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The effect of different salinity levels on some morphological traits of 20 genotypes of monogerm and sugar beet polygerm in greenhouse conditions

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Abstract

Sugar beet is one of the strategic products of our country with high efficiency in terms of food. On the other hand, salinity is one of the most important limiting factors of economic use of grounds for cultivation of agricultural plants and one of the most significant research areas of researchers of the new plant science is the study of biological changes of the plant in stress conditions and the observation of physiologic and morphological changes. Thus, studying and choosing of traits that could be used instead of performance traits in choosing resistant or stress-sensitive cultivars, will be much easier and less costly. Thus, for this purpose, an experiment was carried out so as to evaluate the 20 genotypes of sugar beet in salinity stress conditions as a factorial experiment and a completely randomized block design in three replications in the greenhouse environment. The results showed that in salinity stress conditions except for the stem dry weight, a significant difference was observed in other traits. Studies showed that there was a significant difference at the 1% level between evaluated genotypes in terms of all evaluated traits. Salinity stress × the genotype interaction was significant only in the traits of per leaf area and stem dry weight. Salinity stress caused a 21.65% reduction in plant height, 20.65% in leaf length, 19.54% in leaf breadth, and 23.37% in leaf area.

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Introduction

The concept of stress in plant refers to the negative and severe effect of some living or non-living factors present in the environment on the plant's natural mechanisms that could lead to a disruption in the production trend of dry material and decrease of performance (Fisher and Wood, 1989). Salinity stress is considered as one of the non-living stresses that decreases the potential for producing agricultural lands. This stress and fighting it is one of the major issues that mankind has struggled with for thousands of years so far; in a way that we could count it as one of the causes of reduction in the lands' capability for producing agricultural crops. Salinization of land began when humans started farming practices and the quick and improper development of irrigation systems in large scale led to the development of salinity phenomenon in arable lands (Khoshkholgh-Sima and Asgari, 2002). Wild ancestors of sugar beet have mainly emerged in the coastal grounds of the seas and hence, the sugar beet is more tolerant against drought and salinity, compared with agricultural plants. It has been shown that compared with other agricultural plants, only cotton and barley are more resistant than the sugar beet, to salinity and drought (Kuck and Scott, 1993). Salinity is one of the most basic limiting factors of growth and production of agricultural crops that face the problem of salinity three times the world area which is three times the area of the lands under cultivation and the sum of salty and sodium soils in Iran is estimated to be about 27 million Hz which is more than half of the arable lands .In agriculture, due to the widespread use of water and soil, the problem of salinity has become more serious. In many areas of the world, the proper sources for usage are on the decline and then again fresh water reserves a part of which is provided by underground reserves, are limited. Due to the increasing consumption of urban societies, industrialization of societies and the increase of consumption per capita, these reserves decrease (Mirzamasoumzadeh, 2013). About 10 % of the whole area of the earth is covered with different kinds of salty soils and with a dominance of NaCI. Also, more than 30%of lands under cultivation and about 30-50% of the world irrigated lands are affected by salinity .These soils have covered about a billion hectares of the land area and 75 million hectares of it are located in South-Western Asia. In Iran, every year six billion cubic meters of salt waters and brackish, flow in the rivers and with the implementation of proper agriculture managements, these waters could be used for agriculture (Mirzamasoumzadeh, 2013). Short-term and long-term salinity stress affects agricultural crops. Its short-term effect includes the decreased growth of stem and probably emergence of the reaction of the roots to the water shortage and it happens in a few days. The long-term effect causes the transmission of large amounts of salt to fully developed leaves and the reduction of photosynthetic activities which happen within several weeks (Mirmohammadi Meybodi and Ghareyazi, 1381). It has been reported that enzymes extracted from most tolerant species to salinity, are as sensitive as plant enzymes to salinity stress (quoted by Sadeghi et al, 2007). In fact, salinity-resistant plants remain immune from the negative effects of salinity, due to the expulsion of ions from leaves or by means of the accumulation of ions in vacuoles and keeping away the cell metabolism process, and in case ions with the potential of toxicity are accumulated on the cell surface specially cytoplasm, it will lead to the destruction of the cell and the plant (Khoshkholgh-Sima and Asgari, 2002).

