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Evaluation of Salinity Tolerance on New Selected Almond × Peach Hybrid Rootstocks

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Abstract

The main objective of this investigation was to evaluate the determination effect of salt tolerance of five new almond× peach hybrid rootstocks namely hybrid 1, 2, 3, 4 and 5 through their vegetative growth parameters and chemical concentrations. This evaluation aimed to recommend these rootstocks for the commercial use. This experiment was carried out at the Horticulture Research Institute, Agriculture Research Center, Giza, Egypt, during two successive seasons (2018-2019 and 2019-2020) respectively. Rootstocks chosen for this study included new almond× peach rootstocks which are resistant to nematode. Salinity irrigated water included four levels of NaCl salt which was 500, 1000, 1500, 2000 ppm and the control which was the usual irrigated water. Results cleared that increasing salinity levels led to reduction in all growth parameters including seedling stem diameter, heights, average leaves number and buds per one, leaf area, fresh and dry weights. High salinity levels declined gradually mineral concentrations like N, P, K, Mg%, Fe and Mn ppm. Moreover the highest level of salinity conducted to the highest level of Na and Cl ppm concentrations. Chlorophyll values take the same trend while proline values take the opposite trend with high salinity due to it considered an indicator to high salinity. Moreover, there were differences between rootstocks to salinity tolerance. Hybrid No.5 was the most resistant hybrid to high salinity concentration followed by hybrid No.4 while hybrid No.3 was the least one. Hybrid No.5 reached the highest values of growth parameters and it shared with hybrid No.4 the highest values of N, P and K, Mg concentrations and the highest levels of Fe, Mn, Na and Cl. Chlorophyll values take the same trend with slightly differences with hybrid No.4. On the other hand hybrid No.3 was the least hybrid in all growth measurements, mineral concentration and chlorophyll except proline concentration it recorded the highest value. From the above investigation we can recommend hybrid number5 or hybrid number4 which had the best results compared to other seedlings rootstock under experiment salinity conditions.

Keywords: *Prunus* rootstock; almond× peach hybrids; salinity; NaCl.

1 Introduction

The cultivation of peach spreads all over the world. In Egypt peach grown in the newly reclaimed lands which include many soil types. In general woody plants are comparatively salt-tolerant during the first germination stage of seed but young seedling is more sensitive and gradually more tolerant with increasing age through the maturity stage. Temperate fruit trees are generally rated as susceptible to soluble salts and above all sensitive to

chloride and irrigation with salty water may significantly reduce tree yields (Najafian et al 2008). Also, the majority of the stone fruit trees (especially almond) are sensitive to salt stresses and their yield regularly reduces at salt concentrations above 1.5 dSm^{-1} but at 4 dSm^{-1} yield decrease to more than half (Hassan and El-Azayem 1990). *Prunus* species are included in the salt sensitive species group and they have different degrees to salt tolerance. The almond × peach hybrid GF677 is in-between salt tolerance compared with GF655/ 2 *(P. insititia)* (which is the relatively tolerant) and Myrobalan hybrid MrS. 2/5 or to peach seedlings (the fewer tolerant) (Massai and Gucci 1998). Kotuby-Amacher et al (2000), reported different species of *Prunus* that reduce yield by 50% related to the salinity concentration (expressed as conductivity).

Several authors recommended using of interspecific hybrids of *Prunus* species as rootstocks. Therefore, using interspecific hybrids is one of the most promising ways to improve new clone rootstocks in *Prunus* species and one of the main features that should be taken into concern when selecting new rootstock for fruit trees is salt and drought tolerance (El-Motaium and Brown 1994; Noitsakis et al 1997).

The tolerance rootstocks mainly reduce the uptake of Na^+ and/ or Cl^- in the grafted shoots of *Prunus* cultivars. The root system physical characteristics had the main effect of mineral concentration of the aerial plant parts. Grafted plants development improved or reduced by water or minerals uptake. Other studies confirmed that increasing K^+, Ca^{+2} or Mg^{+2} translocation to the leaves associated with grafted plants salt tolerance. Therefore, the essential role of rootstock is determining tree performance under saline conditions. Other studies have also shown relation between salt tolerance and boron sensitivity in *Prunus* rootstock that make some of them more suitable more to saline soil (Jalil et al 2012).

Irrigated lands which located in semiarid zones face salinity problem. These agriculture zones between 100 to 110 million hectares; of which 20 to 30 million hectares damaged by salt accumulation and an estimated 0.25to 0.5 million hectares are less production yearly because of salt accumulation (FAO 2002). The problem of salinity is especially serious in arid and semiarid areas due to excessive evaporation and the scarcity of good water quality for irrigation. The word salinity related to the total concentration of Na^+, Ca^{+2}, Mg^{+2}, K^+, HCO^{-3}, and Cl^- ions in the soil solution. High salt levels lead to osmotic stress coupled with ionic imbalances caused by the increased uptake of toxic ions such as Na^+ and Cl^- (Tilbrook et al 2014). The salt stress has also an adverse effect on mineral Ca^{+2} and K^+ homeostasis (Tounekti et al 2012). An excess or deficiency of the major elements in plant's tissues may cause disorders with respect to nutrient availability, uptake, transport or partitioning within the plant. Thus, there may be a need to use fertilizers to alleviate the harmful effects of excessive soil salinity. Salinity is a serious human ecological concern because the important crops are sensitive to salinity (Byrt and Munns 2008). Hence, salt tolerance plants improved crop yield and support agriculture on marginal lands. Salinity affected in different degrees on plant growth stage such as plant emergence, survival, growth, maturity and yield (Pilar et al 2011). Generally, the main objective of this investigation was to evaluate the effect of NaCl at different concentrations on vegetative growth parameters and chemical concentrations of new almond× peach hybrid rootstocks.

2 Materials and Methods

2.1 Plant material and salt treatments

This experiment was carried out at the Horticulture Research Institute, ARC, Giza, Egypt, during two successive seasons (2018-2019 and 2019-2020). Rootstocks chosen for this study included five new almond × peach hybrids which coming from hybridization between Om Elfahm almond cv. as mother tree and Okinawa peach rootstock as father tree and they are classified as nematode resistant (Soliman 2014).

To conduct this research, rootstocks were propagated by the hardwood cutting to have a true to type seedlings. Cutting was taken from trees (f1 trees eight years old) of the hybridization maintained above. Hardwood cuttings of these hybrids were taken in late January of each season (≈20 cm were prepared and dipping in 3000 ppm IBA for 30 seconds to stimulate rooting formation). Cuttings were placed in black plastic bags included mixture of peat moss: sand (3:1 by volume) under greenhouse conditions. Seedlings were routinely subjected to the same nursery practices managements and irrigated with well water till the beginning of experiment treatments.

Seedlings for the present investigation were selected as possible uniformity in size and growth and free from any apparent infection. Seedlings were irrigated with water containing total soluble salts as in **Table 1**. The treatments were adopted by added NaCl at four concentrations (500, 1000, 1500 and 2000 ppm) in both seasons. To avoid osmotic shock, salinity levels were obtained by adding NaCl salt in equal parts on a 4 days interval each one increased 500ppm over than the previous one till the final salt concentration.

