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SALT TOLERANCE IN SOME OLIVE CULTIVARS AS AFFECTED BY SPRAYING WITH SOME GROWTH REGULATORS
II- EFFECT ON LEAF AND STEAM CHEMICAL CONSTITUENTS

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ABSTRACT

The effect of some growth regulators on shoot (total sugars & total carbohydrates) and leaf free amino acids & proline content as well as leaf mineral contents of three olive cultivars transplants, irrigated with saline solution 6000 ppm, SAR6 with 2 levels of chloride ($Cl:SO_4$) ratio were studied. PP_{333} at 500 ppm, BA at 20 ppm and CCC at 1000 ppm solely foliar spray were used in this study to give more explanation about the protect against salt injury during 2002 and 2003 seasons. Data obtained during both seasons revealed that both total carbohydrates and soluble sugars of olive shoots followed two conflicted trends regarding their response to olive cultivar or foliar sprayed growth regulators and chloride level. Herein, Coronaiki olive transplants had statistically the richest shoot total carbohydrate content and the poorest shoot total soluble sugars, while the reverse was found with Aghizi transplants. Meanwhile, Manzanillo cv. was intermediate in this concern. However, both stem total carbohydrate and total sugars followed two conflicted trends in response to either salt concentration or chloride level ($Cl:SO_4$ ratio). Hence, rising salt concentration or $Cl:SO_4$ ratio resulted in increasing shoot total soluble sugars, while the reverse was true with total carbohydrate content. In addition, leaf total free amino acids, praline contents, leaf Ca & Na contents being progressively increased with salinity concentration or $Cl:SO_4$ ratio while leaf N, P, K, Mg, Fe, Mn & Zn contents took the other way around. Moreover, PP_{333}, BA & CCC foliar spray reflected two conflicted trends, where total carbohydrates was decreased but total sugars was increased.

Concerning leaf total amino acids and proline contents, Aghizi transplants had statistically the richest leaves, while the reverse was found with Coronaki cv. Meanwhile, PP_{333} & BA as well as CCC foliar spray significantly decreased both amino acids and proline contents as compared with plants irrigated with saline solution. In addition, increased chloride level in irrigation water increased both leaf amino acids and proline contents during two seasons of study.

As for leaf mineral contents, data obtained revealed that Coronaiki cv. had the richest leaves and exceeded statistically the two other cultivars regarding leaf N, P, K, Mg, Fe, Mn & Zn contents from one hand, but the poorest leaves regarding leaf Ca & Na content from the other. The reverse was true with Aghizi cultivar. Moreover, sprayed growth regulators (PP_{333}, BA & CCC) solely for salt stressed olive transplants statistically increased leaf N, P, K, Mg, Fe, Mn & Zn contents as compared with unsprayed salt stressed ones while the reverse was true with leaf Ca and Na contents. In addition, increasing chloride level in irrigation water significantly decreased leaf N, P, K, Mg, Fe, Mn & Zn contents but increased leaf Ca and Na of salt stressed olive transplants during the study.

INTRODUCTION

Agricultural expansion needs in sandy soil a great amount of suitable irrigation water which already not sufficient to meet all the expected demand in this respect, as long as there in an obvious shortage in irrigation water specially under the conditions of the new reclaimable areas, the projects of reclamation depend on wells, sanitary drainage, diluted sea water ...etc. Generally, the problem of soil salinity and saline water used for irrigation is considered as a limiting factor for the success of such projects. Steinhardi *et al*, (1995).

In addition, plant growth is adversely in saline soils by the presence of high concentrations of soluble sodium as well as certain soluble cations, due to increase in osmotic pressure and reduction in water availability to plants. Since, the olive cultivars plantations may be located principally in (arid and semi-arid zones) this will arise some proplems connected with salinity of soil or the sources of irrigation. Sense *et al*, (1990); Kelin *et al*., (1994); Ghanta *et al*., (1995); Steinhardt *et al*., (1995); Al-Juburi, (1996); El- Azab *et al*, (1998); Al-Juburi and Uasry, (2000); Okubo and Sakuratani, (2000) and Guracia *et al*, (2002). The present study was designed to study the effect of salt stress on stem and leaf chemical constituents of three olive cvs. grom in sandy soil under 6000 ppm, SAR6 and two levels of chloride (low and high) in irrigation water.

Moreover, minimizing the injuries resulted by salt stress through folair spray with some growth regulators in order to allecviate such disorders observed on growth of the three investigated olive cultivars.

