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Response of some new wheat varieties (Triticum aestivum L.) to salinity in iraqi kurdistan region

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ABSTRACT

Aim: The main objective of the study was to estimate response of some wheat varsities and the effect of varieties on the given water uptake, germination and growth parameters and then determinant the salt tolerance level of varieties and compare salinity tolerance between varieties to identify.

Materials and Methods: Charmo, Maroof and Alla were new promising rust-resistant wheat varieties had been tested for their salinity tolerance through seed water uptake, (germination percentage and germination mean), as well as the growth of radical and plumule. The varsities were tested for their salt tolerance level by using salt solutions concentration levels with a control, 0.01, ,0.03.0,05, 0.07, and 0.09 molL -1, which were answer to 0.0, 0.58, 1.75, 2.9 , 4.01 and 5.26 gL -1, that symbolized as C0, C1, C2, C3, C4 and C5.

Results: The results showed significant effects of varsities on water uptake, germination percentage germination meantime, wet and dry radical, but not significant effect on radical number and length as well as plumule length and wet dry plumule. The effects of salt levels on germination parameters and growth of varieties, a significant effect of salt on germination mean, germination percentage, radical and plumule length as well as on wet radical weight. And the interaction between varsities and salt levels, the result has shown a significant effect of interaction between varsities and salt levels on dry radical. Salt levels from C3 have indicted to have a significant effect on germination on wet radical but not a significant effect on water uptake, dry radical, as well as on wet and dry plumule.

Conclusion: It was concluded that the effect of varieties on germination and growth parameters showed that charmo and maroof are better than Alla, Charmo and Maroof found tolerating C2 inspite of Alla.

Keywords: Salinity, New wheat varieties, Germination, Wet and dry radical, Plumule, Tolerance lev, EC dS/m.

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Introduction

In recent years, wheat production levels have not satisfied demand, triggering price instability and hunger riots. With a predicted world population of 9 billion in 2050, the demand for wheat is expected to increase by 60% (FOA). The beginning of the 21st century is marked by global scarcity of water resources, environmental pollution and increased salinization of soil and water. Increasing human population and reduction in land available for cultivation are two threats for agricultural sustainability (Shrivastava and Kumar, 2015 and Shahbaz and Ashraf, 2013).

In arid and semi-arid regions with low rainfall and high temperature, salinity is one of the major environmental stresses which reduce plant growth. In these regions, Groundwater continuously moves towards cultivation (Nadeem et al., 2013 and Li et al., 2003). The extent of salinity damage to plants depends on a number of different factors including species, genotype, plant growth phase, ionic strength, duration of salinity exposure, the composition of the salinizing solution, and which plant organ is exposed (Robin et al, 2016). Regarding the effects of salinity on nutrients and water uptake by the plant, as well as physiological aspects (Munnes and Tester, 2008) confirmed that the salinity effect the availability of nutrients and water as well as induces osmotic stress which reduces the growth and photosynthesis in plants.

The stage of germination, root formation, and seedling growth are the primary stages for plant growth and its response to its biotic and abiotic environment and be used as measurement for plant tolerance in the given environment (Biabani et al, 2013 and Ghoulam and Fares 2001). It was stated that germination is a critical stage of the plant cycle and improved tolerance of high salinity could improve the stability of plant production (Kader and Jutzi, 2004). Mean germination time of pepper seed lots (Capsicum annuum L.) that the reciprocal of the rate of germination has been shown to be highly indicative of emergence performance in seed lots pepper in transplant modules (Demir et al., 2008). It was about importance of dry matter stated that dry matter content which is the chemical potential of the crop and reflects its true biological yield (Mbah EU and Okoro, 2019).

Growth reduction due to salinity is attributed to ion toxicity and nutrient imbalance, which causes not only high sodium (Na^+) and chloride (Cl^-) accumulation in plants, but also antagonistically affects the uptake of essential nutrient elements such as potassium (K^+), calcium ($Ca2^+$) and magnesium ($Mg2^+$) in competition with Na^+ and also nitrate ($NO3^-$) in contrast with C^{-l} (Esfandiri et al, 2011, Zörb et al, 2004 and Sairam et al., 2002).

As a temporal difference in plant response to salinity (Robin et al, 2016 and Munns, 2005) hypothesized that after exposure to salinity a first phase of growth reduction of plants occurs rapidly due to an 'osmotic effect' and a second phase of growth reduction, which is a much slower process, taking days to weeks, arises from a 'salt-specific effect' through accumulation of salt ions, primarily in older leaves (Robin et al, 2016, Munns, 2002 and Munns, 2005).

