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Studies on Alleviating Salinity Stress Disorders of two Grape cultivars Transplants

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ABSTRACT

This study was carried out at the Fac. of Agric., Benha Univ. during 2014 and 2015 seasons in an endeavor to alleviate the adverse impact of irrigation with high saline water solution on growth and some leaf physiological properties of Crimson seedless and Superior salt stressed grape transplants through anti-salt stress substances manipulation (BA at 25 mg/L, potassium sulphate at 300 mg/L, potassium silicate at 5 ml/L and magnetic iron at 5 g/transplant). The collected data proved that there was a significant increment including all investigated growth parameters (plant height; stem diameter; number of lateral shoots; total number of leaves/transplant, fresh and dry weight of the different plant organs, leaf and total assimilation area, total plant dry weight and top/root ratio). Hard leaf character (H.L.C.), was significantly decreased, however, the reverse was detected in both leaf water potential (L.W.P.) and leaf relative turgidity (L.R.T.) as compared with control. The maximum improvement of both investigated parameters was achieved when the transplants were sprayed with potassium silicate at 0.5% along with magnetic iron at 5 g/transplant both soil application applied twice monthly during both seasons of study.

Key words: Grape rooted cuttings, Crimson seedless, Superior grape, Vegetative growth, Leaf physiological properties, Potassium silicate, Salt stress, salinity and magnetic iron.

Introduction

Grapes is considering one of the most important fruit crops all over the world. World cultivated area about 7.5 million ha. produced about 67 m. tones (FAO, 2015). According to the (FAO) 75.866 square kilometers of the world land are dedicated to grapes. Approximately 71% of world grape production is used for wine 27% as fresh fruit and 2% as dried fruits. The area dedicated to vineyard is raising by about 2%/year.

Moreover, it is considered to be the second most important fruit crop after citrus in Egypt as its acreage, production and exportation. The harvest area estimated by 150000 feddans produced 1.07 million tons according to Ministry of Agriculture and Land Reclamation (2002).

Salinity is a major abiotic stress factor reducing growth and yield of wide varieties of crops all over the world (Tester and Davvenport, 2003). The reduction in growth may be related to adverse effects of excess salts on ion homeostasis, water balance, mineral nutrition and photosynthetic carbon metabolism (Munns, 2002).

Salinity can be minimized with reclamation, water and drainage, but the cost of engineering and management is very high. Increasing costs for water and energy emphasis the need for an alternative strategy (Shannon, 1984).

As alternative strategy for overcoming the negative effects of salinity on plant growth and yield could be attempt to treat the plants with some recovering compounds as silicon and magnetic iron, where irrigation water is known to be or may become saline.

The function of Si as a protective agent is probably one of the most important for plants. Si can reduce salinity stress and reduce transpiration in plant (Epstein, 1994).Metal toxicity, salinity, drought and temperature stresses can be alleviated by Si application (Liang *et al.*, 2007).

Drought tolerance brought about by the application of “Si” may result from decreased transpiration (Epstein, 1999) and the presence of silicified structure in plants suggested a reduction of leaf heat-load providing an effective cooling mechanism and then improving the plant tolerance to high temperatures (Wang *et al.*, 2005). The resistance to salt stress has been found to be due to the enhancement of enzymes such as superoxide dismutase (SOD) and catalase, preventing membrane oxidative damage (Moussa, 2006).

Magnetic iron is a revolution in the world of raw agriculture, as it crude and has natural prosperities and it contact with water resulted an electromagnetic field to help the passage of useful elements to the

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plants. As a results of chemical fertilizers misuses, the mature of the agriculture land is changed and exhausted and turned to be salted. Therefore, the alternative is to use natural element as magnetic iron.

The main target of the present investigation is to evaluate the impact of BA, K_2SO_4, potassium silicate, and magnetic iron on reducing the salinity adverse in relation to growth and some leaf physiological properties of Crimson and Superior grape transplants irrigated with 9000 ppm saline solution with 12 SAR.

Materials and Methods

The present investigation was carried out during two successive 2014 and 2015 experimental seasons in the Pomology nursery, Horticulture Department belonging to Experimental Station, Faculty of Agriculture, Benha University at Moshtohor region, Kalubia Governorate, Egypt. One-year-old grape rooted cuttings (*Vitis vinifera*) of two cultivars namely: Crimson seedless and Superior were carefully chosen as being healthy and uniform as possible in their vigour to be used as plant materials in this concern.

Response of saline stressed grape transplants to some recovering materials:

This experiment was outlined and designed as an attempt to decrease the depressive effect resulted by using the relative higher concentrated saline solution for irrigation transplants of Crimson and Superior grape cvs. under study in this experiment.

