SALICORNIA PLANTS GROWTH AND YIELD AS AN INDICATOROF SALT STRESS CONDITIONS

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ABSTRACT

Salt stress became the most challenge for agriculture production and development. Two practical trials were carried out in a private farm at Abdo Basha Village, Kafr El-Dawwar, Behaira Governorate during two winter growing seasons 2017 and 2018 seasons to study the effect of the irrigation levels with salt water i.e., (9000, 18000, 24000 and 36000 ppm of water salinity and Nile water as control) on growth, yield and accumulation of salt in different plant parts of Salicornia grown in boxes in cultivated soil.

Results indicated that plant height, leaves number, number of branches, fresh and dry weights of shoots increased with increasing salt water levels at 80,120,150 and 180 days of plant age during 2017 and 2018 seasons. Also, root growth characteristics i.e., root length, fresh ad dry weights were increased with increasing salt water levels at 80,120,150 and 180 days of plant age during 2017 and 2018 seasons. Yield and seed yield were increased with salt water levels during 2017 and 2018 seasons. Different salt irrigation water levels i.e., 9000 ppm salt water, 18000 ppm salt water, 24000 ppm salt water and 36000 ppm salt water) decreased salt concentration (ppm) in soil at 0, 80, 120, 150 and 180 days of plant age during 2017 and 2018 seasons. The control gave the lowest value for soil salt concentration (ppm) at different plant stages during the two growing seasons. Increasing salt water levels decreased salt concentration in soil attributed to the salt water percentage during plant life time in both seasons. The most beneficial treatment for

increasing yield and its components and decreasing the salt from the soil was that36000 ppm of salt water during first and second seasons.
Key words: Salicornia plants, Salt water, growth characteristics, yield.

INTRODUCTION

High salinity, one of the most harmful environmental stresses for plants, limits the productivity and growth of food and feed crops on cultivated and Irrigated land worldwide (Isca *et al.*, 2014; Patel, 2016 and Roy *et al.*, 2014).In this respect, Previous studies have shown that increased salinity not only results from residual sea water but also, from the accumulation of artificial fertilizers or natural resources from cluster minerals (Munns & Tester, 2008; Roy *et al.*, 2014 and Zhu, 2001).

The primary cause of this salinity stress is an increase in sodium (Na+) and chloride (Cl−) ions, the most abundant salt ions in natural sources (Jaleel *et al.*, 2007; Shabala & Mackay (2011), Aghaleh *et al.*, 2009; Nie *et al.*, 2015). Salinization is the process of increasing the concentration of total dissolved salts in soil and water either due to natural processes (primary salinization) or anthropogenic actions (secondary salinization) (Ghassemi *et al.*, 1995).The process of secondary salinization is exacerbated by the use of saline ground water and poor quality waste water for irrigation, as well as by clearing deep-rooted forest lands for pasture and crop production (Lambert & Turner, 2000 and Barrett- Lennard, 2002). Globally, irrigated land represents only 15% of the total cultivated land but produces one third of the world's food (Munns, 2005).On average, it is estimated that about 100Mha of land have become saline due to irrigation (Ghassemi *et al.*, 1995; Pessarakli & Szabolics, 1999), so about 11% of the world's irrigated areas are already affected by some degree of salinization (FAO, 2012). Alarmingly, the amount of salt-affected land and its continuous expansion is highest in some of the most populated and economically challenged countries such as Bangladesh.

Halophytes are naturally evolved salt-tolerant plants that represent at most 2% of terrestrial plant species (Flowers & Colmer, 2008). They have the ability to complete their life cycle in a NaCl- rich environment where almost 99% of salt sensitive species die because of NaCl toxicity, and thus may be regarded as a Source of potential new crops (Glenn *et al.*, 1999). Although halophytes have been recognized for hundreds of years, their definition remains equivocal (Flowers and Colmer, 2008).

Halophytic species possess a range of highly efficient and complementary morphological, physiological and anatomical characteristics to combat and even benefit from a saline environment (Flowers *et al.*, 1977; Flowers & Colmer, 2008 and Shabala & Mackay, 2011). In Egypt, the halophytic grasses Leptochloafusca, Spartina patens and S. virginicus are used for forage production. Their dry matter (DM) yield ranged between 1.1 and 6.5 t DM/ha/year making them ideal as for- age crops in the desert areas where only saline water is available for irrigation (Ashour *et al*., 1999).Salicornia have been tested as fodder crops as renewable energy sources (biofuel) for phytoremediation (Eganathan *et al.*, 2006), as landscaping ornamentals and as food for human consumption (Ventura *et al.*, 2011).Salicornia is used as traditional medicine treating hypertension, cephalalgia and scurvy In Korea, it is used in the treatment of constipation, obesity, diabetes and cancer. The purpose of this work was to investigate the possibility of including the halophyte Salicornia in life support systems (in simulation experiments) in order to involve NaCl in the material cycling and to estimate the effect produced by substrate salinization and light intensity on the NaCl uptake by Salicornia plants as an indicator for salt stress conditions.

