**Trials for Alleviating the Adverse Effects of Salinity on Some Grapevine Cvs**

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**Abstract:** During 2013 and 2014 seasons, transplants of three grapevine cvs Flame seedless, Red Roomy and Superior were subjected to soil salinity at 1000 to 2000 ppm and three antioxidants namely citric acid at 1000 ppm, potassium silicate at 1000 ppm and salicylic acid at 50 ppm as an attempt for enhancing the tolerance of these grapevines cvs to soil salinity. Flame seedless grapevine cv showed a remarkable tolerance to soil salinity till 2000 ppm, especially when accompanied with using any one of the three antioxidants. The best antioxidant in controlling salinity was salicylic acid followed by potassium silicate. Based on the obtained results, Flame seedless grapevine could tolerate 2000 ppm salinity in the soil when subjected to spraying salicylic acid at 50 ppm. Both Red Roomy and Superior grapevine cvs could tolerate 1000 ppm soil salinity also when the transplants were subjected to spraying salicylic acid at 50 ppm.

[Abd El-Hameed M.M. Wassel; Farouk H. Abdelaziz; Mervat A. Aly and Atiat A.M. Moustafa. **Trials for Alleviating the Adverse Effects of Salinity on Some Grapevine Cvs.** *World Rural Observ* 2015;7(4):14-21]. ISSN: 1944-6543 (Print); ISSN: 1944-6551 (Online). <http://www.sciencepub.net/rural>. 3

**Keywords**: grpevien cvs, soil salinity, tolerance, antioxidants.

**1. Introduction**

Nowadays, many trials were established for enhancing the tolerance of some grapevine cvs to salinity. Using antioxidants are beneficial in this respect through their positive action on enhancing the tolerance of trees to biotix and abiotic stresses. Citric acid, silicon and salicylic acid were found by many authors to maintain plant water balance and structure of xylemvessels and layers under higher transpiration rates. (**Rao *et al.,* 2000; Ding, *et al.,* 2001; Iwaski *et al.,* 2002; Hattori *et al.,* 2003 and Ding and Wang, 2003)**.

Salinity caused an obvious reduction on growth and nutrient uptake of grapevines (**Singh *et al.,* 2000; Viana *et al.,* 2001; Fisarakis *et al.,* 2001; Abd El- Hady *et al.,* 2003 and Mohamed – Khani *et al.,* 2013**).

Antioxidants were found by many authors to stimulate growth characters in different grapevine cvs (**Uwakiem, 2011; Refaai, 2011; Al- Obeed, 2011; El- Hanafy, 2011; El- Kady- Hanaa, 2011; Osman, 2014 and Al- Wasfy, 2014)**.

The target of this study was examining the effect of some antioxidants on enhancing the tolerance of some grapevine cvs to soil salinity.

**2. Material and Methods**

This pot experiment was conducted during the two successive seasons of 2013 and 2014 on Nursery of El- Mataana Agricultural Experimental Station situated at Esna district,, Luxor Governorate in order to test the response and tolerance of the transplants of grapevine cvs Superior, Red Roomy and Flame seedless to salinity in the soil. Uniform and healthy two hundred 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 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 CaCO3 % | :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 |

The experiment included twenty – seven treatments from two factors namely A & B. The first factor (A) consisted from three grapevine cvs namely a1) Superior, a2) Red Roomy and a3) Flame seedless. The second factor (B) included the following nine treatments:

b1) Control (untreated transplants).

b2) Soil salinity at 1000 ppm alone.

b3) Soil salinity at 1000 ppm + spraying citric acid at 1000 ppm.

b4) Soil salinity at 1000 ppm + potassium silicate at 1000 ppm.

b5) Soil salinity at 1000 ppm + spraying salicylic acid at 50 ppm.

b6) Soil salinity at 2000 ppm alone.

b7) Soil salinity at 2000 ppm + spraying citric acid at 1000 ppm.

b8) Soil salinity at 2000 ppm + potassium silicate at 1000 ppm.

b9) Soil salinity at 2000 ppm + spraying salicylic acid at 50 ppm.

Each treatment was replicated three times, ten seedling per each. Soil salinity was derived from mixing sodium chloride and sodium sulphate in an equal weight (1:1 by weight). Concentration of 0.05, 0.1, 0.2 and 0.4 % salinity were caused by mixing (1.5+ 1.5 g + 3+ 3g & 6 + 6g and 12 + 12g from sodium chloride + sodium sulphate/ bag, respectively.