There upon, the investigated recovering chemicals included:

1- Benzyl adenine (BA) spray at 25 mg/L.
2- Potassium sulphate spray at 300 mg/L.
3- Potassium silicate at 5 ml/L either foliar or soil (drench) application.
4- Magnetic iron at 5.0 g/transplant applied solely or combined with potassium silicate foliar applied at 5 ml/L.

Consequently, the salinity stressed transplants of both grape cultivars, which irrigated with higher saline concentration (9000 ppm) and SAR (12) that prepared after Sharaf *et al.* (1985) as shown in Table (1) were subjected to the following recovering treatments:

1- Irrigation with 9000 ppm saline solution of SAR 12 plus tap water spray twice weekly as control.
2- Irrigation with 9000 ppm saline solution of SAR 12 plus BA spray at 25 mg/L twice monthly.
3- Irrigation with 9000 ppm saline solution of SAR 12 plus potassium sulphate spray at 300 mg/L twice monthly.
4- Irrigation with 9000 ppm saline solution of SAR 12 plus potassium silicate spray at 5 ml/L twice monthly.
5- Irrigation with 9000 ppm saline solution of SAR 12 plus potassium silicate as soil drench at 5 ml/L plus water spray each applied twice monthly.
6- Irrigation with 9000 ppm saline solution of SAR 12 plus magnetic iron as soil added at 5 g/transplant plus water spray each applied twice monthly.
7- Irrigation with 9000 ppm saline solution of SAR 12 plus potassium silicate foliar spray at 5 ml/L + magnetic iron soil added at 5 g/transplant each applied twice weekly.

Table 1: Preparation of used saline solutions (9000 ppm and SAR 12).

Salt added per liter*													
$CaCl_2$		$MgSO_4$		KCl		K_2SO_4		Na_2SO_4		NaCl		SAR**	$Cl:SO_4$ meq./L
gm	meq.	gm	meq.	gm	meq.	gm	meq.	gm	meq.	gm	meq.		
2.05	36.94	2.00	33.33	-	-	0.40	4.60	2.20	30.99	2.35	40.17	12	1.1

* *Salts added in grams were estimated as anydrous form*

$$** \; SAR = Meq \; \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

Experiment layout:

Accordingly, two simple experiments were conducted (an experiment devoted for each grape cultivar), whereas the complete randomized block design was used for arranging the differential investigated recovering treatments. Herein, each treatment was replicated five times and every replicate was represented by two grape transplants. So, 70 salt stressed transplants of each grape cultivar subjected to irrigation with saline solution (9000 ppm) of the SAR (12) were needed for investigating the aforesaid recovering treatments. Seventy, salt stressed transplants of each cultivar were classified according to their vigour into five categories each included 14 transplants plus two additional ones, so a reserve would be available in this regard. Seven investigated recovering treatments were arranged within transplants of each category at the rate of 2 transplants per every recovering treatment. The salt stressed transplants (irrigated with 9000 ppm saline solution of SAR 12 were subjected to the corresponding recovering treatment from April 15th till September 15th 2014 and 2015 years during 1st and 2nd seasons, respectively.

Methodology as has been followed in this investigation is determined as follows:

After the experiments had been terminated on mid-September of 2014 and 2015 years during two seasons, the response to the differential investigated (saline solutions & recovering treatments) was evaluated through determining the changes in the following measurements.

Vegetative growth measurements:

As the experiment was terminated during each season 14 growth measurements (plant height, stem thickness, No. of both lateral shoots and leaves/plant, average leaf area, total assimilation area/plant, fresh and dry weights of three plant organs (leaves, shoots and roots), total plant dry weight and top/root ratio in response to recovering treatments were evaluated.

Leaf physiological properties:

The following three leaf physiological characteristics of both grape cvs. transplants under study in response to the differential investigated treatments (saline solutions and recovering treatments) were determined.

Hard leaf character (H.L.C.):

It was determined according to the following equation:

$$[\ \text{H.L.C.} = \frac{\text{Dry weight of leaf (g)}}{\text{Leaf area (dec}^{2}\text{)}} = \text{dry matter/doc}^{2}\text{(g)}]$$

$$\text{Whereas, dry weight of leaf (in g)} = \frac{\text{Dry weight of the leaves at the end of experiment}}{\text{No. of leaves at the end of experment}}$$

The method was suggested by Youssef (1990), Hassan (1998) and Laz (1999).

Leaf water potential (L.W.P.):

$$\text{L.W.P.} = \frac{\text{Leaf fresh weight-Leaf dry weight}}{\text{Leaf fresh weight}} \times 100$$

The method followed and the equation used for calculations L.W.P. have been suggested by Halma (1934) and confirmed by Wilson *et al.* (1953) and Peynado and Young (1968).

