American-Eurasian J. Agric. & Environ. Sci., 3 (5): 717-725, 2008
ISSN 1818-6769

Salinity Tolerance of Maize in Embryo and Adult Stage

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Abstract: This Study was conducted under laboratory and greenhouse conditions to select those genotypes of corn tolerant to salinity and to evaluate the different characteristics during germination and growth stages. A factorial experiment was conducted in a randomized block design form with four replications. The treatments included four saline concentrations (0 50, 100 and 130 mM NaCl liter^{-1}) and 23 genotypes (11 Iranian and 12 Chinese). The results of the laboratory experiment showed that the effect of salinity, genotypes and their interaction on radicle and plumule lengths were significant at the germination stage. Comparison of means mentioned that the 1, 4, 11, 12, 17, 21 and 22 genotypes had larger radicle and plumule. These cultivars were entered into a second factorial experiment with the same levels of salinity to select the best cultivar based on some other characteristics. The results showed that the effects of salinity and genotypes and their impact on length, specific leaf weight and diameter were significant, but stem diameter, internode distance, root and stem dry weight, leaf area, number of nodes and sodium-potassium ratio were significantly different between genotypes and salinity levels demonstrate while the root-shoot ratio was different only between genotypes. Finally, the results obtained that, relative to elegance and longer shoot and roots of genotypes, especially at the germination and seedling stages, countersuit the tolerance of genotypes 11, 12 and 22 at the reproductive stages.

Key words: Corn · Hydroponics · Salinity Tolerance · Shoot/Root Ratio

INTRODUCTION

Supplying the needs of people is going to increase, so they will need to exploit all of the potentiality such as: water, soil and plant. For this, all of the problems caused by the reduction in yield must be solved. Some of the most emitting factors are environmental stresses. These stresses can be divided into two groups: biotic and abiotic stresses. Salinity and temperature are the most important abiotic stresses. Estimations show that 10% of land in the world is salty or ultra–salty. In Iran 25.5 million hectares are exposed to mean salinity and 8 million hectares are exposed to ultra salinity [1]. To exploit this land, without with the highest expense of salinity removed, also needs a long period of time. One way to allow the exploitation of this land is by the selection of genotypes tolerant to salinity and using of these plants in salty land. By this method, tolerant genotypes to the salinity are selected by using inbreeding programs for cultivation in areas which have some salinity problems in the water or soil. According to these salinity tolerance characteristics, there is a large difference between and among genotypes at different growth stages. For example, salinity tolerance at the germinating stage and during growth and development is not the same. Sugar beet is sensitive to salinity at the germinating stage and then during growth stages, it is more tolerant, while vice versa, maize is resistant at the germinating stage and then becomes sensitive to the salinity. A study of the effect of salinity on the germination of maize and soybean showed that maize was more resistant than soybean, because increasing salinity to 11 mM, reduced maize germination from 82% to 12% and in soybean from 62% to 2% [2]. The effect of different level of salinity as a result of different amounts of Na Cl (50, 100, 150, 200 mM lit^{-1}) on the germination of wheat genotypes showed that the percentage of germination, number of radicles, length of plumule and radicle are decreased by increasing in salinity.

In addition, there was more growth in plants at a 50 mM salt concentration than in the control treatment [3]. Reduction of germination, length of radicle, length of plumule, number of abnormal seedling, wet weight, germination rate and vigor in barley were affected by

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salinity [4]. Studies of the effect of 150 mM/lit sodium chloride showed that the germination percentages of the tolerant genotypes are more than those of sensitive genotypes [5,6]. Another study showed that if electrical conduction of the nutrient solution increases to more than 17 mM, maize germination is decreased [7]. A study of the effect of salinity on wheat, barley and critical showed, that if salinity is increased, the stem and root dry weight is decreased [8]. In salinity stress situations, the susceptibility of the roots is less than that of the shoots and the growth of roots is greater than that of the shoots [9, 10].

