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Effect of polyethylene glycol on some greenhouse characteristics in sugar beet genotypes

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Abstract

To study the physiological aspects of drought on a number of traits of 20 sugar beet genotypes, an experiment was performed in 2014 in the laboratory of Islamic Azad University, Ardebil branch as two-factor factorial in a completely randomized block design with three replications. The first factor included zero control (water) and 0.8 MPa, while the second factor included studied genotypes. The examined traits included plant height, leaf length, leaf width, number of leaves per plant, root length, fresh weight of shoot and root fresh weight. Analysis of variance results showed significant differences between stress levels except for root length and root fresh weight in the rest of traits. Also, there were significant differences between studied genotypes regarding all the traits. Also, the only interaction of stress levels × shoot fresh weight genotype showed a significant difference. Also, a reduction was seen in plant height, leaf length, leaf width, number of leaves per plant and root fresh weight in stress conditions compared to normal terms, respectively as 29.28%, 26.95%, 32.92%, 7.77% and 37.14%.

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Introduction

Sugar beet progenitor was emerged in seashore lands, so sugar beet are resistant to drought and salinity condition compared to other crops plants. It has shown that just cotton and grain are more resistant to drought and salinity condition compared to sugar beet (Cook and Scott, 1998). Sugar beet is a two years old plant, during first year this plant is laid in the earth without any root and sugar is congregate. Producing natal structure is done in sugar beet during third year and then produce blossom root (Abdollahian Noghabi, 2001). During recent years, different variation of sugar beet was used to produce vegetable and in Greece and Rome this plant was used due to high nutritional value (Cook and Scott, 1998). Sugar is economic and politic goods. Since World War II Due to severe dumping it has seen the highest volatility and currently continues (Hosseini and Mohammad Ibrahim, 1385).Drought stress plays important role in reducing global crop production as the most abiotic stress. (Farshadfar and Mohammadi, 2005). Drought is a widespread phenomenon in many areas, which can reduce seed yield and stability yield (Yadav *et al*, 2002). Drought stress occurs when the amount of water irrigation or rain , wasted water don't supply plant through evaporation or transpiration In these conditions, the plant can absorb water from the soil and doesn't absorb water remaining in the soil profile (Madhj and Fathi, 2008). Drought stress was one of the major problems to produce farms plants in Iran and the world, as well as a serious threat to the successful production of crops around the world (Ober, 2001). significantly about one -third of the arable lands are faced to water shortages (Clover *et al*, 1998) and is reported drought stress as a major factor to decrease sugar beet performance (Ober, 2001).In many studies, PEG has been used as a drought stress factor (Tsveltkov and Weele, 2000). Polyethylene Glycol is a macromolecules mixture (molecular weight 8000-6000), which cannot enter to the seed and don't not cause to side effects at salts (Michel and Kaufman, 1973).PEG was used in most of plants in order to create osmotic stress which resulting of flexibility, chemical and biological interaction deny, Immobility, non-toxic and non-ionic of PEG characteristic used (Al-Bahrany, 2002). The purpose of this study was to evaluate the effect of polyethylene glycol on some greenhouse characteristics of the sugar beet genotypes.

In this study, the traits of plant height, leaf length, leaf width, number of leaves per plant, root length, fresh weight of shoot and root fresh weight were evaluated.

Material and methods

Location of test implementation

in order to prepare seeds, modification institute of seeds at Karaj was visited and after receiving seeds table 1) Bracteole was done. This study was done in 2011 at greenhouse as two-factor factorial experiments. Factor a (drought level: 1 normal irrigation, 2: Polyethylene glycol 6000 with 30% concentration) and factor b (genotype) was performed. Experiment was done as Factorial in completely randomized design frame with three replications in this study;

