Minufiya J. Agric. Res. Vol.41 No. 1(1): 117 – 140 (2016) **"http://www.mujar.net"**

EFFECT OF SOME MINERAL NUTRIENTS, GROWTH REGULATORS, ANTITRANSPIRANT AND SALT STRESS ON THE GROWTH AND MINERAL CONTENT OF GRAPEVINE SEEDLINGS

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(Received: Nov. 29 , 2015)

ABSTRACT: *The present investigation was conducted during 2013 and 2014 growing seasons in order to evaluate the influence of different mineral nutrients, growth regulators and antitranspirants in reducing salinity hazards in grapevine seedlings.*

One year old Thompson seedless grapevine seedlings were used in this study.

The results indicated that, raising the salinity level of the irrigation solution from zero to either 2500 ppm or 5000 ppm NaCl caused significant reduction in the seedling growth rate, total leaf area and top, root and total dry weights of grapevine seedlings. As for the trunk cross - sectional area of the experimental seedlings, it significantly decreased with increasing the salinity level. The growth rate, total leaf area and top, root and total dry weights of the grapevine seedlings were positively influenced by the application of nitrogen, phosphorus, potassium, gibberellic acid, paclobutrazol or paraffin oil antitranspirant treatments. Nevertheless, the trunk cross-sectional area was not affected by the different treatments except, the addition of gibberellic acid to grapevine seedlings; as that positively influenced the trunk cross – sectional area. Significant positive interactions were generally noticed between both or either salinity level and fertilization and spray treatments on most of the indices used for describing the growth of the grapevine seedlings. The influence of salinity on the concentration of the different nutrient elements was negative, in most cases, except for leaf and root sodium and chloride content, as they markedly increased with increasing the salinity level of the irrigation water. Most of the significant influences of fertilization and spray treatments seemed to be positive on most of the determined mineral nutrients. The statistical interactional reactions between either or both salinity levels and the other treatments on the leaf and root mineral composition were positive in most cases.

Key words: *Salinity, mineral nutrient, growth regulators, antitranspirant, grapes*

INTRODUTION

In Egypt, water availability is considered the prime constraint that determines the addition of new cultivable areas. Agricultural expansion needs a huge amount of available irrigation water which is already not sufficient to meet all the expected demands. The usage of water of poor quality had been widely tried, but with varying degrees of success. The presence of undesirable harmful salts; in quantity and quality, greatly determines the use of such water. The different effects of salts on plants was classified by *Bernstein* (1964) into primary injury; which includes the toxic effect of ions, and secondary injury; which includes nutritional deficiency and osmotic effects. The primary salt stress take two forms, a direct membrane strain causing permeability changes and hence ions efflux and indirect metabolic strain which causes metabolic disturbances. On the other hand, the secondary stress of salinity also has two forms; nutrient deficiency stress and osmotic stress with turgor loss *(Aly*, 2005*).* The simultaneous presence of harmful salts in the root zone can influence ion uptake and translocation by plants. Synergistic and antagonistic effects can increase or decrease the intensity of these processes. With the increasing use of saline water in agriculture, improving fertilization as a mean of alleviating growth inhibition had received great attention. The addition of nitrogen, phosphorus and potassium as well as other mineral nutrients under high sodium and chloride levels was recommended by numerous investigators to improve the yield, growth responses and water economy of many plants *Tabatabaei (2006) and Hagagg, Laila et al., (2012).* Moreover, the application of growth promoters and even growth retardants was found to play an important role in modifying the growth and development of plants grown under salinity stress condition by conjucting with their physiological and biochemical activities *(Little and Loach,* 1975*)*.Besides, the drastic changes in the hormonal make up in salt - stressed plants including abscisic acid, accumulation, ethylene evolution , auxins , gibberellic acid and cytokinins reduction were also found to occur. Exogenously introduced growth promoters partially reversed the negative effect of stress condition on the different physiological aspects especially photosynthesis and translocation processes*, (Strak and Czajkowska,* 1981*)*. Noteworthy, the application of moderate and low rates of growth retardants such as paclobutrazol tended to stimulate root growth and increase root to shoot ratios and also to slow down the rate of water loss, consequently influencing the plant water status and tolerance to salt stress, *(Swietlik and Miller,* 1983*).* In addition, antitranspirants also seem to participitate in this respect. Antitranspirants provide a physical barrier to the escape of water at transpiring surfaces. Hence, it act through minimizing the excesses of transpiration over that of uptake. This improve in water economy would probably help salt- stressed plants in maintaining their physiological and biochemical processes, at least at an acceptable base line.

Therefore, this study was conducted to evaluate the effect of some mineral nutrients elements, growth regulators and antitranspirant in alleviating salt stress in grapevine seedlings widely planted in newly cultivated areas.

MATERIALS AND METHODS

The present investigation was carried out during 2013 and 2014 growing seasons in order to evaluate the influence of different mineral nutrients, growth regulators and antitranspirant in reducing salinity hazard in grapevines seedlings . One–year-old Thompson seedless grapevine (*Vitis vinefera*, L.) seedlings were used in this study. The seedlings were raised form stem cuttings taken from mature trees grown in the Experimental Station of the Hort. Res. Inst., Agric. Res. Center. In February of both 2013 and 2014 seasons, the stem cuttings were singly planted in black polyethylene bags filled with about two kilograms of clay loam soil and held in the greenhouse of the Horticulture Department, Faculty of Agriculture, Minufiya University, until the spring of the next season; when they received the different experimental treatments.

Eighty four seedlings were chosen in March of both 2013 and 2014 seasons. The selected seedlings were as uniform as possible in size and length, and were kept in the greenhouse for about three months before the commencement of the experimental treatments. In mid-June of both years of study, the selected seedlings were divided into three groups and each group received one of the following sodium chloride solutions: 5000 ppm, 2500 ppm, and 0 ppm NaCl (tap water). Salinity treatments were achieved by irrigating each seedling twice a week with 500 ml from one of the three saline solutions. The application of the different saline solutions continued till the termination of each experimental season. After one week from the commencement of the salinity treatments, the seedlings of each group i.e. receiving one of the three saline levels (zero, 2500 or 5000 ppm NaCl), were again sub-divided to 7 sub- groups and each sub-group received one of the following treatments:

100 ppm Nitrogen, 50 ppm Phosphorus , 100 ppm Potassium, 100 ppm Gibberellic acid, 250 ppm Paclobutrazol, 5% Paraffin oil antitranspirant or untreated control .

To this spray solution Triton B was added as a wetting agent at the rate of 0.1 % .

All fertilization and foliar spray treatments were applied to the seedlings once every week till the termination of each experimental season. Fertilization treatments were achieved by adding 500 ml /seedling from any of the experimental nutrients, and the foliar spray treatments by applying 50 ml /seedling from any of the spray solutions.

A split plot design was used, in which the main plots were allocated to the salinity levels and the sub - plots were allocated for fertilization or spray treatments. Thus; 84 seedlings were used in either year of study (3 salinity levels x 7 fertilization or spray treatments x 4 replicates =84 seedlings in each experimental season).