Materials and methods

The greenhouse experiments were carried out in April 2012 in the personal greenhouse located in Ardebil City. In the greenhouse environment to evaluate genotypes in terms of resistance and sensitivity stress conditions, the experiment was conducted as a factorial experiment and a completely randomized block design. The first treatment was normal salinity (Metropolitan Water District) and the second treatment was the Sodium Chloride salinity of 16 DS m. to provide the used seeds, institute of improvement and the sugar beet seed preparation located in Karaj, was visited after reception, the seeds were pulverized and bracketed, and in the Ardebil institute of production of sugar beet seeds, they were

classified into two monogerm and polygerm groups. In the pots with a diameter of 30 cm and a height of 40 cm containing drainage, 20 seeds of each cultivar were planted in the depth of 2/5 cm using forceps in the sifted Perlite environment with a diameter of 4. Among the cultivars with lower viability, 30 seeds were panted. Immediately after planting, irrigation with water was conducted from above the pots and containers with a capacity of 500 cc were applied under each pot, and every 3 days it reached a volume of 500 cc by Metropolitan Water District. In the first month, according to the low need of plant to nutrients the half Hoagland concentration solution (Table 2-3) was used which was made in the laboratory and with exact ratios according to the table, and in next months, the complete Hoagland concentration solution was used. 30 days after planting (3 to 4 true leaf stage), some Perlirte was added to the surface of pots to help the proper establishment of plants and 60 days after planting (in the 5 to 6 leaf stage), the weak plants were thinned and in each pot 8 plants remained. After 70 days of planting, the implementation of treatments started.

Table 1. Compounds and their levels in the Hoagland food nutrition

Chemical name	Stock solution amount(g/1lit)	Amount of 100 liters(ml)
$NH_4H_2PO_4$	115	100
KNO_3	101	600
$Ca(NO_3)_2 4H_2O$	236	400
$MgSO_4 7H_2O$	246	200
Fe-EDTA	5	150
H_3BO_3	0.38	150
$ZnSO_4 7H_2O$	0.22	150
$MnSO_4 4H_2O$	1.02	1000
$CUSO_4 5H_2O$	0.08	100
$(NH_4)_6MO_7O_{24} 4H_2O$	0.02	100

Table 2. Genotypes used in this study.

Number	Germ type	Name of genotype	Number	Germ type	Name of genotype
1	Poly Germ	30881-88	11	Poly Germ	31270
2	Poly Germ	30883-88	12	Poly Germ	31267
3	Mono Germ	30906	13	Mono Germ	31290
4	Mono Germ	30908	14	Mono Germ	31291
5	Mono Germ	30915-88	15	Mono Germ	31262
6	Poly Germ	30919-88	16	Mono Germ	31266
7	Poly Germ	30920-88	17	Poly Germ	30923-89
8	Poly Germ	30922	18	Poly Germ	Jolge
9	Poly Germ	86213-89	19	Poly Germ	MSC2*7233-P29
10	Poly Germ	31269	20	Poly Germ	7233-P29

The implementation of treatments was carried out by means of solutions beneath the pots. In all solutions, the Hoagland food solution was used for the needed elements of plants to be in their growth environment and no stress be leveled due to the shortage or toxicity of elements to the plant and thus not affect the results of the experiment. The solution under the pots reached a volume of 500 cc every 3 days with the Metropolitan Water District and every 8 times the solution under the pots was changed the containers under the pots were washed and re-filled by a new solution with the determined volume. It must be noted that during the period, in case the electrical conduct of drain resulting from the perlite increased, the electrical conduct of the salty solution was adjusted in proportion to that eventually the electrical conduct of the root environment be adjusted on the 16 DS m. The traits under study include the plant height, leaf length, leaf breadth, leaf area, stem dry weight, and total plant weight which were measured.