Leaf relative turgidity (R.R.T.):

Discs of about 1.0 cm in diameter were removed from each leaf sample to determine their fresh weight immediately then placed in closed containers (Petri dishes) until they become constant in weight (after 24 hours) at room temperature 20°C ±2 in shade. The discs were surface dried with plotting paper and weighed for their turgid weight. Dry weight of each 10.0 discs was determined after 24 hours. Leaf relative turgidity was estimated according to the following equation after Halma (1934) and followed by Elmistron and Hillyer (1937); Mohamed (1993), Nomir (1994) and Osman (2005).

$$\text{L.R.T.} = \frac{\text{Fresh weight- Dry weight}}{\text{Turgid weight- dry weight}} \times 100$$

Statistical analysis

All data obtained during both seasons of the present investigation were subjected to analysis of variance and significant difference among means were determined according to Senedecor and Cochran (1972). In addition, significant difference among means were distinguished according to the Duncan`s multiple range Duncan (1955). Whereas capital letters were used for differentiating between values of the effect of investigated recovering treatments.

Results and Discussion

1. Vegetative growth:

Effect of some anti-salt stress compounds on recovering from salt stress symptom of Crimson and Superior grape transplants.

1.1. Plant height (cm):

Concerning the effect of using some anti-salt stress substances that suggested as harmful symptoms correcting tools which emerged under irrigation with high saline water (9000 ppm) combined with 12 SAR for Crimson and Superior grape cvs.

Data presented in Table (2), reveal that the transplants of the two grape cvs. which were sprayed with potassium silicate at the rate of 5 ml/L coupled with the addition of: magnetic iron salt added at the rate of 5 g/transplant each applied twice monthly (T_7) were the tallest one as compared with the other treated transplants. Furthermore, the addition of magnetic iron at the rate of 5 g/transplant twice monthly as soil amendenent (T_6) came in the second rank.

On the other hand, the untreated transplants (control), recorded the least value of the investigated parameter.

This result is in agreement with that reported by Abdel-Rahman *et al.* (2009) on Navel orange trees; Abdel-Aal and Oraby (2013) on mango transplants and Ali *et al.* (2013) who reported that magnetic iron (100 and 150 kg/Feddan) were very effective in stimulating shoot length and leaf area of Thompson seedless grape vines.

Table 2: Some vegetative growth measurements (plant height and stem diameter) of saline stressed Crimson seedless and Superior grape transplants as influenced by some recovering substances applied during 2014 & 2015 experimental seasons.

Recovering treatments	Crimson seedless cv.		Superior cv.	
	Plant height (cm.)	Stem diameter (cm)	Plant height (cm.)	Stem diameter (cm)
2014 season				
T1 Control (water spray)	32.67G	0.60F	41.34G	0.70F
T2 BA (spray)	49.44F	0.70F	54.90F	0.90EF
T3 K_2SO_4 (Spray)	57.72E	0.90E	83.91D	1.10DE
T4 K Silicate (Spray)	92.22C	1.40C	109.40C	1.50C
T5K Silicate (Soil)	68.67D	1.10D	67.64E	1.20D
T6 Magnetic iron (Soil)	112.10B	1.80B	128.70B	1.83B
T7 K Silicate + magnetic (T4 & T6)	131.00A	2.30A	154.00A	2.30A
2015 season				
T1 Control (water spray)	28.49G	0.55F	36.00G	0.54F
T2 BA (spray)	42.54F	0.68E	48.00F	0.78E
T3 K_2SO_4 (Spray)	60.70E	0.84D	65.00E	0.95DE
T4 K Silicate (Spray)	74.81C	1.23C	93.00C	1.20C
T5K Silicate (Soil)	67.65D	1.13C	85.00D	1.10CD
T6 Magnetic iron (Soil)	90.72B	1.66B	106.00B	1.40B
T7 K Silicate + magnetic (T4 & T6)	109.10A	1.94A	128.00A	1.70A

Means within each column followed by the same capital letter/s didn't significantly differ at 5 % level.

1.2. Stem diameter:

Table (2) reflect that the transplants which received potassium silicate at the rate of 5 ml/L twice monthly as foliar spray combined with magnetic iron at the rate of 5 g/transplant twice monthly as soil application (T7), reflected the highest value of stem diameter during both seasons of study. Meanwhile, magnetic iron at the rate of 5 g/transplant twice monthly as soil application (T6) occupied the second rank in this respect.

On the other hand, BA spray at the rate of 25 mg/L twice monthly gave the least value of stem diameter as compared with the other investigated treatments.