The salinity threshold in maize is 1.8dSm^{-1} and if it increases to 2.7, 6.8 and 8.6 dS m^{-1}, it causes decrease in the yield of the maize to 10, 25 and 50%, respectively. At 15.3 dS m^{-1} salinity, maize yield was decreased to 0 [11]. Under saline conditions, growth of the leaf cells was decreased, then the plant becomes poorer, their leaves are smaller and the color of the leaves changes to dark green. Decreases in the speed of the plant growth, shoots length, the period of plant growth and rapidity in the entering to the reproductive stage are entirely caused by salinity. All of these factors lead to a decrease in grain yield and productivity. Genotypes tolerant to salinity have a more special leaf weight than sensitive genotypes. We can use genetic differences between genotypes and species in plant breeding programs [12], and select plants with high potential under saline conditions.

The other salinity effect is confusion in nutrient absorptive and translation, especially Ca and K. Ion poisoning which is the consequence of sodium-related confusion in all of the plant's vital activities. In high concentrations of salt, plants reduce the sodium in the cytoplasm by the entrance and exit of ion and with K stability, reduce the ratio of Na to K. Hence the ratio of Na to K is an appropriate factor for identifying genotypes tolerant to salinity in plants. Experiments on some of the Gramineacea family, such as maize, have shown that, with the absorption of Na is increased with the absorption of salinity and the K level and the ratio of K to Na in root and stem is decreased [13-15]. In the same experiment, it was also determined that, with the increase of salinity stress, Na in plant is increased and K is decreased [16].

A study of the situation of Na, K, Cl conditions in rice under salinity stress conditions has showed that the ratio of Na to K is increased with the effect of salinity [12]. Sodium concentrations decrease the osmotic potential in plant cells and the other growing parameters.

Salinity tolerance is important at all of the growing stages of a plant, especially the germination stage. Those genotypes which have more tolerance to the salinity in this stage produce stronger seedling at other growing stages and have more yields essentially. In this study, salinity effects on the germination characterization and seedling traits of maize were examined and the genotypes which have had better qualities from the length point of radicle and plumule were investigated in order to have a more accurate study of physiological and morphological traits such as wet and dry weight, accumulation of Na and K ions, leaf area, high of the bush and length and diameter of maize. At the end, the best genotype which was superior according to salinity tolerant traits was selected.

MATERIALS AND METHODS

Plant Material: This study was conducted for the investigation of salinity tolerance of 23 Iranian and Chinese maize genotypes was performed in two stages: seedling and complete growth period. The genotypes consisted of 12 maize genotypes of introduced Chinese genotypes, which were thought to be salinity tolerant and 11 Iranian genotypes of single cross groups (Table 1). Seeds were from the Karaj Seed and Seedling Breeding Institute.

Experimental Method: The experiment consisted of two dependent stages. The experimental design used for the first stage was a factorial in randomized complete block design form with four replications. The first factor consisted of: concentrations of NaCl and control.

S_1=control (de ionized distilled water)
S_2=50 mM lit^{-1} NaCl (MERK Germany) equal to 4.2 dS m^{-1}
S_3=100 mM lit^{-1} NaCl equal to 8.4 dS m^{-1}
S_4=150 mM lit^{-1} NaCl equal to 12.6 dS m^{-1}

The second factor comprised 23 genotypes of maize. Before this experiment, the seeds were decontaminated with 2/1000 Vitavax fungicides solution. Also during cultivation 10 seeds were cultivated using metal forceps without any touch of hands on the perlite. In the first experiment because of the small size of the plant and the better possibility for measuring the root and stem, a cultivation bed was selected small vases with 10×15 cm which were full of mixed perlite. Distilled water, 300 mLit Hogland nutrient solution with some specific amount of salt for each treatment was used for irrigation [17]. The amount of salt present in the vases was monitored every day for stabilizing the amount of salt in the period of germination and reducing the effect of evaporation in the

Table 1: Maize genotypes used in this study in order 11 genotypes from Iran (V1-V11) and 12 genotypes from China (V12 –V23)

Code Nomber	Genotype	Origion	Code Nomber	Genotype	Origion
V1	S.C 71	Iran	V12	XT01	China
V2	S.C 72	"	V13	XT02	"
V3	S.C 73	"	V14	XT03	"
V4	S.C 74	"	V15	GX322	"
V5	S.C 75	"	V16	GX355	"
V6	S.C 76	"	V17	HWY66	"
V7	S.C700	"	V18	SQ407	"
V8	S.C 701	"	V19	SQ408	"
V9	S.C 703	"	V20	XN120U	"
V10	S.C 704	"	V21	XN4	"
V11	S.C 720	"	V22	XNO26g	"
		"	V23	108H	"

vases. For this reason, the level of solution was examined once every two days and deionized distilled water was added if the level of solution was lower than the level determined. Temperature was 27°C during the germination and growth period of the plant.

