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CHARACTERIZATION OF *BUNIUM PERSICUM* ACCESSIONS TO SALT STRESS

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ABSTRACT
Salinity is an increasing problem in the world. Study of the salinity tolerance in medicinal plants is very important in cultivating them in saline lands. A complete random design experiment was carried out in order to study the effect of salinity stress on *Bunium persicum* plants in hydroponic environment with four replications in germination stage and three in seedling stage. The genotypes of *Bunium persicum* were from Jangal–Khageh Kalat, Sirzad Kalat, Semnan, Alamut Ghazvin, Chalmir Dargaz, Bagheran Birjand, Babaaman Bojnord, Kerman, Shiraz, Ferizi Chenaran, Yazd and Markazi province. Salinity levels include control (zero concentration), 50, 100, 150 and 200 mM NaCl. The results showed significant reduction in germination rate, germination percentage, shoot length, root length, vigority, shoot dry weight, root dry weight, total biomass and shoot/root ratio with increasing salinity in *Bunium persicum* genotypes compared with the control. A significant difference was observed between *Bunium persicum* genotypes. Anyway, *Bunium persicum* genotypes showed more tolerance in germination stage than seedling stage. In different genotypes Sirzad Kalat showed the lowest reduction and Alamut Ghazvin showed more reduction compared with the control in germination stage. In the seedling stage Yazd genotype showed the lowest reduction and Markazi province genotype showed more reduction compared with the control. In the germination and seedling stages Babaaman of Bojnord genotype showed more tolerance to salt stress.

KEY WORDS: Salinity, hydroponic, NaCl, *Bunium persicum*.

INTRODUCTION

Salinity is main factor to limit plant geographical dispersion and effect on vegetative or reproductive quality of plants (Kumar *et al.*, 2004). Nowadays using of medicinal plants has developed between people (Osaski *et al.*, 2002). Furthermore because of weather condition in Iran, agricultural lands include salty soil. Recent studies showed that 15% of total arable area are salt (Karimi and Shekari, 1996 and Postini and Zahtab Salmani, 1997). So it is important for study and investigation of salinity tolerance of medicinal plants and production of salt tolerant plants. Measuring of morphological index such as growth rate of shoots and roots is a good index for evaluation salinity tolerance (Shalhevet, 1993 and Munns *et al.*, 1982). Plants can divide into two groups: resistant and sensitive to salinity, and salty water might be used for resistant's plants irrigation (Francois *et al.*, 1986). One of the effective factor on salinity tolerance is protective of swelling cell that plant can resist of growth decreasing. One method for protecting swelling cell is osmotic regulation with absorption of salty ions and production of organic materials (Safarnejad *et al.*, 1996). Under salinity stress some elements disrupts absorption of others. Under salinity stress P and N limit plant growth (Gorham, 1996, Shalhevet, 1993 and Shannon, 1986). It is due to competition between elements because of disrupting adjustment of ion translocation (Niu *et al.*, 1995). Plant response to salinity stress is different because of growth stage, development and plant age (Kerepsi and Galiba, 2000). So it is important to select salt tolerant plants for high yield and inhibiting of growth reduction (Munns *et al.*, 1982 and Shannon, 1986). In hydroponic method, plants provide nutrients from solution directly. Furthermore nutrients and elements can be controlled (Lahoti and Rahimzadeh, 1995). In hydroponic condition, effects on different stress salinity, drought and nutrient shortage could be studied. *Bunium persicum* is from Umbelliferae family. It is a perennial shrub, without trichome and standing . Roots are gland form and levees are alternative (Rashed Mohasel, 1992). This plant has dormancy and germinates late (Castillo and Jordan, 1997). In this research, effect of salinity stress on germination and seedling stages of different genotypes of *Bunium persicum* with hydroponic method was studied.

