Tolerance of Some Grapevine Cultivars to Salinity and Calcium Carbonate in the Soil

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Abstract: During 2013 and 2014 seasons transplants of four grapevine cvs Flame seedless, Ruby seedless, crimson seedless and Superior were subjected to salinity at 0.05 to 0.4% and calcium carbonate at 2.5 to 20% in the soil. The target was detecting the tolerance of these grapevine cvs to salinity and lime in the soil. Transplants of grapevine cv Flame seedless and Ruby seedless recorded the highest values of growth and root characters, leaf relative turgidity, leaf succulence grade, pigments, total carbohydrates, total soluble sugars and uptake of N, P and K and the lowest values of and uptake of Ca, Na and Cl. Increasing concentrations of salinity from 0.0 to.4% and calcium carbonate from 0.0 to 20% was followed by reducing all parameters except soluble sugars, and uptake of Ca, Na and Cl. Salinity had injurious effects on grapevine transplants than calcium carbonate. Based on the highest values of growth and roots as well as leaf relative turgidity and leaf succulence grade, Flame seedless grapevine cv was more tolerant to salinity and lime in the soil, since it tolerated salinity till 0.2% and lime till 10% followed by Ruby seedless that tolerated 0.1% salinity and 5% lime. Subjecting the transplants of all the investigated grapevine cvs to salinity at 0.4% and lime at 20% resulted in a great damage on the transplants.

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1. Introduction

Grape (*Vitis vinifera L*) is considered among the most popular fruits worldwide and in Egypt. Total cultivated area in the world reached. 85 Million hectares and total yearly production of more than 70 million ton fruits (according to **F.A.O., 2015**).

According to 2013 Ministry of Agriculture and Reclamation Statistics, the fruiting area and the production of grapevines in Egypt reached 164310 feddans and 1434666 ton fruits, respectively. Minia Governorate in future will be considered a top in grapevine plantations particularly in reclaimed sandy soils. In 2013 fruiting area and production reached 21045 feddan and 163886 ton fruits, respectively.

The extension in vineyards is mostly in the new reclaimed lands which have some problems, including soil salinity and higher calcium carbonate content.

Progressive salt accumulation causes a major problem in many cultivated regions of the Egypt as a result of high ground water table especially when accompanied with poor drainage. Using heavy soluble fertilizers is another cause for enhancing soil solution salinity. The majority of the new lands in Egypt were sandy and/ or calcareous soils.

The adverse effects of salinity either in soil or in water on growth were confirmed in different grapevine cultivars (**Eissa *et al.*, 2003 and Homai, 2003**). Grapevine is considered as moderate sensitive to salinity. However, grapevine response to salinity depends on several factors such as rootstook, scion, irrigation system, soil type and climate or combination between them. Moreover, changing some of these factors with the same irrigation water could produce entirely different results (**Ahmed, 2007**).

On average, the water on Earth contains 30 grams of salt per liter (**Sotripopoulos, 2007**) and saline soils are estimated to be about 900 million hectares. According to the statistics given 13% of our lands is arid, 61% is half-arid and about 14.1% of the total area of the country are saline soils and alkaline saline (**Heidari, 2002)**. The complex effects of salinity causes a reduction in growth which is due to osmotic effect or reduction in water absorption and specific effect of ion such as sodium and chlorine that particularly have toxic effects on fruit trees (**Jalili, 1998**). Salinity is one of the environmental dead stresses that has recessed the growth of agricultural products in many parts of the world (**Flowers, 2004 and Taiz and Zeiger, 2006**). Halophyte plants are able to survive a long time in saline soils and continue their growth with two mechanisms of preventing salt from entering the plant tissues and reducing the salt concentration through accumulating salt in the vacuole of the cells (**Munns, 2002**). Some Glycophyte plants, can also prevent entering salt into their tissues, but they cannot accumulate salt in their vacuoles as well as Halophyte plants. Most Glycophyte plants cannot even prevent the entrance of salt into their tissues and thus the salt concentration in older leaves rise to the extent that can cause death in these types of leaves (**Munns, 2002**). Increasing in salinity levels causes reduction in transpiration (**Shani and Ben- Gal, 2005**).

Previous studies showed that salinity in the soil and irrigation water especially at the higher concentrations caused major inferior effects on growth and nutritional status of the transplants in different grapevine cvs (**Walker *et al.*, 2000**; **Paranichianakis, *et al.*, 2000; Fisarakis *et al.*, 2001; Bourgouin *et al.*, 2001; Walker *et al.*, 2002; Urdanoz and Aragues, 2009; Mehanna *et al.*, 2010; Kok, 2012; Karimi and Yousef, Zadeh, 2013 and Mohammed-Khani *et al.*, 2013**).

The results of **Baveresco *et al.* (2000a) and (2000b); Baveresco and Zamboni, 2001; Saxton, 2002; Baveresco *et al.*, 2003 and Cinelli *et al.*, (2003)** confirmed the adverse effects of calcium carbonate in the soil on growth and vine nutritional status in various grapevine cvs.

The adverse effects of salinity on growth could be attributed to their effect on increasing soil osmotic pressure and reducing leaf turgidity, uptake of nutrients and water, plant pigments, total carbohydrates, respiration, transpiration, stomatal conductance, photosynthesis, activity of enzymes, CO_2 assimilation, cell division, plant metabolism (**Mass and Grattan, 1999; Stevens and Walker, 2002; and Bassoi *et al.*, 2003**).

Edmond *et al.*, (1975) and Miller *et al.*, (1990) found that the soil contained higher amounts of calcium carbonate is characterized by higher pH, lower soil fertility, organic matter, higher hard pans and the higher ability to fix most nutrients and makes them unavailable for plants.

Occurrence of lime in the soil retarded the uptake of all nutrients in the soil (**Nijjar, 1985**).

The target of this study was examining the tolerance of grapevine cvs Superior, Crimson seedless, Ruby seedless and Flame seedless to salinity and lime in the soil.

2. Material and Methods

This pot experiment was conducted during the two successive seasons of 2013 and 2014 on Nursery of Minia Fac. of Agric. situated at Minia Univ., Minia Governorate in order to test the response and tolerance of the transplants of grapevine cvs Superior, Crimson, Ruby seedless and Flame seedless to salinity and lime in the soil. Uniform and healthy two hundreds and seventy one-year old own rooted transplants of each grapevine cv. were selected for achieving of this investigation.

The soil was washed several times with water, air dried and subjected to mechanical, physical, water holding properties and chemical analysis according to procedures outlined by **Jackson, 1958** and **Black *et al.* (1965).** The obtained data of the soil analysis are given in Table (1).

Table (1): Analysis of the tested soil

Particle size distribution:	
Sand %	:87.65
Silt %	:11.85
Clay	:0.50
Texture	: sandy
pH(1:2.5 extract)	:7.15
EC (1: 2.5 extract) (ds/ m^{-1})	:0.01
Total $CaCO_3$ %	:0.50
Organic Matter %	:0.9
Total N %	:0.05
Available P (according to Olsen, ppm)	:30.3
Available K (Ammonium acetate, ppm)	:180
Water holding properties:-	
Field capacity %	:8.0
Wilting point %	:2.5
Available water %	:5.5

This experiment included two factors. The first factor (A) comprised from own rooted transplants of four grapevine cvs Superior, Crimson seedless, Ruby seedless and Flame seedless, while the second factor (B) included the following nine soil salinity and lime (calcium carbonate) treatments.

1- Unsalinized and unlime soil (check treatment).
2- Soil salinity at 0.05%
3- Soil salinity at 0.1 %
4- Soil salinity at 0.2%
5- Soil salinity at 0.4%
6- Liming soil with calcium carbonate at 2.5 %
7- Liming soil with calcium carbonate at 5.0 %
8- Liming soil with calcium carbonate at 10 %.
9- Liming soil with calcium carbonate at 20 %.

Therefore, the experiment involved 36 treatments (4 x 9) each treatment replicated three times ten transplants per replicate (1080 transplants i.e. 270 transplants from each grapevine cv.)

Soil salinity was derived from mixing sodium chloride and sodium sulphate in an equal weight (1:1 by weight).

All transplants were winter pruned to two eyes then planted in the last week of February in both seasons in 40 cm diameter and 50 cm height of black polyethylene bags as one transplant per each bag. Each bag was filled with 6 kg sandy soil. The bags were equipped with bottom holes to allow excess water drainage. The investigated salts and calcium carbonate at the named concentrations were added to the soil and mixed thoroughly to ensure the uniformity. Irrigation was done after the depletion of 35% of the available water of each treatment allover the season and the given amount of water was calculated by using the following equation which suggested by **Esraelsn and Hanson (1962)**.

Q= A.W. x d.wt = 5.5 x 6000 = 3309

Where Q = quantity of added water, A.W. = available water = (field capacity – Willing point) and d.wt = dry weight of soil /bag (kg.) Water content of soil was kept at field capacity by weight during the time of the trial.

In every growing season, inorganic nitrogen, phosphorus and potassium fertilizers were applied to the grapevine transplants in all treatments at the standard recommended rate for this age of transplant (one year old) to ensure that these nutrients did not limit the growth. Nitrogen was added at the rate of 4.0 g ammonium nitrate (33.5 % N) per pot divided into three equal doses. Orthophosphoric acid at 0.05 % as a source of P was sprayed three times. Potassium was added at 4.0 g potassium sulphate (48 % K_2O) /pot divided into three equal doses. These nutrients were applied once every two months starting from the third week of March in both seasons. At one month after planting in every growing season, the micro nutrient solution No.1 (containing 0.05 % ferrous sulphate and 0.02 % zinc sulphate) and the micro nutrient solution No.2 (containing 0.05 % manganese sulphate, 0.02 % copper sulphate, and 0.1 % boric acid) were sprayed four times at one month interval started at one month after planting. Application of the micronutrient solution No.1 was followed by application of the micronutrient solution No.2 at 10 days interval.

In every growing season, weeds were handly controlled. The grapevine transplants of all treatments were sprayed once on the first of April with fine sulphur at the rate of 0.5 g/L to control pests and fungi. Horticultural practices were carried out as usual in both seasons.

This factorial experiment (36 treatments) was set up in a complete randomized design. The main factor was the four grapevine cvs Superior, Crimson seedless, Ruby seedless and Flame seedless, while the second factor consisted from the previous nine treatments from soil salinity and lime. Each treatment was replicated three times, ten transplants per each.

During both seasons, the following traits were measured:

1- Percentage of survival.

2- Growth characters namely plant height, stem thickness (cm.), number of leaves/ plant, leaf area$(cm)^2$, number of lateral shoots and dry weight of whole plant (g.).

3- Root characters namely main root length (cm), number of secondary roots, dry weight of roots / plants and area of root distribution $(cm)^2$.

4- Percentage of leaf relative turgidity and leaf succulence grade (H_2O/ dec_2 of leaf) (according **El-Mistran and Hillyer, 1937; El-Henawi, 1986; Nomier- Safaa, 1994 and Hassan, 1998**).

5- Chlorophylls a & b, total chlorophylls and total carotenoids (**Von- Wettstein, 1957**) and total carbohydrates (**A.OA.C., 2000)**.

6- Percentage of (**Bates *et al.,* 1973, Paquin and Lechasseur, 1979 and Irigoyen *et al.,* 1992**) and soluble sugars (**Irigoyen *et al.,* 1992**).

7- Uptake of N, P, K, Ca, Na and Cl (according to **Black *et al.,* 1965 and Wilde *et al.,* 1985**).

All the obtained data were collected, tabulated and subjected to the proper statistical analysis according to **Snedecor and Cochran (1967)** using new L.S.D. at 5% test for comparing between means of all treatments.

3. Results and Discussion

1-Effect of salinity and lime in the soil on survival percentage:

It is obvious from the obtained data in Table (2) that the survival percentage was significantly varied among the four grapevine cvs growing under salt and lime stress conditions. The maximum values were recorded on the transplants of grapevine cvs. Flame, Ruby, Crimson seedless and Superior, in descending order. Flame seedless grapevine cv recorded the highest survival percentage followed by Ruby seedless. Planting transplants of grapevine cv. Superior under salt and lime stress conditions gave the lowest percentage of transplant survival. These results were true in both seasons.