MATERIALS AND METHODS

The present investigation was conducted during two successive seasons, 2002 and 2003 at Sheik-Khalifa Farm, Al-Ain U.A.E. Uniform and healthy one-year-old (*Olea europea* L.) transplants of three olive cultivars namely "Coronaiki; Manzanillo and Aghizi Shami" were the plant material used in this study. In both seasons and during 2nd week of March these plants were planted in pots of 30 cm. in diameter that have been filled with specific weight of media consisting of polting soil and sand at equal propositions. Irrigation was done every other two days by providing each pot with ¾ liter of tap water until May 1st during first and second seasons. The following treatments were used:

1- Control (tap water).
2- Saline solution with 6000 ppm; SAR6 and low $Cl:SO_4$.
3- Saline solution with 6000 ppm; SAR6 and high $Cl:SO_4$
4- Saline solution with 6000 ppm; SAR6 and low $Cl:SO_4$ + PP_{333} at 500 ppm.
5- Saline solution with 6000 ppm; SAR6 and high $Cl:SO_4$ + PP_{333} at 500 ppm.
6- Saline solution with 6000 ppm; SAR6 and low $Cl:SO_4$ + BA at 20 ppm.
7- Saline solution with 6000 ppm; SAR6 and high $Cl:SO_4$ + BA at 20 ppm.
8- Saline solution with 6000 ppm; SAR6 and low $Cl:SO_4$ + CCC at 1000 ppm.
9- Saline solution with 6000 ppm; SAR6 and high $Cl:SO_4$ + CCC at 1000 ppm.

The different treatments were arranged in a complete randomized design where each treatment was replicated three times with two pots/each replicate. The different saline solutions were prepared as shown in Table (1) to be applied starting from May 1st till the experimental wasterminate in November, during the two seasons of study. Transplants in each treatment were applied with saline solution every four days at the rate of ¾ liter/pot. The growth regulator treatments were applied each four times (June 15th, July 15th, August 15th and September 15th) during the first and second seasons. "Tween 20" as a surfactant at 0.1 % was added to all foliar spray solution.

The accumulated salts were removed every 2 weeks from the pots by irrigation, followed by rewatering with salt solution the next day. Control treatment was applied only with tap water at ¾ liter four days apart.

Table (1): Preparation of different saline solutions used.

Saline solutions	Salt added per liter*															
	$CaCl_2$		$MgSO_4$		KCl		K_2SO_4		Na_2SO_4		NaCl		**	Cl	SO_4	Cl/SO_4
	gm	meq	gm	meq	gm	meq	gm	meq	gm	meq	gm	meq	SAR	meq/l	meq/l	ratio
6000 ppm, SAR6, Low Cl	1.11	20	1.2	0.2	0.03	0.453	1.85	21.264	1.35	19.07	0.46	7.79	6	28.2	60.334	0.467
6000 ppm, SAR6, high Cl	1.67	30	0.6	10	0.44	5.838	1.65	8.96	0.45	6.338	1.2	20.51	6	56.35	35.292	1.596

* Salts added in grams were estimated as anhydrous form.

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

I- Chemical analysis.

In this regard shoot content of (total carbohydrate and total soluble sugars) and leaf content of (total free amino acids & proline) as well as leaf mineral composition in response to various investigated treatments included in 2002 and 2003 experiments were concerned.

I-1. Total sugars:

Total sugars were determined in dry samples (0.1 gm.) photometrically at 490 mm to the phenol method and using ethyl alcohol for 1 hour at 70 °C as described by Dubis *et al.*, (1956).

I-2. Total carbohydrates (free & compound sugars):

Total carbohydrates were determined in dry samples (0.1 gm)

II-1. photometrically at 490 Mm according to the phenol method and using sulphuric acid for 2 hour at 100 °C as described by Dubis *et al.*, (1956).

II-3. Estimation of total amino acids and proline contents:

a) Total free amino acids

Total free amino acids were determined according to the photometric Ninhydrin method of Moor and Stein, (1948). The blue colour produced by Ninhydrin reaction at 100 °C was determined in colouremetr at 570 mμ of alanine was used for calculation of total amino scids content.

b) Proline content.

The proline was determined in fresh leaves according to the method described by (Bates *et al.*, 1973) and confirmed by Draz, (1986).

I-4. Leaf mineral determination:

a) Total nitrogen by semi-micro-Kjeldahl method as out lined by (Pregl, 1945).
b) Phosphorus using spokal spectrophotometer at 88.2 μ.v. according to the method described by (Murphy and Riely, 1962).
c) Potassium and sodium estimated by flame photometrically using the methods recommended by Brown and Lilleland, (1946).
d) Calcium, magnesium, iron, manganese and Zinc were determined using Atomic absorption spectrophotometer "Perkin Elemer-3300" after Chapman and Pratt, (1961). N, P, K, Ca, Mg and Na concen-trations were expressed as percentage whereas Fe, Mn and Zn nutrients were calculated as ppm.

All the obtained data were subjected to analysis of variance and significant difference among means were determined according to Snedecor and Corchran, (1972). In addition, significant differences among means were distinguished according to the Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

I- Effect of foliar sprays with PP_{333}, BA and CCC on stem total carbohydrates and sugars contents of three olive cultivars transplants:

A- specific effect:

Concerning the specific effect of olive cultivar on stem, total of carbohydrates and sugars content of Coronaiki; Manzanillo and Aghizi olive transplants, irrigated with 6000 ppm, SAR6 and two levels ($Cl:SO_4$) ratio on saline solutions, data presented in Table (2) revealed that Coronaiki cv. had significantly the greatest value of stem total carbohydrates content followed in a decreasing order by Manzanillo and Aghizi olive cultivars during 2002 and 2003 experimental seasons. The reverse was true during both seasons regarding shoot total soluble sugars content compared to that previously discussed with stem total carbohydrates, where Aghizi was significantly the richest and Coronaiki cv. the poorest. The result go in line with that reported by Al Guburi, 1996 on date palm and Hasan (2005) on olive cultivars.

