IV- RESULTS AND DISCUSSION

Undoubtedly, salinity is considered one of the most important factor which plays a vital role on plant growth through its depressive effect on both metabolic activities and water relations with the various plant tissues. This the following presentation of results and discussion dealing with the effect of salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in saline solutions used for irrigation on some growth measurements, physiological aspects and chemical constituents of transplants organs of both betulaefolia and communis pear rootstocks in the first experiment. Moreover, response of saline stressed transplants for two rootstocks. to the foliar spray of some growth regulators i.e., (cycocel, benzyladenine, and pachlobatrazol) were also evaluated.

IV-I- The first experiment:

IV-I-1- Effect of salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in irrigation water on some vegetative growth measurements and chemical contents of the two pear rootstocks transplants:

IV-I-1-1- Effect on some vegetative measurements:

Obtained data represented in **Tables (2, 3, 4, and 5)** show that all studied vegetative growth measurements which expressed as stem height, stem diameter, root length, total plant length, number of both leaves and lateral shoots per transplant and both leaf area and total leaves (assimilation) area as well as fresh and dry weights of plant organs (leaves, stems, roots, total plant and top/root ratio) in response to the three investigated salinity concentrations (2000, 4000 and 6000 ppm) combined with two levels from both sodium adsorption ratio (SAR3 and SAR6) and 2 $Cl:SO_4$ ratio (low & high) in saline solutions used for irrigation of two pear rootstocks (betulaefolia and communis) transplants during 2004 and 2005 seasons.

1- Effect on stem height and stem diameter (cm):

A- Specific effect:

Regarding the specific effect of salinity concentrations on both stem height and stem diameter of both betulaefolia and communis pear rootstocks transplants, data presented in **Table (2)** revealed that all the three investigated saline solutions i.e., (2000, 4000 and 6000 ppm.) resulted in an obvious decrease in stem height and stem diameter during the first and second seasons of study. Such decrease was significant when the three salt concentrations used i.e., 2000, 4000 and 6000 ppm, were compared to the control (transplants irrigated with tap water). On the other hand, the saline irrigation treatment of 6000 ppm in the irrigation water had the greatest depressive effect on stem height and diameter for the two pear rootstocks transplants under study. While, the saline irrigation solution treatment of 2000 ppm. exhibited the lowest decrease in stem height and diameter. Meanwhile, the treatment of 4000 ppm salt concentration was intermediate in this respect. Furthermore, the differences between the three salinity concentrations were significant as each was compared to the two other ones. Such trends were true during 2004 and 2005 seasons of study.

The obtained data concerning the specific effect of salt concentrations in water irrigation on stem height and diameter are in harmony with those obtained by **Kabeel (1985)** on some deciduous fruits seedlings, **Bondok *et al.*, (1995-b)** on peach transplants, **Omar (1996)** on apricot and mango seedlings, **El-Naggar (2002)** on persimmon seedlings, **Osman (2005)** on apple rootstocks and **Darwesh (2006)** on pear and apple rootstocks. They indicated that stem height and diameter reduced with increasing salt concentration in the irrigation water.

With respect to the specific effect of sodium adsorption ratio (SAR), data tabulated in **Table (2)** displayed obviously that the higher ratio of SAR i.e., (SAR6) resulted significantly in decreasing both stem height and diameter than the lower one (SAR3) in the two pear rootstocks transplants under study during 2004 and 2005 seasons. These results are in agreement with that mentioned by **Behairy (1984)** on Thompson seedless and American grapevines, **Kabeel (1985)** on apricot, plum and Thompson grapevines seedlings, **Abd El-Magied (1998)** on bitter almond rootstocks seedlings and **Darwesh (2006)** on apple and pear rootstocks transplants. All reported that increasing SAR ratio from 3 to 6 resulted in a significant reduction in both stem height and diameter.

Concerning the specific effect of chloride level i.e., ($Cl:SO_4$ ratio) of saline water used for irrigation on both stem height and diameter, it could be noticed from data in **Table (2)** that, the higher ($Cl:SO_4$) ratio resulted in a significant decrease in both stem height and diameter as compared to the lower one. Such trend was detected with the two pear rootstocks transplants during the two experimental seasons. These results are similar to that achieved by **Kabeel (1985)** on some deciduous fruit species, **Omar (1996)** on apricot and mango seedlings, **El-Naggar (2002)** on persimmon seedlings, **Osman (2005) and Darwesh (2006)** on some rootstocks transplants of apple and pear. They revealed that both stem height and diameter was decreased significantly by increasing the level of chloride ($Cl:SO_4$ ratio) in irrigation water.

B- Interaction effect:

Referring the interaction effect of the three investigated factors i.e., salinity concentrations, sodium adsorption ratio (SAR) and chloride levels in saline water used for irrigation on both stem height and diameter, the obtained results in **Table (2)** show obviously that a considerable and statistical depressive effect was detected for both betulaefolia and communis pear rootstocks during the two seasons of study. In this respect, combination between the highest salt concentration (6000 ppm) x the higher ratio of SAR (SAR6) x higher chloride level ($Cl:SO_4$ ratio), exhibited the greatest decrease in stem height and diameter.

However, the lowest decrease in both stem height and diameter was detected by these rootstocks transplants irrigated with saline solution of 2000 ppm; SAR3 and lower chloride level ($Cl:SO_4$ ratio) as compared to the transplants continuously irrigated with tap water

Table (2): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on stem height (cm.) and stem diameter (cm.) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Rootstocks / Treatments		Stem height (cm.)						Stem diameter (cm.)					
		betulaefolia			Communis			betulaefolia			Communis		
		Low	High	Mean*	low	High	Mean*	low	High	Mean*	low	High	Mean*
2004 season													
Control		155.9a	155.9a	155.9A	119.5a	119.5a	119.5A	0.740a	0.740a	0.740A	0.850a	0.850a	0.850A
2000 ppm	SAR3	157.2a	153.6ab	151.4B	118.2a	110.8b	111.1B	0.730a	0.710a	0.695B	0.840a	0.823b	0.818B
	SAR6	148.0bc	146.7c		110.1b	105.4c		0.690ab	0.650bc		0.810bc	0.797c	
4000 ppm	SAR3	144.6cd	140.2d	134.4C	97.23d	85.64e	84.82C	0.620cd	0.590de	0.573C	0.770d	0.740e	0.735C
	SAR6	132.7e	120.1f		80.86f	75.53g		0.560ef	0.520fg		0.740e	0.690f	
6000 ppm	SAR3	111.3g	100.1h	95.8D	70.64h	65.12i	63.47D	0.490gh	0.470gh	0.468D	0.660g	0.610h	0.603D
	SAR6	90.66i	81.22j		60.77j	57.36k		0.460h	0.450h		0.580i	0.560j	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		139.8A	128.9B		98.33A	91.13B		0.636A	0.601B		0.768A	0.735B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		134.0A	128.3B		93.90A	88.48B		0.613A	0.590B		0.750A	0.724B	
2005 season													
Control		151.2a	151.2a	151.2A	115.6a	115.6a	115.6A	0.713a	0.713a	0.713A	0.880b	0.880b	0.880A
2000 ppm	SAR3	150.2ab	147.2bc	146.4B	112.6a	112.3a	107.2B	0.713a	0.690b	0.683B	0.900a	0.850c	0.838B
	SAR6	147.6bc	140.8d		105.7b	98.16c		0.680b	0.650c		0.810d	0.790e	
4000 ppm	SAR3	136.0e	125.4f	121.2C	89.74d	85.96e	84.68C	0.620d	0.610d	0.598C	0.750f	0.720g	0.703C
	SAR6	117.5g	105.9h		82.13f	80.87f		0.590e	0.570f		0.690h	0.650i	
6000 ppm	SAR3	90.96i	85.41j	83.89D	73.75g	68.11h	68.00D	0.520g	0.490h	0.473D	0.630j	0.580k	0.579D
	SAR6	80.83k	78.36k		67.69h	62.43i		0.450i	0.430j		0.557l	0.550l	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		129.7A	121.7B		96.71A	91.03B		0.634A	0.600B		0.774A	0.726B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		124.9A	119.2B		92.46A	89.06B		0.612A	0.593B		0.745A	0.717B	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction).

Means followed by the same letter/s were not significantly different at 5 % level.

(control). Meanwhile, the other combinations treatments were intermediate with various tendency of variances in this concern. Such trend was true with both pear rootstocks transplants during the first and second seasons of study. The obtained results could be confirmed with those mentioned by **Kabeel (1985), Omar (1996), Abd El-Magied (1998), Osman (2005) and Darwesh (2006)** on transplants of some deciduous fruit species.

2- Root length and total plant length (cm.):

A- Specific effect:

With respect to the influence of the three investigated factors under study i.e., salt concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on the root length and total plant length (cm.) of both betulaefolia and communis pear rootstocks transplants throughout 2004 and 2005 seasons, data obtained are tabulated in **Table (3)**.

Regarding the root length and total plant length (cm.) of the two pear rootstocks transplants under study as affected by the specific effect of different salinity concentrations, data represented in **Table (3)** revealed clearly that the three concentrations of saline solutions under study i.e., (2000, 4000 and 6000 ppm.) exhibited an obvious decrease in root length and total plant length (cm.) during the two seasons of study. Such decrease was significant as compared to transplants irrigated with tap water during the two experimental seasons for both two rootstocks cvs. under study. On the other hand, data show that the saline solution at 6000 ppm concentration had the great depressive effect on root length and total plant length (cm.) of the two pear rootstock transplants, while the saline irrigation solution treatment of 2000 ppm concentration resulted in the lowest decrease in both root length and total plant length (cm.), whereas the concentration of 4000 ppm was an intermediate in this respect. In addition, the differences between the three investigated salt concentrations were significant as each was compared to the two other ones during the first and second seasons for the two pear rootstocks in this study. In this concern, was found by **Omar (1996), Abd El-Magied (1998), El-Naggar (2002), Osman (2005) and Darwesh (2006)** on some deciduous fruit rootstocks transplants.

Referring the specific effect of sodium adsorption ratio (SAR), data as shown in **Table (3)** displayed obviously that increasing the level SAR i.e., (SAR6) in irrigation water resulted in a significant decrease in root length and total plant length (cm.) than lower one (SAR3). Such trend was detected during the two seasons for the two pear rootstocks transplants under this investigation.

As for the specific effect of chloride levels, it is quite evident from the present data in **Table (3)** revealed that the higher chloride level (increasing $Cl:SO_4$ ratio) in saline solution used for irrigation showed very slight decrease in root length and total plant length (cm.). The differences between the two chloride levels was completely absent from the standpoint of statistical analysis. Such trend was detected for both betulaefolia and communis pear rootstocks transplants. In addition, increasing chloride level from low to high resulted in a significantly decrease in total plant length in both pear rootstock during the two seasons of study.

These results concerning the effect of SAR and chloride level in irrigation water, generally are in harmony with the finding of **Abd-El-Magied (1998),** on bitter almond seedlings, **El-Naggar (2002),** on Trablos persimmon seedlings, **Osman (2005) and Darwesh (2006)** on some apple and pear rootstocks transplants.

B- Interaction effect:

Regarding the interaction effect of the three studied factors in this investigations i.e., salinity concentrations, sodium adsorption ratio and chloride levels ($Cl:SO_4$ ratio) on root length and total plant length (cm.), data in **Table (3)** showed clearly that the variable response of pear rootstocks transplants to the various combinations of irrigation water used during the two seasons. The most depressive irrigation solutions on root length and total plant length (cm.) of pear rootstocks transplant was in concomitant to that combination between the highest salinity concentration combined with the higher level of both SAR and $Cl:SO_4$ ratios i.e., (6000 ppm x SAR6 x higher $Cl: SO_4$ ratio), whereas the higher decrease in root length and total plant length (cm.) was resulted. While, three other combinations of the (6000 ppm) saline solutions ranked the second in the increasing order. Furthermore, the least decrease in root length and total plant length (cm.) was detected by those pear rootstock transplants irrigated with the combinations of the lowest salts concentration, SAR ratio and lower chloride level i.e., (2000 ppm x SAR3 x low $Cl: SO_4$ ratio) as compared to those transplants continuously

Table (3): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on total plant length and root length (cm.) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Rootstocks / Treatments		Root length (cm.)						Total plant length (cm.)					
		betulaefolia			Communis			betulaefolia			Communis		
		low	High	Mean*	low	High	Mean*	Low	High	Mean*	low	High	Mean*
2004 season													
Control		69.33a	69.33a	69.33A	32.33a	32.33a	32.33A	225.2a	225.2a	225.2A	151.9a	151.9a	151.9A
2000 ppm	SAR3	67.66ab	67.33ab	67.25A	29.26ab	25.07bc	24.42B	224.9a	220.9ab	218.6B	147.5a	135.8b	135.5B
	SAR6	67.33ab	66.66ab		23.21b-d	20.12c-e		215.3bc	213.3bc		133.3bc	125.5c	
4000 ppm	SAR3	63.66ab	61.66bc	59.63B	19.82c-e	17.12d-f	17.31C	208.3cd	201.8d	194.0C	117.0d	102.8e	102.1C
	SAR6	57.08c	56.11c		16.14ef	16.14ef		189.8e	176.2f		97.0ef	91.7fg	
6000 ppm	SAR3	48.37d	42.33e	39.62C	14.25ef	13.17ef	12.68D	159.6g	142.4h	134.4D	84.9gh	78.3hi	76.2D
	SAR6	34.12f	33.66f		11.29f	12.02f		124.8i	114.9j		72.1ij	69.4j	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		61.21A	56.70B		22.92A	20.45B		201.0A	185.6B		121.3A	111.6B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		58.22A	56.73A		20.90A	19.42A		192.6A	185.0B		114.8A	107.9B	
2005 season													
Control		71.66a	71.66a	71.66A	33.66a	33.66a	33.66A	222.9a	222.9a	222.9A	149.3a	149.3a	149.3A
2000 ppm	SAR3	67.33ab	67.66ab	66.17B	29.66a	24.66b	24.61B	217.5ab	214.9b	212.6B	142.3ab	136.9b	131.8B
	SAR6	65.37ab	64.33ab		22.33bc	21.79b-d		212.9b	205.1c		128.1c	119.9d	
4000 ppm	SAR3	62.66b	61.66b	58.19C	18.52c-e	19.19c-e	17.82C	198.6c	187.0d	179.4C	108.3e	105.2ef	102.5C
	SAR6	54.33c	54.11c		17.33d-f	16.22e-g		171.8e	160.0f		99.5fg	97.1g	
6000 ppm	SAR3	42.65d	41.26d	37.83D	15.88e-h	13.09f-h	12.97D	133.6g	126.7g	121.7D	89.6h	81.2i	90.0D
	SAR6	34.22e	33.17e		11.67gh	11.22h		115.1h	111.5h		79.4ij	73.7j	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		60.82A	56.11B		23.54A	20.99B		190.5A	177.8B		120.3A	112.0B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		56.89A	56.26A		21.29A	19.98A		181.8A	175.4B		113.8A	109.0B	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction).

Means followed by the same letter/s were not significantly different at 5 % level.

irrigated with tap water (control) during the two seasons of study. The other combinations treatments came in between the abovementioned two categories. These findings are in accordance with those obtained by **Omar (1996)** on apricot and mango seedlings, **Abd El-Magied (1998)** on bitter almond, **El-Naggar (2002)** on persimmon seedlings, **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks.

3- Effect on number of leaves and lateral shoots/ transplant:

A- Specific effect:

Data obtained concerning the specific effect of the various salts concentrations, sodium adsorption ratio (SAR) and chloride levels (Cl:SO_4 ratio) on number of leaves and lateral shoots per transplant of both betulaefolia and communis pear rootstocks transplants are represented in **Table (4)**.

Referring the specific effect of salinity concentrations, it could be noticed from results in **Table (4)** that the depression in number of leaves and lateral shoots/transplant was closely associated with increasing salt concentration in irrigation water as compared with the control (tap water) for the two investigated pear rootstocks during both 2004 and 2005 seasons of study. Furthermore, all salts concentrations used in this investigation i.e., (2000, 4000 and 6000 ppm) significantly decreased number of leaves and lateral shoots/transplants, since such decrease was more remarkable with the highest salts concentration i.e., (6000 ppm), while the 2000 ppm saline solution resulted in the lowest decrease in number of leaves and lateral shoots/transplant for both studied pear rootstocks transplants. Meanwhile, the 4000 ppm salts concentration was in between in this respect. Additionally, the differences between the three salinity concentrations were significant as each was compared to the other ones throughout 2004 and 2005 seasons of study. The obtained results concerning the specific effect of salts concentrations in suitability of water irrigation are in harmony with that found by **Kabeel (1985),** on some deciduous fruit species; **Prior *et al.*, (1992)** and **Walker (1994)** on grapevines; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on persimmon rootstock transplants, **Osman (2005)** on some apple rootstocks transplants.

Regarding the specific effect of sodium adsorption ratio (SAR), results represented in the same Table show clearly that increasing the level of SAR from lower level (SAR3) to higher one (SAR6) in irrigation water exhibited the highest decrease in number of leaves and laterals per transplant of the two investigated pear rootstocks during both 2004 and 2005 seasons of study. Moreover, such decrease was significantly more depression with the higher SAR than the lower ones, this trend was detected throughout the two seasons of study. Similar results in this concern were obtained by **Kabeel (1985)** on peach, apricot and grapevine seedlings; **El-Naggar (2002)** on Trablos persimmon rootstock seedlings and **Osman (2005)** on some apple rootstocks.

With respect to the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on number of leaves and lateral shoots per transplant, it could be observed from data ambulated in **Table (4)** that increasing chloride level from low to high i.e., (higher $Cl:SO_4$ ratio) resulted in a slight decrease in number of leaves and lateral shoots per transplant. On the other hand, such decrease was not significant, moreover, this trend was detected during both 2004 and 2005 seasons of study for both betulaefolia and communis pear rootstocks transplants. Similar observation was also achieved and mentioned by **Kabeel (1985),** on some deciduous fruit species; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on Trablos persimmon seedlings and **Osman (2005)** on some apple rootstocks transplants.

B- Interaction effect:

Concerning the interaction effect of all studied factors under this investigation i.e., salts concentration, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in irrigation water on number of leaves and lateral shoots per transplant, data obtained in the abovementioned **Table (4)** show a considerable an statistical effect of both betulaefolia and communis pear rootstocks transplants to different combinations of saline water for irrigation during both 2004 and 2005 seasons of study. It could be noticed that the highest decrease in number of leaves and lateral shoots per transplant was detected by that combination between the highest salinity concentrations (6000 ppm) and higher levels of both (SAR6) and chloride ($Cl:SO_4$ ratio) i.e., (6000 ppm. x SAR6 x high $Cl:SO_4$ ratio). Whereas, the lowest decrease was in concomitant to those transplants irrigated with

Table (4): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on number leaves and laterlas shoots per plant of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Number of leaves/plant						Number of laterlas shoots/plant					
		betulaefolia			Communis			betulaefolia			Communis		
		low	High	Mean*	low	High	Mean*	Low	High	Mean*	low	High	Mean*
2004 season													
Control		39.50a	39.50a	39.5A	28.08a	28.08a	28.08A	10.00a	10.00a	10.00A	4.00a	4.00a	4.00A
2000 ppm	SAR3	37.83b	35.75c	34.77B	27.33b	26.25c	24.96B	9.67b	9.00c	8.83B	4.00a	3.67a	3.33B
	SAR6	33.93d	31.58e		95.67d	22.33e		8.66d	8.00f		3.00b	2.67bc	
4000 ppm	SAR3	30.25f	28.83g	27.56C	20.75f	18.83g	18.02C	8.66d	8.33e	8.25C	2.67bc	2.33cd	2.33C
	SAR6	26.68h	24.50i		17.08h	15.42i		8.00f	8.00f		2.33cd	2.00de	
6000 ppm	SAR3	22.67j	20.25k	19.48D	13.50j	11.58k	10.83D	7.33g	6.67h	6.67D	1.67ef	1.67ef	1.58D
	SAR6	18.33l	16.67m		9.83l	8.42m		6.33i	6.33i		1.67ef	1.33f	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		31.82A	28.83B		21.80A	19.14B		8.71A	8.17B		3.00A	2.63B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		29.88A	28.15B		20.07A	18.70B		8.38A	8.05B		2.76A	2.52B	
2005 season													
Control		38.83a	38.83a	38.83A	28.33a	28.33a	28.33A	9.33bc	9.33bc	9.33A	3.67a	3.67a	3.67A
2000 ppm	SAR3	37.00b	35.68c	34.75B	26.83b	25.75c	24.58B	9.00b	8.67c	8.42B	3.33b	3.67a	3.42B
	SAR6	34.08d	32.25e		23.67d	22.08e		8.33d	7.67e		3.67a	3.00c	
4000 ppm	SAR3	30.68d	27.75g	27.00C	19.75f	17.50g	17.00C	7.00f	6.67g	6.58C	3.00c	3.00c	2.75C
	SAR6	25.50h	24.08i		16.17h	14.58i		6.33h	6.33h		2.67d	2.33e	
6000 ppm	SAR3	22.25j	20.17k	19.23D	13.17j	11.75k	10.90D	6.33h	6.00i	5.83D	2.00f	1.67g	1.67D
	SAR6	18.17l	16.33m		10.00l	8.67m		5.67j	5.33k		1.67g	1.33h	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		31.40A	28.51B		21.42A	18.98B		7.79A	7.29B		3.00A	2.75B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		29.50A	27.87B		19.70A	18.38B		7.43A	7.14B		2.86A	2.67B	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction).

Means followed by the same letter/s were not significantly different at 5 % level.

(2000 ppm) saline solution of (SAR3) and lowest chloride level (low $Cl:SO_4$ ratio) as compared to those transplants irrigated continuously with tap water (control treatment) during the first and second seasons of study. Meanwhile, the other remain combinations treatments were in between the aforesaid two extremes with variable tendency effectiveness in this respect. The present results are in a complete agreement with those mentioned by **Kabeel (1985)** on some deciduous fruit species; **El-Naggar (2002)** on Trablos persimmon seedlings and **Osman (2005)** on some apple rootstocks transplants.

4- Effect on leaf area and total leaves (assimilation) area (cm^2) per plant.

A- Specific effect:

With regard to the specific effect of the different investigated factors in this study i.e., salts concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on both leaf area (cm^2) and total leaves (assimilation) area (cm^2) per plant, data represented in **Table (5)** displayed clearly that there was a significant effect for salts concentrations in irrigation water on the two aforesaid characters of both betulaefolia and communis pear rootstocks. However, it was noticed that both leaf area (cm^2) and total leaves (assimilation) area (cm^2) per plant described significantly to general with increasing the salts concentrations in the irrigation water as compared to the control (tap water) during 2004 and 2005 seasons. Such decrease was significant as the three salts concentrations (2000, 4000 and 6000 ppm) either compared each other from one hand or with tap water from author. In addition, the most depressive effect was always in concomitant to the highest salts concentration i.e., (6000 ppm.). Contrary to that the (2000 ppm.) saline solution resulted in the lowest decrease, meanwhile the salt concentration of (4000 ppm.) was intermediate in this respect. Data obtained are supported with those findings of **Tursunov (1972), Pandey and Divate (1976), Meligi *et al.*, (1983) and Hatem (1984)** on grapevine; **Kaul (1981) Patil and Patil (1982)** on pomegranate; **Al-Khateeb (1989)** on some fig varieties; **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants, all they revealed that leaf area (cm^2) and total leaves (assimilation) area (cm^2) decreased with increasing salinity.