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 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 **Israelsen 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 point0 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 % K2O) /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.

The three antioxidants namely citric acid, potassium silicate (25 %Si + 10% K2O) and salicylic acid were sprayed three times started on the first week of June, July and August during both seasons. Triton B as a wetting agent was added to all antioxidant solutions a 0.05%. Salicylic acid solutions was adjusted to pH 6 by using sodium hydroxide 1.0 N It was solubilized in few drops of Ethyl alcohol before use. Spraying was done till run off (0.5 litre / transplant).

This factorial experiment (27 treatments) was set up in a complete randomized design. The main factor was the three grapevine cvs Superior, Red Roomy and Flame seedless, while the second factor consisted from the previous nine treatments from soil salinity and antioxidant treatments. Each treatment was replicated three times, ten transplants per each.

During both seasons, the following measurements were recorded:

1. Survival %.
2. Plant height (cm.)
3. Area of root distribution / plant (cm)2
4. Leaf relative turgidity (**El- Mistrobn and Hillyer, 1937; El- Hefnawi, 1986 and Nomier- Safaa, 1994**).
5. Leaf succulence grade (**El- Hefnawi, 1986; Nomier- Safaa, 1994 and Hassan, 1998**).
6. Uptake of N, P and K by multiplying dry weight of plant by concentration of each element (mg/ plant) (**Piper, 1950; Wilde et al., 1985 and A.O.A.C., 2000)**.

Statistical analysis was done according to **Snedecor and Cochran 1967** using new L.S.D. test at 5%.

**3. Results and Discussion**

**1- Survival %:**

It is clear from the data in Table (2) that Flame seedless grapevine cv significantly had the highest values of survival % Superior cv had the lowest values.

Subjecting the transplants of the three grapevine cvs growing under salinity to any one of the three antioxidants namely citric acid at 1000 ppm, potassium silicate at 1000 ppm and salicylic acid at 50 ppm significantly enhanced survival % comparing with those under salinity conditions alone. The best antioxidant in this respect was salicylic acid.

Growing Flame seedless grapevine transplants under salinity and subjecting them to salicylic acid at 50 ppm gave the maximum percentage of survival.

**2- Plant height:**

It is clear from the data on Table (3) that plant height significantly varied among the three grapevine cvs. It was maximized in grapevine cv, Flame seedless. Superior grapevine cv had the minimum values. These results were true during both seasons.

Plant height significantly reduced with increasing soil salinity from 1000 to 2000 ppm. Using any one of the three antioxidants to grapevine transplants had significant promotive effect on plant height of transplants growing under salinity conditions comparing with those under soil salinity without antioxidant treatments. The best antioxidant in this respect was salicylic acid followed by potassium silicate. Spraying salicylic acid at 50 ppm significantly counteracted the adverse effects of salinity on plant height.

The maximum plant height was recorded on Flame seedless transplants under 1000 ppm salinity and subjected to spraying salicylic acid at 50 ppm. In Flame seedless transplants, increasing salinity levels from 1000 to 2000 ppm with the assistance of using salicylic acid at 50 ppm failed to show significant reduction on plant height.

**3- Area of root distribution / plant:**

Data in Table (4) obviously reveal that the area of root distribution / plant significantly differed among the three grapevine cvs. The maximum values were recorded on grapevine cvs Flame seedless, Red Roomy and Superior, in descending order.

Soil salinity at 2000 ppm significantly decreased the area of root distribution / plant comparing with salinity at 1000 ppm. No significant reduction was observed with increasing salinity concentrations from 0.0 to 1000 ppm. Using any antioxidants significantly succeeded in alleviating the adverse effects of salinity on the area of root distribution / plant.

The maximum values were recorded on Flame seedless transplants growing under 1000 ppm salinity and subjected to spraying salicylic acid at 50 ppm during 2013 and 2014 seasons.

**4- Leaf water relative turgidity and leaf succulence grade:**

It is clear from the data in Tables (5 & 6) that leaf water relative turgidity and leaf succulence grade significantly varied among the three grapevine cvs. Both were maximized in grapevine cvs Flame seedless. Grapevine cv. Superior had the lowest values during both seasons.