MATERIALS AND METHODS

In this research, in order to investigate the effect of salinity stress on *Bunium persicum* plants, the changes that rising from salinity was studied in germination and seedling stages. A complete random design experiment was carried out with four replications in germination stage and three in seedling stage. The genotypes of *Bunium persicum* were from Jangal–Khageh Kalat, Sirzad Kalat, Semnan, Alamut Ghazvin, Chalmir Dargaz, Bagheran Birjand, Babaaman Bojnord, Kerman, Shiraz, Ferizi Chenaran, Yazd and Markazi province. Because of shortage seeds of Markazi province and Ferizi Chenaran, Markazi province genotype studied in seedling stage and Ferizi Chenaran genotype studied in germination stage. Salinity levels include control (zero concentration, 50, 100, 150 and 200 mM NaCl in germination stage and control, 50, 100 and 150 mM NaCl in seedling stage. In order to break seed dormancy, seeds placed in refrigerator for two months. For sterilization, 1.5 % $HOCl_2$ for 3 min, sterile distilled water

and binomial for 2 min were used. Finally seeds were rinsed with sterile distilled water and then were sown in glasses that were sterilized with $HOCl_2$. Hewit solution with NaCl concentrations were poured in to 300 cm^3 glasses and 20 seeds sown in each glass (Fig 1). Every glass was as a replication. Then glasses transferred to growth room at $25\pm2^{C^\circ}$ and florescent light with a 16- h photoperiod (Akhondi *et al.*, 2004). After 14 days, different traits such as, germination percentage, length shoot, length root, vigority, shoot and root fresh weight, shoot and root dry weight, total biomass and shoot/root ratio were measured. For dry weight, fresh samples placed in oven at 80 $^{\circ C}$ for 48 hours. Below formula were used for germination percentage and biomass:

$PG = N_i / N \times 100$

PG → germination percentage

N_i → germination seeds until ith day

N → total seed

Biomass = root dry weight + shoot dry weight

Vigority was determined according to Anderson and Abdul-Baki method using below formula:

Vigority = [germination percentage × mean of length seedling (mm)] / 100

In seedling stage, in order to provide seedling, some seeds of each genotype were sown on beeds in glasses filled with Hewit solution without NaCl and after 14 days transferred to hydroponic with different salty level (Akhondi *et al.*, 2004). In order to adoption, seedling transferred to glass without NaCl for 48 hours. Then transferred to glasses with 0, 50, 100 and 150 mM NaCl (Fig 2). After 2 weeks root and shoot length, root and shoot fresh weights were measured (Fig 3). Shoot and root length were measured by 0.1 mmd ruler and fresh weight measured by 0.0001 gr digital scale.

Statistical analysis for each variable using SAS software. Means were compared by duncan´s multiple range test at $p\leq0.05$.

RESULTS

Effect of salinity stress on germination stage:

Results showed significant differences between *Bunium persicum* genotypes in germination percentage at 1% level (Table 1). Increasing salinity, reduced germination percentage in genotypes. Reduction of germination percentage of Jangal -khageh Kalat, Sirzad Kalat, Chalmir Dargaz, Bagheran Birjand, Babaaman Bojnord, Kerman and Yazd was 96.05, 82.5, 88.75, 87.19, 93.83, 98.25 and 94.46% respectively. This reduction was 100% in other genotypes. ANOVA showed significant differences between *Bunium persicum* genotypes in all of traits at 1% level in germination stage (Table 1). With increasing NaCl in germination stage, root length, shoot length, vigority, dry and fresh weight, shoot/root ratio and biomass reduced (Tab. 3). Root length reduction of Jangal–Khageh Kalat, Sirzad Kalat, Chalmir Dargaz, Bagheran Birjand, Babaaman Bojnord, Kerman and Yazd was 95.01, 88.61, 81.94, 70, 88.89, 92.54 and 97.17% respectively in 200 mM NaCl (Table 3). Reduction of shoot length in Jangal–Khageh Kalat, Sirzad Kalat, Chalmir Dargaz, Bagheran Birjand, Babaaman Bojnord, Kerman and Yazd was 93.69, 87.23, 87.68, 88.13, 93.31, 92.79 and 96.65% respectively in 200 mM NaCl compared with the control in germination stage (Table 3). Reduction of vigority in Jangal –Khageh Kalat, Sirzad Kalat, Chalmir Dargaz, Bagheran Birjand, Babaaman Bojnord, Kerman and Yazd was 99.59, 97.96, 98.46, 97.5, 98.98, 99.5 and 99.32% respectively in 200 mM NaCl compared with the control (Table 3). In germination stage the highest root fresh weight (7.54 mg/p) was observed on control in Kerman genotype and the lowest root fresh weight (zero) was observed on 200 mM NaCl in Semnan, Alamut Ghazvin, Shiraz and Ferizi Chenaran (Table 3). In germination stage the highest root dry weight (0.51 mg/p) was observed on control in Chalmir Dargaz genotype and the lowest root dry weight (zero) was observed on 200 mM NaCl in Semnan, Alamut Ghazvin, Shiraz and Ferizi Chenaran (Table 3). In germination stage the highest shoot fresh weight (17.28 mg/p) was observed on control in Chalmir Dargaz genotype and the lowest shoot fresh weight was observed on 200 mM NaCl in Semnan, Alamut Ghazvin, Shiraz and Ferizi Chenaran (Table 3).