Regarding the specific effect of spraying with some growth regulators (PP_{333}, BA and CCC) on the two parameters, Table (2) displays that two conflicted trends were detected. Hence, irrigation with saline solutions gave a significant decrease in stem total carbohydrates and increased total sugars compared with control (tap water) treatment. Such trend in agreement with the obtained results of Nasr *et al.*, (1977), Aly (1979) and Hasan (2005). Moreover, PP_{333} at 500 ppm and BA at 20 ppm and CCC at 1000 ppm increased significantly total carbohydrates and reduced total sugars in stem as compared with olive plants irrigated with saline solutions during both seasons of study. With regard to the specific effect of $Cl:SO_4$ ratio of saline used for irrigation on both stem total carbohydrates and total sugars contents, in could be observed from data in Table (2) that the higher ratio resulted in a significant decrease of stem total carbohydrates content below the lower ones, while the reverse was true in stem total soluble sugars content during two seasons of study. These results confirmed that reported by Ahmed (1994), who found that foliar application of 500 ppm cycocyl increased total carbohydrates and soluble sugars contents in pomegranate shoots compared with control.

B- Interaction effect:

Data obtained during both seasons regarding the response of total carbohydrates and total sugars extents to interaction effect of various combination between three studied factors, Table (2) shows that both components didn't coincide in their trend of response. Hence, the highest stem total carbohydrates content was always in significant relationship to salt stressed Coronaiki transplants sprayed with BA at 20 ppm concentration x low chloride during both seasons. Meanwhile the reverse was detected by unsprayed salinity Aghizi transplants irrigated with 6000 ppm solution, SAR6 and high $Cl:SO_4$ ratio which exhibited the least value of total carbohydrates. Moreover, other combinations were in between the abovementioned to extremes.

Nevertheless, stem total soluble sugars followed an opposite trend regarding the response to interaction effect of 3 factors. Herein, the highest level of total sugars was markedly coupled with the unsprayed salt stressed transplants irrigated Aghizi transplants with 6000 ppm, SAR6 with high level of chloride ($Cl:SO_4$ ratio). The reverse was true with BA sprayed Coronaiki olive transplants x low chloride level. In addition, other combinations were in between.

II- Leaf total free amino acids and proline contents:

A- Specific effect:

With regard to the specific effect of olive cultivars, data in Table (2) revealed that Aghizi cultivar had the richest leaves in their contents of both total free amino acids and proline followed in a descending order by Manzanillo and Coronaiki cvs., such trend was true during both seasons and differences were significant as each cultivar was compared to the other ones. These results are in agreement with the findings of Hasan (2005) on some olive cultivar; El-Azab, (1992), and Garcia *et al*, (2002); on some citrus rootstocks.

Concerning the specific effect of growth regulators, data obtained displayed that both leaf free amino acids and proline followed the same trend. Total free amino acids and proline contents in leaves increased significantly by irrigation with 6000 ppm salt concentration comparing with those of tap water (control) during 1^{st} and 2^{nd} seasons. Proline might act as an osmoregulator against salinity stress and its accumulation considered as on adaptive to stress conditions Handa *et al.*, (1985).

Salt stress increased leaves total amino acids and proline contents in conformity with those obtained by El-Hefnawi (1986) on guava plants; Ahmed and Ahmed (1997) and Hasan (2005) on some olive cultivar. Moreover, both total free amino acids and proline were reduced in leaves of PP_{333}, BA & CCC) foliar sprayed transplants. Such reducetion was significant as PP_{333}, BA and CCC sprayed transplants compared to the unsprayed stressed ones during both seasons of study. However, BA foliar spray at 20 ppm was relatively more effective than both CCC and PP_{333} as their effect on both total free amino acids and proline was concerned during 1^{st} and 2^{nd} seasons. As for the specific effect of the Cl:SO_4 ratio, of saline solution for irrigation on leaf total free amino acids and proline contents, data in Table (2) reveals that the higher ratio resulted in a significant increase as compared to the lower one during the study. Such trend is in agreement with the obtained results by Hasan (2005).

B- Interaction effect:

Table (2) indicates a significant variance in either total free amino acids or proline contents as interaction effect of olive cultivar, sprayed growth regulators and chloride level in irrigation water with 6000 ppm sanalized water of higher chloride level showed the highest values of both total free amino acids and proline contents during two seasons. On the other hand, sprayed salt stressed (at lower C1:S04 ratio) Coronaiki olive transplants with BA or CCC showed the lowest values of both total free amino acids and praline contents. Such trend was true during both seasons and differences between combinations of both categories i.e., those of the superior from one hand and the inferior from the. other were significant.