Subjecting grapevine transplants to salinity at 2000 ppm significantly reduced such two physiological characters comparing with exposing to soil salinity at 1000 ppm. Soil salinity at 1000 ppm caused unsignificant reduction on such two characters. Treating the plants with antioxidants significantly promoted such two physiological traits. Using antioxidants significantly was very effective in alleviating the adverse effects of salinity on both two physiological characters. The best antioxidant was salicylic acid followed by potassium silicate.

The maximum values were recorded on Flame seedless transplants grown under 1000 ppm salinity and subjecting to salicylic acid at 50 ppm.

**5- Uptake of N, P and K by plants:**

Data in Tables (7 & 8 & 9) clearly show that the highest uptake of N, P and K were recorded on grapevine cv. Flame seedless. The lowest values were recorded on grapevine cv. Superior. These results were true during both seasons.

Growing the transplants under soil salinity at 2000 ppm significantly reduced the uptake of N, P and K rather than growing at normal conditions or at salinity conditions reached 1000 ppm. Uptake of N, P and K slightly reduced on the transplants growing under 1000 ppm salinity. Using any antioxidants via spraying significantly was responsible for enhancing the uptake of these nutrients. Therefore, application of any antioxidants significantly was favourable for overcoming the adverse effects of salinity on uptake of these nutrients. The best antioxidant in this respect was salicylic acid at 50 ppm.

Growing Flame seedless transplants under 1000 ppm salinity and subjecting them to salicylic acid at 50 ppm gave the maximum values. The lowest values were recorded on Superior transplants subjecting to 2000 ppm soil salinity without any antioxidant treatments.

**Discussion:**

The harmful effects of salinity on growth and uptake of nutrients in different fruit crops might be attributed to its negative effects on cell division, photosynthesis, metabolism, plant pigments and building of organic foods (**Ayers, 1950**). The tolerance of some grapevine cvs to salinity might be attributed to their ability to prevent salts from entering the plant tissues and reducing the salt concentration through accumulating salts in the vacuoles of the cells (**Flowers, 2004**).

The reducing effect of salinity on growth and uptake of nutrients was emphasizd by the results of **Singh *et al.,* (2000); Viana *et al.,* (2001) Fisarakis *et al.,* (2001); Abd El- Hady *et al.,* (2003) and Mohamed – Khani *et al.,* (2013).**

The beneficial effects of antioxidants on alleviating the adverse effects of salinity on salinity might be attributed to their positive action on cell division and the tolerance of plants to biotic and abiotic stresses (**Rao *et al.,* 2000, Ding, *et al.,* 2001 and Ding and Wang, 2003**).

The promoting effect of antioxidants on growth characters was supported by the results of **Uwakiem (2011); Refaai (2011); Al- Obeed (2011) and Al- Wasfy (2014).**

Table (2): Effect of different salinity and antisalinity treatments on the survival percentage of some grapevine transplants during 2013 & 2014 seasons.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Salinity and anti salinity treatments  (B) | 2013 | | | | 2014 | | | |
| Grapevine cvs (A) | | | | | | | |
| **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** | **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** |
| b1 Control | 81.3 | 85.3 | 90.0 | **85.5** | 82.0 | 86.0 | 91.0 | **86.3** |
| b2 Salinity at 1000 ppm | 81.0 | 85.0 | 69.9 | **85.3** | 81.7 | 85.8 | 90.6 | **86.0** |
| b3 Salinity at 1000 ppm +citric acid | 82.3 | 86.6 | 71.9 | **86.9** | 83.0 | 87.3 | 92.6 | **87.6** |
| b4 Salinity at 1000 ppm + silicon | 84.0 | 88.0 | 93.9 | **88.6** | 84.8 | 88.7 | 94.6 | **91.0** |
| b5 Salinity at 1000 ppm + salicylic acid | 86.0 | 90.6 | 75.0 | **90.5** | 86.8 | 91.3 | 95.7 | **91.2** |
| b2 Salinity at 2000 ppm | 71.0 | 75.0 | 89.6 | **78.5** | 71.8 | 75.8 | 90.3 | **79.3** |
| b3 Salinity at 2000 ppm +citric acid | 73.8 | 77.0 | 91.7 | **80.6** | 74.5 | 77.8 | 92.4 | **81.5** |
| b4 Salinity at 2000 ppm + silicon | 75.0 | 79.0 | 93.7 | **82.5** | 75.7 | 79.8 | 94.5 | **83.3** |
| b5 Salinity at 2000 ppm + salicylic acid | 76.5 | 81.0 | 94.7 | **84.1** | 77.2 | 81.8 | 95.6 | **84.8** |
| Mean (A) | **78.9** | **83.0** | **92.2** |  | 79.7 | 83.8 | 93.0 |  |
| New L.S.D. at 5% | A | B | AB |  | A | B | AB |  |
| 1.0 | 1.0 | 1.7 |  | 1.0 | 1.1 | 1.8 |  |

