Response of Vegetative Growth of Some Mango Seedling Clones to Salinity

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Abstract: The present study was carried out during the two successive seasons of 2013 to 2015 in a private nursery at Kafr El Sheikh Governorate, Egypt on Succary Abiad mango cultivar and four polyemberyonic unknown mango genotypes grown in Ismailia and Suez Governorates. The trees were 10-15 years old and grown under high salinity stress. One tree from each region was selected and labeled to be the source of seeds each season. Seeds were freshly extracted from ripen fruits then sowed in polyethylene bags during August. The seedling received the recommended agricultural practices from august to April. At the first of May, the seedlings were treated with different concentrations of sodium chloride till the end of August. Data showed that the vegetative growth (plant height, leaves number and area, stem thickness, roots number, fresh weight and dry weight). Data indicated that clone 3 is the best rootstock followed by Succary Abiad cv., clone 2 and clone 1 while clone 4 is the most sensitive to salinity.
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1. Introduction:

Mango (*Mangifera Indicia L*) is considered one of the most important fruit crop in tropical and subtropical areas of the world which is known as the "King of tropical fruits ". Major producers include India, Pakistan, Brazil, Australia, South Africa, Egypt and USA. **(Ploetz *et al.* 2002)**. Mango expanded through out Egypt. It ranks second after citrus. The leading producing Governorates in Egypt are Ismailia, Sharkia, Giza, Fayoum, Behiera and Qalubia. The total planted area of mango in Egypt reached 240804 fed, according to the **Ministry of Agricultures Egypt (2014)**. Several factors affect the productivity of mango trees, i.e. rootstocks and salinity. Salinity is one of the most brutal environmental factors limiting the productivity of crop plants because most of the crop plants are sensitive to salinity which caused by high concentrations of salts in the soil or irrigation water, The area of land affected by salinity was increased day by day. For all-important crops, drought and high salinity reduced yields between 20% and 50%; (**Shannon, 1998, Shrivastava and Kumar, 2015).** In Egypt approximately 2.1 million fed. suffer from salinization problems in the cultivated areas. Furthermore, 60% of the cultivated lands in the Northern Delta, 20% of the Southern Delta and Middle of the Upper Egypt regions are all salt affected (**Abdel-Hafez, 2011)**. According to the world water crisis, Egypt will suffer from water shortage in next decades, so water quality such as saline water is needed as an alternative for irrigation **(Yassin, 2005).** Many authors were interested in exploring the mechanism of salt injury in different plants. **Bernistein (1975)** and **Miller *et al.*, (1990)** explained the adverse effects of salinity on plants growth in the following two topics:

The increase in osmotic potential of the soil, which certainly result in reduction in the availability of water to the plants (water stress).

The specific toxic effect of some ions, such as Cl^-, Na^+ and especially in the certain sensitive crops, consequently caused a disturbance in the normal metabolism of plants. In addition, mango is considered sensitive to saline conditions, leading to scorched leaf tips and margins, leaf curling, and in sever cases reduces growth, abscission of leaves and death of trees **(Mass, 1986)**. Another important factor influencing fruit trees productivity is rootstocks **(Giacobbo, 2008)**. Most fruit trees are commonly propagated on rootstocks, rather than begin grown on their own roots. The selection of a suitable rootstock is a significant economic factor in fruit culture **(Wheaton *et al.*, 1991).** Using the rootstocks showed significant growth and scion contents of nutrient elements **(Ma *et al.*, 2005 and Robbani *et al.*, 2006)** are important factors in the salt tolerance of fruit crops, which are sensitive to salinity and susceptible to toxic effects of Na and Cl **(Mass and Hoffman, 1977).** So, the present investigation was undertaken to study the salinity tolerance of some mango seedlings clones, used as rootstocks in the new explanted area which suffer from salinity problem in its soil or irrigation water.

2. Materials and Methods:

The present study was carried out during the successive seasons of 2013/2014 and 2014/2015 in a private nursery at Kafr El-Sheikh Governorate, Egypt to evaluate the tolerance of some mango seedlings clones to salt stress, using sodium chloride. In this study Succary Abiad mango cultivar and four mango

seedlings clones (seedily unknown cultivars) were selected from private orchards at Ismailia and Suez Governorates. The trees were 10-15 years old and grown under salinity stress. Fruits were harvested on August. All selected trees were polyemperyonic. One tree from each region was selected to be the source of seeds in each season of this study.

Seeds were freshly extracted from ripen fruits and washed with tap water, planted at the end of Augusts into polyethylene bags (35 × 20 cm) filled with mixture of sand and peat moss (2: 1 v/v). Sand was washed to remove salts. Each bag contained one seed.

One month old healthy seedlings with greenish leaves and nearly uniform in growth vigor were used. The seedlings received the recommended agricultural practices fertilization and pest diseases control. In each bag, one seedling was left and the others including the sexual seedlings were removed.