Ill - Effect of foliar application with PPass, BA and CCC on leaf mineral contents:

A- Specific effect:

Concerning the specific effect of olive cultivar, data in Tables (3, 4 & 5) reveled that Coronaiki cultivar exceed statistically the two other cultivar (Mauzanillo & Aghizi) regarding leaf N, P, K, Mg, Fe, Mn and Zn contents. However with both (Ca & Na) contents took the other way around during two seasons. The results are in harmony with those reported by Hasan (2005) on some olive transplant.

Regarding the, specific effect of treatments on leaf mineral content of olive transplants it, is quite obvious from data presented in Tables (3, 4 & 5) that irrigation with salt concentration decreased significantly leaf N, P, K, Mg, Fe, Mn and Zn contents but significantly increased leaf Ca & Na content during 2002 and 2003 seasons. This results are in harmony with those reported by Behairy et^al.^ (1985) on guava and olive plants and Hasan (2005) on some olive cvs. Moreover, the specific effect of growth regulators (PPsss, Ba & CCC) it is quite clear that BA, CCC and PPw foliar spray for salts stressed olive transplants statistically increased leaf N, P, K, Mg, Fe, Mn & Zn contents as compared with unsprayed salt stressed ones while the reverse was true with leaf Ca and Na contents during two seasons of study .The same findings were obtained by Sharaf *et al.* (1985); Ghanta *et al.*, (1995) on Avocado American and European grape seedlings. In addition, increasing chloride level (C1:S04 ratio) in irrigation water significantly decreased leaf N, P, K, Mg, Fe, Mn and Zn contents but increased leaves Ca and Na of salt stress olive transplants during the two seasons of study. These results agreement with that reported by Klien *et al* (1994) on Manzanello olives trees and Hasan (2005) on olive transplants.

B- Interaction effect:

A significant response to interaction effect of various combinations between olive cultivar, sprayed growth regulators and chloride level (C1:S04 ratio) in irrigation water. However, combinations represented (Coronaiki x CCC x low chloride level); (Coronaiki x BA x low chloride level) exhibited the highest leaf (N, P, Mg and Zn) and (K, Mn and Fe); respectively as well as lowest leaf Ca & Na contents. In addition, unsprayed Aghizi olive transplants irrigated with 6000 ppm salt solution with high chloride level gave the highest value of leaf Ca & Na contents and lowest value of leaf N, P, K, Mg, Fe, Mn & Zn during two seasons of study. However, other combinations were in between the aforesaid two extremes.

Table (2): Total carbohydrates (D.W.) %; total sugars (D.W.) %, total free amino acids (mg/100 g.f.w.) and proline (mg/100 g.f.w.) of 6000 ppm, 6-SAR saline solution irrigated olive transplants as influenced by specific and interaction effcts of olive cvs., foliar spray with some growth regulators, Cl:SO4 ratio and their combinations during 2003 and 2004 experimental seasons.

Treatments	Cultivars	Total carbohydrates (dry weight) % Coronaiki	Manza.	Aghizi.	Mean*	Total sugars (dry weight) % Coronaiki	Manza.	Aghizi.	Mean*
2002									
Control (tap water)		40.58a	35.15b	34.42c	36.72A	1.950l	2.003l	2.071l	2.008C
Control	Low CL	24.22l	21.82p	21.04q	21.22E	3.773hi	4.293fg	4.537d	4.478A
	High CL	22.04op	20.27r	17.90s		4.167g	4.973b	5.127a	
PP_{333}	Low CL	24.61kl	27.15fg	26.42h	24.08D	3.473jk	3.827hi	4.277fg	4.164B
	High CL	20.47r	23.46m	22.38no		4.160g	4.477de	4.773c	
BA.	Low CL	32.85d	24.70k	27.33f	26.63B	3.437jk	3.760i	3.923h	4.003B
	High CL	25.86i	23.74m	25.28j		3.710i	4.353ef	4.833bc	
CCC	Low CL	28.02e	26.82g	26.12hi	24.66C	3.387k	3.557j	3.760i	4.034B
	High CL	23.38m	22.58n	21.03q		4.223fg	4.527d	4.750c	
Mean**		26.89A	25.08B	24.66C		3.587C	3.974B	4.228A	
Mean***		Low		High		Low		High	
		28.08A		25.24B		3.469B		4.006A	
2003									
Control (tap water)		40.34a	36.60b	33.67c	36.87A	1.990o	1.990o	2.011o	1.997D
Control	Low CL	16.50n	16.11n	14.94o	15.34E	3.776h	4.291e	4.540c	4.480A
	High CL	15.24o	15.05o	14.22p		4.170f	4.972b	5.131a	
PP_{333}	Low CL	26.68f	26.37f	21.59i	22.41D	3.423j	3.554i	4.052g	3.917B
	High CL	21.62i	19.76l	18.43m		3.843h	3.231ef	4.400d	
BA.	Low CL	32.43d	26.60f	25.76g	24.40B	2.952n	3.051mn	3.453ij	3.394C
	High CL	21.34ij	20.85jk	19.43l		3.351j	3.762h	3.792h	
CCC	Low CL	28.55e	22.43h	21.37ij	22.94C	3.211k	3.091lm	3.181kl	3.389C
	High CL	22.19h	22.38h	20.70k		3.545i	3.555i	3.753h	
Mean**		24.99A	22.91B	21.12C		3.362C	3.500B	3.813A	
Mean***		Low		High		Low		High	
		26.00A		22.79B		3.238B		3.633A	