Table (3): Effect of different salinity and antisalinity treatments on the plant height (cm) of some grapevine transplants during 2013 & 2014 seasons.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Salinity and anti salinity treatments  (B) | 2013 | | | | 2014 | | | |
| Grapevine cvs (A) | | | | | | | |
| **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** | **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** |
| b1 Control | 73.3 | 75.2 | 85.0 | **77.8** | 80.1 | 81.6 | 86.0 | **82.5** |
| b2 Salinity at 1000 ppm | 73.0 | 74.9 | 84.3 | **77.4** | 79.8 | 81.4 | 85.4 | **80.2** |
| b3 Salinity at 1000 ppm +citric acid | 74.0 | 75.9 | 86.3 | **78.7** | 74.9 | 82.6 | 86.5 | **81.3** |
| b4 Salinity at 1000 ppm + silicon | 75.8 | 76.9 | 88.3 | **80.3** | 76.5 | 83.7 | 88.2 | **82.8** |
| b5 Salinity at 1000 ppm + salicylic acid | 77.0 | 79.0 | 90.4 | **82.1** | 77.8 | 85.0 | 90.3 | **84.2** |
| b2 Salinity at 2000 ppm | 66.1 | 68.0 | 84.0 | **72.7** | 66.8 | 69.1 | 85.0 | **73.6** |
| b3 Salinity at 2000 ppm +citric acid | 68.2 | 70.2 | 86.0 | **74.8** | 69.0 | 71.3 | 86.3 | **75.5** |
| b4 Salinity at 2000 ppm + silicon | 70.0 | 72.0 | 88.0 | **76.6** | 70.7 | 73.0 | 88.0 | **77.2** |
| b5 Salinity at 2000 ppm + salicylic acid | 71.3 | 73.3 | 90.1 | **78.2** | 72.0 | 74.4 | 90.0 | **78.8** |
| Mean (A) | **72.0** | **74.0** | **87.0** |  | 73.5 | 78.0 | 87.3 |  |
| New L.S.D. at 5% | A | B | AB |  | A | B | AB |  |
| 1.0 | 1.1 | 1.8 |  | 1.0 | 1.1 | 1.8 |  |

Table (4): Effect of different salinity and antisalinity treatments on the area of root distribution per plant (cm)2 of some grapevine transplants during 2013 & 2014 seasons.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Salinity and anti salinity treatments  (B) | 2013 | | | | 2014 | | | |
| Grapevine cvs (A) | | | | | | | |
| **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** | **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** |
| b1 Control | 215.0 | 275.5 | 251.0 | **233.8** | 217.5 | 238.6 | 255.0 | **237.0** |
| b2 Salinity at 1000 ppm | 214.4 | 234.9 | 250.0 | **233.1** | 217.3 | 238.0 | 254.0 | **236.4** |
| b3 Salinity at 1000 ppm +citric acid | 221.0 | 241.9 | 256.3 | **239.7** | 224.0 | 245.0 | 261.0 | **243.3** |
| b4 Salinity at 1000 ppm + silicon | 228.3 | 249.0 | 266.0 | **247.7** | 231.3 | 252.0 | 271.0 | **251.4** |
| b5 Salinity at 1000 ppm + salicylic acid | 236.0 | 257.7 | 275.0 | **256.2** | 239.0 | 260.8 | 281.0 | **260.2** |
| b2 Salinity at 2000 ppm | 191.0 | 197.0 | 249.0 | **212.3** | 195.0 | 200.0 | 253.0 | **216.0** |
| b3 Salinity at 2000 ppm +citric acid | 198.4 | 205.3 | 255.0 | **230.1** | 199.0 | 209.0 | 260.0 | **222.6** |
| b4 Salinity at 2000 ppm + silicon | 203.0 | 211.9 | 265.0 | **226.6** | 204.0 | 216.0 | 270.0 | **230.0** |
| b5 Salinity at 2000 ppm + salicylic acid | 209.3 | 218.4 | 247.0 | **233.9** | 210.0 | 220.0 | 280.0 | **236.6** |
| Mean (A) | **214.7** | **227.9** | **260.1** |  | 215.2 | 231.0 | 265.0 |  |
| New L.S.D. at 5% | A | B | AB |  | A | B | AB |  |
| 4.1 | 4.3 | 7.3 |  | 4.0 | 4.1 | 7.1 |  |

