ISSN 1314-6246 Sobhani & Mohammadzadeh 2017 *J. BioSci. Biotech.* 2017, 6(2): 83-90
RESEARCH ARTICLE

Alireza Sobhani [1]
Ahmadreza Mohammadzadeh [2]

The effect of saline water on quantitative and qualitative characteristics of melon genotypes

Authors' addresses:
[1] Seed and Plant Improvement Institute, Khorasan Razavi Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Mashhad, Iran.
[2] Soil and water Institute , Khorasan Razavi Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Mashhad, Iran.

Correspondence:
Alireza Sobhani
Seed and Plant Improvement Institute, Khorasan Razavi Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Mashhad, Iran

e-mail: alisobhany@yahoo.com

Article info:
Received: 11 Julyl 2017
Accepted: 17 April 2018

ABSTRACT
Currently, the development of salt tolerant cultivars is one of the most effective methods to increase the efficiency of saline soils and water resources in arid and semi-arid regions of the world. In this regard, the effect of saline water (6.2 and 12 dS m^{-1}) was investigated on yield and qualitative characteristics of 9 commercial melon genotypes (Daregazy, Khaghani, Ghasri, Jafarabady, Bandi, Chahpaliz, Honeydew, Ananas melon and Abbas shuri) in Abbas-Abad Research Station in 2006 and 2007. The maximum (18.56 ton ha^{-1}) and minimum (8.55 ton ha^{-1}) fruit yields were obtained from Jafarabady and Daregazy genotypes irrigated with 6.2 dS m^{-1} saline water, respectively. Daregazy and Abbas shuri showed the maximum (15.67%) and minimum (11.17%) sugar percentage, respectively. Although melon genotypes responded to salinity in different ways, fruit yield decreased with increasing salinity level in all genotypes. When melon genotypes were irrigated with 12 dS m^{-1} saline water, the maximum (8.71 ton ha^{-1}) and minimum (5.56 ton ha^{-1}) fruit yields were obtained from Jafarabady and Daregazy, respectively, suggesting that these genotypes are the most salt tolerant and salt sensitive genotypes in term of fruit yield. Sugar percentage in Daregazy, Jafarabady, Bandi and Ananas melon genotypes decreased with increasing salinity level, whereas sugar percentage increased in Khaghani, Ghasri, Chahpaliz, Honeydew and Abbas shuri genotypes.