This result is standing with those reported by Eman *et al.* (2010) on Le-Conte pear trees and Aly *et al.* (2015) who mentioned that magnetic iron enhanced shoot length and shoot thickness of Valencia orange trees. Also, potassium silicate stimulated stem diameter, in this respect Abdel-Aal and Oraby (2013) on mango and Marwad *et al.* (2015) who mentioned that a mixture containing potassium silicate was able to enhance height and pseudostem diameter of Grand Naine Banana Transplants.

1.3. No. of lateral shoots/transplant:

Table (3) refers that the response of No. of lateral shoots/transplant for two grape cvs. (Crimson and Superior) to the different studied treatments was an image of each other during both seasons of study, i.e. the highest values of the investigated parameter were obtained when the transplants of both grape cvs. were sprayed with potassium silicate at the rate of 5 ml/L twicemonthly combined with magnetic iron at the rate of 5 g/transplant twice monthly as soil application (T_7), descendly followed by adding magnetic iron at the rate of 5 g/transplant twice monthly as soil application (T_6); spraying with potassium silicate at the rate of 5 ml/L twicemonthly (T_4) and soil addition of potassium silicate at the rate of 5 ml/L twice monthly (T_5) during both seasons of study.

This result is in harmony with that mentioned by El-Zaawely *et al.* (2013) who noticed that magnetic field treatments increased number of branches per plant, number of leaves and leaf area of sweet pepper.

1.4. No. of leaves/transplant:

Table (3) indicatesthat the behavior of the two investigated grape cvs. as related to the total No. of leaves/transplant was identical in both grape cvs., whereas the highest values of the investigated parameter in both grape cvs. were associated with the combination between spraying with potassium silicate at the rate of 5 ml/L plus adding magnetic iron as soil amendment at the rate of 5 g/transplant as each was appliedtwice monthly (T7). The least value was detected with BA spray transplants at the rate of 25 mg/L twice monthly.

Similar results were also found by Eman *et al.* (2010) on Le-Conte pear trees; Ismail *et al.* (2010) on Navel orange trees and Aly *et al.* (2015) who indicated that magnetic iron enhanced average leaves number/shoot and leaf area of Valencia orange trees.

Table 3: Some vegetative growth measurements (No. of laterals shoot & leaves/transplant) of saline stressed Crimson seedless and Superior grape transplants as influenced by some recovering substances applied during 2014 & 2015 experimental seasons.

Recovering treatments	Crimson seedless cv.		Superior cv.	
	No. of laterals shoot/ transplant	No of leaves/ transplant	No. of laterals shoot/ transplant	No of leaves/ transplant
	2014 season			
T1 Control (water spray)	1.00F	6.50G	1.00G	7.00G
T2 BA (spray)	1.00F	9.75F	2.00F	12.00F
T3 K_2SO_4 (Spray)	2.00E	13.00E	3.00E	16.00E
T4 K Silicate (Spray)	4.00C	18.25C	6.00C	23.00C
T5K Silicate (Soil)	3.00D	16.00D	5.00D	20.00D
T6 Magnetic iron (Soil)	5.00B	27.25B	7.00B	30.50B
T7 K Silicate + magnetic (T4 & T6)	6.00A	33.75A	8.00A	35.25A
2015 season				
T1 Control (water spray)	1.00F	5.00G	1.00G	5.25G
T2 BA (spray)	1.00F	8.00F	2.00F	10.25F
T3 K_2SO_4 (Spray)	2.00E	12.00E	3.00E	15.00E
T4 K Silicate (Spray)	4.00C	16.00C	5.00C	21.00C
T5K Silicate (Soil)	3.00D	14.00D	4.00D	18.00D
T6 Magnetic iron (Soil)	5.00B	19.75B	6.00B	29.00B
T7 K Silicate + magnetic (T4 & T6)	6.00A	26.00A	7.00A	34.00A

Means within each column followed by the same capital letter/s didn't significantly differ at 5 % level.

1.5. Average leaf area (cm^{2-}) and total assimilation area (cm^2):

Table (4) reveals that the reaction between average leaf area (cm^2) of Crimson grape transplants and the anti-salt stress investigated substances was paralleled to that recorded with total assimilation area (cm^2), i.e. the two investigated parameters have the same trend. Subsequently, the transplants which sprayed with potassium silicate at the rate of 5 ml/L combined with magnetic iron at the rate of 5 g/transplant each applied twice monthly (T_7) exhausted and reflected the highest values of both average leaf area and total assimilation area, followed by adding magnetic iron as soil application at the rate of 5 g/transplant twice monthly (T_6), Spray potassium silicate at the rate of 5 ml/L fortnightly (T_4) and potassium silicate as soil amendment at the rate of 5 ml/L fortnightly (T_5) in descending order during 2014 and 2015 seasons.

On the other way around, the untreated transplants (control) reflected the lowest values of both investigated parameters.