The objective of this research was to study the response of some wheat varsities which are rust resistant in respect of the effect of salt levels that is concerning seed water uptake germination parameters, growth parameters and study the effect of varieties on the given water uptake, germination and growth parameters and then determinant salt tolerance level of varieties and compare salinity tolerance between varieties to identify most tolerant varieties to salinity.

Materials and Methods

The study was carried out in the laboratory of the Department of Biotechnology and Crop Science in the College of Agricultural Engineering Sciences at the University of Sulaimani, where we used the seeds of varsities Charmo, Maroof and Alla which are new promising rust-resistant wheat that I obtained them from the laboratory of the Department of Biotechnology and Crop Science. The experiment carried out by preparing a control and five levels of salt solutions concentration (0.01 ,0.03, 0.05,0.07 and 0.09 $molL^{-1}$), which solutions are equivalents to 0.58, 1.75, 2.92, 4.01 and 5.26 gL^{-1} of NaCl and a 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 concentrations (0.01,0.03, 0.05, 0.07.and 0.09 $molL^{-1}$). The seeds in dishes were covered with filter papers to prevent pollution and evaporation till they began to germinate in 20-25°C, and humidity degrees 50-60% with 12 hours dark and 12 hours' light. After germination, the filter papers removed and then in 10 days were examined for the effects of these salt concentrations levels on seed percentage germination(SPG), germination meantime, seed water uptake and salt tolerance as well as radical and plumule were tested for weight measuring of 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).

Mean germination time (MGT) = $\Sigma Fx/\Sigma F$; where F is the number of seeds germinated on day x. (Ansari and Ksiksi, 2016)

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).

Statistics: A factorial experiment in completely randomized design (CRD) conducted to test the five concentrations of NaCl as well as control (Distilled water), each treatment combination replicated 3 times. Two ways ANOVA used as general test, while LSD test was used for comparing between means with 99% certainty.

-Radical is used for root

- plumule is used for shoot.

Results and Discussion

The significant effect of varieties on germination percentage, germination mean time, water uptake and weight of wet and dry radical, but have no significant effect on the radicle number and length, plumule length and weight of wet and dry plumule Charmo has the heights germination mean time value and germination percentage value in relation to Maroof and Alla (Table 1). But Maroof has the higher value of seed water uptake in relation to Charmo but however maroof has the lower germination percentage and germination meantime, and it does mean, that was not necessarily the higher water uptake also means the higher germination as other factors may play role in higher germination value for example seed viability, age and the environment of the storage of seeds. However, results confirm thetcharmo and then Mahroof have better value in germination percentage, germination meant time as well as in wet and dry weight of radical in relation to Alla. Mehmet et al (2006) also reported similar findings.

The significant effect of salinity on germination, germination mean time, root and shoot length and the weight of wet radical but no significant effect on the seed water uptake, weight of dry radical, wet and dry plumule. The results indicate the direct relation between germination percentage and germination meantime with root and shoot length and wet weight of radical, and it does mean that the high salt level halter growth in both roots and shoots due to subject of salt stress (Table 2). Esfandiari et al (2011) also advocated of similar findings.

The interaction (Table 3) between salt levels and varieties and their effect on germination and growth parameters shows there is the difference between varieties interaction with salt level and their effect on test parameters. However, the interaction between salt levels and varieties has no significant effect on any of parameters except of dry radical, because of accumulation of more salt in dry radical in relation to wet radical, plumule and dry plumule. Munns (2002) also reported similar findings.

Table 1: Response of the varieties in term of the studied characters

Varieties	**Germination Mean**	**Root Number**	**Root Length (cm)**	**Shoot Length (cm)**	**Water uptake (ml)**	**Germination (%)**	**Wet Radical (g)**	**Dry Radical (g)**	**Wet Shoot (g)**	**Dry Shoot (g)**
Charmo	5.632	4.444	6.131	6.594	0.054	54.44	0.026	0.009	0.063	0.039
Maroof	4.838	4.222	5.789	6.589	0.062	53.33	0.024	0.008	0.066	0.041
Alla	1.311	4.389	5.194	6.933	0.024	17.78	0.009	0.001	0.141	0.047
LSD ($p \leq 0.01$)	0.754	n.s	n.s	n.s	0.018	9.15	0.012	0.003	n.s	n.s