Referring the specific effect of sodium adsorption ratio of saline solution used for irrigation, it could be observed from data in the same **Table** that the higher SAR ratio i.e., (SAR6) exhibited a significant decrease in both leaf area (cm^2) and total leaves (assimilation) area per plant than the lower one in the two pear rootstocks under study during both 2004 and 2005 seasons. The obtained results are in accordance with those reported by **Al-Khateeb (1989)** on some fig varieties; **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks.

Concerning the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on both leaf area (cm^2) and total leaves (assimilation) area per plant, data tabulated in **Table (5)** indicated clearly that the higher $Cl:SO_4$ ratio in irrigation water decreased both leaf area and total leaves (assimilation) area/plant.

Such decrease was significant for the two studied pear rootstocks during the two experimental seasons. In this connection, the findings of **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks was similar to that abovementioned reported.

B- Interaction effect:

As for the interaction effect of the different combinations treatments between the three investigated factors i.e., various salinity concentrations combined with two levels from both sodium adsorption ration and chloride levels (Cl:SO_4 ratio) on leaf area (cm^2) and total leaves (assimilation) area per plant (cm^2), data obtained in the same aforesaid **Table (5)** displayed clearly that the most depressive effect of irrigation solution on both leaf area (cm^2) and total leaves (assimilation) area per plant (cm^2) was resulted by the combination between the higher concentration of salt and the higher level of both SAR and chloride (Cl:SO_4 ratio) i.e., (6000 ppm. x SAR x high Cl:SO_4 ratio), however the greatest decrease and the least value of both leaves parameters was recorded. Whereas, other combinations of 6000 ppm. saline solutions ranked statistically the second in an increasing order. Contrary to that, the least depressive effect and the lowest decrease in both leaf area (cm^2) and total leaves (assimilation) area (cm^2)/transplant was generally detected by those transplants irrigated with the lower salts concentration, SAR and chloride level i.e., (2000 ppm saline solution of SAR3 and low Cl:SO_4 ratio). Such decrease was significant as compared to those continuously irrigated with tap water (control). The remained combinations treatments came in between with

Table (5): **Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on average leaf area and total assimilation leaves area (cm^2) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.**

Treatments \ Rootstocks		Average leaf area (cm^2)						Total assimilation leaves area (cm^2)					
		betulaefolia			Communis			betulaefolia			Communis		
		low	High	Mean*	low	High	Mean*	Low	High	Mean*	low	High	Mean*
2004 season													
Control		42.18a	42.18a	**42.18A**	26.55ab	26.55ab	**26.38A**	1666.1a	1666.1a	**1666.1A**	745.4a	745.4a	**745.4A**
2000 ppm	SAR3	42.29a	41.57a	**40.03B**	26.85a	26.13ab	**25.72B**	1599.6b	1486.1c	**1396.4B**	733.7a	685.9b	**655.0B**
	SAR6	38.89b	37.39b		25.76b	24.13c		1319.3d	1180.6e		661.3c	538.9d	
4000 ppm	SAR3	34.38c	33.76c	**31.89C**	23.54c	22.46d	**21.94C**	1040.0f	973.1g	**884.1C**	488.5d	422.9e	**397.8C**
	SAR6	30.81d	28.62de		21.54e	20.22f		821.9h	701.2i		368.0e	311.7f	
6000 ppm	SAR3	26.32ef	24.66fg	**25.02D**	19.86f	18.53g	**18.45D**	596.6j	499.4k	**489.6D**	268.1g	214.6g	**201.5D**
	SAR6	26.44ef	22.67g		17.89gh	17.52h		484.7l	377.9m		175.9gh	147.5h	
Mean (SAR3 & 6)**		**SAR3**	**SAR6**		**SAR3**	**SAR6**		**SAR3**	**SAR6**		**SAR3**	**SAR6**	
		35.92A	**33.65B**		**23.81A**	**22.52B**		**1190.9A**	**1027.2B**		**538.1A**	**461.1B**	
Means* of CL**		**Low**	**High**		**Low**	**High**		**Low**	**High**		**Low**	**High**	
		34.47A	**32.98B**		**23.14A**	**22.22B**		**1075.5A**	**983.5B**		**491.6A**	**438.2B**	
2005 season													
Control		42.68a	42.68a	**42.69A**	26.31a	26.31a	**26.31A**	1657.3a	1657.3a	**1657.1A**	745.2a	745.2a	**745.2A**
2000 ppm	SAR3	42.68a	41.32b	**40.23B**	26.31a	26.18a	**25.72B**	1579.2b	1474.3c	**1401.6B**	705.8b	674.1b	**633.4B**
	SAR6	39.52c	37.41d		25.73a	24.66b		1346.8d	1206.5e		609.0b	544.6c	
4000 ppm	SAR3	34.11e	31.87f	**30.79C**	23.59c	22.83c	**22.15C**	1046.5f	884.4g	**837.4C**	465.9cd	399.5d	**378.7C**
	SAR6	29.43g	27.76h		21.55d	20.63e		750.5h	668.5hi		348.4e	300.8de	
6000 ppm	SAR3	25.98i	24.32j	**24.09D**	19.46f	18.55g	**17.91D**	578.1i	490.5j	**465.9D**	256.2fg	218.0gh	**197.1D**
	SAR6	23.19k	22.89k		17.03h	16.58h		421.4k	373.8k		170.3h	143.7i	
Mean (SAR3 & 6)**		**SAR3**	**SAR6**		**SAR3**	**SAR6**		**SAR3**	**SAR6**		**SAR3**	**SAR6**	
		35.70A	**33.20B**		**23.69A**	**22.35B**		**1170.9A**	**1010.2B**		**526.2A**	**450.9B**	
Means* of CL**		**Low**	**High**		**Low**	**High**		**Low**	**High**		**Low**	**High**	
		33.94A	**32.61B**		**22.85A**	**22.25B**		**1054.2A**	**965.0B**		**471.5A**	**432.3B**	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction).
Means followed by the same letter/s were not significantly different at 5 % level.

tendency of variability in their effectiveness. Such trend was true with both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons of study. These results are confirmed with that mentioned by **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants.

5- Effect on fresh and dry weights of plant organs (leaves, stems, roots), top/root ratio and total plant fresh and dry weights:

A- Specific effect:

Obtained data throughout both 2004 and 2005 seasons of study concerning the response of fresh and dry weight of plant organs (leaves, stems, roots and total plant) as well as the dry weight of top and top/root ratio of both pear rootstocks i.e., betulaefolia and communis pear rootstocks to the specific and interaction effects of the three investigated factors under study i.e., salt concentrations, sodium adsorption ratio (SAR) and chloride levels (Cl:SO_4 ratio) of irrigation water are represented in **Tables (6, 7, 8, 9 & 10)**.

Regarding the specific effect of salinity concentrations, data obtained indicated obviously that all three investigated concentrations of saline solutions (2000, 4000 and 6000 ppm.) resulted in an gradual decrease in both fresh and dry weights of plant organs (leaves, stem, roots, top and total weight of plant) of both betulaefolia and communis pear rootstocks transplants during the two experimental seasons of study. Such decrease was significant as compared to those pear transplants irrigated with tap water (control). Since, the most depressive effect and the greatest loss in the fresh and dry weights of plant organs (leaves, stem, roots, top and total weight of plant) were always concomitant to the highest concentration of salinity (6000 ppm.), meanwhile the lowest concentration (2000 ppm.) of saline solution resulted in the lowest decrease in fresh and dry weights of plant organs for the two pear rootstocks transplants during two seasons of study. However, salinity concentration of (4000 ppm.) was intermediate in this concern. Furthermore, the differences between the three salinity concentrations levels (2000, 4000 and 6000 ppm) were significant as each was compared to the two other ones for the studied abovementioned measurements of the two investigated pear cvs. rootstocks during both 2004 and 2005 seasons of study. These results are in confirmed with the finding of **Taha *et al.*, (1972)** on some grapevine cvs., **El-Azab *et al.*, (1973) and Nasr *et al.*, (1974)** on pecan seedlings, **Aly (1979), Al-Saidi (1980) and Meligi *et al.*, (1983)** on grapevines, **Behairy *et al.*, (1984)** on Thompson seedless and American grapevines, **Kabeel (1985)** on some deciduous fruit species, **Bondok *et al.*, (1995-a)** on some peach rootstocks transplants, **Osman (2005) Darwesh (2006)** on pear and apple rootstocks. They indicated that both fresh and dry weights of plant organs (leaves, stem, roots, top and total weight of plant) were decreased gradually by increasing the concentration of salinity in irrigation water.

With respect to the specific effect of sodium adsorption ratio (SAR), it is quite evident from results represented in Tables **(6, 7, 8, 9 & 10)** that increasing SAR from 3 to 6 in irrigation water resulted in a decreasing in both fresh and dry weights of different plant organs i.e., leaves, stems, roots, top and total plant weight. Such decrease was significant for the fresh and dry weights of all abovementioned measurements of betulaefolia and communis pear rootstocks except with both stem dry weight of communis rootstock transplants in 2004 and 2005 seasons and leaf dry weight of both betulaefolia in the first season and communis rootstock in the second one, where those decreases were insignificant. This trend was detected for both the two pear rootstocks cvs. during the two experimental seasons. These findings could be supported with those obtained by **Behairy *et al.*, (1984)** on Thompson seedless and American grapevines, **Kabeel (1985)** on some deciduous fruit species, **Al-Khateeb (1989)** on fig plants; **Omar (1996)** on apricot and mango seedlings, **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks. They revealed that increasing SAR in irrigation water exhibited a significant reduction in fresh weights for all plant organs and in dry weight for most plant organs. However, both root and total plant dry weight in the first season for the two pear rootstocks transplants and dry weight of total plant of communis rootstock in the second season only showed in significantly differences between high or low chloride levels in irrigation water, **El-Naggar (2002)** on Trablos persimmon seedlings.

Referring the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on both fresh and dry weights of plant organs under study. It is quite clear from the present data in **Tables (6, 7, 8, 9 & 10)** that the higher ratio of chloride level i.e., (high

$Cl:SO_4$ ratio) resulted in a significantly in depressing of all abovementioned studied measurements than the lower one except with the top dry weight, however the differences between the two levels of chloride ($Cl:SO_4$ ratio) were no significant. Such trend was true in both two pear rootstocks transplants during the 1^{st} and 2^{nd} seasons of study with some exceptions.

Considering the specific effect of salinity concentrations on top/root ratio on dry weight basis, data in **Table (9)** revealed that obviously, increasing the salts concentrations in saline solutions used for irrigation water resulted in an increase in top/root ratio. However, the highest concentration of salinity i.e., (6000 ppm) exhibited the greatest value of top/root ratio on dry weight basis, followed by the 4000 ppm salt concentration, meanwhile the transplants were irrigated with both tap water (control) and the concentration of salinity at 2000 ppm showed the least value of top/root ratio. Such trend was true for the two pear rootstocks under study during 2004 and 2005 seasons of study. The same abovementioned trend was observed with the specific effect of sodium adsorption ratio (SAR) on top/root ratio during the first and second seasons of study.

B- Interaction effect:

With regard to the interaction effect of all investigated factors under study i.e., salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on both fresh and dry weights of plant organs (leaves, stem, roots, top and total weight of plant) of betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons, data presented in **Tables (6, 7, 8, 9 & 10)** displayed obviously that a considerable and statistical response, however all saline solutions significantly decreased those measurements in most cases as compared with those of control in the two seasons of study. Moreover, the most depressive effect of irrigation solutions on fresh and dry weights of studied plant organs was in closed relationship to such transplants of betulaefolia and communis pear rootstocks irrigated with the highest concentration of salinity combined with the higher levels of both SAR and chloride ($Cl:SO_4$ ratio) i.e., (6000 ppm x SAR6 x high $Cl:SO_4$ ratio). On the other hand, the opposite trend was observed with those transplants of pear rootstocks irrigated with the lower concentration of salinity, lower ratio of SAR and the lowest level of chloride i.e., (2000 ppm x SAR3 x low $Cl:SO_4$ ratio). Since, the least reduction in fresh and dry weights of different studied plant organs were detected by abovementioned treatments as compared with the control (transplants irrigated with tap water) during the first and second seasons of study.

In addition, the other combinations treatments came in between with tendency of variability in their effectiveness as compared to the abovementioned two extents. Such trends were detected during the first and second seasons of study for the two studied varieties of pear rootstocks transplants. These results are in accordance with those previously reported by **Kabeel (1985)** on some deciduous fruit species, **Omar (1996)** on apricot and mango seedlings, **Abd El-Magied (1998)** on almond seedlings, **El-Naggar (2002)** on persimmon seedlings, **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants.

From the abovementioned results one may conclude that the growth of two pear rootstocks transplants under study i.e., betulaefolia and communis as being indicated from the values of fresh and dry weights of plant organs (leaves, stem, roots, top and total weight of plant) from one hand, and the vegetative growth measurements i.e., (stem length, stem diameter, number of both leaves and branches/transplant, leaf area and assimilation area from the other have been adversely affected by the application of saline solution which may lead to the suggestion that salinity induced earliness of plant senescence, as a result of the accumulation of toxic levels of some ions (Na^+ and / or Cl^-) this may an adaptive mechanism in two pear rootstocks to retranslocate excess amount of Na^+ and/or Cl^- out of younger leaves to the older leaves to put them away from the physiologically active tissue (**Winter, 1982**). Whereas, the control plants (non stressed plants) did no show such decline in their fresh and dry weights of plant organs, probably because of the balanced ions composition in their tissue. Also, they were able to remain physiologically active to the relatively longer period than the saline one.

Moreover, **Bernistein and Hayward (1958)** indicated that the degree of reduction in growth caused by water stress is the same wither, the total soil moisture stress is compared mainly of tension or osmotic components. They suggested that salinity like drought, may reduce the water potential of plant cells on the point

Table (6): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on leaves fresh and dry weight of leaves (gm.) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Leaves fresh weight (gm.)						Leaves dry weight (gm.)					
		betulaefolia			Communis			betulaefolia			Communis		
		low	High	Mean*	low	High	Mean*	Low	High	Mean*	low	High	Mean*
2004 season													
Control		42.57a	42.57a	**42.57A**	29.86a	29.86a	**29.86A**	11.53a	11.53a	**11.53A**	8.11a	8.11a	**8.11A**
2000 ppm	SAR3	42.11a	40.32b	**39.43B**	29.22a	28.36a	**26.79B**	11.22ab	10.88a-c	**10.72B**	8.01ab	7.32a-d	**7.49B**
	SAR6	39.51b	37.78c		26.44b	23.15c		10.52a-d	10.25a-e		7.52a-c	7.12b-d	
4000 ppm	SAR3	34.23c	30.86d	**29.40C**	22.46c	21.81cd	**21.13C**	9.91b-e	9.55c-f	**9.46C**	6.73cd	6.49d	**5.87C**
	SAR6	27.82e	24.68f		20.72de	19.51ef		9.25d-g	9.11e-g		5.37e	4.88e	
6000 ppm	SAR3	22.13g	20.64g	**19.61D**	18.39f	14.45g	**14.67D**	8.96e-g	8.42fg	**8.31D**	5.23e	5.11e	**4.97D**
	SAR6	18.53h	17.14h		13.55gh	12.29h		7.98g	7.87g		4.92e	4.63e	
Mean (SAR3 & 6)**		**SAR3**	**SAR6**		**SAR3**	**SAR6**		**SAR3**	**SAR6**		**SAR3**	**SAR6**	
		34.43A	**31.08B**		**24.30A**	**21.92B**		**10.25A**	**9.76A**		**6.89A**	**6.33B**	
Means* of CL**		**Low**	**High**		**Low**	**High**		**Low**	**High**		**Low**	**High**	
		33.68A	**31.82B**		**23.81A**	**22.41B**		**10.11A**	**9.89A**		**6.75A**	**6.47A**	
2005 season													
Control		41.31a	41.31a	**41.31A**	29.12a	29.12a	**29.12A**	11.22a	11.22a	**11.22A**	7.76a	7.76a	**7.76A**
2000 ppm	SAR3	41.08a	40.88ab	**39.45B**	28.53a	28.05a	**26.63B**	11.13a	10.68ab	**10.58B**	7.33ab	7.11a-c	**6.97B**
	SAR6	39.12b	36.72c		25.34b	24.56bc		10.52ab	10.01a-c		6.80a-c	6.65a-d	
4000 ppm	SAR3	35.49c	32.56d	**30.94C**	23.41c	21.66d	**21.26C**	9.65b-d	9.15c-e	**9.01C**	6.25b-e	5.85c-f	**5.68C**
	SAR6	29.09e	26.62f		20.11de	19.88e		8.71d-f	8.51d-g		5.39d-g	5.23e-g	
6000 ppm	SAR3	24.63g	21.79h	**20.88D**	17.93f	15.61g	**14.89D**	8.11e-h	7.75f-h	**7.60D**	4.99e-g	4.82fg	**4.57D**
	SAR6	19.21i	17.88i		13.22h	12.78h		7.41gh	7.11h		4.38g	4.08g	
Mean (SAR3 & 6)**		**SAR3**	**SAR6**		**SAR3**	**SAR6**		**SAR3**	**SAR6**		**SAR3**	**SAR6**	
		34.88A	**31.41B**		**24.18A**	**21.77B**		**9.86A**	**9.34B**		**6.48A**	**6.01A**	
Means* of CL**		**Low**	**High**		**Low**	**High**		**Low**	**High**		**Low**	**High**	
		33.90A	**32.38B**		**23.35A**	**22.60B**		**9.75A**	**9.46A**		**6.33A**	**6.16A**	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction). Means followed by the same letter/s were not significantly different at 5 % level.

Table (7): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on stem fresh and dry weight (gm.) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Stem fresh weight (gm.)						Stem dry weight (gm.)					
		betulaefolia			Communis			betulaefolia			Communis		
		Low	High	Mean*	low	High	Mean*	low	High	Mean*	low	High	Mean*
2004 season													
Control		97.75a	97.75a	97.75A	64.99a	64.99a	64.99A	34.98a	34.98a	34.98A	25.47a	25.47a	25.47A
2000 ppm	SAR3	82.20b	79.15b	74.89B	62.86a	56.34ab	56.49B	32.11a	31.41ab	30.02B	24.75a	22.53ab	22.26B
	SAR6	72.21bc	65.98cd		55.73ab	51.02a-c		29.12bc	27.45cd		21.36ab	20.41ab	
4000 ppm	SAR3	64.05cd	61.88c-e	59.03C	44.84b-d	44.40b-d	42.84C	26.69cd	26.22c-e	25.08C	20.11ab	19.65ab	19.20C
	SAR6	57.60d-f	52.60e-g		42.27b-d	39.84b-d		24.83de	22.56ef		18.95a-c	18.11a-c	
6000 ppm	SAR3	47.67f-h	42.79gh	42.39D	36.34cd	37.84b-d	34.04D	20.93fg	19.45fg	19.34D	17.33bc	16.82bc	15.62D
	SAR6	40.44h	38.68h		35.33cd	26.63d		18.81fg	18.16g		16.21bc	12.11c	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		71.65A	65.37B		51.58A	47.60B		28.35A	26.36B		21.52A	19.76A	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		65.99A	62.69A		48.91A	45.87A		26.78A	25.75A		20.60A	19.30A	
2005 season													
Control		82.60a	82.60a	82.60A	62.88a	62.88a	62.88A	31.77a	31.77a	31.77A	24.66a	24.66a	24.66A
2000 ppm	SAR3	78.23ab	77.77ab	73.47B	60.35a	57.77ab	55.50B	30.56a	33.20a	30.05B	23.76a	23.11a	22.66B
	SAR6	74.11b	63.78c		55.57a-c	48.31a-f		29.88a	26.55b		22.23a-c	21.55a-c	
4000 ppm	SAR3	60.31c	53.47d	54.02C	53.76a-d	51.23a-e	48.69C	25.13bc	22.66cd	22.94C	24.11a	22.67ab	21.82C
	SAR6	51.88d	50.44de		46.57a-f	43.18b-f		22.32cd	21.65de		20.88a-c	19.62a-c	
6000 ppm	SAR3	46.49ef	43.27fg	41.74D	37.28d-f	40.74c-f	36.94D	20.48d-f	19.66d-f	19.05D	18.45a-c	18.11a-c	17.10D
	SAR6	39.81gh	37.38h		35.38ef	34.34f		18.52ef	17.55f		16.23bc	15.61c	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		65.59A	60.33B		53.36A	48.64B		26.90A	25.00B		22.44A	20.68A	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		61.92A	58.39B		50.26A	48.35A		25.52A	24.72A		21.47A	20.76A	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction).

Means followed by the same letter/s were not significantly different at 5 % level.

Table (8): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on root fresh and dry weight (gm.) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Root fresh weight of roots (gm.)						Root dry weight (gm.)					
		betulaefolia			Communis			betulaefolia			Communis		
		Low	High	Mean*	low	High	Mean*	low	High	Mean*	low	High	Mean*
2004 season													
Control		83.95a	83.95a	83.95A	53.52a	53.52a	52.52A	36.19a	36.19a	36.19A	23.11a	23.11a	23.11A
2000 ppm	SAR3	83.56a	80.82ab	77.24B	52.59ab	50.96ab	48.68B	36.18a	35.14ab	33.75B	22.77a	22.16a	21.20B
	SAR6	71.70bc	72.89a-c		45.60bc	45.56bc		31.44a-c	32.25a-c		20.00ab	19.88ab	
4000 ppm	SAR3	68.41c	62.90cd	58.29C	41.66cd	42.01cd	39.27C	30.54bc	28.18cd	26.31C	18.43bc	18.43bc	17.23C
	SAR6	53.26de	48.60ef		37.41de	36.02de		24.21de	22.29ef		16.34cd	15.73cd	
6000 ppm	SAR3	45.87e-g	39.24f-h	38.24D	32.73ef	31.14ef	29.33D	21.24e-g	18.34f-h	17.78D	14.36de	13.66de	12.86D
	SAR6	35.24gh	32.60h		27.14f	26.29f		16.41gh	15.14h		11.91e	11.53e	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		68.59A	60.27B		44.77A	40.63B		30.25A	26.77B		19.50A	17.70B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		63.14A	60.14B		41.52A	40.79B		28.03A	26.79A		18.13A	17.79A	
2005 season													
Control		81.90a	81.90a	81.90A	52.87a	52.87a	52.87A	35.30a	35.30a	35.30A	22.79a	22.79a	22.79A
2000 ppm	SAR3	81.07a	74.48b	73.39B	49.46ab	47.44a-c	47.17B	35.10a	32.33b	32.38B	21.41ab	20.63a-c	20.55B
	SAR6	71.17bc	66.82c		46.56bc	45.22b-d		31.22bc	30.88bc		20.42b-d	19.75b-d	
4000 ppm	SAR3	65.43cd	60.49d	56.45C	43.66cd	43.32cd	42.29C	29.21cd	27.25d	25.52C	19.32b-e	19.00c-e	18.55C
	SAR6	51.45e	48.42e		42.05cd	40.12d		23.39e	22.22e		18.36de	17.52e	
6000 ppm	SAR3	46.40ef	41.14fg	39.56D	39.94d	32.47e	31.75D	21.48ef	19.21f	18.40D	17.52e	14.24f	13.56D
	SAR6	36.31gh	34.40h		30.94e	23.65f		16.89g	16.03g		12.11g	10.36g	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		66.60A	59.05B		45.26A	41.78B		29.40A	26.40B		19.71A	18.01B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		61.96A	58.24B		43.64A	40.73B		27.51A	26.17B		18.85A	17.76B	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction). Means followed by the same letter/s were not significantly different at 5 % level.

