Middle East Journal of Agriculture Research, 3(3): 677-693, 2014
ISSN 2077-4605

Grafting Salinity Tolerant Rootstocks and Magnetic Iron Treatments for Cantaloupe Production under Conditions of High Salinity Soil and Irrigation Water

[1]El-Eslamboly, A. A. S. A. and [2]Abdel-Wahab, M. A. S.

[1]Protected Cultivation Res. Dept., Horticulture Research Institute, ARC, Egypt
[2]Plant Nutrition and Soil Fertility Res. Sec., Dept., Soil, Water and Environment Research Institute, ARC, Egypt

ABSTRACT

Salinity is one of the major abiotic stresses that reduce plant growth and crop productivity in many vegetable production areas of the world. Grafting can represent an important tool that can reduce yield losses cause by salinity stress in high-yielding genotypes of cucurbits. The aim of the present study is to evaluate the compatibility and tolerant to salinity of many commercial and local rootstocks with cantaloupe (scion), also, studying the role of magnetic iron in overcoming salinity stress and the interaction between the magnetic iron and grafting treatments.

The study was conducted during the two seasons of 2012 and 2013 under natural condition in areas affected by salinity at Wadi El- Natrown farm. Split plot in randomized complete block design with three replications was used. Magnetite (magnetic iron) addition (0 and 300kg/ feddan) were randomly arranged in main plot and grafted cantaloupe Visa hybrid F1 onto five rootstocks were distributed randomly in sub plots. The rootstocks used were Bottle gourd (PI 534556 01 SD), Calabash gourd (*Lagenaria siceraria*), three commercial interspecific hybrids rootstocks (*Cucurbita maxima* × *Cucurbita moschata)* namely Shintosa, Ercole F1 hybrid (Nun 6001 F1) and Super Shintosa F1 hybrid treatments beside ungrafted cantaloupe.

The results showed that, magnetic iron treatments gave significant increments on all vegetative growth, yield and physical fruit characteristics. Significant decreases were obtained in the stem diameter, total soluble solids (TSS) and total sugar content.

Grafting on tolerant rootstocks is an effective method to overcome the problems of salinity. Grafting Visa F1 hybrid on all rootstocks gave significant increment in most vegetative growth, yield and fruit characteristics except TSS was decreased in both seasons. Bottle and calabash gourd *Lagenaria siceraria* rootstocks can be considered highly tolerant to saline condition, it was evident from the high content of Na in the leaves without any harmful effect on other vegetative growth characters or fruit yield. Cucurbita hybrids rootstocks such as Super Shentosa, Shentosa and Ercole gave high yield, with low total sugar content and TSS in melon fruits. Grafting cantaloupe on all rootstocks under study gave undesirable effects on fruit quality such as total soluble solids.

The interaction between magnetite additions and grafting did not show any significant effects on vegetative growth except number of leaves, plant fresh and dry weight. In the same time that interaction gave significant increment in total yield without any effects in fruit physical and chemical characteristics.

The study recommends that, applying magnetic iron and grafting melon onto tolerant rootstocks to saline can reduce the damage caused by the stresses of salinity**.**

Key word: Cantaloupe, salinity, grafting, rootstocks, growth, yield, fruit quality

Introduction

Approximately 20% of the world's cultivated land and nearly half of all irrigated land are affected by salinity (Zhu, 2001). Therefore, salinization has been a major factor limiting agricultural crop production (Parida and Das, 2005). Hence, the salt tolerance of crops is necessary to sustain the increasing demand in food production in many regions in the world. Excessive accumulation of Na+ results in toxicity and growth inhibition (Saqib *et al.,* 2005). Numerous recent studies have used traditional breeding programs and molecular engineering to improve plant salt tolerance (Cuartero *et al.,* 2006), but commercial success has been very limited because of the issue of salt tolerance (Flowers, 2004). Recently, there has been a great deal of effort in determining the response of grafted plants to saline conditions and in demonstrating that grafting is a valid strategy for increasing the salt tolerance of tomato (Martinez-Rodriguez *et al*., 2008), and muskmelon (Xu *et al.*, 2006). On cucumber more studies also suggests that grafting improves plant adaptation to salt stress (Huang *et al.,* 2009).

Melon is an important crop in arid and semiarid regions with salinity problems. Field experiments have shown that melon is a potential crop for irrigation with saline water (Shani and Dudley, 2001). Salt tolerance of melon varies widely and depends on the cultivar and the type of cultivation (Mendlinger and Pasternak, 1992).

Corresponding Author: El-Eslamboly, A. A. S. A., Protected Cultivation Res. Dept., Horticulture Research Institute, ARC, Egypt
E-mail: azaz2005asd@yahoo.com

The impact of grafting on cucurbits includes not only a stronger resistance against pathogens but also a higher tolerance to abiotic stress conditions such as salinity, heavy metals, nutrient stress, thermal stress, water stress, organic pollutants, and alkalinity (Schwarz *et al.,* 2010). Recently, the use of salt tolerant rootstock was demonstrated to be a valid strategy in increasing the salt tolerance of melon (Romero *et al.,* 1997), tomato (Martinez-Rodriguez *et al.,* 2008). Many studies on cucumbers suggested that the use of salt tolerant rootstock improved plant adaptation to salt stress (Zhu *et al.,* 2008). Previous studies suggested that lower accumulation of Na+ and/or Cl_ in the plant's shoot is the main reason for higher salt tolerance of grafted tomato (Estan *et al.,* 2005), melon (Romero *et al.,* 1997), and cucumber (Zhu *et al.,* 2008). In addition, previous studies demonstrated that higher salt tolerance of grafted cucumber plants was highly associated with improved K+ content in the leaves (Zhu *et al.,* 2008). In contrast to the improved ion status, the leaf water status was not affected by the use of salt tolerant rootstock in tomato (Estan *et al.,* 2005). However, this must be investigated in cucumber plants, because the salt tolerance mechanism may differ greatly among different plant species (Munns and Tester, 2008). The use of rootstock could increase the fruit yield of cucumber (Hoyos, 2001), and previous studies suggested that grafting (rootstock) has no significant effect on fruit dry matter and soluble sugar content of cucumber under unstressed conditions (Zhong and Bie, 2007). In addition, salinity could reduce fruit yield, but increase the content of soluble solids, providing better taste (Trajkova, *et al.,* 2006).

Romero, *et al.* (1997) compared the effect of salinity (4.6 dSm^{-1}) on two varieties of melon (*Cucumis melo* L.) grafted onto three hybrids of squash (*C. maxima Duch.* ×*C. moschata* Duch.) with its effects on ungrafted melons and found that grafted melons were more tolerant to salinity and gave higher yields than ungrafted ones.

Plant growth is influenced by several factors (environmental conditions, plant nutritional status and hormone activities) related to different physiological processes. The development of an adequate root system structure has been related to improved growth of melon plants grafted onto Cucurbita species (Bletsos, 2005). *Lagenaria sicerarias* (Mol.) Standley is one of the species commonly used as rootstock for watermelon to increase plant growth and enhance water transport and plant nutrition (Oda, 1995). According to Yetisir *et al.* (2007), all the grafted plants of watermelon showed a higher number of leaves and greater dry weight than the non-grafted control plants (Yetisir *et al.,* 2007).

Edelstein *et al.* (2011) compared Na content in grafted and nongrafted melon, they found that, a large decrease in the Na+ content for grafted plants. These differences between their Na+ concentrations suggest that the grafted plants exclude more Na+ than the non-grafted plants and so limit its concentration in their leaves. Similar results were obtained by Colla *et al.* (2010b) for melon and watermelon plants.

Magnetic iron (magnetite) is one of the most important factors affecting plant growth. In this connection, El-Hifny *et al.* (2008) pointed out that increasing magnetite levels up to 150 or 200kg/fed. led to increase the vegetative growth characters, curd weight, yield and mineral contents, i.e. N, P, K and Fe in leaves and curds of cauliflower, but decreased Na and Cl concentrations in leaves and S content in leaves and curds. The highest yield was produced when 200kg magnetite/fed. was added combined with using the high ridge planting method. Similar, results were attained by Abd El-All (2003) on eggplant and Ali *et al.* (2011) on *Capsicum annuum*

In squash, using magnetic water in irrigation led to decreasing salts concentration and leaching the saline out of the soil. Therefore, the plant content of Na and Cl was lesser than that plants irrigated with tap water (Abd El-All *et al.* 2013).

Abd El-All and Mohammed (2014) reported that, magnetic iron treatment greatly reduced the harmful effects of soil salinity and significantly improved vegetative growth, yield and some physiological parameter such as leaf osmotic pressure and temperature which had some effect on transpiration rate. On other hand, magnetic iron markedly decreased Na, Cl, S and sulforaphane content compared to the control.

Rootstocks can decrease the accumulation of Cl− and Na+ in *Cucumis melo* scion leaves (Romero *et al.,* 1997). This may be due to the exclusion or decreased absorption of Cl− by the roots and replacement or substitution of total K+ by total Na+ in the leaves. Yang *et al.* (2006) demonstrated that grafted cucumber plants have higher net photosynthesis, stomatal conductance, and intercellular CO_2 concentrations under NaCl stress than self-rooted plants. Under salt stress, watermelon grafted onto salt-tolerant rootstock demonstrated improved vigor and yield, and maintained good fruit quality compared to watermelon-watermelon-grafted controls (Liu *et al.,* 2004). It was suggested that increased salt tolerance of grafted watermelon is linked to increased peroxidase activity and decreased superoxide dismutase activity (Liu *et al.,* 2004).

Therefore, this study was to investigate the feasibility of using both grafting on some tolerant rootstocks and Magnetic iron (magnetite) to increase fruit yield and quality of cantaloupe under saline conditions.

Materials and Methods

The present study was carried out during the two seasons of 2012 and 2013 in infested soil in a farm at Wadi El-Natrown, Egypt.