The experiment was designed as split plot complete randomized blocks as follow.

A- Four selected clones along with control (Succary Abiad) were allocated in the main plot as follows.

1- Succary Abiad commercial rootstock from Ismailia region.

2- Clone 1 and Clone 4 were collected from the labeled tree at Suez region.

3- Clone 2 and Clone 3 were collected from the labeled tree at Abousoair (Ismailia region).

The different clones were Unknown varieties (Seedly mango).

B. Seven concentrations of saline irrigation water were allocated in subplots as follows: (0.0, 500, 1000, 1500, 2000, 2500 and 3000 mg/l Na Cl).

Seedlings were treated by the different concentrations of sodium chloride started from the first week of May to end of August; the seedlings were treated every week with 3 times with different concentrations solution of Na Cl through May to the end of August. (It was keeping the mixture over field capacity).

The experiment comprised 35 treatments (5 rootstocks x 7 salinity levels, each treatment was replicated three times with 3 seedlings per replicate.

The Following measurements were carried out:

1- Vegetative growth:

{Seedling height (cm), Number of leaves per plant, Leaf area (cm^2). according to **Ahmed and Morsy (1999),** 4-Foliage area ($cm^{2)}$, Stem diameter (cm), Fresh weight / plant (g), and Dry weight /plant (g)}.

2- Root measurements:

{Root length (cm), Number of root per plant, Root fresh weight (g), and Root dry weight (g)}.

3-Statistical analysis:

Data recorded in all seasons were subjected to analysis of variance according to **Snedecor and Cochran** (**1980**) and L.S.D test was used to differentiate means using the **MSTAT-C** statistical Package **(MSTAT-C, 1990)**.

3. Results and Discussion:

1-Vegetative growth:

1-1 Increment in plant height.

At the beginning of salinity treatments, the seedlings were not similar in their vigor, so the plant height was measured as percentage of plant height increment during the period of salinity treatments. Data in Table (1) show that in the first season Succary Abiad cv. and clone 4 seedlings appeared significant increase in their plant height within the low concentration (500 mg/l) of Na Cl. This could be due to that Na is one of the beneficial nutrient elements at the low concentration. With increasing the Na Cl concentration higher than 500 mg/l the seedlings of Succary Abiad cv. and those of the four clones showed obvious reduction in their plant height. The reduction increased as salinity concentrations increased. The increments in plant height of Succary Abiad cv. seedlings and those of clone 1, 2 and 3 were much closed with non significant differences. Among them the seedlings of clone 4 appeared the lowest plant height with significant differences compared to Succary Abiad cv. or any of the other three clones. In the second season, approximately similar trend was noticed although the increases of plant height within the low Na Cl concentration were observed with clones 2 and 3 only. Also the plant height increment of clone 4 seedlings showed no significant differences with Succary Abiad cv. Seedlings or the other clones except clone 2 seedlings. Seedlings or the other clones except clone 2 seedlings. The reduction in plant height as salinity increased could be due to the inhibitive effect of salinity on chlorophyll content (Table 12) which affected directly on the photosynthesis process and metabolism of new tissues moreover salinity inhibitive effects on cell division and cell size.

As for the effect of interaction between seedling genotypes and salinity concentration, data show that the highest increments in plant height were observed within the seedlings irrigated with normal water (control) and those irrigated with the lowest concentration of sailings (500 mg/l). The lowest increments for this parameter were noticed in the seedlings subjected to the highest Na Cl concentration (3000 mg/l). The obtained results in our study are in agreement with those reported by **Abd El Karim (1991), Wahdan (2004), Mohamed (2008), Pravana et al (2014)** on mango and **Demiral (2005), Hassan (2005) and Kchaou et al (2010)** on olive.

Table (1): Effect of irrigation water salinity on increment of plant height (%) of some mango seedling clones in 2014 and 2015 seasons.

Conc.		Clones of Mango, Increment on Plant height (%)					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	34.0	35.0	52.3	35.1	27.0	36.7
	500	42.4	39.4	41.8	28.2	43.2	39.0
	1000	25.9	18.1	38.8	42.2	26.0	30.2
	1500	28.4	40.8	24.3	17.8	18.9	26.0
	2000	30.8	41.2	20.6	19.8	12.3	24.9
	2500	26.5	34.2	16.7	24.9	4.7	21.4
	3000	21.6	7.9	21.0	19.0	11.1	16.1
	Average	30.0	30.9	30.8	26.7	20.5	
LSD at 5% for clones				4.44			
LSD at 5% for Conc.				5.78			
LSD at 5% for interaction				12.93			
2015	Control	33.8	34.9	19.4	17.3	29.6	37.0
	500	26.1	32.6	29.8	39.3	30.9	31.7
	1000	18.1	27.0	35.3	32.8	33.3	29.3
	1500	18.4	44.2	29.5	15.4	21.8	25.9
	2000	14.1	25.4	32.8	29.4	14.9	23.3
	2500	21.4	27.7	21.6	20.5	17.4	21.7
	3000	29.2	17.7	25.3	17.6	5.8	19.1
	Average	23.0	29.9	27.7	24.6	22.0	
LSD at 5% for clones				7.04			
LSD at 5% for Conc.				6.35			
LSD at 5% for interaction				14.23			