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

Table 2: Effect of different NaCl concentrations on the studied characters

NaCl Conc.	**Germination Mean**	**Root Number**	**Root Length (cm)**	**Shoot Length (cm)**	**Water uptake (ml)**	**Germination (%)**	**Wet Radical (g)**	**Dry Radical (g)**	**Wet Shoot (g)**	**Dry Shoot (g)**
C0	4.80	4.556	7.872	7.611	0.046	54.444	0.042	0.007	0.064	0.044
C1	4.39	4.333	6.489	7.756	0.049	48.889	0.020	0.004	0.066	0.037
C2	4.27	4.556	5.767	7.433	0.060	44.444	0.017	0.008	0.069	0.042
C3	4.11	4.556	5.328	6.811	0.058	42.222	0.015	0.009	0.068	0.044
C4	3.32	3.667	4.056	5.133	0.034	36.667	0.009	0.005	0.149	0.051
C5	2.64	4.444	4.717	5.489	0.034	24.444	0.014	0.004	0.123	0.037
LSD ($p \leq 0.01$)	1.05	n.s	1.345	1.114	n.s	12.938	0.016	n.s	n.s	n.s

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

Table 3: The interactions effect of the varieties and different NaCl concentrations on the studied characters.

Varieties × NaCl Conc.	Germination Mean	Root Number	Root Length (cm)	Shoot Length (cm)	Water uptake (ml)	Germination (%)	Wet Radical (g)	Dry Radical (g)	Wet Shoot (g)	Dry Shoot (g)
CharxC0	6.40	4.667	7.800	7.100	0.048	70.000	0.050	0.012	0.053	0.050
CharxC1	6.17	4.667	8.033	8.100	0.039	63.333	0.033	0.006	0.060	0.030
CharxC2	5.90	5.000	6.667	7.833	0.085	56.667	0.023	0.010	0.063	0.040
CharxC3	5.83	4.667	4.8837	6.100	0.075	56.667	0.013	0.009	0.063	0.040
CharxC4	5.00	3.333	4.333	5.033	0.037	50.000	0.010	0.010	0.067	0.047
CharxC5	4.50	4.333	5.067	5.400	0.040	30.000	0.027	0.008	0.073	0.030
MarxC0	6.00	4.000	9.283	7.733	0.053	66.667	0.050	0.006	0.070	0.040
MarxC1	5.17	4.333	5.917	7.867	0.076	60.000	0.017	0.006	0.077	0.050
MarxC2	5.17	4.333	5.550	7.100	0.071	56.667	0.023	0.012	0.063	0.033
MarxC3	4.80	4.333	5.383	6.667	0.085	53.333	0.027	0.017	0.063	0.040
MarxC4	4.50	4.000	4.233	5.100	0.051	46.667	0.015	0.004	0.063	0.047
MarxC5	3.33	4.333	4.367	5.067	0.038	36.667	0.012	0.004	0.057	0.037
AllaxC0	2.00	5.000	6.533	8.000	0.037	26.667	0.027	0.002	0.070	0.043
AllaxC1	1.85	4.000	5.517	7.300	0.032	23.333	0.010	0.001	0.060	0.030
AllaxC2	1.74	4.333	5.083	7.367	0.026	20.000	0.004	0.002	0.080	0.053
AllaxC3	1.71	4.667	5.717	7.667	0.013	16.667	0.005	0.001	0.077	0.053
AllaxC4	0.47	3.667	3.600	5.267	0.014	13.333	0.003	0.001	0.317	0.060
AllaxC5	0.09	4.667	4.717	6.000	0.024	6.667	0.003	0.001	0.240	0.043
LSD (p≤0.01)	n.s	n.s	n.s	n.s	n.s	n.s	n.s	0.007	n.s	n.s

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

Conclusions

According to (Chavez,2018) classification of soil salinity tolerance to durum wheat, 0.5 mol/L /C3 that is approximately answering to 2.75 Electrical Conductivity (Soil Extract)dS/m), (Anonymouse, 2022) that is according to(FAO, 1985)*Triticum aestivum L.* is not tolerating level. In this regard, we can realize the Alla is not the tolerated variety to salinity at level C2 as do Charmo and Maaroof. According to the rustles, in general, charmo is better than Maaroof and Maaroof is also better then Alla, so it does mean that Alla is the poorest I variety in the tolerance to salinity. And Alla cannot be recommended be used in soil with over C1 but charmo can be used at level C2-C3.

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