It is clear from the obtained data that survival percentage was affected significantly by the tested salinity and lime levels. The values ranged from 86.3 to 91.6 in the first season and from 87.3 to 92.5 % in the second one. It was clear that survival percentage was gradually decreased as salinity and lime in the soil were increased. Liming the soil with calcium carbonate at 2.5 to 20 % significantly increased survival percentage compared to soil salinization at 0.05 to 0.4 %. The uppermost values were recorded by the control, while the lowermost values resulted from the highest salinity level namely 0.4%. Significant differences on survival percentage were detected among all levels of salinity and lime in the soil. These results were true in both the two experimental seasons.

Percentage of survival in the four grapevine cvs was significantly affected by the interactions between salinity and lime treatments and the tested grapevine cvs. Transplants of the grapevine cv. Flame grown under unsalinized and unlime soil had the maximum values of survival percentage (95.6 and 96.5 %) in both seasons, respectively. On the other hand, the least values were obtained in the grapevine cv Superior grown under salinity condition at 0.4%. The other combinations recorded in between values. The highest values of survival percentage recorded under the salinity and lime conditions of the Flame grapevine cv., supported the tolerance of such grapevine cv to salinity and lime conditions. These results were true in 2013 and 214 seasons.

These results regarding the reduction on survival percentage in saline stressed grapevines are in concordance with those obtained by **Rofael (2004)** on Red Roomy and Ruby seedless grapevines and **Ragab (2004)** on Ruby seedless grape transplants.

2-Effect of salinity and lime in the soil on vegetative growth characters:

It is evident from the data in Tables (3 to 8) that the investigated growth characters namely plant height, stem thickness, number of leaves/ plant, leaf area, number of laterals / plant and dry weight of whole plant were significantly varied among the transplants of the four grapevine cvs., Superior, Crimson seedless, Ruby seedless and Flame. Flame grapevine transplant recorded the highest values of these growth characters followed by Ruby seedless grapevine transplants. The lowest values were recorded in the grapevine cv Superior. These results were true in both the two experimental seasons.

Data concerning the effect of salinity and lime treatments on growth characters clearly show that salinity at 0.05 to 0.4% and calcium carbonate at 2.5 to 20 % in the soil significantly inhibited growth characters namely plant height, stem thickness, number of leaves/ plant, leaf area, number of lateral shoots and dry weight of whole plant compared to the check treatment. The inhibition on these growth characters was significantly associated with increasing concentrations of salts and calcium carbonate in the soil. The damage on such growth characters was higher in salinity treatments than in lime ones. Untreated transplants of the four grapevine cvs recorded the maximum values. Transplants of all the investigated grapevine cvs grown under 0.4 % salinity had the minimum values. Varying concentrations of salinity and lime significantly reduced such growth characters. These results were true in both seasons.

The interactions between salinity and lime concentrations and the four tested cultivars of grapevine significantly affected these growth characters. The maximum values were detected on Flame grapevine transplants unsalinized and untreated with lime (The check treatment). In most cases, the great inhibition in such growth characters was recorded on Superior grapevine transplants subjected to 0.4 % soil salinity. Under the same salinity and lime levels transplants of the grapevine cvs, Superior Crimson seedless, Ruby seedless and Flame in ascending order had the highest values. According to the values of these growth characters, the tolerance of the tested grapevine cvs to salinity and lime in the soil could be arranged as follows in descending order, Flame, Ruby seedless, Crimson seedless. In other words, grapevine cvs Flame and Superior were considered resistant and sensitive grapevine cvs to such stress conditions, respectively. Superior grapevine cv was sensitive tolerance to salinity and lime in the soil.

The inhibiting effects of salinity on vegetative growth characters are in line with the findings of **Taha *et al.* (1972), Kulinich (1975), Khanduja *et al.* (1980), Al- Saidi and Alawi (1984) and Shehata *et al.* (1996a and 1996 b**) on Thompson seedless grapevine cv. The results of **Shani *et al.* (1993)** on Salt Greek and Superior grapevine cvs **Ragab (2000)** on Ruby seedless grapevines and **Abdel- Hady *et al.* (2003)** on Flame seedless grapevine cv supported the present results.

The decreasing effect of lime on vegetative growth of Thompson seedless grapevine was emphasized by the results of **Yulin Su and Miller (1961); Winkler (1965); Winkler *et al.* (1974); Weaver (1976); Miller *et al.* (1988) and Saxton (2002).** The same conclusion was also observed in Pinot Blanc grape cv by **Bavaresco *et al.* (1999)**, **Bavaresco *et al.*, (2003)** and **Schmidt *et al.*, (2005),** on Thompson seedless grapevines

3-Effect of salinity and lime in the soil on some root characters:

It is clear from the obtained data in tables (9 to 12) that root parameters were significantly affected among the four grapevine cvs. They were maximized in the transplants of grapevine cvs Flame, Ruby seedless, Crimson seedless and Superior, in descending order. Transplants of Superior grapevine cv registered the minimum values of root parameters namely root distribution, main root length, number of secondary roots and dry weight of roots/ plant. These results clarified that the great stimulation on growth characters of Flame and Ruby seedless grapevine cvs previously mentioned was ascribed to the great distribution of roots of these cvs. However, the low vigour of Superior grapevine cv was attributed to the poor development of roots under stress conditions. These findings emphasized the great tolerance of grapevine cv Flame to salinity and lime conditions and the sensitivity of grapevine cv Superior to such stresses. These results were true in both seasons.

It is concluded from the obtained data that root parameters were significantly depressed in response to growing the transplants of the four grapevine cvs under soil salinity at 0.05 to 0.4 % and lime at 2.5 to 20 % compared to the check treatment. The damage caused by soil salinity on roots was superior that produced from liming the soil. Significant reduction on root parameters was observed among all salinity and lime treatments except among the lower two concentrations of salinity and lime. These were a gradual depression on root parameters with increasing concentrations of salinity and calcium carbonate in the soil. Untreated transplants had the maximum values. Salinity at 0.4 % resulted in the lowest values. Similar results were obtained in both seasons.

The investigated interaction caused significant effect on root characters in transplants of the four grapevine cvs., Superior, Crimson seedless, Ruby seedless and Flame seedless grapevine cvs had the greatest values of root parameters, in ascending order under the same level of salinity and lime in the soil. The lowest values were registered in Superior grapevine cv growing under 0.4% ppm salinity. The untreated Flame grapevine transplants had the maximum values. These results were true in both seasons.

The results of damage caused by salinity on roots parameters in grapevine cvs are in coincidence with those obtained by **Samra (1985)** on Perlette, Beauty seedless, Delight and Thompson seedless grapevine cvs, **Taylor *et al*. (1987)** on Thompson seedless grapevine cv. and **Ab EL- Hady *et al.* (2003)** on Flame seedless grapevine cv. In Ruby seedless grapevine cv., the results of **Rofael (2004) and Ragab (2004)** supported these results.

4-Effect of salinity and lime in the soil on the percentage of leaf relative turgidity and leaf succulence grade.

It is clear from the obtained data in Tables (13 & 14) the varying grapevine cvs was accompanied with significant differences on the percentage of leaf relative turgidity and leaf succulence grade. The maximum values were presented in the grapevine cvs Flame seedless, Ruby seedless, Crimson seedless and Superior, in descending order. The highest values of such two physiological aspects in grapevine cv. Flame seedless showed the great tolerance of such cv for tolerance of both salinity and lime in the soil. However, the minimum values of such two characters in grapevine cv. Superior means the great sensitive of such cv to salinity and lime. These results were true during both seasons.

Subjecting grapevine cvs to salinity at 0.05 to 0.4% and lime at 2.5 to 20% in the soil had significant reduction on the percentage of leaf relative turgidity and leaf succulence grade over the check treatment (Unsalinity and unlime conditions). Salinity significantly depressed such two physiological traits than liming the soil. There was a gradual reduction in such two characters with increasing the concentrations of soil salinity and lime. No significant reduction on such two aspects were observed among the higher two concentrations of salinity and lime. Salinity at 0.4 % gave the minimum values. The higher values were recorded on untreated transplants. Similar results were announced during both seasons.

The investigated combinations had significant effect on the percentage of leaf relative turgidity and leaf succulence grade. Values significantly were differed according to the stress treatment and the cultivar of grapevine. Grapevine cv. Flame seedless had equal values at salinity concentrations from 0.05 to 0.2% and lime from 2.5 to 10%. However, grapevine cvs Superior had the same values at 0.05% salinity and 2.5 % lime in the soil. The other grapevine cvs ranked in between effect. These results clarified the tolerance of Flame seedless and the sensitive of Superior grapevine to salinity and lime in the soil. The maximum values were observed on grapevines cv. Flame growing under normal conditions. The lowest values were recorded on the grapevine cv Superior growing under salinity at 0.4%. These results were true during both seasons.

5-Effect of salinity and lime in the soil on plant pigments.

It is revealed from the obtained data in Tables (15 to 18) that plant pigments namely chlorophylls a and b, total chlorophylls and total carotenoides significantly were affected by varying grapevine cvs. They were maximized in the transplant of the grapevine cvs Flame, Ruby seedless, Crimson seedless and Superior, in ascending order. Transplants of the grapevine cv Flame contained the highest values, followed by Ruby seedless grapevine cv. The lowest values were detected on grapevine cv. Superior. These results clarified that the destruction of pigments in the leaves of Flame seedless grapevines growing under saline and lime conditions was low. This explained the tolerance of Flame grapevines to salinity and lime conditions. However, the great destruction of plant pigments in the leaves of Superior grapevine cv could resulted in decreasing the tolerance to salinity and lime conditions.

It is evident from the obtained data that plant pigments namely chlorophylls a and b, total chlorophylls and total carotenoides significantly were reduced in transplants subjected to salinity at 0.05 to 0.4% and lime at 2.5 to 20 % compared to the check treatment. The depression on such plant pigments was associated with increasing salinity and lime concentrations in the soil. The adverse effects on plant pigments was remarkably shown in transplants treated with salinity compared to those under lime conditions. The untreated transplants had the uppermost values. The minimum values were detected on plants grown under salinity conditions at 0.4%. These results were true in both seasons.

Plant pigments were significantly affected by the studied interaction. The maximum values were detected on transplants of grapevine cv. Flame grown under unsalinized and unlime conditions. The minimum values were detected on transplants of grapevine cv. Superior growing under 0.4% salinity. Similar results were announced in both seasons.

The results concerning the adverse effects of salinity on plant pigments were previously found by **Salem (1961), Petrosyan *et al*., (1979) and Mehta (1988)** on Thompson seedless grapevines, **Singh *et al.* (2000)** on Perlette grapevine cv and **Ben- Asher *et al.* (2006)** on Cabernet Sauvignon grapevines.

The negative effect of lime on plant pigments of Thompson seedless grapevine was confirmed by the results of **Ostrovskaya *et al.* (1990)** and **Gruber and Kosegarten (2001)**. The present results are also in agreement with those obtained by **Nikolic and Kastori (1997)** and **Bavaresco *et al.* (1999)** on Riesling and Pinot Blanc grapevines cvs.

6-Effect of salinity and lime in the soil on the percentages of total carbohydrate and soluble sugars.

It is worth to mention from the data in Tables (19 to 21) that values of total carbohydrates, and soluble sugars in the leaves significantly were differed according to grapevine cvs. Total carbohydrates and soluble sugars significantly were maximized and was minimized in grapevine cvs Flame, The grapevine cv Superior gave the lowest values of total carbohydrates and soluble sugars and the highest values of praline.

Stress caused by salinity at 0.05 to 0.4% and lime at 2.5 to 20% reduced total carbohydrates and increased praline and soluble sugars. Grapevine cv Superior had the highest values of and soluble sugars and the lowest values of total carbohydrates when grown under salinity at 0.4%. These results were true during both seasons.

The investigated interaction had significant effect on these chemical traits. The maximum values of total carbohydrates and total soluble sugars and the lowest content was presented in Flame seedless grapevine grown under normal conditions.

7-Effect of salinity and lime in the soil on the uptake of N, P, K, Na and Cl by transplant.