Treatments	Cultivars	Total free amino acids mg/100 g f.w. Coronaiki	Manza.	Aghizi.	Mean*	Proline (mg/100 g. F.W.) Coronaiki	Manza.	Aghizi.	Mean*
2002									
Control (tap water)		1.114o	1.597no	2.176mn	1.629E	0.145m	0.127n	0.115n	0.129E
Control	Low CL	5.823de	4.810f-h	8.623b	7.164A	0.270h-j	0.290c-g	0.310b	0.299A
	High CL	6.237d	7.963c	9.527a		0.290c-g	0.307bc	0.330a	
PP_{333}	Low CL	2.973kl	3.603jk	3.847j	3.831C	0.270h-j	0.280e-i	0.283d-h	0.286B
	High CL	3.743j	3.920ij	4.900fg		0.290c-g	0.293b-f	0.300b-d	
BA.	Low CL	2.453lm	2.593lm	4.570g-i	3.541D	0.250kl	0.257j-l	0.267h-k	0.267D
	High CL	3.007kl	3.557jk	5.063fg		0.263i-l	0.277f-i	0.290c-g	
CCC	Low CL	2.213mn	4.153h-j	4.160h-j	4.113B	0.247l	0.263i-l	0.267h-k	0.275C
	High CL	3.757j	5.060fg	5.333ef		0.273g-j	0.297b-e	0.303bc	
Mean**		3.480C	4.140B	5.355A		0.255C	0.266B	0.274A	
Mean***		Low		High		Low		High	
		3.647B		4.464A		0.243B		0.260A	
2003									
Control (tap water)		2.040j	2.070j	2.200j	2.103D	0.130k	0.120k	0.113k	0.121E
Control	Low CL	6.520d	9.857c	10.60ab	9.172A	0.290de	0.333c	0.330c	0.414A
	High CL	6.773d	10.32bc	10.96a		0.300d	0.350b	0.880a	
PP_{333}	Low CL	3.257i	3.340i	4.670f	4.518C	0.250ij	0.263g-j	0.297d	0.282B
	High CL	4.823f	4.530fg	6.490d		0.267f-i	0.297d	0.320c	
BA.	Low CL	3.413hi	3.973gh	4.530fg	4.349C	0.250ij	0.263g-j	0.253h-j	0.252D
	High CL	4.623f	4.590fg	4.967ef		0.263g-j	0.277e-g	0.267f-i	
CCC	Low CL	3.173i	4.690f	5.143ef	4.779B	0.246j	0.257h-j	0.270f-h	0.271C
	High CL	4.910f	5.183ef	5.577e		0.277e-g	0.283d-f	0.290de	
Mean**		4.392C	5395B	6.126A		0.253C	0.271B	0.336A	
Mean***		Low		High		Low		High	
		4.632B		5.337A		0.244B		0.296A	

*; ** and *** means refer to specific effect of treatment concentration, olive cvs. and $Cl:SO_4$ ratio, respectively.

Values within the same column or row for any of three investigated factors were individually differentiated by capital litter's while for the interaction small letters were used, as means followed by same letter/s were not significantly difference.

Table (3): N, P and K (%) of 6000 ppm, 6-SAR saline solution irrigated olive transplants as influenced by specific and interaction effects of olive cvs., foliar spray with some growth regulators, Cl:SO4 ratio and their combinations during 2002 and 2003 experimental seasons.