Table (5): Effect of different salinity and antisalinity treatments on the leaf relative turgidity % of some grapevine transplants during 2013 & 2014 seasons.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Salinity and anti salinity treatments  (B) | 2013 | | | | 2014 | | | |
| Grapevine cvs (A) | | | | | | | |
| **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** | **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** |
| b1 Control | 41.7 | 43.0 | 50.0 | **45.9** | 44.3 | 46.3 | 51.0 | **47.2** |
| b2 Salinity at 1000 ppm | 41.6 | 42.9 | 49.3 | **44.6** | 43.9 | 45.9 | 50.9 | **46.9** |
| b3 Salinity at 1000 ppm +citric acid | 43.7 | 45.0 | 54.0 | **47.5** | 46.0 | 48.1 | 55.0 | **49.7** |
| b4 Salinity at 1000 ppm + silicon | 45.0 | 48.0 | 57.9 | **50.3** | 49.0 | 51.0 | 58.0 | **52.6** |
| b5 Salinity at 1000 ppm + salicylic acid | 46.7 | 51.0 | 60.0 | **52.5** | 51.9 | 54.0 | 61.0 | **55.6** |
| b2 Salinity at 2000 ppm | 37.3 | 39.0 | 49.0 | **41.7** | 37.3 | 39.9 | 50.7 | **42.6** |
| b3 Salinity at 2000 ppm +citric acid | 38.5 | 40.5 | 53.9 | **44.3** | 39.4 | 42.0 | 54.9 | **45.4** |
| b4 Salinity at 2000 ppm + silicon | 39.9 | 42.3 | 57.7 | **46.6** | 40.9 | 44.0 | 57.8 | **47.5** |
| b5 Salinity at 2000 ppm + salicylic acid | 40.6 | **44.1** | **59.7** | **48.1** | 42.3 | 46.0 | 60.9 | **49.7** |
| Mean (A) | **42.0** | **44.0** | **54.6** |  | 43.9 | 46.3 | 55.5 |  |
| New L.S.D. at 5% | A | B | AB |  | A | B | AB |  |
| 1.1 | 1.2 | 2.0 |  | 1.1 | 1.2 | 2.0 |  |

Table (6): Effect of different salinity and antisalinity treatments on the leaf succulanarde of some grapevine transplants during 2013 & 2014 seasons.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Salinity and anti salinity treatments  (B) | 2013 | | | | 2014 | | | |
| Grapevine cvs (A) | | | | | | | |
| **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** | **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** |
| b1 Control | 1.86 | 1.96 | 2.22 | **2.01** | 1.89 | 1.99 | 2.33 | **2.07** |
| b2 Salinity at 1000 ppm | 1.84 | 1.95 | 2.20 | **1.99** | 1.87 | 1.98 | 2.32 | **2.05** |
| b3 Salinity at 1000 ppm +citric acid | 1.94 | 2.04 | 2.35 | **2.11** | 2.00 | 2.10 | 2.43 | **2.17** |
| b4 Salinity at 1000 ppm + silicon | 2.06 | 2.17 | 2.51 | **2.46** | 2.13 | 2.24 | 2.55 | **2.30** |
| b5 Salinity at 1000 ppm + salicylic acid | 2.20 | 2.31 | 2.66 | **2.39** | 2.30 | 2.41 | 2.70 | **2.47** |
| b2 Salinity at 2000 ppm | 1.41 | 1.52 | 2.19 | **1.70** | 1.43 | 1.50 | 2.31 | **1.74** |
| b3 Salinity at 2000 ppm +citric acid | 1.51 | 1.64 | 2.34 | **1.83** | 1.54 | 1.60 | 2.42 | **1.85** |
| b4 Salinity at 2000 ppm + silicon | 1.62 | 1.74 | 2.50 | **1.95** | 1.66 | 1.70 | 2.54 | **1.96** |
| b5 Salinity at 2000 ppm + salicylic acid | 1.73 | 1.83 | 2.65 | **2.07** | 1.77 | 1.81 | 2.69 | **2.09** |
| Mean (A) | **1.80** | **1.90** | **2.40** |  | 1.84 | 1.92 | 2.47 |  |
| New L.S.D. at 5% | A | B | AB |  | A | B | AB |  |
| 0.09 | 0.10 | 0.17 |  | 0.10 | 0.10 | 0.17 |  |

