Effect of NaCl on the Germination and growth parameters of Some Flax Varieties (*Linum usitatissimum L.)*

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Abstract

As a result of the phenomenon of climate change, drought and salinity are becoming an actual challenge to agriculture crop production. Flax is also one of the important agricultural crops that face the problem of salinity, that is why the study of its salinity tolerance level an inevitable in order to not just keep its production level, but also increased it that can answer to the population marketers demand for the world population. Seeds of Flax Varieties (Linum usitatissimum L) Syria, Rabar variety and Hikmat variety where tested of salinity tolerance with four levels of salt solution in sterilized water (0.02 ,0.04, 0.06 and ,0.08 molL-1) and control ,that the e given Salt solutions are equivalent to 1.7, 2.3, 3.5 and 4.7 gL -1 of NaCl , that answer to 1.8, 3.6, 5.5, and 7.3 Sd/m respectively The results shows clearly significant effect of varieties on germination percentage ,speed and index, and significant decreasing of germination percentage , germination speed and germination index by increasing salinity levels. Regarding growth issue , the results show significant effect of varieties on and growth parameters except of root wet weight which has no significant effect by varieties. Rebar variety exceed over Hiklmat variety and Syria variety by its only higher value of root wet weight. but Hikmat variety exceed over rebar and Syria by it is highest value of root numbers and shoot length, and Syria exceed over Hikamt variety and Raber variety by root try weight, shoot wet and dry weight as well as root length. with increasing salinity levels decrease growth parameters, except of shoot dry weight that control has less value in relation to other salt levels and is equal to 4.7 gL -1. The explanation to this instance, that control has less weigh value in relation to other salt levels, is because of accumulation of more salt substances in shoots in salt solution levels in compare with control, and the same explanation is valid to the result of roottoo. Significant interaction between salt levels and varieties about germination parameters indicate that Raber variety has is the supreme variety which tolerate better salinity in relation to Hikmat and Syria. Reducing root numbers and length due to salinity has significant effect on the tolerance degrees of plants, as the longer and more root number , the better for plants to penetrate soil and cover more area in soil ,which make Plant to tolerate more salinity and drought. 1.7 gL -1 which nswer to 1.8 Sd/m is the tolerance level of Flax to soil salinity, in this regard, Rebar has the height value of germination parameters at all salt levels, and by comparative way Rabar can also tolerate salt level (2.3 gL -1) too that answer to 3.6 Sd/m, because 2.3 gL -1 of Rabar variety almost equal or even higher then (1.7 gL -1) in some germination parameter of Hikamt variety and Syria variety , therefore , Rabaer variety can tolerate in a soil from 1.8Sd/m to 3.6Sd/m , but Hikmat variety and Syria cannot tolerate soil salinity above 1.8Sd/m.

Keywords: *Salinity, Flax varieties, , germination, growth , tolerance. Sd/m .*

Introduction.