Treatments \ Cultivars		Nitrogen (%)				Phosphorus (%)				Potassium (%)			
		Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***
2002													
Control (tap water)		3.220a	3.130b	3.100b	**3.150A**	0.450a	0.390b	0.280cd	**0.373A**	2.270b	2.610a	2.320b	**2.400A**
Control	Low CL	1.300n	1.057p	1.197o	**1.082E**	0.130j-n	0.117l-n	0.107mn	**0.108D**	0.900l	0.740m	0.620n	**0.673E**
	High CL	1.103p	0.863r	0.970q		0.120k-n	0.093mn	0.083n		0.670n	0.637n	0.473o	
PP_{333}	Low CL	2.253f	2.183gh	2.227g	**1.999D**	0.287cd	0.260d-f	0.183g-j	**0.207B**	1.450gh	1.357i	1.337i	**1.308D**
	High CL	1.953j	1.633m	1.747l		0.270c-e	0.127j-n	0.117l-n		1.420h	1.320i	0.963k	
BA.	Low CL	2.460e	2.430e	2.517d	**2.223B**	0.217e-g	0.200g-i	0.177g-k	**0.173C**	1.747c	1.603d	1.520ef	**1.509B**
	High CL	2.150h	1.827k	1.954j		0.180g-j	0.150h-m	0.113l-n		1.430gh	1.413h	1.340i	
CCC	Low CL	2.663c	2.313f	1.960j	**2.100C**	0.323c	0.290cd	0.207f-h	**0.225B**	1.607d	1.543e	1.470f-h	**1.437C**
	High CL	2.033i	1.760l	1.870k		0.213fg	0.170g-l	0.147i-m		1.480fg	1.307i	1.213j	
Mean**		**2.126A**	**1.911C**	**1.949B**		**0.243A**	**0.200B**	**0.157C**		**1.442A**	**1.392B**	**1.251C**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		2.267A		**1.954B**		**0.241A**		**0.194B**		**1.540A**		**1.391B**	
2003													
Control (tap water)		3.350a	2.890c	2.990b	**3.077A**	0.410a	0.310b	0.270c	**0.330A**	2.140ab	2.100b	2.180a	**2.140A**
Control	Low CL	1.277n	1.030p	1.173o	**1.036E**	0.113k	0.100kl	0.093l	**0.095E**	0.870lm	0.797n	0.670p	**0.719E**
	High CL	1.030p	0.800r	0.907q		0.103kl	0.087lm	0.073m		0.737o	0.650p	0.590q	
PP_{333}	Low CL	2.447e	2.027i	2.270fg	**2.059D**	0.293b	0.253c-e	0.187gh	**0.213C**	1.307f	1.353ef	1.127h	**1.034D**
	High CL	1.950j	1.790l	1.870k		0.250de	0.160i	0.133j		0.953jk	0.820mn	0.643p	
BA.	Low CL	2.633d	2.307f	2.470e	**2.241B**	0.237ef	0.230f	0.203g	**0.194D**	1.540c	1.487d	1.373e	**1.243B**
	High CL	2.250g	1.860k	1.927j		0.200g	0.160i	0.13j		1.353ef	0.903e	0.803n	
CCC	Low CL	2.853c	2.193h	2.433e	**2.176C**	0.303b	0.267cd	0.250de	**0.238B**	1.393e	1.303f	1.193g	**1.109C**
	High CL	2.013i	1.717m	1.847k		0.223f	0.203g	0.180h		1.033i	0.960j	0.770no	
Mean**		**2.200A**	**1.846C**	**1.987B**		**0.237A**	**0.197B**	**0.169C**		**1.258A**	**1.153B**	**1.039C**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		2.290A		**1.946B**		**0.235A**		**0.193B**		**1.389A**		**1.109B**	

*; ** and *** means refer to specific effect of treatment concentration, olive cvs. and Cl:SO_4 ratio, respectively.

Values within the same column or row for any of three investigated factors were individually differentiated by capital litter`s while for the interaction small letters were used, as means followed by same letter/s were not significantly difference.

Table (4): Ca, Mg and Na (%) of 6000 ppm. 6-SAR saline solution irrigated olive transplants as influenced by specific and interaction effects of olive cvs., foliar spray with some growth regulators. Cl:SO4 ratio and their combinations during 2002 and 2003 experimental seasons.

Treatments \ Cultivars		Calcium (%)				Magnesium (%)				Sadium (%)			
		Coronaiki	Manza.	Aghizi.	Mean*	Coronaiki	Manza.	Aghizi.	Mean*	Coronaiki	Manza.	Aghizi.	Mean*
2002													
Control (tap water)		2.100mn	1.830q	1.790q	1.907E	0.930a	0.760d	0.810c	0.833A	0.196s	0.132u	0.167t	0.165E
Control	Low CL	3.127f	3.857d	4.590b	3.952A	0.373j	0.303lm	0.317kl	0.313D	0.635h	0.693g	1.023b	0.966A
	High CL	3.253e	3.983c	4.900a		0.330k	0.270n	0.287m		0.813e	0.950c	1.663a	
PP_{333}	Low CL	1.710r	1.823q	2.127lm	2.221C	0.870b	0.663gh	0.720e	0.720C	0.843d	0.507l	0.573j	0.674B
	High CL	2.177l	2.613i	2.877h		0.820c	0.580i	0.667g		0.583j	0.713f	0.827de	
BA.	Low CL	1.890p	2.013o	2.937g	2.456B	0.813c	0.733e	0.750d	0.740B	0.313q	0.337p	0.433n	0.436D
	High CL	2.147lm	2.490j	3.26e		0.820c	0.647h	0.677fg		0.377o	0.527k	0.627i	
CCC	Low CL	1.323t	2.06no	2.120m	2.029D	0.870b	0.687f	0.757d	0.719C	0.277r	0.377o	0.420n	0.448C
	High CL	1.657s	2.357k	2.657i		0.687f	0.647h	0.663gh		0.467m	0.513kl	0.633i	
Mean**		2.154C	2.558B	3.029A		0.724A	0.589C	0.628B		0.500C	0.528B	0.707A	
Mean***		Low		High		Low		High		Low		High	
		2.353B		2.673A		0.690A		0.640B		0.462B		0.613A	
2003													
Control (tap water)		1.990op	1.950p	1.830r	1.923E	0.950a	0.820c	0.890b	0.887A	0.181s	0.116t	0.195s	0.164E
Control	Low CL	3.207f	3.530c	3.647b	3.520A	0.430l	0.350n	0.400m	0.360D	0.943f	1.157d	1.203c	1.158A
	High CL	3.290e	3.697b	3.807a		0.363m	0.283p	0.333o		0.977e	1.257b	1.410a	
PP_{333}	Low CL	1.583s	1.883q	2.117m	2.276D	0.823c	0.633i	0.700g	0.688C	0.563o	0.647m	0.707l	0.742B
	High CL	2.413k	2.577j	3.083g		0.773e	0.560k	0.637i		0.813k	0.837ij	0.883g	
BA.	Low CL	800r	2.027no	2.990h	2.374C	0.797d	0.717f	0.70e	0.722B	0.420r	0.487q	0.513p	0.608D
	High CL	1.993op	2.367k	3.067g		0.770e	0.673h	0.673h		0.527p	0.843hi	0.857h	
CCC	Low CL	1.483t	2.070mn	3.177f	2.582B	0.663e	0.673h	0.723f	0.666C	0.417r	0.573o	0.613n	0.651C
	High CL	2.240l	2.677i	3.363d		0.687gh	0.603j	0.647i		0.627n	0.823jk	0.850hi	
Mean**		2.222C	2.531B	3.089A		0.695A	0.590C	0.634B		0.608C	0.749B	0.803A	
Mean***		Low		High		Low		High		Low		High	
		2.352B		2.690A		0.685A		0.644B		0.582B		0.746A	