It is clear from the obtained data in Tables (22 to 27) that varying the tested grapevine cvs significantly altered the uptake of N, P, K, Na, Ca and Cl. The maximum uptake of N, P and K and the minimum uptake of Ca, Na and Cl were observed in transplants of the grapevine cv Flame, Ruby seedless, Crimson seedless and Superior, in descending order. Transplants of grapevine cv. Flame uptake more amounts of N, P and K and the lowest amounts of Ca, Na and Cl and the vice versa was detected on the transplants of grapevine cv. Superior. This means that grapevine cv Flame and Superior considered more tolerance and sensitive to salinity and lime conditions, respectively. These results were true in both seasons.

Salinity conditions significantly caused a great reduction on uptake of N, P and K and a higher promotion on uptake of Ca, Na and Cl. The effect either in increase or in decrease significantly was depended on concentrations of salinity in the soil. The depression on uptake of N, P and K and the stimulation on uptake of Ca, Na and Cl were remarkably appeared in transplants grown under salinity conditions than those under lime environment. The highest uptake of N, P and K and the minimum uptake of Ca, Na and Cl was recorded on transplants grown under unsalinized and unlime soil. Soil salinity at 0.4 % caused a great reduction on uptake of N, P and K and higher promotion on uptake of Ca, Na and Cl. These results were true in both the two experimental seasons.

The investigated interaction had significant effect on the uptake of N, P, K, Ca, Na and Cl by transplants of the four grapevine cvs. The highest uptake of N, P and K and the minimum uptake of Ca, Na and Cl were recorded on the transplants of grapevine cv Flame grown under unsalinized and unlime conditions. Treating transplants of the grapevine cv. Superior with salinity at 0.4% gave the lowest values of N, P and K uptake and the highest uptake of Ca, Na and Cl. Similar trend was observed in both seasons.

The collapsing and reducing effects of salinity on uptake of N, P and K were supported by the results of **Joolka *et al.* (1977)** on grapevine cvs Delight, Thompson and Beauty, **Allam–Aida (1988)** on Banaty and Ruby seedless grapevine cvs and **Paranichianakis *et al.* (2000)** on Sultanina grapevine. The inferior effects of salinity on uptake of elements in Red Roomy grapevine were reported by **El- Gazzar *et al.* (1979)**, **Hatem (1984) and El- Naggar and Amer (1990)**. The same previous authors reported that salinity increased Na and Cl in the plant portions.

The results of **Yulin Su and Miller (1961); Miller *et al.* (1988); Ostrovskaya *et al.* (1990); and Bavaresco *et al.* (2005)** on Thompson seedless grapevine cv ensured the interrupting effect of lime on the uptake of N, P, K, and promoting impact on both Na and Cl.

Previous studies explained the adverse effects of salinity on vegetative growth, roots, plants pigments and uptake of elements namely N, P, K and Mg in the light of its effect on the following points. (According to **Ayers 1950; Miller *et al,* 1990 and Heck *et al,* 2002**).

1- The increase in the osmotic potential of the soil which certainly result in reduction in the availability of water to the plants (**Nijjar, 1985**).

2- The specific toxic effect of some ions which causes a disturbance in normal metabolism of plants (**Miller *et al.*, 1990)**.

3- The increase on the respiration rate.

4- Destroying the enzymes activity within plant tissues such as catalase and peroxidase.

5- Accumulation of Cl and Na that badly affect the stomato closure.

6- Making the soil more compact and male physical and chemical properties of the soil.

7- The increase in natural growth inhibitors.

8- Salinity causes a damage in membrane permeability The damages in plant regulation system.

9- Preventing the uptake of N, P, K, Mg and most micro nutrients.

10- Collapsing the biosynthesis of organic foods especially carbohydrates.

11- Reducing plant photosynthesis by increasing mesophyl resistance to lower CO_2 fixation and reducing transpiration rate.

12- Retarding the biosynthesis of pigments through inhibited stomatal conductance and Hill reaction as well as reduced the uptake of Mg and N and increased photorespiration. The effect of salinity on the structure and function of chloroplasts which in turn increasing the activity of chlorophylls which breakdown chlorophylls.

The reasons of the negative effects of lime (calcium carbonate) in the soil on growth and nutritional status of the grapevines could be summarized under the following topics.(According to **Pavalopusek, 2008 and 2009)**.

1- The poor physical and chemical properties of the soil.

2- The lower availability of water and nutrients.

3- The lower soil fertility.

4- The possibility of forming a surface crust and / or indurated layers at shallow depth.

5- The higher soil pH and the greater fixation capacity for most nutrients.

6- The lower of water penetration and root distribution.

Downton *et al.*, (1990) made an investigation of the time- course of inhibition of photosynthesis in salt-stressed Sultana grapevine (*Vitis vimfera* L.). Leaves revealed two types of stomatal behaviour. Up to tissue concentrations of 165m Mcloride the inhibition was due to a uniform decrease in stomatal conductance, as indicated from autoradiograms of $^{14}CO_2$ fixation and no change in the relationship of assimilation to calculated intercellular partial pressure of CO_2 (A-C1) compared with control plants. The occurrence of non-stomatal inhibition of photosynthesis at higher levels of leaf chloride, suggested by a decline in the slope of the calculated A-C1 relationship, was associated with non- uniform $^{14}CO_2$ uptake over the leaf surface similar to that previously observed for ABA- treated and water- stressed grapevine leaves where non-stomatal inhibition of photosynthesis was shown to be an artifact arising from non- uniform leaves where non-stomatal inhibition of photosynthesis was shown to be an artifact arising from non- uniform stomatal behaviour. These observations also provide an explanation for the stimulation of photorespiration during salt stress. In salt- stressed grapevines cv. Sultana, when leaves contained 165 mM chloride, there was a great inhibition in stomatal conductance and higher stimulation of photorespiration. These effects lead to photosynthetic reduction.

Osmotic regulation as an important consistency is to avoid osmotic stress. Because it causes maintaining the information pressure and cell volume and this phenomenon is along with the accumulation of metabolities such as Betaine glycine, mannitol and soluble sugars (**Heidari Sharif Abad H., 2002**). In terms of salinity stress the amount. is a strong source to store carbon, nitrogen and a purifier of free radicals, also maintains the structure of cell membrane and proteins (**Jalili Marandi, 1998**). Another role of is maintaining the buffering capacity of cells in terms of salinity. In order to escape Tom plasmolysis and establishing cell inflammation in the cells of organic plants, under the conditions of some environmental stresses such as drought and salinity, larger molecules such as starch broke into sucrose and then broke into smaller molecules such as glucose and fructose. This led to the negative potential of water in cells and osmotic regulation. In addition to the conversion of starch to soluble such as the reduction in sugar consumption is also another factor for increasing the sugar concentration the cell (**Jalili Marandi., 1998**). Also the reduction of cell growth reduces the conversion of soluble carbohydrates into structural polysaccharides and hemicelluloses. The final results of these reactions is he accumulation soluble sugars in plants (**Jalili Marandi., 1998**). It has been observed in the conducted experiments that by adding sodium chloride to the culture medium of grape cuttings, the amount of soluble sugars increase and these compounds have an important role in regulating the osmotic potential of leaves (**Singh., 2000**).

Soil salinity affects growth and yield in grapevine by osmotic and specific ion Cities (**Maas and Grattan 1999; Shani and Ben Gal, 2005; Stevens and Walker, 2002**). The osmotic effect on vine growth is proportional to the decrease in the osmotic potential of the soil solution, operates from low values of soil salinity, and reduces leaf water potential, transpiration and photosynthes. The specific ion toxicity operates when the vines accumulate certain ions such as Chloride (Cl), Sodium (Na) and Boron (B) above levels that cause detrimental effects due to direct toxicities or nutritional-induced imbalances. In practical terms, since increases in salinity are normally inked to increases in some of the above mentioned toxic ions, the effects of the osmotic and specific ion stresses cannot be generally separated.

Ion accumulation occurs largely in old leaves, produces marginal leaf necrosis (**Maas and Grattan, 1999**) and decrease leaf area and growth (**Fisarakis *et al.,* 2001**) Toxic levels of Na are uncommon in leaves because Na is not translocated in appreciable amounts from the roots to the leaves. Hence, Cl is the Principal toxic ion for grapevines growing under saline conditions (**Nijjar *et al.,* 1985**).

Salt tolerance in salt resistant Flame seedless grapevines is may be related to ion exclusion, a rapid change in the metabolism of plants to face the higher concentration of salts in their tissues, ion accumulation and the compartmentalize of ion in the vacuole and not in the cytoplasm, hence metabolic process are not inhibited. These ions in the vacuoles balanced with neutral organic solutes in the cytoplasm and lower the leaf osmotic potential, some, protecting enzymes and ribosomal activities (**Walker *et al.,* 2000**).

However, salt tolerance in glycophyts (non hallophytes) is related to ion exclusion because of the plant's inability to compartmentalize toxic in a useful way and to adjust osmotically. A rapid change in the metabolism of plants to face the higher concentration of salts in their tissues was observed in salt resistant plants (**Strogonov, 1964**).

Chapman (1966) reported that the tolerance of fruit crops to salinity is dependent very largely upon the kind of soil salinity (Cl, SCO_4, etc.), upon the species, variety or race being investigated and upon its state of development (whether juvenile, adult, flowering etc.)

The tolerance of plants towards salinity dependent not only on the kind of saline ion but also upon the species (Junk**, 1968**).

In addition, **Lerner (1985)** explained why plants tolerant salinity through the action of salinity as a major osmoticum. Also, the toxicity doing by ions could be prevented by compartmentation or by some other mechanism of protecting enzymes and ribosomal activities. Otherwise, the cell could pump out most of the salt diffuses and that allowing the whole plants to overcome the salinity stress. In this case, osmotic stress may be relieved by accumulation of organic solutes to maintain turgor.

Table (2): Effect of different concentrations of salinity and calcium carbonate on the survival percentage of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	88.1	90.3	92.5	95.6	**91.6**	89.0	91.0	93.4	96.5	**92.5**
b_2 Salinity at 0.05%	87.9	88.6	91.9	95.2	**90.9**	88.7	89.7	93.0	96.2	**91.9**
b_3 Salinity at 0.1 %	78.0	88.4	91.8	95.0	**88.7**	78.8	89.3	92.6	95.9	**89.1**
b_4 Salinity at 0.2 %	70.0	80.0	85.6	94.9	**82.6**	71.0	81.0	86.6	95.8	**83.6**
b_5 Salinity at 0.4 %	60.0	71.2	76.3	81.6	**72.3**	60.9	72.1	77.2	82.5	**73.2**
b_6 Calcium carbonate at 2.5 %	88.0	90.0	92.3	95.5	**91.4**	88.8	91.0	93.3	96.4	**92.4**
b_7 Calcium carbonate at 5 %	85.9	88.8	92.2	95.4	**90.6**	86.9	89.8	93.3	96.4	**91.6**
b_8 Calcium carbonate at 10 %	83.0	86.6	90.0	95.3	**88.7**	84.0	87.6	91.0	96.4	**89.7**
b_9 Calcium carbonate at 20 %	81.0	84.6	88.3	91.2	**86.3**	81.9	85.7	89.4	92.2	**87.3**
Mean (A)	**80.21**	**85.38**	**88.98**	**93.3**		**81.1**	**86.3**	**89.9**	**94.2**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	1.2	1.1	2.2			1.3	1.2	2.4		

Table (3): Effect of different concentrations of salinity and calcium carbonate on the plant height (cm) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	64.0	66.2	68.6	71.4	**67.5**	64.7	66.9	69.3	72.1	**68.2**
b_2 Salinity at 0.05%	63.5	65.5	68.3	71.0	**67.1**	63.9	66.2	69.0	71.8	**67.7**
b_3 Salinity at 0.1 %	47.0	65.4	68.2	69.9	**62.6**	47.7	66.1	69.0	70.6	**63.3**
b_4 Salinity at 0.2 %	42.6	57.3	61.0	69.8	**57.7**	43.3	56.0	61.8	70.5	**57.9**
b_5 Salinity at 0.4 %	38.9	51.3	58.6	62.6	**52.8**	39.7	52.0	59.3	63.3	**53.6**
b_6 Calcium carbonate at 2.5 %	63.7	66.0	68.5	71.3	**67.4**	64.0	66.8	69.2	72.0	**68.0**
b_7 Calcium carbonate at 5 %	60.0	65.9	68.4	71.2	**66.4**	60.8	66.5	69.1	72.0	**67.1**
b_8 Calcium carbonate at 10 %	57.1	65.8	67.3	71.0	**65.3**	57.8	66.5	68.1	71.8	**66.0**
b_9 Calcium carbonate at 20 %	50.0	60.9	62.9	66.0	**59.9**	50.7	61.6	63.6	66.7	**66.6**
Mean (A)	**54.1**	**62.7**	**65.7**	69.3		**54.7**	**63.2**	**66.5**	**70.1**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	1.0	1.1	2.2			1.1	1.1	2.2		

Ostroovskaya *et al.* (1990) studied the alterations in superoxide dimutase SOD activity on grapevine cv. Thompson grown on soil containing 30-35 % CaC03. Such enzyme was greatly increased. limitation of lime induced chlorosis is determined not only by reduced chlorophyll biosynthesis but also by 'other consequences of iron deficiency in tissues, particularly by the high rate formation of Jsuperoxide and other activated oxygen species, causing destructive changes in the photosynthetic apparatus. The increased in SOD activity may be regarded as a protective mechanism against the formation of suproxide.