Each treatment comprised three replications with five rootstocks per each replicate. Fifteen plants were irrigated with well water served as a control treatment.

Table 1. well water analysis

Cations				Anions				EC	PH
K^+	Na^+	Mg^{++}	Ca^{++}	SO^{--}_4	Cl^-	HCO^-_3	Co_3	ppm	
0.31	5.24	2	2.51	2.60	3.61	3.85	…	320	7.40

Samples and data of this investigation were collected at the end of each season (15 weeks) as coming:

2.2 Morphological parameters

Growth characters including
Seedling stem diameter (cm.) Seedling heights (cm.)
Number of leaves per seedling Number of buds per seedling
Leaf area (cm^2) Fresh weight (g.)
Dry weight (g.)

2.3 Chemical analysis

Leaf samples were washed with tap water and dried at 70°C till constant weight and then ground and stored for analysis. The ground samples were digested with sulphoric acid and hydrogen peroxide according to Evenhuis (1978). 0.5gram of dried samples was digested using H_2SO_4 and H_2O_2 as described by Cottenie (1980).

The extracted samples were used to determine the following minerals content as follows:

Total nitrogen% was determined according to (A.O.A.C.2000).

Total phosphorus% (gm/ 100gm D.W.) was measured according to Murphy and Riley (1962).

Potassium contents% (gm/ 100gm D.W.) were determined according to Piper (1950).

Magnesium% (gm/ 100gm D.W.) was determined in plant according to Richards (1954).

Iron (ppm) was determined according to Brandifeld and Spincer (1965).

Chloride (ppm) of leaves was estimated according to the methods of Higinbothan et al (1967).

Sodium (ppm) were determined by Flam photometer E.E.L., Model (Jackson, 1967).

Proline (µg/g leaves) was determined as described by Bates et al (1973)

Leaf chlorophyll content (mg/100 g leaves f.wt.) was determined according to Saric et al (1976).

2.4 Statistical analysis

Data were statistically analyzed in completely randomized design (CRD) with two factors, five new almond ×peach hybrid rootstocks and irrigation water salinity in 5 levels of NaCl salt with three replications for each treatment. Data were analyzed according to the method of (Snedecor and Cochran 1980), LSD test at 5%level was used for comparison between means of each rootstock.

3 Results and Discussion

3.1 Effect of various salinity levels on seedling stem diameter (cm.) and height (cm.) of new almond × peach hybrid rootstocks

Data presented in **Table 2** showed that, most vegetative growth parameters were significantly affected by salt treatments. Low salinity level showed the highest significant increase in seedling stem diameter as well as its height (cm.), as compared with high salinity levels for both seasons of study. Whereas different hybrids showed different response to the applied treatments.

Data showed that control treatment reached the highest significant value of seedling stem diameter in the 1st season (1.59 cm.) and the 2nd season (1.60 cm.) as well as 500ppm with slightly differences in the 1st season and without differences in the 2nd one. On the other hand 2000 ppm recorded the lowest significant values for stem diameter in both seasons (0.89 and 0.91 cm. respectively).

As for different hybrids, data cleared that in both seasons hybrid No.5 recorded the highest significant seedling stem diameter (1.43 cm.in the 1st season & 1.30 cm. in the 2nd one) as well as hybrid No.1 (1.30 cm.) & No.4 (1.39 cm.) in the 2nd season. However the lowest significant value was recorded with hybrid No. 2 and No. 3 in both seasons (in the 1st season 1.12&1.17cm. and in the 2nd season 1.18 cm. for both hybrids respectively).

Regardless the interaction between both factors, it was clear that hybrid No.5 with control treatment recorded the highest significant value in this respect (1.78 in 2018 and 1.70 cm. in 2019), while hybrids No. 2 & No. 3 got the least significant value with 2000 ppm (0.78 for the 1st season and 0.82 cm. for the 2nd season). As for the specific effect of salinity levels on seedling height (cm.), data in **Table 2** showed that control treatment recorded the highest significant values for both seasons (101.79 & 112.28 cm. respectively). Moreover the highest salinity level (1500 & 2000 ppm) recorded the lowest significant values (67.53 & 58.35 cm.in the 1st season & 72.20 & 62.63 cm. in the 2nd season respectively).

Referring to different hybrids, it is clear that hybrid No.5 recorded the highest significant value (93.24 in 1st season&102.08 in 2nd season). On the other hand hybrid No.3 gained the lowest significant value (69.86 and 70.99cm. in the1st season and the 2nd one respectively).

Interaction between both studied factors showed that, the highest significant value of seedling height (cm.) were recorded with control with hybrid No.5 in both seasons (118.32 & 128.97cm. respectively). Whereas hybrids No.2 and No.3 under high salinity level got the lowest significant value (49.72&54.19cm. for hybrid No.2 and 51.26& 56.39cm. for No.3 in both seasons respectively).

These results are in agreement with Najafian et al 2008 who cleared that at the highest salinity concentration, the minimum length of GF_{677} stem was recorded. Also, Zrig et al 2016 reported that it was no surprise that Garnam and Bitter almond shoot length were reduced by the addition of 75 mM NaCl to the growing medium. Moreover, Zhang et al 2016 reported that tomato leaf, shoot height and stem diameter reduced under salinity stress caused by photosynthesis reduction, tissues expansion reduction and cell divided inhibition.

Table 2. Effect of various salinity levels on seedling stem diameter (cm.) and height (cm.) of new almond×peach hybrid rootstocks

Salinity levels (ppm)		1st season					Mean	2nd season					Mean
		Control	500	1000	1500	2000		Control	500	1000	1500	2000	
Seedling stem diameter (cm)	Hybrid 1	1.57ab	1.46b-d	1.29de	1.04fg	0.89gh	1.25BC	1.66ab	1.49a-c	1.32cd	1.08ef	0.95fg	1.30A
	Hybrid 2	1.41c-e	1.30c-e	1.18ef	0.91gh	0.78h	1.12C	1.44a-c	1.33cd	1.35cd	0.96fg	0.82g	1.18B
	Hybrid 3	1.48b-d	1.37c-e	1.19ef	1.03fg	0.78h	1.17C	1.50a-c	1.33cd	1.21de	1.07ef	0.82g	1.18B
	Hybrid 4	1.69ab	1.55a-c	1.35c-e	1.13ef	0.98f-h	1.34AB	1.71a	1.63ab	1.40b-d	1.19d-f	1.03e-g	1.39A
	Hybrid 5	1.78a	1.69ab	1.47b-d	1.19ef	1.03fg	1.43A	1.70a	1.54a-c	1.23de	1.07ef	0.97e-g	1.30A
	Mean	1.59A	1.47AB	1.30B	1.06C	0.89C		1.60A	1.46A	1.30AB	1.07C	0.91D	
Seedling height (cm.)	Hybrid 1	98.47bc	89.15cd	78.27	67.44f-h	56.72hi	78.01BC	107.33bc	86.10ef	86.10ef	73.51gh	62.39hi	83.08BC
	Hybrid 2	92.47cd	84.67de	73.29e-g	61.83g-i	49.72i	72.40CD	102.64cd	93.98de	79.89fg	62.45hi	54.19i	78.63C
	Hybrid 3	90.5cd	80.91d-f	70.74fg	55.84hi	51.26i	69.86D	100,52cd	88.19ef	78.52fg	60.87i	56.39i	70.99D
	Hybrid 4	109.11ab	97.54bc	84.73de	72.85e-g	64.92gh	85.83AB	110.20bc	106.32bc	92.36de	76.50fg	65.57g-i	90.19B
	Hybrid 5	118.32a	106.95ab	92.17cd	79.67d-f	69.11fg	93.24A	128.97a	118.72ab	100.47cd	87.64ef	74.64gh	102.08A
	Mean	101.79A	91.84A	79.84B	67.53C	58.35C		112.28A	98.66B	87.46C	72.20D	62.63D	