Table (9): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level (Cl:SO_4 ratio) and their combinations of saline irrigation water on total plant fresh and dry weight (gm.) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Total plant fresh weight (gm.)						Total plant dry weight (gm.)					
		betulaefolia			Communis			betulaefolia			Communis		
		Low	High	Mean*	low	High	Mean*	low	High	Mean*	low	High	Mean*
2004 season													
Control		224.3a	224.3a	224.3A	136.3a	136.3a	136.3A	82.69a	82.69a	82.69A	56.69a	56.69a	56.69A
2000 ppm	SAR3	207.9b	200.3c	191.6B	131.3b	126.8c	122.6B	79.51ab	77.43b	74.50B	55.53a	52.01ab	50.96B
	SAR6	183.4d	174.6e		118.6d	113.9e		71.08c	69.96cd		48.88bc	47.41bc	
4000 ppm	SAR3	166.7f	155.6g	146.7C	107.8f	107.1f	102.7C	67.14de	63.95e	60.84C	45.27cd	44.57cd	42.30C
	SAR6	138.7h	125.9i		100.2g	95.64h		58.29f	53.96g		40.66de	38.72ef	
6000 ppm	SAR3	115.7j	102.7k	100.2D	91.06i	78.06j	75.75D	51.13g	46.21h	45.43D	36.92e-g	35.59fg	33.45D
	SAR6	94.21	88.41m		71.63k	62.231		43.20hi	41.17i		33.04g	28.27h	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		174.7A	156.7B		114.3A	104.3B		68.84A	62.88B		47.91A	43.79B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		161.6A	153.1B		118.13A	102.86B		64.72A	62.20B		45.28A	43.32A	
2005 season													
Control		205.8a	205.8a	205.8A	144.9a	144.9a	144.9A	78.29a	78.29a	78.29A	47.45a	47.45a	45.45A
2000 ppm	SAR3	200.4a	193.1b	186.3B	138.3ab	133.3bc	129.3B	76.79ab	76.21b	73.01B	45.17ab	43.74ab	43.22B
	SAR6	184.4c	167.3d		127.5c	118.1d		71.61c	67.44d		42.65bc	41.30bc	
4000 ppm	SAR3	161.2e	146.5f	141.4C	120.8d	116.2d	112.2C	63.99e	59.06f	57.46C	43.43a-c	41.67bc	40.37C
	SAR6	132.4g	125.5h		108.7e	103.2e		54.42g	52.38h		39.24cd	37.14d	
6000 ppm	SAR3	117.5i	106.2j	102.2D	95.15f	88.82f	83.57D	50.07i	46.62j	45.05D	35.97de	32.35e	30.66D
	SAR6	95.3k	89.71		79.53g	70.77h		42.82k	40.691		28.34f	25.97f	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		167.1A	150.8B		122.8A	112.2B		66.17A	60.74B		42.16A	38.69B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		156.7A	147.7B		116.41A	110.76B		64.57A	60.10B		40.32A	38.52A	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and Cl:SO_4 ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and Cl:SO_4 ratios, while small letters were used for distinguishing their combinations (interaction).

Means followed by the same letter/s were not significantly different at 5 % level.

Table (10): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on top dry weight/plants and top/root ratio of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Top dry weight/plant (gm.)						Top/root ratio					
		betulaefolia			Communis			betulaefolia			Communis		
		Low	High	Mean*	low	High	Mean*	low	High	Mean*	low	High	Mean*
2004 season													
Control		46.51a	46.51a	46.51A	33.58a	33.58a	33.58A	1.31c-e	1.31c-e	1.31BC	1.45c-e	1.45c-e	1.45BC
2000 ppm	SAR3	43.33ab	42.29a-c	40.74B	32.76a	29.85ab	29.75B	1.22de	1.21de	1.22C	1.44c-e	1.37e	1.41C
	SAR6	39.64b-d	37.70c-e		28.88a-c	27.53b-d		1.28c-e	1.19e		1.45c-e	1.40de	
4000 ppm	SAR3	36.60de	35.77d-f	34.53C	26.84b-e	26.14b-f	25.07C	1.20e	1.27c-e	1.34B	1.46c-e	1.44c-e	1.48B
	SAR6	34.08e-g	31.67f-h		24.32c-f	22.99d-f		1.47b-d	1.43c-e		1.50b-e	1.52b-d	
6000 ppm	SAR3	29.89g-i	27.87hi	27.65D	22.56d-f	21.93ef	20.59D	1.41c-e	1.53a-c	1.59A	1.57bc	1.62b	1.61A
	SAR6	26.79i	26.03i		21.13fg	16.74g		1.70ab	1.73a		1.78a	1.47c-e	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		38.60A	36.12B		28.40A	26.09B		1.31B	1.43A		1.47B	1.50A	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		37.92A	36.79A		27.96A	26.54A		1.36A	1.37A		1.51A	1.46A	
2005 season													
Control		42.99a	42.99a	42.99A	32.42a	32.42a	32.42A	1.22de	1.22de	1.22C	1.42ef	1.42ef	1.42C
2000 ppm	SAR3	41.69a	43.88a	40.63B	31.09ab	30.22ab	29.63B	1.19e	1.37bc	1.26BC	1.45ef	1.47e	1.44BC
	SAR6	40.40a	36.56b		29.03a-c	28.20b-d		1.30cd	1.19e		1.42ef	1.43ef	
4000 ppm	SAR3	34.78bc	31.81cd	31.94C	30.36ab	28.52a-d	27.50C	1.19e	1.17e	1.27B	1.57cd	1.51de	1.49B
	SAR6	31.03d	30.16de		26.27c-e	24.85de		1.34bc	1.38bc		1.44ef	1.42ef	
6000 ppm	SAR3	28.59d-f	27.41e-g	26.65D	23.44ef	22.93ef	21.67D	1.33bc	1.43b	1.46A	1.34f	1.63bc	1.64A
	SAR6	25.93fg	24.56g		20.61f	19.69f		1.54a	1.54a		1.70b	1.91a	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		36.77A	34.34B		28.93A	26.69B		1.27B	1.34A		1.48B	1.52A	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		36.05A	35.06A		28.20A	27.41A		1.29A	1.31A		1.47B	1.53A	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction).
Means followed by the same letter/s were not significantly different at 5 % level.

that the cells or one or both of its components osmotic potential and pressure became limiting to growth.

On the other hand, the reduction in growth parameters and both fresh and dry weights of different plant organs (leaves, stem, roots, top and total weight of plant) of two studied pear rootstocks cvs. irrigated with any level of salinity (2000, 4000 and 6000 ppm.) might be attributed to osmotic pressure of the substrate which may restrict the uptake of water plant roots (**Hayward and Suprr 1943 and Slatyer, 1961**), or due to the disturbance in metabolic pathway of plants as a result of the adverse effect of salts on enzymatic activities (**Strogonov, 1962**). In addition to that, **Wadleigh and Gaush (1944), Greenway (1963) and Delane *et al.*, (1982)** suggested that the reduction in growth, fresh and dry weights of plants was due to drastic changes in the ion relationships of plants as a result of the adverse effect of Na^+ and Cl^- ions on metabolism or from disturbed water relations.

IV-I-2- Effect of slat concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in irrigation water on some leaf physiological characteristics of two pear rootstocks:

1- Effect on leaf osmotic pressure (L.O.P.):

A- Specific effect:

Concerning the specific effect of salt concentrations on leaf osmotic pressure, it is clear from **Table (11)** that a significant positive relationships was detected between such character and slat concentration in irrigation water. Herein, the value of the leaf osmotic pressure increased significantly with increasing the salt concentrations in the irrigation water from tap water up to 6000 ppm in both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons. Such results appeared to agree with that obtained by **Ayers (1950), Bernstein (1961)** on various plants; **Lioyed and Howie (1989)** on Novel orange; **Abd El-Karim (1997)** on three grapevines; **Abo-El-Khashab (1997)** on peach and olive**; Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants. In this connection, **Hayward and Wadleigh (1949)** indicated that the tolerance of plant to salt depends on its ability to regulate the intake of ions so as to affect the increase in leaf osmotic pressure L.O.P. without excessive accumulation of ions. In addition, **Slyter (1961) and Bernstein, (1961 & 1975)** stated that when plant are exposed to osmotic substrances, a sufficient amount of the substrate is absorbed to increase the internal osmotic pressure by an amount equal to the increase in the substrate osmotic pressure. In this concern, the increase in concentration of the accumulation and total leaf osmotic pressure L.O.P. of cell sap for eight orange plants were studied (**Abd El-Rahman *et al.*, 1971**).

With regard to the specific effect of sodium adsorption ratio (SAR), obtained data in **Table (11)** pointed out that the leaf osmotic pressure L.O.P. was statistically increased with the higher SAR ratio i.e., (SAR6), as compared to the lower SAR ratio (SAR3). This trend was detected for both betulaefolia and communis pear rootstock transplants during the two experimental seasons.

Referring the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on leaf osmotic pressure L.O.P., data in **Table (11)** showed that the leaf osmotic pressure L.O.P. was increased significantly by increasing chloride level ($Cl:SO_4$ ratio). Such trend was detected during 2004 and 2005 seasons for the two pear rootstocks transplants under study. The obtained results regarding the specific effect of both SAR and $Cl:SO_4$ ratios on leaf osmotic pressure L.O.P are in general agreement with that previously reported by **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants

B- Interaction effect:

With regard to the interaction effect of the different investigated factors i.e., salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on leaf osmotic pressure L.O.P, data in **Table (11)** reveals that specific effect of each investigated factor was reflected directly on the interaction effect of its combination. In other words, pear transplant irrigated with the highest salinity solution combined with the higher ratio of both SAR and chloride i.e., (6000 ppm x SAR6 x high $Cl:SO_4$ ratio), statistically exhibited generally the highest value of leaf osmotic pressure L.O.P. as compared to either other salinity combinations or control i.e., those continuously irrigated with tap water. Meanwhile, the least effective irrigation saline solution on increasing leaf osmotic pressure L.O.P. was that combination between the lowest salt concentration, the lower ratios of both SAR and chloride i.e., (2000 ppm x SAR3 x low $Cl:SO_4$ ratio), where a relative lower increase over control was resulted. In addition, the other combinations treatments came in between with tendency of variability in their effectiveness as compared to abovementioned two extents. Such trend was detected throughout the two seasons of study for the two pear rootstocks transplants. These results are in conformity with those mentioned by **Abd El-Rahman (1999)** on Annona plants; **Attia (2002)** on some olive seedlings; **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants, all indicated that increasing levels of salinity and both SAR and chloride in water irrigation led to increase the leaf osmotic pressure L.O.P. in the leaves.

2- Effect on leaf water potential (L.W.P.):

A- Specific effect:

With regard to the specific effect of the different three investigated factors in this study i.e., (salinity concentrations, sodium adsorption ratio (SAR) and $Cl:SO_4$ ratio) on the percentage of leaf water potential of both betulaefolia and communis pear rootstock transplants, data obtained in this concern are presented in **Table (11)**.

Considering the specific effect of different salts concentrations, the obtained results as shown in **Table (11)** declared obviously that all three investigated saline concentrations i.e., (2000, 4000 and 6000 ppm) resulted in an obvious decrease in the percentage of leaf water potential (L.W.P.) throughout 2004 and 2005 seasons of study. To clarify this, it was noticed that the percentage of leaf water potential (L.W.P.) decreased gradually with increasing salts concentration in irrigation water. Such decrease in leaf water potential (L.W.P.) was significant as each concentration was compared to two other ones or to those of tap water irrigated transplants. On the other hand, the most depressive effect was in closed relationship with the highest salinity concentration i.e., (6000 ppm) which resulted in the least value of leaf water potential (L.W.P.) during the two seasons. On the contrary, the least decrease in leaf water potential (L.W.P.) % was closely related to the lowest salts concentration i.e., (2000 ppm) in 2004 and 2005 seasons. However, the saline solution of the (4000 ppm) concentration was intermediate in this concern. The present results were supported by the finding of **Divate and Pandey (1979)** on grapevine; **Beshir (1982)** on fig transplants; **Hatem (1984)** on grapevine; **El-Hefnawi (1986)** on guava plants. Additionally, **Stevens and Harrey (1990)** stated that increasing salinity caused a decline in leaf water potential. Moreover, the same observations and results on guava plants were found by **Kaul (1981)** who indicated that salt stress reduced plant water status (especially with SO_4) and increased leaf diffusive resistance.

Concerning the specific effect of sodium adsorption ratio on the percentage of leaf water potential, it could be noticed from the data in the same **Table** that increasing SAR ratio from 3 to 6 in saline solution used for irrigation resulted in a significant decrease in leaf water potential (L.W.P.) value for both two pear rootstocks transplants during 2004 and 2005 seasons of study.

Referring the specific effect of chloride levels ($Cl:SO_4$ ratio) on the percentage of leaf water potential (L.W.P.), it is quite clear from data in **Table (11)** that the higher $Cl:SO_4$ ratio of saline solution used for irrigation reduced significantly the leaf water potential (L.W.P.) % as compared to the lower $Cl:SO_4$ ratio. Such trend was detected with the betulaefolia and communis pear rootstock transplants in the two experimental seasons.

The obtained results regarding the specific effect of both SAR and $Cl:SO_4$ ratios are in accordance with that previously reported by **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks, who revealed that the percentage of leaf water potential decreased significantly with raising levels of both SAR and $Cl:SO_4$ ratios in saline solutions used for irrigation.

B- Interaction effect:

Considering the interaction effect of the three investigated factors under study i.e., salts concentrations sodium adsorption ratio and chloride level) on the leaf water potential (L.W.P.), obtained results in **Table (11)** displayed clearly a variable response of both pear rootstocks transplants (betulaefolia and communis pear rootstocks) to the different combinations of irrigation water solutions used during 2004 and 2005 seasons of study. However, the most depressive effect on leaf water potential (L.W.P.) was resulted by two pear rootstocks transplants irrigated with combination between the highest salt concentration and higher ratio of both SAR of study. However the saline solution 2000 ppm of irrigation water exhibited the lowest decrease, meanwhile the saline irrigation treatment of 4000 ppm salts concentration in irrigation water was intermediate in this concern. Moreover, the differences between the three salinity concentrations (2000, 4000 and 6000 ppm) were significant as each was compared to two other ones from one hand and as compared to those of tap water irrigated (control) transplants from the other during both 2004 and 2005 seasons of study. These results could be confirmed with the finding of many investigators, **Bernstein (1961)** on various plants; **Fenn *et al.*, (1970)** on avocado plants; **El-Hefnawi (1986)** on guava seedlings; **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants.

With respect to the specific effect of sodium adsorption ratio (SAR), data as shown in the same **Table (12)** displayed obviously that higher ratio of SAR i.e., (SAR6) resulted significantly in decreasing the percentage of leaf relative turgidity (L.R.T.) than the lower one i.e., (SAR3) during the first and second seasons of study.

Referring the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on the leaf relative turgidity (L.R.T.) percentage, it could observed from data in **Table (12)** that higher level of ($Cl:SO_4$ ratio) resulted in a significant decrease in leaf relative turgidity (L.R.T.) percent than the lower one in two seasons of study.

These findings regarding the specific effect of both SAR and $Cl:SO_4$ ratio on the percentage of leaf relative turgidity are in harmony with those obtained by; **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants.

B- Interaction effect:

Considering the interaction effect of the three investigated factors under study i.e., salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on the leaf relative turgidity (L.R.T.) data are presented in **Table (12)** showed clearly that a considerable and statistical effect in the two seasons of study, whereas the least values and the most depressive irrigation solution on the leaf relative turgidity (L.R.T.) percent of both betulaefolia and communis pear rootstock transplants was always in concomitant to that combination between the highest salts concentration with the higher level of both SAR and $Cl:SO_4$ ratio i.e., (6000 ppm x SAR6 x high $Cl:SO_4$ ratio). Contrary to that, the lowest decrease in the percentage of leaf relative turgidity (L.R.T.) was resulted by pear transplants irrigated with the lowest salinity concentration with the lower levels of both SAR and chloride i.e., (2000 ppm saline solution x SAR3 x low $Cl:SO_4$ ratio), as compared to the control (tap water irrigation) during both 2005 and 2006 seasons of study. On the other hand, other combinations treatments came intermediate the abovementioned two extents in the two seasons. these results are in accordance with those reported by **El-Hefnawi (1986)** on some guava seedlings; **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants.

4- Effect of on leaf succulence grade (L.S.G.):

Obtained results during both 2004 and 2005 seasons of study concerning the response of leaf succulence grade (L.S.G.) to the specific and interaction factors under study are presented in **Table (12)**.

A- Specific effect:

With respect to the specific effect of salts concentrations on leaf succulence grade (L.S.G.) of both betulaefolia and communis pear rootstock transplants, data obtained in **Table (12)** displayed obviously that leaf succulence grade was significantly affected by all three salinity concentrations under study. However, decreasing the salts concentrations in the irrigation water resulted in decreasing in leaf succulence grade (L.S.G.) of the two studied pear rootstocks transplants as compared to the transplants continuously irrigated with tap water (control) throughout the first and second seasons of study. The obtained results are in harmony with those achieved by **El-Hefnawi (1986)** on guava seedlings; **Nomir (1994)** on Kaki plants; **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks transplants.

Concerning the specific effect of sodium adsorption ratio (SAR) on leaf succulence grade (L.S.G), data obtained in the same **Table** showed clearly that increasing SAR from lower ratio i.e., (SAR 3) to higher ones i.e., (SAR 6) exhibited decreasing the leaf succulence grade (L.S.G.) for both betulaefolia and communis pear rootstock transplants. Such abovementioned decrease was slight and not significant during the two experimental seasons of study.

Referring the specific effect of chloride levels (Cl : SO_4 ratio) of saline solution used irrigation on leaf succulence grade (L.S.G.). It could be noticed from data tabulated in **Table (12)** that the same trend of SAR was observed with the chloride levels. in the other words, the leaf succulence grade (L.S.G.) decreased slowly with increasing the chloride level from lower (Cl : SO_4 ratio) to higher ones, however this decrease was insignificant during both 2004 and 2005 seasons. These results regarding the specific effect for both SAR and Cl : SO_4 ratio are in a partial coincidence with findings of **Nomir (1994)** on Kaki plants and both **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks transplants.

B- Interaction effect:

Considering the interaction effect of the three investigated factors i.e., salts concentrations, SAR and chloride levels (Cl:SO_4 ratio) on leaf succulence grade (L.S.G.) of both betulaefolia and communis pear rootstock transplants, obtained results tabulated in **Table (12)** revealed clearly that the lowest value of leaf succulence grade (L.S.G.) was generally associated with both betulaefolia and communis pear rootstock transplants grown under salts stress condition especially with transplants irrigated with the highest concentration of saline solution combined with the higher ratio of SAR i.e., (6000 x SAR 6) regardless of the (Cl:SO_4 ratio). Contrary to that the highest value of leaf succulence grade (L.S.G.) was always in concomitant with tap water (control). In addition to that, other combination treatments were in between the abovementioned the two extremes with no significant differences between the most of treatments under study. Such trend was detected throughout the first and second seasons of this investigation. These results are in agreement with those

Table (12): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on leaf relative turgidty and leaf succulence grade of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Leaf relative turgidty (%)						Leaf succulence grade (L.S.G.)					
		betulaefolia			Communis			betulaefolia			Communis		
		Low	High	Mean*	low	High	Mean*	low	High	Mean*	low	High	Mean*
2004 season													
Control		57.29a	57.29a	57.29A	51.62a	51.62a	51.62A	1.578a	1.575ab	1.577A	1.569a	1.568ab	1.569A
2000 ppm	SAR3	57.01a	55.86b	53.61B	51.13b	48.57c	46.75B	1.569b	1.567b	1.570B	1.565a-c	1.567a-c	1.564B
	SAR6	52.64c	48.92d		45.13d	42.17e		1.573ab	1.570b		1.562a-c	0.060a-c	
4000 ppm	SAR3	45.13e	41.63f	39.75C	39.52f	35.63g	34.15C	1.565b	1.563c	1.565C	1.556a-c	1.552a-c	1.552B
	SAR6	37.88g	34.35h		32.27h	29.16i		1.565bc	1.566bc		1.549a-c	1.5851a-c	
6000 ppm	SAR3	31.74i	28.16j	26.80D	28.33j	24.58k	23.70D	1.563c	1.56cd	1.558D	1.548c	1.548bc	1.546C
	SAR6	24.15k	23.16l		22.38l	19.52m		1.555d	1.555d		1.547c	1.547c	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR6	SAR3		SAR6	SAR3	
		46.76A	41.96B		41.38A	36.73B		1.568A	1.567A		0.058A	0.057A	
Means*** of CL		Low	High		Low	High		High	Low		High	Low	
		43.69A	41.34B		38.63A	35.89B		1.567A	1.565A		0.057A	0.055A	
2005 season													
Control		57.46a	57.46a	57.46A	51.26a	51.26a	51.26A	1.584a	1.583a	0.084A	1.564a	1.559a-c	1.562A
2000 ppm	SAR3	57.11a	55.23b	52.78B	51.09a	49.76b	47.50B	1.580ab	1.579ab	0.080B	1.562ab	1.560ab	1.562A
	SAR6	51.16c	47.63d		46.38c	42.76d		1.582a	1.578ab		1.564a	1.561ab	
4000 ppm	SAR3	43.82e	40.18f	38.91C	39.58e	36.24f	35.33C	1.578ab	1.575ab	0.76C	1.559a-c	1.558a-c	1.558B
	SAR6	37.28g	34.36h		33.79g	31.69h		1.577ab	1.575ab		1.557a-c	1.559a-c	
6000 ppm	SAR3	31.72i	27.56j	26.72D	28.18i	25.83j	24.01D	1.571ab	1.568ab	0.75C	1.556a-c	1.555bc	1.553C
	SAR6	24.17k	23.42l		22.85k	19.17l		1.561b	1.561b		1.551c	1.551c	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR6	SAR3		SAR6	SAR3	
		46.32A	41.62B		41.65A	37.40B		1.577A	1.575A		1.559A	1.558A	
Means*** of CL		Low	High		Low	High		High	Low		High	Low	
		43.252A	40.83B		39.02A	36.67B		1.576A	1.574A		1.559A	1.558A	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction).

Means followed by the same letter/s were not significantly different at 5 % level.

of other researchers **El-Hefnawi (1986); Nomir (1994), Osman (2005), Darwesh (2006)** on guava, Kaki and some apple and pear rootstocks transplants. All stated that leaf succulence grade (L.S.G.) was affected by increasing salts concentrations regardless the ratio of both sodium adsorption ratio or chloride levels ($Cl:SO_4$ ratio) in saline solution used for irrigation.

IV-I-3- Effect of the different salts concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in irrigation water on some chemical constituents:

Regarding the response of some chemical constituents i.e., leaves photosynthetic pigments, shoots total carbohydrates content, leaf praline content and leaves mineral composition to the specific and interaction effects of three investigated factors under study i.e., (salt concentrations, SAR and chloride levels) in irrigation water on both betulaefolia and communis pear rootstocks transplants throughout 2004 and 2005 seasons of study are tabulated in **Tables (13 to 20)**.