Key words: salinity, genotypes, melon, yield

Introduction

Soil and water salinity is one the main environmental stress the directly limits crops growth and production in arid and semi-arid regions. Considering the water shortage, today the world is facing, irrigation with saline water is successfully practiced in some regions to produce specific crops. In addition, taking advantage from salt tolerant cultivars developed by breeders is one of the most effective strategies to cope with salinity and increase soil and water use efficiency in such areas around the globe. In Khorasan Province, located in North East of Iran, a very high proportion of land is suffering from saline soil and saline water resources. Melon is one of the most important summer crops in Khorasan Province, where ecological conditions let farmers cultivate the crop widely across the region. Melon benefits from extensive and relatively deep root system, which allows the plant to absorb water even under high soil osmotic pressure through increasing soluble concentration in the roots. Therefore, melon can survive in saline and dry soils and even produce desirable yield (Abedi, 1995) Increased demand for melons, limited cultivation around the country and its economic value, encourage farmers to produce this crops more. Most of the researchers believe that Africa is the main origin of the melons, but at the same time, considering the high diversity in India, there are studies introducing India as the main origin of the melons. In Afghanistan, China and Spain melons diversity is considerable. Melon (*Cucumis melo* L.) is an annual species and belongs to Cucurbitaceae family. Melon is semi-salt-tolerant species (Maas, 1986) Salinity threshold for melon is 2.2 dS m^{-1} so that each unit increase in salinity from this threshold reduces yield by 7.3%. From the literature, melon genotypes differ from each other in terms of salt tolerance so that this difference is more obvious under higher salinity conditions (Bernstein, 1964; Mangal *et al.*, 1988). However, it should be kept in mind that salt tolerance or salt sensitivity highly depends on environmental conditions, salinity type and growth stage (Mangal *et al.*, 1988; Sivritepe *et al.*, 1999). It has been reported that melon tolerate salinity at germination stage but the vegetative development is more susceptible to salinity (Mendlinger, 1994). In addition, a melon is able to tolerate salt stress from fruit set until harvest (Carvajal *et al.*, 1998; Del Amor *et al.*, 1999). Like most of the crops, a melon is salt sensitive at germination stage and early juvenile stage (Franco *et al.*, 1993; Nukaya *et al.,* 1984). Although, melon is known as a salt-tolerant crop, salt stress can reduce its growth (Franco *et al.*, 1993; Mendlinger & Fossen, 1993), disturb metabolic pathways (Mavrogianopoulos *et al.,* 1999) and cause a significant reduction in yield and quality (Del Amor *et al.*, 2000; Meiri *et al.*, 1995; Mendlinger, 1994; Ahmadzadeh *et al.*, 2016). Salinity affects plants morphology, anatomy and metabolism (Levitt, 1980). In addition, salinity decreases soil water potential and plants cells osmotic potential, phenomena that lead to reduced cell elongation and division. Generally, under salt stress conditions stomata start to close and the rate of photosynthesis is reduced, which finally lead to plant death (Ashraf, 1994). Reduced shoot growth is the first response to salinity (Munns & Termaat, 1986). Salt stressed plants have lower growth rate, are shorter and their leaves are not expanded well and dark green in colour (Mer *et al.,* 2000). Furthermore, reduction in root growth, fresh and dry weight, leaf area and leaf number, as well as an increase in chlorophyll degradation, are the main consequences of salinity stress (Franco *et al.,* 1993; Greenway & Munns, 1980; Yeo & Flowers, 1984). Reduction in the dry matter has been reported by (Feigin, 1990) who studied melon yield under 9 dS m^{-1} salinity stress. They have found that salinity has a great impact on melon fruit yield (Feigin, 1990). Similar results have been reported by (Gunes *et al.*, 1996) in pepper. In a study, (Meiri *et al.,* 1981) have reported that increase in salinity level decreases fruit size but increase ripening rate (Masvi, 1966; Meiri *et al.,* 1981) Salinity increases nitrate content in salt tolerant melon and tomato compared with salt-sensitive cultivars (Flores *et al.*, 2001). Botia *et al.* (2004) found that irrigation with saline water during whole growing season decreases fruit yield but increases salt tolerance. They have also reported that irrigation with saline water from fruit setting stage onward did not affect economical yield and even fruit quality increased as total soluble solids and ripening coefficient increased. In addition, it has been found that the effect of salt stress depends on growth stage. Salinity increased sugar content, acidity and total soluble solids, whereas decreased fruit yield (Botia *et al.*, 2004). It has been confirmed that salinity affect the chemical composition of plant tissues (Feigin *et al.,* 1987) Salinity reduces nitrogen concentration in melon (Feigin *et al.*, 1987; Kafkafi *et al.*, 1992) which may be due to antagonistic effect between chlorine ion and nitrate (Feigin *et al.,* 1987; Kafkafi *et al.,* 1982). In some studies, nitrate influx rate and interaction between nitrate and chlorine have been attributed to cultivars salt tolerance (Kafkafi *et al.*, 1992; Perez-Alfocea *et al.*, 1993). According to Feigin (1990) salinity increases sodium and chlorine concentration in shoots whereas reduces potassium and magnesium concentration (Feigin, 1990). They have also reported that chlorine concentration in shoots linearly increases with increasing chlorine concentration in nutrients solution (Feigin *et al.*, 1984). Bohra and Doffling (1993) have stated that salinity causes ions imbalance and nutrient deficiency in plants through increasing sodium competitive coefficient. Potassium deficiency in melons grown under salt stress conditions is due to competition between potassium and sodium (Bohra & Doffling, 1993). Under severe salinity stress, calcium uptake and transport is lower than that under normal conditions. Calcium plays a vital role in cell membrane stability and selective permeability (Cramer *et al.*, 1989). Reduction in shoots calcium concentration may be due to the reduction in calcium transport through xylems (Lynch & Lauchli, 1985). A significant interaction has been found between calcium and sodium (Cramer *et al.,* 1989). Lower calcium and magnesium concentration in the roots may be due to lignin accumulation in the cell wall which reduces cells permeability to calcium and magnesium (Savvas & Lenz, 1996). Under calcium deficiency, cells membrane selective permeability will change and sodium passive uptake causes sodium accumulation and toxicity (Savvas & Lenz, 1996). Salt stress promotes leaves early senescence (Sahu & Mishra, 1987; Sivritepe *et al.*, 1999) through accumulating sodium and chlorine in the cells (Yeo & Flowers, 1983; Yeo *et al.,* 1991). Increase in sodium and reduction in potassium concentration in leaves of melon genotypes has been previously documented (Kusvaran *et al.*, 2007). They have reported that sodium toxicity threshold differs amongst melon genotypes. In general, genotypes with lower sodium uptake showed more salt resistance as found in most of the crops. Chlorine toxicity has been identified as one of the most important reasons for growth reduction in melon genotypes (Kusvaran *et al.,* 2007). Melons sodium and chlorine sensitivity have been reported in several studies (Carvajal *et al.*, 1998; Navarro *et al.*, 1999). For instance Kusvuran *et al.*, (2007) concluded that leaves chlorine content is the most important factor affecting salt tolerance in melon. Salt tolerant genotypes were found to be more able to accumulate more chlorine ion in their leaves (Kusvuran *et al.*, 2007).