1-2- Leaves number:

Table (2) illustrate the effect of genotypes and salinity concentration on the number of leaves per plant. Data show that in the first season, clone 4 appeared the highest number of leaves per plant followed by clone 3, clone 2 clone 1 and Succary Abiad cv. As for the effect of salinity on this parameter, data reveal that the increase in salinity concentrations decreased the number of leaves per plant In the second season data showed that clone 3 gave the highest number of leaves per plant followed by clone 4, clone 2, clone 1 and the Succary Abiad cv. salinity concentrations gave similar trend like that of the first season. The interaction effect of seedling genotypes and salinity concentrations, Table (2) and Fig (3-4) showed that in the first season clone 4 irrigated with normal water (control) gave the highest leaves number per plant followed by clone 4 irrigated with 1000 mg/l saline water. The lowest values obtained by clone 1 x saline water at 2000 mg/l followed by Succary Abiad cv. X 2500 or 3000 mg/l Na Cl. In the second season, clone 3 irrigated with normal water (control) gave the highest number of leaves per plant followed by clone 3 subjected to 500 mg/l saline water. The lower values recorded by Succary Abiad cv. and clone 1 under irrigation with 3000mg/l Na Cl water.

1-3-Leaf area:

Data in Table (3) show that in the first season, Succary Abiad cv. clone 2 and clone 1 appeared the highest values of leaf area followed by clone 3 then clone 4. The differences among Succary Abiad, clone 2 and clone 1 were not significant. Leaf area for clone 4 showed the lowest value with significant differences as compared to each of Succary Abiad cv., or Clone 1 or clone 2. The second season revealed that the clone 2 gave the height value then clone 1 and Succary Abiad cv. The Na Cl concentration in the irrigation water showed no significant effect on the leaf area in both seasons of study. Also the indications among seedling genotypes and Na Cl concentrations had no significant differences during the two seasons of study. among seedling genotypes and Na Cl concentrations had no significant differences during the two seasons of study.

1-4-Foliage area:

Data in Table (4) show that in the first season, the foliage area was the highest with clone 2 (1230.4 cm2 / plant) followed by clone 1 (1188.3), clone 3, Succary Abiad cv. then clone 4. The differences among all seedling genotypes were not significant. The second season showed similar trend but the differences were significant among clone 2 and each of the Succary Abiad cv. clone 3 and clone 4. Also clone 4 gave the lowest value of foliage area (1019.2) with significant differences among it and each of the other four genotypes. The salinity concentrations affected the foliage area; the increase in salinity concentrations decreased the foliage area.

Table (2): Effect of irrigation water salinity on leaves number/plant of some mango seedling clones in 2014 and 2015 seasons.

Conc.		Clones of Mango, Leaves number/plant					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	29.4	20.9	26.7	29.5	36.7	30.2
	500	24.4	25.2	28.0	28.2	25.1	28.1
	1000	27.3	28.6	26.4	29.2	31.2	25.3
	1500	18.9	25.2	25.9	30.2	26.2	25.3
	2000	19.3	18.0	25.0	26.8	29.4	23.7
	2500	18.2	26.6	22.8	25.8	24.7	23.6
	3000	18.1	22.9	20.8	22.3	24.5	24.7
	Average	22.2	25.0	25.1	27.4	29.8	
LSD at 5% for clones				1.313			
LSD at 5% for Conc.				2.203			
LSD at 5% for interaction				2.207			
2015	Control	26.0	25.9	32.6	38.0	27.00	29.9
	500	22.6	30.4	23.4	35.6	33.6	29.1
	1000	25.3	22.9	26.7	34.5	28.3	29.0
	1500	24.1	25.9	23.3	33.9	27.1	26.3
	2000	19.0	23.6	25.4	31.7	19.6	23.8
	2500	20.3	19.3	21.4	21.5	21.3	20.8
	3000	15.8	15.8	24.6	27.10	23.7	21.4
	Average	21.9	24.3	25.3	31.5	25.8	
LSD at 5% for clones				1.337			
LSD at 5% for Conc.				2.059			
LSD at 5% for interaction				2.059			

Table (3): Effect of irrigation water salinity on leaf area (cm^2) of some mango seedling clones in 2014 and 2015 seasons.