The experiment was terminated when the seedlings irrigated with the highest saline concentration; 5000 ppm NaCl, showed chlorosis on 50 % of the leaf blades in seedlings.

Total plant growth was estimated by measuring the length of each plant together with its laterals two times; the first at the beginning of the salt treatments, and the second at the termination of the experiment. The growth rate of each plant was calculated using the following equation:

$$\text{Growth rate} = \frac{\text{final length} - \text{initial length}}{\text{initial length}}$$

For leaf area determination, ten leaves from the grapevine seedlings were taken at the termination of the experiment. The leaves were carefully drawn on graph paper and the leaf area was measured by counting the squares 10 the nearest cm. Besides, the trunk circumference of each replicate was measured at the soil surface and the trunk cross- sectional area of each seedling was calculated.

The seedlings of the grapevine were then carefully lifted from the polyethylene bags, washed several times with tap water and then rinsed three times in distilled water. Thereafter, the shoot system was separated from the root system and oven dried at 70 C to a constant weight. The dry weights of the top and root system of each replicate were recorded. The dried leaf and root materials of each replicate were ground using a porcelain mortar and a pestle. A 0.2 gm from the leaf and root ground dried materials of each replicate was digested with sulphuric acid and hydrogen peroxide according to *Kalra et al*., (1989). In this digested solution, phosphorus, potassium, calcium, sodium, chloride were determined. Total nitrogen determined by Kjeldahl method (APHA, 2005). Phosphorus determined by vanadomolybdophosphoric yellow color method (Jackson, 1958) . Calcium was determined by the versenate (EDTA) method according to *Cheng and Bray* (1951). Potassium and sodium were measured against a standard using a flame photometer. For chloride determination, 0.1 gm of the ground leaf and root material of each replicate was wetted with 6 per cent calcium acetate solution, ignited to 450 C for four hours and then extracted with hot water. Chloride in the extracts was determined by the silver nitrate method according to *Jackson and Brown* (1955).

All obtained data of the present study during the both growing seasons were subjected to variance using the normal F. test, and means were compared by least significant difference (LSD) at 0.05 level of probability according to the methods of *Snedecor and Cochran* (1980).

RESULTS AND DISCUSSION

1-Effect of mineral nutrients, growth regulators and antitranspirant on the growth characteristics of grapevine seedlings grown under different salinity levels:-

1) Growth rate:

The results of the present investigation generally, revealed that the growth rate of the experimental seedlings was noticeably influenced by salinity stress conditions. A significant reduction in the seedlings growth rate was quite evident with raising the salinity level of the irrigation solution from zero to either 2500 ppm or 5000 ppm NaCl. This result was quite apparent during both experimental seasons (Table 1). The growth rate of grapevine seedlings irrigated by 2500 ppm NaCl was reduced by as much as 22.90% and 30.39% in the first and second season, respectively, in comparison with those irrigated only by zero ppm NaCl level. The corresponding values for the 5000 ppm salinity level were 46.91% and 54.25% in the first and second season, respectively. The fact that salinity adversely affected the growth rate of the experimental seedlings was also reported by numerous other investigators such as: *Israeli et al.,* (1986); working on different fruit species. The apparent reduction in the growth rate of the seedlings under salinity stress conditions might be attributed to a marked decrease in the water absorbing potential of the seedling under such conditions might be attributed to a marked decrease in the water absorbing potential of the seedlings under such conditions (*Graham and Syversten,* 1989). In the meantime, *Levitt* (1980) reported that water shortage in the most critical factor in plant growth process. Besides, *Bernstein et al.,* (1972) pointed out that the accumulation of specific ions such as sodium and chloride, in the different plant tissues, would probably exert an inhibitory effect on plant growth and development. Quite aside from the salinity effects, the data of the present investigation indicated that, in both seasons of study, the seedlings growth rate was positively affected by most of the nutritional, growth regulators or antitranspirant treatments experimented herein. The growth rate of grapevine seedling treated by fertilization and spray treatments was significant higher than that of the control seedlings. The data of the present study also revealed that there were significant positive interactions between the different salinity levels nitrogen, phosphorus and gibberllic acid treatments. The positive influences of fertilization and spray treatments on the growth of seedlings grown under salinity stress conditions was also observed other investigators such as: *Awad and Routras* (1987) working on sour oranges, *EL-Siddig and Ludders* (1994) on apple and *El – Abd* (1996) on sour orange. They all agreed that such treatments tended to minimize the adverse effects of salinity on the different plant growth characteristics and also enhanced their ability to use increasing concentrations of saline water.

2) Total leaf area

The data representing the influence of salinity stress conditions on the total leaf area of grapevine seedlings are shown in Table (2). The results, generally, revealed that the seedlings total leaf area (cm^2/seedling) significantly decreased by increasing the salinity level of the irrigation water. This result was evident during both growing seasons . The leaf area of grapevine seedlings irrigated by 5000ppm NaCl was reduced by as much as 54.01% and 41.76% in the first and second season, respectively, in comparison with those irrigated by zero ppm NaCl. These results are in general agreement with those reported by *Youssif* (1989) on pomegranates. He agreed that a noticeable reduction in the leaf area was quite evident with increasing the salinity level of the substrate. Quite aside from the salinity effects, the data of both experimental seasons indicated that most of the nutritional, growth regulators and antitranspirant treatments positively influenced the leaf area of grapevine seedlings. Nitrogen, potassium and phosphorus supplementations as well as gibberellic acid sprays caused a marked increase in the leaf area of grapevine seedlings. The exceptional case from this general trend was noticed with paclobutrazol treatment . Regarding the interactional influences between salinity and the other treatments on the seedlings leaf area, the data in Table (2) indicated that the application of nitrogen and potassium nutrients significantly increased the leaf area in grapevines grown under 2500 and 5000 ppm salinity levels. Salinity, positive interactions were also noticed between both salinity levels and the addition of paraffin oil antitranspirant.

The foundation that nitrogen, potassium and phosphorus nutrients as well as gibberellic acid and antitranspirant sprays generally promoted the leaf growth process in salt – affected plants was also reported by other investigators such as: *El- Siddig and Ludders* (1995) working on nitrogen, *Rao* (1986); on potassium, *Morales et al.,* (1992) on phosphorus, *Younis et al.,* (1991) on gibberllic acid and *El – Abd* (1996); on antitranpirant.