*Means having the same letter (s) in a column or line are not significantly different at 5% level

*Capital letters refer to the effect of main factor while small one refer to the interaction effect between factors

3.2 Effect of various salinity levels on average number of leaves, buds and leaf area of new almond ×peach hybrid rootstocks

The vegetative growth parameters of the new hybrids (average number of leaves, buds and leaf area) in the studied two seasons were shown in **Table 3**. Increasing application of salt levels significantly decreased the studied vegetative growth parameters in both seasons. Data also showed the superiority of hybrid No.5 and inferiority of hybrid No.3.

Among the application of various salinity levels on average number of leaves, the control treatment gave the highest significant values compared to the other treatments (24.90 & 30.05 in 2018 and 2019 respectively). While the highest concentration (2000 ppm) recorded the lowest significant value (4.68 in the 1st season &5.30 in the 2nd season).

As for the effect of the salinity treatments on hybrids data showed that hybrid No.5 recorded the highest significant value of average leaves number in both seasons (19.25 & 22.4 respectively), but hybrid No. 3 got the lowest significant values (11.25 &15.75 in 1st season and 2nd season).

Regarding the combined effect between the two studied factors on average number of leaves, it was clear that data take the same trend, hybrid No.5 with control recorded the highest value (29.75 & 35.40 in both seasons respectively). On the other hand hybrid No.3 treated with 2000ppm of salinity recorded the lowest value (1.75 in 1st season&1.93in 2nd season).

As for the specific effect of different salinity treatments on average number of buds, data was similar to average number of leaves. Unsalinized plants recorded the highest significant value (24.9&27.1 in both seasons). While the high salt concentration (2000 ppm) got the lowest significant value (13.95&15.45 in both seasons respectively).

Referring to the specific effect due to the different hybrids, data showed that hybrid No.5 reached the highest significant values of average number of buds in both seasons (22.4 & 25.2 respectively). On the other hand hybrid No.3 got the lowest significant value (15.75 in 1st season &18.9 in 2nd season)

Data in **Table 3** showed the interaction effect of both factors on average number of leaves where it was clear that hybrid No.5 with control reached the highest significant value in both seasons (29.75& 31.75 respectively). On opposite, high salinity level with hybrid No.3 in the 1st season (11.25) and hybrid No.2 in the 2nd season (13.50) recorded the lowest significant values in his respect.

Moreover, Data in **Table 3** showed the effect of factors on average leaf area (cm^2). Data recorded the same trend for the specific effect of each factor while the interaction took slightly differences.

It was clear that control plants recorded the highest significant value in both seasons (13.51 & 14.04 cm^2 respectively) as well as 500ppm (13.09& 13.30cm^2 in both seasons respectively), while the lowest significant value recorded with 2000ppm (7.66cm^2 in 1st season&8.29cm^2 in 2nd one).

As for the effect of hybrids types on average leaf area, hybrid No.5 recorded the highest significant value (11.68cm^2 in 1st season and 13.08cm^2 in 2nd season). On the other hand hybrids No.1, 2 and 3 recorded the lowest significant value of leaf area (cm^2).

As for the interaction between the two studied factors on average leaf area (cm^2), it was clear that hybrid No.5 at the low salt concentration (500ppm or control) got the highest significant value in both seasons (13.83 & 15.42 cm^2 for control 13.83 & 14.8 9cm^2 for 500 ppm). On the other hand the lowest significant values were recorded with hybrids No.1, 2&3 with the high salt concentration.

Table 3. Effect of various salinity levels on average number of leaves, average number of buds and average leaf area of new hybrid rootstocks

Salinity levels (ppm)		1st season					Mean	2nd season					Mean
		Control	500	1000	1500	2000		Control	500	1000	1500	2000	
Average number of leaves	Hybrid 1	24.00bc	20.75c-e	13.25fg	9.25g-i	4.75jk	14.4BC	30.00b	24.90cd	15.77fg	9.16hi	5.56ij	18.4BC
	Hybrid 2	21.75b-d	18.75d-f	11.00fg	5.75i-k	2.25k	11.9CD	27.25b-d	23.00de	12.75gh	7.00i	2.50j	16.5CD
	Hybrid 3	22.25b-d	17.50ef	10.25g-i	4.50jk	1.75k	11.25D	25.59cd	21.00de	12.81gh	5.27ij	1.93j	15.75D
	Hybrid 4	26.75ab	23.50b-d	16.75ef	11.50gh	6.25i-k	16.95AB	32.00ab	28.25bc	19.50ef	12.75gh	7.00i	20.45AB
	Hybrid 5	29.75a	25.00ab	18.50d-f	14.00fg	8.50h-j	19.15A	35.40a	30.00bc	21.28de	16.38fg	9.52hi	22.4A
	Mean	24.90A	21.10A	13.95B	9.00C	4.68C		30.05A	25.43A	16.42B	10.12C	5.30C	
Average number of buds	Hybrid 1	24.00b-d	20.75d-f	17.50f-h	16.00gh	13.75h-j	18.4B	26.50b-d	24.25c-e	21.25e-g	18.0gh	15.50hi	21.1B
	Hybrid 2	21.75c-e	18.75e-g	15.50g-i	14.50h-j	12.00ij	16.5BC	25.25b-d	23.25c-e	19.75f-h	15.50hi	13.50i	19.45C
	Hybrid 3	22.25c-e	17.50f-h	14.75h-j	13.00h-j	11.25j	15.75C	24.75c-e	21.75e-f	19.24f-h	15.00hi	13.75i	18.90C
	Hybrid 4	26.75ab	23.50b-d	19.00e-g	17.25f-h	15.75g-i	20.45A	27.25a-c	26.25b-d	22.75d-f	19.00f-h	16.00hi	22.25B
	Hybrid 5	29.75a	25.00bc	20.75d-f	19.50e-g	17.00f-h	22.4A	31.75a	29.25ab	24.75c-e	21.75e-g	18.50gh	25.2A
	Mean	24.9A	21.1AB	17.5BC	16.05CD	13.95D		27.1A	24.95A	21.55B	17.85C	15.45C	
Average leaf area (cm^2)	Hybrid 1	13.30a	12.77ab	10.64cd	7.98fg	7.45g	10.43B	12.77bc	12.77bc	11.17de	8.51fg	7.98fg	10.64C
	Hybrid 2	13.30a	12.77ab	10.11cd	7.45g	6.92g	10.11B	13.30bc	12.77bc	10.11de	7.45g	6.38g	10.00C
	Hybrid 3	13.83a	12.77ab	10.64cd	7.98fg	6.92g	10.43B	13.83ab	12.77bc	10.64de	7.98fg	7.98fg	10.64C
	Hybrid 4	13.30a	13.30a	11.17bc	9.04d-f	8.51ef	11.06AB	14.89a	13.30bc	11.70cd	10.11de	9.57ef	11.92B
	Hybrid 5	13.83a	13.83a	12.23b	10c-e	8.51ef	11.68A	15.42a	14.89a	14.36ab	11.17de	9.57ef	13.08A
	Mean	13.51A	13.09A	10.96B	8.49C	7.66C		14.04A	13.30A	11.60B	9.05C	8.29D	