Experiment dry osmotic first treatment (normal water) and a second treatment of dry osmotic using polyethylene glycol 6000 concentration was 30% and in pots with a diameter of 30 cm and a height of 40 cm that have drainage was 20 seeds each digit in depth 2.5 cm using forceps straight perlite medium diameter of 4 mm were grown. Varieties thatwere less than 30 seeds were planted viability. Immediately after planting, the pots were irrigated with water under each potwa spliced in containers with a capacity of 500 cc. And every 3 days by municipal water volume was 500 cc. In the first month according to the needs of low concentrations of plant nutrients in half Hoagland solution (Table 2), the experimentally and a detailed comparison table was properly used and the subsequent months of full concentration Hoagland solution was used. After 30 days of sowing (stage 3 or 4 true leaves), so meperlite were added to the pots. To help establish appropriate plants and after 60 days of implantation stage (5 to 6 leaf stage) plants in each pot were thinned to 8 plants remained low after 70 days of treatment was begun planting treatments using Overall solution were carried out under the pots. Hoagland solution was used in all solutions to environmental elements required for plant growth and lack of any tension or toxic elements into the plant will be, and the results affect.

Before data analysis, establish the assumption of normal distribution of deviations, homogeneity of variance was examined. The mean yield using Duncan test at 5% probability level by SPSS-18 software and graph drawing was done by Excel.

Results and discussion

Analysis of variance and mean comparison in greenhouse drought conditions after examining the normality of data distribution of analysis of variance of data resulted from assessing the studied characteristics in greenhouse conditions and drought as in the table (Table 3) showed that the difference was significant between the two conditions regarding all assessed traits with the exception of root length and root fresh weight at the 1% probability level and regarding the number of leaves per plant at the 5% probability level. The studies showed significant differences between the genotypes evaluated in all the traits at 1% probability level. Regarding the interaction of stress levels × shoot fresh weight genotype, the difference was significant at 1% probability level and non- significant for other traits. The following genotypes had the highest value regarding height and were in the class "a": 2 , 3 , 4 , 6 , 8 , 11 , 13 , 14 , 15 , 16 , 17 , 18 , 19 and 20. In contrast, the genotypes 1 and 5 had the lowest height (Table 4). The genotype interaction in the terms of this trait was significant (Table 3), and the plant height decreased as 29.29% in stress conditions compared to the normal status (Fig. 1). The results on mean comparison showed that the genotypes of 15, 16, 17, 18 and 19 had the highest value in terms of leaf length and were in class "a" (Table 4). The results on mean comparison showed that the genotypes of 4, 6, 7, 11, 13, 14, 15, 16, 17, 18, 19 and 20 were in class "a" regarding leaf width and had the highest value accordingly (Table 4). In contrast, the genotype 1 had the lowest leaf width, and the values of leaf length and leaf width showed 26.95% and 32.92% decrease under stress conditions than the normal ones, respectively (Figure 2). Comparison of means results between studied genotypes in terms of these traits indicated that the highest value was related to the genotype number 18, while genotypes 9 and 20 had the minimum number of leaves per plant (Table 4). The results on mean comparison showed that (Table 4) the genotypes 6, 15, 16, 17, 18 and 19 had the highest value and were in class "a". The results on genotypes mean indicated (Table 4) that the genotypes 15, 16, 17, 18 and 19 were in class "a" regarding shoot fresh weight, and had the highest value. In contrast, genotype 1 had the lowest shoot fresh weight. As previously mentioned, the genotype interaction was significant in stress conditions regarding this trait so that in normal circumstances, the genotype 18 had the highest value of and genotype 9 had the lowest value (Table 5). The number of leaf per plant and root fresh weight in stress conditions compared to normal conditions showed 7.77% and 37.14 % decrease, respectively (Fig. 3).

Table 1. Genotypes used in this study.

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

Table 2. Compounds and their levels in Hoagland solution.