Table (1): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on growth rate of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	0.132	0.125	0.078	0.112	0.157	0.143	0.076	0.125
100 ppm N	0.311	0.284	0.222	0.272	0.336	0.237	0.199	0.257
50 ppm P	0.367	0.247	0.238	0.284	0.358	0.274	0.284	0.305
100 ppm K	0.371	0.221	0.119	0.237	0.380	0.282	0.072	0.245
100 ppm GA_3	0.328	0.273	0.165	0.255	0.439	0.300	0.227	0.322
250 ppm Pac	0.177	0.101	0.037	0.105	0.228	0.062	0.032	0.107
5 % Antitra	0.235	0.238	0.166	0.213	0.243	0.198	0.090	0.177
Average	0.275	0.212	0.146		0.306	0.213	0.140	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.039	0.063	0.11		0.056	0.091	0.158	

Table (2): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on the total leaf area (cm^2) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	409.1	303.4	196.6	303.0	607.8	457.8	330.8	465.5
100 ppm N	727.8	479.2	305.9	504.3	691.0	680.0	530.0	633.7
50 ppm P	714.4	270.8	234.4	406.5	859.0	363.3	297.8	506.7
100 ppm K	885.7	468.7	379.9	578.1	1031.3	701.8	595.5	776.2
100 ppm GA_3	509.4	383.4	277.4	390.1	587.3	487.0	430.0	501.4
250 ppm Pac	429.8	284.7	260.3	324.9	478.0	394.0	395.0	422.3
5 % Antitra	746.8	446.2	379.4	524.1	1042.3	630.3	506.0	726.2
Average	631.9	376.6	290.6		756.7	530.6	440.7	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	40.5	66.1	93.4		46.3	75.6	130.9	

3) Trunck cross – sectional area

The data representing the effect of salinity on the trunk cross – sectional area of grapevine seedlings are shown in Table 3. The data of both seasons of the present investigation, generally, indicated that salinity stress conditions seemed to be affected by salinization on the trunk cross – sectional area of grapevine seedlings. Similar statistical values were observed under zero, 2500 and 5000 ppm NaCl levels. A significant decline in the trunk cross- sectional area of grapevine seedlings was observed under both, the 2500 the 5000 ppm NaCl levels. These results are in line with those reported by *Boman* (1994) on grapefruit. He reported that tree canopy was reduced by about 7% for each 1.0 ds/m increase in irrigation water salinity above the base level of 0.7 ds/m. *Ezz and Nawar* (1993) and *Abd Ella* (1997) concluded that salinity, stress condition decreased the trunk cross- sectional area. Concerning the effect of the different nutritional, growth regulators and antitranpirant treatments, the data of the present investigation, generally, indicated that, in both seasons, the seedlings trunk cross- sectioned area, except in only few cases, was not marked by affected by these treatments. Among the different treatments, it seemed that gibberellic acid sprays was the only treatment that caused an apparent increase in the trunk cross – sectional area of grapevine seedlings. The data of the present investigation also revealed that there were significant interactions between the different salinity levels and gibberellic acid, paclobutrazol as well as the antitranspirant treatment. The trunk cross – sectional area of grapevine seedlings sprays by gibberellic acid, paclobutrazol or paraffin oil antitranspirant, and irrigated by 2500 ppm or 5000 ppm NaCl salinity level was significantly higher than those only irrigated by saline water. These results partly agreed with those reported by *Schreiner and Ludders* (1992) testing the effect of potassium on apples and *Boman* (1994), testing the effect on nitrogen on grapefruits under saline conditions. Besides, *El-Siddig and Ludders* (1994) concluded that nitrogen nutrient slightly affected the trunk growth of apple trees, though it significantly increased shoot and leaf growth.

Table (3): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on stem cross-sectinal area (cm^2) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	1.368	0.884	1.052	1.101	0.946	0.649	0.672	0.756
100 ppm N	0.899	0.923	1.079	0.967	0.763	0.760	0.758	0.760
50 ppm P	1.153	0.788	0.805	0.915	0.874	0.768	0.786	0.809
100 ppm K	0.964	1.191	1.105	1.087	0.796	0.839	0.806	0.814
100 ppm GA_3	1.134	0.847	0.997	0.993	1.053	0.745	0.936	0.911
250 ppm Pac	0.832	1.179	0.810	0.940	0.724	0.936	0.609	0.756
5 % Antitra	0.870	1.103	0.732	0.902	0.984	0.853	0.588	0.808
Average	1.031	0.988	0.940		0.877	0.793	0.736	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.084	0.165	0.286		0.068	0.111	0.191	

4) Total, top and root dry weights:

a) Total dry weight:

Concerning the effect of salinity stress conditions, the data of this investigation, generally, indicated that salinity exerted an apparent negative influence on the total dry weight of the experimental seedlings (Table, 4).

In both seasons, a significant reduction in the total dry weight of seedlings was marked with increasing the saline concentration of the irrigation water up to 5000 ppm. These results agreed with those found by numerous investigators working on various fruit species. For example *El – Kobbia* (1983); on oranges and almonds and *Youssif* (1989); on pomegranates, concluded that there was an appreciable reduction in the total dry weight of the different fruit species with increasing the salinity level of the substrate. Regardless of the salinity effects, the data during both years of study, generally, indicated that most of the nutritional, growth regulators and antitranspirant treatments tested positively influenced the total dry weight of the experimental seedlings. Nevertheless, the only exceptional case from this general trend was observed with the paclobutrazol treatments. On the other hand, grapevine seedlings treated by nitrogen, phosphorus, potassium, gibberellic acid and paraffin oil antitraspirant had significantly higher total dry weight than those of the control treatment. It was also noticed that the gibberellic acid treatment was the most effective treatment in increasing the total dry weight of the seedlings. The data also indicated that significant interactions were noticed between salinity, on one hand, and gibberellic acid, antitranspirant, nitrogen, potassium and phosphorus amendments, on the other hand. In general, gibberellic acid and paraffin oil antitranpirant treatments showed positive interactions under both 2500 and 5000 ppm salinity level. Other positive interactions were also noticed between salinity and nitrogen phosphorus or potassium treatments, in grapevine seedlings grown under 2500 ppm or 5000 ppm NaCl salinity level. For example, the addition of nitrogen, at the rate of 100 ppm, to grapevine seedlings grown under 2500 ppm NaCl as well as seedlings grown under 5000 ppm salinity level promoted the accumulation of total dry weight in such seedlings than in those receiving the comparable salinity stress level (control). In other words, it might be pointed out that treating the seedling growing under salinity stress conditions by gibberllic acid, paraffin oil, nitrogen, phosphorus or potassium apparently tended to minimize the adverse effect of salinity in reducing the total dry weight of the seedlings, and also in enhancing the accumulation of dry matter under the prevailing saline conditions of this study. These findings seem to be agreement with those obtained by other investigators such as: *Radi et al.,* (1989) working on NaCl - gibberellic acid interaction. They concluded that such treatment partly or completely counteracted the growth inhibition of NaCl and increased plant dry weight. *Radi et al*., (1989). Added that gibberellic acid increased the photosynthetic pigments content in salt exposed plants. Noteworthy, any increase in the photosynthetic pigmentation would directly and positively affect dry another accumulation. Besides, *Rao* (1986) attributed the positive effect of potassium nutrient on total dry weight to an increase in the stomatal resistance under moisture stress. In addition, *Malash and Flowesr* (1984) returned the increment of total dry weight of plants sprayed by antitranspirant to its role in increasing the leaf water retaining capacity and chlorophyll contents. However, *El-Kobbia and Ibrahim* (1986) returned this effect of the antitranpirant to its influence in reducing the salt accumulation in roots.El-*Siddig and Ludders* (1994) concluded that nitrogen enhanced total dry weight. They also concluded that this effect could be attributed to increase nutrient and decrease salt uptake.