After two weeks, the quality of treatment and growth of the seedlings, length of radicle and plumule were measured exactly with ruler. The basis for germination was considered to be the exit of a radicle with a length of 2 mm. The percentage of growth of the radicle and plumule for each genotype and in each concentration of salt was found by calculating the ratio of the amount of growth of the organ in salt to the amount of growth of the organ in control condition [18].

According to the results of statistical analysis, eight genotypes (V1, V4, V11, V12, V17, V18, V21 and V22) which had longer radicle and plumule were selected. The selected genotypes were again analyzed in a factorial experiment with a base complete randomized block design. The experiment treatments consisted of a control and different concentrations of salt in the first experiment and eight selected genotypes. Cultivation was in vases with dimensions of 30 x 70 cm with a mixed perlite for the cultivation bed. For irrigation, some mixed nutrient solution of Hogland (Merk, Germany) was used. After 12 weeks, dry weight of root (gr) and shoot (gr) and the root to the shoot ratio (R/S), leaf area (cm^2), special leaf weight (gr cm^{-2}), number of nodes on the stem, internodes distance, stem diameter (cm), ear length and diameter (cm) and Na to K ratio (Na/K) in the plant were analyzed. The leaf below the stamen leaf was used for measuring the amount of Na and K [18]. For the variance analyses of traits and their mean comparison, statistical software such as Sas and MSTATC were used and for designing diagrams, EXEL was used. The inputs after angle changes were analyzed for the result analysis of percentage of the relative growth of radicle and plumule at different concentrations of salt.

RESULTS

The percentage and the radical and plumule length of maize genotypes have shown that there isn't any statistically significant difference between genotypes, but there was significant difference between the concentrations of salt (p=0.01), showing a reduction of the germination percentage of all genotypes with a salinity increase (Table 4). So mean of the germination percentage of the maize genotypes in control and 150 mM salt treatment by the salinity increase, decrease from 78% to 61%. The means of the amount of genotype germination at 50 and 100 mM salt (Na Cl) concentrations were 71 and 69 percent in all the genotypes, respectively. This shows that the genotype germination percentage decreases as the salinity increases. These results are similar to the results of Minhas *et al.* [19], Saberi and Rashed [3] and Tajbakhsh [4] who claim a germination reduction in some plants under salinity situations. Study of genotype germination in all the salinity levels showed that the most amount of germination was in v14 genotype (with 78.75% germination) and the least amount was in V7 genotype (with 59% germination). The most effect on salinity was in V23 genotype in all genotypes and germination was decrease from 92% (in control treatment) to 52 % (in 150 mM salt) that showed high sensitivity of this genotype. On the other hand, amount of germination reduced from 72 to 70% in V17 genotype, which shows the tolerance and stability of germination of this genotype under salinity conditions just 2% of germination was decreased in V17 genotype than the control

Table 2: Analysis of variance for shoot and root length at different salt concentrations of salt and relative root and shoot length at maximum salt concentration (150 mM NaCl)

		(M.S)			(M.S.)	
S.O.V.	d.f.	Shoot length	Root length	d.f	Relative shoot growth	Relative root growth
Replication (R)	3	20.672*	5.053$^{n.s}$	3	219.2$^{n.s}$	544.2*
Genotype (G)	22	313.013**	131.286**	22	370.9$^{n.s}$	987.2*
Salt concentrations (S)	3	1554.99**	2196.67**	1	7$^{n.s}$	112.4*
G×S	66	26.153**	36.095**	22	5$^{n.s}$	0.5$^{n.s}$
Error (E)	273	7.751	8.012	135	273.5	182.20
CV (%)	-	26.15	18.94	-	30	26.37

* and **: Significant at 5% and 1% level and n.s: Non significant

Table 3: Mean comparisons of relative root and shoot length and germination percent of Iranian and Chinese genotypes at maximum salt concentration (150 mM NaCl)