Grapevines cvs Cvus (salt resistant), Muskule (salt sensitive) and Sultani Cekirdekzis (moderately salt sensitive) were subjected to salt stress by irrigating them with solutions containing 0, 0.5 or 0.75 % NaCl. Under conditions of salt stress, stomatal conductance and transpiration were strongly inhibited in Muskule and Sultani Cekirdekzis and slightly decreased in Cvus. The salt tolerance of Cvus was due to an osmotic regulation ability which was absent from the other cvs (**Sivritepe, 2000**). Occurrence of lime in the soil retarded the uptake of all nutrients in the soil (**Nijjar, 1985**).

Table (4): Effect of different concentrations of salinity and calcium carbonate on the stem thickness (cm) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	1.11	1.21	1.33	1.42	**1.26**	1.20	1.30	1.41	1.51	**1.35**
b_2 Salinity at 0.05%	1.08	1.16	1.31	1.39	**1.23**	1.17	1.25	1.40	1.48	**1.32**
b_3 Salinity at 0.1 %	0.70	1.16	1.31	1.38	**1.13**	0.79	1.25	1.40	1.47	**1.23**
b_4 Salinity at 0.2 %	0.63	0.92	1.02	1.38	**0.98**	0.72	1.01	1.09	1.45	**1.07**
b_5 Salinity at 0.4 %	0.54	0.80	0.92	1.15	**0.85**	0.61	0.87	0.99	1.22	**0.92**
b_6 Calcium carbonate at 2.5 %	1.10	1.20	1.32	1.41	**1.25**	1.19	1.29	1.41	1.50	**1.34**
b_7 Calcium carbonate at 5 %	1.03	1.19	1.32	1.40	**1.23**	1.12	1.28	1.41	1.49	**1.32**
b_8 Calcium carbonate at 10 %	6.95	1.12	1.20	1.39	**1.16**	1.04	1.21	1.29	1.48	**1.25**
b_9 Calcium carbonate at 20 %	0.80	1.00	1.13	1.25	**1.04**	0.89	1.09	1.22	1.37	**1.14**
Mean (A)	**0.88**	**1.08**	**1.20**	**1.35**		**0.97**	**1.17**	**1.29**	**1.44**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.07	0.06	0.12			0.06	0.06	0.12		

Table (5): Effect of different concentrations of salinity and calcium carbonate on the number of leaves/ plant of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	47.0	51.0	54.0	57.0	**52.2**	47.9	51.8	54.9	57.9	**53.1**
b_2 Salinity at 0.05%	46.6	50.0	53.5	56.2	**51.6**	47.5	50.9	54.4	57.2	**52.5**
b_3 Salinity at 0.1 %	33.0	49.9	53.0	56.0	**47.9**	34.0	50.7	54.0	56.9	**48.9**
b_4 Salinity at 0.2 %	29.0	38.0	41.0	56.0	**41.0**	29.9	39.0	42.0	56.9	**41.9**
b_5 Salinity at 0.4 %	25.0	35.0	38.0	48.0	**36.5**	26.0	36.1	39.1	49.1	**37.6**
b_6 Calcium carbonate at 2.5 %	46.9	50.0	54.0	57.0	**51.9**	47.8	51.6	54.9	57.8	**53.0**
b_7 Calcium carbonate at 5 %	44.0	50.0	53.8	57.0	**51.2**	44.9	51.4	54.9	57.6	**52.2**
b_8 Calcium carbonate at 10 %	41.0	46.9	49.0	56.7	**48.4**	42.0	47.9	50.0	57.4	**49.3**
b_9 Calcium carbonate at 20 %	37.0	41.0	46.0	51.0	**43.7**	37.9	42.0	47.0	51.9	**44.7**
Mean (A)	**38.8**	**45.7**	**49.1**	**54.9**		**39.7**	**46.8**	**50.1**	**55.9**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	2.0	2.0	4.0			1.9	2.0	4.0		

Table (6): Effect of different concentrations of salinity and calcium carbonate on the leaf area $(cm)^2$ of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	71.0	77.6	81.9	84.0	**78.6**	72.1	78.7	83.0	85.1	**79.7**
b_2 Salinity at 0.05%	70.5	76.9	81.5	83.5	**78.1**	71.6	77.5	82.5	84.5	**79.0**
b_3 Salinity at 0.1 %	70.4	76.8	81.3	83.4	**77.9**	64.0	77.3	82.4	84.3	**77.0**
b_4 Salinity at 0.2 %	62.0	69.9	76.0	83.3	**72.8**	63.1	71.0	77.0	84.3	**73.8**
b_5 Salinity at 0.4 %	59.0	66.7	73.9	78.9	**69.6**	60.0	67.7	74.9	80.0	**70.6**
b_6 Calcium carbonate at 2.5 %	70.9	77.4	81.9	84.0	**78.5**	71.9	78.5	83.0	84.9	**79.6**
b_7 Calcium carbonate at 5 %	70.6	77.0	81.6	84.0	**78.3**	69.0	77.9	82.5	84.9	**78.6**
b_8 Calcium carbonate at 10 %	67.0	74.0	79.0	83.9	**75.9**	67.9	75.0	80.0	84.9	**76.9**
b_9 Calcium carbonate at 20 %	64.7	72.1	77.1	81.3	**73.8**	65.8	73.1	78.1	82.3	**74.8**
Mean (A)	**67.3**	**74.2**	**79.3**	**82.9**		**67.2**	**75.2**	**80.2**	**83.9**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	1.0	1.0	2.0			0.9	1.0	2.0		

Table (7): Effect of different concentrations of salinity and calcium carbonate on the number of lateral shoots / plant of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	7.0	9.0	10.9	11.9	**9.7**	9.0	11.0	13.0	14.0	**11.7**
b_2 Salinity at 0.05%	6.9	8.7	10.6	11.2	**9.3**	8.6	10.5	12.6	13.2	**11.2**
b_3 Salinity at 0.1 %	2.0	8.6	10.4	11.1	**8.0**	3.0	10.4	12.4	13.1	**9.7**
b_4 Salinity at 0.2 %	1.0	5.3	6.7	11.0	**6.0**	2.0	6.4	7.7	13.0	**7.2**
b_5 Salinity at 0.4 %	1.0	4.2	5.6	7.6	**4.6**	2.0	5.2	6.6	8.6	**5.6**
b_6 Calcium carbonate at 2.5 %	7.0	8.9	10.9	11.8	**9.6**	8.8	10.9	12.9	13.9	**11.6**
b_7 Calcium carbonate at 5 %	5.8	8.8	10.8	11.6	**9.2**	6.8	10.7	12.7	13.8	**11.0**
b_8 Calcium carbonate at 10 %	4.7	7.4	9.0	11.4	**8.1**	5.7	8.4	10.1	13.7	**9.4**
b_9 Calcium carbonate at 20 %	3.0	6.3	7.8	10.0	**6.7**	4.0	7.3	8.8	11.1	**7.8**
Mean (A)	**4.2**	**7.4**	**9.2**	**10.8**		**5.5**	**8.9**	**10.7**	**12.7**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	1.0	1.0	2.0			1.0	1.8	2.0		

Table (8): Effect of different concentrations of salinity and calcium carbonate on the whole dry weight of plant (g.) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	18.1	20.3	22.6	25.3	**21.6**	19.0	21.2	23.5	26.2	**22.5**
b_2 Salinity at 0.05%	17.8	20.0	22.0	25.0	**21.2**	17.9	21.0	23.0	26.0	**21.9**
b_3 Salinity at 0.1 %	13.0	19.6	21.9	24.9	**19.8**	14.0	20.5	22.8	25.8	**20.8**
b_4 Salinity at 0.2 %	11.9	15.1	17.0	24.8	**17.2**	12.8	16.0	17.9	25.7	**18.1**
b_5 Salinity at 0.4 %	10.0	14.0	15.9	20.9	**15.2**	11.0	15.1	17.0	22.0	**16.3**
b_6 Calcium carbonate at 2.5 %	18.0	20.3	22.6	25.2	**21.5**	19.0	21.3	23.4	26.2	**22.5**
b_7 Calcium carbonate at 5 %	16.6	20.3	22.5	25.2	**21.1**	18.0	21.3	23.3	26.2	**22.2**
b_8 Calcium carbonate at 10 %	15.4	18.4	19.9	25.1	**19.7**	16.3	19.3	20.8	26.1	**20.6**
b_9 Calcium carbonate at 20 %	14.3	16.9	18.8	23.0	**18.2**	15.3	18.0	19.8	24.0	**19.3**
Mean (A)	**15.0**	**18.3**	**20.3**	**24.4**		**15.9**	**19.3**	**21.3**	**25.3**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	1.0	1.1	2.2			0.9	1.0	2.0		

Table (9): Effect of different concentrations of salinity and calcium carbonate on the main root length (cm) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)
b_1 Control	39.6	42.7	45.9	50.0	**44.5**	41.1	44.2	47.5	51.5	**46.1**
b_2 Salinity at 0.05%	39.1	42.5	45.3	49.2	**44.0**	40.5	44.0	46.8	50.7	**45.5**
b_3 Salinity at 0.1 %	29.0	42.1	45.0	49.1	**41.3**	30.5	43.6	46.4	50.6	**42.8**
b_4 Salinity at 0.2 %	25.0	35.0	39.9	49.0	**37.2**	26.6	36.6	41.5	50.5	**38.8**
b_5 Salinity at 0.4 %	19.6	30.0	35.9	43.3	**32.2**	21.1	31.6	37.5	44.8	**33.7**
b_6 Calcium carbonate at 2.5 %	39.5	42.7	45.9	49.9	**44.5**	41.0	44.2	47.5	51.5	**46.0**
b_7 Calcium carbonate at 5 %	37.0	42.7	45.8	49.9	**43.8**	38.6	44.2	47.3	51.4	**45.4**
b_8 Calcium carbonate at 10 %	34.0	40.0	43.0	49.5	**41.6**	35.5	41.6	44.5	51.3	**43.2**
b_9 Calcium carbonate at 20 %	31.0	37.3	41.6	45.6	**38.8**	32.5	38.8	43.1	47.1	**40.4**
Mean (A)	**32.6**	**39.4**	**43.1**	**48.3**		**34.1**	**40.9**	**44.7**	**49.9**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	1.4	1.3	2.6			1.4	1.4	2.8		