Chemical name	Stock solution amount(g/1lit)	Amount of 100 liters(ml)
NH4H2PO4	115	100
KNO3	101	600
Ca(NO3)24H2O	236	400
MgSO47H2O	246	200
Fe-EDTA	5	150
H3BO3	0.38	150
ZnSO47H2O	0.22	150
MnSO44H2O	1.02	1000
CUSO45H2O	0.08	100
(NH4)6MO7O244H2O	0.02	100

Table 3. ANOVA analysis of assessed greenhouse traits in studied genotypes of sugar beet in drought stress conditions.

S.O.V	df	Mean of Square						
		Plant height	Leaf length	Leaf width	Number of leaves per plant	Root length	Shoot fresh weight	Root fresh weight
Rep	2	191.275**	5.938	2.717	1.758	26.917	194.123**	2.453**
Stress level (A)	1	2915.602**	310.794**	104.907**	13.333*	0.481	641.719**	0.305
Genotype (B)	19	90.111**	20.828**	3.409**	4.633*	35.476*	61.238**	1.615**
A × B	19	24.392	3.012	1.37	2.895	25.163	31.755**	0.48
Error	78	34.484	3.79	1.183	2.827	17.676	14.398	0.445
C.V%		20.43	18.9	22.91	20.30	23.48	10.77	19.65

* and **, respectively, significant at the 5% level and 1%.

Table 4. Mean comparison of studied genotypes of sugar beet regarding assessed greenhouse traits in drought conditions.

Trait														Num
Root fresh weight		Shoot fresh weight		Root length		Number of leaves per plant		Leaf width		Leaf length		Plant height		Genotype
4.033	f	.25	d	14.52	bc	8.33	abcd	3.22	f	6.75	g	19.50	e	1
4.517	ef	.45	bcd	15.58	abc	8.67	abcd	3.97	ef	9.36	ef	27.58	abcd	2
9.617	bcde	.54	bcd	18.50	abc	9.67	ab	3.78	ef	9.67	cdef	27.58	abcd	3
9.917	bcd	.56	bcd	21.25	a	8.50	abcd	4.70	a-f	10.50	b-f	30.00	abcd	4
9.217	b-f	.50	bcd	16.17	abc	7.83	bcd	4.28	cdef	9.31	ef	27.08	e-a	5
11.40	b	1.27	ab	18.42	abc	8.50	abcd	5.06	a-e	10.31	b-f	30.33	abcd	6
10.78	bc	.55	bcd	21.08	a	8.00	abcd	4.89	a-e	8.83	fg	26.83	bcde	8
8.567	b-f	.68	bcd	19.08	ab	8.17	abcd	4.39	b-f	8.72	fg	27.42	abcd	7
4.833	def	.31	cd	15.50	abc	6.83	d	4.20	def	9.56	def	23.75	de	9
9.000	b-f	.49	bcd	15.83	abc	7.50	cde	4.19	def	8.78	fg	24.58	cde	10
5.367	def	.34	cd	12.93	c	8.00	abcd	4.84	a-e	9.61	def	28.42	abcd	11
6.050	cdef	.32	cd	17.67	abc	7.17	cd	4.50	b-f	8.50	fg	23.67	de	12
8.817	b-f	.93	bcd	16.67	abc	8.00	abcd	4.25	cdef	10.03	cdef	31.42	abcd	13
8.900	b-f	.96	bcd	16.30	abc	7.83	bcd	4.72	a-e	9.70	cdef	31.17	abcd	14
12.17	ab	1.20	abc	20.17	ab	8.33	abcd	5.72	abc	13.50	a	32.67	abc	15
12.42	ab	1.19	abc	21.33	a	9.50	abc	5.50	abcd	11.86	a-e	31.75	abcd	16
13.23	ab	1.20	abc	20.50	a	8.50	abcd	5.81	ab	12.42	ab	30.58	abcd	17
16.35	a	1.99	a	19.83	ab	10.33	a	5.83	ab	14.17	a	35.08	a	18
11.77	ab	2.00	a	17.33	abc	9.00	abcd	6.00	a	12.25	abc	31.08	abcd	19
9.200	b-f	1.04	bcd	19.50	ab	7.00	d	5.14	a-e	12.17	abcd	34.25	ab	20
9.308		0.84		17.91		8.28		4.75		10.30		28.74		Mean

Dissimilar letters indicate significant differences at the 5% level.