Conc.		Clones of mango, Leaf area (cm^2)					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	52.10	41.66	45.62	51.31	39.30	46.08
	500	45.81	48.96	59.39	36.24	38.58	45.74
	1000	33.79	46.78	37.23	41.39	31.58	38.19
	1500	58.01	43.46	46.89	39.58	32.47	45.00
	2000	54.30	64.52	41.18	48.43	42.27	5.14
	2500	73.43	46.19	54.23	41.61	27.36	48.53
	3000	49.72	44.69	60.93	38.34	25.52	43.88
	Average	52.50	48.04	49.35	42.44	34.64	
LSD at 5% for clones				8.413			
LSD at 5% for Conc.				NS			
LSD at 5% for interaction				NS			
2015	Control	83.61	78.35	68.68	42.62	34.74	60.41
	500	58.55	75.99	69.38	45.10	41.51	58.11
	1000	69.23	57.00	68.87	46.22	50.10	58.28
	1500	59.43	77.49	75.14	53.18	37.07	59.86
	2000	64.26	60.25	62.24	31.88	44.28	52.58
	2500	57.88	56.40	58.50	44.42	31.03	49.65
	3000	50.14	56.66	75.34	50.78	32.25	53.03
	Average	63.30	64.73	68.31	44.88	38.72	
LSD at 5% for clones				7.627			
LSD at 5% for Conc.				NS			
LSD at 5% for interaction				NS			

In the first season, the foliage area per plant decreased without significant differences with increasing Na Cl in the irrigation water from 0.0 up to 2000 mg/l. The higher concentrations (2500 and 3000 mg/l) showed significant decreasing. In the second season, a similar trend was found with higher values than those in the first season. The interaction effect showed a significant effect and the highest values was

Gained from clone 3 (1549.1 cm2/plant) irrigated with normal water (control) in the first season and from clone2 (2234.3) with control in the second season. The lowest values of this parameter (622.1) was obtained from clone 4 irrigated with 3000 mg/l saline water in the first season and from clone 4 (631.2) irrigated with 2500 mg/l saline water in the second season. The other combination showed in between values. The decrease in the total foliage of the seedling as a result of salinity increased although the leaf area did not affected by salinity increasing was due to the decrease in the leaves number. The obtained results in this study agree with those of **Abd-El-Karim (1991), Ahmed and Ahmed (1997), Morsy (2003), Wahdan (2004), Hafez et al (2011) and Paranava et al. (2014).** All of them recorded significant reduction in total leaf area per plant of mango seedlings with increasing salinity of soluble salts in irrigation water.

Table (4): Effect of irrigation water salinity on foliage area (cm2/plant) of some mango seedling clones in 2014 and 2015 seasons.

Conc.		Clones of mango, Foliage area (cm^2/plant)					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	1533.5	1250.8	1209.1	1549.1	1463.5	1401.2
	500	1113.5	1226.4	1662.9	1020.5	1357.5	1276.2
	1000	932.6	1340.2	980.9	1209.5	1005.6	1093.8
	1500	1079.9	1104.9	1209.6	1194.2	980.4	1113.8
	2000	1096.9	1171.5	1020.5	1300.1	1246.2	1157.1
	2500	1236.0	1225.8	1241.9	1076.6	675.6	1091.3
	3000	913.6	998.8	1287.8	859.2	622.1	936.3
	Average	1122.4	1188.3	1230.4	1172.8	1050.1	
LSD at 5% for clones				NS			
LSD at 5% for Conc.				298.7			
LSD at 5% for interaction				556.1			
2015	Control	2193.7	1876.6	2234.3	1614.4	940.9	1772.0
	500	1329.0	2323.4	1647.1	1617.3	1396.1	1662.6
	1000	1783.4	1692.6	1843.5	1600.3	1444.3	1672.8
	1500	1432.5	1895.1	1737.7	1689.4	1108.1	1572.6
	2000	1200.9	1400.3	1559.0	1010.2	862.3	1208.1
	2500	1194.5	1092.9	1223.3	939.1	631.2	1016.2
	3000	743.0	796.4	1671.5	1372.3	751.5	1067.0
	Average	1412.1	1582.5	1702.3	1406.1	1019.2	
LSD at 5% for clones				254.0			
LSD at 5% for Conc.				273.07			
LSD at 5% for interaction				625.7			

1-5-Stem thickness:

Table (5) illustrate the effect of irrigation with saline water on the increments in seedling stem thickness. Data show that in the first season the increments in stem thickness were much closed and the differences among Succary Abiad cv. and the other four clones were not significant. In the second season, clone 4 showed the highest increment in its stem with significant differences as compared to Succary Abiad cv. or each of clone1 and 2. Concerning salinity concentrations, data showed that the increase in salinity concentrations exhibited significant decrease in the stem thickness as the interaction effect was significant in the two seasons. The highest value of stem thickness increment was resulted from clone 4 irrigated with normal water (control) in the first and second seasons (51.0 %). The lowest values was obtained from combination of clone 4 (3000 mg/l) (11.3 %) in the first season and from combination of clone 1 (2500 mg/l) (13.5%). The decrease in the stem thickness increment as salinity concentrations increased could be due to the inhibitive effect of salinity on the foliage area (Table 4) and this directly reflected on the decreasing photosynthesis products which need for stem increments. The obtained results in this study are in agreement with those of **Morsy (2003), Hafez et al (2011) and Abdel Aal and Oraby (2013),** all of them reported that mango seedling stem diameter was decreased with salinity increase.