Results and discussion

After analyzing the distribution normality of the data, the Variance analysis of the data resulting from

evaluation of studied traits in greenhouse conditions and salinity stress as demonstrated in table 3 showed that in salinity stress conditions the traits of plant height, leaf length, leaf breadth, and leaf area were all significant at the 1% level and in terms of other evaluated traits, the difference was not significant. Analysis showed that between evaluated genotypes, there was a significant difference at the 1% level in terms of all evaluated traits. The salinity stress × genotype interaction in per leaf area traits, were stem dry weight and total plant weight and it was not significant in other traits. Salinity stress caused a reduction in 21.65% of plant height, 20.65% of leaf length, 19.54% of leaf breadth and 23.37% of leaf area (Fig 1 & 2). The results of studying the mean of genotypes indicated that genotypes 13, 14, 15, 16, 17, 18, 19 and 20 were the highest and were located in class a; in contrast, genotypes 1 & 9 had the shortest height among other genotypes (Table 4). Genotypes 15, 17, 18, 19 and 20 had a high value in terms of leaf length and were located in class a, while the genotype 1 had the lowest leaf length among studied genotypes (table 4). Genotypes 17, 18, 19 and 20 had the highest value in terms of leaf breadth, while genotype 1 had the lowest value and was located in class f (Table 4).

Table 3. Variance analysis of evaluated greenhouse traits in the studied sugar beet genotypes in salinity stress conditions.

S. O. V	df	MS				
		Plant height	Leaf length	Leaf width	Shoot dry weight	Leaf area
Rep	2	307.97**	14.924*	3.719**	0.247	1468.68**
Stress level	1	1591.41**	181/72**	37.241**	0.078	3209.74**
Genotypes	19	126.34**	25.76**	6.663**	0.784**	1109.84**
Stress level × Genotypes	19	29.005	4.329	0.679	0.16*	155.08**
Error	78	37.776	4.276	1.149	0.09	112.31
CV (%)		20.47	19.37	20.91	33.91	27.13

* and ** Significantly at p < 0.05 and < 0.01, respectively.

Table 4. Mean comparison of studied sugar beet genotypes in terms of the evaluated greenhouse traits in salinity stress conditions.

Genotypes	Trait								
	Plant height		Leaf length		Leaf width		Shoot dry weight		Leaf area	
1	22.00	f	7.45	f	3.25	f	0.2705	j	15.05	i
2	27.25	b-f	8.92	def	3.78	ef	0.3838	ij	23.50	ghi
3	30.75	a-e	10.67	cde	4.31	def	0.9412	c-g	30.50	fgh
4	30.00	b-f	9.92	def	4.53	cdef	1.0185	b-g	40.76	cdef
5	29.83	b-f	10.25	cdef	4.75	cde	0.7378	d-i	35.79	defg
6	33.42	a-d	11.61	bcd	5.94	abc	0.8423	c-h	46.20	bcde
7	27.67	b-f	9.08	def	5.14	cde	0.7077	e-i	32.55	efg
8	26.50	c-f	9.22	def	4.97	cde	0.74	d-i	34.24	defg
9	22.08	f	8.67	ef	4.22	def	0.6222	ghij	18.40	hi
10	25.58	def	8.72	ef	4.59	cdef	0.6158	ghij	35.07	defg
11	27.75	b-f	9.36	def	4.61	cdef	0.4733	ghi	31.14	fgh
12	24.50	ef	8.64	ef	4.45	def	0.6478	f-j	25.62	ghi
13	31.33	a-e	10.53	cde	4.58	cdef	0.9008	c-g	32.70	efg
14	35.67	ab	10.97	bcde	5.25	bcde	1.1382	bcd	50.59	abc
15	34.50	abc	12.80	abc	5.50	bcd	1.3543	b	52.94	abc
16	30.83	a-e	11.31	bcde	5.44	bcd	1.2268	bc	47.52	bcd
17	33.58	abcd	12.72	abc	6.58	ab	1.1052	bcde	55.66	ab
18	35.17	ab	14.61	a	7.00	a	1.8235	a	63.57	a
19	33.42	abcd	13.56	ab	7.08	a	1.051	b-f	55.24	ab
20	38.67	a	14.56	a	6.56	ab	1.0617	bcde	54.24	abc
Mean	30.03		10.68		5.13		0.88		39.06	

