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SALT TOLERANCE IN SOME OLIVE CULTIVARS AS AFFECTED BY SPRAYING WITH SOME GROWTH REGULATORS
I- EFFECT ON GROWTH, LEAF CHLOROPHYLL A & B AND SOME LEAF PHYSIOLOGICAL PROPERTIES.

BY

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ABSTRACT

The effect of some growth regulators on growth, leaf chlorophyll a & b content and some physiological properties of three olive cultivars transplants, irrigated with saline solution at 6000 ppm with SAR6 and two chloride level ($Cl:SO_4$) ratio were irrigated. PP_{333} at 500 ppm, BA at 20 ppm and CCC at 1000 ppm were used in this study to give more explanation about the protect against salt injury during 2002 & 2003 seasons. The results which could be deducted of this study are Coronaiki cv. was the superior one with all the investigated growth measurements, dry weight of plant organs, leaf chlorophyll (A & B) content and L.O.P. & L.R.T. while Aghizi cv. was the inferior as well as Manzanillo was in between. In addition, salt concentration at SAR 6 or high $Cl:SO_4$ ratio in saline solution significantly decreased all the investigated growth measurements, plants organs dry weights, leaf chlorophyll A & B contents as compared with control transplants (tap water).

Moreover, growth regulators (PP_{333}, BA and CCC) solely foliar spray treatment caused a significant increase of growth measurements (stem & total plant length, no. of leaves & no. of laterals/plant, leaf area & assimilation area/plant), plant organs dry weights and leaf physiological properties (L.S.G., L.R.T. and transpiration rate). On the contrary, leaf osmotic pressure (L.O.P.) and hard leaf character (H.L.C.) took the other way around during the study.

INTRODUCTION

Agricultural expansion needs a great amount of suitable irrigation water which already is not sufficient to meet all the expected demands. For that the possibility of using saline water for irrigation specially underground water is of great value; but till now it is still very limited, because this water contain a considerable amount of harmful salts. The applicability of saline water for irrigation is first of all dependent upon the concentration, composition of salts dissolved therein, and upon the degree to which plants are salt tolerance. Since, the olive cultivars plantation may be located principally in the new reclaimed lands (arid and simi-arid zones), this will arise some problems with salinity of soil or the source of irrigation. Salinity affects plant growth differentially. The need for overcoming the adverse effects of salinity on plants had lead several investigators to test some growth substances. On American and European grape seedlings Sharf *et al*., (1985) mentioned that both BA and CCC significant decrease stem length of the two grape varities and increased leaves, stem and total plant dry weight over plants irrigated with saline solutions. On tomato, Knavel, (1969) reported that CCC and BA treated plants were more drought resistant and tended to decrease the water loss or increase the efficiency of water movement through leaf tissues.

The present study was carried out to investigate the effect of one concentration (6000 ppm with SAR6 and 2 levels of $Cl:SO_4$ ratio) in the irrigated water on growth, leaf chlorophyll A & B and leaf physiological properties in 3 olive cultivars transplants with the hope to find out the regulation of salinity by application of PP_{333}, BA and CCC to plants grown in sandy soil under saline conditions was also studied.

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 polling 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 at that time starting from May 1st till the experiment was terminated 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 Foliar spray with either tap water or any of the three growth regulators i.e. paclobutrazol (pp_{333}); benzylamino adenine (BA) and cycocel (ccc) at the rate of 500, 20 and 1000 ppm, respectively was applied each four times starting from (June 15th till 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 with tap water, followed by rewatering with salt solution the next day. Control treatment was applied only with tap water at ¾ liter four days apart.

- Investigated measurements:

I- Vegetative growth:

Stem length, total plant length, number of leaves/plant, number of laterals, leaf area and total foliage area/plant as assimilation area/ transplants (cm^2) was calculated on the base of number of leaves/plant x average leaf area, the method was described by Motskobili, (1984) and followed by Mohsen *et al.*, (1987).

Thereafter, transplanting were divided into three portions : stem, roots and leaves. Oven dried at 70° C till constant weight. organ plant dry weight of leaves, stem and root were calculated.

II- Photosynthetic pigments: leaf photosynthetic pigments were determined which were extracted by pure actone. The optical densities of pigments were measured colorimetrically at 662 and 644 mm for chlorophyll A & B, respectively. Pigments contents were calculated according to Wettstein (1957).

III- Leaf physiological properties:-

III-1. Leaf relative turgidity (L.R.T.)

L.R.T. was estimated according to the following equation described by Elmistron and Hiller (1937) and followed by Nomir (1994).

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 $\dfrac{Na}{\sqrt{\dfrac{Ca+Mg}{2}}}$

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

III-2. Leaf succulence grade (L.S.G.); was estimated according to the following equation.

$$L.S.G. = \frac{\text{Leaf water content (mg.)*}}{\text{Leaf area (dec.)}^2} \times 100$$

* Leaf area content (in g.) =

$$= \frac{\text{F. weight} - \text{dry weight of the leaves at the end of experimental}}{\text{Number of leaves at the end of experimental}} \times 100$$

According to Nomir (1994).

III-3. Hard leaf character (H.L.C.).

It was estimated according to the following equation:

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

$$\text{Dry w. of leaf (in g.)} = \frac{\text{dry weight of the leaves at the end of experimental}}{\text{Number of leaves at the end of experimental}}$$

The method was suggested by Youssef (1990).