*; ** and *** means refer to specific effect of treatment concentration, olive cvs. and $Cl:SO_4$ ratio, respectively.

Values within the same column or row for any of three investigated factors were individually differentiated by capital litter's while for the interaction small letters were used. as means followed by same letter/s were not significantly difference.

Table (5): Zn, Mn and Fe (ppm) of 6000 ppm, 6-SAR saline solution irrigated olive transplants as influenced by specific and interaction effects of olive cvs., foliar spray with some growth regulators, Cl:SO4 ratio and their combinations during 2002 and 2003 experimental seasons.

Treatments \ Cultivars		Zinc (ppm)				Manganese (ppm)				Iron (ppm)			
		Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***
2002													
Control (tap water)		150.9b	163.2a	120.3c	**144.8A**	93.60a	75.30b	63.70c	**77.53A**	226.3c	255.3a	230.8b	**237.5A**
Control	Low CL	48.98t	46.74u	43.71z	**44.96E**	28.32s	27.07t	26.23u	**26.24E**	74.86s	85.33r	70.85t	**69.70E**
	High CL	45.77v	43.91y	40.62z		26.58u	25.48v	23.77w		64.83u	61.45v	60.87w	
PP_{333}	Low CL	83.11h	74.46l	56.04r	**68.36C**	38.78l	31.51p	30.53q	**32.08D**	153.8g	150.5i	152.9h	**148.6B**
	High CL	73.88m	72.37n	50.28s		33.46o	29.51r	28.72s		149.7j	139.2n	145.5l	
BA.	Low CL	84.29g	80.33i	59.39p	**62.87D**	55.60d	50.23f	48.15g	**46.99B**	166.2d	148.7k	157.5f	**142.0D**
	High CL	63.04o	45.51w	44.63x		50.86e	38.97l	38.11m		145.3l	110.9q	123.4p	
CCC	Low CL	94.22d	86.48f	87.48e	**80.04B**	45.98h	42.17i	39.89k	**40.78C**	165.2e	139.4n	144.2m	**147.3C**
	High CL	78.87j	75.90k	57.51q		41.14j	38.15m	37.35n		152.5h	132.9o	149.6j	
Mean**		**87.38A**	**85.20B**	**68.03C**		**50.79A**	**43.37B**	**40.01C**		**152.5A**	**147.9B**	**146.6C**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		85.31A		**75.10B**		**46.47A**		**42.98B**		**154.8A**		**143.2B**	
2003													
Control (tap water)		166.3a	145.1b	125.9c	**145.8A**	86.70a	69.80b	59.80ef	**72.10A**	269.4a	245.4b	214.6c	**243.2A**
Control	Low CL	45.40s	43.38t	39.55v	**37.29E**	33.47t	29.75u	27.53v	**28.28E**	61.83v	70.45u	81.53s	**67.29E**
	High CL	36.43w	31.90y	27.08z		29.36u	27.50v	22.05w		55.34w	61.82v	72.77t	
PP_{333}	Low CL	81.26h	71.96i	62.85o	**61.82C**	61.17d	59.97e	40.76o	**49.34C**	147.5g	151.2f	153.8e	**145.8B**
	High CL	66.44m	47.65r	40.74u		57.02i	38.96q	38.15r		136.6m	141.2i	144.2h	
BA.	Low CL	85.20e	67.18l	66.04n	**57.91D**	66.43c	59.01gh	56.18j	**53.56B**	151.3f	151.2f	160.7d	**142.6C**
	High CL	53.26p	40.70u	35.09x		59.39fg	40.36op	39.97p		124.9r	132.5p	134.7n	
CCC	Low CL	95.48d	81.83g	68.92j	**74.40B**	58.79h	53.45k	41.48n	**47.54D**	140.0j	144.0h	137.2l	**136.8D**
	High CL	83.67f	68.49k	48.04q		48.96l	46.34m	36.23s		128.0q	134.1o	137.6k	
Mean**		**87.98A**	**74.33B**	**64.01C**		**58.80A**	**49.49B**	**42.19C**		**148.5A**	**147.7B**	**145.2C**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		83.10A		**67.79B**		**53.62A**		**46.71B**		**152.0A**		**142.2B**	

*; ** and *** means refer to specific effect of treatment concentration, olive cvs. and $Cl:SO_4$ ratio, respectively.