1- Effect on leaves photosynthetic pigments (leaf content of chlorophyll A, B and carotenoids):

Results obtained are represented in **Table (13 and 14)** concerning the specific and interaction effects of the different three studied abovementioned factors on the leaves content of chlorophyll A and B as well as carotenoids content in both two pear rootstocks under study during the first and second seasons of study.

A- Specific effect:

With respect to the specific effect of the different concentrations of salt, in saline solutions used for irrigation on some leaf pigments i.e., (chlorophyll A, B and carotenoids), data obtained in **Tables (13 & 14)** showed clearly that a negative relationship was observed between all three investigated (2000, 4000 and 6000 ppm) saline solutions and leaf content of pigments (chlorophyll A, B and carotenoids). However, all salinity concentrations abovementioned resulted was an obvious decrease in leaf chlorophyll A and B as well as carotenoids content of both betulaefolia and communis pear rootstocks transplants during the two seasons. Such decrease was significant as compared to those of tap water irrigated transplants (control). It could be noticed generally that a gradual decrease in leaf pigments content such was shown as salinity in irrigation was increased during the two seasons. Moreover, data revealed that the most depressive effect was always related with the highest salts concentration (6000 ppm), however the highest values and the lowest decrease in this concern was resulted by the (2000 ppm) saline solution. Since, the (4000 ppm) salts concentration in irrigation water was intermediate. Also, it could be observed that the differences between the three salinity concentrations were significant as each was compared to the two other ones with chlorophyll A, B and caroteinoids content of two pear rootstocks leaves during 2004 and 2005 seasons. Therefore, it could be stated that, salinity reduced severely the photosynthetic pigments content in both betulaefolia and communis pear rootstocks transplants. These results are in agreement with those findings of **Pandey and Divate (1976), Salem (1981) and Hatem (1984)** on grape who reported that green pigments content (chlorophyll A and B) and caroteinoids were decreased with increasing salinity. Also, **Kabeel (1985)** on some deciduous fruit species, **Attia (1994), Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks, all they mentioned that the salt concentration in irrigation water decreased significantly total chlorophyll content as compared with those of the control (transplants were irrigated with tap water).

With regard the specific effect of sodium adsorption ratio of saline solution used for irrigation in suitability of water for irrigation on both chlorophyll A and B as well as caroteinoids content in both betulaefolia and communis pear rootstocks transplants leaves, it is quite evident from data in the same Tables that, increasing sodium adsorption (SAR) from 3 to 6 in irrigation water resulted significantly in decreasing in photosynthetic pigments of leaves (chlorophyll A & B and caroteinoids) compounds in studied two pear rootstocks transplants during both 2004 and 2005 seasons.

As for the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on the leaves content from chlorophyll A, B and caroteinoids in the two investigated pear rootstocks transplants. It could be observed from results tabulated in the aforesaid two Tables that the higher ratio of chloride in saline solution used for irrigation resulted in decreasing both chlorophyll (A & B) and caroteinoids contents. In other words, increasing the level of chloride from low to high in irrigation water exhibited the highest decrease in photosynthetic pigments compounds (chlorophyll A & B and caroteinoids) of both betulaefolia and communis pear rootstocks transplants during the two experimental seasons of study. Moreover, such decrease was significant throughout the first and second seasons.

In this concern the obtained results regarding the specific effect of both SAR and chloride levels on the leaves contents from chlorophyll (A & B) and caroteinoids are similar and agreement with those findings by **Kabeel (1985)** on grape, peach and plum seedlings, **Omar (1996)** on apricot and mango seedlings, **Abd El-Magied (1998)** on bitter almond seedlings, **El-Naggar (2002)** on Trablos persimmon seedlings, **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants. They found that chlorophyll A, B and caroteinoids content in leaves significantly decreased with increasing either SAR or chloride levels in saline solution used for irrigation.

B- Interaction effect:

With respect to the interaction effect of the three investigated factors under study i.e., salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on chlorophyll (A & B) and caroteinoids of both betulaefolia and communis pear rootstocks transplants, results obtained in **Tables (13 & 14)** displayed obviously that the variable response of the pear rootstocks transplants to the different combinations of irrigation water used during 2004 and 2005 seasons. However, the highest decrease in leaves chlorophyll A, B and caroteinoids content was detected by that combinations (6000 ppm x SAR x high $Cl:SO_4$ ratio)., while the lowest decrease in leaf pigments content was obtained by those transplants irrigated with (2000 ppm)

Table (13): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on leaf chlorophyll (A) and chlorophyll (B) content of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Chlorophyll (A) (mg/g. f.w.)						Chlorophyll (B) (mg/g. f.w.)					
		betulaefolia			Communis			betulaefolia			Communis		
		Low	High	**Mean***	low	High	**Mean***	low	High	**Mean***	low	High	**Mean***
2004 season													
Control		2.33a	2.33a	2.33A	1.88a	1.88a	1.88A	1.41a	1.41a	1.41A	1.00a	1.00a	1.00A
2000 ppm	SAR3	2.27a	2.15b	2.10B	1.87a	1.81b	1.80B	1.40ab	1.39b	1.36B	0.99a	0.97b	0.95B
	SAR6	2.01c	1.96cd		1.78c	1.74d		1.35c	1.29d		0.94c	0.91d	
4000 ppm	SAR3	1.94c-e	1.88de	1.87C	1.71e	1.67f	1.65C	1.22e	1.16f	1.12C	0.87e	0.85f	0.83C
	SAR6	1.86de	1.81ef		1.63g	1.59h		1.09g	1.03h		0.82g	0.79h	
6000 ppm	SAR3	1.64gh	1.71fg	1.65D	1.55i	1.50j	1.49D	0.96i	0.90j	0.87D	0.76i	0.73j	0.71D
	SAR6	1.65gh	1.58h		1.47k	1.43l		0.84k	0.77l		0.70k	0.67l	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		2.03A	1.94B		1.74A	1.68B		1.23A	1.15B		0.90A	0.85B	
Means* of CL**		Low	High		Low	High		Low	High		Low	High	
		1.96A	1.92A		1.70A	1.66B		1.18A	1.14B		0.87A	0.85B	
2005 season													
Control		2.16a	2.16a	2.16A	1.87a	1.87a	1.87A	1.40a	1.40a	1.40A	0.93a	0.93a	0.93A
2000 ppm	SAR3	2.09ab	2.04bc	2.01B	1.86a	1.84a	1.81B	1.38ab	1.36ab	1.34B	0.93a	0.92a	0.89B
	SAR6	197cd	1.91de		1.81a	1.75b		1.34b	1.27c		0.86b	0.84b	
4000 ppm	SAR3	1.88de	1.85ef	1.81C	1.71bc	1.67cd	1.65C	1.20d	1.12e	1.10C	0.82c	0.79d	0.78C
	SAR6	1.78fg	1.73gh		1.63de	1.58ef		1.07e	0.99f		0.77e	0.73f	
6000 ppm	SAR3	1.70gh	1.63hi	1.60D	1.54fg	1.51g	1.48D	0.94f	0.88g	0.84D	0.70g	0.67h	0.66D
	SAR6	1.57ij	1.51j		1.45h	1.41h		0.82h	0.75i		0.64i	0.61j	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		1.93A	1.85B		1.73A	1.67B		1.21A	1.13B		0.84A	0.79B	
Means* of CL**		Low	High		Low	High		Low	High		Low	High	
		1.88A	1.83B		1.70A	1.66B		1.16A	1.11B		0.81A	0.78B	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction).
Means followed by the same letter/s were not significantly different at 5 % level.

Table (14): Effect of the different salts concentrations, sodium adsorption ratio (SAR) and chloride levels (Cl:SO4 ratio) of saline irrigation water on leaf carotein content of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Carotein					
		betulaefolia			Communis		
		Low	High	Mean*	low	High	Mean*
2004 season							
Control		1.01a	1.01a	**1.010A**	0.967a	0.967a	**0.967A**
2000 ppm	SAR3	0.977b	0.947c	**0.956B**	0.943b	0.923c	**0.926B**
	SAR6	0.967b	0.933c		0.937bc	0.900d	
4000 ppm	SAR3	0.903d	0.867e	**0.874C**	0.863e	0.843e	**0.848C**
	SAR6	0.880e	0.847f		0.857ef	0.827g	
6000 ppm	SAR3	0.827g	0.773i	**0.85D**	0.800h	0.770ij	**0.779D**
	SAR6	0.793h	0.747j		0.787hi	0.760j	
Mean (SAR3 & 6)**		**SAR3**	**SAR6**		**SAR3**	**SAR6**	
		0.921A	**0.892B**		**0.890A**	**870B**	
Means* of CL**		**Low**	**High**		**Low**	**High**	
		0.914A	**0.898B**		**0.885A**	**0.875B**	
2005 season							
Control		0.977a	0.977a	**0.977A**	0.953a	0.953a	**0.953A**
2000 ppm	SAR3	0.963ab	0.933cd	**0.941B**	0.937ab	0.927bc	**0.927B**
	SAR6	0.950bc	0.917d		0.933b	0.913c	
4000 ppm	SAR3	0.880e	0.863e	**0.863C**	0.887d	0.863ef	**0.868C**
	SAR6	0.870e	0.840f		0.873de	0.850f	
6000 ppm	SAR3	0.803g	0.767h	**0.779D**	0.823g	0.793h	**0.802D**
	SAR6	0.790g	0.757h		0.810g	0.780h	
Mean (SAR3 & 6)**		**SAR3**	**SAR6**		**SAR3**	**SAR6**	
		0.901A	**0.879B**		**0.896A**	**0.879B**	
Means* of CL**		**Low**	**High**		**Low**	**High**	
		0.895A	**0.885B**		**0.892A**	**0.883B**	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and Cl:SO4 ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and Cl:SO4 ratios, while small letters were used for distinguishing their combinations (interaction). Means followed by the same letter/s were not significantly different at 5 % level.

saline solution of SAR and lower chloride level (2000 ppm x SAR x low $Cl:SO_4$ ratio) as compared to those continuously irrigated with tap water (control) during the two seasons of study. In addition, the other combinations treatments came in between with relatively variable tendency in their effectiveness. These obtained results are coincident with that mentioned by **Kabeel (1985)** on some deciduous fruit species; **Omar (1996)** on apricot and mango seedlings, **Abd El-Magied (1998)** on bitter almond seedlings, **El-Naggar (2002)** on Trablos persimmon seedlings, **Osman (2005)** and **Darwesh (2006)** on some apple and pear transplants.

From these results it could be stated that the decline in photosynthetic pigments content of salt stressed transplants might be due to the decrease in the absorption of minerals needed for chlorophyll biosynthesis i.e., iron and magnesium (**Reddy, 1967**) or due to the reduction of chlorophyll molecules (**Poljakoff** and **Gale, 1975**) or due to inhibition of chlorophyll synthesis (**Patil *et al.*, 1984**).

2- Effect on Stem total carbohydrates content:

A. Specific effect :

Regarding the specific effect of different salts concentrations in the saline solution used for irrigation on stem total carbohydrates content of both betulaefolia and communuis pear rootstocks transplants, it is obvious from the results in **Table (15)** that, stem total carbohydrates content decreased significantly with increasing salts concentrations in the irrigation water during 2004 and 2005 seasons. Such decrease was significant when comparing the three salt concentrations (2000, 4000 and

6000 ppm) to those transplants irrigated continuously with tap water (control). In addition, transplants irrigated with the saline solutions of 6000 ppm in the irrigation water had statistically the poorest (the lowest value) of stem total carbohydrates content followed in descending order by those irrigated with 4000 ppm saline solutions. Meanwhile, transplants irrigated with lowest salts concentrations (2000 ppm) was the highest value in this concern. These findings are in harmony with those obtained by **Nasr *et al.*, (1977)** on plum and peach; **Aly (1979)** on some fruit species; **Beshir (1982)** on fig plants and **Lioyd** and **Howie (1989)** on Washington navel orange who proved that the actual amounts of carbohydrates in different plant organs were adversely affected with increasing salinity level.

Regarding the specific effect of sodium adsorption ratio (SAR), data as shown in **Table (15)** displayed obviously that, increasing sodium adsorption ratio form SAR3 to SAR6 in irrigation water exhibited significantly decrease the stem total carbohydrates content during the two experimental seasons.

As for the specific effect of the $Cl:SO_4$ ratio of saline solutions used for irrigation on stem total carbohydrates content, it could be observed from data in **Table (15)** that the higher $Cl:SO_4$ ratio significantly decreased stem total carbohydrates contents, during the two seasons of study.

B. Interaction effect:

With regard to the interaction effect of the investigated the three factors (salinity concentrations; SAR and $Cl:SO_4$ ratio) on stem total carbohydrates content, **Table (15)** shows a considerable and statistical response in both seasons of study, where the most depressive irrigation solution in stem total carbohydrate was resulted by that combination between the higher salinity concentrations combined with the highest levels of both SAR and chloride ($Cl:SO_4$ ratio) (6000 ppm x SAR6 x higher $C:SO_4$ ratio) whereas, the lowest value of stem total carbohydrate content was resulted. Moreover, other combinations of 6000 ppm saline solution ranked second in an increasing order. On the other hand, the opposite trend was observed with pear rootstocks transplants irrigated with the 2000 ppm saline solutions with SAR3 and lower chloride level (low $Cl:SO_4$ ratio), where the lowest reduction of stem total carbohydrates content was exhibited as compared to the control (tap water irrigation) during both 2004 and 2005 seasons. In addition, other combinations were in between the abovementioned two extremes.

3- Effect on leaf proline content:

A. Specific effect:

Regarding the specific effect of salinity concentrations in the saline solutions used for irrigation on leaf praline content of both betulaefolia and communuis pear rootstocks transplants, data obtained in **Table (15)** revealed that a significant variances in leaf praline content were clearly noticed due to salts concentrations effect for salts concentrations in irrigation water during the two seasons of study. It was also noticed from the obtained results that proline content in the leaves increased significantly and gradually with increasing the salt concentrations of the irrigation water as compared to that of tap water irrigation (control). Moreover, pear rootstocks transplants irrigated with the saline solutions of 6000 ppm had statistically the richest leaves of praline content, followed in descending order by those irrigated with 4000 ppm saline solutions, however transplants irrigated with the lowest salts concentrations (2000 ppm) was the inferior in this concern. Furthermore, differences between the three salinity concentrations were significant as each was compared to two other ones during 2004 and 2005 seasons. Proline might act as an somoregulator compound against salinity stress and its accumulation considered as an adaptive response to stress conditions **Handa *et al.*, (1985)**.

Salt stress increased leaves proline content is in conformity with those obtained by **Downton** and **Loveys (1981)** on salinity stressed grapevines; **Kaul (1981)** on guava plants; **Rajasekaran** and **Shanmugavelu (1983)** on tomato plants and **El-Hefnawi (1986)** on guava plants and **Nieves *et al.*, (1991)** found that free proline increased with salinity increased in the leaves of both Verna and Fino lemon scions cultivars.

With respect to the specific effect of SAR, it was clear that, increasing sodium adsorption ratio from SAR3 to SAR6 in irrigation water resulted significantly in increasing leaf proline content during the two seasons of study.

Considering the specific effect of the chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on leaf proline content data tabulated in the same **Table** pointed out that leaf praline content increased significantly with increasing the levels of chloride from the lower $Cl:SO_4$ ratio to the higher one during both 2004 and 2005 seasons of study.

B. Interaction effect:

As for the interaction effect of different combinations between three investigated factors (concentration of salts; SAR and $Cl:SO_4$ ratio) on leaf proline content data obtained during the two experimental seasons and represented in **Table (15)**, displayed clearly that, the specific effect of each investigated factor was reflected directly on it`s own combinations. However, transplants irrigated with the highest concentrated saline solution (6000 ppm) combined with the higher levels of both SAR (SAR6) and chloride levels (high $Cl:SO_4$ ratio) (6000 ppm x SAR6 x high $Cl:SO_4$ ratio) had statistically the richest leaves in their proline contents. **Table (15)** show generally, the data indicated that leaf proline content were significantly increased as compared with control during the two seasons of study.

On the contrary, the lowest increase in leaf proline content was resulted by those transplants supplied with saline solution of 2000 ppm combined with the lower levels of both SAR and $Cl:SO_4$ ratio (2000 ppm x SAR6 x lower $Cl:SO_4$ ratio) as compared to the control treatments (transplants irrigated continuously with tap water) which had significantly the poorest leaves in their proline content. In addition, other combinations were in between with slight tendency of variance. These results are confirmed by those of **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants.

Table (15): **Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on stem total carbohydrates content and proline content of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.**

Treatments \ Rootstocks		Stem total carbohydrates content						leaf proline content (mg/100 gm f.w.)					
		betulaefolia			Communis			betulaefolia			Communis		
		Low	High	**Mean***	low	High	**Mean***	low	High	**Mean***	low	High	**Mean***
2004 season													
Control		13.14a	1314a	13.14A	11.45a	11.45a	11.45A	16.77l	16.77l	16.77D	18.07k	18.07k	18.07D
2000 ppm	SAR3	12.71b	12.15d	12.30B	11.26b	11.03c	10.70B	18.33l	19.89k	21.58C	20.54j	20.93j	22.91C
	SAR6	12.41c	11.92e		10.39d	10.11e		22.62j	25.48i		24.05i	26.13i	
4000 ppm	SAR3	10.89f	10.21g	10.31C	9.49f	9.19g	8.90C	28.73h	32.11g	33.44B	29.77h	33.54g	36.14B
	SAR6	10.71f	9.43h		8.64h	8.26i		34.97f	37.96e		37.70f	43.55e	
6000 ppm	SAR3	8.72i	7.54k	7.80D	7.08j	6.78k	6.39D	41.47d	44.46c	45.99A	48.88d	55.25c	56.68A
	SAR6	8.29j	6.65l		6.14l	5.54m		47.45b	50.57a		59.15b	63.44a	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		11.06A	10.71B		9.72A	9.00B		27.32B	31.57A		30.63B	36.27A	
Means* of CL**		Low	High		Low	High		Low	High		Low	High	
		10.98A	10.15B		9.21A	8.91B		30.05B	32.46A		34.02B	37.27B	
2005 season													
Control		12.72a	12.72a	12.72A	10.89a	10.89a	10.89A	17.03l	17.03l	17.03D	18.33k	18.33k	18.33D
2000 ppm	SAR3	12.63a	12.37b	12.23B	10.71b	10.53c	10.38B	19.11l	21.58k	22.78C	19.89k	24.18j	24.80C
	SAR6	12.18b	11.72c		10.17d	10.09d		23.92j	26.52i		25.74j	29.38i	
4000 ppm	SAR3	11.06d	10.45e	10.15C	9.14e	8.85f	8.44C	29.25h	32.63g	33.80B	36.53h	41.86g	42.90B
	SAR6	9.94f	9.13g		8.17g	7.61h		35.23f	38.09e		44.33f	48.88e	
6000 ppm	SAR3	8.49h	7.72i	7.35D	6.74i	6.06j	5.80D	41.34d	45.63c	46.83A	52.13d	55.64c	57.92A
	SAR6	7.02j	6.17k		5.48k	4.91l		48.75b	51.61a		59.93b	63.96a	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		11.02A	10.20B		9.23A	8.53B		27.95B	32.27A		33.36B	38.61A	
Means* of CL**		Low	High		Low	High		Low	High		Low	High	
		10.58A	10.04B		8.76A	8.42B		30.66B	33.30A		36.70B	40.32A	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction).

Means followed by the same letter/s were not significantly different at 5 % level.

4- Effect on leaf mineral content:

In this respect, leaf mineral composition of both betulaefolia and communis pear rootstocks transplants as influenced by the different salts concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) were studied. The leaf contents of N, P, K, Ca, Mg, Na, Fe, Zn and Mn were estimated as a ratio on the dry weight (%) for the six macro elements, while as ppm for the three micro-nutrients were concerned. Data obtained during both 2004 and 2005 seasons were represented in **Tables (16, 17, 18, 19 and 20)**.

1- Effect on leaf nitrogen content:

Results concerning the effect of salts concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in irrigation water and their interaction on nitrogen content (%) of leaves for both betulaefolia and communis pear rootstocks transplants are tabulated in **Table (16)**.

A. Specific effect:

With respect to the leaf nitrogen content (%) of the pear rootstocks treatments in response to the specific effect of the different salts concentrations in the irrigation water. It could be observed from results presented in **Table (16)** that, nitrogen content in leaves decreased significantly with increasing salts concentrations in the irrigation water from 2000 ppm to 6000 ppm comparing of those of control (non salinized or tap water) which appeared to contain nitrogen level usually higher than those in salinized ones during the first and second seasons of study. Data obtained regarding the effect of salinity stress on total nitrogen content of leaves are in agreement with those reported by many investigators such as **Salem (1981)** on grape seedlings; **Abdalla *et al.*, (1981)** on El-Sultani Fig; **Patil and Patil (1982)** on pomegranate plants. **Kabeel (1985)** on some deciduous fruit species; **Sharaf *et al.*, (1985)** on Thompson seedless and American grapes seedlings; **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on persimmon seedlings; **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks transplants. They mentioned that increasing salts concentrations in irrigation water decreased the total nitrogen content of leaves.

Regarding the specific effect of the two levels of sodium adsorption ratio (SAR3 & SAR6) in irrigation water on the leaf nitrogen content, it is quite clear from data tabulated in the same **Table** that the higher ratio of SAR (SAR6) resulted in significantly decreased in leaf nitrogen content than the lower ones (SAR3). In other words a significant decrease was detected with increasing SAR from 3 to 6 during both 2004 and 2005 seasons of study. In this regard, data obtained are in accordance with findings of **Kabeel (1985)**; **Sharaf *et al.*, (1985)**; **Al-Khateeb (1989); Omar (1996)**; **Abd El-Magied (1998)**; **El-Naggar (2002)**; **Osman (2005)** and **Darwesh (2006)**. They stated that the leaf nitrogen content was decreased by increasing sodium adsorption ratio (SAR) in many deciduous fruits transplants.

Considering the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on leaf nitrogen content, data in **Table (16)** shows obviously that the higher ratio of ($Cl:SO_4$ ratio) caused a significantly decreased in leaf nitrogen content of both pear rootstocks under study comparing the lower one during the 1st and 2nd seasons of study.

B. Interaction effect:

With respect to the interaction effect resulted by the different combinations of the three investigated factors salts concentrations, sodium adsorption ratio and chloride levels ($Cl:SO_4$ ratio) in irrigation water. Obtained results in **Table (16)** displayed obviously that the most depressive irrigation solution on leaf nitrogen content of both betulaefolia and communis pear rootstocks transplants was always in concomitant to that combinations between the highest salinity concentration combined with the higher ratio of both SAR and $Cl:SO_4$ (6000 ppm x SAR6 x higher $Cl:SO_4$ ratio) as compared to either control (tap water) or other saline solutions investigated during the two experimental seasons. Contrary to that, the least reduction in leaf nitrogen content below control was detected by those pear transplants irrigated with saline solution of (2000 ppm x SAR3 x lower $Cl:SO_4$ ratio) during both 2004 and 2005 seasons of study. Moreover, the other combinations treatments were in between in this concern. These results are in harmony with those mentioned by **Kabeel (1985)** on some deciduous fruit species; **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on persimmon seedlings and **Darwesh (2006)** on some pear and apple rootstocks transplants. This reduction in nitrogen content, it might be attributed to rapid protein decay under salinity conditions (**Prisco** and **O`Leary, 1972**), the reduced capacity from protein synthesis (**Aliza *et al.*, 1967**) and or reduced uptake and cooperation of protein amino acids into protein (**El-Shourbagy *et al.*, 1980**). Moreover, there were disturbances in the nitrogen metabolism in plant under salinity conditions.