Table (4): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on total dry weight (gm) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	20.77	16.42	13.04	16.74	16.48	12.85	11.83	13.72
100 ppm N	22.23	20.24	18.22	20.23	22.58	15.65	14.40	17.54
50 ppm P	29.43	15.97	15.44	20.28	33.88	15.80	16.18	21.95
100 ppm K	29.02	21.43	15.29	21.91	29.53	12.63	12.30	18.15
100 ppm GA_3	32.05	24.39	18.81	25.08	35.60	24.68	13.78	24.69
250 ppm Pac	18.33	14.83	13.06	15.40	18.65	13.75	12.33	14.91
5 % Antitra	30.77	23.82	18.14	24.24	34.53	17.65	13.35	21.84
Average	26.08	19.58	16.00		27.32	16.14	13.45	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	1.48	2.41	4.17		1.07	1.75	3.03	

b) Top dry weight

The data representing the influence of salinity stress conditions on the top dry weight of experimental seedlings are showed in Table (5) . The results, generally, indicated that salinity, in most cases, negatively influenced the top weight of grapevine seedlings. Such reduction was quite apparent especially under the highest salinity level (5000 ppm NaCl) rather than under the moderate one (2500 ppm NaCl). These findings might be supported by those obtained by *Therios and Misopolinos* (1988); on olives and *Youssif* (1989); on pomegranates. They all agreed that increasing the salinity level of the media was accompanied by a corresponding decrease in the top dry weight. Apart from the salinity effects, the data of the present study showed that the top dry weight of the seedlings positively responded to most of the nutritional, growth regulators and antitranspirant treatments. In comparison with the control seedlings, the data of both seasons revealed that a significant increment in the top dry weight was noticed with seedlings receiving gibberellic acid, nitrogen or phosphorus treatments. Likewise, a similar positive influence was also noticed with seedlings treated by antitranspirant sprays and seedlings receiving the potassium treatment. Regarding the interactional influences between salinity and the other treatments on the top dry weight of the seedlings, the data of both seasons, generally indicated that gibberellic acid and paraffin oil antispirament sprays evidently promoted the top growth seedlings grown under either 2500 or 5000 ppm salinity levels. These results are in agreement with those recorded by *Awad and Bouters* (1987); experimenting with gibberellic acid, *El-Siddig and Ludders* (1995), with nitrogen nutrient and *El- Abd* (1996) with antitranspirant. They also observed the beneficial effects of such treatments on the top dry weight of plants grown under salinity stress conditions.

Table (5): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on top dry weight (gm) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	11.87	9.54	7.82	9.74	9.20	7.15	7.40	7.92
100 ppm N	13.10	12.17	11.50	12.26	12.80	9.00	9.30	10.37
50 ppm P	16.68	9.73	9.29	11.90	18.73	9.18	9.80	12.57
100 ppm K	17.64	13.45	9.32	13.47	18.95	8.45	8.20	11.87
100 ppm GA_3	18.14	15.11	12.02	15.09	20.90	15.23	8.53	14.89
250 ppm Pac	10.86	9.08	7.17	9.04	10.78	8.63	6.78	8.73
5 % Antitra	19.52	14.97	11.37	15.28	21.68	11.05	9.00	13.91
Average	15.40	12.01	9.78		16.15	9.81	8.43	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	1.01	1.65	2.86		0.87	1.42	2.45	

c) Root dry weight:

These results of the present study, generally, indicated that the root dry weight of the experimental seedlings was noticeably influenced by the saline level of the water used in irrigation (Table 6). In both the two seasons, the root dry weight of grapevine seedlings significantly decreased with increasing the salinity level of the irrigation water up to 5000 ppm NaCl. These results are in complete agreement with those recorded by *Therios and Misopolinos* (1988) and *Youssif* (1989) working on different fruit species. They reported that the root dry weight showed a considerable decrease with increasing the salinity level of the media. Regardless of salinity influences, the root dry weight seemed not to be greatly affected by the different nutritional, growth regulators and antitranspirant treatments. As an average of all salinity levels, gibberellic acid sprays seemed to be the only treatment that caused a significant increase in the root dry weight of the grapevine seedlings. The results of the present study also revealed that only few interactional effects were noticed between salinity and the other experimental treatments. The application of paclobutrazol, paraffin oil antitranspirant or potassium to seedlings irrigated either by 2500 or 5000 ppm salinity levels did not apparently affect the accumulation of dry matter in the seedlings root of grapevines. Although this general trend was also noticed with seedlings grown under the 5000 ppm NaCl salinity level and sprayed by gibberellic acid, a significant positive interaction was quite apparent between gibberllic acid and the 2500 ppm NaCl salinity level. In other words, grapevine seedlings sprayed by 100 ppm gibberllic acid every week and irrigated by 2500 ppm NaCl twice a week had significant higher root dry weight values than comparable seedlings grown only under salinity conditions. The fact that gibberellic acid sprays positively influence the root dry matter of salt grown seedlings might be attributed to the well known role played by gibberellic acid in stimulating and promoting the plant growth even under salt stress conditions. *Shaheen and El - Sayed* (1984) concluded that gibberellic acid increased shoot dry weight. Besides *Parasher and Varma* (1988) recorded that gibberellic acid enhanced plant growth under saline conditions. Noteworthy, the effect of gibberellic acid in promoting the vegetative growth of salt affected plants would probably maintain more photosynthates that could be allocated towards root growth; and hence participating in increasing its dry weight.

II-Effect of mineral nutrients, growth regulators and antitranpirant on the leaf and root mineral composition of grapevine seedlings grown under different salinity levels:

1) Nitrogen

The data representing the influence of salinity stress conditions of leaf and root nitrogen percentages in grapevine seedlings are shown in Tables 7 and 8 . In both experimental seasons, the results of the present study, generally, indicated that salinity stress conditions tended, in most cases, to decrease the concentration of nitrogen in either the leaf or the root tissues of the experimental seedlings. The decrease in leaf and root nitrogen content varied proportionally to the salinization of the irrigation solution. The only exceptional case from this general trend was noticed in grapevine seedlings; as the 5000 ppm salinity level caused an appreciable increase in the root nitrogen content. These results might be supported by those obtained by *Salama et al.,* (1992) working on different fruit species and *Nigam et al., (*2002) on mango. They all agreed that increasing the salinity level of the media tended to decrease the concentration of nitrogen in either the leaf or the root tissues of the different fruit species. Regardless of salinity effects, the data of the present study showed that, during both seasons, the nitrogen status of the experimented seedlings seemed not to be greatly affected by the different nutritional, growth regulators or anitiranspirant treatments. As an average of all salinity level, the leaf nitrogen content of grapevine seedlings was not statistically altered by the application of potassium, phosphorus, gibberellic acid or paclobutrazol treatments. Yet, the addition of nitrogen to grapevine seedlings caused an appreciable increase in their leaf nitrogen content.. As for the root nitrogen content, it seemed not to follow a definite trend in response to the different experimental treatments. Regarding the interactional influences between salinity and the other treatments, the data of both seasons, generally, indicated that most of the interactional effects were positive. The addition of 100 ppm nitrogen to grapevine seedlings increased their leaf nitrogen content, though they were irrigated by 2500 ppm or 5000 ppm NaCl. No other significant interactional influences were noticed on the leaf nitrogen content of the experimental seedling. Regarding the root nitrogen, the results of the present study indicated that gibberellic acid sprays was the only treatment that affected the root nitrogen content under the prevailing salinity conditions. It significantly reduced the nitrogen concentration in the roots of grapevine seedlings grown under 5000 ppm NaCl. The fact that significant positive interactions were noticed between salinity, on one hand, and nitrogen amendments as well as gibberellic acid and antitransparent sprays, on the other hand, was noticed by other workers such as; *Radi et al.,(*1989); on gibberellic acid, *Salama et al.,* (1992); on paclobutazol and *El-Siddig and Ludders* (1995); working on nitrogen. They found that these treatments positively saline conditions. However, Wieland and Wample (1985) reported that paclobutrazol did not influence the plant nitrogen content. Noteworthy, *Stark and Czajkowska)* (1981) pointed out that gibberellic acid might affect ion absorption by root as well as its distribution within the whole salt – stressed plants. They added that these effects might be mediated through the influence of gibberellic acid changing membrane properties, i.e. lipids composition, ATP – ase activity and the conformation of enzyme proteins, which would disturb the selectivity of ion uptake as well as the distribution of ions in the cells and among particular organs.

Table (6): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on root dry weight (gm) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	8.9	6.88	5.23	7.00	7.28	5.70	4.43	5.8
100 ppm N	9.13	8.08	6.72	7.98	9.78	6.65	5.10	7.18
50 ppm P	12.75	6.24	6.16	8.38	15.15	6.63	6.38	9.39
100 ppm K	11.38	7.98	5.98	8.45	10.58	4.18	4.10	6.29
100 ppm GA_3	13.92	9.33	6.79	10.01	14.70	9.45	5.25	9.80
250 ppm Pac	7.48	5.76	5.89	6.38	7.88	5.13	5.55	6.19
5 % Antitra	11.25	8.85	6.78	8.96	12.85	6.60	4.35	7.93
Average	10.69	7.57	6.22		11.17	6.33	5.02	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.70	1.15	1.98		0.84	1.37	2.37	

Table (7): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on leaf nitrogen percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	2.08	1.90	1.80	1.92	2.37	1.28	1.44	1.69
100 ppm N	2.14	2.96	1.84	2.31	2.19	2.94	1.18	2.10
50 ppm P	2.04	2.20	1.57	1.94	2.22	1.97	0.67	1.62
100 ppm K	2.00	1.43	1.61	1.68	2.15	1.01	1.03	1.40
100 ppm GA_3	2.41	1.70	1.91	2.00	2.86	2.05	0.95	1.95
250 ppm Pac	1.65	1.76	1.98	1.79	1.62	1.56	1.90	1.69
5 % Antitra	2.16	1.95	1.72	1.94	2.23	2.43	0.91	1.86
Average	2.07	1.99	1.78		2.23	1.89	1.15	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.16	0.25	0.43		0.22	0.37	0.63	

Table (8): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on root nitrogen percentage (on dry weight basis)of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	1.52	1.58	1.82	1.64	1.98	1.63	1.54	1.72
100 ppm N	1.84	1.81	1.89	1.84	2.09	2.09	1.98	2.05
50 ppm P	1.56	1.5	1.66	1.58	1.18	1.38	1.72	1.43
100 ppm K	1.37	1.42	1.63	1.47	1.37	1.53	1.78	1.56
100 ppm GA_3	1.40	1.52	1.32	1.41	1.33	1.61	1.59	1.51
250 ppm Pac	1.58	1.51	2.07	1.72	1.64	1.48	1.68	1.60
5 % Antitra	1.53	1.48	1.79	1.60	1.53	1.59	1.89	1.67
Average	1.54	1.55	1.74		1.59	1.62	1.74	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.16	N.S.	0.42		N.S.	0.30	N.S.	

2) Phosphorus

The data concerning the effect of salinity stress conditions on leaf and root phosphorus percentages in grapevine seedlings are presented in the Tables 9 and 10 . In both experimental seasons, the results of the present study, generally, indicated the response of phosphorus to salinity stress conditions varied greatly according to tissue under consideration as well as between the different fruit species. In grapevine seedlings, neither leaf nor root phosphorus content was statistically affected by salinity stress conditions. Similar conclusion was reported by *Swietlik et al.,* (1982). Aside from the salinity effects during both experimental seasons indicated that most of the nutritional growth regulators and antitranspirant treatments seemed not to influence greatly the phosphorus status of the experimental seedlings, especially in the root tissues. As an average of all salinity levels the leaf and root phosphorus content was not appreciably affected by the applications of nitrogen or paclobutrazol to the seedlings of the grapevine seedlings. Noteworthy, even the addition of phosphorus did not statistically influence the phosphorus status of the seedlings, except in grapevine leaves; as it significantly increased in response to the application of the phosphorus treatment. Similarly, an apparent increment in the concentration of leaf phosphorus was observed as a result from spraying grapevines by gibberllic acid. During both experimental seasons, the data also indicated that the interaction influences between salinity and the different treatments on leaf and root phosphorus content did not follow a consistent trend. In accordance with these results those responded by *Abd El-Rahman* (1987). He concluded that the influence of gibberellic acid on the phosphorus content of salt – treated plants was stimulatory or inhibitory; depending upon the plant type, gibberellic acid concentration and salinity level. Similar results were also found by *Lotfy et al.,* (1987), and *El – Abd* (1996) with respect to antitranspirants. They reported that the phosphorus content of plants did not follow a definite trend in response to antitranspirant sprays. In the meantime, the results showing the positive effect of potassium on leaves phosphorus content were reported by *Sweitlik et al.,* (1982), who found that potassium nutrient decreased the leaf phosphorus content of apples grown under stress conditions.