Table (7): Effect of different salinity and antisalinity treatments on the uptake of N/ plant (mg) of some grapevine transplants during 2013 & 2014 seasons.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Salinity and anti salinity treatments  (B) | 2013 | | | | 2014 | | | |
| Grapevine cvs (A) | | | | | | | |
| **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** | **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** |
| b1 Control | 312.0 | 333.3 | 363.0 | **336.1** | 315.5 | 335.9 | 363.9 | **338.4** |
| b2 Salinity at 1000 ppm | 311.0 | 331.9 | 361.0 | **334.6** | 314.9 | 335.0 | 362.9 | **337.6** |
| b3 Salinity at 1000 ppm +citric acid | 321.0 | 341.9 | 372.0 | **345.0** | 324.0 | 345.0 | 375.0 | **348** |
| b4 Salinity at 1000 ppm + silicon | 330.0 | 360.0 | 390.0 | **360** | 333.0 | 360.0 | 396.0 | **363** |
| b5 Salinity at 1000 ppm + salicylic acid | 341.0 | 371.0 | 401.0 | **371** | 344.0 | 375.0 | 404.0 | **374.3** |
| b2 Salinity at 2000 ppm | 281.3 | 300.0 | 360.0 | **313.8** | 383.3 | 300.0 | 362.9 | **315.4** |
| b3 Salinity at 2000 ppm +citric acid | 290.0 | 309.0 | 371.0 | **323.3** | 293.0 | 311.0 | 374.6 | **326.2** |
| b4 Salinity at 2000 ppm + silicon | 299.0 | 318.9 | 389.0 | **335.6** | 305.0 | 320.0 | 35.0 | **340.0** |
| b5 Salinity at 2000 ppm + salicylic acid | 304.0 | 324.0 | 400.6 | **342.9** | 311.9 | 331.7 | 403.9 | **349.12** |
| Mean (A) | **309.9** | **332.2** | **378.6** |  | 313.8 | 334.8 | 382.0 |  |
| New L.S.D. at 5% | A | B | AB |  | A | B | AB |  |
| 6.1 | 6.3 | 10.7 |  | 6.0 | 6.3 | 10.7 |  |

Table (8): Effect of different salinity and antisalinity treatments on the uptake of P plant (mg) of some grapevine transplants during 2013 & 2014 seasons.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Salinity and anti salinity treatments  (B) | 2013 | | | | 2014 | | | |
| Grapevine cvs (A) | | | | | | | |
| **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** | **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** |
| b1 Control | 55.2 | 59.0 | 65.0 | **59.7** | 56 | 60.0 | 66.0 | **60.67** |
| b2 Salinity at 1000 ppm | 55.0 | 58.7 | 64.7 | **59.5** | 55.9 | 59.8 | 65.9 | **60.53** |
| b3 Salinity at 1000 ppm +citric acid | 59.0 | 65.0 | 70.0 | **64.7** | 59.9 | 64.0 | 70.0 | **64.63** |
| b4 Salinity at 1000 ppm + silicon | 63.0 | 70.0 | 74.9 | **69.6** | 64.9 | 69.9 | 74.0 | **69.60** |
| b5 Salinity at 1000 ppm + salicylic acid | 67.9 | 75.0 | 81.0 | **74.6** | 68.8 | 74.0 | 80.0 | **74.27** |
| b2 Salinity at 2000 ppm | 48.0 | 53.0 | 64.5 | **55.2** | 48.8 | 52.0 | 65.8 | **55.53** |
| b3 Salinity at 2000 ppm +citric acid | 51.0 | 57.0 | 69.7 | **59.2** | 51.9 | 54.5 | 69.9 | **58.77** |
| b4 Salinity at 2000 ppm + silicon | 54.0 | 61.0 | 74.7 | **63.2** | 54.9 | 57.0 | 73.9 | **61.93** |
| b5 Salinity at 2000 ppm + salicylic acid | 58.5 | 66.0 | 80.8 | **68.4** | 59.4 | 58.9 | 79.8 | **66.03** |
| Mean (A) | **57.0** | **62.7** | **71.7** |  | 57.8 | 61.12 | 71.7 |  |
| New L.S.D. at 5% | A | B | AB |  | A | B | AB |  |
| 2.1 | 2.2 | 3.8 |  | 2.0 | 2.0 | 3.4 |  |