2- Effect on leaf phosphorus content:

Data in **Table (16)** shows during the two seasons of study the effect of the three investigated factors salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in irrigation water and their interaction on leaf phosphorus content (%) of both betulaefolia and communis pear rootstocks transplants.

A. Specific effect:

Concerning the leaf phosphorus content of the two pear rootstocks transplants under study in response to the specific effect of salts concentrations (2000, 4000 and 6000 ppm), it is obvious from data presented in **Table (16)** that pear transplants irrigated with salinized solutions had significant effect on phosphorus concentration in leaves of transplants. Also, it could be noticed that phosphorus concentration in leaves decreased gradually with increasing salt concentration from 2000 ppm to 6000 ppm. in addition to that, transplants irrigated with non salinized solution (tap water) their leaves appeared continued significantly higher phosphorus than those in salinized the two experimental seasons.

The present results are similar to that reported by **El-Azab *et al.*, (1978)** on apricot and peach; **Abdalla *et al.*, (1981)** on fig plants; **Salem (1981)** on grapevine;

Patil and **Patil (1982)** on pomegranate; **Kabeel (1985)** on some deciduous fruit species; **Bondok** ***et al.*****, (1995)** on peach seedlings; **Omar (1996)** on apricot seedlings; **El-Naggar (2002)** on persimmon seedlings; **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks. They found that, leaf phosphorus content decreased with increasing salts concentration in irrigation water.

With regard to the specific effect of sodium adsorption ratio (SAR), it is quite evident from data in the same **Table** that, leaf phosphorus concentration was decreased by increasing sodium adsorption ratio from lower ratio (SAR3) to higher ones (SAR6). Such decrease was significant during both 2004 and 2005 seasons of study. In this concern, the same trend was found by **Kabeel (1985)** on some deciduous fruit seedlings; **El-Ashram** ***et al.*****, (1985)** on some citrus rootstocks seedlings; **Sharaf** ***et al.*****, (1985)** on European and American grape plants, **Abd El-Magied (1998)** on bitter almond seedlings and **El-Naggar (2002)** on persimmon seedlings. All they mentioned that leaf phosphorus content decreased as SAR level increased.

As for the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solutions used for irrigation on leaf phosphorous content. It could be noticed from data in **Table (16)** that, the higher ratio of $Cl:SO_4$ in irrigation water caused a very slight decrease in leaf phosphorus content of both betulaefolia and communis pear rootstocks transplants during the two seasons of study, but such decrease not significant. These results are similar to that mentioned by **Kabeel (1985)** on some deciduous fruit species; **Abd El-Magied (1998)** on bitter almond seedlings and **El-Naggar (2002)** on persimmon seedlings. All stated that no definite differences were detected in this respect.

B. Interaction effect:

Considering the interaction effect of the different investigated factors i.e., salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) of saline solutions used for irrigation on leaf phosphorus content in response to the interaction effect of various combinations between three studied aforesaid factors, data obtained in **Table (16)** showed obviously that a significant effect on leaf phosphorus content in the two pear rootstocks transplants during both seasons was observed. However, the highest decrease in leaf phosphorus content was resulted by those pear transplants irrigated with saline solution of the highest salinity concentration and higher level of SAR (6000 ppm x SAR6) regardless the chloride levels in irrigation water as compared with those continuously irrigated with tap water (control) or other investigated combinations treatments during 2004 and 2005 seasons of study. Meanwhile, the opposite trend was noticed with that pear rootstocks transplants irrigated with 2000 ppm saline solution x SAR3 x lower $Cl:SO_4$ ratio, however this treatment exhibited the lowest decrease value of leaf phosphorus content. In addition, other combinations were in between in this concern. Such trend was true during both the first and second seasons of study. These present data are in conformity with these reported by **Kabeel (1985)** on some deciduous fruits seedlings; **El-Naggar (2002)** on persimmon seedlings; **Osman (2005)** and

Table (16): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on leaf N (%) and P (%) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		N (%)						P (%)					
		betulaefolia			Communis			betulaefolia			Communis		
		Low	High	**Mean***	low	High	**Mean***	Low	High	**Mean***	low	High	**Mean***
2004 season													
Control		2.67a	2.67a	2.67A	2.42a	2.42a	2.42A	0.236a	0.236a	0.236A	0.227a	0.227a	0.227A
2000 ppm	SAR3	2.45ab	2.22bc	2.32B	2.21b	2.18b	2.10B	0.215b	0.213b	0.201B	0.211ab	0.214ab	0.205B
	SAR6	2.08cd	2.53a		2.10c	1.91d		0.192c	0.184cd		0.200bc	0.193c	
4000 ppm	SAR3	1.98c-e	1.73ef	1.71C	1.75e	1.61f	1.55C	0.173de	0.161ef	0.157C	0.188cd	0.173de	0.170C
	SAR6	1.68f	1.43g		1.45g	1.40gh		0.148f	0.147f		0.160ef	0.159ef	
6000 ppm	SAR3	1.37g	1.31g	1.29D	1.35hi	1.30ij	1.25D	0.152f	0.147f	0.136D	0.144fg	0.138g	0.126D
	SAR6	1.26g	1.20g		1.26j	1.10k		0.127g	0.118g		0.110h	0.111h	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		2.05A	1.94B		1.91A	1.76B		0.192A	0.174B		0.190A	0.173B	
Means* of CL**		Low	High		Low	High		Low	High		Low	High	
		1.93A	1.87B		1.79A	1.70B		0.178A	0.172A		0.177A	0.174A	
2005 season													
Control		2.61a	2.61a	2.61A	2.32a	2.32a	2.32A	0.232a	0.232a	0.232A	0.228a	0.228a	0.228A
2000 ppm	SAR3	2.44b	2.29c	2.25B	2.16b	2.16b	2.10B	0.212b	0.216ab	0.203B	0.211ab	0.219a	0.211B
	SAR6	2.15d	2.11e		2.11b	1.95c		0.195c	0.189c		0.215a	0.197bc	
4000 ppm	SAR3	1.97f	1.61g	1.64C	1.89c	1.63d	1.60C	0.171d	0.169de	0.159C	0.183cd	0.171de	0.167C
	SAR6	1.57h	1.42i		1.47e	1.39ef		0.151fg	0.145fg		0.159ef	0.156ef	
6000 ppm	SAR3	1.36j	1.29k	1.26D	1.38ef	1.33fg	1.27D	0.153ef	0.145fg	0.137D	0.143fg	0.135g	0.128D
	SAR6	1.221	1.18m		1.27g	1.11h		0.134g	0.116h		0.118h	0.114h	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		2.02A	1.86B		1.90A	1.74B		0.191A	0.174B		0.190A	0.177B	
Means* of CL**		Low	High		Low	High		Low	High		Low	High	
		1.90A	1.79B		1.80A	1.70B		0.178A	0.173A		0.180A	0.174A	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction). Means followed by the same letter/s were not significantly different at 5 % level.

Darwesh (2006) on some pear and apple rootstocks transplants.

3- Effect on leaf potassium content:

Obtained results as shown in **Table (17)** displayed clearly the effect of both salts concentrations and sodium adsorption ratio (SAR) as well as chloride levels ($Cl:SO_4$ ratio) and their interaction on leaf potassium content of the two pear rootstocks transplants (betulaefolia and communis) during both 2004 and 2005 seasons of study.

A. Specific effect:

With respect to the specific effect of salinity concentrations on the leaf potassium content of both betulaefolia and communis pear rootstocks transplants, obtained data in **Table (17)** revealed clearly that all three investigated concentrations of saline solutions (2000, 4000 and 6000 ppm) resulted in a decreasing in the leaf potassium content of both studied pear rootstocks transplants during the two seasons of study. Such decrease was significant as compared to those of transplants irrigated continuously with tap water (control treatment). On the other hand, generally a gradual decrease in leaf potassium content was shown as salinity concentration in irrigation water increased. Moreover, the differences between the three salts concentrations were significant as compared to each the other during both 2004 and 2005 seasons of study. Furthermore, it could be say that, this depressive effect of salinity on potassium content may explain the competitive effect of "Na" ions existed in the prepared saline solutions applied and consequently on the potassium absorption. These findings could be supported with those obtained by **Rains (1972)**, who confirmed such a competition between Na^+ and K^+ ions in the growth media. Additionally to that, **Cooper *et al.*, (1952)**, stated that increasing calcium concentration in irrigation water led to depressed the potassium content in the leaves of grapefruit. Also, **Pearson *et al.*, (1957)**, mentioned that increasing levels of salinity as NaCl in irrigation water caused a decrease in leaf potassium content. In this concern, the obtained data are in a complete agreement with those mentioned by **Kabeel (1985)** on Thompson grapevine, peach and plum seedlings; **Al-Khateeb (1989)** on some fig varieties; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on persimmon seedlings and both **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks plants. All they indicated that potassium content in the leaves decreased by increasing salts concentrations in the irrigation solutions.

Referring the specific effect of sodium adsorption ratio (SAR) of saline solutions used for irrigation on leaf potassium content. It could be noticed from data tabulated in the same **Table** that increasing SAR from 3 to 6 resulted in significantly decreasing the leaf potassium content in both betulaefolia and communis pear rootstocks transplants during the two experimental seasons of study. In this respect, **Bower** and **Wadleigh (1949)** stated that increasing the exchangeable Na percentage of the substrate resulted in a decrease in plant potassium content. Other investigators, **Kabeel (1985)** on three deciduous fruits seedlings; **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond seedlings and **Darwesh (2006)** on some pear and apple rootstocks transplants, mentioned that a similar trend was observed in this concern.

Concerning the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on leaf potassium content. It could be observed from results tabulated in **Table (17)** that, increasing chloride levels ($Cl:SO_4$ ratio) in irrigation water decreased the leaf potassium content in the two studied pear rootstocks in most abovementioned transplants, whereas this decrease was not significant in most cases during 2004 and 2005 seasons of study. These results are similar to that reported by **Kabeel (1985)**; **Omar (1996)**; **Abd El-Magied (1998)**; **El-Naggar (2002); Osman (2005)** and **Darwesh (2006)** on some deciduous fruit species.

B. Interaction effect:

Regarding the interactions effect of the different studied factors i.e., salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) of saline solutions used for irrigation on leaf potassium content of both betulaefolia and communis pear rootstocks transplants, obtained results in the same **Table** showed obviously that the richest leaves in their potassium content (the lowest decrease in leaf potassium content) were exhibited by those transplants irrigated with 2000 ppm saline solution combined with the lower levels of both SAR and $Cl:SO_4$ (2000 ppm x SAR3 x lower $Cl:SO_4$ ratio) as compared to other investigated combinations treatments. Moreover, the highest decrease in leaf potassium content (the poorest leaves in their K content) was associated with those transplants irrigated with that combinations and higher level of both SAR and $Cl:SO_4$ ratio (6000 ppm saline solution x SAR6 x higher $Cl:SO_4$ ratio). In addition, other combinations treatments came intermediate between the aforesaid two extremes. On the other hand, the control treatment (transplants irrigated continuously with tap water) showed the riches absolutely leaves in their potassium content. Such trend were detected during both 2004 and 2005 seasons of study. Obtained results in this study are in accordance with that findings of **Kabeel (1985)** on grapevine, peach and plum seedlings; **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on persimmon seedlings, **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks transplants.

4- Effect on leaf calcium content:

Data tabulated in **Table (17)** display obviously the specific effect of salts concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in irrigation water and their interaction on calcium concentration in leaves of both betulaefolia and communis pear rootstocks transplants.

A. Specific effect:

With regard to the specific effect of salts concentrations in irrigation water, it is quite evident from the obtained results represented in **Table (17)** that the level or concentration of calcium in the two pear rootstocks leaves was significantly increased with increasing salts concentrations in irrigation water during both 2004 and 2005 seasons of study. Such increase was significant as compared to those of tap water irrigated transplants, whereas untreated transplants (control) were of least value of calcium concentration in leaves, however the opposite trend was remarkable for transplants irrigated with salinized water at the highest salts concentration (6000 ppm) which had the richest leaves content in Ca concentration. This trend was detected during the two experimental seasons.

This might due to according to **Wallace *et al.*, (1952)** to that plants with low potassium content obtained under salinity conditions, trend to compensate their low potassium content by either high calcium and/or magnesium contents in leaves.

These results are similar to that obtained by **Kabeel (1985)** on apple, peach and plum seedlings; **Abd El-Ghani (1990)** on peach; **Omar (1996)** on apricot seedlings, **Abd-El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on Trablos persimmon seedlings; **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks transplants. They reported that as the salinity level in the irrigation water increased a subsequent increased was noticed in calcium accumulation in plants.

Regarding the specific effect of sodium adsorption ratio (SAR) on leaf calcium content, data obtained in the same **Table** indicated clearly that the higher ratio of SAR (SAR6) increased significantly calcium content in the leaves than the lower ones (SAR3) in both studied pear rootstocks transplants during the first and second seasons of study. These results are in accordance with the findings of **Kabeel (1985)** on some deciduous fruit species; **Al-Khateeb (1989)** on some fig varieties; **Omar**

(1996) on apricot seedlings; **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants. All they stated that the higher ratio of sodium adsorption resulted in a significant increase in leaf calcium content.

Considering the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solutions used for on leaf calcium content. It could be noticed from data in **Table (17)** that increasing the level of chloride ($Cl:SO_4$ ratio) in irrigation water from lower to higher ratio exhibited statistically increased in leaf calcium content for both betulaefolia and communis pear rootstocks transplants during the two seasons of study. These obtained results are agreement with those mentioned by of **Kabeel (1985)**; **Omar (1996)**; **Abd El-Magied (1998)**; **El-Naggar (2002)**; **Osman (2005)** and **Darwesh (2006)** on many fruit deciduous rootstocks transplants, they pointed out that leaf calcium content increased by increasing chloride level ($Cl:SO_4$ ratio).

B. Interaction effect:

With regard to the interaction effect of the three investigated factors salts concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on leaf calcium of betulaefolia and communis pear rootstocks transplants, results obtained in **Table (17)** revealed that, the variable response of studied pear rootstocks transplants to various combinations of irrigation water during both the first and second seasons of study. However, the highest leaf content of Ca percentage was resulted by that combination between the highest salts concentrations combined with the higher level of SAR and higher ratio of $Cl:SO_4$ (6000 ppm saline

Table (17): **Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on leaf K (%) and Ca (%) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.**

Treatments \ Rootstocks		K (%)						Ca (%)					
		betulaefolia			Communis			betulaefolia			Communis		
		low	High	**Mean***	low	High	**Mean***	low	High	**Mean***	low	High	**Mean***
2004 season													
Control		2.158a	2.158a	2.158A	1.892a	1.892a	1.892A	1.54j	1.54j	1.54D	1.76m	1.76m	1.76D
2000 ppm	SAR3	1.937b	1.872c	1.817B	1.711a	1.659c	1.599B	1.68i	1.73i	1.80C	1.88l	1.97k	2.08C
	SAR6	1.785d	1.675e		1.546d	1.480e		1.81h	1.98f		2.17j	2.31i	
4000 ppm	SAR3	1.648e	1.593f	1.537C	1.342f	1.289g	1.205C	1.91g	2.58e	2.59B	2.42h	2.66g	2.68B
	SAR6	1.496g	1.411h		1.163h	1.026i		2.62e	3.24b		2.75f	2.90e	
6000 ppm	SAR3	1.259i	1.112j	1.086D	0.892j	0.789k	0.741D	2.78d	3.02c	3.13A	3.66d	3.75c	3.81A
	SAR6	1.063j	0.912k		0.697l	0.587m		3.21b	3.50a		3.87b	3.96a	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		1.717A	1.582B		1.433A	1.285B		2.10B	2.43A		2.48B	2.68A	
Means* of CL**		Low	High		Low	High		Low	High		Low	High	
		1.621A	1.533B		1.320A	1.246B		2.22B	2.51A		2.64B	2.76A	
2005 season													
Control		2.245a	2.245a	2.245A	1.887a	1.887a	1.887A	1.52m	1.52m	1.52D	1.76j	1.76j	1.76D
2000 ppm	SAR3	2.023b	1.985b	1.903B	1.771b	1.541c	1.570B	1.67l	1.82k	1.89C	1.81j	1.97i	2.05C
	SAR6	1.827c	1.775c		1.538c	1.429d		1.91j	2.19i		2.13h	2.29g	
4000 ppm	SAR3	1.612d	1.565d	1.475C	1.387e	1.238f	1.216C	2.45h	2.61g	2.75B	2.32g	2.43f	2.49B
	SAR6	1.453e	1.269f		1.196g	1.042h		2.81f	3.11e		2.57e	2.64de	
6000 ppm	SAR3	1.238f	1.087g	0.984D	0.869i	0.751j	0.706D	3.32d	3.41c	3.53A	2.76c	2.86b	3.05A
	SAR6	0.873h	0.738i		0.671k	0.533l		3.60b	3.78a		2.66d	3.91a	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		1.750A	1.553B		1.416A	1.273B		2.29B	2.56A		2.21B	2.47A	
Means* of CL**		Low	High		Low	High		Low	High		Low	High	
		1.610A	1.523B		1.331A	1.203B		2.47B	2.63A		2.29B	2.55A	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction). Means followed by the same letter/s were not significantly different at 5 % level.

solution x SAR6 x higher $Cl:SO_4$ ratio), meanwhile the poorest leaves in their calcium content (the lowest leaves in their calcium content) was always concomitant to those transplants irrigated with 2000 ppm of saline solution of SAR3 and lowest $Cl:SO_4$ ratio as compared to those continuously irrigated with tap water (control) during both 2004 and 2005 seasons of study. This may mean that the three investigated factors can act together in affecting leaf calcium content addition to that in separable way. In other combinations treatments were in between in this respect. The present results are in general supported with those reported by **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond; **El-Naggar (2002)** on persimmon seedlings; **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks transplants.

5- Effect on leaf magnesium content:

Tabulated results in **Table (18)** revealed obviously the specific effect of salts concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in irrigation water and their interaction on leaf magnesium content of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons of study.

A. Specific effect:

Considering the specific effect of different salts concentrations on leaf magnesium content, it is obvious from data in **Table (18)** that magnesium concentration in the leaves of betulaefolia and communis pear rootstocks transplants decreased significantly with increasing salts concentrations in irrigation water during the two experimental seasons. Such decrease was significant as compared to those transplants irrigated continuously with tap water (control). On the other hand, the most depressive effect was always in concomitant to the highest salinity concentration (6000 ppm). however, the 2000 ppm concentration exhibited the lowest decrease in leaf magnesium content. Meanwhile the concentration of 4000 ppm was an intermediate in this concern. Moreover, the differences between the three salinity concentrations were significant as each was compared to the two other ones. Such trend was true during the two seasons of study. These results are similar to that achieved by **Kabeel (1985)** on three deciduous fruit species; **Al-Khateeb (1989)** on some fig varieties; **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on persimmon seedlings and **Darwesh (2006)** on apple and pear rootstocks transplants. They concluded that by using different saline solutions in irrigation, the leaf magnesium content was significantly decreased as compared to those irrigated with tap water (control).

Referring the specific effect of sodium adsorption ratio (SAR) of saline solution used in irrigation water on leaf magnesium content, it was quite evident from data in the same **Table** that increasing the level of sodium adsorption ratio in irrigation water from SAR3 to SAR6 significantly decreased the leaf magnesium content in both betulaefolia and communis pear rootstocks transplants during the two seasons of study. Obtained results are agreement with that mentioned by **Kabeel**

(1985); **Al-Khateeb (1989)**; **Omar (1996)**; **Abd El-Magied (1998)**; **El-Naggar (2002); Osman (2005)** and **Darwesh (2006)** on several deciduous fruit rootstocks transplants.

With respect to the specific effect of chloride level (Cl:SO_4 ratio) of saline solution used for irrigation on leaf magnesium content of the two pear rootstocks transplants under study, it is obvious from the results tabulated in **Table (18)** that increasing the level of chloride (Cl:SO_4 ratio) from lower to higher ratio in irrigation water resulted in a decrease in leaf magnesium of both betulaefolia and communis pear rootstocks transplants. Such decrease was detected and significant throughout both 2004 and 2005 seasons of study. Similar observations were reported by **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on persimmon seedlings and **Darwesh (2006)** on pear and apple rootstocks transplants.

B. Interaction effect:

Regarding the interactions effect of the three investigated factors salts concentrations, sodium adsorption ratio (SAR) and chloride levels (Cl:SO_4 ratio) on leaf magnesium content. Results obtained and presented in **Table (18)** revealed clearly that, magnesium concentration in leaves of both betulaefolia and communis pear rootstocks transplants was greatly affected by the concentration of three factors, however these factors can act together in affecting Mg content in the leaves during the first and second seasons of study. Moreover, the pattern of magnesium distribution showed that leaves of pear transplants irrigated with the higher salts concentration combined with the highest level of both (SAR) and (Cl:SO_4 ratio) (6000 ppm x SAR6 x higher Cl:SO_4 ratio) exhibited the lowest value of leaf magnesium concentration as compared to those transplants irrigated continuously with tap water (control) during the two experimental seasons. On the other hand, the lowest decrease in the leaf magnesium content was resulted by those transplants of the two pear rootstocks irrigated with (2000 ppm of saline solution x SAR3 x lower Cl:SO_4 ratio) as compared to non salinized transplants (control treatment). In addition, other combinations treatments were intermediate between the two abovementioned extremes. Such trend was true during both 2004 and 2005 seasons of study. In this concern, the present results are in a complete agreement with those findings by **Kabeel (1985)** on grapevine, plum and peach seedlings; **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on persimmon seedlings; **Osman (2005)** and **Darwesh (2006)** on some apple and pear rootstocks transplants.

6- Effect on leaf sodium content:

With regard to the specific effect and interaction effects of the three investigated factors under study salinity concentrations, sodium adsorption ratio (SAR) and chloride levels (Cl:SO_4 ratio) on leaf sodium content of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons of study, data obtained in this respect are tabulated in **Table (18)**.

A. Specific effect:

Concerning the specific effect of different salts concentrations on leaf sodium content of betulaefolia and communis pear rootstocks transplants, data in **Table (18)** displayed obviously that all the three investigated saline solutions (2000, 4000 and 6000 ppm) resulted in an obvious increase in the leaf sodium content increase was significant when the salts concentrations used (2000, 4000 and 6000 ppm) as compared to tap water irrigated transplants (control). In other words, the leaf sodium concentration on dry weight basis, increased gradually with increasing salts concentrations in irrigation water from 2000 ppm to 6000 ppm. On the other hand, non salinized transplants appeared to contain sodium level usually lower than those in salinized ones throughout 2004 and 2005 seasons of study. Furthermore, saline solution at concentration of 6000 ppm in the irrigation water had the great stimulate effect on leaf sodium content of pear rootstocks transplants whereas, the saline irrigation solution treatment of 2000 ppm exhibited the lowest increase in the leaf sodium content however, the treatment of 4000 ppm concentration was intermediate in this concern. In addition, the differences between the three salinity concentrations were significant as each was compared to the two other ones during the two experimental seasons of study. The obtained data regarding the specific effect of slats concentration in water irrigation are in an agreement with reported by **Mobayen** and **Mitherope (1980)** who reported that Na concentration in leaves was linearly correlated to it`s concentration in the external solution. Also, similar observations were achieved by **Sweidan *et al.*, (1982)** on apricot; **Sharaf *et al.*, (1985)** on grape; **Kabeel (1985)** on some deciduous fruit species; **Al-Khateeb (1989)** on some fig varieties; **Omar (1996)** on apricot seedlings; **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks transplants. They indicated that sodium content in salt treated plants was increased with increasing salinity concentration in irrigation, water.