Iranian genotype	Root	Shoot	Germination (%)	Chinese genotype	Root	Shoot	Germination (%)
V1	77.25^{a}	57.25^{a-d}	66.25^{a-e}	V12	43.25^{d-h}	69.25^{a-d}	71.87^{a-e}
V2	67.25^{a-c}	45.75^{a-d}	73.75^{a-e}	V13	43.25^{d-h}	43.25^{b-e}	66.87^{a-e}
V3	61.25^{a-d}	34.25^{d}	63.75^{a-e}	V14	34.25^{f-h}	48.5^{a-e}	78.75^{a}
V4	73^{ab}	25.5^{a-d}	61.25^{c-e}	V15	40.5^{d-h}	50.75^{a-e}	68.12^{a-e}
V5	67.25^{a-c}	55^{a-d}	62.5^{c-e}	V16	43.25^{d-h}	49^{a-e}	77.5^{ab}
V6	56^{a-f}	50.50^{a-d}	66.87^{a-e}	V17	50.75^{b-h}	65.25^{a-c}	75.62^{a-d}
V7	62.5^{a-d}	51^{a-d}	59.37^{e}	V18	23.75^{h}	73^{a}	69.37^{a-e}
V8	52.25^{b-h}	43.75^{b-d}	69.37^{a-e}	V19	45.75^{c-h}	61.75^{a-d}	73.75^{a-e}
V9	68.25^{a-c}	38.75^{c-d}	71.87^{a-e}	V20	27.75^{h}	59.25^{a-e}	68.75^{a-e}
V10	57.25^{a-e}	47.75^{a-d}	60de	V21	31.75^{gh}	68^{a-c}	65^{a-e}
V11	77.25^{a}	57.75^{a-d}	68.75^{a-e}	V22	38^{e-h}	61.25^{a-d}	68.12^{a-e}
				V23	25^{h}		

In each row means followed by similar letters are not significant different at Duncan 5%

treatment and Generally, the results of germination percentage under salt concentrations showed that the salinity caused the reduction of this characteristic, but the reduction of germination percentage was not equal under salt concentrations (Table 3).

The study of radicle and plumule length in different levels of salt concentrations has shown that there was a statistically significant difference (p=0.01) between treatment and genotype and two mentioned traits have been affected by the salt. The growth of genotypes in 150 mM salt was significantly difference (Table 3). All the Iranian genotypes had longer radicles while Chinese genotypes hade longer plumules (Table 3). This characteristic can be used in breeding programs and after suitable crosses genotype with better and longer radicle and plumule can be selected in compare with their parents [20, 21]. By the increasing in the amount of salt from 0 to 150 mM the mean of the length of radicle and plumule in Iranian genotypes decreased from 24.7 and 14.58 to 11.4 and 9.46, respectively. Also in Chinese genotypes decreasing this amount from 15.9 and 13.2 to 4.6 and 7.46, respectively shows more tolerance of Iranian genotypes in comparison to Chinese genotypes under salinity conditions at this stage.

The study of the percentage of the growth of radicle and plumule under 150mM concentration of salt also showed there in V3 and V13 there was the minimum percentage of the radicle and plumule growth, respectively. In V11 genotype there was the most amount of growth of radicle and plumule in the highest level of salinity (150 mM salt). According to the study of the measurement of the length of root and stem in non-salinity and the most amount of salt and comparison the mean of the percentage of the growth of radicle and plumule (Table 4), V1, V4 and V11 of Iranian genotypes and V12, V14, V18, V21 and V22 of Chinese genotypes which have had longer length of radicle and plumule have been selected for the study of morphological traits in second experiment (Table 3).

Table 4: Analysis of variance for shoot and root dry weight, root /shoot, Na/K, SLW and LA at different salt concentrations of salt in different genotype

		M.S					
S.O.V.	d.f	Root dry weight	Shoot dry weight	Root shoot	Na/K	SLW	LA
Replication (R)	3	38.25*	19225236 n.s	2.62 n.s	414.2 n.s	59944*	95608500 n.s
Genotype (G)	7	51.3**	41761691**	6.88**	1162**	85284**	282240000**
Salt concentrations (S)	3	64.9**	52476231**	3.75 n.s	1584**	1012.4**	34865412**
G×S	21	20.2 n.s	19814235 n.s	2.59 n.s	526.1 n.s	51252**	1162301 n.s
Erro r(E)	93	14.15	11645156	1.97	325.8	21609	70560000
CV (%)	-	5.6	9.1	14.3	19.5	21.2	16.4