Table (9): Effect of different salinity and antisalinity treatments on the uptake of K / plant of some grapevine transplants during 2013 & 2014 seasons.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Salinity and anti salinity treatments  (B) | 2013 | | | | 2014 | | | |
| Grapevine cvs (A) | | | | | | | |
| **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** | **a1 Superior** | **a2**  **Red Roomy** | **a3**  **Flame** | **Mean (B)** |
| b1 Control | 201.0 | 211.0 | 221.0 | **211.0** | 204.1 | 210.0 | 220.0 | **211.4** |
| b2 Salinity at 1000 ppm | 200.0 | 210.0 | 220.0 | **200.0** | 203.9 | 209.9 | 220.0 | **211.3** |
| b3 Salinity at 1000 ppm +citric acid | 208.0 | 219.0 | 229.9 | **219.0** | 211.9 | 217.3 | 229.0 | **219.4** |
| b4 Salinity at 1000 ppm + silicon | 217.0 | 229.0 | 241.0 | **229.0** | 217.0 | 225.0 | 236.0 | **226** |
| b5 Salinity at 1000 ppm + salicylic acid | 229.0 | 241.0 | 252.0 | **240.6** | 231.0 | 233.0 | 243.0 | **235.8** |
| b2 Salinity at 2000 ppm | 171.0 | 181.0 | 219.0 | **190.3** | 174.0 | 180.0 | 219.0 | **191.0** |
| b3 Salinity at 2000 ppm +citric acid | 182.0 | 192.0 | 229.0 | **201.0** | 181.0 | 186.0 | 228.8 | **158.6** |
| b4 Salinity at 2000 ppm + silicon | 187.0 | 199.0 | 240.0 | **208.7** | 188.0 | 193.0 | 235.9 | **205.6** |
| b5 Salinity at 2000 ppm + salicylic acid | 193.0 | 204.0 | 251.5 | **162.1** | 193.9 | 200.0 | 243.3 | **212.4** |
| Mean (A) | **198.7** | **209.6** | **233.7** |  | 200.5 | 206.0 | 243.7 |  |
| New L.S.D. at 5% | A | B | AB |  | A | B | AB |  |
| 5.0 | 5.1 | 8.7 |  | 5.0 | 5.2 | 8.8 |  |

**Conclusion:**

For enhancing the tolerance of grapevine cvs Flame seedless to salinity (2000 ppm) and both Red Roomy and Superior (1000 ppm) it is suggested to spray salicylic acid at 50 ppm three times.