Materials and Methods

The current study was carried out to evaluate the effects of saline water on growth, yield and qualitative characteristics of commercial melon genotypes. Nine melon genotypes (Daregazy, Khaghani, Ghasri, Jafarabady, Bandi, Chahpaliz, Honydew, Ananas melon and Abbas shuri) were tested in a completed randomized block design with three replicates in Abbas-Abad Research Station, Khorasan, Iran in

Table 1. *Water chemical properies.*

Source	EC (dS m^{-1})	pH	HCO3^{-1} meL^{-1}	Cl$^-$	SO4^{-2}	S-Anion	Ca^{+2}	Mg^{+2}	Na$^+$	S.A.R
1	6.2	7.8	6.6	43	14.4	64	4	17	43	13.2
2	12	7.4	5.5	74.5	40	120	20.8	35.2	64	12.1

Table 2. *Soil physicochemical properrties*.

Depth	EC (dS m^{-1})	pH	T.N.V (%)	OC (%)	P (mg.kg^{-1})	K (mg.kg^{-1})	Fe (mg.kg^{-1})	Mn (mg.kg^{-1})	Zn (mg.kg^{-1})	Cu (mg.kg^{-1})	Texture
0-30	2.9	8.2	14.3	0.6	17.2	306.5	2.9	3.4	0.2	0.6	Loam
30-60	4.5	8.2	18.8	0.2	12.4	207.2	2.5	2.4	0.6	0.4	Sandy loam

Table 3. *Comparison of means on fruit yield, sugar percentage and skin weigt to flesh weight ratio in melon genotypes as affcted by saline water irrigation.*

Genotype	6.2 dS m^{-1}			12 dS m^{-1}		
	Fruit yiled (kg ha^{-1})	Sugar (%)	Skin weight to flesh weight ratio	Fruit yiled (kg ha^{-1})	Sugar (%)	Skin weight to flesh weight ratio
Daregazy	5438 bc	15.67 a	0.76 bc	2822 de	12.67 ab	0.74 bcd
Khaghani	8583 b	12.17bcd	0.67cde	3205 cd	12.37 ab	0.72 bcde
Ghasri	6932 bc	12.00bcd	0.63def	3778 cd	13.67 a	0.57 def
Jafarabady	6638 bc	12.50 bc	059 ef	3783 cd	12.67 ab	0.50 ef
Bandi	8422 b	12.17bcd	0.55 f	5478 b	9.83 c	0.82 abc
Chahpaliz Khatooni	5555 bc	11.00 cd	0.78 ab	3538 cd	14.50 a	1.10 a
	7778 b	12.33 bc	0.70bcd	4155 c	14.00 a	0.62 cdef
Honeydew	5778 bc	14.67 ab	0.26 g	3972 cd	12.67 ab	0.46 f
Ananas melon	3905 b	12.33 bc	0.27 g	1955 e	13.00 ab	0.71 bcde
Abbas shuri	12055 a	9.5 d	0.87 a	8178 a	11.00 bc	0.91 ab

In each column, same letter indicates no significant difference at the 5% level according to LSD test.

Table 4. *Comparison of means on sodium and potassium content in melon leaves at flowering stage in 2006 genotypes as affcted by saline water irrigation.*

Genotype	6.2 dS m^{-1}			12 dS m^{-1}		
	Na (%)	K (%)	Na/K	Na (%)	K (%)	Na/K
Daregazy	1.4*	1.5	0.93	1.3	1.9	0.68
Khaghani	1.8	1.1	1.63	1.8	1.8	1.83
Ghasri	1.9	1.4	1.35	1.6	1.6	1.00
Jafarabady	2.0	1.2	1.66	1.4	1.7	0.82
Bandi	1.8	1.6	1.12	1.9	1.5	1.26
Chahpaliz	0.9	1.4	0.64	1.3	1.8	0.72
Ananas melon	1.5	1.5	1.00	1.2	1.2	1.00
Honeydew	2	0.9	2.22	1.9	1.7	1.11
Abbas shuri	1.1	2.1	0.52	0.9	1.7	0.52

*Average of three number

2006 and 2007. The irrigation was performed using saline water with electrical conductivity of 6.2 and 12 dS m^{-1} (Table 1). Each plot consisted of two rows, 10 m long with a 3 m row width. The seeds were sown on the rows 90 cm apart. Soil samples were collected prior seed sowing to determine physicochemical properties (Table 2). Chemical fertilizers were applied according to soil analysis results. One third of nitrogen fertilizer (urea) was supplied at the time of seedbed preparation and the rest was applied at flowering and fruit setting stages. At flowering stage leaves and stems samples were collected to measure sodium, chlorine, potassium, magnesium, calcium and nitrogen content. In addition, sugar percentage, skin to flesh ratio (weight and dimeter) were determined. Fruit yield was determined at the harvest time. All data were subjected to analysis of variance using MSTAT-C.