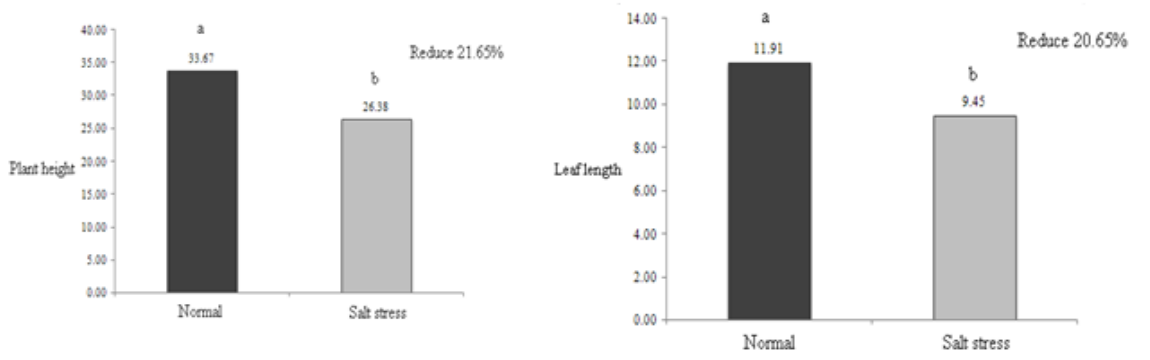


Fig. 1. average of stress level traits of plant height and leaf length and the reduction rate in plant height and leaf length affected by salinity stress.

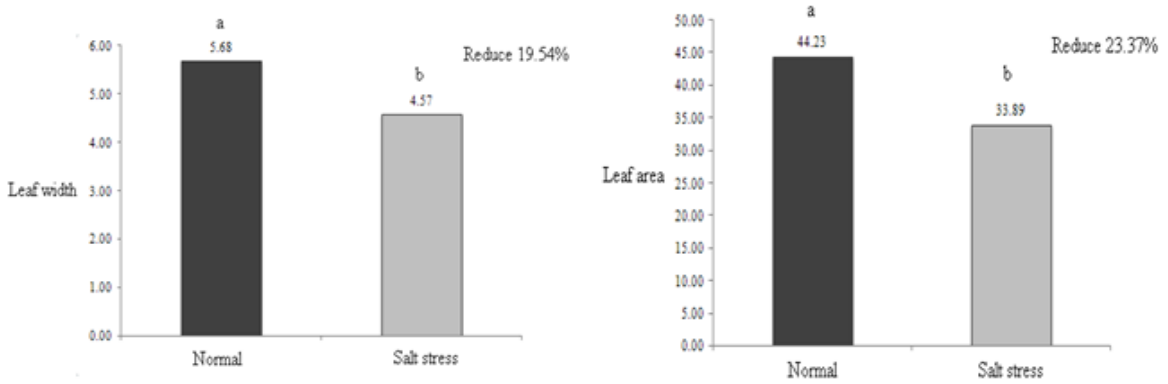


Fig. 2. average of stress level traits of leaf breadth and leaf area and reduction area of leaf breadth and leaf area affected by salinity stress.

