weights, shoot and root were putted in oven of 70 c^0 for 24 hours. Then dry weights were obtained using sensitive balance. The data collected was statistically analyzed by completely randomized design procedure. The least significant difference (LSD) was used to compare the treatments means. [10].

3. RESULTS AND DISSCUTION

Purity test results indicated that the purity percentage was 96.4%, the broken seeds and the inert materials were 3.22% and 0.23% respectively. Results in (Fig1) indicated that salinity significantly affected seed germination at all counts except for the first count. It was observed that high salinity level (1.5%) significantly ($p \leq 0.05$)decreased number of germinated seeds compared with other treatments, however, the control recorded the highest number of germinated seeds but the differences were not significant when compared with the other treatments(0.5% and1.0%Na Cl) .



	0.0% NaCl	0.5 Na Cl	1.0% Na Cl	1.5%Na Cl
1st count	2.5	1.3	2.5	0.5
2nd count	21	16	16.5	8.5
3thd count	24	23.8	21	14.3
4th count	24.5	23.8	21.3	14.5
5th count	24.5	23.8	21.3	14.5

Fig 1: Effect of salinity level on germination of Chickpea Seeds

High salinity level (1.5%) reduced germination percentage significantly ($p \leq 0.05$).Maximum germination percentage (98%) was observed in the control treatment and the minimum (58%) was found with 1.5% Na Cl concentration (Table 1).the difference between the control and the high concentration level was highly significant ($p \leq 0.01$),while, the differences between the other treatments were not significant ,but the germination percentage decreased with increasing salinity level(95% and 83%) for ,0.5% and1% Na Cl concentration respectively .These results corresponds to [11 ; 14] who stated that germination was directly related to the amount of water absorbed and delay of germination was related to the salt concentration of the medium. [18] Stated that as the levels of salinity were enhanced, germination rate was declined. Results obtained by [16] were in the same line that salinity significantly delayed germination and germination counts at 300-400mMNaCl.

Table 1: Effect of salinity level on seeds germination % of chickpea

Treatments	0.00%Na Cl control)	0.50% Na Cl	1.00% Na Cl	1.50% Na Cl
Germination %	98.0	95.0	83.0	58.0
LSD	15.91**			
C.V%	8.5			

** Significant at ($P \geq 0.01$)

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The number of leaves/ plant decreased as Na Cl concentration increased (Table 2).the number of leaves decreased significantly ($p \leq 0.01$) as Na Cl increased to 1.5% when compared to control which produced the highest number of leaves while, the differences between control and the other treatments were not significant .Seedling length decreased with increasing NaCl concentration, as salinity level increased the seedling length decreased these results in line with those reported by [12] .The higher salinity level produced the shortest seedling compared with other treatments. and the differences were highly significant ($p \leq 0.01$).The reduction in seedling length were 44%,13.5% and 2.7% for 1.5,1.0 and 0.5% Na Cl concentration relative to control. Seedling fresh and dry weights followed the same trend of seedling length that shoot fresh and dry weights reduced with increasing salinity level high salinity (1.5%) resulted in highly significant reduction($p \leq 0.01$) in both parameters measured . Although, fresh and dry weights were decreased but the differences when compared the control with 0.5% and1.0% were not significant .high salinity (1.5%) decreased fresh weight by39%, While, dry weight reduction was 44.8% relative to the control. Similar results were reported by [2 ; 3 ; and 9] . This reduction may be due to effect of salt in osmotic potential to the point which prevent the uptake of water and nutrients, or may be due ion toxicity that resulted in decline of shoot growth. Salinity reduces the amount of water extractable from soil by chickpea and induces osmotic potential adjustment [7].

Table 2: Effect of salinity level on chickpea seedlings growth parameters

Treatments	No. of leaves/seedling	Seedling length (cm)	Seedling fresh weight (g)	seedlings dry weight (g)
0.00%Na Cl control)	4.6	11.10	3.85	0.58
0.50% Na Cl	4.4	10.89	3.83	0.58
1.00% Na Cl	4.0	9.60	3.60	0.56
1.50% Na Cl	3.2	6.20	2.35	0.32
LSD	0.76**	2.88**	1.17**	0.066**
C.V%	8.2	13.6	15.3	2.3

* Significant at (P≥0.05)
** Significant at (P≥0.01)

Results in Table (3) showed that root (radical) length and dry weight of chickpea were not affected significantly by salinity level .These results contrast with results obtained by [14] ,this might be due to the variation in growing medium and the environment which is soil and nursery in this study compared with Petri-dish and laboratory. Soil properties and environment might affect root development and water retention which induced better root growth in the short duration time. However, the differences were not significant but the control produces the longest root (7.95 cm) and the heavier root dry weight (0.23g) compared with other treatments. In the other hand as shown in table (3) salinity level significantly ($p \leq 0.05$) decreased shoot and root fresh especially with high concentration compared to control, this might be due to the effect of salinity level on water uptake .in low salinity level root can absorb more water than in high salt media due to osmotic effect .These results were in line with results reported by [12 and 21].

Table 3: Effect of salinity level on chickpea root growth parameters

Treatments	Root length (cm)	Root fresh weight (g)	Root dry weight (g)
0.00%Na Cl control)	7.95	0.67	0.23
0.50% Na Cl	7.05	0.38	0.14
1.00% Na Cl	7.10	0.37	0.15
1.50% Na Cl	7.20	0.26	0.14
LSD	1.48^{ns}	0.396*	1.7^{ns}
C.V%	8.9	41.9	40.7

* Significant at (P≥0.05)
ns = not significant

4. CONCLUSION

The current study indicate that increasing Na Cl concentration effected seed germination, germination percentage, plumule length, radical length, fresh and dry weights of plumule and radical of chickpea. Salinity effect under pot experiment and field may not be the same to the laboratory experiment due to the variation of the environmental and soil conditions.

ACKNOWLEDGMENT

Appreciation is extended to the nursery staff, faculty of forestry sciences and the Chemistry Laboratory Staff, University of Zalingei, Sudan for their assistance.

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