The same finding was obtained by Ali *et al.* (2013) on Thompson seedless grape; Gad El-Kareem *et al.* (2014) on Zaghloul date palm; Ibrahim and Al-Wasfy (2014) on Valencia orange trees; Mohamed *et al.* (2015) on Succary mango trees and Akl*et al.* (2015) whoindicated that single and combined application of potassium silicate at 0.05 to 0.2% improved average shoot length, total No. of leaves/shoot and leaf area cm^2 of Manfaluty pomegranate trees.

Table 4: Some vegetative growth measurements (average leaf area and total assimilation area) of saline stressed Crimson seedless and Superior grape transplants as influenced by some recovering substances applied during 2014 & 2015 experimental seasons.

Recovering treatments	Crimson seedless cv.		Superior cv.	
	Average leaf area (cm^2)	Total assimilation area (cm^2)	Average leaf area (cm^2)	Total assimilation area (cm^2)
	2014 season			
T1 Control (water spray)	17.24G	112.0G	21.55G	161.0G
T2 BA (spray)	19.81F	193.0F	24.76F	297.0F
T3 K_2SO_4 (Spray)	23.57E	307.0E	29.44E	471.0E
T4 K Silicate (Spray)	31.44C	576.0C	39.46C	932.0C
T5K Silicate (Soil)	30.04D	481.0D	37.55D	751.0D
T6 Magnetic iron (Soil)	37.39B	1018.0B	46.74B	1402.0B
T7 K Silicate + magnetic (T4 & T6)	41.33A	1468.0A	51.68A	1808.0A
	2015 season			
T1 Control (water spray)	15.34G	77.0G	20.33G	107.0G
T2 BA (spray)	17.13F	141.0F	23.65F	243.0F
T3 K_2SO_4 (Spray)	21.21E	255.0E	28.47E	427.0E
T4 K Silicate (Spray)	28.34C	454.0C	38.64C	811.0C
T5K Silicate (Soil)	25.57D	359.0D	34.78D	626.0D
T6 Magnetic iron (Soil)	35.46B	700.0B	48.22B	1329.0B
T7 K Silicate + magnetic (T4 & T6)	39.32A	1023.0A	50.63A	1721.0A

Means within each column followed by the same capital letter/s didn't significantly differ at 5 % level.

1.6. Root fresh and dry weights (g):

Table (5) reveals that Crimson and Superior grape transplants which were sprayed with potassium silicate at 5 ml/L fortnightly combined with the addition of magnetic iron at 5 g/transplant twice monthly as soil amendment (T_7) reflected the highest values of root fresh and dry weights as compared with the other investigated recovering substances.

Soil addition of magnetic iron at the rate of 5 g/transplant twice monthly (T_6) came in the second rank in this respect followed by spraying with potassium silicate at the rate of 5 ml/L twice monthly (T_4) which arranged as the third order. The control (untreated transplants) was the inferior one in this respect during both seasons of study.

Similar result was found by Matichenkov *et al.* (1999) on grapefruit seedlings and Matichenkov *et al.* (2001) who indicate that Si nutrition was responsible for a significant increase in dry and green mass of Valencia and grape fruit root transplants.

Meanwhile, Esitkea (2003) indicated that magnetic field application increased fresh and dry root weights of strawberry as compared with control. Also, in this respect, Abdel-Aal and Oraby (2013) declared that treated mango transplants with silicon at 150 mg/kg soil increased fresh and dry weights of shoots and roots.

Table 5: Some vegetative growth measurements (root fresh and dry weights) of saline stressed Crimson seedless and Superior grape transplants as influenced by some recovering substances applied during 2014 & 2015 experimental seasons.

Recovering treatments	Crimson seedless cv.		Superior cv.	
	Root fresh weight (g)	Root dry weight (g)	Root fresh weight (g)	Root dry weight (g)
	2014 season			
T1 Control (water spray)	10.19G	2.36G	12.52G	2.73G
T2 BA (spray)	11.65F	3.43F	14.26F	4.40F
T3 K_2SO_4 (Spray)	13.18E	5.25E	17.65E	7.28E
T4 K Silicate (Spray)	20.24C	9.83C	35.51C	11.12C
T5K Silicate (Soil)	18.18D	7.91D	33.50D	8.45D
T6 Magnetic iron (Soil)	27.66B	13.15B	56.24B	21.36B
T7 K Silicate + magnetic (T4 & T6)	35.83A	15.26A	63.40A	28.43A
	2015 season			
T1 Control (water spray)	9.34G	2.14G	11.71G	2.15G
T2 BA (spray)	11.57F	3.53F	13.54F	3.43F
T3 K_2SO_4 (Spray)	14.68E	4.92E	18.10E	5.56E
T4 K Silicate (Spray)	18.70C	7.93C	32.35C	10.43C
T5K Silicate (Soil)	16.42D	6.83D	31.26D	9.52D
T6 Magnetic iron (Soil)	23.25B	9.18B	49.61B	18.62B
T7 K Silicate + magnetic (T4 & T6)	31.63A	12.66A	58.35A	21.60A

Means within each column followed by the same capital letter/s didn't significantly differ at 5 % level.