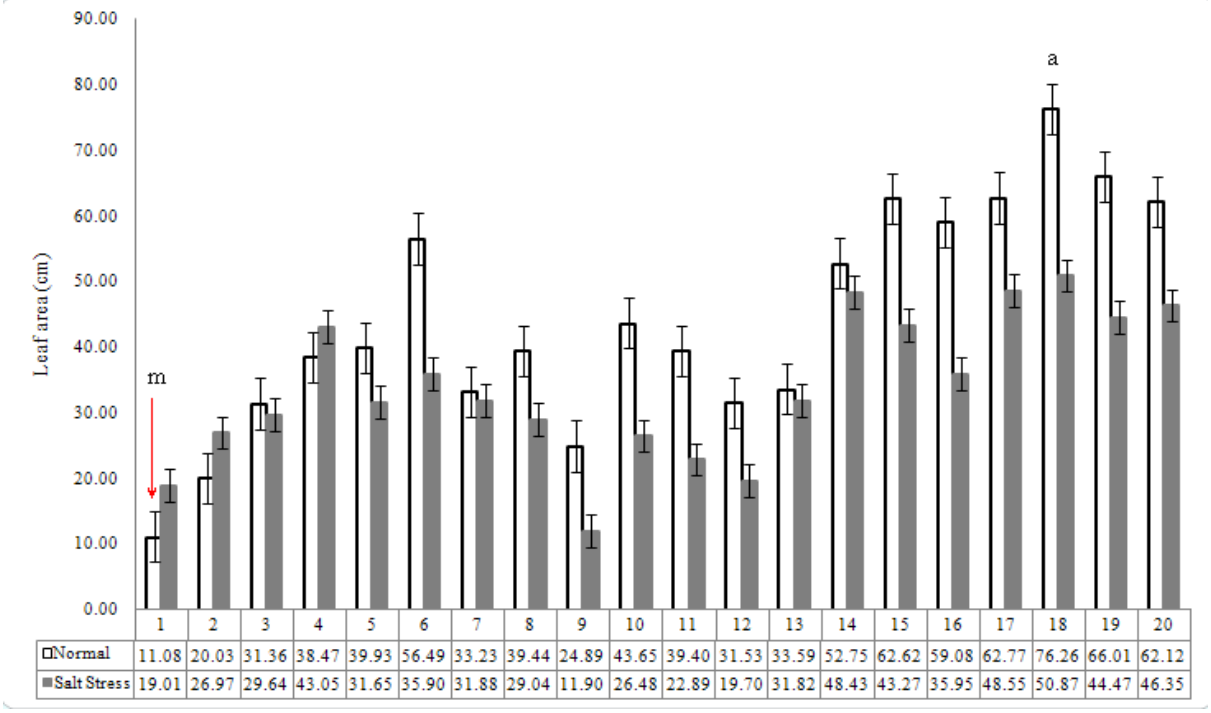
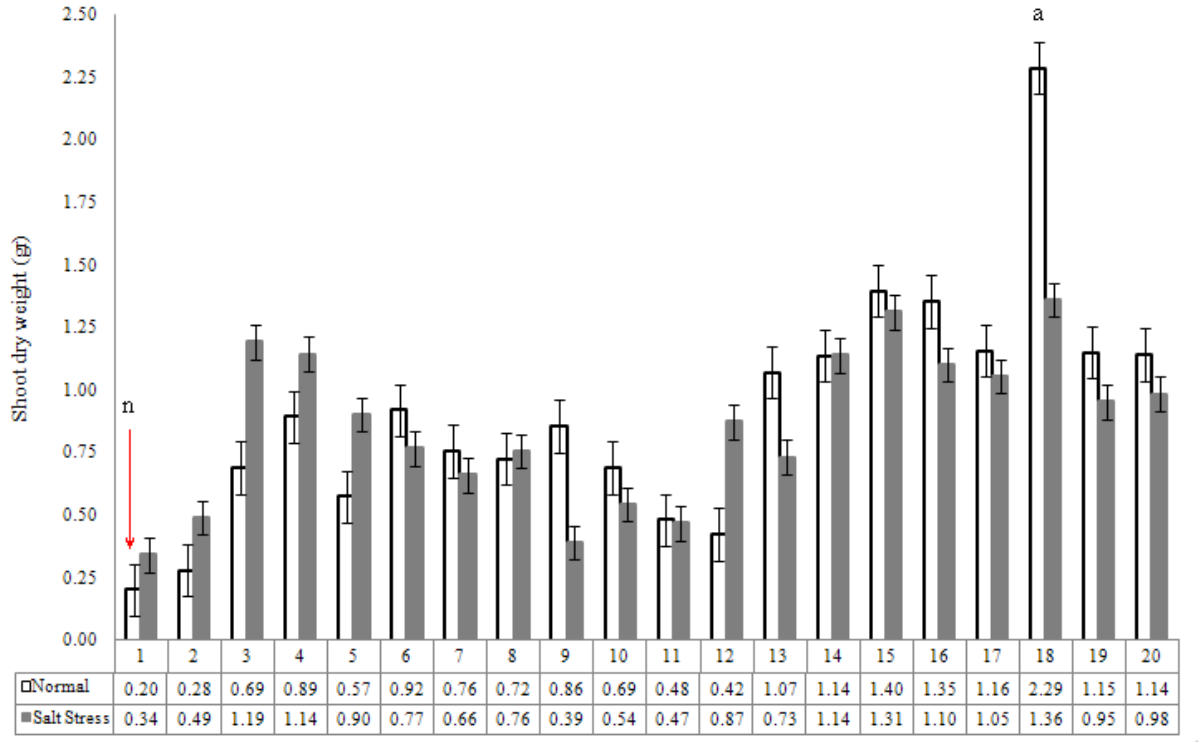