Table (9): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on leaf phosphorus percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	0.560	0.567	0.567	0.575	0.502	0.363	0.426	0.430
100 ppm N	0.553	0.635	0.557	0.582	0.593	0.581	0.332	0.502
50 ppm P	0.703	0.549	0.670	0.641	0.843	0.578	0.472	0.631
100 ppm K	0.677	0.568	0.628	0.624	0.840	0.557	0.524	0.640
100 ppm GA_3	0.737	0.582	0.672	0.663	0.867	0.596	0.395	0.619
250 ppm Pac	0.484	0.752	0.604	0.613	0.389	0.611	0.414	0.471
5 % Antitra	0.733	0.516	0.630	0.326	0.888	0.619	0.382	0.623
Average	0.635	0.600	0.618		0.700	0.558	0.421	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	N.S.	0.065	0.104		0.039	0.063	0.110	

Table (10): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on root phosphorus percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	0.561	0.645	0.762	0.656	0.764	0.924	1.119	0.936
100 ppm N	0.667	0.634	0.668	0.656	1.004	0.885	0.988	0.959
50 ppm P	0.609	0.714	0.703	0.675	0.998	1.076	0.954	1.009
100 ppm K	0.666	0.749	0.588	0.668	1.067	1.143	0.771	0.994
100 ppm GA_3	0.663	0.614	0.712	0.663	1.039	0.849	0.997	0.962
250 ppm Pac	0.650	0.740	0.687	0.692	1.145	1.087	0.987	1.073
5 % Antitra	0.671	0.750	0.738	0.720	1.057	1.174	0.992	1.074
Average	0.641	0.692	0.694		1.011	1.020	0.973	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	N.S.	N.S.	0.169		N.S.	N.S.	0.271	

3- Potassium

The data representing the influence of salinity stress conditions on leaf and root potassium percentages in grapevine seedlings are shown in Tables 11 and 12 . In both experimental seasons, the results of the present investigation, generally, indicated that salinity stress condition tended, in most cases, to decrease the concentration of potassium in either the leaf or the root tissues of the experimental seedlings. This reduction was significant in the leaf and root tissues of grapevine seedlings grown under either 2500 ppm or 5000 ppm NaCl. These results might be supported by those found by *Khanduja et al*., (1980) and *Salama et al.,* (1992) on grapevines and *Ezz and Nawar* (1993); on sour oranges. They all agreed that increasing salinity level decreased the potassium content of the plant. Noteworthy, *Ezz and Nawar* (1993) pointed out that increasing sodium uptake by the seedling under saline conditions, would probably impair the cationic balance of the tissues, causing a noticeable depression in potassium absorption. Meanwhile, *El-Kobbia* (1983); on olives, oranges and almonds and Youssif (1989); on pomegranates, reported that salinity stress conditions did not affect the concentration of potassium. Regardless of the salinity effects, the data of both experimental seasons indicated that most of the nutritional, growth regulators and antitranspirant treatments positively influenced the leaf potassium content of the experimental seedlings. As an average of all salinity levels, gibberllic acid treatment significantly increased leaf and root potassium in grapevine. Similarly, the application of nitrogen, potassium and phosphorus nutrients as well as paraffin oil antitranspirant sprays significantly increased the leaf potassium content of grapevines. In addition, the root potassium content of grapevine seedlings also tended to increase significantly by paclobutrazol sprays. Regarding the interactional influences between the two salinity levels and the other treatments on the leaf potassium content of the experimental seedlings, the data in both seasons, indicated the most the interactional reactions were positive. This effect was quite evident under 2500 ppm NaCl level rather than under 5000 ppm level. The data also indicated that the application of nitrogen, phosphorus or antitranspirant significantly increased the leaf potassium content of grapevines grown under 2500 ppm salinity level. Similarly, gibberellic acid sprays increased the leaf potassium content in the experimental seedlings grown under 2500 ppm NaCl salinity level. The application of paraffin oil antitranspirant, phosphorus and gibberellic acid or nitrogen to grapevine seedlings irrigated by 2500 ppm NaCl significantly increased the root potassium content. No other significant interactional influences were noticed on leaf or root potassium content of the experimental seedlings. These results agreed with those reported by *Abd El-Rahman* (1987), *Awad and Boutros* (1987) and *Radi et al.,* (1989) concerning gibberellic acid. They concluded that gibberellic increased the potassium content. *Awad and Boutros* (1987) reported that gibberellic acid minimized the adverse effects of salinity by increasing the potassium content, and consequently the osmotic pressure of plant tissues. In addition, *Radi et al.,* (1989) reported that gibberellic acid sprays increased the total uptake of potassium. As for antitranspirant, *Malash and Flowers* (1984), *Lotfy et al,* (1987) and *El – Abd* (1996) reported that antitranspirant sprays increased plant potassium percentages under saline conditions. *Davenport et al.,* (1975) added that antitranspirant tended to minimize transpiration rate over that of water uptake. Consequently, this would improve the water balance. *Salama et al.,* (1992) working on puclobutrazol, concluded that these treatments had positive influences of plant potassium content under salinity stress conditions.

Table (11): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on leaf potassium percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	0.84	0.84	0.83	0.83	0.88	0.82	1.12	0.94
100 ppm N	1.32	1.11	0.89	1.11	1.38	0.85	1.21	1.15
50 ppm P	1.23	1.55	0.73	1.17	1.42	1.67	1.00	1.36
100 ppm K	1.29	0.77	1.09	1.05	1.60	0.76	1.65	1.34
100 ppm GA_3	1.22	1.20	0.99	1.13	1.38	1.25	1.46	1.36
250 ppm Pac	1.01	0.85	0.78	0.88	0.99	0.77	0.92	0.89
5 % Antitra	1.50	1.21	1.09	1.26	1.30	1.17	1.60	1.38
Average	1.20	1.07	0.91		1.29	1.04	1.28	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.10	0.15	0.27		0.12	0.21	0.36	

Table (12): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on root potassium percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	0.94	0.71	0.83	0.82	1.44	0.95	1.22	1.20
100 ppm N	0.95	0.89	0.86	0.90	1.24	1.31	1.37	1.31
50 ppm P	0.88	0.91	0.79	0.86	1..44	0.98	1.11	1.18
100 ppm K	1.13	0.71	0.70	0.85	1.19	1.46	1.25	1.30
100 ppm GA_3	1.09	0.89	1.07	1.02	1.34	1.33	1.64	1.44
250 ppm Pac	1.45	0.77	0.70	0.97	2.06	1.13	1.01	1.40
5 % Antitra	0.92	0.98	0.87	0.92	1.22	1.47	1.30	1.33
Average	1.05	0.84	0.83		1.42	1.23	1.27	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.09	0.14	0.24		0.13	0.22	0.39	