One of the potential threats to agriculture is the impact of climate change in attaining sustainable development of agriculture and food security [1] . The phenomenon of climate change is now a reality. Change in hydrological systems and rise in temperature and sea level will add more salinity to the soil and underground water in dry regions and coastal regions , and this will further add to the constraints of food production [1] . [1,2] stated ,that over 6 % of the world's land is salt-affected (434 million hectares (Mha) sodic and 397 Mha saline). Of the current 230 Mha of irrigated land 45 (Mha) are salt-affected (19.5 %), and of 1500 Mha under dry land agriculture, 32 Mha are salt-affected (2.1 %) to varying degrees. Salinity occurs through natural or human-induced processes that result in the accumulation of dissolved salts in the soil water to an extent that inhibits plant growth. About one-third of the world's irrigated area faces the threat of waterlogging and 20 % of irrigated area is salt affected [1,3]. Flax (Linum usitatissimum L.) is the member of the genus linum in the family linaceae,and it is considered as the oldest cultivated crops [4.5.6.7] . And it is one of the oldest crops of the Fertile Crescent, that is believed to have its origin in southern Europe, the Near East, or Central Asia [4.5, 6,7].There are two main purposes for Flax cultivation, firstly for oil from its seed and secondly for fiber from its stem .Flaxseed is rich in oil (41%) and protein (20%), the oil has a high percentage of essential fatty acids, 75% polyunsaturated fatty acids, 57% alpha-linolenic acid, which is an omega-3 fatty acid, and 16% linoleic acid, which is an omega-6 fatty [8] .Historically, the oil from the linseed has been used as a drying agent for oil varnishes and printing ink. Recently, the oil from the linseed oil is dependent as the healthy vegetable oil for human consumption, as mentioned earlier the oil are very high of alpha linolenic acid (omega-3 fatty acid) essential for humans health: and the highest content of plant (lignans) of all plant or seed products also use in human food [9]. For economic productions of flax, good management practices including use of recommended varieties; good seed bed preparation, proper seeding rate and commended fertilizer are essential [10] . Soil salinity is a worldwide problem in arid and semi-arid regions, which drastically alters both physical and biological environments [11.10]. Many social and economic problems are caused by salinity that affects the growth, productivity and distribution of plants [12] . Soil salinity has significantly increased in recent years due to several factors related to climate change like excessive irrigation, low precipitation, high surface evaporation, rock weathering, ion exchange and poor cultural practices [13,14,15] and [16] .Salinity leads to delayed germination and emergence, low seedling survival, irregular crop stand and lower yield due to abnormal morphological, physiological and biochemical changes [17,18]. Salinity has been on the rise and recent estimates suggest that the economic impact of soil salinity on irrigated land is bound to surpass 27 billion US $ per year and about 50% of the arable land would be salinized by the year 2050 [5, 19,20]. In light of phenomena of climate change, and so the negative consequences of salinity on the aspects of social, economic, and ecosystem, it will be more necessary to study agricultural seed crops response to salinity and determine the tolerance level of each cultivated crops in order to manage the threats of salinity in coming threatened saline area.

the objective of the present research is to study the effects of salinity on three varieties of Flax , and determine the tolerance salt level of varieties with respect of germination and growth parameters .

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 University of Sulaymania, The experiment included three varieties of Flax varsities Syria, Rabar and Hikmat which obtained them from the laboratory of the Department of Biotechnology and Crop Science. The experiment carried out by preparing a control treatment in sterilized water and four levels of salt solution in sterilized water too (0.02 ,0.04, 0.06 and ,0.08 $molL^{-1}$) and control . The given Salt solutions are equivalent to 1.7, 2.3, 3.5 and 4.7 gL^{-1} of NaCl , that answer to 1.8, 3.6, 5.5, and 7.3 Sd/m [21] . 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 (10) and were added 10 ml of salt solutions (0.02,0.04 , 0.06,.and 0.08 $molL^{-1}$). The seeds in dishes were covered with filter papers to prevent pollution and evaporation till they began to germinate in 15-20 ° C and humidity degrees 50-60%. After germination the filter papers removed and then in 7 days were examined for the effects of these concentrations levels on seed percentage germination(SPG), germination speed and germination index. After 14 days , wet weight of roots and shoots , number of roots , length of shoot and roots were noted, as well as dry weight of and shoot were measured after drying at $50C^0$ for 72h .

SPG %= (Number of germinated seeds/number of cultivated seeds) × 100[22].

GS = n1/d1+n2/d2+n3/d3+ [23] .

GI=%germination in each treatment/ % germination in the control [24].

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. Experiment designed according to CRD factorial and data were statistically analyzed using Software (XLSTAT) version16, and the significant differences between means were compared using LSD range, $P \leq 0.05$.

Results and discussion

Germination parameters.

Flax varieties differ in their minimum, optimum, and maximum germination results [25].In this regards our results show in table (1) clearly significant effect of varieties on germination percentage ,speed and index, and it is also confirmed by [26].