Plant material

- Melon hybrid: - Melon hybrid Visa from Seminis Seeds Company
- Rootstocks

Rootstocks	Source
Bottle gourd *(Lagenaria siceraria)*, PI 534556 01 SD	USDA gene bank
Calabash gourd *(Lagenaria siceraria)*	Local variety
Shintosa F1 hybrid (*Cucurbita maxima* × *C. moschata*)	Sakata Seed Company
Ercole F1 hybrid (*C. maxima* × *C,moschata*) Nun 6001F_1	Nunhems Seed Company
Super Shintosa F1 hybrid (*C. maxima* × *C. moschata*)	G.S.I. Seed Company

Nursery of scions and rootstocks

Melon hybrid Visa was grafted on to five rootstocks by tongue approach methods. Visa hybrid seeds (scions) were sown in the greenhouse at experimental farm of Kaha, Qalubia Governorate on the 5th of March in 2012 in the first season and 26th of February in 2013 in the second season. After seven days from sowing the melon seeds (scions) the Bottle gourd, Calabash gourd (*Lagenaria siceraria*) and the interspicific rootstocks **S**hintosa, Ercole Nun 6001 and Super Shintosa (*Cucurbita maxima* × *Cucurbita moschata*) were sown in speedling trays with 84 cells filled with a mixture of peat-moss and vermiculite at the ratio of 1:1 (v/v). Three hundred grams of ammonium sulphate, 400 g calcium superphosphate, 150 g potassium sulphate, 50 ml. nutrient solution and 50 gm of a fungicide were added for each 50 kg of the peat-moss. After seven days all seedling of rootstocks and melon (scions) were transformed onto plastic pots of 8 cm diameter, filled with the same mixture (one seedling of the rootstocks with one seedling of melon (scions) in the same pot). The grafting was performed in all rootstocks and melon (scions) when the stem diameter reached about 4mm. Before grafting, the scions and rootstocks were irradiated by the sunlight for 2-3 days and the soil was kept dry to avoid spindly growth as recorded by Oda (1995).

The tongue approach grafting

This method originated in the Netherlands (Ishibashi, 1965), and is now widespread in Japan, Spain, France, and Italy (Lee and Oda, 2003). It is easy to use, has a high success rate, and the grafted seedlings have a uniform growth rate (Davis *et al.*, 2008).

Grafting steps

The scions and rootstocks should be approximately the same diameter in the TAG method. Therefore the melon seeds were planted seven days before the rootstock seeds. At the first true leaf stage, the cut was made by using a sharp blade, in both stem of the melon and rootstock. The rootstock was cut through the hypocotyl at a 35◦ to 45◦ angle. The scions were cut from bottom to the top, while the rootstocks were cut from top to bottom. This is usually the case after the rootstock has fully developed cotyledons and the scion has cotyledons and the first true leaf. Each slit was like a tongue, and were fitted together and sealed with an aluminum wrap and grafting clips to allow healing to take place .

Healing was begun after five days and the rootstock stem was removed. Ten days after grafting the melon root was cut. The metal strips were remained on the plant once the plant has healed, while the grafting clips were removed 15–20 days after grafting .

Grafted seedlings were removed after grafting immediately into shaded plastic low tunnel for healing and hardening. A polyethylene sheet was laid on the floor of low tunnels and covered with a shallow layer of water. Grafted seedlings were placed above speedling trays which placed on bricks to support the plants above the water layer. The plastic tunnel was closed to achieve a temperature 25-32 ºC and (>85% RH) humidity. Four to five days after grafting, the hardening process began by peeling away the top layer of shade net. The water was drained out of the floor pan. Meanwhile, the plastic covered was gradually removed for four to five days.

Grafted plants were moved out of the tunnel and placed into a screen house, twelve days after grafting until ready for transplanting. The plants remained in the screen house for seven to eight days after removing the scion roots for further development and hardening. The entire process took 30 to 35 days from transplanting.

Grafted melon seedlings were transplanted in Wadi El-Natrown farm, Egypt, on April 9, 2012 and 12th April, 2013 for first and second season respectively. Grafted plants were transplanted in rows 10 meter length and 1.0 meter width. The space between plants was 0.75m. The plant density reached 5600 plants per feddan. The single treatment contained 15 plants in one row.

The graft union of grafted seedlings was kept above the soil line, to avoid development of adventitious roots from the scion that penetrate the soil and cause disease bypassing of resistant rootstock that may lead to infection and death of the entire plant. The conventional agricultural practices *i.e.*, irrigation, fertilization, and weeding and pest control followed standard commercial practices, were done as recommended by the Ministry of the Agriculture in Egypt, for melon production. Plots were first harvested after 90 days from transplanting. Fruits were graded, counted and weight. Fruits having a regular shape were classified as marketable fruits, while the diseased and malformed fruits were considered as unmarketable. At the end of each season, the following data were calculated.

Studied characteristics

The following data were recorded during growth period until the end of harvesting.

Vegetative growth characteristics

Vegetative growth characters, were recorded after 90 days from transplanting of three plants randomly chosen from each plot as follows

-Plant length (cm)
-Average internodes length (cm)
-Leaf area (cm^2): It was expressed as the mean leaf area in cm^2 using the fresh weight method. The leaves were cleaned from dust and then weight to nearest 0.001 g. Therefore 20 disks of known area were separated as weight.

$$leaves\ area\ \text{cm}^2 = \frac{fresh\ weight\ of\ all\ leaves}{fresh\ weight\ of\ 20\ disks} \times 20 \times \text{the area of disk}$$

Where, the area of a disk is about 1.0 cm

-Number of leaves per plant
-Stem diameter
-Number of branches/plant
-Plant fresh weight (kg)
-Plant dry weight (g): It was measured as the weight of the same plants used for plant fresh weight after being dried out in an oven with driven hot air at 70 °C until a constant weight.
-Plant dry matter percentage: It was measured by this equation

$$\text{Plant dry matter\%} = \frac{\text{Plant dry weight(g)}}{\text{Plant fresh weight(g)}} \times 100$$

Yield and its components

-Total number of fruits/plant
-Total weight of fruits /plant
-Early yield: It was estimated as the weight and number of fruits/fed of all harvested fruits during the first week of harvesting.
-Early yield (number/feddan)
-Marketable yield
-Total yield (ton/feddan)
-Total number of fruits/feddan
-Percentage of decreasing yield

Fruit characteristics

-Fruit length (cm)
-Fruit diameter (cm)
-Fruit shape index: It was calculated by dividing fruit length on fruit diameter.
-Average fruit weight (kg)
-Fruit flesh thickness (mm): Using a caliper.
-Skin firmness (kg/cm): Skin firmness is the resistance of the skin to a penetrometer fitted with an 11 millimeter diameter plunger D. Ballaufmfg. Co. Inc. Washington, D.C. by $Lbs/Inch^2$ and data were transformed to kg/cm^2 by this equation

$$X\ \left(kg / cm^2\right) = Y\ \left(Lb / Inch^2\right) \times \frac{0.4536}{6.4516}$$

-Fruit size (cm^3): It was measured by using water displacement technique by displacement the same size from water in normative beaker and estimated the same size from water. This was done in a special container which was filled with water until overflows form the spout. Fresh fruits were immersed and the overflow water volume was measured in a graduated cylinder.

-Total soluble solids (T.S.S. %): it was measured in fruit juice by using a hand refractometer. Three fruits were taken at random from each treatment for this test. This was estimated according to the methods of A.O.A.C. (1980).
- Fruit dry matter %: It was determined by allowing 100 g of fruit fresh weight to dry in an oven at 70°C till a constant weight.

Chemical composition:

The determinations of chemical analysis of melon fruit were as follow:
Total sugar in fruits (mg/g) dry weight, according to the method described in A.O.A.C. (1980).

Macro and micronutrients in leaves

In each treatment, five leaves from melon plants randomly selected from each experimental unit were taken after 70 days from transplanting. Leaves were washed with distilled water, dried at 70° C under ventilation and then grounded in stainless steel mill.

Total elements *i.e.,* N, P, K, Na and Ca in leaves were extracted by wet digestion in a mixture of nitric, sulphoric and perchloric acids in a volumetric ratio of 8:1:1, as described by Chapman and Pratt (1978).

-Total nitrogen in leaves was assayed in mg/g dry weight, by micro-Kjeldahle method indicated by Pregl, (1945).

-Potassium, Sodium and Calcium concentrations in leaves, in mg/g dry weight, were determined using flam-photo metrically according to the method described by Brown and Lilliland (1946).

-Total phosphorus (%) was determined calorimetrically according to, the method described by Murphy and Riely (1962), as modified by John (1970).

- Proline: proline content in leaves was determined in mg/g. dry weight according to Bates *et al.* (1973).

Soil and water analysis

Three soil samples were taken prior to transplanting from 0-30 cm depth. The irrigation water sample was collected from underground water. Soil and water samples were analyzed at Central Lab Unit Soil and Water Research Institute. The soil and water analysis are tabulated in Table (1).

Table 1. Soil and water analysis

Mechanical			Textural Class	pH in 1-2.5 Soil : water suspension	Ec: Soil paste 1:1 ds/m		S.P
Sand	Silt	Clay	Sand loamy	7.9	7.4		23%
60%	25%	15%					
Soluble anions and cations							
Cations C mol^{-1}				Antions C mol^{-1}	Meq/L		
Co_3	HCo_3	Cl	So_4	Ca	Mg	Na	K
0	4.8	52.1	18.7	8.15	4.51	61.55	1.32
Available macro and micro elements							
N	P	K	Fe	Mn	Zn	Cu	
16.7	1.67	92.9	3.01	0.33	0.25	0.34	

Water analysis

Ec	Ph	SAR	Antions C mol^{-1} Meq/L	Co_3	HCo_3	Cl	So_4
				0	11.4	22	1.54
5.5 dsm	7.9	7.25	Cations C mol^{-1}	Ca	Mg	Na	K
				5.32	3.2	26	0.23

Experimental design and statistical analysis

Split plot in randomized complete block design with three replicated was used in the experiment. Magnetite addition treatments were randomly arranged in main plot and grafting treatments were distributed randomly in sub plots. Data were statistically analyzed using analyses of variance by the technique of analysis of variance ANOVA, with the Stat soft statistical package MSTATC software program (Michigan State University. East Lansing, MI, USA). Probabilities of significance among treatments and means were compared with least significant difference L.S.D. ($P \leq 0.05$) were used to compare means within and among treatments according to Gomez and Gomez (1984).