* and **: Significant at 5% and 1% level and n.s: Non significant

Table 5: Analysis of variance for ear length and diameter, internode distance, number of node and stem diameter at different salt concentrations of salt in different genotype

		M.S				
S.O.V.	d.f	Ear Length	Ear diameter	internode Dis	No node	Stem diameter
Replication (R)	3	95089 *	505.1 n.s	4050.3 *	29.2 n.s	514.2 *
Genotype (G)	7	313013 **	821.8**	5478.3**	37.9 **	787.2 **
Salt concentrations (S)	3	355499 **	1926.6 **	64781.2**	51.4 **	912.4 **
G×S	21	150326**	536.1 **	2052.6 n.s	14.5 n.s	215.5 n.s
Error (E)	93	68121	238.9	1497.6	10. 9	175.3
CV (%)	-	14.5	10.3	8.6	5.2	5.4

* and **: Significant at 5% and 1% level and n.s: Non significant

The selected genotypes from the first experiment again have cultivated under some salt concentrations. The results of this stage showed that the characteristics of stem diameter, internodes distance, root and stem dry weight, leaf area, number of nodes, special leaf weight, ear length and diameter, R/S and Na/K are different (p=0.01) between eight selection genotypes. Also according to these traits there was a statistically significant difference (expect R/S) between the salt level and control treatment. These studies showed that specific leaf weight and ear diameter and length were significantly difference (p=0.01) among genotypes under different salinity concentrations and also for these traits the counter effect genotypes under salt concentrations were significant (Table 4, 5). The results showed that because of increasing salinity all these traits expect special leaf weight trait, Na/K and R/S had decreased.

These results are similar to the Hoo Kim Yeong results [13]. The results of his experiments showed that increasing the salinity, increases the absorption of Na in some of the Gramineae such as maize and then Na/K increases. The obtained results are similar to the findings Jaing-Xing [14] and Muhammed *et al*. [16], too. With increasing the salinity growth and yield of all the plant decreased which is the result of increasing osmotic pressure in cells. In these situations, the maize plants did not have a normal growth, the plants became weaker, the leaves became smaller and their color changed to dark green and also the height of the plant decreased. These results are similar to the finding of Aminpour and Aghaee [22] that studied the salinity effects on alfalfa. Because of increasing the salinity, leaf areas of plants were reduced. The decreasing of producer organs caused reduction of other traits such as height and yield. Mozaffar and Gooding [23] also found the reduction of shoot, number of leaves and leaf area according to the salinity on wheat. The growth of plant decreased too and the plants entered into the procreative phase in shorter time. Generally, increasing the salt concentration has caused reduction of vegetative growth period. Under salinity stress conditions, sensitivity of root is less than shoot and the roots are lowerly influenced by salinity [18]. Epstein *et al*. [20] told that in all the selected genotypes, salt increase caused the decreasing of shoot and root dry weight, but reduction in root was comparatively than stem which shows that roots have more tolerance than shoots.

Reduction of stem growth and consequently increasing the R/S in all the genotypes were not equal. This ratio for 8 selected genotypes under the most salt