*Means having the same letter (s) in a column or line are not significantly different at 5% level
*Capital letters refer to the effect of main factor while small one refer to the interaction effect between factor

These results are in agreement with Massai and Gucci 1998 who cleared that in all almond rootstocks significant decrease in stem height, leaf area and leaf number had recorded under high salinity levels (6 and 9 dSm-1). The interaction between salinity levels and genotypes was significant only on leaf area index. Low salinity levels (1.5 and 3 dSm-1) were not significant in all plant growth parameters. The decline in leaf growth is the earliest response to salinity.

3.3 Effect of various water salinity levels on fresh weight (g.) and dry weight (g.) of new almond × peach hybrid rootstocks

Data in **Table 4** showed the effect of various water salinity levels on fresh and dry weights of the different hybrids. Data showed that both measurements take the same tendency as the previous growth parameters, both measurements were high with control while the opposite was true with 2000ppm.also hybrid No.5 was the superior one.

As for the specific effect of salinity levels, it was clear that control treatments reached the highest significant value of fresh weight (132.84&140.98g./ plant) and dry weight (55.80 & 59.22g./plant) in both season respectively.

Moreover, data in **Table 4** showed the hybrid specific effect. Where hybrid No.4 recorded the highest significant fresh weight (122.68 g./plants) and dry weight (50.24 g./plants) in the 1st season as well as hybrid No.5 in the1st season and 2nd season (120.24 & 129 g/ plants in fresh weight and 49.24& 52.85 g/ plants in dry weight). On the other hand hybrid No.3 got the lowest significant value in both measurements in both seasons.

As for the interaction between the two studied factors, data cleared that hybrid No. 4 irrigated with control treatment reached the highest significant value of fresh weight (136.7 g/ plants) and dry weight (57.42 g/ plants) in the 1st season as well as hybrid No.5 in the 2nd season (144.5&60.69g./plant for fresh and dry weight respectively). While, hybrids No.1 and No.3 got the lowest significant value of both measurements with the high salt concentration. These results are in agreement with Massai and Gucci 1998 who showed that high salinity levels caused significant reduction in dry and fresh weight of all almond rootstock genotypes.

3.4 Effect of various water salinity levels on leaf nitrogen, phosphorus and potassium contents (g/100g dry weight) of new almond ×peach hybrid rootstocks

Data in **Table 5** reflected the effect of various water salinity levels on leaf nitrogen, phosphorus and potassium contents (g /100 g dry. wt) of new hybrid rootstocks. Data showed that the low concentration of salinity was better than the high salinity level. However, the effect of salinity levels on different hybrids takes the same trend as the previous growth parameters.

As for the effect of various water salinity levels, the highest significant values of N and K% were recorded with different hybrids irrigation with control (1.91 & 1.99 for N% and 2.11 & 2.34 for K% in 1st season and 2nd season respectively). On the other hand the highest salt concentration 2000ppm gave the lowest significant levels of both minerals N% (1.27 & 1.51) and K % (1.47 & 1.74) in both seasons. However, all hybrids were superior effective in levels of N% and K% but hybrid No.5 recorded the highest level of N% (1.66&1.80), and K% (1.83& 1.99) in both season respectively as well as hybrids No.1, 2 and 4 with slightly differences. Moreover P% showed no significant differences between all hybrids in both seasons but hybrids No.1 and3 recorded low significant value in the 1st season (0.21).

Interaction between the two studied factors was significant with leaf mineral contents in most cases, where the highest values of N% and K% were recorded by hybrid No. 5 irrigated with control treatment followed by the same hybrid with 500 ppm. Hybrid No.5 with control recorded for N% (1.97 & 2.05) while for K% recorded (2.32 & 2.41) in both seasons.

Table 4. Effect of various water salinity levels on fresh weight (g.) and dry weight (g.) of new almond ×peach hybrid rootstocks

Salinity levels (ppm)		1st season					Means	2nd season					Mean
		control	500	1000	1500	2000		Control	500	1000	1500	2000	
Fresh weight (g)	Hybrid 1	134.8a	127.1cd	112.5fg	109.2gh	97.6j	116.24B	137.6cd	130.2ef	126.4gh	116.5jk	109.6lm	124.06C
	Hybrid 2	131.6a-c	125.4de	114.2f	106.3hi	104.3i	116.36B	143.5ab	135.7c-e	122.5hi	113.4kl	108.6m	124.74BC
	Hybrid 3	128.4b-d	121.3e	111.2f-h	103.4i	98.2j	112.5C	140.1a-c	132.6ef	120.4ij	110.2lm	105.6m	121.78D
	Hybrid 4	136.7a	128.6b-d	122.3e	115.7f	110.1f-h	122.68A	139.2bc	134.2de	129.6fg	117.4i-k	112.6kl	126.6B
	Hybrid 5	132.7a	126.5c-e	121.4e	113.2fg	107.4hi	120.24A	144.5a	138.2b-d	127.9fg	119.8ij	114.6kl	129A
	Mean	132.84A	125.78B	116.32C	109.56D	103.52E		140.98A	134.18B	125.36C	115.46D	110.2D	
Dry weight (g)	Hybrid 1	56.62ab	54.65bc	46.13f	43.24gh	37.68j	47.66BC	57.79cd	55.99d	51.83ef	46.14hi	42.31kl	50.82BC
	Hybrid 2	55.27bc	53.92cd	46.82f	42.95gh	40.26i	47.85BC	60.27ab	58.35bc	50.23fg	44.91ij	41.92l	51.14AB
	Hybrid 3	53.93cd	52.16d	45.60f	40.95i	37.91j	46.11C	58.84a-c	57.12cd	49.37g	43.64jk	40.76l	49.95C
	Hybrid 4	57.42a	55.30bc	50.15e	45.82f	42.50gh	50.24A	58.48bc	57.71cd	53.14e	46.49hi	43.46jk	51.86AB
	Hybrid 5	55.74a-c	54.40c	49.78e	44.83fg	41.46hi	49.24AB	60.69a	59.43a-b	52.44ef	47.45h	44.24ij	52.85A
	Mean	55.80A	54.09A	47.70B	43.56C	39.96D		59.22A	57.72A	51.40B	45.73C	42.54D	