Results and Discussion

First year results

The results indicated that melon genotypes differ to each other in terms of salt tolerance so that under severe salinity stress this difference was more obvious. When melon plants were irrigated with 6.2 dS m^{-1} saline water, the maximum and minimum fruit yield was obtained from Abbas shuri and Ananas melon genotypes, respectively. Fruit yield decreased in all genotypes with increasing salinity level. The maximum and minimum reduction was related to Khaghani and Honeydew genotypes, respectively. In general, sugar percentage increase with increasing salinity level. The effect of salinity on skin weight to flesh weight ratio was different in different genotypes. Increase in salinity increased skin thickness in Honeydew, Ananas melon and Chahpaliz genotypes. Leaves and stems chemical composition were affected by salinity (Table 3). Sodium and chlorine concentration increased with increasing salinity level whereas potassium and magnesium concentration decreased. In all genotypes and both salinity levels, chlorine concentration in stems was higher than that in the leaves. It appears that keeping lower concentrations of chlorine in the leaves is a vital mechanism in protecting photosynthesis tissues against salt stress. The lowest sodium and chlorine concentrations were related to Abbas shuri genotype (Table 4, 5, 6 and 7).

Second year results

The results indicated that the effect of saline water (6.2 dS m^{-1}) was significant on fruit yield, sugar percentage and skin thickness to flesh thickness ratio. Comparison of means of fruit yield indicated that Jafarabady and Daregazy genotypes produced the maximum and minimum fruit yield, respectively. By contrast, the maximum and minimum sugar percentage was related to Daregazy and Jafarabady Ghasri, decreased genotypes, respectively. Ananas melon and Jafarabady genotypes showed the maximum and minimum skin to flesh ratio, respectively (Table 8). In addition, the results indicated that the effect of saline water (12 dS m-1) was significant on sugar percentage and skin thickness to flesh thickness ratio. Comparison of means of fruit yield indicated that Jafarabady and Abbas shuri genotypes produced the maximum and minimum fruit yield, respectively. Moreover, Daregazy and Jafarabady genotypes showed the highest and lowest sugar percentage, respectively.

The maximum skin to flesh ratio was obtained from Honeydew genotype, whereas the minimum ratio was observed in Daregazy and Bandi genotypes. According to the sugar percentage and skin thickness to flesh thickness ratio results, it can be concluded that fruit yield decreases with increasing salinity level in all studied genotypes. However, this reduction was not the same among the genotypes, suggesting that genetics plays a key role in salt tolerance in melon.

Table 5. *Comparison of means on sodium and potassium content in melon stems at flowering stage in 2006 genotypes as affcted by saline water irrigation.*

Genotype	6.2 dS m^{-1}			12 dS m^{-1}		
	Na (%)	K (%)	Na/K	Na (%)	K (%)	Na/K
Daregazy	3.3*	5.6	0.58	2.9	5.7	0.50
Khaghani	4.9	5.4	0.90	4.5	5.3	0.84
Ghasri	4.8	5.3	0.90	4.5	5.3	0.84
Jafarabady	5.7	5.1	1.11	4.6	5.7	0.80
Bandi	4.9	4.2	1.16	4.7	4.6	1.02
Chahpaliz	3.3	5.2	0.63	3.7	5.0	0.74
Ananas melon	5.0	3.9	1.28	4.4	4.1	1.07
Honeydew	4.3	6.0	0.71	3.7	5.8	0.63
Abbas shuri	3.2	4.9	0.65	3.0	4.8	0.62

*Average of three number

Table 6. *Comparison of means on nitrogen and chlorine content in melon leaves at flowering stage as affcted by saline water irrigation.*

Genotype	2006				2007			
	6.2 dS m^{-1}		12 dS m^{-1}		6.2 dS m^{-1}		12 dS m^{-1}	
	N (%)	Cl (%)	N (%)	Cl (%)	N (%)	Cl (%)	N (%)	Cl (%)
Daregazy	3.4*	3.5	4.9	4	4.2	3.3	4.2	3.2
Khaghani	3.2	3.2	4.0	3.6	4.2	3.3	4.9	3.5
Ghasri	3.5	3.4	3.4	4.4	4.6	4.0	4.5	3.4
Jafarabady	3.5	3.1	3.9	3.1	4.5	3.3	4.6	3.0
Bandi	3.8	3.8	4.2	3.9	4.7	3.3	4.5	3.6
Chahpaliz	3.3	3.2	4.0	3.8	3.9	2.7	4.6	3.0
Ananas melon	4.0	3.4	4.6	3.6	3.8	2.8	4.6	2.9
Honeydew	3.7	3.2	4.5	3.4	4.5	3.8	5.0	3.6
Abbas shuri	3.8	2.8	3.7	2.6	4.3	3.2	4.7	3.0

*Average of three number

Table 7. *Comparison of means on nitrogen and chlorine content in melon stems at flowering stage as affcted by saline water irrigation.*