The results showed, that variety of Rebar is exceed Hikmat variety and Syria variety , and Hikmat variety exceed Syria variety except of germination percentage where Syria exceed Hikmat variety . Soil salinity is a common problem over the world, especially in areas with water deficit and irrigation water supply for field crops. NaCl may be inhibitory to the activities of some enzymes that may play critical roles in seed germination [27, 28]. Decreasing of germination percentage , speed and index by increasing salinity levels shown in table (2) which also confirmed by [29, 30 and 31].Significant interaction between salt levels and varieties about germination parameters is shown in table (3) ,where Raber variety is the supreme variety that tolerate better salinity in relation to Hikmat variety and Syria variety . According to [23] (1.7 gL -1) , which answer to 1.8 Sd/m the tolerance level of Flax to soil salinity, in this regard, Rebar has the height value of germination parameters at all salt levels, and by the comparative way, Rabar variety can tolerate C2 level that answer to 3.6 Sd/m, because (2.3 gL -1) of Rabar variety almost equal or even higher then (1.7 gL -1) in the some germination parameter of Hikamt variety and Syria , therefore , Rabaer variety can tolerate in a soil from (1.7 gL -1 *-(2.3 gL -1),* 1.8Sd/m to 3.6Sd/m , but Hikmat variety and Syria variety cannot tolerate soil salinity above 1.8Sd/m.

Growth parameters.

The varieties of Flax has significant effect on growth of root and shoot , this have been proved by many studies [32,33].The results of our research as stated in table (1) shows significant effect of varieties on growth parameters except of root wet weight which has no significant effect by varieties. Rebar variety exceed over Hiklmat variety and Syria variety by its only higher value of root wet weight but Hikmat variety exceed over rebar and Syria by its highest value of root numbers and shoot length, . Syria exceeds over Hikamt variety and Raber variety by its dry root weight, shoot wet and dry weight as well as root length. The effect of flax varieties on growth also confirmed by [33].The way to evaluate salinity tolerance is the examination of the effect of salt stress effects on root and shoot of most crops [34. 31]. In this regard as it was expected, with increasing salinity levels decrease growth parameters, table (2) shows significant effect of salinity on all growth parameters except of shoot dry weight where it is showed that control has less value in relation to other salt levels and is equal to salt solution level (4.7 gL -1). The explanation to this instance is, that control has less weigh value in relation to other salt levels, because of accumulation of more salt substances in shoots in salt solution levels in compare with control, and the same explanation is valid to the result of roots too. Reducing root numbers and length due to salinity has significant effect on the tolerance degrees of plants, as the longer and more root number , the better for plants to penetrate soil and cover more area in soil ,which make plant to tolerate more salinity and drought . Reducing shoot numbers by salinity means reducing panicle and tillers of Flax which is confirmed by [35] in their study , and so it leads to less yield in the harvest. Significant interaction between varieties and salt levels along on with germination and growth parameters as it is shown in Table (3). Regarding growth parameters , the table shows significant interaction between salt levels and varieties, but what is concern the fluctuation of the value of root and shoot dry weight along with salt levels in compare with control, the same explanation is valid as stated above about effects of salinity on growth parameter of varieties.

Table (1) effect of varieties on studied characteristics :

Varieties	*% Germination*	*Germination Speed*	*Germination Index*	*Root dry weight (gm)*	*Shoot dry weight (gm)*	*Root wet weight (gm)*	*Shoot wet weight (gm)*	*Root Number*	*Root length*	*Shoot length*
Rabar	81.333	18.000	86.667	0.002	0.004	0.007	0.015	1.333	5.333	4.600
Hikmat	73.333	11.400	82.000	0.002	0.001	0.003	0.016	2.467	6.933	4.667
Syrial	74.667	9.400	77.333	0.003	0.005	0.006	0.027	1.733	7.533	4.267
LSD $_{0.05}$	1.805	0.435	2.244	0.001	0.003	N.S	0.004	0.172	0.570	0.293

