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Original Research Article

The effect of NaCl on germination parameters of Wheat (*Triticum aestivum* L.)

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Abstract

Wheat as an important staple food crop that is facing serious threat by increasing the phenomenon of salinity in the vast area worldwide. Due to climate change, more arable lands are going to be depended on irrigation which causes raising of salinity in the soil where then affect negatively on seed germination and growth of plants. Araz, is one of the used wheat cultivar in Iraq and Kurdistan where it was tested for its salt tolerance level by using salt solutions 0.01, 0.02 and 0.05 mol L-1, which answer to 0.58, 1,17 and 2,92g -1, and comparing these solutions as TDS (Total Dissolved Solids) to Electrical Conductivity (Soil Extract) EC(dS/m) for salt tolerance classification. The results showed significant effects of salt level 0,01 molL-1 on germination parameters except for seed water uptake. By increasing salt levels to 0.02mol and 0.05molL-1 the effects are negatively increased. What is concerning the effect of salt levels on growth parameters, the obtained results indicated that generally and without exception negatively effects of salt levels on growth parameters but. There were no difference effects between salt levels 0.01mol/L and 0.02molL-1on fresh weight of radicle, while increasing salt levels to 0.02 molL-1 up to0.05 molL-1the effects on growth were more severe. Salt level 0.05 molL-1 which is equivalent to TDS range 2,000-5,000 mgL-1 and it is answer to 3,0 -7,5 EC (dS/m , seen as not tolerance for cultivation wheat cultivar Araz.

Keywords: Climate change Salinity Germination Growth EC salt tolerance level.

INTRODUCTION

Wheat is one of the most important crop plants worldwide with an annual production of about 736 million metric tons [1], but suffers significant grain yield losses due to soil salinity [2].

The impact of global climate change on increasing salinity has been confirmed by studies conducted by [3, 4], where they stated in their studies that increasing salinity level has negative effect on both human and plant life.

Due to climate change, more arable lands are going to be depended on irrigation which causes raising of salinity in the soil (www.agric.wa.gov.au) in many arid and semi-arid areas including Iraq and Kurdistan Salinity has become a main abiotic stress due to high temperature that causes evaporation and lead to salt accumulation in soil and it is affecting plant growth [5].

Attak et al., [5], confirmed in their study, that the concentrations of salts have detrimental effects on germination of seeds and plant growth, that causes the delay of germination and growth of seedlings.

The response of wheat to salt stress is genetically and physiologically controlled and may differ from one growth stage to another. Thus, a better understanding of these mechanisms and processes would help in the breeding programmes to enhance wheat production under salt stress [2]. Strategies to increase wheat production in the salt- affected areas (such as leaching and drainage), the cultivation of tolerant genotypes is recognized as the most effective way to overcome this limitations. The prerequisite is the identification of wheat genotypes with proven wide adaptation under saline conditions [2] and therefore identification of salt tolerance level is essential for each crop In saline areas to determine its possibility for adaptation.

The EC is used as criteria for screening test of cultivars to salinity tolerance and it is necessary to be used to find reasonable soil for a required cultivar [6]. The objective of this study is to determine Araza's salt tolerance degree by comparing its DTC levels to Ec classifications [7, 4].

The Objective of this Research

The objective of this research is to start studying the effects of different salt levels on each Wheat (Triticum aestivum L.), cultivars, and hereby began with Araz cultivar, were study the effect of salt levels on germination parameters and to determine the salt tolerance level of cultivar Araz.

MATERIAL AND METHODS

The study was carried out in the laboratory of the department of Bio-Technology and Crop Science in the College of Agriculture Science at Sulayamani University where I used the seeds of wheat (Araz cultivar) which had been obtained from the laboratory of crop Science. The experiment carried out by preparing three levels of salt solution (0.01, 0.02 and 0.05 $molL^{-1}$), which equivalents to 0.58, 1.17 and 2.92 gL^{-1} of NaCl respectively in sterilized water as well as in control.

After the obtained seeds were sterilized in 70% diluted Ethanol solution for 2 minutes then they were washed with sterilized water. Seeds were put in Petri dishes (10 seeds per Petri dish) containing filter paper (Whatman No.1) and were added 10 ml of salt solutions (0.01,0.02 and 0.05 $molL^{-1}$). The seeds in dishes were covered with filter papers to prevent pollution and evaporation until they began to germinate in 20-25°C, and humidity degrees 50-60%. After germination, the filter papers removed and then in 10 days were examined for the effects of these concentrations levels on seed percentage germination(SPG), germination speed(GS), seed water uptake and salt tolerance as well as radical and plumule were tested for growth by measuring length of radical and Plumule and their dry and fresh weight. The dry weight was measured after drying at 65ºC for 48h.

SPG %= (Number of germinated seeds/number of cultivated seeds) × 100….... (Mehmet and Kaya, 2006 [8]).