III-4. Determination of leaf osmotic pressure (in bar).

Leaf osmotic potential was estimated according to Gusov (1960).

III-5. Transpiration rate

T. R. was estimated according to Attia (2002).

*** Statistical analysis:**

All obtained results were subjected to analysis of variance and significant differentces among means were determined according to Snedecor and Cochran (1972). In addition, significant differences among means were distinguishing according to the Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of foliar sprays with PP_{333}, BA and CCC on saline stressed transplants of three olive cultivars:

In this regard specific effect of three investigated factors namely, i.e., olive cultivar (Coronaiki; Manzanillo and Aghizi Shami), sprayed with some growth regulators (PP_{333} at 500 ppm, BA at 20 ppm and CCC at 1000 ppm) and chloride levels (low & high) of saline solutions 6000 ppm with SAR6 and their possible combinations on salinity stressed olive transplants were studied pertaining the response of the following parameters.

I- Vegetative growth measurements:

Data obtained during both 2002 and 2003 experimental seasons regarding the specific effect of the three investigated factors involved in this study i.e., olive cultivars; sprayed growth regulators, $Cl:SO_4$ ratio and interaction effect of their combinations are presented in Table (2).

A- Specific effect:

Concerning the specific effect of the olive cultivar, it is quite evident that Coronaiki cultivar transplants had statistically the tallest stem, total plant length, highest number of both leaves and laterals/plant followed in a descending order by Manzanillo, while the reverse was detected with those of Aghizi transplants during the two seasons. These results are in agreement with the findings of Hasan (2005).

Referring the specific effect of sprayed growth regulators, treatments, data from Table (2) show that growth measurements parameters of three olive transplants, irrigated with the saline solutions gave a significant decrease in all growth measurements. These results are in agreement with that reported by Pokroveskaya (1954 and 1957) showed that in glycophytes both cell division and cell elongation were inhibited with increasing salinity. Antipov (1958) showed that the smaller size of alfalfa grown in saline areas, determiner more by a decrease in cell number than cell size. However, Nieman (1965) concluded that the number of cells per nut leaf area *Phaseoulus vulgaris* L. tended to remain constant through most of the growth period in both the control and the salt stunted leaves. Meiri and Poljakoff-Mayber (1971) revealed that salinity reduced the total leaf area and delayed the development of new leaves bean plants. In addition, spraying both PP_{333} at 500 ppm and BA at 20 ppm as well as CCC at 1000 ppm to the olive transplants significantly improved the average stem length, total plant length, number of leaves /plant and number of laterals/plant of three olive cultivars as compared to plants irrigated with saline solutions during 2002 and 2003 seasons, as presented in Table (2). Data also show that CCC foliar spray at 1000 ppm gave the highest values of stem length, total plant length, no. of leaves/plant and no. of laterals /plant followed by BA at 20 ppm foliar spray, meanwhile the PP_{333} foliar spray treatment appeared to be less effective than the above-mentioned ones. These results are in agreement with those reported by El-Deen *et al.*, (1979) on olive seedlings and Sharaf *et al.* (1985) on American and European grape seedlings. In addition, the specific effect of chloride level (Cl:SO_4 ratio) on vegetative growth parameters, it could be observed from data in Table (2) that the higher Cl:SO4 ratio resulted in a significant decrease in all growth parameters under study. Simi results were also found by Hasan (2005) on olive transplants.

B- Interaction effect:

As for the interaction effect of variance combinations between olive cultivars, sprayed growth regulators and chloride level on stem length, total plant length, no. of leaves/plant and total plant length of olive transplants, data in Table (2) indicated obviously that the highest values of four growth parameters were closely related to Coronaiki transplants irrigated with 6000 ppm saline solution of SAR6 and lower Cl:SO_4 ratio as well as sprayed with CCC at 1000 ppm. However, the lowest values of four vegetative growth parameters were detected by irrigation Aghizi transplants with 6000 ppm saline solution of SAR6 with higher Cl:SO_4 ratio.

II- Leaf area (cm^2), total assimilation area (dec^2)/plant and chlorophyll A & B content.

A- Specific effect:

With regard to specific effect of oli cultivars, data in Table (3) showed that all parameters followed typically the same trend of response. Hence; Coronaiki had statistically the highest values of average leaf area, assimilation area/plant and chlorophyll A & B contents as compared to the analogous ones of two other olive cultivars. Moreover, Aghizi olive cultivar ranked 2nd while Manzanillo olive cultivar recorded the lowest values in this respect. These are results in agreement with that reported by Hasan (2005) on olive cultivars. In addition, the specific effect of sprayed growth regulators on average leaf area, assimilation area and chlorophyll A & B contents, data obtained revealed that the 3 growth regulators significantly increased the four parameters as compared to control (unsprayed salts stressed transplants). However, CCC foliar spray at 1000 ppm exerted the most stimulus effect followed in a descending order by BA at 20 ppm and PP_{333} at 500 ppm during the study. Moreover, the specific effect of Cl:SO_4 ratio of saline solution used for irrigation on leaf area, assimilation area/plant, chlorophyll A & B content, it could be noticed that the higher ratio resulted in a decreasing significantly the four parameters under study.

B- Interaction effect:

Referring the interaction effect of various combinations between the 3 investigated factors, data showed obviously available response. Herein combination between Coronaiki transplants irrigated with 6000 ppm salt solution of SAR6 and lower Cl:SO_4 ratio as well as sprayed with CCC at 1000 ppm exhibited statically the highest values of four parameters. On the contrary, unsprayed any of olive cultivars transplants and irrigated with 6000 ppm saline solution of SAR6 with either lower or higher Cl:SO_4 ratio exhibited the lowest values during the study.