In germination stage increasing salinity reduced shoot dry weight. Reduction of shoot dry weight in Jangal–Khageh Kalat, Sirzad Kalat, Chalmir Dargaz, Bagheran Birjand, Babaaman Bojnord, Kerman and Yazd was 80.92, 79.19, 74.87, 76.35, 91.38, 89.21 and 91.23% respectively in 200 mM NaCl compared with the control (Table 3).

In germination stage increasing salinity reduced shoots / root ratio. This reduction in Chalmir Dargaz was 30.43 in 200 mM NaCl compared with the control (Table 3).

In germination stage reduction of total biomass in Jangal – Khageh Kalat, Sirzad Kalat, Chalmir Dargaz, Bagheran Birjand, Babaaman Bojnord, Kerman and Yazd was 84.08, 75.66, 68.49, 76.06, 87.33, 89.01 and 90.44% respectively in 200 mM NaCl compared with the control (Table 3).

Effect of salinity stress on seedling stage:

ANOVA showed significant differences between *Bunium persicum* genotypes in all of traits at 1% level in seedling stage (Table 2). Increasing salinity, reduced root length, shoot length, root and shoot fresh weight (Table 4).

Reduction of root length in Jangal–Khageh Kalat, Sirzad Kalat, Semnan, Alamut Ghazvin, Bagheran Birjand, Babaaman Bojnord, Kerman, Shiraz and Yazd was 79.72, 65.9, 45.74, 63.33, 65.24, 55.85, 52.5, 75.28 and 21.75 % respectively in 150 mM NaCl compared with the control in seedling stage (Table 4). This reduction in Chalmir Dargaz and Markazi province was 100% (Table 4).

Reduction of shoot length in Jangal–Khageh Kalat, Sirzad Kalat, Semnan, Alamut Ghazvin, Bagheran Birjand, Babaaman Bojnord, Kerman, Shiraz and Yazd was 79.12, 13.3, 30.3, 39.33, 41.14, 35.35, 27.97, 71.91and 49.92 % respectively in 150 mM NaCl compared with the control in seedling stage(Table 4). In seedling stage the lowest root fresh weight (zero) was observed on 150 mM NaCl in Chalmir Dargaz and Markazi province (Table 4). In seedling stage the highest shoot fresh weight (42.71 mg/p) was observed on control in Babaaman Bojnord and the lowest shoot fresh weight (zero) was observed on 150 mM NaCl in Chalmir Dargaz and Markazi province genotype (Table 4).

TABLE 1. Variance analysis of interaction between salt stress and 8 accessions of *Bunium persicum* for growth characters at germination stage *

S.O.V		Germination (%)	Biomas (mg/plant)	Shoot/Root ratio	Shoot Dry Weight (mg/plant)	Shoot Fresh Weight (mg/plant)	Root Dry Weight (mg/plant)	Root Fresh Weight (mg/plant)	Vigority	Shoot Length (mm)	Root Length (mm)
Treatment	54	3023.922**	1.363**	8.253**	0.832**	99.238**	0.084**	18.029**	6318.716**	1882.834**	1062.75**
Accesion	10	1424.065**	0.625**	12.302**	0.357**	41.057**	0.063**	9.073**	1967.583**	491.519**	505.221**
Salinity	4	35097.878**	15.689**	18.966**	9.849**	1196.993**	0.743**	196.359**	73651.608**	23427.574**	11713.137**
Accesion* salinity	40	216.49**	0.115 ns	6.169**	0.049 ns	4.008 ns	0.023**	2.435**	673.211**	76.189**	137.094**
Error	165	83.986	0.094	3.147	0.046	3.454	0.013	1.315	77.364	34.726	39.654

n.s, non significant & **,significant in α= %1

TABLE 2. Variance analysis of interaction between salt stress and 8 accessions of *Bunium persicum* for growth characters at seedling stage