Results and Discussion

Magnetic iron effects

Vegetative growth characters

Data in Tables (2 and 3) showed that there were significant differences between the two levels of magnetite in plant length, leaves area, number of branches and leaves, plant fresh and dry weight, dry matter percentage in both seasons. No significant differences were noticed between the two levels of magnetite (0 and 300) in stem diameter in both seasons. Magnetite addition (300Kg) gave a significant increment in most vegetative characters. Magnetic iron (magnetite) is an important factor affecting plant growth. In this connection, El-Hifny *et al*. (2008) pointed out that increasing magnetite levels up to 150 or 200kg/fed. led to increase the vegetative growth on cauliflower. Similarly, were those results attained by Abd El-All (2003) on eggplant and Ali *et al*. (2011) on *Capsicum annuum*.

Table 2. Effect of magnetite additions to saline soil on vegetative growth in cantaloupe.

Magnetite	2012					2013				
	Plant length (m)	Stem diameter (mm)	Number of branches	Number of leaves	Leaves area (cm^2)	Plant length (m)	Stem diameter (mm)	Number of branches	Number of leaves	Leaves area (cm^2)
0	2.52	23.89	7.90	270.75	21635	2.37	23.65	7.70	286.44	21819
300	2.82	25.37	8.90	376.65	24199	2.77	26.08	8.80	383.59	24493
LSD $t_{0.05}$	0.23	NS	0.76	35.08	1713.7	0.25	NS	0.66	18.31	1032.7

Table 3. Effect of magnetite additions to saline soil on plant fresh, dry weight and dry matter percentage in cantaloupe.

	2012			2013		
	Plant			Plant		
	Fresh weight (gm)	Dry weight (gm)	Dry matter percentage%	Fresh weight (gm)	Dry weight (gm)	Dry matter percentage%
0	1209.72	110.17	9.10	1195.28	109.39	9.2
300	1350.83	121.39	9.00	1311.11	118.78	9.1
LSD $t_{0.05}$	40.540	1.2000	0.002	62.670	6.370	0.001

Yield and its component

Data in Table (4) indicated that, there were significant increments in number of fruit per plant, plant yield, early, marketable and total yield due to the magnetite addition (300Kg/ feddan) compared with control in the first and second seasons under study. Nearly similar results were obtained by El-Hifny *et al*. (2008) they reported that the highest yield was produced when 200kg magnetite/fed was added combined with using the high ridge planting method.

Table 4. Effect of magnetite additions to saline soil on yield characters in cantaloupe.

Magnetite	2012					2013				
	No of fruit per plant	Yield Kg/Plant	Total	Marketable	Early	No of fruit per plant	Yield Kg/Plant	Total	Marketable	Early
			Yield (ton/ feddan)					Yield (ton/ feddan)		
0	2.27	1.901	10.65	9.798	2.629	2.24	1.890	10.59	9.77	2.639
300	3.33	3.189	17.86	16.678	3.565	3.30	3.181	17.82	16.66	3.453
LSD $t_{0.05}$	0.3	0.420	2.38	2.26	0.42	0.18	0.300	1.160	1.280	0.430

Fruit characteristics

Data in Table (5 and 6) illustrated that, the physical fruit characters such as fruit weight, size, length and diameter showed significant increment by using the magnetite compared with control (non addition). In contrast, magnetite addition gave lowest values in fruit firmness, total soluble solids and total sugar content; these results may be due to the positive effect of magnetic iron addition in water uptake. In this regard (Hilal and Hilal, 2000) reported that, magnetic treatment of saline irrigation water can be used as an effective method for soil desalinization. It decreases the hydration of salt ions and colloids, having a positive effect on salt solubility, accelerated coagulation and salt crystallization.

Fruit flesh thickness and fruit shape index did not showed any significant effect for using the magnetite addition, these results may be due to, the fruit shape index and fruit flesh thickness are considered genetic characteristic.

Table 5. Effect of magnetite additions to saline soil on fruit characters in cantaloupe.

Magnetite	2012					2013				
	Fruit					Fruit				
	Weight (gm)	Size (cm^3)	Length (cm)	Diameter (cm)	Shape index	Weight (gm)	Size (cm^3)	Length (cm)	Diameter (cm)	Shape index
0	833.08	928.06	11.67	12.18	0.96	838.76	967.51	11.11	12.00	0.93
300	946.47	1079.44	12.38	13.00	0.95	953.29	1096.52	11.75	12.91	0.91
LSD $t_{0.05}$	54.65	45.1	0.332	0.359	0.037	52.01	17.01	0.54	0.710	NS

Table 6. Effect of magnetite additions to saline soil on fruit characters in cantaloupe.

Magnetite	2012				2013			
	Fruit Firmness (Kg/cm^2)	Flesh Thickness (cm)	Total sugar (mg/g)	TSS	Fruit Firmness (Kg/cm^2)	Flesh Thickness (cm)	Total sugar (mg/g)	TSS
0	2.28	3.19	26.06	12.52	2.26	3.189	26.82	12.53
300	1.97	3.37	25.76	12.33	2.08	3.356	25.80	12.48
LSD $t_{0.05}$	0.04	NS	0.650	0.06	0.07	NS	0.100	0.03

Data in Table (7) showed that, magnetite additions gave the highest values in NPK in addition to Ca contents in cantaloupe leaves. The magnetite addition led to a significant decrease in sodium uptake and accumulation in leaves. The results may be due to the positively effects for magnetic treatments on desalinization of soils and water irrigation.

Magnetic treatment decreases the hydration of salt ions and colloids, having a positive effect on salt solubility, accelerated coagulation and salt crystallization. Water becomes degassed in the process of being magnelized, and this degassing increases soil permeability, which creates an increase in irrigation efficiency (Bogatin *et al.,* 1999). Moreover, MW interacts with the structural Ca in cell membranes, making the cell more permeable. The reduced surface tension observed in MW results in better infiltration of water and a reduction in water and chemicals use (Goldsworthy *et al.,* 1999).In this connection, El-Hifny *et al.* (2008) pointed out that increasing magnetite levels up to 150 or 200kg/fed. led to increase the mineral contents, *i.e.* N, P, K and Fe in leaves and curds of cauliflower, but decreased Na and Cl concentrations in leaves.

Magnetite additions in soil led to decrease the proline content in the plant leaves. Adding 300 kg of magnetite have a significant decrease in the proline content in the leaves. This result may be due to the role of magnetism in reducing the harmful effects of salinity and push the harmful elements especially Na from the circumference of plant roots.

Table 7. Effect of magnetite additions to saline soil on NPK, Na, Ca and proline content in cantaloupe leaves.

Magnetite	2013					
	N mg/g Dwt.	P Mg/g Dwt.	K mg/g Dwt.	Na mg/g Dwt.	Ca mg/g Dwt.	Proline mg/g Dwt.
0 Kg/feddan	29.85	3.24	23.55	27.71	53.99	7.68
300 Kg/feddan	32.29	3.49	25.59	25.17	54.01	6.45
LSD $t_{0.05}$	0.92	0.16	0.64	2.20	1.59	0.46

Grafting effects

Data in Table (8) indicated that, there were significant increment in plant vigor of grafted plants compared to nongrafted (control) of the melon Visa hybrid F1 under the saline soil in both seasons. This was shown in plant length (cm), stem diameter, leaves area (cm^2) and number of branches and leaves. Grafting cantaloupe on *Lagenaria* rootstocks (Bottle and Calabash gourd) gave significant increment in plant length in both seasons. While grafting cantaloupe on interspecific hybrid rootstocks (*Cucurbita maxima* × *Cucurbita moschata)* rootstocks such as Shintosa, Super Shintosa and Ercole gave the highest values in stem diameter, leaf area, number of branches and leaves followed by plants grafted on both bottle and calabash gourd followed by the control in both seasons.

Grafting melon cultivated in an infested field with salinity showed good vegetative growth compared with nongrafted plants. This agrees with that of Salam *et al.* (2002) they reported that, both the length of vine and number of lateral branches produced in the grafted plants were higher than those of the nongrafts. Differential hormone synthesis (cytokinins, abscisic acid, ethylene, gibberellins, auxins) controlled by root systems could lead to variations in growth and root to shoot ratios (Zijlstra *et al.,* 1994).

The use of rootstock has been successfully demonstrated to increase salt tolerance of vegetable plants by reducing Na+ toxicity. These vegetables include melon (Romero *et al.,* 1997).