Table (2): Effect of some growth regulators foliar spray on some growth measurements of three olive cultivars transplants irrigated with 6000 ppm, SAR6 and two levels of $Cl:SO_4$ saline solution during 2002 and 2003 seasons.

Treatments	Cultivars	Stem length (cm.)				Number of leaves/plant				Number of laterals				Total plant length (cm.)			
		Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***
2002																	
Control (tap water)		59.32a	55.32b	48.30c	**54.31A**	103a	93.0c	99.0b	**98.3A**	3.987a	3.120d	3.960b	**3.689A**	106.7a	98.69b	86.43c	**97.26A**
Control	Low CL	38.14k	37.53l	29.47r	**34.65D**	49.24s	47.15t	43.82v	**45.85E**	1.390q	1.067t	0.833v	**1.220E**	55.36m	50.86o	41.92q	**48.59E**
	High CL	36.97m	37.25lm	28.55s		47.22t	45.82u	41.82w		1.277r	1.001u	1.750w		52.94n	50.09op	40.37r	
PP_{333}	Low CL	45.94e	39.72j	35.03o	**37.79C**	86.39g	82.77i	70.35k	**70.35D**	2.527h	2.633g	2.075l	**2.040D**	77.48f	66.70i	60.21l	**64.09D**
	High CL	39.25j	36.41n	30.42q		66.55n	63.34p	52.70r		2.277k	1.500p	1.227s		66.69i	60.47l	53.01n	
BA.	Low CL	48.33c	47.08d	34.80o	**41.20B**	88.40e	87.27f	84.36h	**76.51C**	2.993e	2.343j	1.577o	**2.112C**	79.13e	78.24ef	60.55l	**66.07C**
	High CL	44.58f	39.53j	32.86p		68.01l	66.99mn	64.05o		2.443i	2.085l	1.232s		68.89h	60.40l	49.21p	
CCC	Low CL	46.75d	43.95g	38.19k	**41.31B**	89.92d	87.93e	86.24g	**77.93B**	3.250c	2.832f	2.084l	**2.371B**	83.60d	72.34g	61.02l	**66.61B**
	High CL	42.31h	41.78i	34.86o		73.61j	67.26m	62.60q		2.083l	2.000m	1.975n		64.60j	63.64k	54.49m	
Mean**		**46.09A**	**43.39B**	**36.08C**		**74.70A**	**71.28B**	**67.22C**		**2.470A**	**2.065B**	**1.857C**		**72.82A**	**66.83B**	**56.36C**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		43.19A		**40.51B**		**79.92A**		**67.66B**		**2.445A**		**2.128B**		**71.95A**		**65.11B**	
2003																	
Control (tap water)		61.12a	56.31b	49.62d	**55.68A**	120.0a	105.0d	120.0a	**115.0A**	3.679a	3.780a	3.814a	**3.758A**	107.2a	97.93b	85.79d	**96.98A**
Control	Low CL	40.83l	40.19m	30.17t	**36.20E**	57.20t	53.79w	47.17y	**51.29E**	1.527l	1.303mn	1.027o	**1.236E**	59.22l	57.21m	45.33p	**52.38E**
	High CL	38.64o	37.75p	29.61u		54.67v	51.29x	43.65z		1.333m	1.250n	0.973o		56.29m	52.81o	43.44q	
PP_{333}	Low CL	46.95f	45.42g	37.28q	**41.94D**	93.63h	85.08j	73.04p	**75.58D**	2.625e	2.583ef	2.250h	**2.266D**	82.36e	76.18g	66.36j	**71.08C**
	High CL	43.97i	43.28j	34.75s		76.19n	69.91r	55.66u		2.473g	1.973i	1.693k		73.35h	71.49i	56.73m	
BA.	Low CL	50.11c	46.94f	40.33m	**43.49B**	107.7c	98.86f	90.64i	**88.22C**	2.786d	2.527fg	2.462g	**2.339C**	77.66f	73.07h	65.91j	**68.15D**
	High CL	45.00g	41.72k	36.86q		80.59l	79.20m	72.35q		2.250h	2.233h	1.777j		70.89i	66.09j	55.29n	
CCC	Low CL	48.36e	47.17f	39.75n	**43.22C**	110.2b	102.8e	98.70g	**89.75B**	3.527c	2.713d	2.473g	**2.457B**	88.32c	77.19f	63.98k	**71.92B**
	High CL	44.45h	43.96i	35.61r		84.35k	76.17o	66.29s		2.250h	2.000i	1.777j		73.80h	71.26i	56.98m	
Mean**		**46.60A**	**44.75B**	**37.11C**		**87.17A**	**80.23B**	**74.17C**		**2.494A**	**2.262B**	**2.027C**		**76.57A**	**71.47B**	**59.98C**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		45.37A		**42.84B**		**90.92A**		**77.02B**		**2.605A**		**2.217B**		**74.92A**		**69.29B**	

*; ** and *** means refer to specific effect of foliar spray with growth regulators, 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): Leaf area (cm.); total leaf (assimilation) area and chlorophyll (A & B) 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 2002 and 2003 experimental seasons.