Genotype	2006				2007			
	6.2 dS m^{-1}		12 dS m^{-1}		6.2 dS m^{-1}		12 dS m^{-1}	
	N (%)	Cl (%)	N (%)	Cl (%)	N (%)	Cl (%)	N (%)	Cl (%)
Daregazy	2.9*	10.2	2.7	8.5	3.8	6.2	3.6	6.5
Khaghani	2.1	12.2	2.4	8.7	3.8	6.6	3.3	7.1
Ghasri	2.2	11.2	2.6	8.9	3.8	6.1	3.5	7.1
Jafarabady	2.0	11.0	2.3	7.8	3.9	5.6	3.5	6.0
Bandi	2.1	12.7	2.3	9.1	4.0	6.4	3.4	7.0
Chahpaliz	1.8	11.2	2.4	8.1	3.5	7.0	3.4	7.2
Ananas melon	2.3	9.9	2.2	8.8	4.1	6.3	3.7	6.9
Honeydew	2.2	11.3	2.4	8.2	3.9	7.6	3.5	8.0
Abbas shuri	2.6	8.0	2.3	9.2	3.7	6.0	3.7	5.6

*Average of three number

Table 8. *Comparison of means on fruit yield, sugar percentage and skin thickness to flesh thickness ratio in melon genotypes as affcted by saline water irrigation in 2007.*

Genotype	6.2 dS m^{-1}			12 dS m^{-1}		
	Fruit yiled (kg.ha^{-1})	Sugar (%)	Skin weight to flesh weight ratio	Fruit yiled (kg.ha^{-1})	Sugar (%)	Skin weight to flesh weight ratio
Daregazy	11662c**	15.67 a	0.034 c	8295 c	15.67 a	0.028 d
Khaghani	19990 bc	11.83 cd	0.063 a	10738bc	13.17bc	0.071 b
Ghasri	14780 bc	14.00 b	0.030 c	9937bc	13.00bc	0.030 d
Jafarabady	30728 a	11.67 d	0.030 c	13639 a	11.00c	0.033 d
Bandi	21042 b	12.17 cd	0.022 c	11690 b	11.17 c	0.028 d
Chahpaliz	16311 bc	15.33 a	0.025 c	9908 bc	14.33ab	0.031 d
Honeydew	17485 bc	12.67 cd	0.046 b	12052bc	13.50 b	0.107 a
Ananas melon	18003 bc	13.00 bc	0.026 c	11244bc	11.33 c	0.032 d
Abbas shuri	15531 bc	12.83bcd	0.051 b	7236bc	14.83 ab	0.046 c

In each column, same letter indicates no significant difference at the 5% level according to LSD test.

Table 9. *Comparison of means on sodium and potassium content in melon leaves at flowering stage in 2007 genotypes as affcted by saline water irrigation.*

Genotype	6.2 dS m^{-1}			12 dS m^{-1}		
	Na (%)	K (%)	Na/K	Na (%)	K (%)	Na/K
Daregazy	1.0*	2.4	0.42	1	2.4	0.42
Khaghani	1.0	2.1	0.48	1.1	2.5	0.44
Ghasri	1.1	2.5	0.44	1.0	2.4	0.42
Jafarabady	1.4	2.2	0.64	1.3	2.1	0.62
Bandi	1.2	2.3	0.52	1.2	2.5	0.48
Chahpaliz	1	2.4	0.42	0.8	2.4	0.33
Ananas melon	1.5	2.7	0.55	1.1	2.2	0.5
Honeydew	1.3	2.1	0.62	1.1	2.2	0.5
Abbas shuri	1.7	2.0	0.85	1.4	2.6	0.54

*Average of three number

Sugar percentage of melon genotypes differed with increasing salinity changes. Sugar percentage was consistent in Daregazy genotype, whereas in Jafarabady, Bandi, Chahpaliz, and Ananas melon and increased in Khaghani, Honeydew and Abbas shuri. Similar results were found in terms of skin thickness to flesh thickness ratio. Increase in salinity level decreased skin thickness to flesh thickness ratio in Daregazy and Abbas shuri genotypes, whereas increased this ratio in Khaghani, Bandi, Jafarabady, Chahpaliz, Honydew and Ananas melon genotypes. Genetic differences are responsible for differences in sugar percentage and skin thickness to flesh thickness ratio (Table 8). Sodium (Table 9), potassium (Table 10), calcium (Table 11) and magnesium (Table 12) concentrations in melon leaves and stems, measured at early flowering stage, indicate that there are significant differences between genotypes in terms of

Table 10. *Comparison of means on sodium and potassium content in melon stems at flowering stage in 2007 genotypes as affcted by saline water irrigation.*