Values within the same column or row for any of three investigated factors were individually differentiated by capital litter's while for the interaction small letters were used, as means followed by same letter/s were not significantly difference.

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مقاومة بعض أصناف الزيتون للملوحة بالرش ببعض منظمات النمو.
٢- التأثير على المحتوى الكيماوى للورقة والساق

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- أجريت هذه الدراسة خلال موسمى ٢٠٠٢، ٢٠٠٣ بمزرعة الشيخ خليفــة – العــين – الإمــارات العربيــة المتحدة. على ثلاث أنواع من شتلات الزيتون (كروناكى، مانزينللو، العجيزى) عمر سنة، بهدف دراسة تــأثير الرش ببعض منظمات النمو (السيكوسيل بتركيز ٥٠٠ جزء فى المليون، والبنزيل أدينين بتركيز ٢٠ جزء فى المليون، الباكلوبترازول بتركيز ٥٠٠ جزء فى المليون) رشاً على الأوراق فى أرعة مواعيد (منتصــف كــل من يونيو، يوليو، أغسطس وسبتمبر) على تقليل الأثر الضار للملوحة على نمو شتلات الزيتون. تــم اختيــار شتلات عمر سنة لهذه الدراسة متقاربة فى نموها للأصناف الثلاث فى ١٥ مارس خلال موســمى الدراســة حيث زرعت فى أصص بلاستيك بقطر ٣٥ سم تحتوى على مخلوط الرمــل والبــوتنج ســويل بنســبة ١:١ ورويت بالماء العادى بمعدل ٣/٤ لتر /أصيص كل يومين حتى أول مايو حيث بدأت معاملات الملوحة.
- صممت تجربة عاملية تشمل ثلاث عوامل مختبرة (صنف الزيتون، نسبة الكلوريدات إلى الكبريتــات بمحلــول ماء الرى المالح، ومنظم النمو) وكذلك التفاعل بين تلك العوامل الثلاث ومدى استجابة الشتلات النامية تحــت إجهاد ملحى (٦٠٠٠ جزء فى المليون، ومستوى ٦ من الصوديوم المدمص) لتلك العوامل وانعكاساتها علــى المحتوى الكيماوى والعناصر للشتلات.
- أحتوت سيقان الصنف كروناكى على أعلى نسبة من الكربوهيدرات وأقل نسبة من السكريات (الكليــة) بينمــا العكس كان صحيحاً مع الصنف العجيزى. ولقد سلك كل من محتوى السيقان من الكربوهيدرات والســكريات الكلية اتجاهين متضادين بالنسبة لتأثرهما بتركيز الأملاح أو نسبة الكلوريدات: الكبريتات فى ماء الرى حيــث زادت محتوى السيقان من السكريات الكلية بينما قلت الكربوهيدرات الكليــة لتأثرهمــا بــأى مــن العــاملين المختبرين.
- ملوحة ماء الرى ٦٠٠٠ جزء فى المليون مع زيادة نسبة الكلوريدات إلى الكبريتات أدت إلى زيــادة محتــوى الأوراق من كل من الأحماض الأمينية الكلية، البرولين وعنصرى الكالسيوم والصوديوم بينمــا قــل محتــوى الأوراق من كل من النيتروجين، البوتاسيوم، المنجنيز والحديد والزنك.
- أدى الرش بأى من منظمات النمو المختبرة إلى زيادة محتوى السيقان من السكريات الكلية وتقليل محتواها مــن الكربوهيدرات الكلية، الأحماض الأمينية والبرولين مقارنة بتلك النامية فى محلول ملحى.
- أظهر الصنف كروناكى تفوقاً ملحوظاً فــى محتــوى الأوراق مــن النيتــروجين، والفوســفور، البوتاســيوم، الماغنسيوم والمنجنيز، والزنك والحديد بينما أحتوى على أقل نسبة من الكالسيوم والصــوديوم، بينمــا أعطــى الصنف عجيزة نتائج عكسية.
- أدى الرش بمنظمات النمو للنباتات النامية فى محاليل ملحية (٦٠٠٠ جزء فى المليون) إلى زيــادة كــل مــن النيتروجين، والفوسفور، البوتاسيوم، الماغنسيوم والحديد والمنجنيز، والزنك بينما قل تركيز كل من الكالســيوم والصوديوم. زيادة نسبة الكلوريدات: الكبريتات فى ماء الرى أعطى عكس النتائج السابقة للنباتات النامية فــى محلول ملحى.