Treatments \ Cultivars		Leaf area (cm.)				Total leaf (assimilation) area				Chlorophyll (A)				Chlorophyll (B)			
		Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***
2002																	
Control (tap water)		3.430b	3.005cd	4.65a	**3.695A**	353.4b	279.5c	460.4a	**364.4A**	1.420b	1.362c	1.565a	**1.449A**	0.893a	0.763b	0.668c	**0.775A**
Control	Low CL	2.000kl	2.113i-k	1.603n	**1.852D**	98.55ij	99.69i	70.31k	**85.03D**	0.873gh	0.710k-n	0.743j-l	**0.758D**	0.273ij	0.243j	0.257j	**0.253E**
	High CL	1.663mn	1.703mn	2.03kl		78.59k	78.10k	84.96jk		0.837h	0.677mn	0.707k-n		0.260j	0.240j	0.243j	
PP_{333}	Low CL	2.807d	3.177c	2.163h-k	**2.627B**	242.6e	263.0d	152.2h	**186.0C**	0.910fg	0.777ij	0.827hi	**0.782C**	0.353gh	0.320hi	0.340gh	**0.318D**
	High CL	2.253g-j	2.430e-g	2.930d		150.0h	154.0h	154.5h		0.760jk	0.660n	0.760jk		0.327g-i	0.270ij	0.297h-j	
BA.	Low CL	2.980d	2.603e	2.077jk	**2.425C**	263.[illegible]	227.2f	175.3g	**187.3C**	1.210d	0.933ef	0.970e	**0.889B**	0.530d	0.320hi	0.450e	**0.362C**
	High CL	2.287g-i	2.280g-i	2.323gh		155.5h	152.8h	148.9h		0.773ij	0.697l-n	0.750j-l		0.320hi	0.260j	0.294h-j	
CCC	Low CL	2.590ef	2.933d	1.843lm	**2.494C**	233.0ef	258.0d	159.0h	**193.8B**	0.843h	0.730j-m	0.753j-l	**0.720E**	0.557d	0.380fg	0.420ef	**0.403B**
	High CL	2.373g	2.407fg	2.817d		174.7g	162.0gh	176.4g		0.727j-m	0.547o	0.717j-n		0.383fg	0.333gh	0.347gh	
Mean**		**2.487C**	**2.517A**	**2.493B**		**194.47A**	**186.0B**	**175.77C**		**0.9287A**	**0.788C**	**0.866B**		**0.433A**	**0.348B**	**0.368B**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		2.665A		**2.572B**		**222.4A**		**184.3B**		**0.975A**		**0.864B**		**0.451A**		**0.393B**	
2003																	
Control (tap water)		3.650b	3.002f	4.220a	**3.624A**	437.2b	315.3c	506.4a	**419.6A**	1.623a	1.465b	1.628a	**1.572A**	0.763a	0.682c	0.732b	**0.726A**
Control	Low CL	2.230p	2.477m	1.807t	**2.152E**	127.6n	133.3m	85.3p	**110.4E**	0.933i	0.837lm	0.897j	**0.854C**	0.463g	0.327m	0.370jk	**0.366C**
	High CL	1.897s	2.087r	2.413no		103.8o	107.1o	105.4o		0.860k	0.770n	0.827m		0.413i	0.270o	0.353kl	
PP_{333}	Low CL	2.153q	3.600b	2.543l	**2.834C**	201.7i	306.4f	185.8k	**212.5D**	0.970g	0.920i	0.950h	**0.834D**	0.497f	0.440h	0.483f	**0.381C**
	High CL	2.797i	2.733jk	3.180e		213.2h	191.1jk	177.1l		0.783n	0.663r	0.717p		0.303n	0.277o	0.287no	
BA.	Low CL	2.9[illegible]3g	3.480c	2.250p	**2.757D**	314.9e	344.1c	203.9i	**245.4C**	1.127c	1.023f	1.063e	**0.880B**	0.600d	0.493f	0.550e	**0.456B**
	High CL	2.403o	2.717jk	2.770ij		193.7j	215.3h	200.5i		0.747o	0.637s	0.680q		0.450gh	.277o	0.367jk	
CCC	Low CL	2.997f	3.347d	2.460mn	**2.884B**	330.3d	344.1c	242.9g	**260.1B**	1.120c	0.770n	1.080d	**0.855C**	0.440h	0.380j	0.403i	**0.376C**
	High CL	2.937g	2.710k	2.853h		247.8g	206.5i	189.2jk		0.847kl	0.563t	0.750o		0.360kl	0.333m	0.343lm	
Mean**		**2.665C**	**2.906A**	**2.722B**		**241.1A**	**240.4B**	**210.7C**		**1.001A**	**0.850C**	**0.955B**		**0.477A**	**0.387C**	**0.432B**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		2.876A		**2.824B**		**272.0A**		**227.3B**		**1.094A**		**0.904B**		**0.508A**		**0.414B**	

*; ** and *** means refer to specific effect of foliar spray with growth regulators, olive cvs. and Cl:SO_4 ratio, respectively. Values within the same column or row for any of the 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.