With regard to the specific effect of sodium adsorption ratio (SAR), it is quite clear from data shown in the same **Table** that the higher ratio of sodium adsorption (SAR6) resulted in significantly increased in the leaf sodium content than he lower ones (SAR3) in both betulaefolia and communis pear rootstocks transplants during both 2004 and 2005 seasons of study. These findings are in harmony with those obtained by **Sharaf *et al.*, (1985)** on Thompson seedless and American grapes; **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on Trablos persimmon seedlings; **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks transplants.

As for the specific effect of chloride levels ($Cl:SO_4$ ratio) of saline solution used for irrigation on leaf sodium content of pear rootstocks transplants under study, it could be observed from data presented in **Table (18)** that the higher ratio (increasing the level of chloride in irrigation water) resulted in a significant increase in leaf sodium content as compared to the lower ones during both the first and second seasons of this investigation. The similar trend of response to the specific effect of chloride levels goes in line with those found some investigators by **Kabeel (1985)** on grape, peach and plum seedlings; **Omar (1996)** on apricot; **Abd El-Magied (1998)** on bitter almond seedlings; **El-Naggar (2002)** on persimmon seedlings; **Osman (2005)** and **Darwesh (2006)** on some rootstocks of pear and apple transplants, who stated that leaf sodium content was affected by increasing chloride levels ($Cl:SO_4$ ratio) in irrigation water.

B. Interaction effect:

Referring the interactions effect of the three investigated factors under study salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on leaf sodium content of the two studied pear rootstocks transplants, results obtained tabulated in **Table (18)** indicated obviously a considerable and statistical effect in both seasons of study where the higher increase in leaf sodium content of pear rootstocks transplants observed by was that combination and the higher ratio of both sodium adsorption ratio (SAR) and chloride level ($Cl:SO_4$ ratio) (6000 ppm x SAR6 x high $Cl:SO_4$ ratio) however, the lowest leaf sodium content was resulted by these transplants irrigated with the lower concentration or ratio of salinity SAR and $Cl:SO_4$ ratio (2000 ppm of saline solution x SAR3 x low $Cl:SO_4$ ratio) as compared to those continuously irrigated with tap water (control treatment). Meanwhile, the other combination treatments were intermediate in this respect. Such trend was detected during both 2004 and 2005 seasons of study. Moreover, these results revealed clearly that the three investigated factors can act together in

Table (18): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on leaf Mg (%) and Na (%) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Mg (%) betulaefolia low	Mg (%) betulaefolia High	Mg (%) betulaefolia Mean*	Mg (%) Communis low	Mg (%) Communis High	Mg (%) Communis Mean*	Na (%) betulaefolia low	Na (%) betulaefolia High	Na (%) betulaefolia Mean*	Na (%) Communis low	Na (%) Communis High	Na (%) Communis Mean*
2004 season													
Control		0.650a	0.650a	0.660A	0.565a	0.565a	0.565A	0.236k	0.236k	0.236D	0.252l	0.252l	0.252D
2000 ppm	SAR3	0.623b	0.581c	0.561B	0.543b	0.516c	0.503B	0.253j	0.293i	0.309C	0.287k	0.313j	0.359C
	SAR6	0.539d	0.501e		0.489d	0.462e		0.328h	0.362g		0.368i	0.466h	
4000 ppm	SAR3	0.465f	0.423g	0.402C	0.454e	0.426f	0.412C	0.388f	0.395f	0.401B	0.527g	0.588f	0.604B
	SAR6	0.381h	0.339i		0.397g	0.371h		0.397f	0.423e		0.623e	0.678d	
6000 ppm	SAR3	0.302j	0.291j	0.267D	0.256i	0.244i	0.241D	0.468d	0.495c	0.511A	0.712c	0.745b	0.785A
	SAR6	0.257k	0.216l		0.240ij	0.225j		0.531b	0.549a		0.834a	0.847a	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		0.501A	0.444B		0.446A	0.414B		0.346B	0.383A		0.460B	0.540A	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		0.461A	0.430B		0.421A	0.401B		0.372B	0.393A		0.505B	0.556A	
2005 season													
Control		0.649a	0.649a	0.649A	0.581a	0.581a	0.581A	0.243l	0.243l	0.243D	0.258m	0.258m	0.258D
2000 ppm	SAR3	0.616b	0.581c	0.562B	0.554b	0.526c	0.512B	0.265k	0.293j	0.316C	0.292l	0.327k	0.359C
	SAR6	0.544d	0.508e		0.498d	0.469e		0.331i	0.376h		0.382j	0.433i	
4000 ppm	SAR3	0.472f	0.435g	0.419C	0.439f	0.413g	0.399C	0.382h	0.411g	0.431B	0.488h	0.523g	0.560B
	SAR6	0.402h	0.365i		0.387h	0.358i		0.447f	0.482e		0.588f	0.641e	
6000 ppm	SAR3	0.318j	0.282k	0.263D	0.232l	0.302j	0.262D	0.511d	0.533c	0.561A	0.713d	0.749c	0.782A
	SAR6	0.244l	0.208m		0.270k	0.244l		0.583b	0.617a		0.803b	0.861a	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		0.500A	0.446B		0.454A	0.424B		0.360B	0.415A		0.451B	0.528A	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		0.464A	0.433B		0.423A	0.413B		0.395B	0.422A		0.503B	0.542A	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction). Means followed by the same letter/s were not significantly different at 5 % level.

affecting leaf sodium content. These findings could be supported with those mentioned by **Kabeel (1985)**; **Omar (1996)**; **Abd El-Magied (1998)**; **El-Naggar (2002)**; **Osman (2005)** and **Darwesh (2006)** on some deciduous fruit rootstocks transplants.

7- Effect on leaf iron content:

The effect of the three investigated factors under study salts concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in solutions used for irrigation and their interaction on leaf Fe content of both betulaefolia and communis pear rootstocks transplants are shown in **Table (19)**.

A. Specific effect:

With regard to the specific effect of salts concentrations in irrigation water, it is obvious from the results represented in **Table (19)** that, iron concentration in the leaf of both betulaefolia and communis pear rootstocks transplants decreased significantly with increasing the concentration of salinity in saline solutions used for irrigation during both 2004 and 2005 seasons of study. Such decrease was significant as compared to those of transplants irrigated with tap water (control). On the other hand, the most depressive effect was always in concomitant to the highest concentration (6000 ppm), meanwhile the lowest salts concentration (2000 ppm) exhibited the highest value in decrease. However, the (4000 ppm) of salts concentration was intermediate in this respect. In addition to that, differences between the three salinity concentrations were significant as each was compared to the two other ones. Such trend was true during the two experimental seasons of study.

These results are in conformity with that findings of **Ivanova (1971)** on apricot, **Stevens *et al.*, (1996)** on grapevines cultivars; **El-Naggar (2002)** on persimmon they reported that leaf Fe content decreased with increasing the concentration of salinity in water irrigation. On the other hand, **Osman (2005)** on some apple rootstocks transplants, he reported that leaf Fe content increased with increasing the concentration of salinity in water irrigation.

Concerning the specific effect of sodium adsorption ratio (SAR) in saline solutions used for irrigation on the leaf Fe content of both investigated pear rootstocks transplants under study. It was quite evident from the same **Table** that increasing sodium adsorption ratio (SAR) from lower ratio (SAR3) to higher ratio (SAR6) in irrigation water induced significantly increased the leaf Fe content in the treated transplants. This trend was detected throughout both 2004 and 2005 seasons of study. The obtained results are in a complete agreement with those reported by **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond seedlings and **Darwesh (2006)** on pear and apple rootstocks transplants.

Regarding the specific effect of the two levels of chloride (low and high $Cl:SO_4$ ratio) in saline solutions used for irrigation on leaf Fe content. It is quite clear from data tabulated in **Table (19)** that increasing the leaf of chloride (high $Cl:SO_4$ ratio) in irrigation water resulted in a decrease in the leaf Fe content of both betulaefolia and communis pear rootstocks transplants. Such decrease was significant and detected during 2004 and 2005 seasons of study. These results are in conformity with the findings of **Abd El-Magied (1998)** on bitter almond; **El-Naggar (2002)** on Tarblos persimmon seedlings; **Osman (2005)** and **Darwesh (2006)** on some pear and apple rootstocks.

B. Interaction effect:

Referring the interaction effect of the three investigated factors under this study salinity concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) in saline solutions used for irrigation on the leaf Fe content of both betulaefolia and communis pear rootstocks transplants, obtained data represented in **Table (19)** revealed obviously that the variable response of pear transplants under study to the different combinations during the two seasons (2004 and 2005) of study. It was quite clearly that the most depressive irrigation solution on Fe concentration in pear leaves was that combination between the highest salinity concentration and higher ratio of both SAR and chloride level (6000 ppm x SAR6 x higher $Cl:SO_4$ ratio). Meanwhile the lowest decrease in the leaf Fe content was resulted by those pear rootstocks transplants irrigated with saline solution contain the lowest salts concentration and the lower ratio of both SAR and chloride level (2000 ppm x SAR3 x low $Cl:SO_4$ ratio) as compared to non salinized transplants (control). On the other hand, other combinations were in between in this concern. Such trend was detected during 2004 and 2005 seasons of study. These obtained results are similar to that achieved by **Omar (1996), Abd El-Magied (1998); El-Naggar**

(2002); Osman (2005) and **Darwesh (2006)** on some deciduous rootstocks transplants.

8- Effect on leaf zinc content:

Results of the two seasons as shown in **Table (19)** displayed clearly that the effect of all investigated factors in this study salinity concentrations, sodium adsorption ratio (SAR) and chloride levels in the irrigation water and their interaction on leaf zinc content in leaves of both betulaefolia and communis pear rootstocks transplants during both 2004 and 2005 seasons.

A. Specific effect:

Considering the specific effect of salts concentrations in saline solutions used for irrigation, it is obvious from the obtained results in **Table (19)** that, Zn concentration in the leaves of both betulaefolia and communis pear rootstocks transplants was significantly decrease with increasing salts concentrations in irrigation water throughout the two experimental seasons of study. Moreover, untreated transplants (control) resulted in the highest value of Zn concentration in the leaves, meanwhile the opposite trend was detected with transplants which irrigated with saline solution at 6000 ppm, since exhibited the highest decrease in leaf Zn content, whereas the 2000 ppm concentration in irrigation water induced the lowest decrease in the leaves Zn content. On the other hand, the 4000 ppm concentration was in between the two abovementioned salts concentrations. Additionally to that, the differences between the three salinity concentrations were significant as each compared to the two other ones. Such trend was true during the first and second seasons of study. The present results are in general accordance with those reported by **Patil** and **Patil (1982)** on pomegranate; **Aly *et al.*, (1986)** on some citrus rootstocks; **El-Hefnawi (1986)** on guava; **Gaser (1986)** on avocado plants; **Omar (1996)** on apricot seedlings and **Osman (2005)** on some apple and pear rootstocks transplants.

With respect to the specific effect of sodium adsorption ratio (SAR) in saline solution used for irrigation, data in the same **Table** revealed clearly that the higher ratio of sodium adsorption (SAR6) exhibited the highest significantly decreased in the leaf Zn content than the lower ones (SAR3) of both betulaefolia and communis pear rootstocks transplants. This trend was true throughout both 2004 and 2005 seasons of this investigation. These findings could be supported with those mentioned by **Omar (1996); Abd El-Magied (1998); El-Naggar (2002)** and **Darwesh (2006)** on apricot, bitter almond; Trablos persimmon and both pear & apple rootstocks transplants, respectively.

Regarding the specific effect of chloride levels ($Cl:SO_4$ ratio) in saline solution used for irrigation on leaf Zn content of pear rootstocks transplants, it is obvious from the results are tabulated in the aforesaid **Table** that increasing the level of chloride (high $Cl:SO_4$ ratio) in irrigation water resulted in significantly decreased the leaf Zn content than the lower ones in both betulaefolia and communis pear rootstocks transplants. Such trend was detected during both 2004 and 2005 seasons of study. The obtained data are in a partial agreement with the findings of **El-Naggar (2002)** in Trablos persimmon seedling, **Osman (2005)** and **Darwesh (2006)** on apple and pear rootstocks transplants.

B. Interaction effect:

Results are represented in **Table (19)** show the effect of interaction between salts concentrations, sodium adsorption ratio (SAR) and chloride level ($Cl:SO_4$ ratio) in saline solutions used for irrigation on the leaf Zn content of both betulaefolia and communis pear rootstocks transplants. It could be noticed from those results that Zn concentration in the leaves of pear rootstocks transplants was greatly affected by the different levels of three factors. Hence, these factors can act together in affecting Zn content in leaves during the two seasons of study. However, the pattern of Zn distribution showed that leaves of transplants irrigated with the higher salts concentrations and higher ratio of both (SAR and $Cl:SO_4$) (6000 ppm x SAR6 x higher $Cl:SO_4$ ratio) resulted in the lowest value of Zn leaf content. Whereas, the least decrease in value as for leaves content was detected by those pear transplants irrigated with the saline solution contain (2000 ppm x SAR3 x lower $Cl:SO_4$ ratio). On the other hand, other combinations of saline solutions were intermediate. Moreover, pear rootstocks transplants irrigated with tap water (control) exhibited the highest leaf Zn concentration as compared to any combination treatment under study. Such trend was true during both 2004 and 2005 seasons of this investigation. In this respect, these results could be supported with those achieved by **Omar (1996); Abd El-Magied (1998); El-Naggar (2002) Osman** and **Darwesh (2006)** all reported that the leaf Zn

Table (19): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on leaf Fe (ppm) and Zn (ppm) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Fe (ppm)						Zn (ppm)					
		betulaefolia			Communis			betulaefolia			Communis		
		low	High	Mean*	low	High	Mean*	low	High	Mean*	low	High	Mean*
2004 season													
Control		126.60a	126.60a	126.60A	104.80a	104.80a	104.80A	29.73a	29.73a	29.73A	23.54a	23.54a	23.54A
2000 ppm	SAR3	122.40a	117.10b	113.53B	99.11b	93.76c	89.51B	28.13b	27.87b	27.04B	22.56b	21.43c	21.10B
	SAR6	109.30c	105.30d		85.83d	79.32e		26.82c	25.33d		20.76d	19.63e	
4000 ppm	SAR3	91.93e	83.76f	81.23C	75.34f	69.63g	67.45C	25.26d	23.19e	23.13C	18.65f	17.49g	17.12C
	SAR6	75.46g	73.76g		64.88h	59.93i		22.38ef	21.67f		16.73h	15.62i	
6000 ppm	SAR3	62.32h	62.74h	59.75D	55.16j	51.53k	48.18D	20.43g	19.17h	18.15D	14.13j	13.08k	12.41D
	SAR6	56.24i	57.69i		45.78l	40.23m		17.34i	15.65j		12.25l	10.16m	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		99.18A	91.38B		81.77A	73.20B		25.44A	23.58B		19.30A	17.78B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		92.94A	89.56B		75.84A	71.31B		24.30A	23.23B		18.37A	17.28B	
2005 season													
Control		128.10a	128.10a	128.10A	102.80a	102.80a	102.80A	28.59a	28.59a	28.59A	22.36a	22.36a	22.36A
2000 ppm	SAR3	119.60b	115.80c	111.73C	97.21b	92.76c	90.04B	27.49b	26.88b	25.97B	21.32b	20.27c	19.74B
	SAR6	107.80d	103.70e		87.56d	82.63e		25.14c	24.36cd		19.23d	18.15e	
4000 ppm	SAR3	92.32f	88.01g	83.02C	77.58g	71.81g	67.93C	24.86c	23.52d	22.95C	17.05f	16.18g	15.78C
	SAR6	76.88h	74.86h		63.77h	58.56i		22.11e	21.32ef		15.77g	14.11h	
6000 ppm	SAR3	63.15i	61.63i	59.35D	53.46j	49.23k	46.77D	20.55f	18.92g	17.82D	13.43h	12.52i	12.09D
	SAR6	57.28j	55.35j		44.76l	39.64m		17.41h	14.39i		11.08j	11.32j	
Mean** (SAR3 & 6)		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6		SAR3	SAR6	
		99.59A	91.51A		80.96A	72.82B		24.93A	22.74B		18.19A	16.80B	
Means*** of CL		Low	High		Low	High		Low	High		Low	High	
		92.16A	89.64B		75.31A	71.06B		23.74A	22.57B		17.18A	16.42B	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratios, while small letters were used for distinguishing their combinations (interaction). Means followed by the same letter/s were not significantly different at 5 % level.

content in some fruit deciduous rootstocks transplants was decreased with increasing the concentrations and ratio of salts, SAR and $Cl:SO_4$ ratio in saline solutions used for irrigation.

9- Effect on leaf manganese content:

Obtained results throughout both 2004 and 2005 seasons of study regarding the specific and interaction effects of the three tested factors under study salts concentrations, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on the leaf manganese content of both betulaefolia and communis pear rootstocks transplants are represented in **Table (20)**.

A. Specific effect:

Concerning the specific effect of salinity concentration on leaf manganese content, data obtained and tabulated in **Table (20)** displayed obviously that all three investigated concentrations (2000, 4000 and 6000 ppm) saline solutions resulted in an obvious decrease in the leaf manganese content of both betulaefolia and communis pear rootstocks transplants during the two experimental seasons of study. Such decrease was significant as compared to those of tap water irrigated transplants (control). On the other hand, the most depressive effect was always in concomitant to the highest salts concentration 6000 ppm during the first and second seasons of study, meanwhile the salts concentration of 2000 ppm in saline solution exhibited the lowest decrease. Whereas, the concentration of 4000 ppm in saline solutions was intermediate in this concern. In addition to that, the differences between the three investigated salinity concentrations were significant as each was compared to the two other ones. Such trend was detected throughout the first and second seasons in this investigation.

The obtained results are in conformity with those stated by **Patil** and **Patil (1982)** on pomegranate; **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond and **El-Naggar (2002)** on Trablos persimmon seedlings. They indicated that, leaf Mn content was decreased with increasing the salts concentrations in saline solutions used for irrigation.

With respect to the specific effect of sodium adsorption ratio (SAR) of saline solutions used for irrigation on leaf manganese content of both betulaefolia and communis pear rootstocks transplants, it could be observed from obtained results in the same **Table (20)** that the higher ratio of sodium adsorption (SAR6) resulted in decreasing in the leaf manganese content of pear rootstocks transplants under study as compared to the lower ones i.e., (SAR3) during both 2004 and 2005 seasons of study. Such decrease was significant in the two seasons. this trend was true during the two seasons in this experiment. These results are in accordance with those obtained by **Omar (1996)** on apricot seedlings; **Abd El-Magied (1998)** on bitter almond and **El-Naggar (2002)** on Trablos persimmon seedlings and **Osman (2005)** on some apples rootstocks transplants, they revealed that increasing SAR was significantly decreased the leaf Mn content in this respect.

Regarding the specific effect of chloride levels ($Cl:SO_4$ ratio)of saline solutions used for irrigation on the leaf manganese content of pear rootstocks transplants under study, it is quite evident from results represented in the same **Table** that the leaf manganese concentration was decrease by increasing the chloride level from low $Cl:SO_4$ ratio up to high $Cl:SO_4$ ratio. This decrease was significant. Such trend was detected during 2004 and 2005 of study. In this concern, these results are similar to that achieved by **Omar (1996)** on apricot; **Abd El-Magied (1998)** on bitter almond and **Darwesh (2006)** on some pear and apple rootstocks transplants.

B. Interaction effect:

Referring the interaction effect of the three investigated factors i.e., salinity concentration, sodium adsorption ratio (SAR) and chloride levels ($Cl:SO_4$ ratio) on the leaf manganese content of both betulaefolia and communis pear rootstocks transplants, data obtained in **Table (20)** revealed clearly that the most depressive saline solution used for irrigation on leaf manganese content was that combination between the highest salinity concentration and the higher ratio of both sodium adsorption and chloride level i.e., (6000 ppm x SAR6 x high $Cl:SO_4$ ratio), meanwhile the lower decrease was resulted by those pear rootstocks transplants irrigated with the lowest concentration or ratio of salinity, sodium adsorption and chloride level i.e., (2000 ppm x SAR3 x lower $Cl:SO_4$ ratio) as compared to those transplants irrigated continuously with tap water (control). On the other hand, the other combinations treatments were intermediate in this concern. Such trend was detected throughout the first and second seasons of this

Table (20): Effect of different salt concentrations, sodium adsorption ratio (SAR), chloride level ($Cl:SO_4$ ratio) and their combinations of saline irrigation water on leaf Mn (ppm) of both betulaefolia and communis pear rootstocks transplants during 2004 and 2005 seasons.

Treatments \ Rootstocks		Mn (ppm)					
		betulaefolia			Communis		
		low	High	**Mean***	low	High	**Mean***
2004 season							
Control		52.43a	52.43a	52.43A	42.83a	42.83a	42.83A
2000 ppm	SAR3	50.33b	48.21c	47.16B	40.61b	38.42c	37.33B
	SAR6	46.11d	44.00e		36.21d	34.07e	
4000 ppm	SAR3	42.88f	40.56g	39.92C	32.55f	30.36g	29.70C
	SAR6	39.00h	37.22i		28.05h	27.83h	
6000 ppm	SAR3	35.53j	33.46k	32.39D	25.67i	23.11j	22.09D
	SAR6	31.34l	29.23m		20.92k	18.65l	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6	
		44.48A	41.47B		34.55A	31.42B	
Means* of CL**		Low	High		Low	High	
		42.52A	40.73B		33.71A	32.26B	
2005 season							
Control		55.69a	55.69a	55.69A	43.37a	43.37a	43.37A
2000 ppm	SAR3	52.21b	50.36c	49.32B	41.21b	39.76c	38.49B
	SAR6	48.13d	46.56e		37.88d	35.11e	
4000 ppm	SAR3	44.26f	42.92g	41.83C	32.57f	30.64g	30.00C
	SAR6	41.68h	38.44i		29.13h	27.68i	
6000 ppm	SAR3	37.21j	35.53k	34.27D	26.18j	23.97k	22.72D
	SAR6	33.28l	31.07m		21.58l	19.13m	
Mean (SAR3 & 6)**		SAR3	SAR6		SAR3	SAR6	
		46.73A	43.82B		35.13A	32.16B	
Means* of CL**		Low	High		Low	High	
		44.64A	42.94B		34.41A	32.88B	

*, ** and *** means refer to specific effect of salinity concentration, SAR ratio and $Cl:SO_4$ ratio, respectively. Capital letters were used for comparing values representing the specific effect of salinity concentration, SAR ratio and Cl:SO4 ratios, while small letters were used for distinguishing their combinations (interaction). Means followed by the same letter/s were not significantly different at 5 % level.

investigation. The present results are in a complete agreement with those mentioned by **Omar (1996); Abd El-Magied (1998); El-Naggar (2002) Osman** and **Darwesh (2006)** all reported that the leaf Mn content in some fruit deciduous rootstocks transplants. All revealed that the combinations of salts, SAR and Cl:So4 ratio at different concentrations in saline solutions used for irrigation led to decrease significantly leaf Mn content and this decrease was increased with increasing the concentrations of combinations.