Table (10): Effect of different concentrations of salinity and calcium carbonate on the number of secondary roots / plant of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)
b_1 Control	47.3	51.6	55.7	60.0	**53.6**	48.0	52.3	56.3	60.7	**54.3**
b_2 Salinity at 0.05%	47.0	51.4	55.3	59.7	**53.3**	47.8	52.1	56.0	60.3	**54.0**
b_3 Salinity at 0.1 %	36.6	51.0	55.0	59.5	**50.5**	37.3	51.8	55.8	60.2	**51.3**
b_4 Salinity at 0.2 %	33.3	41.6	46.0	59.0	**44.9**	34.0	42.3	43.0	59.6	**44.7**
b_5 Salinity at 0.4 %	30.0	38.6	43.6	51.6	**40.8**	30.8	38.7	41.0	52.3	**40.7**
b_6 Calcium carbonate at 2.5 %	47.2	51.6	55.6	60.0	**53.6**	48.0	52.3	56.3	60.6	**54.3**
b_7 Calcium carbonate at 5 %	44.0	51.5	55.5	60.0	**52.7**	44.8	52.2	56.2	60.6	**53.4**
b_8 Calcium carbonate at 10 %	41.0	47.7	52.0	59.9	**50.1**	41.8	48.5	52.8	60.6	**50.9**
b_9 Calcium carbonate at 20 %	39.0	44.0	49.6	56.0	**47.1**	39.7	11.7	45.3	56.7	**46.6**
Mean (A)	**40.6**	**47.6**	**52.0**	**58.4**		**41.3**	**48.3**	**51.4**	**59.0**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	2.0	2.0	4.0			1.9	2.0	4.0		

Table (11): Effect of different concentrations of salinity and calcium carbonate on the dry weight of roots (g.) / plant of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)
b_1 Control	3.77	4.11	4.49	5.11	**4.37**	3.81	4.15	4.54	5.15	**4.41**
b_2 Salinity at 0.05%	3.74	4.06	4.44	5.07	**4.32**	3.78	4.10	4.48	5.12	**4.37**
b_3 Salinity at 0.1 %	2.80	4.05	4.44	5.06	**4.10**	2.84	4.10	4.46	5.10	**4.12**
b_4 Salinity at 0.2 %	5.59	3.33	3.88	5.06	**3.71**	2.64	3.37	3.89	5.11	**3.75**
b_5 Salinity at 0.4 %	2.31	3.23	3.70	4.64	**3.47**	2.35	3.27	3.56	4.67	**3.46**
b_6 Calcium carbonate at 2.5 %	3.76	4.10	4.47	5.10	**4.36**	3.80	4.14	4.51	5.15	**4.40**
b_7 Calcium carbonate at 5 %	3.50	4.08	4.46	5.10	**4.28**	3.55	4.13	4.50	5.15	**4.33**
b_8 Calcium carbonate at 10 %	3.20	3.71	4.24	5.09	**4.06**	3.24	3.75	4.28	5.15	**4.10**
b_9 Calcium carbonate at 20 %	3.00	3.51	4.00	4.91	**3.85**	3.04	3.55	4.04	4.97	**3.90**
Mean (A)	**3.20**	**3.80**	**4.23**	**5.01**		**3.22**	**3.84**	**4.25**	**5.06**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.07	0.08	0.16			0.06	0.06	0.12		

Table (12): Effect of different concentrations of salinity and calcium carbonate on the area of root distribution per plant (cm^2) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)
b_1 Control	215.0	269.6	297.3	331.3	**278.3**	217.0	271.5	299.3	333.3	**280.3**
b_2 Salinity at 0.05%	211.0	264.0	293.0	325.0	**273.2**	213.0	262.9	296.3	327.0	**275.5**
b_3 Salinity at 0.1 %	120.0	263.0	292.8	323.0	**249.7**	122.0	265.0	294.9	325.0	**251.7**
b_4 Salinity at 0.2 %	101.2	194.0	231.0	271.0	**199.3**	103.2	196.0	233.0	324.0	**201.5**
b_5 Salinity at 0.4 %	83.3	160.0	211.0	241.0	**173.8**	85.3	162.0	212.9	283.0	**185.8**
b_6 Calcium carbonate at 2.5 %	213.0	268.0	295.0	330.0	**275.5**	216.0	270.0	298.7	332.9	**279.4**
b_7 Calcium carbonate at 5 %	198.0	266.0	294.0	329.0	**271.7**	200.0	268.0	298.0	332.0	**274.5**
b_8 Calcium carbonate at 10 %	171.0	241.0	264.0	327.3	**250.7**	173.0	245.0	267.0	331.6	**253.6**
b_9 Calcium carbonate at 20 %	141.0	218.0	247.0	301.0	**226.7**	**142.9**	220.0	249.1	303.0	**228.7**
Mean (A)	**161.5**	**238.2**	**269.4**	**308.7**		**163.6**	**234.6**	**272.1**	**321.3**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	10.0	10.9	21.8			10.0	10.5	21.0		

Table (13): Effect of different concentrations of salinity and calcium carbonate on the leaf relative turgidity % of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a1 Superior	**a2 Crimson**	**a3 Ruby**	**a4 Flame**	**Mean (B)**	**a1 Superior**	**a2 Crimson**	**a3 Ruby**	**a4 Flame**	**Mean (B)**
b_1 Control	41.7	44.9	48.0	51.7	**46.6**	42.0	45.2	48.3	52.0	**46.9**
b_2 Salinity at 0.05%	41.1	44.0	47.5	51.2	**45.9**	41.9	44.3	47.8	51.5	**46.4**
b_3 Salinity at 0.1 %	32.0	43.9	47.1	51.0	**43.5**	32.3	44.2	47.4	51.3	**43.8**
b_4 Salinity at 0.2 %	29.6	37.0	40.0	51.0	**39.4**	30.0	37.3	40.4	51.1	**39.7**
b_5 Salinity at 0.4 %	26.0	34.4	38.3	43.1	**35.4**	26.3	34.7	38.6	43.4	**35.7**
b_6 Calcium carbonate at 2.5 %	41.6	44.8	47.9	51.6	**46.5**	42.0	45.1	48.2	52.0	**46.8**
b_7 Calcium carbonate at 5 %	39.0	44.6	47.7	51.5	**45.7**	39.3	45.0	48.0	51.8	**46.0**
b_8 Calcium carbonate at 10 %	36.6	41.1	45.0	51.4	**43.5**	37.0	41.4	45.4	51.8	**43.9**
b_9 Calcium carbonate at 20 %	35.0	39.9	43.0	48.0	**41.5**	35.3	40.2	43.3	48.3	**41.8**
Mean (A)	**35.8**	**41.6**	**44.9**	**50.0**		**36.2**	**41.9**	**45.2**	**50.3**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	1.5	1.4	2.8			1.5	1.5	3.0		

Table (14): Effect of different concentrations of salinity and calcium carbonate on the leaf succulence grade g H_2O/ dec^2 of leaf of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a1 Superior	**a2 Crimson**	**a3 Ruby**	**a4 Flame**	**Mean (B)**	**a1 Superior**	**a2 Crimson**	**a3 Ruby**	**a4 Flame**	**Mean (B)**
b_1 Control	1.86	1.99	2.11	2.25	**2.05**	1.90	2.03	2.15	2.30	**2.10**
b_2 Salinity at 0.05%	1.83	1.96	2.09	2.23	**2.02**	1.87	2.00	2.13	2.27	**2.06**
b_3 Salinity at 0.1 %	1.58	1.71	2.08	2.23	**1.90**	1.62	1.99	2.12	2.27	**2.00**
b_4 Salinity at 0.2 %	1.50	1.59	1.84	2.23	**1.79**	1.54	1.63	1.88	2.27	**1.83**
b_5 Salinity at 0.4 %	1.40	1.47	1.74	2.05	**1.66**	1.44	1.51	1.78	2.09	**1.70**
b_6 Calcium carbonate at 2.5 %	1.85	1.98	2.10	2.25	**2.04**	1.89	2.02	2.14	2.29	**2.10**
b_7 Calcium carbonate at 5 %	1.78	1.97	2.10	2.24	**2.02**	1.82	2.01	2.14	2.28	**2.06**
b_8 Calcium carbonate at 10 %	1.72	1.90	2.00	2.24	**1.96**	1.76	1.95	2.04	2.28	**2.00**
b_9 Calcium carbonate at 20 %	1.66	1.81	1.92	2.09	**1.87**	1.70	1.85	1.96	2.19	**1.91**
Mean (A)	**1.68**	**1.82**	**1.99**	**2.20**		**1.72**	**1.90**	**2.03**	**2.24**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.04	0.03	0.06			0.03	0.03	0.06		

Table (15): Effect of different concentrations of salinity and calcium carbonate on the chlorophyll a in the fresh leaves (mg/ 100 g F.W.) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a1 Superior	**a2 Crimson**	**a3 Ruby**	**a4 Flame**	**Mean (B)**	**a1 Superior**	**a2 Crimson**	**a3 Ruby**	**a4 Flame**	**Mean (B)**
b_1 Control	9.11	13.14	17.17	20.11	**14.90**	9.20	13.23	17.27	20.20	**14.97**
b_2 Salinity at 0.05%	9.09	13.06	17.13	20.03	**14.82**	9.18	13.15	17.22	20.12	**14.91**
b_3 Salinity at 0.1 %	7.30	13.06	17.12	20.03	**14.37**	7.40	13.16	17.21	20.12	**14.47**
b_4 Salinity at 0.2 %	7.11	10.11	13.07	20.02	**12.60**	7.20	10.20	13.16	20.11	**12.66**
b_5 Salinity at 0.4 %	6.60	9.00	12.05	15.22	**10.71**	6.70	9.10	12.15	15.32	**9.56**
b_6 Calcium carbonate at 2.5 %	9.10	13.11	17.16	20.11	**14.87**	9.20	13.20	17.25	20.20	**14.96**
b_7 Calcium carbonate at 5 %	8.71	13.10	17.14	20.07	**14.75**	8.81	13.20	17.24	20.17	**14.85**
b_8 Calcium carbonate at 10 %	8.41	12.00	15.11	20.05	**13.90**	8.51	12.09	15.20	20.15	**13.98**
b_9 Calcium carbonate at 20 %	8.00	11.00	14.12	17.0	**12.53**	8.11	11.10	14.22	17.10	**12.63**
Mean (A)	**8.16**	**11.95**	**15.56**	**19.20**		**8.25**	**11.50**	**15.65**	**19.27**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.10	0.10	0.20			0.09	0.10	0.20		

Table (16): Effect of different concentrations of salinity and calcium carbonate on the chlorophyll b in the fresh leaves (mg/ 100 g F.W.) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)
b_1 Control	2.15	2.79	2.99	3.29	**2.80**	2.20	2.81	3.11	3.41	**2.90**
b_2 Salinity at 0.05%	2.13	2.76	2.96	3.24	**2.77**	2.18	2.77	3.08	3.39	**2.85**
b_3 Salinity at 0.1 %	1.80	2.75	2.95	3.24	**2.68**	1.70	2.76	3.08	3.38	**2.73**
b_4 Salinity at 0.2 %	1.70	2.41	2.60	3.00	**2.42**	1.60	2.00	2.50	3.34	**2.36**
b_5 Salinity at 0.4 %	1.60	2.31	2.49	2.91	**2.20**	1.44	1.90	2.40	2.64	**2.10**
b_6 Calcium carbonate at 2.5 %	2.14	2.78	2.99	3.28	**2.79**	2.19	2.80	3.10	3.40	**2.87**
b_7 Calcium carbonate at 5 %	2.02	2.77	2.99	3.27	**2.76**	2.00	2.78	3.10	3.40	**2.82**
b_8 Calcium carbonate at 10 %	1.95	2.64	2.80	3.25	**2.66**	1.90	2.50	2.90	3.25	**2.51**
b_9 Calcium carbonate at 20 %	1.88	2.55	2.71	3.12	**2.58**	1.80	2.30	2.70	3.00	**2.45**
Mean (A)	**1.93**	**2.64**	**2.83**	**3.12**		**1.89**	**2.51**	**2.83**	**3.24**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.06	0.07	0.14			0.06	0.06	0.12		

