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THE ROLE OF POTASSIUM CHLORIDE IN REDUCING THE EFFECT OF SODIUM CHLORIDE ON GERMINATION AND ROOT GROWTH OF WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

The aim of study is to determine the effects of potassium chloride and sodium chloride combinations on germination and rooting rate in wheat. Four treatments were used (Distilled water, NaCl 100 mmol/L, NaCl 100 mmol/L+KCl 100 mmol/L, NaCl 100 mmol/L+ $CaCl_2$100 mmol/L) were used for two varieties of wheat (Dijlla, 1999). was carried out in laboratories at Department .of Biology, Tomsk University state during winter season 2017-2018. The results showed that the percentage of seed germination of the two cultivars in all treatments, where the Variety Iba 99 is superior to the Dijlla in all treatments, NaCl + $CaCl_2$ percent was found to be more than sodium salts alone differed significantly($P<0.05$). Results showed a significant effect of root length due to treatments, the highest root length was noticed in Dijlla variety treated with NaCl+$CaCl_2$ (1.23 cm) while the shortest length root was noticed in the same variety which treated with NaCl (0.66 cm).

***Keywords*:** Potassium chloride and sodium chloride, growth, Wheat.

Introduction

The establishment of the wheat crop is the first goal to be considered when cultivating in unsuitable environmental conditions such as saltwater irrigation. This goal is achieved by ensuring rapid and consistent germination. The germination stage is one of the most sensitive stages of salinity in the wheat crop. That salt stress Decrease in germination and seedling growth (Hampson, *et al.*, 1990).especially since wheat is classified as a semi-tolerant crop of salinity (Ragab *et al.*, 1990) .Salinity carries a complex character that is dominated by many genes (Jain *et al.*, 1997). Increased salt content in the soil or in irrigation water leads to increased ammonia pressure which reduces the readiness of free water in the root area and is similar to this condition. The stress resulting from the drought, which reduces the growth due to the low voltage in the leaves (Mass, 1986). This is confirmed by the fact that the harmful effect of the salts on the plant comes from the inability of the plant to absorb the water necessary for the activities of the vitality and to create a state of chemical dehydration and nutrient imbalance (Yoko 2002). The nutrient imbalance results from the competition of Na^+ and Cl^- with nutrients such as K^+, Ca^{+2}, NO_3 (Yuncai and Schmidhaher, 2005). From our point of view, one of the interesting and truly practical problems is determining the optimal concentration of calcium in a medium in which the stability of the or other plant species to the action of excessive salinity will be maximum. And in this sense, it is difficult to overestimate the importance of experiments on intact plants in aquatic culture. the major aim of the current study is to determine the suitable concentration of KCl and NaCl than reducing the harmful effects of salts on germination and rooting rate in wheat under laboratory condition and using the results as guidelines to improve wheat growth under farming conditions.

Materials and Methods

A global experiment was carried out by four factors Completely Randomized Design (CRD) three replicates in laboratories at Dep. of Biology, Tomsk University state during the years 2017-2018. The first treatment was two varieties of soft wheat (Iba 99, Tigris) and the second treatment is (Distilled water H_2O, NaCl, NaCl + KCl , NaCl + $CaCl_2$). The seeds of the wheat varieties were grown on filter paper in Petri dishes dripping 15 cm in each dish 25 seed in each dish. The dishes were then placed in an incubator and the temperature was set at 25 °C. After 48 hours, the percentage of germination seed length and root length was studied. Data were analyzed by Statistical analyses computer program (SAS, 2102) and the liner model was:

$$Yijk = \mu + Ti + eijk$$

Where:

μ: is an overall mean
Ti: effect of treatment (NaCl , KCl and combinations)
Eijk: is a random error.

Duncan's multiple range test (Duncan, 1955) was used to compare differences among means.

Results and Discussion

Results represented in Table 1 showed a significant effect ($P<0.05$) of germination rate in both varieties of wheat resulting from treatments, the highest germination rate in Dijlla variety was recorded in distilled water namely, 88% compared with the lowest value with recorded in NaCl+$CaCl_2$ treatment namely 70%.

Table 1: Effect of NaCl and KCl on germination rate in wheat.