S.O.V	DF	Shoot Fresh Weight (mg/plant)	Root Fresh Weight (mg/plant)	Shoot Length (mm)	Root Length (mm)
Treatment	43	356.028**	342.879**	1294.125**	7061.544**
Accession	10	594.267**	1123.824**	1520.412**	9755.847**
Salinity	3	2462.745**	665.29**	10069.594**	55420.195**
Accession*salinity	30	65.942 ns	50.324 ns	341.15 ns	1327.579 ns
Error	88	53.089	48.469	245.875	880.028

n.s, non significant & **,significant in α= %1

TABLE 3. Mean comparison of interaction between salt stress and 8 accessions of *Bunium persicum* for growth characters at germination stage *

Accession	NaCl Conc. (mM)	Biomas (mg/plant)	Shoot/Root ratio	Shoot Dry Weight (mg/plant)	Shoot Fresh Weight (mg/plant)	Root Dry Weight (mg/plant)	Root Fresh Weight (mg/plant)	Vigority	Shoot length (mm)	Root Length (mm)	Germination (%)
Jangal Khajeh (Kalat)	0	2.01ab	3.205bcdefgh	1.52b	15.68abc	0.48abc	6.53abc	128.09a	65abc	66.2a	97.50abc
	50	1.38cdefghij	2.277cdefghi	0.96de	10.25ghi	0.42abcde	4.89cdefgh	45.60f	33.8ghi	36.6efghi	65.38efg
	100	1.09ghijklmn	1.930defghi	0.72efghijk	7.90ijk	0.38abcdefg	4.19defghi	13.94ijkl	23.1jklm	22lmno	30.78hijklm
	150	0.55opqrstuv	1.5defghi	0.41jklmno	2.64qrstuv	0.14klmno	1.30nopqr	0.96l	7.9qrstuv	6.4rstuv	3.85qrst
	200	0.32tuvw	3.750bcdef	0.29lmnop	1.45stuv	0.04no	0.36qr	0.53l	4.1stuv	3.3stuv	3.85qrst
Sirzad (Kalat)	0	1.89bc	3.716bcdef	1.49bc	15.07bcd	0.40abcdef	5.56bcd	125a	69.7a	55.3b	100a
	50	1.23efghijk	2.370cdefghi	0.86defgh	10.21ghi	0.37abcdefg	5.14bcdefg	66.93e	40.4fg	39.2defgh	83.75de
	100	1.08ghijklmno	1.910defghi	0.69efghijk	6.75jklmn	0.39abcdefg	3.91defghij	14.38ijkl	24.4ijkl	21.6mno	33.75hijkl
	150	0.55pqrstuv	2.490cdefghi	0.39jklmno	2.76qrstuv	0.16hijklmno	2.11jklmnopq	4.46l	12.3nopqrst	14opqrs	18.75jklmno
	200	0.46rstuvw	5.375abc	0.31lmnop	2.97pqrstuv	0.15ijklmno	0.76opqr	2.55l	8.9pqrstuv	6.3rstuv	17.50jklmnop
emnan	0	1.70bcde	4.031bcde	1.36bc	14.38cde	0.34abcdefghij	4.92cdefgh	110.56bc	67.7ab	48bcd	95abc
	50	0.91ijklmnopqrs	3.427bcdefgh	0.69efghijk	7.23ijklm	0.21fghijklmn	2.27ijklmnopq	20.46hijk	25.5ijk	15.8nopqr	46.05ghi
	100	0.50qrstuvw	2.165defghi	0.35klmnop	3.35pqrstu	0.15ijklmno	1.28nopqr	3.63l	9.6pqrstuv	8rstuv	14.48mnopqr
	150	0.66mnopqrstuv	2.027defghi	0.48ijklmn	3.89nopqrs	0.19ghijklmno	0.66pqr	1.52l	9.3pqrstuv	4.6stuv	9.20opqrst
	200	0w	0i	0p	0v	0o	0r	0l	0v	0v	0t
Alamut (Ghazvin)	0	1.64bcdef	3.940bcde	1.31bc	13.20cdefg	0.34abcdefghijk	4.13defghi	105.56c	64.7abc	44.9cde	96.25abc
	50	1.10ghijklm	2.854bcdefghi	0.82defghi	8.71hij	0.29cdefghijklm	3.66defghijk	49.90f	32ghij	29.9hijklm	80.50de
	100	0.91ijklmnopqrs	2.586cdefghi	0.65efghijkl	5.99jklmnop	0.26defghijklm	2.73ijklmno	11.88ijkl	22klmn	14.1opqrs	32.50hijklm
	150	0.43stuvw	1.806defghi	0.29lmnop	2.25qrstuv	0.14jklmno	1.53lmnopqr	1.13l	6.1rstuv	4.8stuv	5.20pqrst
	200	0w	0i	0p	0v	0o	0r	0l	0v	0v	0t