III- Leaves, stem, root and total plant dry weights:

A- Specific effect:

Concerning the specific effect of olive cultivars, data in Table (4) showed that all parameters followed typically the same trend. Hence; Coronaiki transplants had the greatest values of leaves, stem, root, and total plant dry weights, while, Manzanillo transplants had the lightest values and Aghizi cultivar was in between during the study. These results are in agreement with El-Said *et al.*, (1995) and Hasan (2005). In addition, the specific effect of sprayed growth regulators, data in Table (4) display that PP_{333} at 500 ppm, BA at 20 ppm and CCC at 1000 ppm sprayed solely increased obviously the leaves, stem, roots and total plant dry weights rather than analogous ones of the unsprayed salt olive transplants during both seasons of study. However, CCC was more effective than either BA or PP_{333} and the increase exhibited by its application in, leaves stem, roots and total plant dry weights over the unsprayed salt stressed olive plants were significant during 1st and 2nd seasons. This result is in agreement with the findings of Sharaf *et al.*, (1985) on American and European grape plants, who found that spraying BA and/or CCC reduced the salinity damage and increased leaves, stem, root and total plant dry weights. Moreover, the specific effect of chloride levels of saline solution used in irrigation in dry weights of plant organs, it is quite clear that dry weights of plant organs were significantly decreased by increasing $Cl:SO_4$ ratio in irrigation water during the study. These results go in line with that found by Hasan (2005) on Coronaiki, Manzanillo and Aghizi transplants.

Foliar spray of Taimor and Alphonso mango seedlings with CCC at 500 ppm alleviated effectively the adverse effect of salinity (Ahmed and Ahmed, 1997), while CCC at 100 ppm slightly increased cucumber seedlings growth Kazin and Khalied (1983). Maximos *et al.*, (1991) reported that Fig cv. El-Suttani were sprayed twice (May and July) with CCC or paclobutrazol each at 500 or 1000 ppm. At 500 ppm both growth regulators increased growth parameters (the number of leaves/plant, plant height, number of laterals and dry weights of (leaves, stems and roots) compared with control, but at 1000 ppm growth was retarded.

B- Interaction effect:

As for the interaction effect of three investigated factors on dry weights of plant organs, data presented in Table (4) showed obviously available response of these measurements to the different combinations during the study. The highest values of plant organs dry weights of olive cultivars were detected by that combination representing spraying CCC at 1000 ppm to irrigate Coronaiki transplants with saline water SAR6 and low $Cl:SO_4$ ratio. Meanwhile, the lowest increase in dry weight plant organs over unsprayed salt stressed olive transplants were detected by those Aghizi transplants irrigated with 6000 ppm of SAR6 and higher chloride levels during the study.

IV- Leaf physiological properties:

In this respect 5 leaf physiological properties namely: leaf osmotic pressure (L.O.P.), leaf relative turgidity (L.R.T.), leaf transpiration rate (L.T.R.), leaf succulence grade (L.S.G.) and hard leaf character (H.L.C.) of salt stressed transplants belong to three olive cultivars (Coronaiki, Manzanillo and Aghizi) in response to foliar spray with 3 growth regulators (PP_{333} at 500 ppm, BA at 20 ppm and CCC at 1000 ppm) were investtigated. Data obtained during 1st and 2nd seasons regarding the specific and interaction effects of olive cultivars, sprayed growth regulators, chloride levels and their combinations are presented in Tables (5 & 6).

A- Specific effect:

Data obtained during both seasons as shown in Tables (5 & 6) revealed that Coronaiki cv. had significantly the greatest values of (L.O.P.); (L.S.G.) and L.R.T. followed in a decreasing order by Manzanillo and Aghizi olive cultivars during 2002 and 2003 seasons. The reverse was true, regarding transpiration rate and (L.L.C.) values compared to that previously discussed with (L.O.P.), (L.S.G.) and (L.R.T.), where Aghizi transplants had significantly the highest values, while Coronaiki cv. had the lowest ones. This results is in agreement with the