Table 8. Effect of grafting cantaloupe on some rootstocks under saline soil condition on vegetative growth characters

Rootstocks	2012					2013				
	Plant length (m)	Stem diameter (mm)	Number of branches	Number of leaves	Leaves area (cm^2)	Plant length (m)	Stem diameter (mm)	Number of branches	Number of leaves	Leaves area (cm^2)
Melon (control)	2.24	17.01	6.40	235.04	18895	2.16	17.17	6.60	248.31	19421
Ercole F1	2.62	28.38	8.80	323.96	22982	2.30	29.20	9.20	330.20	21844
Shintosa F1	2.52	27.68	9.60	349.96	23957	2.52	29.35	9.00	351.52	24043
S. Shintosa F1	2.62	28.33	10.0	377.00	25026	2.63	28.83	9.60	384.28	25100
Bottle gourd	2.93	23.43	8.20	332.80	23722	2.90	22.63	7.80	344.76	24346
Calabash gourd	3.11	22.93	7.40	323.44	22921	2.91	22.00	7.40	351.00	24183
LSD $t_{0.05}$	0.16	1.020	0.92	24.91	1238.6	0.13	0.72	1.15	26.93	702.76

Data in Table (9) indicated that, in salinity soil grafting melon on all rootstocks had a significant increment in both fresh and dry weight compared with the control plants in both seasons. The dry matter percentage recorded significant decrease by grafting cantaloupe on Lagenaria rootstocks (Bottle and Calabash gourd) compared with control plants, at the same time, the highest value in dry matter percentage was detected in control plants followed by grafted on interspecific hybrid rootstocks (Shintosa, Ercole Nun 6001 and Super Shintosa) followed by Lagenaria rootstocks (Bottle and Calabash gourd) in the first and second season. In this connection, Huang *et al.* (2009) reported that reduction of cucumber shoot dry weight under saline condition can be alleviated by grafting onto bottle gourd rootstock ‘Chaofeng 8848 (*L. siceraria*).

Table 9. Effect of grafting cantaloupe on some rootstocks under saline soil condition on plant fresh, dry weight and dry matter percentage.

Rootstocks	2012			2013		
	Plant			Plant		
	Fresh weight (gm)	Dry weight (gm)	Dry matter percentage	Fresh weight (gm)	Dry weight (gm)	Dry matter percentage
Melon (control)	1096.7	101.83	9.3	1039.2	97.50	9.4
Ercole F1	1340.8	121.67	9.1	1346.7	123.17	9.2
Shintosa F1	1399.2	127.17	9.1	1357.5	123.67	9.1
S. Shintosa F1	1421.7	128.00	9.0	1369.2	124.50	9.1
Bottle gourd	1215.0	108.33	8.9	1189.2	107.00	9.0
Calabash gourd	1208.3	107.67	8.9	1217.5	108.67	8.9
LSD $t_{0.05}$	38.91	3.55	0.02	51.66	4.11	0.02

Results in Table (10) showed that there were significant differences between the grafted and ungrafted cantaloupe under saline condition in number of fruits per plant, plant yield, early, marketable and total yield in both seasons. Grafted melon onto Super Shintosa rootstock gave the highest values in all yield characteristics followed by Shintosa, Ercole, calabash gourd and bottle gourd rootstock respectively, these results were shown in the first and second season. Control plants gave the lowest values in all yield characters in both seasons.

The results agree with that of Romero *et al.* (1997) they found that grafted melons were more tolerant to salinity and gave higher yields than ungrafted ones. Rivero *et al.,* (2003) demonstrated that grafting affects directly increased plant yield.

Its influence can be exerted by the interaction of some or all of the following processes: increase of water and nutrient uptake due to the rootstock’s vigorous root system (Ruiz *et al.,* 1997) enhanced production of endogenous-hormones (Zijlstra *et al.,* 1994) and enhancement of scion vigor (Leoni *et al.,* 1990). The joint action of some or all of these processes could explain the higher yield often observed in grafted plants at any level of salinity in the root zone.

Table 10. Effect of grafting cantaloupe on some tolerant rootstocks under saline soil condition on yield characters.

Rootstocks	2012					2013				
	No. of fruit per plant	Yield Kg/Plant	Total	Marketable	Early	No. of fruit per plant	Yield Kg/Plant	Total	Marketable	Early
			Yield (ton/ feddan)					Yield (ton/ feddan)		
Melon (control)	2.14	1.693	9.483	8.662	2.515	2.14	1.701	9.527	8.718	2.368
Ercole F1	2.92	2.748	15.388	14.170	3.182	2.78	2.631	14.732	13.575	3.145
Shintosa F1	3.19	3.070	17.195	15.955	3.492	3.07	2.962	16.585	15.390	3.418
S. Shintosa F1	3.43	3.271	18.320	17.278	3.720	3.34	3.210	17.977	16.965	3.553
Bottle gourd	2.53	2.165	12.122	11.100	2.752	2.61	2.275	12.742	11.710	2.848
Calabash gourd	2.60	2.322	13.003	12.262	2.923	2.70	2.436	13.642	12.937	2.943
LSD $t_{0.05}$	0.22	206.63	1.16	1.17	0.41	0.22	239.74	1.34	1.34	0.35

Melon is an important crop in arid and semiarid regions with salinity problems. Field experiments have shown that melon is a potential crop for irrigation with saline water (Shannon and Francois, 1978). Salt tolerance of melon varies widely and depends on the cultivar and the type of cultivation (Mendlinger and Pasternak, 1992).

Data presented in Table (11) clearly show the significant effect of grafting cantaloupe Visa F1 hybrid on all rootstocks in fruit characteristics such as fruit weight, size, length and diameter in both seasons. The highest values of all physical fruit characterstics were obtained by grafting into Super Shintosa and Shintosa in both seasons, while the lowest values of both characteristics were obtained by control plant. These results may be due to the roots system vigor and the increasing the water and elements uptake in the rootstocks.

These results agrees with those of (Xu *et al.,* 2005 and Qi *et al.,* 2006) they reported that fruit size resulted in higher yield since grafted plants, have strong root systems, and increased photosynthesis. Salam *et al.* (2002) demonstrated a 3.5 times higher yield in grafted watermelon (*Citrullus lanatus*) due to larger fruit size, and more fruit per plant.

Yetisir *et al.* (2007) reported that watermelon grafted on interspecific squash hybrid (*C. maxima* × C. moschata) had increased fruit size by 52%. Two squash interspecific hybrid rootstocks('Shintoza' and 'Tetsukabuto') increased both watermelon yield and fruit size by an average of 90% and 26%, respectively compared to ungrafted 'Reina de Corazones' watermelon plants (Miguel *et al.,* 2004). In a review, Sakata *et al.* (2007) wrote that yield and fruit weight of 'Shintoza' grafted watermelons were higher than those with other rootstocks. Moreover, Alan *et al.* (2007) obtained greater fruit weight (by 22%) in watermelon cv. 'Crispy' grafted on different interspecific hybrid, although only under plastic tunnel. This was especially true in watermelon, and to a lesser extent in melon (*C. melo* L.) (Miguel, *et al*., 2004).

Table 11. Effect of grafting cantaloupe on some tolerant rootstocks under saline soil condition on fruit characters.

Rootstocks	2012					2013				
	Fruit					Fruit				
	Weight (gm)	Size (cm^3)	Length (cm)	Diameter (cm)	Shape index	Weight (gm)	Size (cm^3)	Length (cm)	Diameter (cm)	Shape index
Melon (control)	789.98	887.88	12.27	12.65	0.95	788.17	914.95	10.72	11.38	0.94
Ercole F1	930.78	1045.43	12.35	12.75	0.96	937.30	1046.32	11.45	12.71	0.90
Shintosa F1	946.18	1063.38	12.40	12.92	0.96	948.62	1106.57	11.92	12.94	0.92
S. Shintosa F1	941.58	1056.57	12.08	12.98	0.96	948.73	1085.68	12.13	12.94	0.94
Bottle gourd	852.73	1001.15	11.98	12.67	0.95	865.68	1020.48	11.05	12.33	0.90
Calabash gourd	877.38	968.08	12.27	12.58	0.95	887.65	1018.07	11.31	12.42	0.91
LSD $t_{0.05}$	55.49	33.49	0.335	0.41	NS	36.11	29.24	0.460	0.37	NS

Crinò *et al*. (2007) reported that melon plants 'Incas', which belongs to the inodorus group of *C. melo* grafted onto Cucurbita interspecific hybrid rootstocks, especially on 'RS 841', produced fruit weight larger by 24% than ungrafted plants and plants grafted onto *C. melo* rootstocks. The largest fruit weight was obtained in 2003 growing season by the same combination Incas/'RS 841', with 2.74 kg, whereas the ungrafted control weighed 2.21 kg. The previous results show that the average fruit weight and size of Cucurbitaceae is often influenced by grafting, and it is an important component of yield. Contrarily to the fruit size, fruit shape index defined by the ratio of equatorial and longitudinal lengths was unaffected by grafting combinations on watermelon, melon, and cucumber (*Cucumis sativus* L.) grown under open field and greenhouse conditions (Yetisir *et al.,* 2003, and Proietti *et al*., 2008).

No significant differences were detected among grafted and ungrafted melons in fruit shape index.

Data in Table (12) showed significant increase of fruit firmness when grafted melon into all rootstocks compared with control. Firmness is one of the typical attributes used to describe the fruit texture. Grafting can influence the firmness in a highly significant way. Watermelon fruits obtained from plants grafted onto Lagenaria rootstocks (Yetisir *et al.,* 2003), and *C. maxima* × *C. moschata* ('RS841' and 'Shintoza Camelforce') (Huitron-Ramirez *et al.,* 2009) were firmer by 24% and 27%, respectively than the fruits from the ungrafted plants independent of cultivar, rootstock and growing conditions. Another study also reports a substantial increase in melon firmness from grafted 'Proteo' plants onto 'P360' (*C. maxima* × *C. moschata*) by 19–32% (Colla *et al.,* 2006).

Flesh thickness increased in the cantaloupe fruit were produced from the grafted melon in the interspecific hybrid cucurbits rootstocks (Super Shintosa, Shintosa and Ercole). Grafting melon into Bottle and Calabash gourd rootstocks did not show any significant differences in flesh thickness.