Genotype	6.2 dS m^{-1}			12 dS m^{-1}		
	Na (%)	K (%)	Na/K	Na (%)	K (%)	Na/K
Daregazy	1.8*	8.6	0.20	1.8	9.1	0.19
Khaghani	2.2	9.0	0.24	2.2	9.8	0.22
Ghasri	2.0	8.5	0.23	2.1	9.1	0.23
Jafarabady	2.1	8.1	0.25	2.1	8.2	0.26
Bandi	2.0	10.0	0.2	2.0	9.5	0.21
Chahpaliz	2.1	9.0	0.23	2.0	8.8	0.23
Ananas melon	2.6	7.9	0.32	1.4	8.4	0.17
Honeydew	2.0	10.5	0.19	1.6	9.3	0.17
Abbas shuri	1.8	8.1	0.22	1.2	8.0	0.15

*Average of three number

Table 11. *Comparison of means on calcium and magnesium content in melon leaves at flowering stage as affcted by saline water irrigation.*

Genotype	2006				2007			
	6.2 dS m^{-1}		12 dS m^{-1}		6.2 dS m^{-1}		12 dS m^{-1}	
	Ca (%)	Mg (%)	Ca (%)	Mg (%)	Ca (%)	Mg (%)	Ca (%)	Mg (%)
Daregazy	4.2*	2.8	3.0	2.1	6.6	1.8	6.2	2.0
Khaghani	4.2	3.2	3.7	2.8	6.4	1.7	6.4	2.0
Ghasri	3.4	2.5	3.9	3.2	6.3	1.6	6.3	1.8
Jafarabady	3.7	2.8	3.7	3.1	5.8	1.7	5.4	1.8
Bandi	3.9	2.0	2.9	2.6	6.1	1.6	6.5	2.0
Chahpaliz	4.0	2.6	3.5	2.7	7.6	1.7	7.0	2.0
Ananas melon	3.5	2.4	3.6	2.5	8.2	1.6	7.3	1.6
Honeydew	3.7	3.0	2.9	2.6	7.1	1.7	5.2	1.6
Abbas shuri	3.8	2.0	4.8	2.7	6.8	1.7	7.0	1.8

*Average of three number

Table 12. *Comparison of means on calcium and magnesium content in melon stem at flowering stage as affcted by saline water irrigation.*

Genotype	2006				2007			
	6.2 dS m^{-1}		12 dS m^{-1}		6.2 dS m^{-1}		12 dS m^{-1}	
	Ca (%)	Mg (%)	Ca (%)	Mg (%)	Ca (%)	Mg (%)	Ca (%)	Mg (%)
Daregazy	1.1	0.9	0.9	0.8	0.9	0.6	1.3	0.8
Khaghani	1.2	1.0	0.8	0.8	0.9	0.7	1.2	0.7
Ghasri	0.8	0.8	0.7	0.8	0.8	0.5	1.3	0.6
Jafarabady	0.9	0.7	0.7	0.7	0.7	0.5	1.2	0.5
Bandi	1.1	0.8	0.8	0.9	0.9	0.6	1.2	0.5
Chahpaliz	1.4	1.1	0.8	0.9	1.2	0.7	1.5	0.6
Ananas melon	1.1	0.8	1.1	0.8	0.9	0.5	1.4	0.6
Honeydew	1.1	1.2	0.8	1.1	1.1	0.5	1.5	0.6
Abbas shuri	1.1	0.8	1.5	1	0.7	0.4	1.2	0.5

*Average of three number

nutrients uptake. Increase in salinity directly affects nutrients concentration in the leaves and stems. Under salinity stress conditions, increase in soluble ions in the soil not only diminishes nutrients uptake efficiency, but also increases the unnecessary absorption of some elements which changes chemical composition of plants cells. The synergistic and antagonistic effects of different nutrients affect this process. Under salinity stress conditions, chlorine and sodium ions uptake and accumulation increase in shoots through transpiration flow. The chlorine uptake is much faster than sodium; therefore, toxicity symptoms appear at an earlier period. In several plant species a negative correlation between shoots chlorine concentration and salt tolerance has been observed. Salinity causes a significant change in chemical composition of above-ground organs. Normally, chlorine and sodium concentrations increase with increasing

Table 13. *Comparison of means on fruit yiled and sugar perenatge in melon genotypes as affcted by saline water irrigation in 2006 and 2007.*

Genotype	6.2 dS m^{-1}		12 dS m^{-1}	
	Fruit yiled (kg ha^{-1})	Sugar (%)	Fruit yiled (kg ha^{-1})	Sugar (%)
Daregazy	8555b**	15.67 a	5561 b	14.17 a
Khaghani	14292 ab	12.00 bc	6977 ab	12.92 abc
Ghasri	10863 b	13.00 b	6860 ab	13.33 abc
Jafarabady	18569 a	12.08 bc	8714 a	11.83 cd
Bandi	14741 ab	12.17 bc	8589 a	10.50 d
Chahpaliz	10938 b	13.17 b	6727 ab	14.42 a
Ananas melon	12637 ab	12.05 bc	8108 a	13.75 cd
Honeydew	10960 b	12.67 bc	6601 ab	12.17 bc
Abbas shuri	13806 ab	11.17 c	7715 ab	12.92 abc

In each column, same letter indicates no significant difference at the 5% level according to LSD test.

salinity, whereas potassium and magnesium concentrations decrease. In all genotypes and in both salinity levels, chlorine content in the stems was more than that in the leaves. It appears that accumulating less chlorine in the leaves is an important protective mechanism to conserve photosynthetically active tissues against salinity stress. The minimum leaves chlorine and sodium concentrations were observed in Abbas-Shori genotype.