Germination rate % (Means + Sd)		
Variety	**Dijlla**	**Iba99**
Treatments		
Distilled water	88.0±4.14 a	84.0±4.09 a
NaCl	71.4±3.25 b	69.3±3.11 b
NaCl+$CaCl_2$	70.7±2.10 b	84.0±5.31 a
NaCl+Kacl	72.0±3.07 b	72.0±2.95 b
Level of significance	*	*

Means with different letters in the same column differed significantly ($P<0.05$)

Due to Iba99, there was a significant difference (P<0.05) among treatments in germination rate, the highest rate was recorded in distilled water and treatments (84%) while the lowest rate which was in NaCl treatment (69.3%).

The results indicated a significant differences between the two varieties of wheat according the different treatments, Dijlla variety was the higher germination rate than Iba99 variety in distilled water treatment, the rates were 88 and 84% respectively (Table 2).

Table 2: Effect of NaCl and KCl on germination rate between varieties.

Germination rate % (Means + Sd)			Level of significance
Variety	**Dijlla**	**Iba99**	
Treatments			
Distilled water	88.0±4.14 a	84.0±4.09 a	*
NaCl	71.4±3.25 b	69.3±3.11 b	NS
NaCl+$CaCl_2$	70.7±2.10 b	84.0±5.31 a	*
NaCl+KaCl	72.0±3.07 b	72.0±2.95 b	NS

Means with different letters in the same row differed significantly (P<0.05)

A significant differences (P<0.05) between wheat varieties in germination rate in NaCl + $CaCl_2$ treatment. The rate increased in Iba99variety compared with the rate in Dijlla variety namely, 84 and 70.7% respectively. Results also showed no significant difference between varsities in germination rate in cases of NaCl and NaCl + KaCl treatments.

The current results are according with the past results which indicated that the plant metabolism was affected highly by the levels of salts in both soil or irrigation water in wheat as well as other plants (Soltani *et al.*, 2008 and AL-Saady, 2015). Azar and Khdijch (2006) reported that the germination rate decrease significantly with increasing of NaCl (0–375 mMol/L) while Mujeeb-ur-Rahman *et al.* (2008) reported that the germination rate reduce significantly with salinity increasing (9.67 ds/m).

The results indicated a significant differences between the two varieties of wheat according the different treatments, Dijlla variety was the longer root length than Iba99 variety in distilled water treatment, the values were 2.50 and 1.84 cm respectively (Table 3). The other treatments indicated that the root length increased significantly in Dijlla variety treated with NaCl + $CaCl_2$ (1.23 cm) while the longest root length in Iba99variety was recorded in NaCl and NaCl + KaCl treatments (0.95 cm).

Results represented in Table 4 showed a significant differences among varieties in every treatment, due the distilled water treatments the Dijlla variety was the higher root length compared with Iba99 variety namely, 2.5 and 1.84 cm respectively.

Table 3: Effect of NaCl and KCl on length of root in wheat.

Length of root /cm (Means + Sd)		
Variety	**Dijlla**	**Iba99**
Treatments		
Distilled water	2.50±0.13 a	1.84±0.08a
NaCl	0.66±0.35b	0.92±0.05b
NaCl+$CaCl_2$	1.23±0.14a	0.89±0.08b
NaCl+KaCl	1.17±0.07a	0.92±0.05b
Level of significance	*	*

Means with different letters in the same column differed significantly (P<0.05)

Due to the other treatments, the highest root length was noticed in Dijlla variety treated with NaCl+$CaCl_2$ (1.23 cm) while the shortest length root was noticed in the same variety which treated with NaCl (0.66 cm).

Table 4: Effect of NaCl and KCl on length of root between varieties.

Length of root /cm (Means + Sd)			Level of significance
Variety	**Dijlla**	**Iba99**	
Treatments			
Distilled water	2.50±0.13a	1.84±0.08a	NS
NaCl	0.66±0.35b	0.92±0.05a	*
NaCl+$CaCl_2$	1.23±0.14a	0.89±0.08b	*
NaCl+Kacl	1.17±0.07a	0.92±0.05a	NS

Means with different letters in the same row differed significantly (P<0.05)

In conclusion, we can conclude from the current results that increased NaCl concentrations leads to inhibited germination and root length of wheat significantly with increased salts stress but the addition of another salts such as $CaCl_2$ or Kacl enhanced the plant performance under NaCl stress and help the plant to be more resist for the negative effects of NaCl.

The current results came accordance with many past studies which to referred to the soil and water salinity and negative effects on roots livability in wheat and limit the crop yield (Tu *et al.*, 2014; Rubin *et al.*, 2016 and Wu *et al.*, 2018)

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