1.7. Leaves fresh and dry weights (g):

Table (6) clears that the behavior of both leaves fresh and dry weight of the two grape cvs. Crimson and Superior cvs. was an image of each other, as both achieved the highest values when the transplants were sprayed with potassium silicate at the rate of 5 ml/L fortnightly coupled with the addition of magnetic iron at the rate of 5 g/transplant twice monthly as soil application (T_7) followed by magnetic iron addition at the rate of 5 g/transplant twice monthly alone (T_6).

Table 6: Some vegetative growth measurements (leaves fresh and dry weights) of saline stressed Crimson seedless and Superior grape transplants as influenced by some recovering substances applied during 2014 & 2015 experimental seasons.

Recovering treatments	Crimson seedless cv.		Superior cv.	
	Leaves fresh weight (g.)	Leaves dry weight (g.)	Leaves fresh weight (g.)	Leaves dry weight (g.)
	2014 season			
T1 Control (water spray)	1.62G	0.42G	1.55G	0.38G
T2 BA (spray)	2.82F	0.71F	2.51F	0.59F
T3 K_2SO_4 (Spray)	4.51E	1.07E	3.70E	0.84E
T4 K Silicate (Spray)	7.79C	1.68C	5.83C	1.20C
T5K Silicate (Soil)	6.67D	1.50D	5.35D	0.98D
T6 Magnetic iron (Soil)	14.99B	2.72B	10.35B	1.70B
T7 K Silicate + magnetic (T4 & T6)	22.09A	3.57A	14.22A	2.10A
	2015 season			
T1 Control (water spray)	1.25G	0.39G	1.33G	0.37G
T2 BA (spray)	2.73F	0.67F	2.45F	0.57F
T3 K_2SO_4 (Spray)	3.96E	0.86E	3.64E	0.76E
T4 K Silicate (Spray)	6.82C	1.20C	5.93C	1.18C
T5K Silicate (Soil)	4.94D	0.96D	4.66D	0.95D
T6 Magnetic iron (Soil)	10.73B	1.68B	9.63B	1.73B
T7 K Silicate + magnetic (T4 & T6)	17.33A	2.32A	13.54A	2.15A

Means within each column followed by the same capital letter/s didn't significantly differ at 5 % level.

On the other hand, BA spray at the rate of 25 mg/L twice monthly reflects the least improvement value of both leaves fresh and dry weights as compared with the other treatments (except the control) meanwhile, the untreated transplants (control) was the inferior one in this respect, during both seasons of study.

This finding is in harmony with those obtained by Ismail *et al.* (2010) who reported that magnetic metal compound fertilizer significantly increased total number of leaves and its dry matter % of Superior grape. Meanwhile, Al-Wasfy (2013) mentioned that spraying potassium silicate at 0.05-0.2% was very effective in enhancing leaves fresh and dry weights of Sakkoti date palm as well as Abdel-Aal and Oraby (2013) declared that mango transplants treated with silicon reflected high increment in leaves fresh and dry weights.

1.8. Shoots fresh and dry weights (g):

Data presented in Table (7) indicate that the highest obtained values of shoots fresh and dry weight were achieved when the transplants were sprayed with potassium silicate at the rate of 5 ml/L twice monthly combined with soil applied of magnetic iron at the rate of 5 g/transplant twice monthly (T_7), followed by solely magnetic iron addition at the rate of 5 g/transplant twice monthly (T_6), foliar spray with potassium silicate at the rate of 5 ml/L once weekly (T_4), soil application of potassium silicate at the rate of 5 ml/L once weekly (T_5) and foliar spraying with potassium sulphate at the rate of 300 mg/L twice monthly, in descending order.

Meanwhile, the least value of both fresh and dry weight were recorded with untreated transplants (control).

Table 7: Some vegetative growth measurements (shoots fresh and dry weights) of saline stressed Crimson seedless and Superior grape transplants as influenced by some recovering substances applied during 2014 & 2015 experimental seasons.