(α =%1) There is no significant different between number with the same world in each column*

Bunium persicum accessions to salt stress

TABLE 3 (continue). Mean comparison of interaction between salt stress and 8 accessions of *Bunium persicum* for growth characters at germination stage *

Accession	NaCl Conc. (mM)	Biomas (mg/plant)	Shoot/Root ratio	Shoot Dry Weigh (mg/plant)	Shoot Fresh Weight (mg/plant)	Root Dry Weight (mg/plant)	Root Fresh Weight (mg/plant)	Vigority	Shoot length (mm)	Root Length (mm)	Germination (%)
Chalmir (Dargaz)	0	2.38a	3.651bcdefgh	1.87a	17.28ab	0.51 ab	7.01ab	122.09ab	70.6a	51.5bc	100a
	50	1.33defghij	2.642cdefghi	0.96de	11.17fgh	0.37abcdefg	5.25bcde	70.85e	44.9ef	35.4efghij	87.5 cd
	100	1.05hijklmnop	1.970defghi	0.70efghijk	7.11jklm	0.36abcdefgh	3.38efghijklm	21.86hij	23.3jklm	21mno	48.75ghi
	150	0.96ijklmnopqrs	1.459efghi	0.57fghijkl	4.28mnopqrs	0.39abcdefg	2.58ijklmnop	2.99l	17.3klmnopq	13.9opqrs	11.25mnopqr
	200	0.75klmnopqrst	2.540cdefghi	0.47ijklmno	3.47opqrst	0.28defghijklm	1.49lmnopqr	1.88l	8.7pqrstuv	9.3qrstuv	11.25mnopqr
Bagheran (Birjand)	0	1.88bc	3.684bcdefg	1.48bc	17.97a	0.40abcdef	6.82ab	116.27abc	73.3a	44.5cde	98.75ab
	50	1.19fghijkl	3.397bcdefgh	0.92def	11.07fgh	0.28defghijklm	3.46efghijkl	45.79f	35.7gh	25.3jklmn	74.68def
	100	0.97ijklmnopqr	2.802bcdefghi	0.71efghijk	6.83jklmn	0.26defghijklm	3hijklmn	13.39ijkl	18.7klmnop	19.4mnopq	34.18hijkl
	150	0.66mnopqrstuv	5.840ab	0.52hijklm	4.97klmnopq	0.14jklmno	1.44mnopqr	5.68l	11.2opqrstu	7.4rstuv	29.10ijklmn
	200	0.45rstuvw	4.650abcd	0.35klmnop	3.01pqrstuv	0.10mno	1.51lmnopqr	2.91l	8.7pqrstuv	13.3opqrst	12.65lmnopqr
Baba Aman (Bojnord)	0	1.50bcdefgh	3.373bcdefgh	1.16cd	12.55defg	0.35abcdefghi	4.91cdefgh	73.46de	53.8d	27.9ijklm	90cd
	50	0.86jklmnopqrs	2.175defghi	0.59fghijkl	6.53jklmno	0.27defghijklm	3.19ghijklmn	26.18ghi	25ijk	22.6mnopq	55.58fgh
	100	0.66lmnopqrstuv	2.547cdefghi	0.46ijklmno	4.33mnopqrs	0.20fghijklmn	1.82klmnopqr	10.65jkl	14.7lmnopqr	12.5opqrstu	37.50hij
	150	0.57nopqrstuv	1.292efghi	0.31lmnop	1.51rstuv	0.26defghijklm	0.60pqr	1.89l	7.3qrstuv	5stuv	13.90klmnopq
	200	0.19uvw	0.521ghi	0.10op	0.25uv	0.09mno	0.47qr	0.75l	3.6tuv	3.1tuv	5.55pqrst
Kerman	0	1.82bcd	3.233bcdefgh	1.39bc	12.86cdefg	0.43abcd	7.54a	74de	52.7de	33.5fghijk	85cd
	50	1.09ghijklmn	2.505cdefghi	0.82defghi	7.70ijkl	0.26defghijklm	4.87cdefgh	24.24hij	27.1hijk	24.9klmn	35.28ijklmn
	100	0.93ijklmnopqrs	3.785bcdef	0.71efghijk	5.12klmnopq	0.22efghijklmn	3.06hijklmn	6.91kl	17.2klmnopq	14opqrs	20.58jklmno
	150	0.60mnopqrstuv	6.937a	0.51hijklm	3.17pqrstuv	0.09mno	1.71klmnopqr	3.31l	12.8nopqrst	10.1pqrstuv	13.23klmnopq
	200	0.20uvw	0.750fghi	0.15mnop	0.30uv	0.05no	0.10r	0.37l	3.8tuv	2.5uv	1.48st