1-6- Plant fresh weight

Table (6) show the effect of irrigation with saline water on the plant fresh weight of Succary Abiad cv. and four mango clones. Data reveal that in the first season Succary Abiad cv. register the highest plant fresh weight followed by clone2, clone1 and clone3. The lowest plant fresh weight was resulted from clone 4.

Table (5): Effect of irrigation water salinity on increment of stem thickness (%) of some mango seedling clones in 2014 and 2015 seasons.

conc.		Clones of mango, Increment on stem thickness (%)					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	47.5	41.9	49.8	26.4	51.0	43.3
	500	34.0	31.9	42.6	41.4	37.0	37.4
	1000	25.5	32.8	20.9	20.1	24.3	24.7
	1500	11.5	20.2	22.0	36.7	27.5	23.6
	2000	22.7	22.0	25.3	25.4	27.9	24.7
	2500	22.4	13.8	12.7	22.1	20.5	18.3
	3000	15.3	18.5	32.0	39.6	11.3	23.3
	Average	25.6	25.9	28.3	30.3	28.5	
LSD at 5% for clones				NS			
LSD at 5% for Conc.				9.62			
LSD at 5% for interaction				21.53			
2015	Control	45.6	47.3	38.0	30.91	51.0	42.6
	500	23.6	41.5	24.7	38.8	57.4	37.2
	1000	27.3	34.6	23.6	32.8	36.6	31.0
	1500	24.8	23.8	34.0	36.5	44.6	33.7
	2000	17.6	26.0	20.6	29.1	14.9	21.6
	2500	16.9	13.5	19.4	23.2	18.5	18.3
	3000	15.0	18.9	26.5	21.9	20.5	20.6
	Average	24.4	24.4	26.7	30.4	35.5	
LSD at 5% for clones				6.61			
LSD at 5% for Conc.				6.27			
LSD at 5% for interaction				14.02			

Table (6): Effect of irrigation water salinity on plant fresh weight (g) of some mango seedling clones in 2014 and 2015 seasons.

Conc.		Clones of mango, Plant fresh weight (g)					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	199.8	141.6	130.5	115.5	92.4	135.96
	500	117.3	141.3	108	66.6	87.6	104.16
	1000	116.4	129.9	99.9	68.1	58.5	94.56
	1500	104.4	97.8	119.1	114.9	58.8	99.00
	2000	133.5	91.8	121.8	94.2	51.3	98.52
	2500	110.7	80.7	103.2	94.2	40.8	85.92
	3000	146.4	84.9	118.8	91.5	37.2	95.76
	Average	132.64	109.7	114.4	92.14	60.94	
LSD at 5% for clones				1.2			
LSD at 5% for Conc.				1.007			
LSD at 5% for interaction				2.251			
2015	Control	127.2	147.9	162.3	137.7	87.9	132.52
	500	134.1	136.2	147.3	122.1	76.2	123.18
	1000	135	125.1	133.2	134.7	61.5	117.9
	1500	104.1	131.1	110.1	122.7	85.2	110.64
	2000	125.1	98.1	101.4	92.1	56.7	94.68
	2500	105.9	119.1	123	94.2	60	100.44
	3000	76.8	74.4	93	106.8	57.6	81.72
	Average	115.4	118.8	124.3	115.8	69.3	
LSD at 5% for clones				1.38			
LSD at 5% for Conc.				1.244			
LSD at 5% for interaction				2.805			

The differences among Succary Abiad cv. and the other four clones were significant. In the second season found that clone 2, clone 1, Succary Abiad cv., clone3, and clone 4 were observed with increasing in these parameters for the four clones and Succary Abiad cv. As for the effect of salinity concentrations, data showed

that a noticeable decrease was observed as salinity concentrations increased. This was evident in the two seasons with significant differences among the various concentrations. The interaction effect was significant in the two seasons. The highest value in the first season was obtained from Succary Abiad cv. grown under control irrigation (199.8 g). The lowest value (37.2) was observed with clone 4 under 3000 mg/l salinity. In the second season, the highest value (162.3 g) gave from clone 2 with control irrigation. The lowest value (57.6 g) was found in clone 4 irrigated with 3000 mg/l salinity. The results of this study are in agreement with those reported by **Abdel Karim (1991), Wahdan (2004)** on mango and these of **Cavalcante et al (2005)** on guava and **Hassan (2005)** on olive. All of them found that fresh weight decreased as salinity concentration increased.