*Means having the same letter (s) in a column or line are not significantly different at 5% level
*Capital letters refer to the effect of main factor while small one refer to the interaction effect between factors

Table 5. Effect of various water salinity levels on leaf nitrogen, phosphorus and potassium contents (g/100g dry. wt) of new almond ×peach hybrid rootstocks

Salinity levels (ppm)		1st season					Mean	2nd season					Mean
		Control	500	1000	1500	2000		Control	500	1000	1500	2000	
N%	Hybrid 1	1.88ab	1.75b-d	1.60de	1.40e-g	1.28g	1.58AB	1.95ab	1.86a-c	1.79b-d	1.60d-f	1.51ef	1.74AB
	Hybrid 2	1.93ab	1.70cd	1.63cd	1.39fg	1.26g	1.58AB	1.98ab	1.83bc	1.71c-e	1.61d-f	1.48f	1.72AB
	Hybrid 3	1.82a-c	1.67cd	1.52df	1.37fg	1.23g	1.52B	1.93ab	1.81bc	1.69c-e	1.57ef	1.46f	1.69B
	Hybrid 4	1.94ab	1.83a-c	1.75b-d	1.41e-g	1.28g	1.64A	2.04a	1.89ab	1.80bc	1.62d-f	1.53ef	1.78AB
	Hybrid 5	1.97a	1.86a-c	1.72b-d	1.45e-g	1.30g	1.66A	2.05a	1.91ab	1.80bc	1.67c-f	1.55ef	1.80A
	Mean	1.91A	1.76AB	1.64B	1.41C	1.27D		1.99A	1.86AB	1.76BC	1.62CD	1.51D	
P%	Hybrid 1	0.24ab	0.24ab	0.21cd	0.19de	0.16e	0.21B	0.28a	0.26ab	0.23b-d	0.21cd	0.20d	0.24A
	Hybrid 2	0.25ab	0.26ab	0.24ab	0.17e	0.17e	0.22AB	0.28a	0.25a-c	0.23b-d	0.22cd	0.21cd	0.24A
	Hybrid 3	0.23bc	0.23bc	0.23bc	0.20c-e	0.16e	0.21B	0.27ab	0.25a-c	0.25a-c	0.22cd	0.20d	0.24A
	Hybrid 4	0.27a	0.27a	0.24ab	0.18de	0.19de	0.23AB	0.29a	0.26ab	0.24b-d	0.21cd	0.20d	0.24A
	Hybrid 5	0.28a	0.26ab	0.23bc	0.22b-d	0.19de	0.24A	0.29a	0.27ab	0.25a-c	0.23b-d	0.21cd	0.25A
	Mean	0.25A	0.25A	0.23A	0.19B	0.18C		0.28A	0.26AB	0.24BC	0.22C	0.21C	
K%	Hybrid 1	2.06ab	1.78b-d	1.67c-e	1.54de	1.45e	1.70BC	2.19a-c	1.99b-d	1.85de	1.77e	1.76e	1.91AB
	Hybrid 2	2.24a	1.78b-d	1.65c-e	1.58de	1.47e	1.75AB	2.25ab	2.01b-d	1.89cd	1.78e	1.71e	1.93AB
	Hybrid 3	1.75cd	1.79b-d	1.66c-e	1.54de	1.42e	1.63C	2.13b-d	1.94c-e	1.86de	1.77e	1.69f	1.88B
	Hybrid 4	2.19a	1.80b-d	1.75cd	1.60c-e	1.49e	1.77AB	2.44a	2.01b-d	1.91c-e	1.83de	1.76e	1.99A
	Hybrid 5	2.32a	1.89bc	1.76b-d	1.65c-e	1.53de	1.83A	2.41ab	2.02b-d	1.92c-e	1.85de	1.76e	1.99A
	Mean	2.11A	1.81B	1.70BC	1.58C	1.47D		2.34A	2.00B	1.89BC	1.80D	1.74D	

*Means having the same letter (s) in a column or line are not significantly different at 5% level

*Capital letters refer to the effect of main factor while small one refers to the interaction effect between factors.

Moreover, hybrid No.5 with 500ppm reached 1.86 & 1.91 for N% and 1.89 & 2.02 for K% in 1st and 2nd seasons respectively. Data showed that hybrid No.4 was same as hybrid No.5 with slightly differences in both seasons. On the other hand, hybrid No.3 recorded the lowest significant values of both minerals (1.23 & 1.46 for N% and 1.42 & 1.69 for K %) in both seasons.

Data in **Table 5** showed that, the high salinity level gives the lowest P% while the low salinity level (control) reached the highest concentration of P% in both seasons. It also clear that there was a slightly differences between hybrids in the 1st season while there was no differences in the 2nd one. As for the interaction between the two factors on P% concentration, data cleared that with low salinity concentration hybrids No. 1, 2, 4 and 5 recorded the highest significant value of P%, while hybrid No.3 was the least hybrid with all salinity concentration.

3.5 Effect of various water salinity levels on magnesium content (g/100g dry weight), leaf Iron and manganese content (ppm) of new almond ×peach hybrid rootstocks

Table 6 showed the effect of various water salinity levels on Mg %, Fe and Mn (ppm) of the new hybrid rootstocks on the two seasons. Data took the same trend as well as the previous measurements. The highest significant values were recorded in either the lowest salt concentration or hybrids No.5 and No.4 while the high salinity treatment and hybrid No.3 was the least hybrid in this respect.

As for the effect of salt concentration, data cleared that the control plants exhibited the highest significant values in both seasons (0.49 &0.44 for Mg%, 201.82 & 186.7 ppm for Fe and 82.2 &75.4 ppm for Mn). The opposite view was true with the high concentration (2000 ppm) (0.30& 0.20 for Mg%, 129.1 & 118.34 ppm for Fe and46.6 for Mn in 1st and 2nd seasons respectively).

Hybrids were greatly affected by different salt concentration. It is clear that hybrid No.5 recorded the highest significant values (0.41 & 0.35 for Mg%, 174.22 & 160.08 ppm for Fe and for Mn 67.6 & 63.8 ppm) as well as hybrid No.4 (0.40 & 0.34 for Mg%, 169.84 & 156.76ppm for Fe and 65.0 & 61.2 ppm for Mn) for both seasons. While hybrid No.3 was the least hybrid in both seasons (0.37 & 0.30 for Mg%, 157.8 & 145.8 ppm for Fe and for Mn 60.6 & 58.0 ppm).

Interaction values cleared that hybrid No.5 irrigated with tap water (control) gained the highest significant values (0.51 & 0.47 for Mg%, 212.9 & 195.1 ppm for Fe and 86.0 &79.0ppm for Mn). On the opposite hybrid No.3 under high salinity concentration (2000 ppm) got the lowest significant values (0.28 & 0.18 for Mg%, 121.0 & 113.2 ppm for Fe and for Mn 44.0 &46.0 ppm) in both seasons respectively.