Conclusions

The two-year analysis of variance showed that fruit yield and sugar percentage were significantly affected by 6.2 dSm^{-1} salinity. In addition, comparison of means indicated that the maximum and minimum fruit yield was related to Jafarabady and Daregazy genotypes, respectively (Table 13). In addition, the maximum and minimum sugar percentages were obtained from Daregazy and Abbas shuri genotypes, respectively. Fruit yield decreased with increasing salinity levels in all studied genotypes. However, this reduction was not the same among the genotypes. At 12 dS m^{-1} salinity level, the maximum and minimum fruit yield was achieved from Jafarabady and Daregazy genotypes, respectively. According to fruit yield results, Jafarabady and Daregazy genotypes were found to be the most tolerant and most sensitive genotypes. With increasing salinity level, sugar percentage decreased in Daregazy, Jafarabady, Bandi and Ananas melon genotypes, whereas increased in Khaghani, Ghasri, Chahpaliz, Honeydew and Abbas shuri genotypes (Table 13).

References

Abedi B. 1995. The effect of pruning on qualitative and quantitative traits of melon. Horticulture Master Thesis, Horticulture Department, Tehran University.

Ahmadzadeh Ghavidel R, Asadi GA, Naseri Pour Yazdi MT, Ghorbani R, Khorramdel S. 2016. Evaluation of radiation use efficiency of common bean (*Phaseolus vulgaris* L.) cultivars as affected by plant density under Mashhad climatic conditions. J. BioSci. Biotechnol. 5(2): 145-150.

Ashraf M. 1994. Breeding for Salinity Tolerance in Plants. Critical Reviews in Plant Sciences, B (1): 17-42.

Bernstein L. 1964. Salt tolerance of plants. USDA Info. Bull. 183. http: //WWW.Scientific commons.org.

Bohra JS, Doffling K. 1993. Potassium Nutrition of Rice (*Oryze Sativa* L.) varieties under NaCl Salinity. Plant and Soil. 152: 299-303.

Botia P, Navarro JM, Cedra A, Martinez V. 2004. Yield and fruit quality of two melon cultivars irrigated with saline water at different stages of development. Agronomy Journal, (93): 1049-1053.

Carvajal M, Del Amor FM, Fernandez-Ballester G, Martinez GV, Cedra A. 1998. Time course of solute accumulation and water relation in muskmelon plants exposed to salt during different growth stages. Plant. Sci.,138: 103-112.

Cramer GR, Epstein E, Lauchli A. 1989. Na-Ca interaction in barley seedlings: relation to ion transport and growth. Plant. Cell. Environ., 12: 551-558.

Del Amor FM, Martinez V, Cedra A. 1999. Salinity duration and conceneration affect fruit yield and quality, and growth and mineral composition of melon grown in perlite. Hortscience 34: 1234-1237.

Del Amor FM, Ruiz-Sanchez MC, Martinez V, Cedra A. 2000. Gas exchange, water relations, and ion concenterations of salt-stressed tomato and melon Plants. J. Plant Nutr. 23: 1315-1325.

Feigin A, Rylski I, Meiri A, Shalhevet J. 1987. Response of melon and tomato plants to chloride-nitrate ratios in saline nutrient solutions. J. Plant Nutr. 10: 1787-1794 .

Feigin A, Rylski I, Shalhevet J. 1984. Response of melon plants to different combination of NO_3, Cl in saline nutrient solutions. Paper presented at Soil Salinity under Irrigation-Processes and Management. Inter. Conference. Inter. Soc. Soil Sci and Israel Soc.

Feigin A.1990. Interactive effects of salinity and ammonium nitrate ratio on growth and chemical composition of melon plants. Marcel Deker Inc.

Flores P, Carvajal M, Martinez V, Navarrvo JM, Cedra A, Del Amor Saavedra FM. 2001. Yield response of soilless melon and tomato to different irrigation water qualities. Acta Horticulture. 559 (1): 333-338.

Franco JA, Esteban C, Rodriguez C. 1993. Effects of salinity on various growth stages of muskmelon CV. Revigal. J. Hort Sci. 68: 899-904.

Greenway H, Munns R. 1980. Mechanisms of Salt Tolerance in Nonhallophytes. Ann. Rev. Plant Physiol., 31: 149-190.

Gunes A, Inal A, Alpaslan M. 1996. Effect of Salinity on Stomatal Resistance, Proline and Mineral Composition of Pepper. J. of Plant Nutrition, 19(2): 389-396.