Table (17): Effect of different concentrations of salinity and calcium carbonate on the total chlorophylls in the fresh leaves (mg/ 100 g F.W.) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)
b_1 Control	11.26	15.93	20.16	23.40	**17.68**	11.40	16.04	20.38	23.61	**17.85**
b_2 Salinity at 0.05%	11.22	15.85	20.09	23.27	**17.60**	11.36	15.92	20.30	23.48	**17.76**
b_3 Salinity at 0.1 %	9.10	15.81	20.07	23.27	**17.06**	9.10	15.92	20.29	23.47	**17.19**
b_4 Salinity at 0.2 %	8.81	12.52	15.67	23.02	**15.00**	8.80	12.20	15.66	23.45	**15.02**
b_5 Salinity at 0.4 %	8.20	11.31	14.54	18.13	**13.04**	8.14	11.00	14.55	17.96	**12.91**
b_6 Calcium carbonate at 2.5 %	11.24	15.89	20.15	23.39	**17.66**	11.39	16.00	20.35	23.60	**15.33**
b_7 Calcium carbonate at 5 %	10.73	15.87	20.13	23.34	**17.51**	10.81	15.98	20.34	23.57	**17.67**
b_8 Calcium carbonate at 10 %	10.35	14.64	17.91	23.30	**16.55**	10.41	14.59	18.10	23.53	**16.65**
b_9 Calcium carbonate at 20 %	9.88	13.55	16.83	20.12	**15.10**	9.91	13.40	16.92	20.10	**14.95**
Mean (A)	**10.8**	**14.60**	**18.40**	**22.8**		**10.14**	**14.56**	**17.37**	**22.53**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.14	0.16	0.32			0.17	0.18	0.36		

Table (18): Effect of different concentrations of salinity and calcium carbonate on the total carotenoids in the fresh leaves (mg/ 100 g F.W.) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)	a_1 Superior	a_2 Crimson	a_3 Ruby	a_4 Flame	Mean (B)
b_1 Control	1.99	2.51	2.80	3.11	**2.60**	2.02	2.54	2.83	3.14	**2.63**
b_2 Salinity at 0.05%	1.97	2.48	2.77	3.07	**2.57**	2.00	2.51	2.80	3.10	**2.60**
b_3 Salinity at 0.1 %	1.51	2.47	2.76	3.06	**2.45**	1.54	2.50	2.79	3.10	**2.48**
b_4 Salinity at 0.2 %	1.41	2.01	2.39	2.71	**2.13**	1.44	2.04	2.42	3.10	**2.25**
b_5 Salinity at 0.4 %	1.32	1.90	2.28	2.59	**2.02**	1.35	1.93	2.31	2.62	**2.05**
b_6 Calcium carbonate at 2.5 %	1.98	2.50	2.79	3.10	**2.59**	2.01	2.53	2.82	3.13	**2.62**
b_7 Calcium carbonate at 5 %	1.90	2.49	2.78	3.10	**2.56**	1.93	2.52	2.81	3.13	**2.60**
b_8 Calcium carbonate at 10 %	1.80	2.31	2.61	3.09	**2.45**	1.83	2.34	2.64	3.01	**2.45**
b_9 Calcium carbonate at 20 %	1.71	2.21	2.51	2.90	**2.33**	1.74	2.24	2.54	2.93	**2.36**
Mean (A)	**1.73**	**2.32**	**2.63**	**2.97**		**1.76**	**2.35**	**2.66**	**3.02**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.06	0.06	0.12			0.06	0.06	0.12		

Table (19): Effect of different concentrations of salinity and calcium carbonate on the percentage of total carbohydrates in the leaves of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	14.0	16.1	18.1	18.9	**16.8**	14.7	16.8	18.8	19.6	**17.5**
b_2 Salinity at 0.05%	13.8	15.8	17.9	18.5	**16.5**	14.5	16.5	18.6	19.2	**17.2**
b_3 Salinity at 0.1 %	8.8	15.7	17.6	18.4	**15.1**	9.5	16.3	18.3	19.1	**15.8**
b_4 Salinity at 0.2 %	7.7	13.9	14.1	15.7	**12.8**	8.5	10.3	14.7	19.0	**13.1**
b_5 Salinity at 0.4 %	6.5	12.4	13.0	14.5	**11.6**	7.2	4.0	13.7	15.2	**11.3**
b_6 Calcium carbonate at 2.5 %	13.9	16.0	18.1	18.8	**16.7**	14.6	16.7	18.8	19.5	**17.4**
b_7 Calcium carbonate at 5 %	12.7	15.9	18.0	18.7	**16.3**	13.4	16.6	18.7	19.5	**17.0**
b_8 Calcium carbonate at 10 %	11.5	16.5	16.9	18.6	**15.9**	12.2	15.0	17.0	19.3	**15.9**
b_9 Calcium carbonate at 20 %	10.0	15.1	15.9	17.0	**14.5**	10.8	12.0	15.1	17.7	**13.9**
Mean (A)	**10.9**	**15.2**	**16.8**	**17.7**		**11.7**	**14.3**	**17.1**	**18.7**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	1.31	1.2	2.4			1.0	1.0	2.0		

Table (20): Effect of different concentrations of salinity and calcium carbonate on the percentage of proline in the leaves of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	0.095	0.070	0.060	0.049	**0.068**	0.100	0.076	0.066	0.055	**0.074**
b_2 Salinity at 0.05%	0.097	0.074	0.063	0.053	**0.071**	0.102	0.079	0.069	0.059	**0.077**
b_3 Salinity at 0.1 %	0.171	0.075	0.063	0.054	**0.090**	0.176	0.081	0.069	0.059	**0.098**
b_4 Salinity at 0.2 %	0.191	0.107	0.095	0.055	**0.112**	0.196	0.112	0.120	0.060	**0.122**
b_5 Salinity at 0.4 %	0.198	0.127	0.102	0.079	**0.126**	0.204	0.132	0.137	0.104	**0.144**
b_6 Calcium carbonate at 2.5 %	0.096	0.071	0.061	0.050	**0.069**	0.101	0.076	0.068	0.055	**0.075**
b_7 Calcium carbonate at 5 %	0.109	0.072	0.062	0.051	**0.073**	0.110	0.077	0.069	0.056	**0.078**
b_8 Calcium carbonate at 10 %	0.129	0.090	0.074	0.052	**0.086**	0.134	0.095	0.089	0.077	**0.098**
b_9 Calcium carbonate at 20 %	0.151	0.097	0.084	0.066	**0.099**	0.156	0.102	**0.111**	0.091	**0.115**
Mean (A)	**0.137**	**0.087**	**0.073**	**0.058**		**0.142**	**0.092**	**0.088**	**0.068**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.007	0.009	0.018			0.008	0.010	0.020		

Table (21): Effect of different concentrations of salinity and calcium carbonate on the percentage of soluble sugars in the leaves of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	0.64	0.74	0.85	0.97	**0.80**	0.66	0.76	0.87	0.99	**0.82**
b_2 Salinity at 0.05%	0.65	0.75	0.87	0.98	**0.81**	0.67	0.77	0.90	1.00	**0.83**
b_3 Salinity at 0.1 %	0.73	0.75	0.88	0.99	**0.83**	0.75	0.77	0.90	1.01	**0.85**
b_4 Salinity at 0.2 %	0.81	0.88	0.95	0.99	**0.90**	0.83	0.90	0.97	1.01	**0.67**
b_5 Salinity at 0.4 %	0.91	0.99	1.06	1.14	**1.02**	0.93	1.01	1.08	1.16	**1.04**
b_6 Calcium carbonate at 2.5 %	0.68	0.73	0.84	0.96	**0.79**	0.65	0.75	0.87	0.99	**0.81**
b_7 Calcium carbonate at 5 %	0.59	0.72	0.83	0.95	**0.77**	0.62	0.75	0.87	0.95	**0.79**
b_8 Calcium carbonate at 10 %	0.50	0.60	0.77	0.94	**0.70**	0.52	0.62	0.80	0.90	**0.71**
b_9 Calcium carbonate at 20 %	0.41	0.54	0.70	0.88	**0.63**	0.43	0.57	0.73	0.81	**0.63**
Mean (A)	**0.65**	**0.74**	**0.86**	**0.97**		**0.67**	**0.71**	**0.83**	0.98	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.05	0.06	0.012			0.05	0.05	0.10		

Table (22): Effect of different concentrations of salinity and calcium carbonate on the uptake of N/ plant (mg) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	312.0	331.0	351.0	389.9	**345.9**	313.9	332.0	352.0	391.0	**347.2**
b_2 Salinity at 0.05%	311.1	327.0	347.0	385.0	**342.5**	312.1	328.2	348.6	386.3	**343.8**
b_3 Salinity at 0.1 %	238.0	326.0	346.0	384.0	**323.5**	240.0	328.0	347.1	386.0	**325.3**
b_4 Salinity at 0.2 %	222.0	271.6	300.0	383.0	**294.1**	223.0	272.5	302.1	383.3	**395.2**
b_5 Salinity at 0.4 %	201.7	250.7	281.7	345.0	**269.7**	202.8	351.8	282.7	346.5	**370.9**
b_6 Calcium carbonate at 2.5 %	312.0	330.0	350.0	388.0	**345.0**	313.0	331.0	351.0	389.1	**346.0**
b_7 Calcium carbonate at 5 %	294.0	328.0	349.0	387.0	**339.5**	296.0	329.0	350.0	388.0	**340.7**
b_8 Calcium carbonate at 10 %	271.0	305.0	331.0	386.0	**323.2**	271.8	306.6	332.3	387.0	**324.4**
b_9 Calcium carbonate at 20 %	251.0	289.0	311.0	361.0	**303.0**	252.1	290.1	312.0	359.7	**303.5**
Mean (A)	**268.1**	**306.5**	**329.6**	**378.7**		**269.4**	**307.7**	**330.8**	**379.6**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	11.1	10.0	20.0			11.2	11.5	23.0		

Table (23): Effect of different concentrations of salinity and calcium carbonate on the uptake of P/ plant (mg) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	55.2	60.2	64.9	71.0	**62.8**	56.0	61.1	65.7	71.7	**63.6**
b_2 Salinity at 0.05%	54.7	58.7	62.9	70.5	**61.7**	55.5	59.5	63.8	71.2	**62.5**
b_3 Salinity at 0.1 %	36.0	58.6	62.0	70.0	**56.6**	36.7	59.5	62.7	71.0	**57.5**
b_4 Salinity at 0.2 %	33.0	49.7	51.9	69.9	**51.1**	33.8	50.5	52.6	70.9	**51.9**
b_5 Salinity at 0.4 %	30.0	44.7	47.9	64.0	**46.6**	31.0	45.6	48.9	65.0	**47.6**
b_6 Calcium carbonate at 2.5 %	55.0	59.9	64.0	70.9	**62.4**	55.7	60.3	65.0	71.5	**63.1**
b_7 Calcium carbonate at 5 %	50.0	59.0	63.9	70.8	**60.9**	50.8	60.0	65.0	71.4	**61.8**
b_8 Calcium carbonate at 10 %	45.1	55.0	58.0	70.6	**57.1**	45.8	55.8	58.9	71.3	**60.2**
b_9 Calcium carbonate at 20 %	41.2	52.0	55.0	67.0	**53.8**	41.9	52.7	55.8	67.7	**54.5**
Mean (A)	**44.4**	**55.3**	**58.9**	**69.4**		**46.2**	**56.1**	**59.8**	**70.2**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	2.0	2.1	4.2			1.9	1.9	3.8		

Table (24): Effect of different concentrations of salinity and calcium carbonate on the uptake of K/ plant (mg) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	201.0	210.0	221.0	233.0	**216.2**	202.2	211.2	222.2	234.9	**217.6**
b_2 Salinity at 0.05%	199.0	207.9	212.9	231.1	**200.7**	200.2	209.0	221.0	232.2	**215.6**
b_3 Salinity at 0.1 %	157.0	207.8	219.8	230.9	**203.8**	158.2	209.0	221.0	232.2	**205.1**
b_4 Salinity at 0.2 %	146.0	174.0	190.0	211.0	**180.2**	147.2	175.0	191.9	212.2	**151.6**
b_5 Salinity at 0.4 %	136.9	160.0	181.9	201.0	**169.9**	138.2	161.0	183.9	202.2	**171.3**
b_6 Calcium carbonate at 2.5 %	200.0	209.0	220.6	232.0	**215.4**	201.0	210.1	222.0	234.0	**216.7**
b_7 Calcium carbonate at 5 %	190.0	208.0	220.0	231.9	**212.5**	191.0	209.1	221.9	233.0	**213.7**
b_8 Calcium carbonate at 10 %	179.0	199.0	215.0	224.7	**203.2**	180.0	200.0	209.0	232.0	**205.2**
b_9 Calcium carbonate at 20 %	169.3	190.0	200.0	219.3	**194.6**	170.0	191.0	204.0	205.0	**192.5**
Mean (A)	**169.2**	**195.6**	**209.8**	**223.9**		**176.4**	**197.2**	**210.7**	224.2	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	4.1	3.9	7.8			4.0	4.0	8.0		