3.6 Effect of various water salinity levels on Na and Cl content (ppm) of new almond×peach hybrid rootstocks

Leaf Na and Cl concentration are important indicator minerals to be noticed for the effect of salinity experiments, data in **Table 7** cleared that the Na concentration of the different hybrids increased significantly at the high salinity level as well as Cl concentration.

Regardless the effect of different salinity levels, data cleared that control treatment of salinity reached the lowest significant values of Na (2.70 & 2.63) and Cl (0.34& 0.33) in 1st season and 2nd season respectively. On the opposite 2000ppm recorded the highest significant values of both minerals (6.54& 6.84 for Na and 2.67& 2.64 for Cl in both seasons respectively).

As for the hybrid type effect on Na and Cl concentration, data showed that hybrid No.5 reached the lowest significant value of Na (4.16 & 4.01) and Cl (1.29 & 1.28), while hybrid No.1 got the highest significant one (4.67 & 4.90 for Na and 1.59&1.49 for Cl) in both seasons respectively.

Table 6. Effect of various water salinity levels on magnesium content (g/100g dry.wt), leaf Iron and manganese content (ppm) of new almond ×peach hybrid rootstocks

Salinity levels (ppm)		1st season					Mean	2nd season					Mean
		Control	500	1000	1500	2000		Control	500	1000	1500	2000	
Mg%	Hybrid 1	0.48ab	0.42b-d	0.40b-d	0.32e-g	0.29g	0.38B	0.45ab	0.36cd	0.30d-f	0.24fg	0.20g	0.31B
	Hybrid 2	0.47ab	0.44a-c	0.39c-e	0.34e-g	0.28g	0.39AB	0.42ab	0.37bc	0.30d-f	0.25fg	0.18g	0.31B
	Hybrid 3	0.46ab	0.42b-d	0.37d-f	0.33e-g	0.28g	0.37B	0.41a-c	0.36cd	0.30d-f	0.24fg	0.18g	0.30B
	Hybrid 4	0.51a	0.42b-d	0.41b-d	0.33e-g	0.31fg	0.40A	0.46a	0.39bc	0.34c-e	0.28ef	0.20g	0.34A
	Hybrid 5	0.51a	0.45a-c	0.4b-d1	0.35d-f	0.32e-g	0.41A	0.47a	0.40a-c	0.35cd	0.28ef	0.23fg	0.35A
	Mean	0.49A	0.43AB	0.40B	0.34C	0.30C		0.44A	0.38A	0.32B	0.26B	0.20C	
Fe (ppm)	Hybrid 1	200.3ab	187.4b-d	167.8e	145.1fg	128.5gh	165.82AB	183.2ab	169.6b-d	150.3ef	140.2fg	117.9i	152.24B
	Hybrid 2	196.1a-c	183.5cd	166.3e	142.5fg	126.6gh	163.00BC	185.8ab	168.1b-d	153.3ef	131.7gh	113.4i	150.46BC
	Hybrid 3	194.6a-c	176.2c-e	157.8ef	139.4f-h	121.0h	157.8C	178.6a-c	162.2c-e	145.8e-g	129.4gh	113.2i	145.84D
	Hybrid 4	205.2a-b	189.9b-d	173.2de	146.6f-g	134.3gh	169.84AB	190.8a	172.2b-d	159.5de	140.9fg	120.4hi	156.76AB
	Hybrid 5	212.9a	192.2a-c	174.6de	156.3ef	135.1gh	174.22A	195.1a	175.3bc	160.9de	142.3fg	126.8hi	160.08A
	Mean	201.82A	185.84A	167.94B	145.98C	129.1D		186.7A	169.48AB	153.96B	136.9C	118.34D	
Mn(ppm)	Hybrid 1	80.0ab	75.0b-d	60.0fg	55.0gh	47.0i	63.4BC	76.0ab	68.0c	63.0cd	51.0fg	47.0g	61.0AB
	Hybrid 2	82.0ab	73.0cd	61.0fg	52.0hi	45.0i	62.6C	74.0ab	69.0bc	60.0de	49.0fg	46.0g	59.6B
	Hybrid 3	79.0a-c	72.0cd	58.0fg	50.0hi	44.0j	60.6C	70.0bc	68.0c	57.0de	49.0fg	46.0g	58.0B
	Hybrid 4	84.0a	75.0b-d	64.0ef	54.0gh	48.0i	65.0AB	78.0a	67.0c	65.0cd	50.0fg	46.0g	61.2AB
	Hybrid 5	86.0a	77.0bc	70.0cd	56.0gh	49.0hi	67.6A	79.0a	70.0bc	67.0c	55.0ef	48.0fg	63.8A
	Mean	82.2A	74.4B	62.6C	53.4D	46.6E		75.4A	68.4AB	62.4B	50.8C	46.6C	

*Means having the same letter (s) in a column or line are not significantly different at 5% level

*Capital letters refer to the effect of main factor while small one refer to the interaction effect between factors

Table 7. Effect of various water salinity levels on Na and Cl content (ppm) of new almond ×peach hybrid rootstocks

Salinity levels (ppm)		1st season					Mean	2nd season					Mean
		Control	500	1000	1500	2000		Control	500	1000	1500	2000	
Na (ppm)	Hybrid 1	2.64i	3.41g-i	4.56ef	5.84b-d	6.92a	4.67A	2.65j	3.36h-j	4.76fg	6.30bc	7.42a	4.90A
	Hybrid 2	2.58i	3.26g-i	4.45e-g	5.51cd	6.77ab	4.51AB	2.57j	3.21ij	4.12f-h	5.84c-e	7.14ab	4.58B
	Hybrid 3	2.76i	3.56g-i	4.11fg	5.21c-e	6.59ab	4.45AB	2.56j	3.07ij	4.35f-h	5.06ef	7.23ab	4.46BC
	Hybrid 4	2.85i	3.07i	4.21e-g	4.96d-f	6.22a-c	4.26BC	2.65j	3.11ij	3.85g-i	5.21d-f	6.25bc	4.21CD
	Hybrid 5	2.66i	3.11hi	3.98f-h	4.82d-f	6.21a-c	4.16C	2.71j	2.85ij	3.51h-j	4.83ef	6.15cd	4.01D
	Mean	2.70D	3.28D	4.26C	5.27B	6.54A		2.63D	3.12D	4.12C	5.45B	6.84A	
Cl (ppm)	Hybrid 1	0.32h	0.92g	1.54ef	2.37bc	2.78ab	1.59A	0.31i	0.71hi	1.32f-h	2.45bc	2.64ab	1.49A
	Hybrid 2	0.29h	0.91g	1.76de	2.16cd	2.94a	1.61A	0.35i	0.89gh	1.56d-f	1.94cd	3.05a	1.56A
	Hybrid 3	0.36h	0.94g	1.63d-f	2.11cd	2.81ab	1.57A	0.31i	0.93gh	1.45ef	2.05cd	2.77ab	1.50A
	Hybrid 4	0.38h	0.71gh	1.17fg	1.96c-e	2.46bc	1.34B	0.31i	0.71hi	1.15f-h	1.85de	2.34bc	1.27B
	Hybrid 5	0.35h	0.76gh	1.21fg	1.81de	2.34bc	1.29B	0.37i	0.69hi	1.11f-h	1.80de	2.42bc	1.28B
	Mean	0.34C	0.81C	1.46B	2.08A	2.67A		0.33D	0.79C	1.32BC	2.02AB	2.64A	

