

Response of Some New Wheat Varieties (*Triticum aestivum* L.) To Salinity in Iraqi Kurdistan Region

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Abstract

Wheat is the most widely grown crop in the world and provides 20% of the daily protein and calories for 4.5 billion people. It is the second most important food crop in the developing world after rice. Charmo, Maroof and Alla are a new promising rust-resistant wheat varieties were have been tested for their salinity tolerance through seed water uptake, (germination percentage and germination mean), as well as growth of radical and plumule. The varsities was 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 are answer to 0.0, 0.58,1.75,9.2 ,4.01 and 5.26 gL⁻¹,that symbolized as C0,C1,C2,C3,C4and C5. The results showed significant effects of varsities on water uptake, germination percentage germination mean time, wet and dry radical, but not significant effect on radical number and length as well as plumule length and wet dry plumule. What is concerning the effects of salt levels on germination parameters and growth of varieties, we noted 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 significant effect of interaction between varsities and salt levels on dry radical. Salt levels from C3 have indicted to have significant effect on germination on wet radical but not significant effect on water uptake, dry radical, as well as on wet and dry plumule. The results of the effect of varieties on germination and growth parameters showed that charmo and maroof are better than Alla. The study showed that Charmo and Maroof are toleration C2 respect but Alla dose not that is why it cannot be recommended to be used in soil with EC 0.80–2.50 which answers to C2 that is equivalent to 456–1425 mgL⁻¹ but Charmo and Maroof have more tolerance at this level respectively.

Keywords: Salinity New wheat varieties Germination Wet and dry radical Plumule Tolerance level.

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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) [1].

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 [2, 3].

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 [4, 5].

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 [6].

Regarding the effects of salinity on nutrients and water uptake by the plant, as well as physiological aspects [7] 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 [8, 9].

Kader and Jutzi [10], stated in their study that, germination is a critical stage of the plant cycle and improved tolerance of high salinity could improve the stability of plant production.

Demir *et al.*, [11] stated in his study about 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.

Mbah, E. U. and Okoro [12], stated about the importance of dry matter that dry matter content which is the chemical potential of the crop and reflects its true biological yield.

Esfandiri *et al.*, [13], Zörb *et al.*, [14], Sairam *et al.*, [15] stated that 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 (Ca^{2+}) and magnesium (Mg^{2+}) in competition with Na^+ and also nitrate (NO_3^-) in contrast with C^{-1} .

As a temporal difference in plant response to salinity [6, 16] 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 [6, 17, 16].

The objective of this research is to study the response of some wheat varieties which are rust resistant with respect of the effect of salt levels what 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 the salt tolerance level of varieties and which varieties are most tolerance to salinity.

MATERIAL 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 varieties 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 (0.02, 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 weight. The dry weight was measured after drying at 65°C for 48h.

$\text{SPG} \% = (\text{Number of germinated seeds} / \text{number of cultivated seeds}) \times 100$ (Mehmet and Kaya, 2006 [18]).

Mean germination time (MGT) = $\Sigma Fx / \Sigma F$; where F is the number of seeds germinated on day x. (Al-Ansari, F and Ksiksi, T, 2016 [19]).

Water uptake% = $(W_2 - W_1 / W_1) \times 100$

Where,

W_1 = Initial weight of seed

W_2 = Weight of seed after absorbing water in a particular time (Mehmet and Kaya, 2006 [18]).

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

Table-1 shows 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. Bur 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 is 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 that charmo 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.

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
Marroof	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<0.01)	0.754	n.s	n.s	n.s	0.018	9.15	0.012	0.003	n.s	n.s

Table-2 shows 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: 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)
C ₀	4.80	4.556	7.872	7.611	0.046	54.444	0.042	0.007	0.064	0.044
C ₁	4.39	4.333	6.489	7.756	0.049	48.889	0.020	0.004	0.066	0.037
C ₂	4.27	4.556	5.767	7.433	0.060	44.444	0.017	0.008	0.069	0.042
C ₃	4.11	4.556	5.328	6.811	0.058	42.222	0.015	0.009	0.068	0.044
C ₄	3.32	3.667	4.056	5.133	0.034	36.667	0.009	0.005	0.149	0.051
C ₅	2.64	4.444	4.717	5.489	0.034	24.444	0.014	0.004	0.123	0.037
LSD (p<0.01)	1.05	n.s	1.345	1.114	n.s	12.938	0.016	n.s	n.s	n.s

The interaction in 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 dry radical, because of accumulation of more salt in dry radical in relation to wet radical, plumule and dry plumule.

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)
Charmo × C ₀	6.40	4.667	7.800	7.100	0.048	70.000	0.050	0.012	0.053	0.050
Charmo × C ₁	6.17	4.667	8.033	8.100	0.039	63.333	0.033	0.006	0.060	0.030
Charmo × C ₂	5.90	5.000	6.667	7.833	0.085	56.667	0.023	0.010	0.063	0.040
Charmo × C ₃	5.83	4.667	4.8837	6.100	0.075	56.667	0.013	0.009	0.063	0.040
Charmo × C ₄	5.00	3.333	4.333	5.033	0.037	50.000	0.010	0.010	0.067	0.047
Charmo × C ₅	4.50	4.333	5.067	5.400	0.040	30.000	0.027	0.008	0.073	0.030
Marroof × C ₀	6.00	4.000	9.283	7.733	0.053	66.667	0.050	0.006	0.070	0.040
Marroof × C ₁	5.17	4.333	5.917	7.867	0.076	60.000	0.017	0.006	0.077	0.050
Marroof × C ₂	5.17	4.333	5.550	7.100	0.071	56.667	0.023	0.012	0.063	0.033
Marroof × C ₃	4.80	4.333	5.383	6.667	0.085	53.333	0.027	0.017	0.063	0.040
Marroof × C ₄	4.50	4.000	4.233	5.100	0.051	46.667	0.015	0.004	0.063	0.047
Marroof × C ₅	3.33	4.333	4.367	5.067	0.038	36.667	0.012	0.004	0.057	0.037
Alla × C ₀	2.00	5.000	6.533	8.000	0.037	26.667	0.027	0.002	0.070	0.043
Alla × C ₁	1.85	4.000	5.517	7.300	0.032	23.333	0.010	0.001	0.060	0.030
Alla × C ₂	1.74	4.333	5.083	7.367	0.026	20.000	0.004	0.002	0.080	0.053
Alla × C ₃	1.71	4.667	5.717	7.667	0.013	16.667	0.005	0.001	0.077	0.053
Alla × C ₄	0.47	3.667	3.600	5.267	0.014	13.333	0.003	0.001	0.317	0.060
Alla × C ₅	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

CONCLUSION

According to [20] classification of soil salinity tolerance to durum wheat, .05 mol/L /C3 that is approximately answering to 3000 TDS (Total Dissolved Solids) which is equivalent to Electrical Conductivity (Soil Extract) EC (dS/mand to (0.75-1.50dS/m) 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 Maaroo. According to the give rustles in general, charmo is better than Maaroo and Maaroo is also better than Alla, so it does mean, that Alla is the poorest in the tolerance to salinity.

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