Recovering treatments	Crimson seedless cv.		Superior cv.	
	Shoots fresh weight (g)	Shoots dry weight (g)	Shoots fresh weight (g)	Shoots dry weight (g)
	2014 season			
T1 Control (water spray)	4.36G	2.16G	5.65G	2.70G
T2 BA (spray)	6.16F	3.72F	8.24F	5.86F
T3 K_2SO_4 (Spray)	9.28E	5.15E	13.13E	7.33E
T4 K Silicate (Spray)	15.46C	10.45C	17.22C	13.19C
T5K Silicate (Soil)	13.89D	7.28D	15.41D	10.55D
T6 Magnetic iron (Soil)	17.74B	12.18B	20.24B	18.50B
T7 K Silicate + magnetic (T4 & T6)	23.65A	14.65A	28.98A	22.41A
	2015 season			
T1 Control (water spray)	3.63G	2.11G	4.59G	2.15G
T2 BA (spray)	5.83F	3.77F	6.13F	3.30F
T3 K_2SO_4 (Spray)	8.21E	6.37E	11.28E	5.46E
T4 K Silicate (Spray)	13.65C	9.44C	15.46C	8.26C
T5K Silicate (Soil)	11.44D	8.56D	14.53D	7.42D
T6 Magnetic iron (Soil)	14.55B	10.43B	19.63B	10.70B
T7 K Silicate + magnetic (T4 & T6)	21.62A	13.67A	28.51A	12.41A

Means within each column followed by the same capital letter/s didn't significantly differ at 5 % level.

1.9. Total plant dry weight (g):

Table (8) indicates that the highest value of total plant dry weight of both cvs. was achieved when the transplants were sprayed with potassium silicate at 5 ml/L twice monthly combined with soil addition of magnetic iron at the rate of 5 g/transplant twice monthly (T_7), followed by application of magnetic iron alone as soil amendment at the rate of 5 g/transplant twice monthly (T_6).

On the other hand, the transplants of both grape cvs. which sprayed with tap water only and never received any of recovering substances (control) had the minimum value of total plant dry weight during the 1st and the 2nd seasons.

1.10. Top/root ratio:

Table (8) shows that spraying with potassium sulphate at the rate of 300 mg/L twice monthly was the Superior one in this respect (T_3). Foliar spray of potassium silicate at the rate of 5 ml/L twice monthly (T_4) came in the second rank for Crimsom cv. in the first season, while the addition of potassium silicate as soil amendment at the rate of 5 ml/L fortnightly standing the second one in the 2nd season for Crimson cv. as well as it considered the promised one for Superior cv. during both seasons of study.

This result goes in line with those reported by Ismail *et al.* (2010) who declared that the lower rates of magnetite significantly increased totalplant dry matter % of Superior grape. Meanwhile, Abdel-Aal and Oraby (2013) reported that mango sprayed transplants with silicon enhanced total transplants dry weight and top/root ratio compared to untreated transplants. In this respect, Abobatta (2015) reported that dry weight (leaves and stem) of Valencia orange trees was improved as an impact of magnetic iron.

Table 8: Some vegetative growth measurements (total plant dry weights & top/root ratio) of saline stressed Crimson seedless and Superior grape transplants as influenced by some recovering substances applied during 2014 & 2015 experimental seasons.

Recovering treatments	Crimson seedless cv.		Superior cv.	
	Total plant dry weight (g)	Top/root ratio	Total plant dry weight (g)	Top/root ratio
	2014 season			
T1 Control (water spray)	4.94G	1.092F	5.81G	1.133D
T2 BA (spray)	7.86F	1.290A	10.84F	1.465A
T3 K_2SO_4 (Spray)	11.47E	1.185C	15.44E	1.125D
T4 K Silicate (Spray)	21.97C	1.235B	25.51C	1.297C
T5K Silicate (Soil)	16.68D	1.112E	19.97D	1.365B
T6 Magnetic iron (Soil)	28.05B	1.120D	41.56B	0.945E
T7 K Silicate + magnetic (T4 & T6)	33.48A	1.192C	52.94A	0.863F
	2015 season			
T1 Control (water spray)	4.63G	1.165F	4.66G	1.175A
T2 BA (spray)	7.96F	1.263E	7.29F	1.180A
T3 K_2SO_4 (Spray)	12.14E	1.470A	11.78E	1.163A
T4 K Silicate (Spray)	18.57C	1.340C	19.87C	0.913B
T5K Silicate (Soil)	16.34D	1.395B	17.88D	0.880B
T6 Magnetic iron (Soil)	21.29B	1.320D	31.05B	0.668C
T7 K Silicate + magnetic (T4 & T6)	28.65A	1.263E	36.15A	0.675C

Means within each column followed by the same capital letter/s didn't significantly differ at 5 % level.