Table (4): Dry weights of plant organs (leaves, stems and roots "gm") and total plant (gm); 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		Dry weight of leaves (gm.)				Dry weight of stems (gm.)				Dry weight of roots (gm.)				Total plant dry weight (gm.)			
		Coronaiki	Manza.	Aghizi.	Mean*	Coronaiki	Manza.	Aghizi.	Mean*	Coronaiki	Manza.	Aghizi.	Mean*	Coronaiki	Manza.	Aghizi.	Mean*
2002																	
Control (tap water)		13.63a	12.58c	13.62b	13.28A	12.02a	11.58a	10.70b	11.43A	13.39a	10.32b	9.67c	11.13A	42.03a	34.46c	33.99d	36.83A
Control	Low CL	3.960g	2.707h	3.858g	3.247E	5.563hi	5.493h-j	4.760k	4.952E	5.290hi	4.070mn	3.463op	3.892E	14.81m	12.27p	12.07p	12.09E
	High CL	3.820g	2.497h	2.650h		5.223i-k	4.890k	3.783l		4.117l-n	3.390o-q	3.020q		13.16o	10.78q	9.453r	
PP_{333}	Low CL	8.740d	7.560e	8.760d	[illegible]D	6.637f	5.983gh	5.703hi	5.612D	5.720fg	4.843jk	3.717n-p	4.501D	21.10h	18.39j	18.18j	17.19D
	High CL	6.170f	4.143g	6.540f		5.947gh	5.280i-k	4.120l		5.550gh	3.820no	3.357pq		18.21j	13.24o	14.02n	
BA.	Low CL	8.994d	7.610e	7.135ef	7.395C	[illegible]cd	6.630f	5.647hi	6.468C	9.640c	6.930e	4.373lm	6.089B	26.60e	21.17h	17.15k	19.95C
	High CL	7.050ef	6.700f	6.883ef		[illegible]de	6.257fg	4.737k		7.600d	4.497kl	3.497op		22.22g	17.45k	15.12m	
CCC	Low CL	9.327d	8.863d	[illegible]d	[illegible]B	8.323c	7.427e	6.633f	6.811B	6.650e	6.013f	5.030ij	5.388C	24.30f	22.30g	20.94h	20.29B
	High CL	7.250ef	6.730f	7.083ef		7.143e	6.380fg	4.957jk		5.613f-h	5.203h-j	3.820no		20.01i	18.31j	15.86l	
Mean**		7.660A	6.599C	7.341B		7.377A	6.658B	5.671C		7.063A	5454B	4.439C		22.49A	18.71B	17.42C	
Mean***		Low		High		Low		High		Low		High		Low		High	
		8.441A		7.156B		7.405A		6.706B		6.608A		5.791B		22.65A		19.89B	
2003																	
Control (tap water)		14.13a	13.23b	13.90a	13.75A	12.93a	11.79b	9.69c	11.47A	10.17a	8.73c	9.21b	9.376A	37.23a	33.75b	32.80c	34.60A
Control	Low CL	3.730n	3.257o	3.297o	3.232E	6.250g	5.357jk	4.223mn	4.995E	5.303f	3.543i	2.940j	3.615E	15.28n	12.16r	10.46s	11.84E
	High CL	3.163o	2.867p	3.077op		5.527hj	4.713l	3.900o		4.693g	3.040j	2.173k		13.38q	10.62s	9.150t	
PP_{333}	Low CL	9.903cd	7.327j	8.343g	[illegible]D	6.210g	6.137g	5.193k	5.445D	4.687g	4.433g	3.113j	3.961D	20.80g	17.90j	16.65l	16.90D
	High CL	6.973k	5.583m	6.867kl		6.010gh	5.120k	4.00no		4.647g	3.990h	2.893j		17.63jk	14.69o	13.76p	
BA.	Low CL	9.743d	8.093h	8.223gh	[illegible]C	7.640e	6.007gh	4.630l	5.624C	6.960d	4.647g	4.537g	5.002B	24.34d	18.75i	17.39k	18.71C
	High CL	[illegible]i	7.257j	7.417j		5.710hi	5.267jk	4.490lm		5.957e	3.943h	3.967h		19.46h	16.47l	15.87m	
CCC	Low CL	10.12c	9.500e	8.617f	[illegible]B	8.267d	7.790e	4.750l	6.380B	4.717g	4.660g	4.417g	4.220C	23.10e	21.95f	17.78j	18.88B
	High CL	7.480j	6.653l	7.297j		6.99f	5.940gh	4.543l		5.223f	3.230j	3.072j		19.69h	15.82m	14.91o	
Mean**		8.115A	7.085C	7.469B		7.282A	6.458B	5.047C		5.817A	4.868B	4.036C		21.21A	18.01B	16.53C	
Mean***		Low		High		Low		High		Low		High		Low		High	
		8.761A		7.579B		7.124A		6.442B		5.472A		4.996B		21.36A		19.02B	

*; ** and *** means refer to specific effect of foliar spray with growth regulators, 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): Leaf osmotic pressure (L.O.P.), leaf relative turgidity (L.R.T). and Transpiration rate (mg H_2O/gm F.W./h) 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:SO_4 ratio and their combinations during 2(g 2002 an d 2003 expermintal seasons.

Treatments \ Cultivars		L.O.P.				L.R.T.				Transpiration rate (mg H2O/gm F.W./h)			
		Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***
2002													
Control (tap water)		11.36m	9.18n	9.06n	**9.87E**	85.33a	77.30b	71.60e	**78.08A**	0.653j	0.932c	0.965b	**0.850A**
Control	Low CL	31.74d	31.54d	26.59e	**32.18A**	45.74s	43.80u	39.68w	**42.66E**	0.283q	0.280q	0.483n	**0.337E**
	High CL	35.99a	34.46b	32.74c		45.16t	43.14v	38.43x		0.240r	0.313p	0.420o	
PP_{333}	Low CL	21.63i	19.17k	19.03k	**20.73C**	74.33c	65.57h	59.60l	**64.43B**	0.493mn	0.767i	0.893d	**0.707D**
	High CL	22.72h	21.62i	20.21j		72.72d	64.03i	50.35q		0.507lm	0.777i	0.803h	
BA.	Low CL	20.34j	19.17k	17.94l	**19.98D**	67.00f	66.42g	60.00k	**59.77C**	0.577k	0.873e	0.983a	**0.776B**
	High CL	21.62i	20.48j	20.34j		60.26jk	53.05n	51.87p		0.523l	0.803h	0.897d	
CCC	Low CL	21.74i	21.62i	20.34j	**22.87B**	65.81h	60.42j	60.59j	**57.49D**	0.583k	0.833g	0.903d	**0.743C**
	High CL	25.23f	24.08g	24.23g		57.12m	52.40o	48.59r		0.507lm	0.777i	0.853f	
Mean**		**23.60A**	**22.37B**	**21.16C**		**63.72A**	**58.46B**	**53.41C**		**0.485C**	**0.706B**	**0.800A**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		20.03B		**22.22A**		**62.88A**		**58.10B**		**0.700A**		**0.665B**	
2003													
Control (tap water)		9.14m	9.27m	8.14n	**8.85E**	93.65a	90.30b	73.38g	**85.78A**	0.732g	0.915b	0.993a	**0.880A**
Control	Low CL	31.15c	31.08c	29.16d	**32.85A**	46.41u	45.02v	42.94x	**43.59E**	0.333o	0.437k	0.487j	**0.388E**
	High CL	36.13a	35.81a	33.77b		45.24v	43.32w	38.62y		0.287p	0.373n	0.410m	
PP_{333}	Low CL	21.90ij	19.53k	22.92g	**21.89C**	82.55c	79.40e	57.83o	**69.07B**	0.487j	0.777f	0.873c	**0.672D**
	High CL	22.92g	22.30hi	21.75j		81.54d	62.18m	50.92t		0.430kl	0.703h	0.760f	
BA.	Low CL	19.73k	19.53k	18.41l	**20.93D**	74.38f	68.59j	62.97l	**62.84C**	0.590i	0.863c	0.923b	**0.746B**
	High CL	23.62f	22.23ij	22.05ij		64.31k	55.50p	51.27t		0.417lm	0.777f	0.907b	
CCC	Low CL	23.13g	23.17g	21.92ij	**23.34B**	71.33h	69.36i	61.61n	**60.27D**	0.690h	0.817e	0.837d	**0.707C**
	High CL	24.60e	24.47e	22.74gh		53.97q	53.55r	51.78s		0.480j	0.690h	0.730g	
Mean**		**23.59A**	**23.04B**	**22.32C**		**68.15A**	**63.02B**	**54.59C**		**0.494C**	**0.706B**	**0.769A**	
Mean***		**Low**		**High**		**Low**		**High**		**Low**		**High**	
		20.55B		**22.60A**		**67.98A**		**60.64B**		**0.717A**		**0.640B**	