Table (2) effect of deferent salt concentration on studied characteristics :

Salt concentration	% Germination	Germination Speed	Germination Index	Root dry weight (gm)	Shoot dry weight (gm)	Root wet weight (gm)	Shoot wet weight (gm)	Root Number	Root length	Shoot length
CO	94.444	16.778	100.000	0.003	0.002	0.013	0.026	3.000	9.444	7.333
C1	85.556	14.778	91.111	0.002	0.006	0.004	0.021	2.111	8.333	5.444
C2	76.667	12.556	83.333	0.002	0.004	0.003	0.019	1.556	7.889	4.556
C3	67.778	11.444	71.111	0.002	0.003	0.003	0.016	1.444	5.667	3.444
C4	57.778	9.111	64.444	0.002	0.002	0.003	0.014	1.111	1.667	1.778
$LSD_{0.05}$	2.331	0.562	2.897	0.001	0.004	0.01	0.005	0.222	0.735	0.378

Table (3) effect of interaction between (Variety & salt concentration) on studied characteristics :

Varieties	Salt concentration	% Germination	Germination Speed	Germination Index	Root dry weight (gm)	Shoot dry weight (gm)	Root wet weight (gm)	Shoot wet weight (gm)	Root Number	Root length	Shoot length
Rabar	CO	93.333	21.000	100.000	0.001	0.002	0.026	0.021	2.333	7.000	7.333
	C1	86.667	19.667	93.333	0.002	0.004	0.005	0.019	1.333	6.667	5.667
	C2	83.333	18.000	86.667	0.001	0.004	0.002	0.013	1.000	6.000	4.333
	C3	76.667	16.667	80.000	0.002	0.007	0.001	0.002	1.000	5.333	3.667
	C4	66.667	14.667	73.333	0.003	0.002	0.001	0.018	1.000	1.667	2.000
Hikmat	CO	93.333	16.000	100.000	0.003	0.001	0.003	0.015	4.333	10.333	7.667
	C1	80.000	14.000	86.667	0.002	0.001	0.003	0.017	3.000	9.000	5.667
	C2	70.000	10.667	80.000	0.002	0.001	0.003	0.016	2.000	7.667	5.333
	C3	66.667	9.667	73.333	0.002	0.001	0.003	0.015	1.667	6.000	3.000
	C4	56.667	6.667	70.000	0.001	0.001	0.002	0.015	1.333	1.667	1.667
	CO	96.667	13.333	100.000	0.006	0.002	0.009	0.043	2.333	11.000	7.000

Syrial	*C1*	90.000	10.667	93.333	0.001	0.013	0.005	0.027	2.000	9.333	5.000
	C2	76.667	9.000	83.333	0.002	0.007	0.004	0.026	1.667	10.000	4.000
	C3	60.000	8.000	60.000	0.002	0.001	0.005	0.025	1.667	5.667	3.667
	C4	50.000	6.000	50.000	0.002	0.002	0.005	0.018	1.000	1.667	1.667
LSD $_{0.05}$		4.037	0.974	5.018	0.003	0.007	0.017	0.009	0.385	1.274	0.655

Conclusion

Regarding to the positive germination and related seedling traits , the variety Rabar overall salt concentrations. and zero salt used over all varieties were significantly predominated in improving the germination and seedling traits. Although Rabar variety within different salt concentration even at the highest concentration level was exceeded all over varieties With salt concentration combinations without exception , but the positive traits declined as the salt concentration were increased even with Raber variety ,that is showing ,the salinity tolerance of Rebar in one hand negative correlation between salt concentrations and all germinations and seedling traits under this study, in this regard, Rabaer variety can tolerate salt levels from 1.8Sd/m to 3.6Sd/m , but Hikmat variety and Syria variety cannot tolerate soil salinity above 1.8Sd/m. These differences in tolerance between varieties could be exploited to develop-varieties with greater tolerances to the allelochemicals produced by weeds or in crop residues and therefore potentially more tolerant of the presence of weeds.

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