Grafting melon on bottle and calabash gourd led to increase the total sugar content in melon fruits and decreased the total soluble solids (TSS). All rootstocks showed significant decreasing in TSS compared with the control plant. These results agrees with Yetisir *et al.* (2003) they reported that soluble solids of watermelon were greatly affected by grafting, but the results were dependent on the rootstock used. But Proietti *et al.* (2008) reported that, the flavor determining characteristics, such as glucose, fructose, sucrose concentration and total soluble solids (TSS) concentration were similar in grafted and ungrafted plants. If *Cucurbita spp.* are used as rootstock with 'Earl's Favorite' melon, the fruit grow better than those on ungrafted plants, but the quality of the fruit netting is poorer and the sugar content is 2–3 ◦Brix (Kamiya and Tamura, 1964).

Trionfetti-Nisini *et al.* (2002) investigated 13 commercial rootstocks and various Cucurbitaceae spp. rootstocks, many of them influenced the soluble solids concentration. Moreover, the total soluble solids concentration of melons grafted onto the pumpkin interspecific hybrid 'P 360' (*C. maxima* ×*C. moschata*) was reported to be lower than those from ungrafted cv. 'Cyrano' (*C. melo* L. var cantaloupensis Naud) (Colla *et al.,* 2006). Otherwise, Crinò *et al.* (2007) reported that the soluble solids concentrations of grafted melons were similar to those grown on their own roots. The photosynthesis rate of grafted melon plant decreased dramatically during late stages of fruit development (Xu *et al*., 2005).

Table 12. Effect of grafting cantaloupe on some tolerant rootstocks under saline soil condition on fruit characters.

Rootstocks	2012				2013			
	Fruit Firmness (Kg/cm^2)	Flesh Thickness (cm)	Total sugar (mg/g)	TSS	Fruit Firmness (Kg/cm^2)	Flesh Thickness (cm)	Total sugar (mg/g)	TSS
Melon (control)	1.89	3.17	26.42	13.98	1.95	3.17	26.86	14.08
Ercole F1	2.18	3.27	24.48	12.70	2.21	3.32	25.13	13.07
Shintosa F1	2.16	3.35	25.52	13.02	2.27	3.40	25.92	12.95
S. Shintosa F1	2.15	3.57	25.73	12.80	2.19	3.60	26.31	12.55
Bottle gourd	2.21	3.15	26.63	11.35	2.21	3.08	26.84	11.35
Calabash gourd	2.15	3.18	26.69	10.72	2.18	3.09	26.80	11.02
LSD $t_{0.05}$	0.09	0.10	0.470	0.46	0.06	0.14	0.360	0.410

Data presented in Table (13) showed that grafting melon into interspecific rootstocks (Super Shintosa, Shintosa and Ercole) led to increasing the leaves content from nitrogen, phosphors and sodium due to increasing the mineral uptake compared with control. Grafting cantaloupe onto Bottle and Calabash gourd gave the highest values in the sodium content in leaves (30.30 and 30.53 respectively). The highest value in potassium leaves content was showed in grafted melon onto Bottle and Calabash gourd. While the lowest values obtained from ungrafted melon (control) and grafted melon onto Ercole F1 and Shintosa F1 respectively. No significant differences were shown between grafted and ungrafted melon in calcium content in leaves.

The nature of tolerance to salinity in grafted cantaloupe on gourd rootstocks varied with the cantaloupe grafted on cucurbita rootstocks. This difference is evident from the obviously difference in sodium and proline content in leaves. Grafting melon on gourd led to increase the sodium content in leaves while. Grafting visa hybrid on cucurbita rootstocks gave highest proline content (7.85, 7.85 and 7.66 mg/g dry weight) and the lowest values in sodium content in leaves (24.82, 26.02 and 24.37 mg/g dry weight). Grafting Visa on *Lagenaria* (Bottle and Calabash gourd) gave significant effects on sodium content in leaves. The highest values of Na content in leaves were detected by grafting visa hybrid on *Lagenaria* rootstocks while the same grafting treatment had the lowest values in proline content in leaves (7.03 and 7.13) compared with other grafting treatments. Generally all grafting treatments gave significant increase in proline content compared with control plant. No significant differences were detected among the grafted melon on all rootstocks under study.

Table 13. Effect of grafting cantaloupe on some tolerant rootstocks under saline soil condition on NPK, Na, Ca and proline content in cantaloupe leaves.

Rootstocks	2013					
	N mg/g Dwt.	P mg/g Dwt.	K mg/g Dwt.	Na mg/g Dwt.	Ca mg/g Dwt.	Proline mg/g Dwt.
Melon (control)	29.47	2.74	22.69	22.59	54.47	4.86
Ercole F1	32.74	3.43	23.37	24.82	54.08	7.85
Shintosa F1	33.10	3.63	23.34	26.02	54.71	7.85
S. Shintosa F1	33.21	3.70	24.54	24.37	53.73	7.66
Bottle gourd	29.86	3.36	27.26	30.31	53.27	7.03
Calabash gourd	28.02	3.32	26.20	30.53	53.77	7.13
LSD $t_{0.05}$	1.56	0.10	1.04	1.53	NS	0.81

Ruiz *et al.* (1996) when grafted melon plants, the rootstock was found to have a positive effect on the foliar levels of total P, reflected by the greater shoot vigour in these plants as well as higher carbohydrate content (glucose, sucrose, fructose and starch). With good P uptake by the roots the concentration of carbohydrates falls, these components being transported from the root to the shoot, thereby increasing the vigour of the aerial part of the plant (Romero *et al.,* 1997). In addition, Ruiz *et al.* (1997) grafted melon *Cucumis melo* onto three rootstocks *i.e.,* Shintoza, RS-841 and Kamel under controlled conditions and fertilized constantly with both macro- and micronutrients showed that the use of the different rootstock genotypes causes little change in the leaf content of macronutrients, principally N and Na. On the contrary, root genotype determined the yield. There was strong relationship between the variations in foliar concentrations of N and Na and yield differences in grafted plants.

In watermelon Pulgar *et al.* (1996) recorded that the highest concentrations of total and soluble K were observed in control plants (not grafted). Control plants had a high concentration of Na (3.49 mg/g). Grafted plants had higher concentrations of total, soluble and organic Ca than control plants.

Beside nitrogen, phosphorus uptake also seems to be enhanced by grafting onto some rootstocks. On the other hand, phosphorus uptake can be reduced by grafting, depending mainly on the genotype of the rootstock (Kawaguchi *et al*., 2008). This was reported for melon (*C. melo* L.) grafted onto pumpkin (*C. moschata* Duch.) 'No. 1 Shengzhen' (Qi *et al.,* 2006).

Santa-Cruz, *et al.* (2002) suggested that the saline ion accumulation in leaves was controlled predominantly by the genotype of the rootstock. In addition, the characteristics of the rootstock able to induce salt tolerance to the shoot depend on the salt tolerance mechanism of the shoot genotype.

Previous studies suggested that lower accumulation of Na+ and/or Cl_ in the plant's shoot is the main reason for higher salt tolerance of grafted tomato (Estan *et al*., 2005), melon (Romero *et al.,* 1997), and cucumber (Zhu *et al.,* 2008). In addition, our previous study also demonstrated that higher salt tolerance of grafted cucumber plants was highly associated with improved K+ content in the leaves (Zhu *et al.,* 2008).

Grafted plants develop numerous physiological and biochemical mechanisms to cope with salt stress. These strategies include (i) salt exclusion in the shoot and retention of salt ions in the root, (ii) better maintenance of potassium homeostasis, (iii) compartmentation of salt ions in the vacuole, accumulation of compatible solutes and osmolytes in the cytosol, (iv) activation of an antioxidant defense system, and (v) induction of hormones mediated changes in plant growth (Colla, *et al.,* 2010a).

In contrast, Tal *et al.* (1979) reported more proline accumulation in salt sensitive species of tomato than in tolerant wild relatives. Working with soybean, Moftah and Michel (1987) found that the proline content could not be used as a sensitive indicator of salt stress. Similarly, Ashraf (1989) reported a negative relationship between proline accumulation and salt tolerance in *Vigna mungo*. In rice, the salt resistant cultivars, Nona Bokra and IR 4630 accumulated less proline in their leaves than the salt sensitive Kong Pao and IR 31785 (Lutts, *et al.,* 1996). A similar negative relationship between proline accumulation and salt tolerance in tomato was observed by Aziz *et al*. (1998). In view of these contrasting reports on the role of proline in salt tolerance, its use as selection criterion for salt tolerance has been questioned (Wyn Jones 1981). Although amides generally accumulate in salt-stressed plants to a lesser extent than do other nitrogen containing compounds (Mansour, 2000).

Proline, which occurs widely in higher plants, accumulates in larger amounts than other amino acids in salt stressed plants (Ali*, et al.,* 1999). Proline accumulation is one of the common characteristics in many monocotyledons under saline conditions (Wyn Jones and Storey, 1978). Proline accumulation occurs in response to water deficit as well as to salt. Thus, synthesis of proline is a non-specific response to low growth medium water potential (Ashraf, 1994). Proline regulates the accumulation of useable N, is osmotically very active (Ashraf, 1994), contributes to membrane stability (Gadallah, 1999) and mitigates the effect of NaCl on cell membrane disruption (Mansour, 1998). Exogenous application of proline caused a decrease in shoot Na+ and Cl− accumulation and thereby enhanced growth under saline conditions in cultured barley embryos (Lone, *et al.,* 1987).

Amino acids have been reported to accumulate in higher plants under salinity stress. The important amino acids in this respect include alanine, arginine, glycine, serine, leucine and valine, together with the amino acid, proline, and the non-protein amino acids, citrulline and ornithine (Mansour 2000).

Effect of interaction between magnetic iron and grafting

Concerning the effect of interaction between magnetic iron addition and grafting cantaloupe onto rootstocks.

Data in Table (14 and 15) showed that no significant differences were noticed in vegetative growth characteristics except number of leaves, plant fresh and dry weight due to the interaction between magnetite and grafting in both seasons.

Data in Table (16) showed that the interaction between magnetite addition and grafting gave significant differences in number of fruit per plant, total yield as kilogram per plant and ton per feddan and marketable yield in both seasons, while early yield did not shows any significant differences due to this interaction.