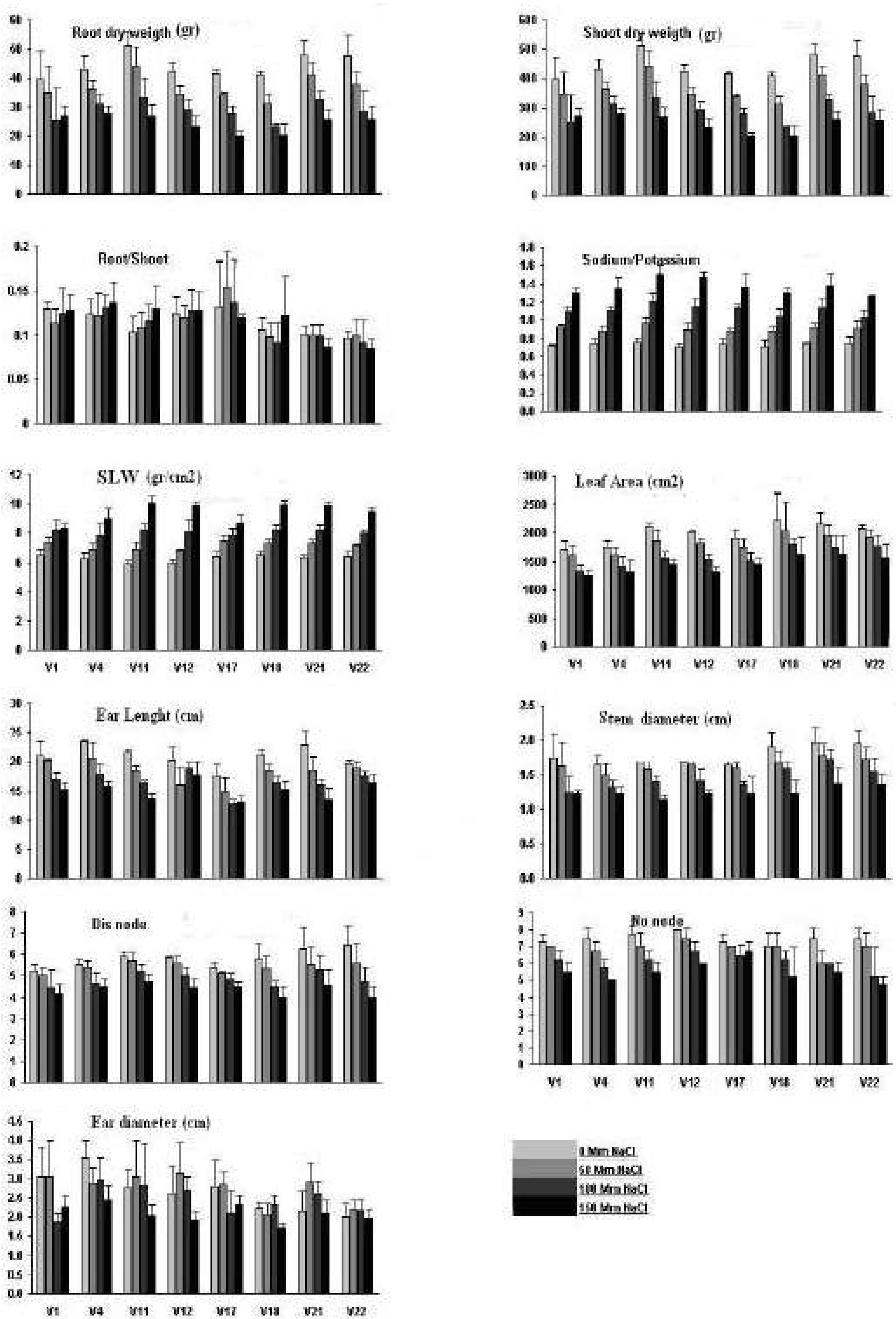

Fig. 1: morpho - physiological characteristics of eight selected genotypes from germination experiment

concentration was 1.2, 1.34, 1.26, 1.27, 1.19, 1.1, 0.86 and 0.85 respectively. In comparison with R/S increasing in the control treatment, it was found that salinity caused increasing this ratio in V4, V11, V12 and V18 genotypes which are 0.14, 0.15, 0.25, 0.25 and 0.05 respectively, except V17 which produced the most R/S under 50 mM salt concentration (the results are not published). Mozaffar and Gooding [23] also founded that in tolerant genotypes of wheat the reduction of root growth is less than stem and the R/S increases. The stem diameter was affected by salinity and increasing the salinity to non-salinity situations has decreased about 30% of the stem diameter. In V4 and V12 genotypes the minimum amount of reduction in stem diameter was observed under salinity conditions to non-salinity conditions and stem diameter decreased from 1.65 to 0.225 cm, in comparison with the other genotypes just 25%, whereas in V18, V21 and V22 genotypes with the genetic potential of longer stem diameter, under salinity situation, the stem diameter decreased more.