IV.II. Second experiment: Effect of foliar sprays with some growth regulators (CCC, BA, PP_{333}), on some vegetative growth, some physiological characteristics and some chemical constituents of two pear transplant rootstocks irrigated with (6000 ppm and SAR 6) saline solutions:

In this regard the response of salinity stressed transplants irrigated with 6000 ppm saline solution of SAR 6 and higher Cl: SO_4 ratio of two pear rootstocks (*Pyrus betulaefolia and Pyrus communis*) in response to foliar spray with 3 growth regulators (CCC, BA and PP_{333}) each solely were investigated. Thus a simple experiment using the complete randomized block design was conducted to investigate the effect of growth regulators sprayed. Taking into consideration that CCC, BA and PP_{333} were foliar sprayed at 500, and 25 and 500 ppm for three former regulators, respectively during 2004 and 2005 seasons.

IV.II.1. Effect on some vegetative growth measurements:

In this concern the response of the following growth parameters were investigated.

1. Stem height; root length, total plant length and stem diameter (cm.):

Referring the effect of salinity concentration treatment on stem height; root length; total plant length and stem diameter, the data in **Table (21)** indicated that the 6000 ppm with SAR6 saline concentrations treatment resulted in significant reduction than control. In this connection, the findings of **Patil and Patil (1982)** on pomegranate; **Behariy *et al.*, (1984); Khamis *et al.*, (1985)** on the Thompson and American grape rooted cuttings, **Kabeel (1985)** on some deciduous fruit seedlings; **Taylor *et al.*, (1987); Al-Saidi *et al.*, (1988) Prior *et al.*, (1992)** on grapevines; **Omar (1996)** on both apricot and mango seedlings; **Abd El-Mageid (1998)** on almond seedlings and **Osman (2005)** on some apple rootstocks.

They found that, salt stressed reduced stem height, root length, total plant length and stem diameter.

Concerning the effect of the sprayed growth regulators on transplant height; root length; total plant length and stem diameter (cm.), data obtained in **Table (21)** showed that 3 growth regulators sprays increased significantly four growth measurements as compared to the salinity stressed transplants, however, BA at 25 ppm sprays were more effective during 2004 and 2005 seasons.

Table (21): Effect of foliar spray with CCC, BA and PP_{333} on stem height, root length, total plant length and stem diameter (cm) of two pear transplants rootstocks irrigated with 6000 ppm and SAR 6 saline solutions during 2004 and 2005 seasons.

Treatments (irrigation saline solution & spray)	*P. betulaefolia*							
	Stem heights (cm.)		Root length (cm.)		Total plant length (cm.)		Stem diameter (cm.)	
	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season
Tap water (Control)	155.90A	151.20A	69.33A	71.66A	225.2A	222.9A	0.74A	0.71A
Saline solution + water spray	81.22D	78.36D	33.66D	33.17D	114.9E	111.5E	0.45D	0.43E
Saline solution + 500 ppm CCC	84.67C	81.42BC	37.21C	37.08C	121.9D	118.5D	0.49C	0.49C
Saline solution + 25 ppm BA	86.87B	83.52B	39.67BC	39.37BC	126.5B	122.9B	0.57B	0.59B
Saline solution + 500 ppm PP_{333}	83.66C	80.37CD	41.32B	41.15B	125.0C	121.5C	0.49C	0.46D
	P. communis							
Tap water (Control)	119.50A	115.60A	32.33A	33.66A	151.90A	149.30A	0.85A	0.88A
Saline solution + water spray	57.36C	62.43C	12.02D	11.22E	69.38C	73.65D	0.56E	0.55E
Saline solution + 500 ppm CCC	58.72BC	63.37C	15.12CD	14.43D	73.84BC	77.80C	0.59D	0.58D
Saline solution + 25 ppm BA	60.33B	65.75B	18.46BC	18.88C	78.80B	84.63B	0.65B	0.65B
Saline solution + 500 ppm PP_{333}	57.89C	62.77C	20.27B	21.57B	78.16B	84.34B	0.61B	0.61C

The same letters were used for comparing values within the same culumn or row not significantly different, respectively.

2. Leaves, stem, root and total plant fresh and dry weights/ transplants:

Data obtained during both 2004 and 2005 experimental seasons regarding the effect of sprayed growth regulators on leaves, stem, root and total plant fresh and dry weights are presented in Tables **(22 and 23).**

Concerning the effect of salinity concentration, data obtained in **Tables (22 and 23)** revealed that, the fresh and dry weights of plant organs was decreased by irrigation with 6000 ppm/SAR6 saline solution in irrigation water.

The decrease was significant as both fresh and dry weights for a given organ and consequently. The total plant weights under an investigated saline solution were compared to those continuously irrigated with tap water (control) during both 2004 and 2005 experimental seasons.

These results confirmed those found by **Fathi (1989)** on apple rootstocks; **Attia (1994)** on apple and olive; **Al-Saidi (1980); Meligi *et al.*, (1983)** on grapevine; **Behariy *et al.*, (1984)** on American and European grape seedlings; **Kabeel (1985)** on some deciduous fruit species; **Noaman *et al.*, (1994)** on pomegranate; **Bondok (1995-a)** on some peach rootstock transplants; **Omar (1996)** on both apricot and mango seedlings; **Abd El-Mageid (1998)** on almond seedlings. All reported that the fresh and dry weight of plant organs decreased by increasing the level of salinity concentrations in irrigation water.

Referring the effect of sprayed growth regulators, it is quite clear that pear rootstock transplants sprayed with CCC or BA as well as PP_{333} had obviously heavier organs, rather the analogous ones of unsprayed salinity stressed transplants during both seasons of study. However, differences between 3 sprayed growth regulators (CCC, BA and PP_{333}) were significant for both fresh and dry weights of plant organs (leaves; stem; root and total plant) during both 2004 and 2005 seasons. Herein, BA foliar spray was statistically more effective than foliar spray with either CCC or PP_{333}.

In this respect **Agafonov *et al.*, (1983)** found that CCC application increased drought tolerance of Golden Delicious apple trees. **Atkjnson and Crisp (1983)** reported that both CCC and PP_{333} growth retardants improved water relation of potted M.25 apple and Golt cherry rootstocks and consequently modified total growth and growth distribution between 3 plant organs (root, stem and leaves), whereas both CCC & PP_{333} increased root system but decreased the aboveground organs. Moreover, **Borsboom (1983)** found that PP_{333} had much greater shoot suppressing effect than CCC. This result is an agreement with the findings of **Sharaf *et al.*, (1985)** on American and European grape plants they found that spraying BA and/or CCC reduced the salinity damage and increased leaves, stem, root and total plant dry weight. Moreover, **Antognozzi** and **Catalano (1985)** and **Antognozzi** and **Preziosi (1986); Ahmed (1990)** and **Hasan (2005)** found that CCC & PP_{333} reduced plant height and leaf area. However, researches of the two former authors pointed out an increase in laterals number, while the later one found the opposite.

Table (22): Effect of foliar spray with CCC, BA and PP_{333} on leaves, stem, root and total plant fresh weight of two pear transplants rootstocks irrigated with 6000 ppm and SAR 6 saline solutions during 2004 and 2005 seasons.

Treatments (irrigation saline solution & spray)	Leaves fresh weight (gm.)		Stem fresh weight (gm.)		Root fresh weight (gm.)		Total plant fresh weight (gm.)	
	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season
P. betulaefolia								
Tap water (Control)	42.42A	41.31A	97.75A	82.58A	83.95A	81.90A	224.10A	205.80A
Saline solution + water spray	17.14D	17.88D	38.68D	37.41D	32.60E	34.40E	88.41E	89.69D
Saline solution + 500 ppm CCC	21.63C	21.84C	50.69B	46.31C	35.58D	38.92D	17.90B	107.10C
Saline solution + 25 ppm BA	24.74B	24.87B	51.28B	49.16B	41.67B	45.63B	117.70C	119.70B
Saline solution + 500 ppm PP_{333}	18.16D	18.21D	48.24C	46.15C	40.22BC	41.23C	106.60D	105.60C
P. communis								
Tap water (Control)	29.86A	29.12A	64.99A	62.88A	53.52A	52.87A	148.40A	144.90A
Saline solution + water spray	12.29D	12.78D	26.63D	33.67D	26.29E	23.65E	65.21D	70.10D
Saline solution + 500 ppm CCC	15.11C	15.65C	32.53C	40.59C	29.21D	26.47D	76.85C	82.71C
Saline solution + 25 ppm BA	18.12B	18.33B	36.14B	44.45B	34.26B	33.61B	88.52B	96.39B
Saline solution + 500 ppm PP_{333}	13.22D	13.37D	31.26C	40.21C	32.59C	30.23C	77.07BC	83.81C

The same letters were used for comparing values within the same culumn or row not significantly different, respectively.

Table (23): Effect of foliar spray with CCC, BA and PP_{333} on leaves, stem, root and total plant dry weight of two pear transplants rootstocks irrigated with 6000 ppm and SAR 6 saline solutions during 2004 and 2005 seasons.

Treatments (irrigation saline solution & spray)	Leaves dry weight (gm.)		Stem dry weight (gm.)		Root dry weight (gm.)		Total plant dry weight (gm.)	
	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season
	P. betulaefolia							
Tap water (Control)	11.53A	11.25A	35.16A	31.77A	36.19A	35.30A	82.88A	78.32A
Saline solution + water spray	7.87D	7.11D	18.16BC	17.55D	15.14C	16.03D	41.17D	40.69D
Saline solution + 500 ppm CCC	8.30C	8.00C	19.88B	18.23C	15.59C	16.73D	43.77C	42.96C
Saline solution + 25 ppm BA	9.37B	8.82B	20.11B	19.27B	17.93B	19.62B	47.41B	47.71B
Saline solution + 500 ppm PP_{333}	7.98C	7.43CD	18.92BC	17.86D	17.39B	17.72C	44.29C	43.01C
	P. communis							
Tap water (Control)	8.11A	7.76A	25.47A	21.33A	23.11A	22.79A	56.69A	51.88A
Saline solution + water spray	4.63D	4.08D	12.11D	15.61C	11.53C	10.43E	28.27D	30.12D
Saline solution + 500 ppm CCC	6.16C	5.27C	12.76C	15.92C	12.56C	11.38D	31.48C	32.57C
Saline solution + 25 ppm BA	7.11B	6.02B	14.23B	17.43B	14.73B	14.47B	36.07B	37.92B
Saline solution + 500 ppm PP_{333}	5.22D	4.63CD	12.27D	15.77C	14.00B	12.91C	31.49C	33.31C

The same letters were used for comparing values within the same culumn or row not significantly different, respectively.

3. **Number of both lateral shoots and leaves per transplant average leaf area (cm^2) and assimilation area (dec^2)/transplants:**

The obtained results as shown in **Table (24)** revealed that, salinizing irrigation water at 6000 ppm/SAR6 had a general significant effect on number of lateral shoots/transplant; number of leaves per/plant, average leaf area (cm.) and assimilation area (cm^2) per transplant of both *P. betulaefolia and P. communis* pear transplants as compared with control treatment during 2004 and 2005 seasons. Moreover, differences between the 6000 ppm/SAR6 salinity concentration was significant as compared to control during the two seasons of study. These results are confirmed by the earlier findings of several investigators i.e., by **Kabeel (1985)** on some deciduous fruit species; **Fathi (1994)** on apple rootstock seedlings; **Bondok*et al.*, (1995)** on Florida prince peach; **Omar (1996)** on some deciduous fruit species; **Abd El-Mageid (1998)** on almond seedlings and **Osman (2005)** on three apple rootstocks. They found that, number of laterals/plant, number of leaves/plant, leaf area and assimilation area/plant decreased considerably with increasing concentration in irrigation water.

These results are in agreement with that, reported by **Pokroveskay (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.

Table (24): Effect of foliar spray with CCC, BA and PP_{333} on number of lateral shoots and leaves/plants, leaf area and leaf assimilation area (cm^2) of two pear transplants rootstocks irrigated with 6000 ppm and SAR 6 saline solutions during 2004 and 2005 seasons.

Treatments (irrigation saline solution & spray)	Number of lateral shoot/transplant		Number of leaves/plant		Leaf area (cm^2)		Leaf assimilation area (cm^2)	
	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season
P. betulaefolia								
Tap water (Control)	10.00A	9.33A	39.45A	38.83A	42.18A	42.68A	1664.0A	1657.1A
Saline solution + water spray	6.33B	5.33C	16.70E	16.33D	22.67D	22.88D	378.6E	373.7E
Saline solution + 500 ppm CCC	7.33B	7.33B	18.75C	18.50B	24.13C	24.03C	452.4C	444.6B
Saline solution + 25 ppm BA	6.67B	6.33BC	19.75B	17.00C	25.32B	25.23B	500.1B	428.9C
Saline solution + 500 ppm PP_{333}	6.33B	5.33C	17.58D	17.34C	22.98D	23.17D	404.0D	401.7D
P. communis								
Tap water (Control)	4.00A	3.67A	28.08A	28.33A	26.55A	26.31A	745.4A	745.2A
Saline solution + water spray	1.33C	1.33B	8.42D	8.58D	17.52E	16.58D	147.5E	142.3D
Saline solution + 500 ppm CCC	3.00AB	3.67A	9.46B	9.58B	18.33D	17.13C	173.4D	164.1C
Saline solution + 25 ppm BA	2.33BC	2.33B	9.00C	9.17C	20.88B	19.42B	187.9B	178.0B
Saline solution + 500 ppm PP_{333}	1.67BC	1.67B	8.92C	9.25C	20.11C	19.25B	179.3C	178.1B

The same letters were used for comparing values within the same culumn or row not significantly different, respectively.

tended to remain constant through most of the growth period in both the control and the salt stunted leaves. **Meiri and Poljakoff (1971)** revealed that salinity reduced the total leaf area and delayed the development of new leaves of bean plants. In addition, spraying both PP_{333} at 500 ppm and BA at 25 ppm as well as CCC at 500 ppm to the olive transplants significantly improved the average number of leaves/plant and number of lateral shoots/plant, leaf area and assimilation area/transplant of two pear transplants rootstocks as compared to plants irrigated with saline solutions during 2004 and 2005 seasons, as presented in **Table (24)**. Data also show that CCC foliar spray at 500 ppm gave the highest values of these parameters followed by BA at 25 ppm foliar spray, meanwhile the PP_{333} foliar spray treatment appeared to be less effective than the abovementioned ones. These results are in agreement with those reported by **Sari El-Deen *et al.*, (1979)** on olive seedlings and **Sharaf *et al.*, (1985)** on American and European grape seedlings.

IV.II.2. Leaf physiological properties:

In this respect 4 leaf physiological properties namely: 1. Leaf osmotic pressure (L.O.P.); 2. Leaf relative turgidity (L.R.T.); 3. Leaf water potential (L.W.P.) and 4. Leaf succulence grade (L.S.G.) of salt stressed transplants belonging to t pear rootstocks under study (*Pyrus* (*betulaefolia and Pyrus communis*) in response to foliar sprays with three growth regulators (CCC, PP_{333} at 500 ppm for each and BA at 25 ppm) were investigated. Data obtained during both 2004 and 2005 seasons regarding the effects of sprayed growth regulators are presented in **Table (25).**

1. Leaf osmotic pressure (L.O.P.)

Referring the effect of salt concentration at 6000 ppm/SAR 6 on leaf osmotic pressure (L.O.P.), it is clear from present results in **Table (25)** that a significant positive was detected between such character and salt concentrations in irrigation water. Herein, the value of leaf osmotic pressure increased significantly with 6000 ppm/SAR 6 salt concentration in the irrigation water as compared with tap water (control) during both seasons of study.

Analogous results were obtained by **Lioyed and Howie, (1989)** on Navel orange, **Abd El-Karim, (1997)** on three grapevine cultivars, **Abo-El-Khashab (1997)** on peach and olive, **Hasan (2005)** on olive transplants and **Osman (2005)** on some apple rootstocks. They reported that, the value of leaf osmotic pressure increased significantly with increasing salt concentration in the irrigation water. In addition, **Hayward** and **Wadleight (1949)** reported that the tolerance of plant to salt depends on its ability to regulate the intake of ions so as to affect the increase in leaf osmotic pressure (L.O.P.) without excessive accumulation of such absorbed ions. **Slatyer (1961)** and **Bernstein (1961 & 1975)** indicated that when plants are exposed to osmotic substances, a sufficient amount of the substrate is absorbed to increase the internal leaf osmotic pressure (L.O.P.) by the amount equal the increase in substrate leaf osmotic pressure (L.O.P.).

Abd El-Rahman *et al.*, (1971) working on eight orange cultivars reported that the increase in concentration of the external solution was a combined by an increase in salt accumulation and total osmotic pressure of cell sap.

Data obtained during both 2004 and 2005 seasons as shown from **Table (25)** shows an obvious decrease in leaf osmotic pressure by any of three sprayed growth regulators i.e., BA, CCC and PP_{333}. However, the decrease exhibited by three growth regulators was significant with comparing to the unsprayed salt stressed transplants from one hand, but BA at 25 ppm foliar spray was the most effective and exhibited significantly the greatest reduction from statistical point of view descendingly followed by CCC and PP_{333} at 500 ppm for each during the two seasons of study.

2. Leaf water potential (L.W.P.)

With respect to the effect of salt concentration on leaf water potential (L.W.P.), data as shown in **Table (25)** displays that leaf water potential values tended to decrease significantly with salinity in irrigation water in both two pear rootstock transplants during the two seasons of study. These results confirmed that reported by **El-Hefnawi (1986)** on guava plants, **Nieves *et al.*, (1991)** on citrus, **Hasan (2005)** on some olive cultivars and **Osman (2005)** on some apple rootstock. In this concern, **Stevens & Harvey (1990)** proved that the increase in salinity caused a decline in leaf water potential (L.W.P.) and an increase in leaf petiole Na^+ and Cl^- content. However, **Kaul (1981)** on guava plant found that salt stress reduced plant water status (specially with SO_4) and increase leaf diffusive resistant.

As for the effect of sprayed growth regulators, data obtained displayed that spraying salt stressed pear rootstock seedlings with any of BA, CCC and PP_{333} resulted in an obvious increase over the unsprayed salt stressed transplants. However, the increase was significant during both seasons, but PP_{333} foliar spray was statistically more effective than other investigated growth regulators.

3. Leaf relative turgidity (L.R.T.):

Data obtained during both 2004 and 2005 seasons are presented in **Table (25)**, it quite evident that 6000 ppm and SAR 6 saline solution resulted in an obvious decrease leaf relative turgidity (L.R.T.) % over control during the two seasons of study. Such decrease was significant as compared to those of tap water irrigated transplants pear rootstocks. Analogical results were obtained **Bernstein (1961)** on various plants, **Fenn *et al.*, (1970)** on avocado trees, **Nomir (1994)** on kaki plants **Hasan (2005)** on olive transplants and **Osman (2005)** on some apple rootstocks transplants.

As for the effect of sprayed growth regulators, data obtained displayed that spraying salt stressed pear rootstock seedlings with any of BA, CCC and PP_{333} resulted in an obvious increase over the unsprayed salt stressed transplants. However, the increase was significant during both seasons, but BA foliar spray was statistically more effective than other investigated growth regulators.

4. Leaf succulence grade (L.S.G.):

Table (25) show that leaf succulence grade (L.S.G.) in both *P. betulaefolia and P. communis* pear rootstocks transplants was significantly affected by salt concentration in irrigation water. In this regard leaf succulence grade (L.S.G.) decreased significantly with control treatment during the two seasons of study. These results are in accordance with those obtained by **El-Hefnawi (1986)** on guava plants, **Nomir (1994)** on kaki plants **Hasan (2005)** on some olive cultivars and **Osman (2005)** on some apple rootstocks transplants.

As for the specific of sprayed growth regulators, **Table (25)** reveals that, spraying salt stressed pear rootstocks with either PP_{333} and CCC at 500 ppm or BA at 25 ppm increased significantly L.S.G. However, CCC foliar spray was more effective descendingly followed by PP_{333} and BA foliar sprays. Differences between three growth regulators were significant as compared each other during 2004 & 2005 seasons.

The present result is in general agreement with the finding of **Al-Khateeb (1996)** regarding the effect of foliar application of growth retardants (CCC and PP_{333}) on water stressed transplants of some fig cultivars.

This result goes partially with that found by **Frakulli *et al.*, (1999)** regarding the effect of paclobutrozol on water relation of olive. They reported that water potential of water stressed olive transplants was increased by PP_{333} spray.

The present result regarding the effect of growth retardant spray on hard leaf character of water stressed

Table (25): Effect of foliar sprays CCC, BA and PP_{333} on leaf osmotic pressure, leaf water potential, leaf relative turgidity and leaf succulence grade of two pear transplants rootstocks irrigated with 6000 ppm with SAR 6 saline solutions during 2004 and 2005 seasons.

Treatments (irrigation saline solution & spray)	Leaf osmotic pressure (bar)		Leaf water potential (H2O/gm/100 gm F.W.)		Leaf relative turgidty (%)		Leaf succulence grade	
	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season
P. betulaefolia								
Tap water (Control)	11.73E	11.52E	73.39A	72.43A	57.29A	57.46A	1.579A	1.584A
Saline solution + water spray	19.83A	19.23A	51.86D	50.23E	23.16E	23.42E	1.55D	1.560E
Saline solution + 500 ppm CCC	15.14C	14.61C	57.83C	56.52C	33.68D	33.86D	1.570AB	1.573B
Saline solution + 25 ppm BA	14.11D	13.07D	62.36B	63.27B	38.81C	38.94C	1.566C	1.568D
Saline solution + 500 ppm PP_{333}	17.19B	16.05B	53.53D	53.49D	47.32B	47.73B	1.567C	1.571C
P. communis								
Tap water (Control)	9.22D	9.80D	71.92A	71.17A	51.62A	51.26A	1.569A	1.564A
Saline solution + water spray	14.55A	15.43A	43.58E	43.01E	19.52E	19.17E	1.547E	1.551D
Saline solution + 500 ppm CCC	13.58AB	14.92A	50.63C	50.13C	32.47D	32.33D	1.563AB	1.559B
Saline solution + 25 ppm BA	11.45C	12.56C	53.82B	53.47B	37.67C	37.47C	1.559D	1.557C
Saline solution + 500 ppm PP_{333}	12.67B	13.81B	47.43D	47.09D	45.55B	45.39B	1.561C	1.558BC

The same letters were used for comparing values within the same culumn or row not significantly different, respectively.

olive transplants is in complete disagreement with **Ahmed (1990)** on fig.

Such influence of growth retardants spray on transpiration rate was in agreement with the findings of **Atkjnson and Crisp (1983) and Behairy *et al.*, (1991)** on potted M.25 apple and figs, respectively. They postulated that growth retardants reduced transpiration rate.