It is obvious from data in Table (17 and 18) which describe the physical and chemical characteristics of fruits, no significant differences were observed in all physical and chemical characteristics because of the interaction between magnetite additions and grafting melon in rootstocks.

Data in Table (19) indicated that the interaction between magnetic iron and grafting melon in tolerant rootstocks gave significant differences in sodium, nitrogen and potassium content in leaves while, did not show any significant differences in calcium, phosphors and proline contents in melon leaves.

Table 14. Effect of interaction between magnetite additions and grafting on tolerant rootstocks on vegetative growth in cantaloupe.

Magnetite	Rootstocks	2012					2013				
		Plant length (m)	Stem diameter (mm)	Number of branches	Number of leaves	Leaves area (cm^2)	Plant length (m)	Stem diameter (mm)	Number of branches	Number of leaves	Leaves area (cm^2)
0 Kg/feddan	Melon (control)	2.07	15.67	6.0	209.04	18286	2.04	15.30	5.2	214.77	17006
	Ercole F1	2.50	27.43	8.0	262.08	21146	2.28	28.23	8.4	269.36	18990
	Shintosa F1	2.54	27.47	8.8	283.92	22327	2.32	27.83	8.4	292.24	22926
	S. Shintosa F1	2.47	27.50	9.2	300.56	23571	2.40	27.53	9.2	319.28	24012
	Bottle gourd	2.69	22.87	8.4	294.32	23160	2.62	21.80	7.6	312.00	24148
	Calabash gourd	2.86	22.43	7.2	274.56	21319	2.58	21.20	7.6	310.96	23833
300 Kg/feddan	Melon (control)	2.41	18.37	6.8	261.04	19504	2.29	19.03	8.0	281.84	21836
	Ercole F1	2.75	29.33	9.6	385.84	24817	2.31	30.17	10.0	391.04	24697
	Shintosa F1	2.49	27.90	10.4	416.00	25586	2.72	30.87	9.6	410.80	25160
	S. Shintosa F1	2.77	29.17	10.8	453.44	26480	2.86	30.13	10.0	449.28	26189
	Bottle gourd	3.17	24.00	8.0	371.28	24284	3.18	23.47	8.0	377.52	24543
	Calabash gourd	3.35	23.43	7.6	372.32	24526	3.23	22.80	7.2	391.04	24534
LSD t0.05		NS	NS	NS	35.23	NS	NS	NS	NS	42.25	NS

Table 15. Effect of interaction between magnetite additions and grafting on tolerant rootstocks on plant fresh, dry weight and dry matter percentage in cantaloupe.

Magnetite		2012			2013		
		Plant			Plant		
	Rootstocks	Fresh weight (gm)	Dry weight (gm)	Dry matter percentage	Fresh weight (gm)	Dry weight (gm)	Dry matter percentage
0 Kg/feddan	Melon (control)	1038.3	97.67	9.4	921.7	87.33	9.5
	Ercole F1	1256.7	113.33	9.0	1285.0	117.00	9.1
	Shintosa F1	1290.0	116.67	9.1	1305.0	119.33	9.1
	S. Shintosa F1	1351.7	122.00	9.0	1330.0	120.67	9.1
	Bottle gourd	1158.3	106.00	9.1	1126.7	103.33	9.2
	Calabash gourd	1163.3	105.33	9.1	1203.3	108.67	9.0
300 Kg/feddan	Melon (control)	1155.0	106.00	9.2	1156.7	107.67	9.3
	Ercole F1	1425.0	130.00	9.1	1408.3	129.33	9.2
	Shintosa F1	1508.3	137.67	9.2	1410.0	128.00	9.1
	S. Shintosa F1	1491.7	134.00	9.0	1408.3	128.33	9.1
	Bottle gourd	1271.7	110.67	8.7	1251.7	110.67	8.9
	Calabash gourd	1253.3	110.00	8.8	1231.7	108.67	8.9
LSD t0.05		55.37	5.02	NS	67.09	5.81	NS

Table 16. Effect of interaction between magnetite additions and grafting on tolerant rootstocks on yield characters in cantaloupe.

Magnetite	Rootstocks	2012					2013				
		No of fruit per plant	Yield Kg/Plant	Total	Marketable	Early	No of fruit per plant	Yield Kg/Plant	Total	Marketable	Early
				Yield (ton/feddan)					Yield (ton/ feddan)		
0 Kg/feddan	Melon (control)	1.92	1.427	7.990	7.630	2.310	1.96	1.426	7.990	7.603	2.260
	Ercole F1	2.37	2.070	11.597	10.633	2.703	2.21	1.950	10.920	10.037	2.763
	Shintosa F1	2.41	2.110	11.817	10.920	2.780	2.35	2.066	11.573	10.640	2.753
	S. Shintosa F1	2.84	2.477	13.877	12.857	2.923	2.72	2.395	13.410	12.487	2.947
	Bottle gourd	2.05	1.700	9.523	8.613	2.467	2.10	1.751	9.807	8.913	2.553
	Calabash gourd	2.01	1.622	9.083	8.133	2.593	2.12	1.753	9.820	8.953	2.560
300 Kg/feddan	Melon (control)	2.35	1.960	10.977	9.693	2.720	2.3	1.976	11.063	9.833	2.477
	Ercole F1	3.47	3.425	19.180	17.707	3.660	3.34	3.311	18.543	17.113	3.527
	Shintosa F1	3.97	4.031	22.573	20.990	4.203	3.79	3.856	21.597	20.140	4.083
	S. Shintosa F1	4.02	4.065	22.763	21.700	4.517	3.96	4.026	22.543	21.443	4.160
	Bottle gourd	3.00	2.629	14.720	13.587	3.037	3.12	2.799	15.677	14.507	3.143
	Calabash gourd	3.19	3.022	16.923	16.390	3.253	3.28	3.118	17.463	16.920	3.327
LSD $t_{0.05}$		0.31	0. 40	1.74	1.65	NS	0.31	3.39	1.9	1.7	NS

Table 17. Effect of interaction between magnetite additions and grafting on tolerant rootstocks on fruit characters in cantaloupe.

Magnetite	Rootstocks	2012 Fruit Weight (gm)	Size (cm^3)	Length (cm)	Diameter (cm)	Shape index	2013 Fruit Weight (gm)	Size (cm^3)	Length (cm)	Diameter (cm)	Shape index
0 Kg/feddan	Melon (control)	742.03	839.97	10.34	11.00	0.94	728.37	824.07	10.01	10.49	0.96
	Ercole F1	873.50	965.40	11.96	12.42	0.96	884.07	977.93	11.43	12.38	0.92
	Shintosa F1	875.93	977.77	12.04	12.50	0.96	879.57	1035.73	11.20	12.35	0.91
	S. Shintosa F1	871.20	963.23	11.96	12.54	0.95	881.03	1021.20	11.50	12.35	0.93
	Bottle gourd	829.33	942.97	11.85	12.38	0.96	834.10	984.37	11.12	12.19	0.91
	Calabash gourd	806.50	879.00	11.85	12.27	0.97	825.43	961.73	11.43	12.23	0.93
300 Kg/feddan	Melon (control)	837.93	935.80	11.81	12.31	0.96	847.97	1005.83	11.43	12.27	0.93
	Ercole F1	988.07	1125.47	12.57	13.07	0.96	990.53	1114.70	11.46	13.04	0.88
	Shintosa F1	1016.43	1149.00	12.65	13.34	0.95	1017.67	1177.40	12.65	13.53	0.94
	S. Shintosa F1	1011.97	1149.90	12.84	13.42	0.96	1016.43	1150.17	12.77	13.53	0.94
	Bottle gourd	876.13	1059.33	12.31	12.96	0.95	897.27	1056.60	10.99	12.46	0.88
	Calabash gourd	948.27	1057.17	12.12	12.88	0.94	949.87	1074.40	11.19	12.62	0.89
LSD $t_{0.05}$		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 18. Effect of interaction between magnetite additions and grafting on tolerant rootstocks on fruit characters in cantaloupe.

Magnetite	Rootstocks	2012 Fruit Firmness (Kg/cm^2)	Flesh Thickness (cm)	Total sugar (mg/g)	TSS	2013 Fruit Firmness (Kg/cm^2)	Flesh Thickness (cm)	Total sugar (mg/g)	TSS
0 Kg/feddan	Melon (control)	2.17	3.00	26.99	13.80	2.07	2.97	27.73	14.23
	Ercole F1	2.43	3.13	24.40	12.60	2.42	3.20	25.63	13.07
	Shintosa F1	2.36	3.33	25.38	13.27	2.41	3.33	26.59	12.97
	S. Shintosa F1	2.31	3.47	25.76	13.03	2.38	3.47	26.86	12.40
	Bottle gourd	2.22	3.10	26.86	11.63	2.17	3.07	27.08	11.43
	Calabash gourd	2.20	3.13	26.97	10.80	2.12	3.10	27.03	11.03
300 Kg/feddan	Melon (control)	1.60	3.33	25.85	14.17	1.82	3.37	25.98	13.93
	Ercole F1	1.94	3.40	24.55	12.80	2.00	3.43	24.63	13.07
	Shintosa F1	1.96	3.37	25.65	12.77	2.13	3.47	25.25	12.93
	S. Shintosa F1	2.00	3.67	25.70	12.57	2.01	3.73	25.77	12.70
	Bottle gourd	2.20	3.20	26.40	11.07	2.25	3.10	26.60	11.27
	Calabash gourd	2.10	3.23	26.40	10.63	2.25	3.03	26.57	11.00
LSD $t_{0.05}$		NS	NS	NS	NS	NS	NS	NS	NS

Table 19. Effect of interaction between magnetite additions and grafting on tolerant rootstocks on NPK, Na, Ca and proline content in cantaloupe leaves.