***; ** and *** means refer to specific effect of foliar spray with growth regulators, olive cvs. and Cl:SO4 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 (6): Leaf succulence grade (L.S.G.) and hard leaf character (H.L.C.) 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 200 g 2002 ar and 2003

Treatments \ Cultivars		Leaf succulence grade (L.S.G.)				hard leaf character (H.L.C.)			
		Coronaiki	Manza.	Aghizi.	**Mean***	Coronaiki	Manza.	Aghizi.	**Mean***
2002									
Control (tap water)		0.850c	1.315a	0.969b	**1.045A**	0.200j	0.200j	0.180k	**0.193E**
Control	Low CL	0.390jk	0.290m	0.500gh	**0.406E**	0.450d	0.507b	0.400e	**0.472A**
	High CL	0.470g-i	0.477gh	0.310lm		0.453d	0.583a	0.440d	
PP_{333}	Low CL	0.683e	0.580f	0.983b	**0.750B**	0.403e	0.370fg	0.367gh	**0.378D**
	High CL	0.734de	0.800c	0.717de		0.477c	0.363fg	0.287i	
BA.	Low CL	0.478gh	0.417ij	0.523g	**0.520C**	0.357fg	0.477c	0.327h	**0.403B**
	High CL	0.743d	0.500gh	0.460hi		0.417e	0.487c	0.353g	
CCC	Low CL	0.393jk	0.373jk	0.603f	**0.434D**	0.360fg	0.370fg	0.357fg	**0.386C**
	High CL	0.383jk	0.493gh	0.353kl		0.410e	0.447d	0.373f	
Mean**		**0.569C**	**0.583A**	**0.602B**		**0.392B**	**0.423A**	**0.343C**	
Mean***		**Low**		**High**		**Low**		**High**	
		0.623B		**0.638A**		**0.355B**		**0.378A**	
2003									
Control (tap water)		0.960b	0.993a	0.843c	**0.932A**	0.210l	0.220l	0.190m	**0.207D**
Control	Low CL	0.357m	0.253q	0.410k	**0.349D**	0.327g	0.410b	0.280ij	**0.360A**
	High CL	0.377l	0.407k	0.290p		0.353ef	0.450a	0.337fg	
PP_{333}	Low CL	0.620g	0.517i	0.747d	**0.639B**	0.290i	0.363de	0.247k	**0.296C**
	High CL	0.717e	0.697f	0.537m		0.277ij	0.350ef	0.250k	
BA.	Low CL	0.357m	0.290p	0.430j	**0.364C**	0.290i	0.360de	0.270j	**0.327B**
	High CL	0.403k	0.393kl	0.310o		0.337fg	0.393c	0.310h	
CCC	Low CL	0.350m	0.280p	0.427j	**0.358C**	0.310h	0.340fg	0.290i	**0.333B**
	High CL	0.360m	0.400k	0.333n		0.347ef	0.375d	0.337fg	
Mean**		**0.500A**	**0.470C**	**0.481b**		**0.305B**	**0.362A**	**0.279C**	
Mean***		**Low**		**High**		**Low**		**High**	
		0.522B		**0.535A**		**0.293B**		**0.316A**	

*; ** and *** means refer to specific effect of foliar spray with growth regulators, olive cvs. and Cl:SO_4 ratio, respectively. Values within the same column or row for any of three investigated f ictors 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.