Fig. 3. Comparison of stress levels × genotype interaction for leaf area trait.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Normal	0.20	0.28	0.69	0.89	0.57	0.92	0.76	0.72	0.86	0.69	0.48	0.42	1.07	1.14	1.40	1.35	1.16	2.29	1.15	1.14
Salt Stress	0.34	0.49	1.19	1.14	0.90	0.77	0.66	0.76	0.39	0.54	0.47	0.87	0.73	1.14	1.31	1.10	1.05	1.36	0.95	0.98

Fig. 4. Comparison of stress levels × genotype interaction for stem dry weight trait.

The results of mean comparison between the studied genotypes in terms of this trait indicated (table 4) that the highest value referred to genotypes 1, 2, 3, 6, 7, 8, 16, 17, 18 and 19 and the lowest value was observed in the genotype 12. The leaf area of genotypes 14, 15, 16, 17, 18, 19 and 10 had the highest value and were located in class a and the genotype 1 had the lowest value. In analyzing the genotype * stress interaction, it was observed (Fig. 3) that in normal conditions, genotype 18 had the highest value. Obviously, genotypes 6, 15, 16, 17, 19 and 20 were also in class a, and the lowest value in normal conditions belonged to genotype 1 and in stress conditions referred to genotype 9. Genotype 18 had the highest value in terms of the stem dry weight and was located in class a; in contrast, genotype 1 had the lowest stem dry weight (Table 4) and comparison of genotype × salinity stress mean in terms of these traits shows that the highest value in normal conditions referred to genotype 18 and the lowest referred to genotype 1 (fig 4). The results obtained in this research correspond to the results of Ebrahimian et al. (2009). Fotuhi *et al.* (2007) with an analysis of 20 genotypes in the salinity stress conditions, stated that in the presence of salinity, the stem dry weight, plant height, and also the leaf morphological traits such as the leaf area, and the special area of the leaf area index substantially decrease which correspond to the results obtained in this research. Khorshidi et al. (2004) stated that according to the existence of a positive and significant correlation between the dry weight leaf length and breadth and the wet weight with the performance of root and performance of white sugar. Thus, by means of these traits, the cultivars could be evaluated.

References

Cooke DA, Scott RK. 1993. The sugar Beet crop science into practice. London, new york chapmon & Hall, p. 675.

Ebrahemian ZA. Ranji M, Rezaei Z. Abbasi Z. 2009. Sifting of Sugar Beet Genotypes Under Salinity Stress in Greenhouse and Farm. Sugar Beet Magazine **(24),** 1.

Fischr RA, Wood JT. 1989. Drought resistance in spring wheat cultivar, yield associations with

morpho-phisiological traits. Australian Journal of Agricultural Research **30,** 1001-1020.

Fotuhi K, Mesbah M, Sadeqian S, Ranji Z, OraziZadeh R. 2007. Evaluation of Resistance to Salinity in Sugar Beet Genotypes. No. 2. Second Edition. Sugar Beet Magazine.

Khorshid A, Mesbah M, Ranji Z, Vahedi S, Mesbah M. 2004. Correlation between Quantative and Qualitative Traits of Sugar Beet in Salinity and Greenhouse Draught Stress Conditions Compared with Quantative and Qualtative Traits of Sugar Beet Compared with Stressless Conditions. Sugar Beet Magazine. No. 17.

Khoshkholgh SN, Asgari H. 2002. Different mechanisms of resistance to salinity. Workshop salinity and mechanisms of plant growth, challenges and strategies. 14 to 18 February 2002. Faculty of Agriculture, Ferdowsi University of Mashhad.

Mirzamasoumzadeh B, Imani AA, Khayamim S. 2013. Evaluation of salt tolerance in sugar beet cultivars in dry conditions the glass greenhouse. Master's thesis. Islamic Azad University of Ardabil.

Sadeghi A. 2007. Evaluation of promising potato varieties tolerance towards salinity. Master Thesis in Plant Breeding, Islamic Azad University of Ardabil.