Kafkafi U, Siddiqi MY, Ritchie RJ, Glass AD, Ruth TJ. 1992. Reduction of nitrate ($13NO_3$) influx and nitrogen (13N) translocation by tomato and melon varieties after short exposure to calcium and potassium chloride salts. J. Plant. Nutr. 15: 959-975.

Kafkafi U, Valovas N, Letey J. 1982. Chloride interaction with nitrate and phosphate nutrition in tomato (*Lycopersicon esculentum* L.). J. Plant. Nutr. 59: 1369-1385.

Kusvuran S, Yasar F, Ellialtioghu S, Abak K. (2007). Utilizing some of screening methods in order to determine tolerance of salt stress in the Melon (*Cucumis melo* L.). Research Journal of Agriculture and Biological Sciences, 3(1): 40-45.

Levitt J. 1980. Responses of Plants to Environmental Stresses. Vol. II, 2nd Ed. – Academic Press, New York.

Lynch J, Lauchli A. 1985. Salt stress disturbs the calcium nutrition in barley (*Hordeum vulgare* L.), New Phytol., 99: 345-354.

Maas EV. 1986. Salt tolerance of plants. Applied Agricultural Research, 1(1): 12-16.

Mangal JL, Hooda PS, Lal S. 1988. Salt tolerance of five muskmelon cultivars. J. Agric. Sci. Camb., 110: 641-643.

Masvi M. 1966. Studies on the absorption of nutrient elements by muskmelon. J. Jap. Soc. Hort. Sci., 35: 57-65.

Mavrogianopoulos GN, Spanakis J, Tsikalas P. 1999. Effects of carbon dioxide enrichment and salinity on photosynthesis and yield in melon. Sci. Hort., 79: 51-63.

Meiri A, Plant Z, Pincas L. 1981. Salt tolerance of greenhouse grown muskmelon. Soil Sci., 131: 189-193.

Meiri S, Lauter DJ, Sharamani N. 1995. Shoot growth and fruit development of muskmelon under saline and non-saline soil-water deficit. Irrigation Sci., 16: 15-21.

Mendlinger S. 1994. Effects of increasing plant density and salinity on yield and fruit quality in muskmelon. Sci. Hort., 57: 41-49.

Mendlinger S, Fossen M. 1993. Flowering, vegetative growth, and fruit-quality in muskmelons under saline conditions. J. Am. Soc. Hort. Sci., 118: 868-872.

Mer RK, Prajith PK, Pandya DH, Pandy AN. 2000. Effect of Salt on Germination of Seeds and Growth Young Plants of (*Hordeum Vulgare*),(*Triticum aestivum*),(*Cicer arietinum*) and (*Brassica guncea*). J. Agr. Crop. Sci.,185: 209-217.

Munns R, Termaat A. 1986. Whole-Plant Responses to Salinity. Aust. J. Plant Physiol., 13: 143-160.

Navarro J M, Botella MA, Martinez M. 1999. Yield and Fruit quality of melon plants grown under saline conditions in relation to phosphate and calcium nutrition. J. Hort. Sci. Biotechnol., 74: 543-578.

Nukaya A, Masui M, Ishida A. 1984. Salt tolerance of muskmelon as affected by diluted sea water applied at different growth stages in nutrient solution culture. J. Jpn. Soc. Hort. Sci., 53: 168-175.

Perez-Alfocea F, Estan MT, Santa Crus A, Bolarian MC. 1993. Effects of salinity on nitrate, total nitrogen, soluble protein and free amino acid levels in tomato plants. J. Hort. Sci., 68: 1021-1027.

Sahu AC, Mishra D. 1987. Changes in Some Enzyme Activities During Excised Rice Leaf Senescence Under NaCl-Stress Biochemie and Physiol. Der pflanzen, 182: 501-502.

Savvas D, Lenz F. 1996. Influence of NaCl concenteration on the nutrient solution on mineral composition of eggplants grown in sand culture. Angew. Bot., 70: 124-127.

Sivritepe HO, Eris A, Sivritepe N. 1999. The effect of priming treatment on salt tolerance in melon seeds. In: Proceeding of The First International Symposium on Cucurbits. Adana. Turkey, 20-23 May 1997. Acta Horticulturae, 492: 287-295.

Yeo AR, Flowers TJ. 1983. Varietal Differences in the Toxicity of Sodium Ions in Rice Leaves. Physiol. Plant, 59: 189-195.

Yeo AR, Flowers TJ. 1984. Mechanisms of salinity resistance in rice leaves, their role as physiological criteria in plant breeding. - In: Staples RC. (ed), Salinity Tolerance in Plants: Strategies for Crop Improvement. John Wiley Sons Inc., p. 151-171.

Yeo AR, Lee KS, Izard P, Boursier PJ, Flowers TJ. 1991. Short and Long Terms Effects of Salinity on Leaf Growth in Rice (*Oryze sativa* L.). J. Exp. Bot., 42: 881-889.