**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. (23) 4 pp. 699- 726.
2. Al- Obeed, R.S. (2011): Enhancing the shelf life and storage ability of Flame seedless grapevines by agrochemical preharvest foliar applications. Middle - East J. of Sci. 8(2): 319-327.
3. Al -Wasfy, M.M.M. (2014): The Synergistic effects of using silicon with some vitamins on growth and fruiting of Flame seedless grapevines. Stem Cell 5 (I): 8-13.
4. Association of Official Agricultural Chemists (2000): Official Methods of Analysis, A.O.A.C. 11th Ed. pp. 494- 500. The A.O.A.C.P.O. Box 540 Benjamin Franklin Station Washington D.C. U.S.A.
5. Ayers, A.L. (1950): Salt tolerance of avocado trees grown in culture solution. Cal. Avocado Year Book, pp. 139- 148.
6. 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.
7. Ding, C. K.; Wang, C.Y.; Gross, K.C. & Smith, D.L. (2001): Reducing of chilling injury and transcript accumulation of heat shock protein genes in tomatoes by methyl asmonate and methyle salicylate. plant science, 161, 1153-1159.
8. Ding, C.K. and Wang, C.Y. (2003): The dual effects of methyl salicylate on ripening and expression of ethylene biosynthetic genes in tomato fruit. Plant science, 164, 89-596.
9. El- Hanafy, W.M.F. (2011): The role of some antioxidants on improving vines productivity in red Roomy grapevine vineyard. M. Sc. Thesis Fac. of Agric, Minia Univ. Egypt.
10. El- Kady - Hanaa, P.M. (2011): Productive performance of Thompson seedless grapevines in relation to application of some antioxidants, magnesium and boron. M. Sc. Thesis Fac. of Agric. Minia Univ. Egypt.
11. El- Hefnawi, S.M. (1986): Physiological studies on guava. Ph., D. Thesis Fac. of Agric. Zagazig Univ. Egypt.
12. El- Mistrobn, C.W. and Hillyer, T.C. (1937): Relative turgidity and soluble solids in leaves proc. Amer. Soc. Hort. Sci. 569-574.
13. 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.
14. Flowers, T.J. (2004): Improving crop salt tolerance. J. of Exper. Botany. 55(396) 307-319.
15. Hassan, A.A.A. (1998): Effect of drought on fruit seedlings. M. Sc. Thesis Fac. of Agric. Al- Azhar Univ. Cairo, Egypt.
16. Hattori, T.; Inanaga, S.; Tanimot, E. Lux, A.; Luxova, M. and Sugimoto, Y. (2003): Silicon induced changes in viscoelastic properties of sorghum root cell walls. Plant Cell Physiol. 44:743-749.
17. Israelsen, O.W. and Hanson, V.E. (1962): Irrigation Principles and Practices. Wiley Tappon- Japan, 3rd Ed. pp. 30- 40.
18. Iwaskai, K.; Meier, P.; Fecht, M. and Hart, W.I. (2002): Effect of silicon supply on apoplastic, manganese concentrations in leave sand their relation to manganese tolerance in cowper *(Vigna unguciulatd)* plant Soil 238:288.
19. Jackson, M.L. (1958): Soil Chemical Analysis. Constable and Co. L.d. London. pp.498.
20. 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.
21. Nomier- Safaa, A. (1994): Physiological studies on Kaki (*Diospyrus Kaki* L.) Ph. D. Thesis Fac. of Agric. Zagazig Univ. Egypt.
22. Osman, M.M. (2014): Response of Superior grapevines grown under hot climates to rest breakages. M. Sc. Thesis Fac. of Agric. Minia Univ., Egypt.
23. Piper, G.S. (1950): Soil and Plant Analysis. Inter- Science New York. pp. 48- 110.
24. Rao, M. V. Koch, J. R. and Davis, K. R. (2000): Ozone a tool for probing programmed cell death in plants. Plant Mol. Bid. 44:346-358.
25. Refaai, M. M. (2011): Productive capacity of Thompson seedless grapevines in relation to some inorganic, organic and biofertilization as well as citric acid treatments. Ph. D. Thesis Fac. of Agric. Minia Univ. Egypt.
26. 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.
27. Snedecor, G. W. and Cochran, G.w. (1967): Statistical Methods 6th Ed. Iowa state, Univ. Press, U.S.A. pp. 60- 70.
28. Uwakiem, M. Kh. (2011); Effect of some organic, bio and slow release N fertilizers as well as some antioxidants on vegetative growth, yield and berries quality of Thompson seedless grapevines Ph. D, Thesis. Fac. of Agric. Minia Univ. Egypt.
29. Viana, A.P.; Pruckner, C.H.; Martinez, H.E.P. Martinez, Y.; Huaman, G.A. and Mosquim, P.R. (2001): Physiological characteristics, of grapevines rootstocks in saline solution. Scientia Agricola, Vol. 58, No.1, pp. 139- 143.
30. Wilde, S. A.; Corey, R. B.; Layer, J. G. and Voigt, G. K. (1985): Soils and Plant Analysis for Tree Culture. Oxford, and IBH, New Delhi, India, pp. 1-142.

10/2/2015