1-7- Plant dry weight:

Table (7) indicate the effect of irrigation mango seedlings with different concentrations of saline water on its dry weight at the end of treatments. Data show that in the first season, clones 1 and2 appeared the highest values followed by Succary Abiad cv. and clone3. The clone 4 gave the lowest value with significant differences as compared to the other genotypes. In the second season, clone 2 showed the highest dry weight followed by Succary Abiad cv. clone 1 and clone3. The clone 4 appeared the lowest value. The differences among Succary Abiad cv. or any of the other clones were significant. As for the effect of salinity on seedlings dry weight data show that seedling dry weight decreased as salinity concentrations increased. This was evident in the two seasons of study. The differences were significant among most levels of Na Cl in the two seasons. The decreases in the dry weight are due to the decrease in the fresh weight as previously mentioned. The interaction effects were water (control) and the lowest value (12.4 g) appeared with clone 4 grown under 3000 mg/l salinity. In the second season, significant. In the first season the height value of the seedling dry weight (50.0 g) was obtained from clone3 irrigated with tap clone 2 with control gave the highest value (47.8 g) while clone 4 showed the lowest value when irrigated with 3000 mg/l salinity water. The other combination showed in between values. The obtained results are in agreement with those of **Demral (2005), Melgar et al (2007) and Kchaou et al (2010)** on olive.

Table (7): Effect of irrigation water salinity on plant dry (g) weight of some mango seedling clones in 2014 and 2015 seasons.

Conc.		Clones of mango, Plant dry weight (g)					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	44.1	45.6	40.4	50.0	30.8	42.2
	500	30.0	41.5	43.6	22.0	26.3	32.7
	1000	35.6	48.3	35.3	24.7	19.5	32.7
	1500	26.3	33.1	40.2	38.0	19.6	31.4
	2000	32.0	35.0	36.8	27.6	17.1	29.7
	2500	25.4	34.5	38.6	29.2	13.6	28.3
	3000	38.4	29.8	32.0	25.7	12.4	27.7
	Average	33.1	38.3	38.2	31.0	19.9	
LSD at 5% for clones				0.80			
LSD at 5% for Conc.				0.88			
LSD at 5% for interaction				1.973			
2015	Control	38.1	28.8	47.8	34.7	20.6	34.0
	500	44.1	41.4	45.0	31.3	25.2	37.4
	1000	34.9	41.4	41.2	44.7	19.0	36.2
	1500	31.1	37.1	36.9	32.7	23.1	32.2
	2000	39.8	33.2	36.4	27.9	16.0	30.7
	2500	27.4	28.2	36.7	31.5	13.7	27.5
	3000	20.3	21.4	33.1	22.8	12.4	22.0
	Average	33.7	33.1	39.6	32.2	18.6	
LSD at 5% for clones				0.749			
LSD at 5% for Conc.				0.616			
LSD at 5% for interaction				1.378			

2- Root measurements:

2-1-Root length:

Table (8) show the root length of Succary Abiad cv. and four clones mango seedlings subjected to salinity stress. Data revealed that in the first season, Succary Abiad cv. appeared the highest value of root length followed by clone 2, clone 1 and clone 3 without significant differences among then. The lowest value of

root length was found by clone 4 with significant differences between it and any of the other four genotypes. In the second season, the heights was clone 2, then Succary Abiad cv. clone 1, clone 3 and clone 4 were observed. Salinity concentrations showed no significant effects on root length in the two seasons of study.

The interaction effects were significant in the two seasons. In the first season, the highest root length (27.0 cm) appeared with Succary Abiad cv. seedlings irrigated with tap water (control) while the lowest value (18.0 cm) was observed by clone 4 treated with 3000 mg/l saline water. In the second season, clone 2 showed the highest value (24.2 cm) of root length, clone 4 appeared the lowest value (21.4 cm) with significant differences only as compared to clone 2. The differences among Succary Abiad cv. clone1, 2 and 3 were not significant. Salinity concentrations showed no significant effect on the root length except the highest concentration (3000 mg/l). The interaction effects were significant, the highest value (25.5 cm) was noticed with each of clone 2 irrigated with 2500 mg/l Na Cl and clone 1 with 1500 mg/l. The lowest value (19.3 cm) was recorded by clone 4 subjected to 2000 mg/l saline irrigation water.

Table (8): Effect of irrigation water salinity on root length (cm) of some mango seedling clones in 2014 and 2015 seasons.