Table (25): Effect of different concentrations of salinity and calcium carbonate on the uptake of Ca of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	399.0	371.0	352.0	311.0	**358.2**	400.0	372.1	353.0	312.2	**359.3**
b_2 Salinity at 0.05%	401.0	375.0	355.0	315.0	**361.5**	402.0	376.0	356.2	316.3	**362.6**
b_3 Salinity at 0.1 %	464.0	376.0	356.0	316.0	**378**	465.0	377.0	357.0	317.1	**379.0**
b_4 Salinity at 0.2 %	484.0	429.9	405.0	316.0	**408.7**	485.0	431.0	406.1	317.3	**409.8**
b_5 Salinity at 0.4 %	500.0	450.0	420.0	355.0	**431.2**	501.0	451.0	421.0	356.0	**432.2**
b_6 Calcium carbonate at 2.5 %	400.0	372.0	353.0	312.0	**359.2**	401.0	373.0	354.0	313.1	**360.3**
b_7 Calcium carbonate at 5 %	416.0	373.0	354.0	313.0	**364.0**	417.0	374.0	355.1	314.3	**365.1**
b_8 Calcium carbonate at 10 %	433.0	399.0	376.0	314.0	**380.5**	434.0	400.0	377.0	315.0	**381.5**
b_9 Calcium carbonate at 20 %	450.0	418.0	389.0	330.0	**396.7**	450.9	418.9	390.0	331.0	**397.7**
Mean (A)	**435.5**	**395.9**	**373.3**	**320.2**		**439.5**	**397.0**	**374.4**	**321.4**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	12.0	11.9	23.8			11.9	11.7	23.4		

Table (26): Effect of different concentrations of salinity and calcium carbonate on the uptake of sodium / plant (mg) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	87.0	84.0	80.0	77.1	**82.0**	87.9	85.0	81.1	77.9	**82.9**
b_2 Salinity at 0.05%	87.5	84.6	80.7	77.6	**82.6**	88.4	85.5	81.5	78.9	**83.6**
b_3 Salinity at 0.1 %	100.5	97.0	81.0	78.0	**89**	101.0	98.0	82.0	79.1	**90.0**
b_4 Salinity at 0.2 %	106.6	100.0	81.1	78.1	**91.4**	107.6	101.0	82.1	79.1	**92.4**
b_5 Salinity at 0.4 %	111.0	107.0	87.0	83.1	**97.0**	112.0	108.1	88.1	84.1	**98.9**
b_6 Calcium carbonate at 2.5 %	87.2	84.3	80.3	77.3	**82.3**	88.2	85.3	81.4	78.3	**83.3**
b_7 Calcium carbonate at 5 %	90.0	88.0	80.4	77.4	**71.4**	91.0	89.0	81.5	78.4	**84.9**
b_8 Calcium carbonate at 10 %	98.0	91.0	80.5	77.5	**85.5**	93.9	92.0	81.6	78.6	**86.5**
b_9 Calcium carbonate at 20 %	97.0	93.3	84.4	81.9	**89.1**	97.1	94.4	85.4	82.9	**89.9**
Mean (A)	**90.5**	**92.1**	**81.7**	**78.6**		**96.3**	**93.1**	**82.7**	**79.7**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	1.9	2.0	4.0			1.9	1.9	3.8		

Table (27): Effect of different concentrations of salinity and calcium carbonate on the uptake of chloride / plant (mg) of some grapevine cvs during 2013 & 2014 seasons.

Salinity and calcium carbonate treatments (B)	2013					2014				
	Grapevine cvs (A)									
	a_1 Superior	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**	**a_1 Superior**	**a_2 Crimson**	**a_3 Ruby**	**a_4 Flame**	**Mean (B)**
b_1 Control	45.0	43.0	40.0	37.3	**41.3**	46.4	44.5	41.6	36.3	**42.2**
b_2 Salinity at 0.05%	45.3	43.4	40.5	37.8	**41.7**	46.8	45.0	42.1	36.6	**42.6**
b_3 Salinity at 0.1 %	52.7	43.4	40.5	37.8	**43.6**	53.0	45.0	42.2	36.7	**44.2**
b_4 Salinity at 0.2 %	54.0	47.0	44.9	37.9	**45.9**	55.0	51.9	47.0	36.8	**47.7**
b_5 Salinity at 0.4 %	55.9	49.5	45.9	40.9	**48.0**	56.9	54.0	48.4	41.9	**50.3**
b_6 Calcium carbonate at 2.5 %	45.2	43.2	40.3	37.5	**41.5**	46.5	44.7	41.8	36.3	**42.3**
b_7 Calcium carbonate at 5 %	47.7	43.3	40.4	37.6	**42.2**	47.9	44.9	42.0	36.4	**42.8**
b_8 Calcium carbonate at 10 %	48.9	44.6	41.7	37.7	**43.2**	50.0	48.0	43.4	36.5	**44.5**
b_9 Calcium carbonate at 20 %	51.0	45.7	43.0	39.9	**44.9**	51.6	49.9	44.9	38.0	**46.1**
Mean (A)	**49.5**	**44.8**	**41.9**	**38.2**		**50.4**	**47.5**	**43.7**	**37.3**	
New L.S.D. at 5%	A	B	AB			A	B	AB		
	0.6	0.7	1.4			0.5	0.6	1.2		

References

1. Abd –El-Hady, A.M., Aly -Mervet, A. and El-Mogy, M.M. (2003): Effect of some soil conditioners on counteracting the adverse effects of salinity on growth and fruiting of Flame seedless vines. Minia J. of Agric. Res. & Develop. Vol. (23) No.4 pp. 699- 726.
2. Ahmed, O.A. (2007): Studies on salt tolerance and nematode residence of some grape rootstocks Ph. D. Thesis Fac. of Agric. Cairo Univ., Egypt
3. Allam- Aida, M.; Higazi, M.A.; Atalla, S.A.; Ahmed, A.S. and Omar, H.A. (1988): Effect of salinity on mineral composition of two grapevine cvs. (*Vitis vinifera, L.*) Minufiya J. Agric. Res. Vol. 3, No.3.
4. Al-Saidi, I.H. and Alawi B.J. (1984): Effect of different concentrations of NaCl and $CaCl_2$ on growth, dry weight and mineral elements of some grapevine cultivars (*Vitis vinifera L.*) Annals of Agric. Sci. Ain Shams Univ. Vol. 29, No.2, pp. 971- 988.
5. Association of Official Agricultural Chemists (A.O.A.C.) (2000): Official Methods of Analysis (A.O.A.C), 12th Ed., Benjamin Franklin Station, Washington D.C., U.S.A.pp.490-510.
6. Ayers, A.L. (1950): Salt tolerance of avocado trees grown in culture solution. Cal. Avocado Year Book, pp. 139- 148.
7. Bassoi, L.H.; Hopmans, J.W.; Jorge, L.A.dC., Alenar, CMd. Silva, J.A.Me.(2003): Grapevine root distribution ibn drip and microsprinkler irrigation. Sci. Doi: 10. 1590/s0103.
8. Bates, L.S.; Waldern, R.P. and Teare, L.D. (1973): Rapid determination of the free for water stress studies plant and soil, 939: 205-207.
9. Bavaresco, L. and Zamboni, M. (2001): The effect of rootstock and plant density on wine quality. Informatore Agraria supplemento 57 (14): 7-10.
10. Bavaresco, L. Bonini, P. and Giachino, E. (2000a): Resistance and seceptibility of some grapevine varieties to lime induced chlorosis. Acta Hort No. 528: 528- 535.
11. Bavaresco, L. Bonini, P. and Pezzutto, S. (2003): Grapevine rootstock effects on lime – induced chlorosis. Nutrient uptake, and source – sink relationships. J. of Plant. Nutrition 26 (7): 1415-1465. New York- USA.
12. Bavaresco, L.; Contu, E. and Trevisan, M. (2000b): Chlorosis occurrence, natural arbuscular mycorhizal infection and stilbene root concentration of ungrafted grapevine rootstock growing in calcareous soil. J. of plant Nutrition 23(11/14) 1685-1697.
13. Bavaresco, L.; Giachino, F. and Colla, R. (1999): Iron chlorosis paradox in grapevine. J. of Plant Nutrition 2 (10) 1589- 1597.
14. Bavaresco, L.; Presutto. P and Civardi, S. (2005): A lime - susceptible rootstock. Am. J. Enol-vitic., 56: 192- 195.
15. Ben- Asher, J.; Tsuyuk, I.; Ami Bravdo, B. and Sagih, M. (2006): Irrigation of grapevines with saline water. II Mathematical simulation of vine growth and yield. Agric. Water management vol. 83 Issues 1-2, pages 22-29.
16. Black, C.A.; Evans, D.D.; Ersminger, L.E.; White, J.L. and Clark, F.E. (1965): Methods of Soil Analysis. Amer. Soc. Agron. Inc. Bull. Medison, Wisconsin, U.S.A. pp. 891- 1400.
17. Bourgouin, B.; Gille, A.; Linder, P. and Monrozies, L. (2001): A survey of vineyard drainage basins in SW France. Phytoma, No. 544, pp. 44.
18. Chapman, V.J. (1966): Vegetation and Salinity. pp. 23- 42 in H. Boyko (ed.) salinity and aridity New approaches to Old Problems, Dr. W. Junke, The Hague.
19. Cinelli, F.; Fisichella, M. and Muleo, R. (2003): Morpho- physiological approaches to investigate lime- induced chlorosis in deciduous fruit trees species. J. Plant Nutr. 26, 2277-2294.
20. Downton, W.J.S.; Loveys, B.R. and Grant, W.J.R. (1990): Salinity effects on the stomatal behaviour of grapevine. New Phytologist, Vol. 116, No.3, pp. 499- 503.
21. Edmond, J.B.; Senn, T.L.; Andrews, F. S. and Halfacre R.G. (1975): Fundamental of Horticulture. McGraw Hill Book company 4th ed. pp. 131.
22. Eissa, A.M.; Haggag, M.N.; El- Sabrout, M.B. and Abd El- Rahman, M.E. (2003): Effect of some sodium salts on the growth, mineral composition and organic content of some grape rootstocks: I- The growth, J. Agric. Sci. Mansoura Univ., 28: 6821-6839.
23. El-Gazzar, A.M.; El-Azab, E.M. and Shehata, M. (1979): Effect of irrigation with fractions and sea water and drainage water on growth and mineral composition of young grapes, guavas, oranges and olives. Alexandria J. of Agric. Res. Vol. 27, No.1, pp.207- 219.
24. El- Hefnawi, S.M. (1986): Physiological studies on guava Ph., D. Thesis Fac. of Agric. Zagazig Univ. Egypt.
25. El- Mistran, C.W. and Hillyer, T.C. (1937): Relative turgidity and soluble solids in leaves proc. Amer. Soc. Hort. Sci. 569-574.