4) Calcium

The data concerning the effect of salinity stress conditions on leaf and root calcium content in grapevine seedlings are presented in Tables 13 and 14. In both experimental seasons, the results of the present investigation, generally, indicated that salinity significantly decreased the leaf calcium content in the grapevine seedlings. This trend was evident under both 2500 ppm and 5000 ppm NaCl. On the other hand, although the root calcium showed a great tendency to increase in the seedlings grown under both salinity levels. These results are in general agreement with those reported by *Khanduja et al.,* (1980); working on grapevines and *Youssif* (1989); on pomegranates. They reported that the concentration of calcium in the leaves decreased by increasing the salinity levels. As for the effect of salinity on the root calcium content, *Attalla et al.,* (1985),on citrus rootstock, found that the salinity stress conditions increased the root calcium content. Besides, *Swietlik et al.,* (1982); on apples and *Abd Ella* (1997); on apricots, pomegranates and olives concluded that the leaf calcium concentration was reduced, while that of the roots increased in the seedlings grown under saline conditions. In the meantime, *El- Kobbia* (1983); on oranges, olives and almonds and *Salama et al.,* (1992); on grapevines reported that salinity did not affect the root calcium content. Quite aside of the salinity effects, the data in both experimental seasons indicated that most of the nutritional and growth regulator the treatments positively influenced the leaf calcium content of the experimental seedlings. As an average of all salinity levels, nitrogen and pcalobutrazol applications significantly increased the leaf calcium in grapevine seedlings. Similarly, the application of phosphorus to grapevines appreciably increased their leaf calcium content. As for the root calcium, the data showed that non of the different treatments experimented herein influenced the root calcium content in the grapevine seedlings. Regarding the interactional influences between both salinity levels and the other treatments on the leaf calcium content of the experimental seedlings, the data in both seasons, indicated that the application of nitrogen or paclobutrazol treatments significantly increased the leaf calcium content of grapevines grown under 2500 ppm salinity level. These results are in line with those of *El- Siddig and Ludders* (1995); working on nitrogen. They found that the addition of these nutrients increased the calcium content of plants grown under saline conditions. In addition, *Bonomo et al.,* (1989); working on apples, found that paclobutazol treatments increased the leaf calcium content of apples grown under stress conditions. *Salama et al.,* (1992) added that the application of paclobutrazol to grapevine seedlings tended to alleviate salinity injuries and also to improve the performance of the seedlings under the salt stress conditions by influencing the influx and the outflux of different nutrient.

Table (13): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on leaf calcium percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	2.27	1.61	1.57	1.82	2.50	1.38	1.63	1.84
100 ppm N	2.38	2.38	2.04	2.27	2.00	2.06	1.75	1.94
50 ppm P	2.65	1.88	2.03	2.19	1.63	1.75	1.67	1.68
100 ppm K	2.28	1.90	1.72	1.99	2.31	1.63	1.69	1.88
100 ppm GA_3	2.03	1.98	1.82	1.96	1.81	1.83	1.50	1.71
250 ppm Pac	2.82	2.19	1.85	2.29	3.00	2.38	1.69	2.36
5 % Antitra	1.82	1.84	1.78	1.81	1.63	1.50	1.56	1.56
Average	2.32	1.92	1.83		2.13	1.79	1.64	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.19	0.30	0.52		0.18	0.29	0.49	

Table (14): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on root calcium percentage (on dry weight basis)of grapevine seedlings in 2013 and 2014 seasons.

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	1.26	1.29	1.22	1.26	1.38	1.38	1.25	1.34
100 ppm N	1.53	1.38	1.47	1.46	1.31	1.69	1.81	1.60
50 ppm P	1.19	1.53	1.35	1.34	1.25	1.67	1.56	1.49
100 ppm K	1.19	1.38	1.44	1.34	1.25	1.63	1.63	1.50
100 ppm GA_3	1.43	1.12	1.38	1.31	1.44	1.25	1.63	1.44
250 ppm Pac	1.32	1.60	1.31	1.41	1.50	1.88	1.56	1.65
5 % Antitra	1.25	1.47	1.41	1.38	1.31	1.63	1.63	1.52
Average	1.31	1.40	1.37		1.35	1.59	1.58	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	N.S.	N.S.	N.S.		0.18	0.31	0.54	

5) Sodium:

The data representing the influence of saline conditions on leaf and root sodium content in grapevine are presented in Tables 15 and 16 . In both experimental seasons, the results of the present investigation, generally, indicated that increasing the salinity, strength of the media increased the accumulation of sodium in either the leaf or the root tissues of the seedling. This increment was pronounced in the leaf and root tissues of grapevine seedlings especially under the highest salinity level; 5000 ppm NaCl. Meanwhile, the 2500 ppm NaCl salinity level did not statistically affect the leaf sodium in grapevines. These results might supported by those found by *Khanduja et al.,* (1980); on grapevines, and *Attalla et al.,* (1985); on citrus rootstocks. They all agreed that raising the sodium level of the substrate caused a corresponding increase in the concentration of sodium in either the leaf or the root tissues. With respect to the influence of the different nutritional, growth regulator and antitranspirant treatment on the sodium status of the seedlings, during both experimental seasons, generally, indicated that most of treatments either increased or did not affect the sodium concentrations. The application of nitrogen amendments or gibberellic acid sprays neither affected the leaf nor the root sodium content of the seedlings. Similarly, the application of pcalobutrazol and paraffin oil antitranspirant did not statistically change the sodium levels in the leaf or root tissues. On the other hand, a noticeable increment in leaf sodium was observed in grapevines treated by phosphorus. Likewise, the addition of potassium increased the leaf sodium in grapevines. Regarding the interactional influences between both salinity levels and the other treatments on the sodium status of the experimental seedlings, the data in both seasons indicated that most of the significant reactions were noticed in grapevine leaves. Statistical positive interactions was observed between either or both salinity levels and the phosphorus treatment on the leaf sodium of grapevines as well as between salinity and the potassium treatment on the leaf sodium content of grapevines. Noteworthy, the interactional reaction between paclobutrazol and salinity seemed to vary greatly according to the tissue under consideration. The reaction between paclobtrazol sprays and salinity decreased the leaf sodium in grapevine. The results obtained by *Salama et al.,* (1992) might be in partial in agreement with those observed herein. The former investigators reported that paclobutrazol suppressed the sodium uptake in grapevine seedlings grown under saline condition. In the meantime, *Zid* (1975) found that increasing the quantities of potassium in the nutrient solution did not limit sodium uptake and accumulation in sour orange seedlings.

6) Chloride:

The data representing the influence of salinity stress conditions on leaf and root chloride percentages in grapevine seedlings are shown in Tables 17 and 18. In both experimental seasons, the results of the present study, generally, indicated that increasing the salinity stress conditions increased the concentration of chloride in either the leaf or the root tissues of the experimental seedlings grown under both 2500 ppm or 5000 ppm NaCl salinity levels. These results are in line with those found by *Attalla et al.,* (1985);on citrus rootstocks, *Israeli et al.,* (1986); on bananas and *El-Siddig and Ludders* (1994); on apples, they reported that salinity stress conditions increased the leaf and root chloride concentrations. Noteworthy, *Feigin* (1985) reported that the concentration of chloride increased linearly as the level of chloride in the salt solution increased. He pointed out that the ability of cell membranes to control salt uptake was reduced by the presence of high chloride levels in the media. Regardless of salinity effects, the data of the present study indicated that leaf chloride accumulation, as an average of all salinity levels, varied in some cases, gibberellic acid and antitranspirant sprays decreased the leaf chloride content in grapevine seedlings, while potassium and antitranspirant treatments increased it only in the leaf tissues. Regarding the interactional influences on the chloride concentration of the experimental seedlings, the data, generally, revealed that positive interactional reactions were noticed between salinity and the other treatments, except those of gibberellic acid and antitranspirant sprays, as their reaction with salinity did not follow definite trend. In grapevine seedlings, the application of potassium amendment and paclobutrazol sprays increased the leaf chloride content under 2500 ppm NaCl level, in comparison with that observed in seedlings only irrigated by tap water. As for the interactional influences between salinity and gibberellic acid or antitranspirant sprays, the data showed that gibberellic acid sprays decreased leaf and root chloride content of grapevines under 5000 ppm salinity level. These results seem to be in line with those obtained by *Schreiner and Ludders* (1992); on potassium. They reported that such treatments increased the leaf chloride in plants grown under saline conditions. Yet, with regards to the negative interactions between salinity and antitranspirant treatment, *Malash and Flowers* (1984) and *El- Abd* (1996) found that antitranspirant sprays decreased the chloride content of plants grown under saline conditions.