Conce.		Clones of mango, Root length (cm)					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	27.0	24.0	24.6	22.0	20.0	23.5
	500	25.3	23.0	24.0	24.0	21.0	23.4
	1000	24.0	25.0	25.0	23.0	21.3	23.6
	1500	25.0	24.0	25.0	23.0	20.6	23.5
	2000	26.3	24.0	25.0	23.0	19.6	23.6
	2500	23.3	24.0	26.0	23.0	19.0	23.06
	3000	25.0	24.0	24.0	23.0	18.0	22.8
	Average	25.1	24.0	24.8	23.0	19.9.0	
LSD at 5% for clones				2.73			
LSD at 5% for Conc.				1.86			
LSD at 5% for interaction				4.183			
2015	Control	23.0	22.0	24.6	20.5	22.5	22.5
	500	23.0	23.3	21.3	22.7	20.3	22.1
	1000	24.3	22.7	24.8	23.5	22.3	23.5
	1500	24.3	25.5	24.8	23.3	21.4	23.9
	2000	25.3	23.2	23.6	25.5	19.3	23.4
	2500	21.6	25.3	25.5	23.2	20.5	23.2
	3000	25.3	25.0	24.5	24.6	24.0	24.7
	Average	23.8	23.8	24.2	23.3	21.4	
LSD at 5% for clones				1.45			
LSD at 5% for Conc.				1.37			
LSD at 5% for interaction				3.073			

2-2- Roots number:

Data in Table (9) appeared that in the first season, Succary Abiad cv. seedlings recorded the highest number of roots followed by clones 1,2,3 and clone 4. The differences among the five genotypes were significant. In the second season, clone3 showed the highest roots number followed by Succary Abiad cv. clones 1 and 2. Clone 4 showed the lowest roots number per plant with significant differences between it and the other genotypes. Concerning the effect of salinity concentrations on seedlings roots number, data showed a significant decrease in the root number with increasing salinity concentrations. The interaction effects showed that in the first season, clone1 x (1000 mg/l Na Cl) gave the highest number of roots per plant (11.6) while the lowest number (2.2) was noticed with clone 3 x (3000 mg/l Na Cl). In the second season, clone1 with control treatment gave the highest roots number per plant (9.0). Clone 4 x 3000 mg/l Na Cl showed the lowest value (5.7) in this respect. The reduction in the roots number as salinity concentration increased is a result of the inhibitor effect of irrigation saline water on the vegetative growth as mentioned before which directly reflected on roots formation.

2-3- Root fresh weight:

Data in Table (10) show that in the first season clone 1 gave the highest value of root fresh weight followed by clone 2, Succary Abiad cv. clone 3 and clone 4. The differences among the five genotypes were significant except between clone 1 and clone 2. In the

second season, clone 2 and clone 3 showed the highest values of root fresh weight followed by clone 1, clone 4 and Succary Abiad cv. The differences between clone 2 and clone 3 and those between clone 1 and clone 4 were not significant. Succary Abiad cv. showed the lowest root fresh weight with significant differences compared to any of the other four clones. Salinity indicated significant decreases in the root fresh weight with increasing salinity concentrations. This was evident in the two seasons of study. The reduction in the root fresh weight could due to the reduction in the roots number as salinity concentration increase (Table 9). The interaction effects were significant in the first and second season. In the first season, the highest root fresh weight (28.4 g) was shown with clone 1 under control and 1000 mg/l Na Cl condition and while lowest value (7.2 g) was gained from clone 4 x 2500 mg/l salinity. In the second season, clone 3 with control treatment gave the highest root fresh weight (24.1 g) while Succary Abiad cv. showed the lowest value (10.0) when irrigated with 3000 mg/l saline water. The other combination in the two seasons appeared in between values.

Table (9): Effect of irrigation water salinity on roots number/plant of some mango seedling clones in 2014 and 2015 seasons.

Conc.		Clones of mango, Roots number/plant					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	7.5	9.6	10.4	5.3	3.0	7.2
	500	10.2	10.5	6.8	2.8	3.7	6.8
	1000	9.4	11.6	8.0	3.1	3.1	7.0
	1500	4.1	6.5	6.0	7.0	3.1	5.3
	2000	10.5	6.8	6.3	5.4	2.6	6.3
	2500	8.1	2.8	7.0	2.5	2.5	4.6
	3000	9.1	4.7	5.0	2.2	2.5	4.7
	Average	8.4	7.5	7.0	4.0	2.9	
LSD at 5% for clones				0.566			
LSD at 5% for Conc.				0.28			
LSD at 5% for interaction				0.626			
2015	Control	8.1	8.3	8.6	9.0	7.8	8.36
	500	7.4	7.6	8.2	8.3	7.6	7.82
	1000	7.4	8.1	7.4	7.7	7.0	7.52
	1500	7.6	7.7	6.7	8.1	7.0	7.42
	2000	7.7	7.6	6.3	7.8	6.2	7.12
	2500	7.1	6.6	6.2	7.3	6.2	6.68
	3000	7.8	6.1	6.2	7.2	5.7	6.6
	Average	7.5	7.4	7.0	7.9	6.7	
LSD at 5% for clones				0.2347			
LSD at 5% for Conc.				0.3217			
LSD at 5% for interaction				0.7194			