*Means having the same letter (s) in a column or line are not significantly different at 5% level

*Capital letters refer to the effect of main factor while small one refer to the interaction effect between factors

Table 8. Effect of various water salinity levels on proline (Ug/g leaves Dw) and chlorophyll (mg/100g leaves Fw.) of new almond ×peach hybrids rootstocks

Salinity levels (ppm)		1st season					Mean	2nd season					Mean
		Control	500	100	1500	2000		Control	500	1000	1500	2000	
Proline (Ug/gleaves D.wt)	Hybrid 1	32.00j	39.00g-i	47.00ef	55.00cd	63.00ab	47.20B	41.00h	48.00g	58.00ef	62.00de	74.00ab	56.60BC
	Hybrid 2	36.00ij	43.00f-h	50.00de	59.00bc	67.00a	51.00A	41.00h	52.00g	60.00de	70.00bc	79.00a	60.40B
	Hybrid 3	35.00ij	40.00g-i	49.00d-f	55.00cd	65.00ab	48.80AB	40.00h	50.00g	59.00d-f	65.00cd	79.00a	63.25A
	Hybrid 4	33.00j	38.00h-j	48.00ef	53.00de	60.00bc	46.40BC	37.00h	48.00g	54.00fg	64.00cd	76.00ab	55.80C
	Hybrid 5	29.00j	36.60ij	44.20fg	51.80de	59.40bc	44.20C	33.00i	42.60h	52.20g	61.80de	71.40b	52.20D
	Mean	33.00D	39.32C	47.64B	54.76B	62.88A		38.4E	48.12D	56.64C	64.56B	75.88A	
Chlorophyll (mg/100g leaves F.wt)	Hybrid 1	1.10ab	1.08ab	0.95d-f	0.85gh	0.69j	0.94B	0.95a	0.86c	0.77d	0.64fg	0.49i	0.74B
	Hybrid 2	1.11ab	1.07bc	0.94ef	0.86g	0.74ij	0.94B	0.92ab	0.84c	0.75de	0.59gh	0.43j	0.71C
	Hybrid 3	1.10ab	1.03c	0.91fg	0.81h	0.69j	0.91C	0.93ab	0.83c	0.70ef	0.54hi	0.42j	0.69C
	Hybrid 4	1.12a	1.09ab	0.98d	0.87g	0.75ij	0.96AB	0.95a	0.87bc	0.82cd	0.64fg	0.51i	0.76A
	Hybrid 5	1.13a	1.10ab	1.01cd	0.89fg	0.77hi	0.98A	0.97a	0.88bc	0.83c	0.68f	0.54hi	0.78A
	Mean	1.12A	1.08A	0.96B	0.86C	0.73D		0.94A	0.86B	0.77C	0.62D	0.48E	

*Means having the same letter (s) in a column or line are not significantly different at 5% level
**Capital letters refer to the effect of main factor,while small one refer to the interaction effect between factors

Moreover the interaction between the two factors, It was noticed that hybrid No.5 with 2000ppm reached the highest significant value of Na (6.21&6.15) and Cl (2.34&2.42 as well as hybrid No.4 with a slightly differences. While hybrid No.2 recorded the lowest significant values of both minerals with control, it got 2.58&2.57for Na and 0.29 for the 1nd season as well as hybrids No.1, 3 and 4 in the 2nd season (0.31).

These results in agreement with those of Jalil et al 2012 who mentioned significant increasing in mineral concentration (Mg^{+2}, Cl^{-} and Na^{+}) in the leaf of almond genotypes, while K^{+} concentrations was not affected because of salinity.

3.7 Effect of various water salinity levels on proline (Ug/g leaves Dw) and chlorophyll (mg/100g leaves Fw.) of new almond ×peach hybrids rootstocks

It is quite evident from data in **Table 8** that high salinity level had negative effect on chlorophyll concentration while proline concentration was increased under high salinity level. Moreover the different genotypes of rootstocks showed different response to salinity but overall hybrid No.5was the superior one in this respect.

Data in **Table 8** reveals obviously the effect of salinity level on proline and chlorophyll, data cleared that high level of salinity recorded the highest significant value of proline (62.88 & 75.88) and the lowest content level of chlorophyll (0.73 & 0.48) in both seasons respectively. On the other hand the control treatment recorded the lowest significant values of proline (33.00& 38.4) and the highest significant values of chlorophyll (1.12 & 0.94) in 2018 and 2019.

Regardless the effect of salinity on different hybrids, hybrid No.3 recorded the highest significant values of proline (48.80 & 63.25) and lowest significant values of chlorophyll (0.91 & 0.69) in the 1st and 2nd season respectively. While hybrid No.5 recorded the opposite in both season for proline (44.20 & 52.20) and for chlorophyll (0.98 & 0.78) as well as hybrid No. 4 which recorded (46.40 & 55.8 for proline and 0.96 & 0.76 for chlorophyll) in both seasons.

The interaction values cleared that under high salinity (2000 ppm) hybrid No.5 recorded the lowest significant values of proline (59.40 & 71.41) and the highest significant values of chlorophyll (0.77 & 0.54) with slightly differences with hybrid No.4. On the other hand under the same salinity level, hybrid No.3 recorded the highest significant values of proline (65.00 & 79.00) and the lowest significant values of chlorophyll (0.69 & 0.42) for both seasons respectively.

The previous results in agreement with Jalil et al 2012 who cleared that increasing salinity level significantly increase leaf proline contents in almond genotypes. Jalil et al 2012 mentioned that significantly reduction in chlorophyll (a, b, total and index) contents of leaves were recorded by increasing salinity level.

4 Conclusion

From the obtained data in this research was clear that hybrid No.5 was the most tolerance hybrid as a rootstock to salinity stress. The highest salinity concentration reduced its growth parameters by about 40% for seedling stem diameter, height, number of leaves, buds and leaf area, reduced fresh weight by 20%and dry one by 25%, chlorophyll content by 30%. On the other hand it decreased proline concentration by 80% and sodium concentration to three fold while chloride to seven folds. From the above data it could be recommended for using hybrid number5 or number4 under high salinity condition (2000 ppm) as a promising rootstocks to face salinity injuries.

References

A.O.A.C (2000) Association of Official Analytical Chemists. Official methods of analysis 17th Ed., Washington, D.C. USA pp 495-510.

Bates, LS; Waldren, RP; Teare, ID (1973) Rapid determination of free proline for water stress studies. *Plant Soil* 39, 205–207.