Magnetite	Rootstocks	2013 N mg/g Dwt.	P mg/g Dwt.	K mg/g Dwt.	Na mg/g Dwt.	Ca mg/g Dwt.	Proline mg/g Dwt
0 Kg/feddan	Melon (control)	25.25	2.56	21.56	25.67	53.90	5.59
	Ercole F1	31.18	3.24	22.4	25.33	53.96	8.51
	Shintosa F1	33.16	3.54	22.54	28.13	54.83	8.31
	S. Shintosa F1	32.52	3.57	23.26	25.30	54.13	8.26
	Bottle gourd	29.28	3.25	26.34	30.60	53.60	7.58
	Calabash gourd	27.70	3.27	25.21	31.21	53.53	7.83
300 Kg/feddan	Melon (control)	33.70	2.91	23.83	19.51	55.03	4.14
	Ercole F1	34.29	3.61	24.34	24.31	54.21	7.20
	Shintosa F1	33.03	3.73	24.15	23.90	54.57	7.39
	S. Shintosa F1	33.90	3.83	25.83	23.43	53.33	7.07
	Bottle gourd	30.45	3.46	28.18	30.00	52.93	6.48
	Calabash gourd	28.34	3.37	27.19	29.87	54.01	6.44
LSD t0.05		2.16	NS	1.89	2.5	NS	NS

Conclusion

- Magnetic iron additions led to improve the vegetative growth and yield.
- Grafting on tolerant rootstocks is an effective method to overcome the problems of salinity.
- Bottle and calabash gourd *Lagenaria siceraria* as rootstocks can be considered highly tolerant to saline condition, it was evident from the increasing of sodium uptake and the high content in the leaves without any harmful in vegetative growth or fruit yields.
- Cucurbita hybrids rootstocks such as Super Shentosa, Shentosa and Ercole increased yield and decreased the total sugar content and TSS in melon fruits.
- Grafting cantaloupe on all rootstocks under study gave undesirable effects on TSS.

- The nature of tolerance of salinity in grafted cantaloupe on *Lagenaria* rootstocks differ than that of the grafted cantaloupe on Cucurbita, appears on the Na and proline content in leaves.
- Breeding tolerant rootstocks to saline condition and compatible with cantaloupe is necessary to produce cantaloupe under high saline conditions without any adverse affect on fruit yield and quality.

References

Abd El-All, F. S., 2003. Different nitrogen sources and magnetic iron addition as affected the productivity of eggplant (*Solanum melongena* L.) plant. Mansoura University Journal of Agriculture Science, 28(4): 2903-2916.

Abd El-All, H. M. and Y. A. Mahammed, 2014. Improvement salt tolerance of broccoli and cauliflower by adding magnetic iron and seamino and reflection of this on yield and sulforaphane content under Sinai condations. Journal of Applied Sciences Research 2011-2020.

Abd El-All, H., M. Seham, M. Ali, and S. M. Shahin, 2013. Improvement growth, yield and quality of squash (*Cucurbita pepo* L.) plant under salinity conditions by magnetized water, amino acids and selenium. Journal of Applied Sciences Research, 9(1): 937-944.

Alan, O., N. Ozdemir and Y. Gunen, 2007. Effect of grafting on watermelon plant growth, yield and quality. Journal of Agronomy, 6(2): 362-365.

Ali, G., P.S. Srivastava, and M. Iqbal, 1999. Proline accumulation, protein pattern and photosynthesis in regenerants grown under NaCl stress. Biologia Plantarum, 42: 89–95.

Ali, T.B., Khalil, E. Soha and A. M. Khalil, 2011. Magnetic treatments of *Capsicum annum* L. grown under saline irrigation conditions. Journal of Applied Sciences Research, 7(11): 1558-1568.

Ashraf, M. 1989. The effect of NaCl on water relations, chlorophyll, and protein and proline contents of two cultivars of blackgram (*Vigna mungo* L.), Plant Soil, 119: 205–210.

Ashraf, M., 1994. Breeding for salinity tolerance in plants, Critical Reviews in Plant Sciences, 13: 17–42.

Association of official analytical chemists (1980). Official Methods of Analysis of the Association of Official Agriculture Chemists. 15th Ed. Published By the A.O.A.C., Washington, D.C., U.S.A, 11018pp.

Aziz, A., J. Martin-Tanguy, and F. Larher, 1998. Stress-induced changes in polyamine and tyramine levels can regulate proline accumulation in tomato leaf discs treated with sodium chloride. Physiologia Plantarum, 104: 195–202.

Bates, L.S., R. P. Waldren, and I.D. Tear, 1973. Rapid determination of free proline for water stress studies. Plant Soil, 39: 205–207.

Bletsos, F.A., 2005. Use of grafting and calcium cyanamide as alternatives to methyl bromide soil fumigation and their effects on growth, yield, quality and fusarium wilt control in melon. Journal of Phytopathology, 153:155–161.

Bogatin, J., Bondarenko, N.P. Gake, E. E. Zrokhinson and I.P. Anayev, 1999. Magentic treatment of irrigation water: experimental results and application conditions. Environmental Science and Technology, 33: 1280-1285.

Brown, J. G. and O. Lilleland, 1946. Rapid Determination of Potassium and Sodium in Plant Materials and Soil Extracts by Flame Photometer. Proceedings of the American Society for Horticultural Science, 48:341–346.

Chapman, H. D. and P. F. Pratt, 1978. Methods of Analysis for Soils, Plants and Waters, Division of Agricultural Sciences, University of California, Berkeley, USA, 3043 pp.

Colla, G., Y.Rouphael, C. Leonardi, and Z. Bie, 2010a. Role of grafting in vegetable crops grown under saline conditions. Scientia Horticulturae, 127: 147-155.

Colla, G., Y. Rouphael,, M. Cardarelli, D. Weighta, A. Salerno, and E. Rea, 2006. Yield, fruit quality and mineral composition of grafted melon plants grown under saline conditions. The Journal of Horticultural Science and Biotechnology, 81: 146-152.

Colla, G., C. M. C. Suãrez, M. Cardarelli, and Y. Rouphael, 2010b. Improving nitrogen use efficiency in melon by grafting. HortScience, 45: 559–565.

Crinò, P., C. Lo Bianco, Y. Rouphael, , G. Colla, , F. Saccardo, and A. Paratore, 2007. Evaluation of rootstock resistance to fusarium wilt and gummy stem blight and effect on yield and quality of a grafted 'inodorus' melon. HortScience, 42: 521–525.

Cuartero, J., M.C. Bolarin, M.J. Asins, and V. Moreno, 2006. Increasing salt tolerance in tomato. Journal of Experimental Botany, 57: 1045–1058.

Davis, A. R., P. Perkins-Veazie, Y. Sakata, S. Lopez-Galarza, J. V. Maroto, S. G. Lee, Y. C. Huh, Z. Sun, A. Miguel, S. R. K. R. Cohen, and J. M. Lee, 2008. Cucurbit Grafting. Critical Reviews in Plant Sciences, 27(1): 50 – 74.

Edelstein, M., Z. Plaut, and M. Ben-Hur, 2011. Sodium and chloride exclusion and retention by non-grafted and grafted melon and Cucurbita plants. Journal of Experimental Botany, 62: 177–184.

El-Hifny, I.M.M., M.E.Ramadan, I.I. El-Oksh and M.M. Soliman, 2008. Effect of some cultural practices on cauliflower tolerance to salinity under Ras Suder conditions. Journal of Biological Chemistry and Environmental Science, 3(1):899-913.

Estan, M. T., M. M. Martinez-Rodriguez, F. Perez-Alfocea, T. J. Flowers, and M. C. Boların, 2005. Grafting raises the salt tolerance of tomato through limiting the transport of sodium and chloride to the shoot. Journal of Experimental Botany, 56: 703–712.

Flowers, T.J., 2004. Improving crop salt tolerance. Journal of Experimental Botany, 55: 307–319.

Gadallah, M.A.A., 1999. Effects of proline and glycinebetaine on *Vicia faba* responses to salt stress. Biologia Plantarum, 42:249–257.

Goldsworthy, A., H. Whitney, and E. Morris, 1999. Water Research, 33(7): 1618-1626.

Gomez, K. A. and A. A. Gomez, 1984. Statistical Procedures for Agricultural Research. International Rice Research Institute, 2nd Ed. Joho Wiley and Sons. Inc. New-York,680 p.

Hilal, M. H. and M. M. Hilal, 2000. Application of magnetic technologies in desert Agriculture. Egyptian Journal of Soil Science, 40(3): 423-435.

Hoyos, P., 2001. Influence of different rootstocks on the yield and quality of greenhouses grown cucumbers. Acta Horticulturae, 559: 139–143.

Huang, Y. Tang, Qiuliang Cao and Bie Zhilong, 2009. Improving the fruit yield and quality of cucumber by grafting onto the salt tolerant rootstock under NaCl stress. Scientia Horticulturae, 122: 26–31.

Huitron-Ramirez, M.V., M. Ramirez-Salinas and F. Camacho-Ferre, 2009. Influence of grafted watermelon plant density on yield and quality in soil infested with melon necrotic spot virus. HortScience, 44: 1838–1841.

Ishibashi, K., 1965. Tongue-approach grafting in cucurbits. Agr. Hort. 40: 1899–1902. (In Japanese) Cited by Davis *et al*. (2008).

John, M.K., 1970. Colorimetric determination of phosphorus in soil and plant material with ascorbic acid. Soil Science, 109: 214-220.

Kamiya, E. and S. Tamura, 1964. Studies on grafting in muskmelon. Bull. Shizuoka Pref. Agri. Exp. Stn. 9: 79–83. (In Japanese) Cited by Davis *et al*. (2008).

Kawaguchi, M., A. Taji, , D. Backhouse and M. Oda, 2008. Anatomy and physiology of graft incompatibility in solanaceous plants, 83: 581–588.