findings of Hasan (2005) on the same olive cultivars. In addition, the specific effect of sprayed growth regulators (PP_{333}, BA and CCC) on five leaf physiological properties, Tables (5 & 6) displays that irrigation olive transplants with saline solution at 6000 ppm resulted in an obvious increase in (L.O.P.) and (H.L.C.) of leaf olive cultivar during both seasons. Such increase was significant as compared to those of tap water irrigated transplants. Analogous results were obtained by Hasan (2005) on three olive cultivars. Meanwhile, both (L.O.P. & H.L.C. responded specifically to the sprayed growth regulators, where, L.O.P. & H.L.C. were significantly decreased by any of 3 sprayed growth regulators i.e., PP_{333}, BA and CCC treatments. However, CCC showed the most reduction values descendingly followed by PP_{333}, BA during both seasons. On the contrary, (L.S.G.) leaf transpiration rate and L.R.T. in response to spray with three growth regulators took the other way around whereas they resulted in a significant increase in L.S.G., transpiration rate and L.R.T. during both seasons of study. Moreover, the specific effect of $Cl:SO_4$ ratio of saline solution used for irrigation on leaf physiological properties, it could be observed from data in Tables (5 & 6) that the higher ratio resulted in a significant increase in (L.S.G, L.O.P. & H.L.C.) while transpiration rate and L.R.T. decreased during two seasons of study. These results are in agreement with the findings of Hasan (2005) on 3 olive cultivars.

B- Interaction effect:

With regard to the interaction effect of various combinations between 3 studied factors on leaf physiological properties, Tables (5 & 6) displayed the more pronounced response of specific effect of sprayed growth regulators rather than the analogous one of either $Cl:SO_4$ ratio or olive cultivar reflected clearly on interaction effect of these investtigated factors. Anyhow, the foliar sprayed salt stressed transplants of Coronaiki cv. (especially lower $Cl:SO_4$ ratio) with any of growth regulators under study increased transpiration rate and L.R.T. but decreased L.O.P. & H.L.C. during the study.

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مقاومة بعض أصناف الزيتون للملوحة بالرش ببعض منظمات النمو.
١) التأثير على النمو ومحتوى الورقة من الكلوروفيل وبعض الصفات الفسيولوجية للورقة

فؤاد محمد عبد اللطيف الجندى
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١) أجريت هذه الدراسة خلال موسمي ٢٠٠٢، ٢٠٠٣ بمزرعة الشيخ خليفة – العين – الإمارات العربية المتحدة. على ثلاث أنواع من شتلات الزيتون (كروناكي، مانزينللو، العجيزى) عمـــر ســنة، بهــدف دراسة تاثير الرش ببعض منظمات النمو (السيكوسيل بتركيز 1000 جزء في المليون، والبنزيل أدينين بتركيز ٢٠ جزء في المليون، الباكلوباترزول بتركيز ٥٠٠ جزء فى المليون) رشا على الأوراق فــي اربعة مواعيد هى (منتصف كل من يونيو، يوليو، أغسطس وسبتمبر) على تقليل الأثر الضار للملوحة على نمو شتلات الزيتون. تم اختيار شتلات عمر سنة لهذه الدراسة متقاربة فــي نموهــا للأصـــناف الثلاث فى ١٥ مارس خلال موسمى الدراسة حيث زرعت فى أصـ ـص بلاستيك بقطر ٣٥ سم تحتــوى على وزن ثابت من مخلوط الرمل والبوتنج سويل بنسبة ١:١ وروبت بالماء العادى بمعدل ٤/٣ لتــر /أصيص كل يومين حتى أول مايو حيث بدأت معاملات الملوحة.

٢) صممت تجربة عاملية تشمل ثلاث عوامل مختبرة (صنف الزيتون، نسبة الكلوريدات إلى الكبريتــات بمحلول ماء الرى المالح، ومنظم النمو) وكذلك التفاعل بين تلك العوامــل الــثلاث ومــدى اســتجابة الشتلات النامية تحت إجهاد ملحي (٦٠٠٠ جزء فى المليون، ومستوى ٦ من الصـــوديوم المــدمص) لتلك العوامل وانعكاساتها على القياسات الخضرية والفسيولوجية للشتلات.

٣) اظهر الصنف كروناكي تفوقا ملحوظا فى كل القياسات الخضرية (الوزن الجاف لكــل مــن الجــذر والساق والأوراق) محتوى الأوراق من كلوروفيل أ، ب وكذلك الضغط الأسموزى للورقة (.L.O.P) والجهد المائي للأوراق (.L.R.T) بينما الصنف عجيزى أظهر اقل استجابة لتلك القياسات. زيادة نسبة الكلوريدات إلى الكبريتات فى محلول ماء الرى للشتلات النامية فى محلول ملحى ٦٠٠٠ جــزء فــى المليون ومستوى ٦ من الصوديوم المدمص أدت إلى تقليل كل القياسات السابقة مقارنـــة بـــالكونترول (ماء عذب).

• رش الشتلات باى من منظمات النمو (السيكوسيل، البنزيل ادينين والباكلوباترزول) أدت إلى إحداث زيـــادة معنوية فى كل القياسات الخضرية (طول الساق، طول النبات الكلى، عدد الأوراق/نبات، عـــدد التفرعـــات الجانبية/نبات، متوسط مساحة الورقة، مساحة الأوراق/نبات والوزن الجاف لأجزاء النبات المختلفة وكـــذلك زيادة الصفات الفسيولوجية للورقة (غضاضة الأوراق (.L.S.G)، الجهد المائى للورقة (L.R.T)، ومعـــدل النتح) بينما أظهرت كل من الضغط الأسموزى للأوراق .L.O.P وصلابة الأوراق .H.L.C نتائج مضادة.