GS = n1/d1+n2/d2+n3/d3+ ……………. (Czabator and Germination, 1962 [9]).

Where,

n = number of germinated seeds, d= number of days.

Water uptake%= (W2-W1/W1) × 100

W1 = Initial weight of seed

W2 = Weight of seed after absorbing water in a particular time …………….. (Mehmet and Kaya, 2006 [8]).

$$\text{Salt tolerance} = \frac{\text{Particular treatment}}{\text{Germination/ growth in control}} \times 100$$

……………. (Oyiga, 2016 [2])

Experimental Design and Statistical Analysis

The experiment was carried out as a completely randomized design with three replications per treatment, and the results were analyzed statistically through one way ANOVA using (XLSTAT) program, and all possible comparisons among the means were conducted following Duncan multiple range test at significant level of (0.01).

RESULTS

Germination

Table-1 shows, that the control treatment exceeded the rest in the character of germination percentage, while there were no significant differences between control and the concentration 0.01$molL^{-1}$, and the lowest germination percentage showed by 0.05$molL^{-1}$. But the difference of germination percentage between 0.01$molL^{-1}$ and 0.02 $molL^{-1}$ was no significant. Both, germination speed and salt tolerance in control treatment exceed the other treatments, however, there are highly significant differences between other concentrations 0.01., 0.02 and 0.05$molL^{-1}$. Control treatment of seed water uptake % exceeded the concentrations of 0.02 molL-1and 0.05$molL^{-1}$, while there was no difference between control treatment and salt concentration 0.01$molL^{-1}$.

Table-1: The effects of salt concentrations on germination percentage, germination speed, salt tolerance and seed water uptake%

Salt concentrations $molL^{-1}$	Germination Percentage %	Germination speed (seed/day)	Salt tolerance (%)	Seed water uptake %
control	96.667 a	1.867 a	108.333 a	40.270 a
0.01	81.667 b	1.667b	74.400b	39.137 a
0.02	71.333 b	1.467c	53.333c	37.150b
0.05	36.667 c	0.500d	47.00c	32.887c

Means followed different letter within a column are significantly different P≤0.05.

Growth

Results in Table 2 shows, that control treatment exceeded all salt solution treatments 0.01, 0.02 and 0.05 molL-1 for the length of the radicle, length of plumule and dry weight of radicle.

The character of the fresh weight for radicle, the treatment of control exceeded only the concentration of 0.05molL-1, while there was no significant difference between control and concentrations 0.01 and 0.02molL^{-1}, but on the other hand there was no significant difference between concentrations 0.01molL^{-1}, 0.02molL-1and 0.05mol/L. In addition, the character of fresh weight for plumule the treatment of control exceeded the other treatments except for the concentration 0.01molL^{-1}, and there was no significant difference between concentrations 0.02molL^{-1}and 0.05molL^{-1}.The final character, dry weight for plumule the treatment of control exceeded all the other treatments, but there were no significant difference between concentration 0.01molL^{-1} and 0.02molL^{-1}, while they surpasses the concentration 0.05molL^{-1}.

Table-2: The effect of salt germination on growth parameter, length of radicle and plumule, fresh weight of radicle and plumule, dry weight of radicle and plumule

Salt concentrations molL -1	Length of Radicle (cm)	Length of Plumule (cm)	Fresh weight of Radicle (gm)	Dry weight of Radicle (gm)	Fresh weight of Plumule (gm)	Dry weight of Plumule (gm)
control	8.067 a	6.900 a	0.068 a	0.006 a	0.059 a	0.007 a
0.01	5.267 b	4.600 b	0.041ab	0.005 b	0.044 a	0.005 b
0.02	3.133 c	2.767 c	0.037ab	0.003 c	0.025 b	0.004 b
0.05	1.900 c	1.767 c	0.026 b	0.002 c	0.016 b	0.003 c

Means followed different letter within a column are significantly different $P \leq 0.05$.

DISCUSSION

There are a rare researches have been done in both Iraq / Kurdistan regarding the effects of salinity on cultivated crops and also very rare studies about individual crop varieties salt tolerance degree /level. However, we realized in the study, the higher salt level the more significant effects, particularly between 0.01molL^{-1} and 0.05 molL^{-1}, but what is concerning the fresh weight of radicle there are no significant difference between salt levels, and explanation for this is, the fresh radicles contain water which reduce the effect of salt in relation to dry weight of radicle (gm). In regard to [7], we can realize that, wheat cv. Araz has less salt tolerance in compare with durum wheat. Wheat cv. Araz is significantly affected by 0.05 mol/L which approximately answer to 3000 TDS which is equivalent to 1.5-3 EC 0.75-1.50dS/m which is cv. Araz not tolerating. Therefore, it is recommended cultivation of cv. Araz in a soil where EC is between (0.75-1.50dS/m).

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