(α =%1) There is no significant different between number with the same world in each column*

TABLE 3 (continue). Mean comparison of interaction between salt stress and 8 accessions of *Bunium persicum* for growth characters at germination stage*

Accession	NaCl Conc. (mM)	Biomas (mg/plant)	Shoot/Root ratio	Shoot Dry Weight (mg/plant)	Shoot Fresh Weight (mg/plant)	Root Dry Weight (mg/plant)	Root Fresh Weight (mg/plant)	Vigority	Shoot length (mm)	Root Length (mm)	Germination (%)
Shiraz	0	1.71bcde	3.339bcdefgh	1.32bc	13.59cdef	0.39abcdef	5.31bcde	84.75d	57.3cd	40.7defg	85bcd
	50	1hijklmnopq	2.469cdefghi	0.70efghijk	7.78ijkl	0.30cdefghijkl	3.27fghijklmn	24.29hij	27hijk	21.2mno	48.50ghi
	100	1.42cdefghi	1.946defghi	0.89defg	4.96klmnopq	0.53a	4.73cdefgh	6.91kl	20.5klmno	32.1ghijkl	13.23lmnopq
	150	0.47qrstuvw	0.982efghi	0.31lmnop	2.56qrstuv	0.16hijklmno	0.95opqr	3.70l	6.8rstuv	7.3rstuv	13.23opqrst
	200	0 w	0 i	0 p	0 v	0 o	0 r	0 l	0 v	0 v	0 t
Ferizi (Chenaran)	0	1.85bc	3.317bcdefgh	1.42bc	13.73cdef	0.43abcd	5.16bcdef	103.91c	60.4bcd	43.5cdef	100a
	50	0.76klmnopqrst	2.485cdefghi	0.54ghijkl	4.33mnopqrs	0.22efghijklmn	2.12jklmnopq	29.39gh	17.1klmnopq	20.2mnop	78.75de
	100	0.49qrstuvw	2.779bcdefghi	0.36klmnop	3.40opqrstu	0.13lmno	1.70klmnopqr	13.15ijkl	11.4opqrstu	15.9nopqr	48.75ghi
	150	0.68lmnopqrstuv	1.176efghi	0.36klmnop	3.63opqrs	0.32bcdefghijkl	2.69ijklmno	3.88l	10.4pqrstu	16.6nopqr	13.75klmnopq
	200	0 w	0 i	0 p	0 v	0 o	0 r	0 l	0 v	0 v	0 t
Yazd	0	1.57bcdefg	2.606cdefghi	1.14cd	11.61efgh	0.44abcd	6.88ab	38.35fg	44.8ef	35.4efghij	47.50ghi
	50	1.12ghijklm	2.194defghi	0.74efghij	7.79ijkl	0.38abcdefg	46.3efghijkl	14.81ijkl	22.7jklm	19.8mnopq	36.83hijk
	100	0.70lmnopqrstu	0.715fghi	0.36klmnop	4.67lmnopqr	0.34abcdefghi	1.50lmnopqr	3.73l	14mnopqrs	9.5qrstuv	13.15nopqrs
	150	0.18uvw	1.250efghi	0.13nop	0.55tuv	0.05no	0.55qr	0.50l	3tuv	1.8uv	5.25pqrst
	200	0.15vw	0.500hi	0.10op	0.20v	0.05no	0.08r	0.26l	1.5uv	1v	2.63rst

(α =%1) There is no significant different between number with the same world in each column*

TABLE 4. Mean comparison of interaction between salt stress and 8 accessions of *Bunium persicum* for growth characters at plantlet stage