Table (15): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on leaf sodium percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	0.608	0.592	0.816	0.672	0.681	0.665	0.752	0.699
100 ppm N	0.685	0.739	0.787	0.737	0.869	0.890	0.839	0.866
50 ppm P	0.731	0.798	0.770	0.766	0.805	0.884	0.805	0.819
100 ppm K	0.655	0.749	0.869	0.758	0.653	0.836	0.799	0.763
100 ppm GA_3	0.649	0.698	0.747	0.699	0.665	0.820	0.778	0.754
250 ppm Pac	0.681	0.693	0.659	0.678	0.774	0.803	0.748	0.775
5 % Antitra	0.714	0.721	0.748	0.728	0.729	0.780	0.740	0.750
Average	0.675	0.713	0.771		0.739	0.806	0.780	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.056	0.086	0.149		0.050	0.080	0.130	

Table (16): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on root sodium percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	0.726	0.754	0.907	0.796	0.628	0.721	0.840	0.730
100 ppm N	0.774	0.840	0.870	0.828	0.656	0.851	0.814	0.774
50 ppm P	0.769	0.770	0.793	0.777	0.698	0.709	0.723	0.710
100 ppm K	0.706	0.766	0.819	0.764	0.705	0.714	0.779	0.733
100 ppm GA_3	0.741	0.803	0.872	0.805	0.672	0.707	0.882	0.754
250 ppm Pac	0.829	0.736	0.830	0.798	0.809	0.744	0.739	0.764
5 % Antitra	0.692	0.769	0.789	0.750	0.625	0.662	0.700	0.662
Average	0.748	0.777	0.840		0.685	0.730	0.782	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.045	N.S.	N.S.		0.070	N.S.	N.S.	

Table (17): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on leaf chloride percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 seasons .

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	0.698	0.930	1.363	0.997	0.625	0.940	1.475	1.013
100 ppm N	0.568	1.098	1.353	1.006	0.600	1.070	1.280	0.983
50 ppm P	0.490	1.013	1.190	0.898	0.535	1.070	1.370	0.992
100 ppm K	0.565	1.160	1.355	1.027	0.670	1.160	1.310	1.047
100 ppm GA_3	0.565	0.983	1.043	0.864	0.689	1.130	1.160	0.992
250 ppm Pac	0.735	1.173	1.400	1.103	0.760	1.320	1.505	1.195
5 % Antitra	0.560	0.855	0.923	0.779	0.630	0.790	0.845	0.775
Average	0.597	1.030	1.232		0.644	1.069	1.278	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.077	0.118	0.203		0.080	0.130	0.225	

Table (18): Effect of salinity, mineral nutrients, growth regulators and antitranspirant on root chloride percentage (on dry weight basis) of grapevine seedlings in 2013 and 2014 season.

Treatments	2013				2014			
	NaCl salinity levels				NaCl salinity levels			
	0 ppm	2500 ppm	5000 ppm	Avg. ppm	0 ppm	2500 ppm	5000 ppm	Avg. ppm
Control	0.423	0.690	0.835	0.649	0.490	0.740	0.980	0.737
100 ppm N	0.475	0.735	0.823	0.678	0.580	0.785	0.995	0.787
50 ppm P	0.408	0.755	0.705	0.623	0.445	0.830	0.740	0.672
100 ppm K	0.363	0.735	0.743	0.614	0.355	0.760	0.760	0.625
100 ppm GA_3	0.445	0.635	0.695	0.592	0.475	0.75	0.680	0.610
250 ppm Pac	0.423	0.713	0.805	0.647	0.400	0.800	0.920	0.707
5 % Antitra	0.305	0.655	0.863	0.608	0.415	0.760	1.070	0.748
Average	0.406	0.703	0.781		0.451	0.764	0.878	
	Salinity	Treat.	Inter.		Salinity	Treat.	Inter.	
L.S.D. 0.05	0.053	N.S.	0.140		0.065	0.115	0.200	

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تأثير بعض المغذيات المعدنية ومنظمات النمو ومضادات النتح والإجهاد الملحي على النمو والمحتوى المعدنى لشتلات العنب

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الملخص العربي

أجرى هذا البحث خلال موسمى 2013– 2014 علي شتلات عمرها سنة من العنب البناتي وذلك لدراسة تأثير بعض العناصر الغذائية المعدنية أو منظمات النمو أو مضادات النتح علي مدى تحمل هذه الشتلات لملوحة ماء الري .

وقد أظهرت النتائج انخفاض معدل نمو الشتلات ومساحة أوراقها الكلية ووزنها الجاف الكلى والوزن الجاف لكل من القمة والمجموع الجذري وذلك بزيادة مستوى ملوحة ماء الري ، كذلك إنخفضت مساحة مقطع ساق الشتلات بزيادة تركيز الأملاح في ماء الري – كما أدت المعاملة بالنتروجين والفوسفور والبوتاسيوم وحمض الجبريليك واالباكلوبيوترازول ومضادات النتح إلي زيادة معنوية في معدل نمو الشتلات ومساحتها الورقية ووزنها الكلي الجاف ووزن قمتها ومجموعها الجذري بينما لم تتأثر مساحة مقطع الساق بتلك المعاملات إلا عند رش الشتلات بحمض الجبريليك حيث زادت مساحة مقطع الساق معنويا – كما لوحظ تداخل معنوي موجب بين كلا تركيزي الملوحة أو أحدهما وأي من معاملات التسميد والرش علي معظم دلائل النمو التي تم قياسها – كما أدت زيادة ملوحة ماء الري إلي إنخفاض تركيز العناصر المعدنية المختلفة في معظم الحالات ، فيما عدا محتوى الأوراق والجذور من عنصري الصوديوم والكلوريد حيث زادت نسبتهما بزيادة ملوحة ماء الري – كانت معظم التأثيرات المعنوية موجبة لمعاملات التسميد والرش على محتوى أوراق وجذور الشتلات من العناصر المعدنية كما أدى التداخل بين معاملات الملوحة ومعاملات التسميد والرش إلي زيادة معنوية في محتوى الأوراق والجذور من معظم العناصر المعدنية .