2-4-Root dry weight:

Data in Table (11) show that in the first season Succary Abiad cv. gave the highest value of root dry weight (10.1 g) followed by clone 2, clone 1, clone 3 and clone 4. The differences among the five genotypes were significant. In the second season, clone 2 and clone 3 showed the highest root dry weight without significant differences and the same values (7.1) followed by, clone 4 and each of Succary Abiad cv. or clone 1 which gave the same value (5.9 g). As for salinity concentration, data showed significant decrease in the root dry weight as salinity concentration increase, this was clear in the two seasons. This reduction is a result of the inhibitive effect of salinity on the root fresh weight. The interaction effects were significant in the two seasons. In the first season the highest value (17.8 g) was noticed with clone 3 with control treatment. The lowest value (4.3 g) was observed in combination of clone 4 by 1000 mg/l Na Cl. In the second season, clone 2 grown under control irrigation gave the highest root dry weight (13.1 g), while Succary Abiad cv. irrigated with 3000 mg/l saline water showed the lowest value (3.9 g). The other combination appeared in between values in each of the two seasons. The obtained results agree those of **Abd El Karim (1991), Wahdan (2004)** on mango; **Cavalcante et al., (2005) and Hassan (2005)** on olive.

Table (10): Effect of irrigation water salinity on root fresh weight (g) of some mango seedling clones in 2014 and 2015 seasons.

Conc.		Clones of mango, Root fresh weight (g)					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	28.0	28.4	25.5	25.8	20.3	25.6
	500	19.2	25.7	26.4	10.6	14.5	19.3
	1000	23.2	28.4	20.1	18.7	12.4	20.56
	1500	16.4	18.8	25.1	19.7	11.4	18.3
	2000	17.1	21.5	20.3	13.6	10.2	16.5
	2500	15.6	20.8	21.8	11.2	7.2	18.54
	3000	22.5	17.4	17.7	18.6	16.5	14.6
	Average	20.3	23.0	22.4	14.2	11.8	
LSD at 5% for clones				0.61			
LSD at 5% for Conc.				0.60			
LSD at 5% for interaction				1.363			
2015	Control	20.6	21.1	23.7	24.1	17.7	24.5
	500	21.4	19.1	18.5	18.5	19.0	19.5
	1000	15.7	17.5	19.0	19.0	18.0	17.8
	1500	14.8	16.4	16.2	16.2	19.0	16.5
	2000	18.7	14.8	17.5	17.5	16.4	16.9
	2500	12.4	12.4	18.6	18.6	15.4	15.8
	3000	10.0	19.6	13.6	13.6	15.1	14.4
	Average	16.2	17.5	18.2	18.2	17.3	
LSD at 5% for clones				0.38			
LSD at 5% for Conc.				0.49			
LSD at 5% for interaction				1.114			

Table (11): Effect of irrigation water salinity on root dry weight (g) of some mango seedling clones in 2014 and 2015 seasons.

Conc.		Clones of mango, Root dry weight (g)					
		Succary Abiad	C1	C2	C3	C4	Av.
2014	Control	17.3	14.3	12.5	17.8	7.2	13.8
	500	9.8	14.3	12.6	5.8	5.7	10.7
	1000	10.5	12.3	9.3	8.6	4.3	9.0
	1500	6.6	10.2	13.7	9.1	4.4	8.8
	2000	10.3	9.8	6.5	6.1	3.9	7.3
	2500	6.4	8.5	9.3	5.4	4.0	6.7
	3000	10.1	5.3	5.3	6.6	5.8	6.6
	Average	10.1	9.2	9.8	8.4	5.0	
LSD at 5% for clones				0.5			
LSD at 5% for Conc.				0.66			
LSD at 5% for interaction				1.492			
2015	Control	10.1	9.3	13.1	12.0	7.0	10.3
	500	7.4	9.1	6.7	10.2	7.1	8.1
	1000	5.0	7.7	6.2	6.2	7.1	6.4
	1500	4.4	7.7	5.5	6.5	6.0	6.0
	2000	5.3	5.0	5.2	5.2	5.3	5.2
	2500	5.3	6.6	8.1	5.1	5.3	6.0
	3000	3.9	4.1	5.2	5.1	6.0	5.0
	Average	5.9	5.9	7.1	7.1	6.2	
LSD at 5% for clones				0.5			
LSD at 5% for Conc.				0.66			
LSD at 5% for interaction				1.442			

Conclusion:

According to the obtained results, Succary Abiad cv, and the other four mango genotypes as rootstock could be evaluated as follows: The clone 3 is the best rootstock followed by Succary Abiad cv., clone 2 and clone 1 while clone 4 is most sensitive to salinity over than 1500ppm.

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