Accession	NaCl Conc. (mM)	Shoot Fresh Weight (mg/plant)	Root Fresh Weight (mg/plant)	Shoot Length (mm)	Root Length (mm)
Jangal-Khajeh (Kalat)	0	31.84abcdefgh	18.03efghijklmn	77.6abc	163.7abc
	50	25.99cdefghijkl	14.46hijklmno	73.2abcd	136.9abcdef
	100	24.45defghijklm	16.86fghijklmno	71.5abcd	111.5cdefghij
	150	3.06qr	3.93op	16.2gh	33.2no
Sirzad (Kalat)	0	31.03abcdefghi	17.32fghijklmno	77.4abc	187.4a
	50	25.90cdefghijkl	16.89fghijklmno	68.3abcd	136.2abcdef
	100	26.17cdefghijkl	13.72hijklmnop	70.8 abcd	95.1efghijklm
	150	21.66efghijklm	8.82jklmnop	67.1 abcd	63.9ijklmn
Semnan	0	25.92cdefghijkl	19.17efghijklm	70.3 abcd	138.6abcdef
	50	21.62efghijklm	20.57defghijkl	66.4 abcd	129.7abcdefgh
	100	22.38efghijklm	20.20defghijkl	63.1 abcd	123bcdefgh
	150	16.03jklmnopq	11.99ijklmnop	49cdef	75.2ghijklmn
Alamut (Ghazvin)	0	29.32abcdefghij	18.87efghijklmn	72.2abcd	151.1abcde
	50	20.99efghijklm	17.40fghijklmno	64.7abcd	144.6abcde
	100	17.62hijklmnop	17.80fghijklmno	60.5abcde	116.3cdefghi
	150	10.93mnopqr	8.10klmnop	43.8def	55.4 jklmno
Chalmir (Dargaz)	0	28.17bcdefghijk	17.51fghijklmno	72.5abcd	133.3 abcdefg
	50	24.21 efghijklm	15.60ghijkllmno	72.1abcd	107.5 cdefghijk
	100	18.05 ghijklmnop	13.73 hijklmnop	66.2abcd	102.6 defghijkl
	150	0 r	0 p	0 h	0 o
Baba Bagheran (Birjand)	0	38.86abcd	26.82bcdefgh	82.4ab	161.7abcd
	50	27.07bcdefghijkl	25.24bcdefgh	72.1abcd	141.1abcdef
	100	35.24acde	21.01defghijk	82.5ab	85.1fghijklmn
	150	18.83fghijklmno	11.17jklmnop	48.5cdef	56.2jklmno
Aman (Bojnord)	0	42.71a	33.17abcd	89.1a	164.9abc
	50	40.67ab	42.64a	78.2abc	175.9ab
	100	26.11cdefghijkl	38.28ab	74.1abcd	107.6cdefghijk
	150	17.61hijklmnop	31.67abcde	57.6abcde	72.8hijklmn

(α =%1) There is no significant different between number with the same world in each column*

TABLE 4 (continue). Mean comparison of interaction between salt stress and 8 accessions of *Bunium persicum* for growth characters at plantlet stage

Accession	NaCl Conc. (mM)	Shoot Fresh Weight (mg/plant)	Root Fresh Weight (mg/plant)	Shoot Length (mm)	Root Length (mm)
erman	0	33.47 abcdef	28.67bcdefg	75.8 abcd	160abcd
	50	29.97 abcdefghij	22.72cdefghij	73.8 abcd	129.5abcdefgh
	100	29.16 abcdefghij	29.58abcdef	73 abcd	124.7bcdefgh
	150	13.30 lmnopqr	29.56abcdef	54.6bcde	76ghijklmn
hiraz	0	40.26 abc	35.58abc	89a	179.1ab
	50	32.67 abcdefg	31.63abcde	80.2abc	156.7abcd
	100	26.01 cdefghijkl	37.74ab	73abcd	139.9abcdef
	150	6.67 opqr	14hijklmno	25fgh	43.3mno
enter ovince	0	21.37 efghijklmn	6.97klmnop	51.8bcdef	62.7ijklmn
	50	16.98 ijklmnopq	8.74jklkmnop	48.2cdef	61.2ijklmn
	100	6 opqr	5.14mnop	45.1def	54.3jklmno
	150	0 r	0 p	0 h	0 o
Yazd	0	15.71 jklmnopq	4.21nop	61.1abcd	63.5ijklmn
	50	7.20 nopqr	6.24lmnop	52.3bcdef	46.9lmno
	100	14.27 klmnopq	12.29ijklmnop	62.7abcd	83.1fghijklm
	150	4.44 pqr	7klmnop	30.6efg	49.8klmno