Lee, J.M. and M. Oda, 2003. Grafting of herbaceous vegetable and ornamental crops. Horticultural Reviews, 28: 61–124.

Leoni, S., R. Grudina, M. Cadinu, B. Madedu, and M.G. Carletti, 1990. The influence of four rootstocks on some melon hybrids and a cultivar in greenhouse. Acta Horticulturae, 28:127–134.

Liu, Y. Q., S. Q. Liu, and H. B. Wang, 2004. Effect of salt-tolerant stock on growth, yield, and quality of watermelon, Shandong Agricultural Sciences, 4: 30–31.

Lone, M.I. Kueh, J.S.H. Wyn Jones, R.G. and Bright, S.W.J. (1987). Influence of proline and glycinebetaine on salt tolerance of cultured barley embryos, Journal of Experimental Botany, 38: 479–490.

Lutts, S., Kinet, J. M. and Bouharmont, J. (1996). Effects of salt stress on growth, mineral nutrition and proline accumulation in relation to osmotic adjustment in rice *(Oryza sativa* L.) cultivars differing in salinity tolerance, Plant Growth Regulation, 1(9): 207–218.

Mansour, M.M.F. (1998). Protection of plasma membrane of onion epidermal cells by glycinebetaine and proline against NaCl stress. Plant Physiology and Biochemist, 36:767–772.

Mansour, M.M.F. (2000). Nitrogen containing compounds and adaptation of plants to salinity stress. Biologia Plantarum, 43: 491–500.

Martinez-Rodriguez, M.M., M.T. Estan, E. Moyano, J.O. Garcia-Abellan, F.B. Flores, J.F. Campos, M.J. Al-Azzawi, T.J. Flowers, and M.C. Bolarín, 2008. The effectiveness of grafting to improve salt tolerance in tomato when an excluder genotype is used as scion. Environmental and Experimental Botany, 63: 392–401.

Mendlinger, S. and D. Pasternak, 1992. Screening for salt tolerance in melons. HortScience, 27: 905–907.

Miguel, A., J. V. Maroto, A. San Bautista, C. Baixauli, , V. Cebolla, B. Pascual, S. López, and J. L. Guardiola, ,2004. The grafting of triploid watermelon is an advantageous alternative to soil fumigation by methyl bromide for control of fusarium wilt. Scientia Horticulturae,103 (1): 9-17.

Moftah, A.B. and B.B. Michel, 1987. The effect of sodium chloride on solute potential and proline accumulation in soybean leaves, Plant Physiology, 83: 283–286.

Munns, R. and M. Tester, 2008. Mechanisms of salinity tolerance. Annual Review of Plant Biology, 59: 651–681.

Murphy, J. and J.P. Riely, 1962. A modified single solution method for the determination of phosphorus in natural waters. Analytica Chimica Acta, 27: 31-36.

Oda, M.,1995. New grafting methods for fruit-bearing vegetables in Japan. Japan Agricultural Research Quarterly, JARQ., 29:187- 194.

Parida, A. K. and A. B. Das, 2005. Salt tolerance and salinity effects on plants: A review. Ecotoxicology and Environmental Safety, 60 (3), 324–349.

Pregl, F., 1945. Quantitative Organic Micro-Analysis. 4th Ed., J. and A. Churchill Ltd., London, pp: 203-209.

Proietti, S., Y. Rouphael, G. Colla, M. Cardarelli, M. De Agazio, M. Zacchini, S. Moscatello, and A. Battistelli, 2008. Fruit quality of mini-watermelon as affected by grafting and irrigation regimes. Journal of the Science of Food and Agriculture, 88: 1107–1114.

Pulgar, G., A. Belakbir, G. Villora, D. Moreno, and L. Romero, 1996. Pyruvate kinase activity as a bioindicator of cations in grafted watermelon plants. Communications in Soil Science and Plant Analysis, 27(5-8): 1027-1046.

Qi, H. Y., T. L. Li, Y. F. Liu, and D. Li, 2006. Effects of grafting on photosynthesis characteristics, yield and sugar content in melon. Journal Shenyang Agriculture University, 37: 155–158.

Rivero, R. M., J. M. Ruiz, and L. Romero, 2003. Role of grafting in horticultural plants under stress conditions. Journal of Food, Agriculture and Environment, 1 (1): 70-74.

Romero, L., A. Belakbir, L. Ragala, and J. M. Ruiz, 1997. Response of plant yield and leaf pigments to saline conditions: effectiveness of different rootstocks in melon plants (*Cucumis melo* L.), Soil Science and Plant Nutrition, 43: 855–862.

Ruiz, J. M., A. Belakbir, I. Lopez-Cantarero, and L. Romero, 1997. Leaf macronutrient content and yield in grafted melon plants. A model to evaluate the influence of rootstock genotype, Scientia Horticulturae, 71: 227-234.

Ruiz, J.M., A. Belakbir, and L. Romero, 1996. Foliar level of phosphorus and its bioindicators in *Cucumis melo* grafted plants: A possible effect of rootstocks. Journal of Plant Physiology, 149: 400-404

Sakata, Y., O. Takayoshi, and S. Mitsuhiro, 2007. The history and present state of the grafting of cucurbitaceous vegetables in Japan. Acta Horticulturae, 731: 159– 170.

Salam, M. A., A. S. M. H. Masum, S. S. Chowdhury, M. Dhar, M. A. Saddeque, and M. R. Islam, 2002. Growth and yield of watermelon as influenced by grafting. Online Journal of Biological Sciences, 2 (5): 298-299.

Santa-Cruz, A., M. M. Martinez-Rodriguez, F. Perez-Alfocea, R. Romero-Aranda, and M. C. Bolarin, 2002. The rootstock effect on the tomato salinity response depends on the shoot genotype. Plant Science, 162: 825–831.

Saqib, M., J. Akhtar and R.H. Qureshi, 2005. Na^+ exclusion and salt resistance of wheat (*Triticum aestivum*) in saline-waterlogged conditions are improved by the development of adventitious nodal roots and cortical root aerenchyma. Plant Science, 169:125-130.

Schwarz, D., U. Beuch, M. Bandte, A. Fakhro, C. Buttner, and C. Obermeier, 2010. Spread and interaction of Pepino mosaic virus (PepMV) and *Pythium aphanidermatum* in a closed nutrient solution recirculation system: effects on tomato growth and yield. Plant Pathology, 59: 443–452.

Shani, U. and L.M. Dudley, 2001. Field studies of crop response to water and salt stress. Soil Science Society of America Journal, 65: 1522–1528.

Shannon, M.C. and L.E. Francois, 1978. Salt tolerance of three muskmelon cultivars. Journal of the American Society for Horticultural Science, 103:127–130.

Tal, M. Katz, A. H. Heiken, and K. Dehan, 1979. Salt tolerance in the wild relatives of the cultivated tomato: proline accumulation in *Lycopersicon esculentum* Mill., *L. peruvianum* Mill, and *Solanum pennellii* Cor. treated with NaCl and polyethylene glycol. New Phytologist, 82: 349–360.

Trajkova, F., N. Papadantonakis, and D. Savvas, 2006. Comparative effects of NaCl and $CaCl_2$ salinity on cucumber grown in a closed hydroponic system. HortScience, 41:437–441.

Trionfetti-Nisini, P., G. Colla, , E. Granati, , O. Temperini, P. Crinò, and F. Saccardo, 2002. Rootstock resistance to fusarium wilt and effect on fruit yield and quality of two muskmelon cultivars. Scientia Horticulturae, 93: 281–288.

Wyn Jones, R.G., 1981. Salt tolerance, in: C.B. Johnson (Ed.), Physiological Processes Limiting Plant Productivity, Butterworths, London, pp. 271–292.

Wyn Jones, R.G. and R. Storey, 1978. Salt stress and comparative physiology in the Gramineae: IV. Comparison of salt stress in Spartina X townsendii and three barley cultivars, Australian Journal of Plant Physiology, 5: 839–850.

Xu, C. Q., T. L. Li, and H. Y. Qi, 2005. Effects of grafting on the photosynthetic characteristics, growth situation, and yield of netted muskmelon, China Watermelon and Melon, 2: 1–3.

Xu, S.L., Q.Y. Chen, X.Q. Chen, and S.H. Li, 2006. Relationship between grafted muskmelon growth and polyamine and polyamine oxidase activities under salt stress. Journal of Fruit Science, 23: 260–265.

Yang, L.F., Y.L. Zhu, C.M. Hu, Z.L. Liu, and G.W. Zhang, 2006. Effects of NaCl stress on the contents of the substances regulating membrane lipid oxidation and osmosis and photosynthetic characteristics of grafted cucumber. Acta Botany Boreal-Occident Sinica, 26: 1195–1200.

Yetisir, H., S. Kurt, N. Sari, and F. M. Tok, 2007. Rootstock potential of Turkish Lagenaria siceraria germplasm for watermelon: Plant growth, graft compatibility and resistance to fusarium. Turkish Journal of Agriculture and Forestry, 31: 381–388.

Yetisir, H., Sari, N. and S.Yücel, 2003. Rootstock resistance to fusarium wilt and effect on watermelon fruit yield and quality. Phytoparasitica, 31 (2): 163–169.

Zhong, Y.Q. and Z.L. Bie, 2007. Effects of grafting on the growth and quality of cucumber fruits. Acta Horticulturae, 761: 341–347.

Zhu, J., Bie, Z.L., Huang, Y. and X.X. Han, 2008. Effect of grafting on the growth and ion concentrations of cucumber seedlings under NaCl stress. Soil Science and Plant Nutrition 6: 895–902.

Zhu, J.K., 2001. Plant salt tolerance. Trends in Plant Science. 6: 66-71.

Zijlstra, S., Groot, S. P. C. and J. Jansen, , 1994. Genotypic variation of rootstocks for growth and production in cucumber: possibilities for improving the root system by plant breeding. Scientia Horticulturae, 56: 185-196.