2.2. Leaf physiological characters:

2.1. Hard leaf character (H.L.C.):

Data presented in Table (9) revealed that the highest reduction in hard leaf character in both investigated grape cvs. was recorded when the transplants of both cvs. were potassium silicate sprayed at the rate of 5 ml/L plus magnetic iron soil addition at the rate of 5 g/transplant each applied twice monthly (T_7). Also, potassium silicate either added as foliar spray (T_4) or as soil application (T_5) at the same rate 5 ml/L twice monthly as well as magnetic iron at 5 g/transplant twice monthly (T_6) shared (T_7) in this respect i.e. both grape transplants were highly responded to the such treatments and recorded the minimum value of H.L.C.The highest value of H.L.C. was recorded with the untreated transplants (control)

2.2. Leaf relative turgidity:

Table (9) displays that the trend of response was too firm to be identical with both grape cvs. and during the two studied seasons. The greatest value of leaf relative turgidity was in closed relationship to potassium silicate sprayed transplants at the rate of 5 ml/L connected with magnetic iron at the rate of 5 g/transplant each added twice monthly (T_7) followed by soil magnetic iron addition alone at the rate of 5 g/transplant twice monthly (T_6), sprayed potassium silicate at the rate of 5 ml/L twicemonthly (T_4) and soil addition of potassium silicate at the rate of 5 ml/L fortnightly (T_5) in descending order during both seasons of study (control).Meanwhile, the reverse was true with untreated salt stressed transplants, which reflect the lowest leaf relative turgidity value.

2.3. Leaf water potential:

Table (9) reveals that potassium silicate foliar spray at 5 ml/L fortnightly combined with magnetic iron at 5 g/transplant twice monthly as soil application (T_7) was the Superior one in this respect as it maximized the leaf water potential of Crimson transplants followed by magnetic iron alone as soil application at 5 g/transplant twice monthly (T_6); potassium silicate foliar spray at 5 ml/L twice monthly (T_4) and potassium silicate as soil amendment at 5 ml/L twice weekly (T_5) in descending order.

On the other way around, the minimum value of L.W.P. was detected with untreated salt stressed transplants (control), followed by BA foliar spray at 25 mg/L twice monthly (T_2) and potassium sulphate foliar spray at 300 mg/L twice monthly (T_3) in ascending order during both seasons of study.

Drought tolerance brought about by the application of "Si" may result from decreased transpiration (Epstein, 1999) and the presence of silicified structure in plants suggested a reduction of leaf heat load, providing plant tolerance to high temperatures (Wang *et al.,* 2005). The resistance to salt stress has been found to be due to the enhancement of catalase, preventing membrane oxidative damage (Moussa, 2006).

Table 9: Hard leaf character, leaf relative turgidity and leaf water potential of saline stressed Crimson seedless and Superior grape transplants as influenced by some recovering substances applied during 2014 & 2015 experimental seasons.

Recovering treatments	Crimson seedless cv.			Superior cv.		
	Hard leaf character	Leaf relative turgidity	Leaf water potential	Hard leaf character	Leaf relative turgidity	Leaf water potential
	2014 season					
T1 Control (water spray)	0.389A	3.88G	73.41G	0.242A	4.54G	74.71E
T2 BA (spray)	0.366A	6.76F	75.06F	0.197B	7.100F	76.72D
T3 K_2SO_4 (Spray)	0.343AB	7.57E	76.91D	0.177C	9.25E	77.19D
T4 K Silicate (Spray)	0.292CD	12.60C	78.42C	0.133D	13.49C	79.40C
T5K Silicate (Soil)	0.313BC	9.13D	77.42D	0.134D	11.57D	81.31B
T6 Magnetic iron (Soil)	0.267CD	15.18B	81.86B	0.121DE	16.38B	83.58A
T7 K Silicate + magnetic (T4 & T6)	0.244D	18.72A	83.84A	0.116E	19.23A	85.23A
	2015 season					
T1 Control (water spray)	0.510A	3.47G	69.19G	0.356A	3.26F	72.56F
T2 BA (spray)	0.478A	5.63F	75.48F	0.237B	5.70E	76.79E
T3 K_2SO_4 (Spray)	0.340B	6.37E	78.32E	0.179C	8.61D	78.34D
T4 K Silicate (Spray)	0.265C	10.64C	82.41C	0.145DE	11.82C	80.09C
T5K Silicate (Soil)	0.269C	8.35D	80.58D	0.152D	9.57D	79.62CD
T6 Magnetic iron (Soil)	0.240C	13.64B	84.33B	0.130E	13.67B	82.01B
T7 K Silicate + magnetic (T4 & T6)	0.227C	17.32A	86.61A	0.125E	17.43A	84.14A

Means within each column followed by the same capital letter/s didn't significantly differ at 5 % level.

Conclusion

It is recommended to treat Crimson and Superior salt stressed grape transplants with potassium silicate spray at 5 ml/L twice monthly along with magnetic iron at 5 g/transplant twice monthly to alleviate the adverse impacts of irrigation with high saline water solution.

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