One of the most important salinity effects in plants is increasing amount of sodium. Tolerant plants to salinity save K in higher salinity and save more amount of K in their vacuole. The Na/K is one of the best recognition parameters of tolerance to the salinity in plants [6,13,14]. Increasing the mount of soil sodium reduced absorption of K and caused increasing the amount of sodium in plant. Results showed that in all the selected genotypes, this ratio has increased as increasing the salinity. Also there was not any statisticaly significant difference among genotypes and all the genotypes have accumulated more sodium by increasing the salt concentrations and in other word all the genotypes have taken more sodium by increasing the salinity. However, in 1% level there was significantly difference between salt concentrations for sodium, which shows sodium level increase in maize plants under 50, 100 and 150 mM concentrations of NaCl. Alternative effects of genotypes and salt concentrations were not observed. By increasing the sodium level water maintenance and consequently wet weight and special leaf weight of plant increased. Result of this study showed that salinity increase caused the increasing of wet weight of plant and special leaf weight, which is similar to the result of Nelson and Schweitzer [12]. The most special leaf weight, 10.10, was observed in V11 genotype, which was 72.65 more than control. Na/K under non-salt conditions for 8 selected genotypes were 0.72, 0.75, 0.76, 0.70, 0.73, 0.70, 0.70 and 0.74 and by increasing the amount of salt, this ratio changed to 1.29, 1.34, 1.5, 1.46, 1.35, 1.3, 1.38 and 1.25 respectively. V11 genotype was 1.5 which was the most amount of Na/K (the result are not published). Because of salinity, some traits such as height, leaf area and finally yield of plant are decreased. The results of this study showed that by increasing the salinity, the number of nodes and internodes distance in 1% level were difference (Table 5) and the height of plants decreased (Figure 1) and by decreasing the height, dry weight of plant decreased. The number of the nodes of V17 genotype has the least change as salt concentration increased and seven nodes of it affected less by salinity but dry weight of this genotype decreased too much. According to the stability of leaf area of this genotype in salt concentrations, the most reduction of dry weight of this genotype was because of the reduction of internodes distance. The result showed that in compare with control treatment in V17 genotype just 6.9% and in V22 genotype 36.7% of the nodes of the plant in 150mM salt concentration have decreased. Also the reduction of internodes distance in V17 genotype was the minimum and in V22 genotype was the maximum and consequently the yield of dry weight of plant was mostly decreased in spiteol having large dry weight of shoot. The leaf area of plants has decreased because of blocking growth of leaf cells and confusion in water and nutrient absorption. The reduction of leaf area lessens the photosynthetic organ of plant and consequently production of plant. This reduction would have first an effect on the shoot weight and then on the bush yield. In this study the leaf area of bushes decreased by salinity increase which was mostly caused by the reduction of leaf size and falling down leaves that was because of mineral accumulation but not because of the reduction of leaf numbers. These results are similar to the finding ofSadat Noori and Neilly [18]. V18 genotype had the maximum leaf area under 150 mM salt condition and V12 genotype had the minimum leaf area was observed under the maximum amount of salt concentration. 34.6% of the leaf area of this genotype reduced under the non-salinity conditions. By reduction of leaf area, also productive organs were decreases and some traits such as the length and diameter of ear are affected by salinity. Salinity increase caused the reduction of ear diameter in V4 genotype up to 39% and the length of ear in V11 genotype up to 36.7%.

DISCUSSION

Generally, according to this study, salinity caused the reduction of germination percentage and the mean of germination percentage of genotypes has reduced in salt treatment to the control. In addition salt sensitivity of radicle and plumule of Iranian genotypes of maize was different from Chinese and generally, under 150 mM salt condition Iranian genotypes had longer plumule but Chinese longer radicle. This characteristic can be used in breeding programs. Eight selected genotypes of the first experiment were different according to the morphological traits and strength of tolerance of salinity. The results also showed that the selection of the genotypes based on better characteristics of length radicle and plumule at germination stage is a symbol of tolerance of genotypes at other growth stages. This result is not similar to the finding of Dewey [24] who told that the selection of the tolerant genotypes of maize on the basis of germination stage is not acceptable. Salinity significantly caused the reduction of all the traits. Except special leaf weight, Na/K and R/S have increased because of salinity. The Increase of these three characteristic caused by increasing the salt, specially sodium, which have accumulated in the leaves and caused the increasing Na/K and then special leaf weight. The increasing R/S is because of the more sensitivity of shoot to root. At last the results showed that according to the weight of root and stem, R/S and Na/K are the most important parameters in valuating of the salinity tolerance. V11, V12 and V22 genotypes are better than the other genotypes and they are introduced as the hopeful in genotypes. V11 genotype has the most tolerance to the other genotypes and is the best in all the traits.

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