IV.II.3. Chemical composition:

In this respect leaf photosynthetic pigments (chlorophyll A & B and carotenoids compounds); proline content and total carbohydrates in stems as well as leaf mineral composition in leaves pear rootstocks in salt stressed pear transplants in response to effect of foliar sprayed with some growth regulators were investigated. Data obtained during both seasons are presented in **Tables (26, 27 and 28).**

1. Effect on leaf photosynthetic pigments (chlorophyll a, b and carotein contents):

Data obtained during 2004 and 2005 seasons regarding the effect of 6000 ppm with SAR 6 saline concentration in irrigation water treatment on chlorophyll (a), (b) and carotein, data obtained revealed that an salinity water caused on obvious decrease in chlorophyll a and b as well as carotein contents of both *P. betulaefolia and P. communis* pear transplants during the two seasons of study. Such decrease was significant as compared with those of tap water (control) irrigated transplants. Thus, it could be stated that salinity reduced severely the photosynthetic pigments content in leaf pear rootstocks. The results are coincided with the findings of **Salem (1981)** on grape who mentioned that salinity decreased leaf chlorophyll content. **Hatem (1984)** reported that, green pigments content (chlorophyll a and B) and caroteinoids in the salt treated romi grape plants grown in calcareous soil decreased with increasing salinity. **Attia (1994)** found that leaf total chlorophyll content in both apple and olive transplants was significantly depressed by rising the salt concentrations.

In addition, **Abo El-Khashab (1997)** found that chlorophyll a, b and carotein were decrease in olive and peach seedlings irrigated with saline water. The same results was found by **Mohamed (1997)** on bitter almond and Nemaguard peach rootstock, **Abbas (1999)** and **Attia (2002)** on olive plants, **Hasan (2005)** on some olive cultivars and **Osman (2005)** on some apple rootstocks.

Referring the effect of sprayed growth regulators, it is quit clear as shown form **Table (26)** that 3 foliar photosynthetic pigments of salt stressed pear rootstock transplants were increased by spraying with any growth regulators kind. On the other hand, BA at 25 ppm foliar spray was more effective, where the increase exhibited in 3 photosynthetic pigments of slat stressed transplants sprayed with BA was significant as compared to the analogous ones of either CCC ,PP_{333} sprayed or unsprayed ones during the two seasons of study.

In addition, the BA efficiency for increasing the 3 investigated foliar photosynthetic pigments was more pronounced than that exhibited by two other sprayed growth regulators and differences were significant as compared to the unsprayed salt stressed transplants during both seasons of study.

These results regarding the influence of growth retardants application on leaf photosynthetic pigments of salt stressed transplants are in accordance with those found by **Kucherova *et al.*, (1979)**; **Nomir and El-Deeb (2000) and Gowda (2002)**, all reported that growth retardants CCC/PP_{333} increased foliar pigments contents i.e., chlorophyll (A & B) and carotenoids compounds.

2. Effect of stem total carbohydrates content:

Regarding the effect of 6000 ppm with SAR6 salt concentration treatment in the irrigation water on stem total carbohydrates content of two pear rootstock transplants; it is obvious from the results in **Table (26)** that, stem total carbohydrates content decreased significantly with salt concentration in irrigation water as compared with control treatment during 2004 and 2005 seasons. These findings are in harmony with those obtained by **Beshir (1982)** on fig plants, **Lioyed & Howie (1989)** on Washington Navel orange who proved that the actual amounts of carbohydrates in different plant organs were adversely affected with rising salinity level in irrigation water. Also in this regard, **Hasan (2005)** on some olive cultivars and **Osman (2005)** on some apple rootstocks transplants. They found that total carbohydrates contents of transplants shoots tended to decrease with increasing salt concentration or sodium adsorption ratio (S.A.R.) and chloride level.

Concerning the effect of sprayed growth regulators on stem total carbohydrates, **Table (26)** displays that, both CCC and PP_{333} each at 500 ppm, as well as BA at 25 ppm foliar spray increased significantly total carbohydrates in stem during both seasons, however BA was significantly more effective than the other two growth regulators as compared to either unsprayed plants or each other during the two seasons of study. The present result regarding the response of total carbohydrates was in harmony with that found by **Gowda (2002)** who reported that PP_{333} increased total carbohydrates. Moreover, **Formento Franzia and Spinola (1984)** postulated that CCC reduced total sugar content in grapes. Findings of **Al-Khateeb (1989)** gave support to the detected trends from the present investigation, whereas he found that CCC & PP_{333} application resulted in increasing stem total carbohydrates but decreased soluble sugars in water stressed fig transplants.

3. Effect of leaf proline content:

Regarding the effect of 6000 ppm with SAR 6 concentration treatment, data obtained in **Table (26)** revealed that leaf proline content increased significantly by salt concentrations treatment of irrigation water as compared with tap water treatment during the two seasons of study. Proline might act as an osmoregulators compared against salinity stress and its accumulation considered as an adaptive response to stress condition **Handa *et al.*, (1985)**.

Salt stress increased leaves proline content is an conformity with those obtained by **Dawnton and Loveys (1981)** on salinity stressed grapevines; **Kaul (1981)** on guava plants; **El-Hefnawi (1986)** on guava plants, **Nieves**

Table (26): Effect of foliar spray with CCC, BA and PP_{333} on stem total carbohydrates content, chlorophyll (a, b & carotein) (mg/gm f.w.), and leaf proline content (mg/100 gm f.w.) of two pear transplants rootstocks irrigated with 6000 ppm and SAR 6 saline solutions during 2004 and 2005 seasons.

Treatments (irrigation saline solution & spray)	Stem total carbohydrates content (mg./100 gm f.w.)		Chlorophyll (A) (mg/gm. f.w.)		Chlorophyll (B) (mg/gm. f.w.)		Leaf carotein content (mg/gm. f.w.)		Leaf proline content (mg./100 gm F.W.)	
	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season
P. betulaefolia										
Tap water (Control)	13.14A	12.72A	2.332A	2.163A	1.409A	1.387A	1.010A	0.977A	16.77E	17.03E
Saline solution + water spray	6.66E	6.17D	1.576C	1.513C	0.771E	0.752D	0.777C	0.757E	50.57A	51.61A
Saline solution + 500 ppm CCC	7.49C	6.70C	1.701B	1.642B	1.108B	1.090B	0.810C	0.820C	36.53C	36.79C
Saline solution + 25 ppm BA	7.74B	7.55B	1.612BC	1.551BC	0.975C	0.971C	0.920B	0.910B	34.06D	33.93D
Saline solution + 500 ppm PP_{333}	6.85D	6.49D	1.595BC	1.535BC	0.811D	0.808D	0.780C	0.790D	40.56B	40.95B
P. communis										
Tap water (Control)	11.45A	10.89A	1.884A	1.865A	0.996A	0.933A	0.967A	0.953A	18.07E	18.33E
Saline solution + water spray	5.54E	4.91E	1.432D	1.412D	0.673E	0.612E	0.760D	0.780C	63.44A	63.96A
Saline solution + 500 ppm CCC	6.40C	5.48C	1.539B	1.519B	0.784B	0.722B	0.830B	0.820B	51.74C	51.87C
Saline solution + 25 ppm BA	6.78B	5.73B	1.461C	1.442C	0.695D	0.634D	0.820B	0.810B	47.45D	47.71D
Saline solution + 500 ppm PP_{333}	6.02D	5.12D	1.451C	1.432C	0.721C	0.658C	0.780C	0.770C	54.47B	54.47B

The same letters were used for comparing values within the same culumn or row not significantly different, respectively.

***et al.*, (1991)** on lemons, **Hasan (2005)** on olive cultivars and **Osman (2005)** on some apple rootstocks. They reported that proline contents being progressively increased with increasing salinity concentrations.

Proline content in leaf dry matter were investigated regarding their response to effect of sprayed some growth regulators. Data obtained during both 2004 and 2005 experimental seasons are presented in **Table (26).**

Concerning the effect of sprayed growth regulators, **Table (26)** reveals that proline was reduced in leaves of BA, CCC and PP_{333} treated transplants. Such reduction was significant during both seasons. However, PP_{333} was significantly more effective than CCC or BA with proline during 2004 and 2005 experimental seasons. The present result regarding the effect of growth retardants on leaf proline contents goes in line with those found by **Al-Khateeb (1996)** on figs and **Gowda (2002)** on olive. However, **Anju-Thakur *et al.*, (1998)** postulated an opposite trend to that detected in the present study. Such conflict may be attributed to other related factors like as hereditary and surrounding external ones.

4- Leaf mineral composition:

Leaf Na, N, P, K, Mg, Ca, Fe, Mn and Zn contents in response to sprayed growth regulators (BA, CCC and PP_{333}) were investigated. Data obtained during both 2004 and 2005 seasons are presented in **Tables (27 and 28).**

4.1- Effect on leaf nitrogen content:

Concerning the effect of 6000 ppm with SAR 6 salt concentration treatment in the irrigation water on leaf N content, it is obvious from **Table (27)** that, nitrogen level decreased significantly with saline solution treatment comparing with those of the control (tap water) in both *P. betulaefolia and P. communis* pear rootstock transplants during 2004 and 2005 seasons.

The data obtained concerning the effect of salinity stress on total nitrogen agreed with those of other investigators i.e., **Salem (1981)** on grape seedlings, **Abdalla *et al.*, (1981)** on El-Sultani fig; **Patil and Patil (1982)** on pomegranate plants; **Kabeel (1985)** on some deciduous fruits; **Sharaf *et al.*, (1985)** on Thompson seedless and American grapes; **Omar (1996)** on apricot and mango seedlings and **Osman (2005)** on some apple rootstocks. They stated that increasing the salt concentration in irrigation water decreased leaf nitrogen content. In this respect, **Shehata (1989)** postulated that excess Cl^- in saline water used for irrigation, antagonized the uptake of nitrate by the affected plants. It might also be attributed to rapid protein decay under saline conditions **Prisco and O`leary (1972)** the reduce capacity for protein synthesis **Aliza *et al.*, (1967)** and/or reduced uptake and incorporation of protein amino acids into protein **El-Shourbagy *et al.*, (1980)**.

As for the effect of BA, CCC and PP_{333} foliar spray, **Table (27)** reveals that two conflicted trends were detected. Herein, BA and CCC spray increased significantly leaf N % of salt stressed transplants. However, PP_{333} foliar spray decreased it during two seasons of study. taking into consideration that BA was more effective than CCC spray.

The obtained results regarding the reductive influence of both CCC & PP_{333} on leaf N % of water stressed transplants are in general agreement with that reported by **Gowda (2002)** but conflicted with **Behairy *et al.*, (1991)**. Such conflict may be due to other related factors like as concentrations; internal and external conditions (nutritional, physiological and hereditary characters).

4.2- Effect on leaf phosphorus content:

Regarding the effect of salinity treatment (6000 ppm with SAR6), **Table (27)** show clearly that phosphorus level in both pear rootstock was significantly affected by salt concentration in irrigation water. In this, regard, phosphorus level decreased significantly in leaves with salt concentration in the irrigation water during the two seasons of study. The obtained results go in line with those reported by **Abdalla *et al.*, (1981)** on fig plants; **Salem (1981)** on grapevine; **Patil and Patil (1982)** on pomegranate; **Kabeel (1985)** on some deciduous fruit seedlings; **Gaser (1986)** on avocado seedlings; **Garacia and Charbaji (1989)** on grapevine plants; **Bondok *et al.*, (1995-a)** on peach plants and **Osman (2005)** on some apple rootstocks transplants. All stated that leaf P content decreased with increasing salts concentrations in irrigation water.

As for the effect of sprayed growth regulators on leaf P% of salt stressed pear transplants two conflicted trends were observed. Hence, a significant increase was obviously resulted in leaf–P content by growth regulators foliar spray. Differences exhibited by various sprayed growth regulators were significant as compared to control during two seasons of study. Such results regarding the effect of growth retardants are in general agreement with those found by **Behairy *et al.*, (1991)**

and Al-Khateeb (1996) both on water stressed figs transplants, as well as **Nomir and El-Deeb (2000)** on Washington navel orange transplants, all reported that an increase in leaf P content was exhibited by growth retardants application.

4.3- Effect on leaf potassium content:

With respect to the effect of salt concentration treatment, it is obvious from the results of **Table (27)** that both *P. betulaefolia and P. communis* pear rootstocks transplants irrigated with salinized water had significantly lower potassium %. These results is similar to that reported by **Khanduja *et al.*, (1980)** on grapevine; **Kabeel (1985)** on three deciduous plants; **Al-Khateeb (1989)** on some fig varieties; **Omar (1996)** on apricot and mango seedlings; **Abd El-Mageid (1998)** on almond plants and **Osman (2005)** on some apple rootstocks. They stated that potassium content in leaves decreased by rising salt concentration in irrigation water.

Concerning the effect of sprayed growth regulators on leaf potassium content, the results presented in **Table (27)** show that, all foliar spray treatments resulted in significant increase in leaf – K content of treated transplants as compared to the unsprayed salt stressed ones. Such trend was true during both seasons of study.

The present result detected regarding the effect of CCC & PP_{333} spray on leaf K content goes in line with those found by **Behairy *et al.*, (1991); Al-Khateeb (1996) and Nomir and El-Deeb (2000).** All reported that an increase in leaf K content was resulted by growth retardant spray.

4.4- Effect on leaf calcium content:

Concerning the effect of salinity concentration treatment in irrigation water on leaf calcium %, data in **Table (27)** revealed that non salinized transplants appeared to be contain Ca level significantly lower than those of salinized ones during 2004 and 2005 seasons.

The results confirmed past researches of **Kabeel (1985)** on grape, peach and plum seedlings; **Gaser (1986)** on avocado seedlings; **Abd El-Ghani (1990)** on peach; **Omar (1996)** on apricot and mango seedlings; **Abd El-Mageid (1998)** on almond plants and **Osman (2005)** on some apple rootstocks, whose results show that Ca^{++} content in salt treated plants was increased with increasing salinity levels

Referring the effect of sprayed growth regulators, **Table (27)** shows that any of BA, CCC and PP_{333} foliar sprays significantly decreased leaf Ca content. Such trend was true during both seasons, however BA was the most effective followed by CCC and PP_{333}, where differences were significant as compared each other during two seasons of study. The depressive effect of growth retardants on leaf Ca content of salt stressed transplants is in disagreement with **Behairy *et al.*, (1991)** who found the opposite. So further studies are needed to throw some lights on such conflict, however the antagonism between K from one hand and Ca from the other may plays a real role in this respect.

4.5- Effect on leaf magnesium content:

With respect to the effect of salinity concentration treatment, data obtained revealed that the 6000 ppm with

SAR 6 salinity treatment resulted significantly in a decreasing leaf Mg content was significantly exhibited during the two seasons of study.

These findings could be supported with those of **Wallace *et al.*, (1952)** who reported that plant with low K level obtained under salinity condition tended to compensate the low K level by either high calcium and or magnesium content in leaves. This results agree with that reported by **Al-Khateeb (1989)** on some fig varieties; **Gaser (1986)** on avocado seedlings; **Omar (1996)** on apricot and mango seedlings; **Abd El-Mageid (1998)** on almond plants and **Osman (2005)** on some apple rootstocks. All concluded that using different saline solutions significantly decreased leaf Mg content.

Referring the effect of sprayed growth regulators, **Table (27)** shows that any of BA, CCC and PP_{333} significantly increased leaf- Mg content as compared to salt stressed during the study. However, BA was the most effective during 2004 and 2005 seasons. The trend of leaf Mg % in response to growth retardant sprays is in disagreement with finding of **Behairy *et al.*, (1991)** on salt stressed fig transplants.

4.6- Effect leaf sodium content (%):

Regarding the specific effect of 6000 ppm with SAR6 salt concentration treatment in irrigation water, data obtained in **Table (27)** revealed that the treatment of investigated saline solution resulted in an obvious increase in leaf Na content over control during the two season of study. Such increase was significant as compared to those of tap water irrigate pear rootstock transplants.

Table (27): Effect of foliar spray with CCC, BA and PP_{333} on leaf nitrogen, phosphorus, potassium, magnesium, calcium and sodium contents of two pear transplants rootstocks irrigated with 6000 ppm and SAR 6 saline solutions during 2004 and 2005 seasons.

Treatments (irrigation saline solution & spray)	Leaf nitrogen content (%)		Leaf phosphorus content (%)		Leaf potassium content (%)		Leaf magnesium content (%)		Leaf calcium content (%)		Leaf sodium content (%)	
	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season
P. betulaefolia												
Tap water (Control)	2.672A	2.613A	0.236A	0.232A	2.158A	2.245A	0.663A	0.649A	1.539E	1.524E	0.236E	0.243E
Saline solution + water spray	1.203E	1.181E	0.111D	0.116D	0.912E	0.738E	0.216E	0.208E	3.504A	3.783A	0.549A	0.617A
Saline solution + 500 ppm CCC	2.103C	2.082C	0.166B	0.171B	1.529C	1.354C	0.345C	0.337C	2.411B	2.422C	0.403C	0.471C
Saline solution + 25 ppm BA	2.221B	2.211B	0.181B	0.182B	1.722B	1.616B	0.365B	0.358B	1.992D	2.125D	0.376D	0.444D
Saline solution + 500 ppm PP_{333}	1.915D	1.875D	0.141C	0.139C	1.437D	1.322D	0.313D	0.309D	2.337C	2.685B	0.448B	0.516B
P. communis												
Tap water (Control)	2.221A	2.180A	0.227A	0.225A	1.892A	1.887A	0.565A	0.581A	1.755C	1.764E	0.252E	0.258E
Saline solution + water spray	1.103D	1.113D	0.111E	0.114D	0.587E	0.533E	0.225E	0.274D	3.957A	3.911A	0.847A	0.861A
Saline solution + 500 ppm CCC	1.971B	1.955B	0.165C	0.163C	1.051C	1.026C	0.336C	0.342C	2.339B	2.327C	0.662C	0.676C
Saline solution + 25 ppm BA	2.017B	2.011B	0.185B	0.184B	1.135B	1.111B	0.371B	0.377B	1.778C	2.105D	0.458D	0.473D
Saline solution + 500 ppm PP_{333}	1.513C	1.572C	0.135D	0.131D	0.965D	0.911D	0.309D	0.265D	2.569B	2.557B	0.733B	0.746B

The same letters were used for comparing values within the same culumn or row not significantly different, respectively.

Analogical results were reported by many investigators; **Patil and Patil (1982)** on pomegranate; **Sweidan *et al.*, (1982)** on apricot seedlings; **Kabeel (1985)** on deciduous fruits; **Gaser (1986)** on avocado; **Garacia and Charbaji (1989)** on grapevine; **Bondok *et al.*, (1995)** on peach plants and **Osman (2005)** on some apple rootstocks. They stated that as the salinity level of the irrigation water increased, a subsequent increase was observed in Na^+ accumulation in plant leaves.

Regarding the effect of foliar sprayed growth regulators (BA, CCC and PP_{333}), **Table (27)** reveals that all reduced significantly leaf Na content of salt stressed transplants, however BA was statistically the most effective. Meanwhile, CCC and PP_{333} sprays didn't only reduced leaf Na content, but also both were statistically of the same effectiveness.

4.7-Effect on leaf iron content:

Concerning the specific effect of salt concentration treatment the obtained results indicated that leaf iron content significantly increased by salt concentration in irrigation water in both pear rootstocks during the two seasons of study. the differences between salt concentration treatment and tap water (control) treatment was significant.

These results confirmed the findings of **Gaser (1986)** on avocado; and **Osman (2005)** on some apple rootstocks. They reported that leaf Fe concentration increased by increasing salinity.

Concerning the effect of sprayed growth regulators obtained results from **Table (28)** indicated that leaf- Fe content of salt stressed pear transplants had been significantly increased by growth regulators foliar spray. Meanwhile, the reverse was true with unsprayed salt stressed transplants. Such results are in partial agreement with **Behairy *et al*., (1991)** who mentioned that CCC increased leaf Fe content of salt stressed fig transplants.

4.8- Leaf manganese content:

Referring the specific effect of salt concentration, data obtained in **Table (28)** revealed that saline solution resulted significantly in a decreasing leaf Mn content as compared to those of tap water irrigation in both *P. betulaefolia and P. communis* pear rootstocks transplants as compared to those of tap water irrigation during 2004 and 2005 seasons.

These findings could be supported with those of **Al-Khateeb (1989)** on some fig varieties, **Abd El-Mageid (1998)** on almond plants and **Osman (2005)** on some apple rootstocks all concluded that using different saline solutions significantly decreased leaf Mn content.

With respect to the effect of the sprayed growth regulators i.e., BA, CCC and PP_{333} on leaf- Mn content, data obtained in **Table (28)** revealed that growth regulators foliar spray treatments significantly increased leaf- Mn contents as compared with unsprayed salt stressed transplants during 2004 and 2005 experimental seasons. Such trend of leaf Mn content in response to growth retardants exhibited in the present study goes in line with that found by **Behairy *et al*., (1991),** who mentioned that leaf Mn level was increased by CCC, but the opposite was detected by PP_{333} application on salt stressed fig transplants.

4.9- Effect on leaf Zinc content:

Regarding the specific effect of 6000 ppm, SAR6 salt concentration treatment in irrigation water, **Table (28)** shows that salt solution treatment resulted in an obvious decrease in leaf Zn content below control in both pear rootstocks during the two seasons of study. differences in leaf Zn content was significant between salinity solution. Compared to those of tap water (control) during 2004 and 2005 seasons. Such trend in supported by those of **Patil and Patil (1982)** on pomegranate; **El-Hefnawi (1986)** on guava plants; **Gaser (1986)** on avocado plants and **Osman (2005)** on some apple rootstocks regarding the salinity influence on leaf Zn content.

Concerning the effect of different sprayed growth regulators i.e., BA, CCC and PP_{333} on leaf – Zn content, it is so obvious that growth regulators foliar sprays significantly increased leaf- Zn content of salt stressed transplants during the two seasons of study **Table (28)**. Such trend of response goes partially with that previously mentioned by **Behairy *et al.*, (1991)** who found that CCC increased leaf Zn content of salt stressed fig plants, but the reverse was detected with PP_{333}.

Table (28): Effect of foliar spray with CCC, BA and PP_{333} on leaf iron, manganese and zinc contents (ppm) of two pear transplants rootstocks irrigated and 6000 ppm with SAR 6 saline solutions during 2004 and 2005 seasons.

Treatments (irrigation saline solution & spray)	Leaf iron content (ppm)		Leaf manganese content (ppm)		Leaf zinc content (ppm)	
	2004 season	2005 season	2004 season	2005 season	2004 season	2005 season
P. betulaefolia						
Tap water (Control)	126.6A	127.10A	52.43A	55.69A	29.73A	28.59A
Saline solution + water spray	57.69E	55.35E	29.23E	31.07D	15.65D	14.39C
Saline solution + 500 ppm CCC	69.13D	67.42D	34.11C	35.57C	16.51C	15.33C
Saline solution + 25 ppm BA	76.47C	75.43C	37.67B	37.47B	18.73B	17.91B
Saline solution + 500 ppm PP_{333}	86.11B	84.32B	31.09D	31.27D	15.88CD	14.83C
P. communis						
Tap water (Control)	104.80A	102.80A	42.83A	43.37A	23.54A	22.36A
Saline solution + water spray	40.23E	39.64E	18.62D	19.13D	10.16D	11.32D
Saline solution + 500 ppm CCC	49.23D	50.26D	21.17C	22.07C	12.26C	12.83C
Saline solution + 25 ppm BA	56.11C	55.62C	25.46B	24.37B	14.59B	14.61B
Saline solution + 500 ppm PP_{333}	60.32B	60.77B	19.11D	19.41D	10.12D	11.77CD

The same letters were used for comparing values within the same culumn or row not significantly different, respectively.