26. El-Naggar, L.M. and Amer. M.H. (1990): Effect of irrigation water quality on soil and plant in grapevine. Egypt. J. Appl. Sci. 5:190- 201.
27. Fisarakis, I.; Chartzoulkis, K. and Stavrakas, D. (2001): Response of Sultana vines (*V. vinifera L.*) on six rootstocks to NaCl salinity exposure and recovery. Agricultural Water Management. Vol. 51, No.1, pp. 13- 27.
28. Flowers, T.J. (2004): Improving crop salt tolerance. J. of Exper. Botany. 55(396) 307-319.
29. Food and Agriculture Organization (F.A.O.) (2014): Quarterly Bulletin of Statistics No. (112): 31 Year Book Annuario Production, 45, 154 - 155.
30. Gruber, B.; and Kosegarten, H. (2001): Inhibited leaf growth of plants grown in alkaline solution and on calcareous soils is a more sensitive Fe-deficiency symptom than leaf chlorosis plant and soil. Sciences Vol. 92- 152- 153.
31. Hassan, A.A.A. (1998): Effect of drought on fruit seedlings, M. Sc. Thesis Fac. of Agric. Al-Azhar Univ. Cairo, Egypt.
32. Hatem, H.H.(1984): Studies on the effect of salinity on grapes. Ph.D. Thesis, Fac. Agric., Cairo Univ.
33. Heck, R.J.; Riessem, H.; Santos, M.C.; Salcedo, I.H. and Alves, R.J.T. (2002): Chemical changes in Argislos under irrigated grape production in the central sea Francisco River Valley Brazil. Revista Brasileira de Ciencia do Solo, Vol. 26, No.1, pp. 141- 202.
34. Heidari Sharif Abad, H. (2002): Plant and Salinity. The Publications of Research Institution For Forests and Rangelands, p. 199.
35. Homai, M. (2003): Plants Reaction to Salinity. The Publications of Irrigation and Drainage Committee in Iran. P. 97.
36. Israelsen, O.W. and Hanson, V.E. (1962): Irrigation Principles and Practices. Wiley Tappon- Japan, 3rd Ed. pp. 30- 40.
37. Irigoyen, J.I.; Emerich, D.W. and Sachez- Diaz, M. (1992): Water stress induced changes in concentration of and total soluble sugar in nodulated alfalfa (*Medicago salive*) plants. Physiologia Plantarum, 84: 55-60.
38. Jackson, M.L. (1958): Soil Chemical Analysis. Constable and Co. L.d. London. pp.498.
39. Jalili- Marandi, R. (1998): Study on the tolerance of 10 grape cultivars at different concentrations of sodium chloride under in vitro condition. Iranian Journal of Agric. Sci. Vol.29, No.3, pp. 525- 533.
40. Joolka, N.K.; Singh, J.P. and Khera, A.P. (1977): Mineral composition of grape as affected by chloride and sulphate salts of sodium in soils. Ind. J. of Agric. Sci., 47 (4): 201- 203.
41. Junk, W. (1968): Saline irrigation for agriculture and forestry. Hoboyko, American Division of the World Academy of Art and Science(4), p. 201-216.
42. Karimi, H. and Yousef Zadeh, H. (2013): The effect of salinity level on the micrological and physiological traits of two grape cultures (*Vitis vinifera L.*). Inter J. of Agronomy and Plant production 4(5): 1108-1117.
43. Khanduja, S.D.; Chaturvedi, K.N. and Carg, V.K.(1980): Effect of exchangeable sodium percentage on the growth and mineral composition of Thompson seedless grapevines. Sci. Hort., 12 (1): 47-53.
44. Kok, D. (2012): Impacts of different salicylic acid doses on salinity tolerance of grapevine rootstocks. J. of Tekirdog Agric. Fac. 9(2): 32-40.
45. Kulinich, P.I. (1975): The accumulation of salts in grapevine organs and its effect on productivity, P.I Sbornik Nauchnykh Robot VNIIV Vinodeliya. No.6 (15), pp. 114- 123.
46. Lerner, H.R. (1985): Adaptation to salinity at the plant cell level. Plant and Soil. 89 3-14.
47. Mass, E.A. and Grattan, S.R. (1990): Crop growths as affected by salinity. In: Skaggs RW, van Schifgaarde J. (eds) Agricultural drainage, Agronomy 38 Amer Soc. Agron, Madison, Wisconsin, pp. 55-110.
48. Mehanna, H.T.; Fayed, T.A. and Roshdy, A.A. (2010): Response of two grapevine rootstocks to some salt tolerance treatments under saline water conditions. J. of Hort. Sci. Ornamental Plants. 2(2): 93-106.
49. Mehta, P.K.; Kachroo, A.; Kaul. M.K. and Yamdagni, R. (1988): Salt Tolerance in Fruit Crops- Rev. Agric., Vol. 9, No.2, pp. 57-68.
50. Miller, R.W.; Donahue, R.L. and Miller, J.U. (1990): Soils "An Introduction to Soils and Plant Growth" Prentice Hall Inter Inc. Englewood Cliffs, New Jersey. Pp. 308- 339.
51. Mohamed Khani, N.; Heidari, R.; Abbaspour, N. and Rahimani, F. (2013): Comparative study of salinity effects on ionic balance and compatible solutes in nine Iranian table grape (*Vitis vinifera* L.) Genotypes. J. Int. Sci. vigne vin 47, 99-114.
52. Munns, R. (2002): Comparative physiology of salt and water stress. Plant cell and Environment. 25: 239-250.
53. Nijjar, G.S. (1985): Nutrition of Fruit Tress. Kalyani Publishers New Delhi- Ludhiana Mrs. Usha Raj. Kumar p. 1- 320.
54. Nikolic, M. and Kastori, R. (1997): Effect of bicarbonate and Fe supply on Fe nutrition of grapevine, J. of Plant Nutrition 23(11/12) /619-1627.

55. Nomier- Safaa, A. (1994): Physiological studies on Kaki (*Diospyrus Kaki* L.) Ph. D. Thesis Fac. of Agric. Zagazig Univ. Egypt.
56. Ostrovskaya, K.L.; Truck, V.V. and Mikhailik, O.M. (1990): Superoxide dismutase activation in response to lime induced chlorosis. New phytologist Vol. 114 Issue 1 p. 39.
57. Paquin, R. and Lechasseur, P. (1979): Observationssve une methode de dosage de la libredans les extraits de plantes. Canadian Journal of Botany. 75: 1851-1854.
58. Paranichianakis, N.V.; Angelakis, A.N. and Chartzoulakis, K.S. (2000): Growth and mineral uptake of Sultanina grapevines irrigated with reclaimed wastewater and the potential for using such water in Crete, Greece. Acta Hort., Vol. 2, No.537, pp. 725- 730.
59. Pavlopusek, P. (2008): Preliminary results of tests of grapevine rootstocks resistance to lime induced chlorosis. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis LVI 299-302.
60. Pavlousek, P. (2009): Evaluation of Lime-induced Chlorosis Tolerance in New Rootstock Hybrids of Grapevine. European Journal of Hort. Sci.; 47(1): 35-41.
61. Petrosyan, G.P.; Saakyan, R.G. and Sakunts, L.E. (1979): Pigment content in leaves and berries in relation to the amount of sodium absorbed by grapevines on ameliorated solonets-Solonchak soil. Bioloicheskii Zhurnal. Armenii., Vol. 32, No.1, pp. 25- 30.
62. Rofael, M.S. (2004): Non conventional methods for irrigation Red Roomy and Ruby seedless grapevines (*Vitis vinifera L.*). Ph. D. Thesis Fac. Agric. Minia Univ. Egypt.
63. Ragab, M.A. (2004): Effect of irrigation with agricultural drainage water on growth and productivity of Ruby seedless grapevine cultivar. Minia J. of Agric. Res. & Develop. 24 (4): 601-620.
64. Salem, A.T. (1981): Effect of treatments by saline water on mineral content and growth of grape seedlings. Ph. D Thesis., Fac. Agric. Cairo. Univ.
65. Samra, J.S. (1985): Sodicity tolerance of grapes with reference to the uptake of nutrients. Indian J. of Hort. Vol. 42. No. 2, pp. 12- 17.
66. Saxton, V. (2002): Calcium in viticulture, unravelling the mysthne of fresh terroir. Australian & New Zealand Wine Industry J. 17 (3): 28- 33.
67. Schmidt, J.; Manty, F.; Hyber, L.; Porten, M. and Huhl, E.H. (2005): Experience with rootstocks varieties in Germany. Proc. Rootstocks symposium- Grapevine rootstocks: Current use research and application, 14- 24.
68. Shani, U. and Ben-Gal, A. (2005): Long –term response of grapevine to salinity: Osmotic effects and ion toxicity. American J. of Enology and Viticulture. 56(2): 148-154.
69. Shehata, M.M.; Elamshary, S. and Khalil, W. (1996a): Young grapevines response to depth salinity of water table. Alexandria J. of Agric. Res. Vol. 41, No. 2, pp. 331- 336.
70. Shehata, M.M.; Kamel, A. and Aly, M.A. (1996b): Association of chlorosis in Thompson seedless grapevines with some soil and nutritional factors under calcareous conditions. Alexandria J. of Agric. Res. Vol. 41, No.2, pp. 303- 312.
71. Singh, S.K.; Sharma, H.C.; Goswami, A.M.; Datta, S. P. and Singh, S.P. (2000): In vitro growth and leaf composition of grapevines cultivars as affected by sodium chloride. Biologia Plantarum. Vol. 43, No. 2, pp. 283-386.
72. Sivritepe, N. (2000): Physiological changes in grapevine induce by osmotic stress originated from salt and their role in salt resistance. Turkish J. of Biology. Vol. 24, No. Supplement, pp. 47-104.
73. Snedecor, G. W. and Cochran, G.w. (1967): Statistical Methods 6th Ed. Iowa state, Univ. Press, U.S.A. pp. 60- 70.
74. Sortipopoulos, T.E. (2007): Effect of NaCl and $CaCL_2$ on grown and contents of minerals, Chlorophyll, praline and sugar in the apple rootstocks M_4 cultured in vitro Biologia Plantrum. 51 (1): 177-180.
75. Stevens, R.M. and Walker, R.R. (2002): Response of grapevines to irrigation- induced saline- sodic soil conditions. Australian J. of Exp. Agric. Vol. 42, No.3, pp. 323- 331.
76. Strogonov, B.P. (1964): Physiological basis of salt tolerance of plants. Sci. Aci. USSR, Davey and Co. New York (C.F. Levitt, 1960).
77. Taha, M.W.; El-Azab, E.M. and Fadish, Z. (1972b): Ionic leaf accumulation in grape, guava and olive plants as affected by the salinity of irrigation water. Alex. J. Agric. Res. 20-299-309.
78. Taiz, L. and Zeigr, E. (2006): Plant Physiology, Sinauer associates. Inc., Publishers, Sunder land, Massachuseets. P. 690.
79. Taylor, R.M.; Fenn, L.B. and Pety, C.A. (1987): Nitrogen uptake by grapes with divided roots growing in differentially salinized soils. Hort. Vol. 22, No.4, p. 664.
80. Urdanoz, V. and Aragues, R. (2009): Three- year field response of drip- irrigated grapevine (*Vitis*

vinifera L. cv. Tempranillo) to soil salinity. Plant soil. 324: 219- 230.

81. Von-Wettstein, D.V.C. (1957): Chlorophyll Latale und der Sumbmikro. Skopishe Formwechsel de Plastids Experimental cell research, 12: 427.
82. Walker, R.R.; Read, P.E. and Blackmore, D.H. (2000): Rootstock and salinity effects on rates of berry maturation, ion accumulation and colour development in Shiraz grapes Australian J. of Grape and Wine res. 6: 227-239.
83. Walker, R.R.; Blackmore, D.H.; Clingeleffer, P.R, and Corelle, R.J. (2002): Rootstock effects on salt tolerance of irrigated field - grown grapevines (*Vitis vinifera* L. cv. Sultana). 1-Yield and Vigour inter relationships Australian J. of Grape and Wine Res. 83-14.
84. Weaver, R.J. (1976): Grape Growing. John Wiley & sons Inc. New York. pp. 100-120.
85. Wilde, S.A.; Cory, R.B.; Lyer, J.G. and Voigt, G.K. (1985): Soils and Plants Analysis for Tree Cultures. Oxford IBH, New Delhi, India, pp 94-105.
86. Winkler, A.J.; Cook, A.J.; Kliewer, W. M. and Lider, L.A. (1974): General Viticulture. California Univ. Press, Barkely. Pp. 110- 120.
87. Yulin- Su, L. and Miller, G.W. (1961): Chlorosis in higher plants as related to organic acid content. Plant Physiology, 36: 415- 420.

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