Brandifeld, EG; Spincer, D (1965) Leaf analysis as guide to nutrition of plant crop. IV Determination of magnesium, zenk, iron and copper by atomic absorption spectroscopy. *Proc. Amer. Soci. Hort Sci* 61, 49-55.

Byrt, CS; Munns, R (2008) Living with salinity. *New Phytol* 179, 903–905.

Cottenie, A (1980) Soils and plant testing as a basis of fertilizer recommendation. *FAO Soil Bull* 38, 2.

El-Motaium, RH; Brown, PH (1994) The relative tolerance of six Prunus rootstocks to boron and salinity. *Am Soc Hort Sci* USA 119, 1169-1175.

Evenhuis, B (1978) Simplified Methods for Foliar Analysis." Koninklijk" Institaut Voorde Tropen, Amsterdam pp 1-17.

FAO. (2002) Crops and drops. Making the best use of water for agriculture. Food and Agriculture Organization of the United Nations, Rome, Italy pp 1-22.

Hassan, MM; El-Azayem, AIA (1990) Differences in salt tolerance of some fruit species. *Egyptian J Hortic* 17, 1-8.

Higinbotham, N; Etherton, B; Foster, RJ (1967) Mineral ion contents and cell trans membrane electropotential of Pea and Oat seedling tissue. *Plant Physoil* 42, 37-46.

Jackson, N. L. 1967. Soil Chemical Analysis. Prentice. Hall Inc. Englewood Cliffs, New Jersy pp 1-498.

Jalil, D; Naser, A; Mehrshad, Z; Mehdi, RN; Eslam, MH (2012) Evaluation of salt tolerance in almond [*Prunus dulcis* (L.) Batsch] rootstocks. *African Journal of Biotech* 11, 11907-11912.

Kotuby, AJ; Koenig, R; Kitchen, B (2000) Salinity and plant tolerance. Utah State University Extension, AG-SO 3, 1-8.

Massai, R; Gucci, R (1998) Salinity tolerance in four different rootstocks for peach. *Acta Hort* 465, 363–369.

Murphy, J; Riley, JP (1962) A modified single solution method for the determination of phosphate in natural waters. *Anal Chim Acta* 27, 31-36.

Najafian, S; Rahemi, M; Travallali, V (2008) Effect of Salinity on Tolerance of Two Bitter Almond Rootstocks. *American-Eurasian J Agric Environ Sci* 3, 264–268.

Noitsakis, B; Dimassi, K; Therios, I (1997) Effects of NaCl induced salinity on growth, chemical composition and water relations of two almond (*Prunus amygdalus* B.) cultivars and the hybrid GF677 (*Prunus amygdalus* × *P. persica*). *Acta Hortic* 449, 641-648.

Pilar, A; Arancha, A; Pilar, L; Juan, AM (2011) Early detection of salt stress tolerance of *Prunus* rootstocks by excised root culture. *Hortscience* 46, 80-85.

Pipper, CS (1950) Soil and plant analysis. *Inter Sci Pub*, New York, USA, pp 368.

Richards, LA (1954) Diagnosis and improvement of saline and alkali soils. Agriculture Handbook No. 60. USDA, Washington DC, pp 1-3.

Saric, M; Kastrori, R; Curie, R; Cupina, T; Gerie, I (1976) Chlorophyll determination. Univ. Unoven sadu parktikum is fiziologize bibjoke, Beagard, Hauncna, Aniga, pp. 215.

Snedecor, GW; Cochran,WG (1980) Statistical Methods. 6th Ed. The Iowa State Univ., Press, Ames., Iowa, USA.

Soliman, GhM (2014) Production of some new peach rootstock by hybridization and tissue culture technique. Ph.D: in Agriculture Science, Agricultural Pomology Dept, Fac of Agric, Ain Shams University pp. 1-132.

Tilbrook, J; Roy, S (2014) Salinity tolerance. In Plant Abiotic Stress, 2nd ed. Wiley-Blackwell, New York, USA pp. 134–178.

Tounekti, T; Abreu, ME; Khemira, H; Munné_Bosch, S (2012) Canopy position determines the photopro-tective demand and antioxidant protection of leaves in salt stressed *Salvia officinalis* L. plants, *Environ Exp Bot* 78, 146–156.

Zrig, A; Ben MH; Tounekti, T; Khemira, H; Serrano, M; Valero,D ;Vadel, AM (2016) Effect of rootstock on salinity tolerance of sweet almond cv. Mazzetto. *South African Journal of Botany* 102, 50–59.

Zhang,IP; Masateru, S; Yanyan, D (2016) Effects of salinity stress on growth, yield, fruit quality and water use efficiency of tomato under hydroponics system. *Agricultural Science* 4, 46-55.

مجلة اتحاد الجامعات العربية للعلوم الزراعية، جامعة عين شمس، القاهرة، مصر
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436
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تقييم تحمل الملوحة في أصول مختارة من هجن جديدة من اللوز × الخوخ

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الهدف الرئيسي من هذه التجربة هو تقييم تحمل خمسة أصول هجن جديدة من اللوز× الخوخ للملوحة بدراسة مقاييس النمو الخضرى والكيميائي لهم بهدف التوصية بالاستخدام التجاري لهذه الاصول في المشاتل. وقد أجريت هذه التجربة في معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر. خلال موسمين متتاليين (2018–2019 و 2019–2020). وشملت الأصول المختارة لهذه الدراسة أصول جديدة من اللوز× الخوخ المقاومة للنيماتودا. واشتملت التجربة أربعة مستويات من كلوريد الصوديوم بتركيزات 500، 1000، 1500، 2000 جزء في المليون الي جانب المقارنة (خمسة معاملات). أوضحت النتائج أن زيادة تركيز الملوحة أدى إلى الحد من جميع مؤشرات النمو وتشمل قطر جذع الشتلات، وارتفاعها، متوسط عدد الأوراق وعدد البراعم لكل شتلة، مساحة الورقة، الوزن الطازج والجاف. كما أدى تركيز الملوحة المرتفع الي النقص التدريجيا لتركيز المعادن مثل N، P، K، Mg، Fe، Mn جزء فى المليون وعلاوة على ذلك كان هناك اختلافات بين الأصول في تحمل الملوحة. حيث كان هجين رقم 5 أكثر الهجن المقاومة للتركيز العالى من الملوحة يتبعه هجين رقم 4. بينما كان هجين رقم 3 أقل الهجن مقاومة لارتفاع تركيز الملوحة. وسجل الهجين رقم 5 القيم المرتفعة لقياسات النمو وتقاسم مع الهجين رقم 4 أعلى قيم N وK و %P وأعلى مستوى من Fe, Mn, Na وCl وأخذت قيم الكلوروفيل نفس الاتجاه مع اختلافات طفيفة مع الهجين رقم 4. وكان الهجين رقم 3 أقل هجين في جميع القياسات باستثناء تركيز البرولين الذي سجل فيه أعلى قيمة. وعليه يمكن التوصية تحت ظروف هذه الجربة باستخدام أصل الهجين رقم5 والهجين رقم4 للزراعة تحت ظروف التركيزات العالية من الملوحة بالتجربة.