Table 5. Mean comparison of interaction of drought stress levels × studied genotypes of sugar beet regarding assessed traits in the greenhouse.

Shoot fresh weight				
Drought		Normal		
4.93	h-m	3.13	k-m	1
4.73	h-m	4.3	i-m	2
8.40	c-m	10.83	b-j	3
7.70	f-m	12.13	b-h	4
8.30	c-m	10.13	b-k	5
7.70	f-m	15.10	b-f	6
6.23	g-m	15.33	bcde	7
7.80	f-m	9.33	b-m	8
7.80	e-m	1.87	m	9
5.27	g-m	12.73	b-g	10
3.40	jklm	7.33	g-m	11
2.23	lm	9.87	b-l	12
7.27	g-m	10.37	b-k	13
6.70	g-m	11.10	b-i	14
7.63	f-m	16.70	b	15
8.33	c-m	16.50	b	16
10.67	b-k	15.80	bc	17
8.83	c-m	23.87	a	18
8	d-m	15.53	bcd	19
7.97	d-m	10.43	b-k	20

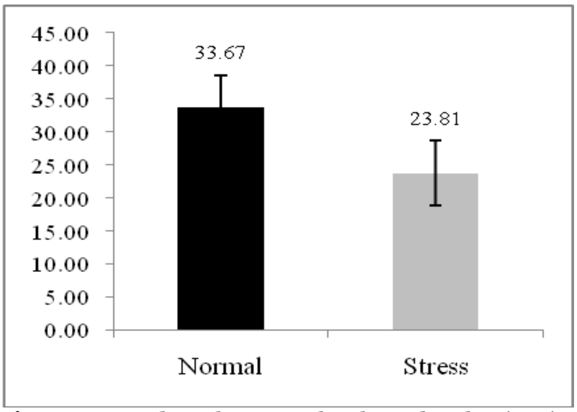

Fig. 1. Mean drought stress levels and reduction in plant height.

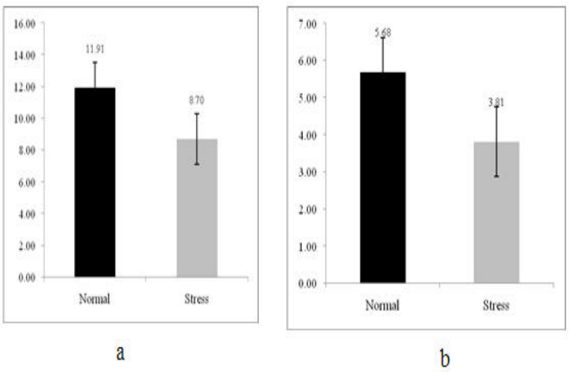

Fig. 2. Mean drought stress levels and reduction in leaf length (a) and leaf width (b).

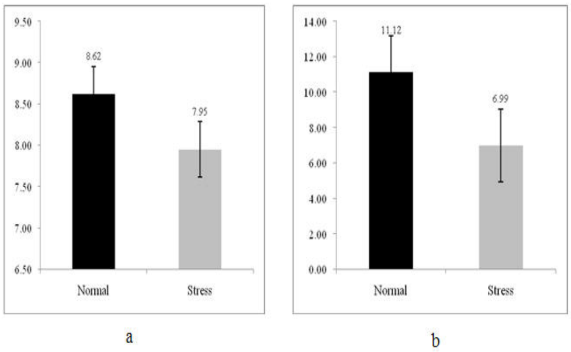

Fig. 3. Mean drought stress levels and reduction in the number of leaves per plant (a) and root fresh weight (b).

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