(α =%1) There is no significant different between number with the same world in each column*

DISCUSSION AND CONCLUSION

With increasing salinity, the germination percentage decreased in all of genotypes. Salami *et al.* (2006), showed that increasing salinity decreased germination percentage and growth in *Valeriana Officinalis* and *Cuminum Cyminum*. Tarzi (1995) reported that increasing salinity caused reduction in germination percentage in *Cuminum Cyminum*. The research showed that increasing salinity caused increasing absorption of Na, K, P and reduction absorption of N and it is because of reduction of germination percentage. Low germination in salty area is related to the reduction of absorbtion due to disordering of osmotic equilibrium and ionic poisonousness that conformed with Safarnejad *et al.* (1996), Penles *et al.* (1997) and Shaloot (1993).

Increasing salinity concentration caused reduction in root length in germination and seedling stage. Shoot length decreased by increasing salinity concentration. Reduction of shoot growth caused damaging to final yield (Shannon, 1986). Some studies showed reduction of wheat growth and reduction of wheat and barely shoot length (Pessaraki *et al.*, 1991, Penules *et al.*, 1997 and Postini and Zahtab Salmani, 1997).

Disorder in growth and death of plants under salinity stress might be due to reduction or death of photosynthesis level (Shannon, 1986 and Postini, 1994). There was converse relation between root dry and fresh weight and increasing NaCl concentration in all *Bunium persicum* genotypes. It might be due to disordering of ionic and osmotic equilibrium and root is the first organ that is exposed to stress (Penules *et al.*, 1997 and Shannon, 1986). Increasing NaCl concentration from control to 200 mM caused reduction of shoot fresh and dry weight in all genotypes in seedling stage. Increasing of harmful elements caused disordering in metabolically and biological activity in plants and finally caused death and reduction of shoot (Gorham, 1996). Salinity stress from high concentration of NaCl caused disordering of osmotic equilibrium and swelling of cell (Gorham, 1996 and Penules *et al.*, 1997). Also shoot weight reduction is due to alter using of energy for organic material that influences on osmotic equilibrium. Nabizadeh (2003) reported that salinity had negative effect on yield of *Cuminum Cyminum*. Shoot / root ratio decreased by increasing salinity in different genotypes of *Bunium persicum.* Reduction of Shoot / root ratio showed that shoot is more sensitive than root to increasing of NaCl concentration. It might be due to root resistance to salinity stress with corking of epidermis and salt accumulation in root cortex (Chipa and Lal, 1995). In other hand leaves falling for salt control reduce shoot / root ratio (Gorham, 1996). Furthermore water stress can reduce number of leaves in plants. So reduction and death of leaves cause reduction of shoot / root ratio under salinity stress (Postini, 1994). Tatal biomass in *Bunium persicum* decreased by increasing of NaCl concentration in germination stage (Tab. 3). Reduction of photosynthesis level and using energy due to control of salinity stress and increasing of ionic and osmotic equilibrium, so it causes reduction of dry yield in many plants such as *Nigalla sativa* (Safarnejad *et al.*, 1386), *Ferula assafoetida* (Mohamad Dost Shiri, *et al.*, 1388), *Foeniculum vulgare* (Safarnejad and Hamidi, 2008), fleawort (Safarnejad *et al.* , 1386), *Cuminum Cyminum*.(Salami *et al.*, 1384) , wheat and barely (Kerepesi and Galiba, 2000).

Results indicated significant differences between *Bunium persicum* genotypes under salinity stress. Reduction of growth indexes caused by salinity stress and this reduction was different between genotypes. Genotypes of Sirzad Kalat, Chalmir Dargaz, Bagheran Birjand and Babaaman Bojnord showed lowest reduction in germination stage and showed more tolerance to stress. In germination stage, Sirzad Kalat showed the lowest reduction in germination percentage and shoot length under salinity stress so it is as a resistance genotype to salinity. Alamut Ghazvin was more sensitive than the others in germination stage. In the seedling stage Yazd genotype showed the lowest reduction and Markazi province genotype showed more reduction compared with the control. Finally results indicated that in the germination and seedling stages Babaaman of Bojnord genotype showed more tolerance to salt stress.

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