MATERIAL AND METHODS

The experimental part of this study was carried out in a private farm at Abdo Basha Village, Kafr El-Dawwar, Behaira Governorate during two winter growing seasons of 2017 and 2018 to study, the effect of irrigation levels with salt water i.e., (9000, 18000, 24000 and 36000 ppm salt water and Nile water as a control 200 ppm) on growth, yield and accumulation of salts in different plant parts. Alsoto determine the beneficial effects of Salicornia plants as an indicator to the salt conditions. Soil of the experiment was collected from salt Daline soil in Abdo Basha Village, Kafr El-Dawwar, Bahira Governorate and distributed in boxes, then sown Salicornia seeds. Uniform seeds of Salicornia plants (10 gr/box) were sown regularly each for depth and the distance between each treatment was arranged in five replicates for each group, i.e. 25 boxes for all treatments. Then, boxes were irrigated every three days with 8 liter (field capacity)of its assigned salt water level (as previously mentioned). This amount of water was continued until the end of

February in both seasons then it was increased to twelve liters /box until the last two weeks before the harvest. Also, there were no fertilizers added during the experiment growing seasons. All other agriculture cultural practices were performed as recommended.

Physical and chemical properties of the experimental Soil: Soil samples were air-dried, crushed, passed through a 2 mm sieve and analyzed for various physicochemical properties. Physical and chemical properties of the experimental soil were determined as follows:

Mechanical analysis was determined using the international pipette method according to Piper (1950).

Table (1): Physical and chemical properties of the experimental soil during 2017 and 2018 seasons

Soil	Soil Texture	pH	SP	Salt concentration ppm
2017	sandy loam	7.9	40	12350
2018	Clay loam	8.1	40	19280

Seeds source: Salicornia seeds were collected from shrubs growing in Odiel salt marshes. Fruits were collected from plants in various salt pan populations. These salt marshes are under the influence of the Mediterranean climate and affected by oceanic influences. Winter is wet and with mild temperatures and summer is long and dry. Mean annual precipitation is 6mm with an interannual variation coefficient of 31%.

Source of salt water: Salt water was prepared dissolving by NaCl 36 g /l as a source of salt (36.000 ppm). Treatments of salt water composite of different concentrations of salt water and fresh Nile water were as follows:T^0 (Nile water as control, 200 ppm). ,T^1 (25% 6 g /l NaCl to make 9000 ppm).,T^2 (50% 18 g / l NaCl to make 18000 ppm).,T^3 (75% 24 g/l NaCl to make 24000 ppm) and T^4 (100% 36 g/l NaCl to make 36000 ppm).Percentages of seedling emergence, three weeks after sowing the number of emerged seedlings for each box was counted in different treatments. Percentages of seedling emergence were counted by dividing the number of emerged seedlings by the number of sown seeds (i.e., 10 g). Then seedlings were trimmed by ten plants for each box. Seeds were sown (10 gr/box) at 10^{th} of December in 2017/2018. The box area was (100x50x50 cm in diameter) and the treatments were distributed in Randomized Complete Block Design (RCBD) with five replicates.

Sampling and collecting data:

(I) Growth characteristics: Growth characteristic measurements were collected and measured at (80, 120, 150 and 180 days) after sowing during 2017 and 2018 seasons. The following parameters were measured or estimated:

Root length (cm)., plant height (cm)., Number of leaves/plant., Number of branches / plant., Root fresh weight g/plant, Shoots fresh weight g/plant., Dry weight of shoots g/plant.

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(II) Yield characteristics: Ten random plant samples of each treatment were chosen to measure and determine the final growth and yield characteristics. The following data were collected.

(III) Final yield characteristics: Seed weight g/plant., Dry weight of straw g/plant., the number of seeds in 1 g.

(IV) **Soil Salt concentration, ppm:** Soil Salt concentration (ppm) was determined in soils at 0, 80, 120, 150 and 180 days after sowing in the experimental soil. Electrical conductivity in 1:2:5 soil water extract was determined according to Black (1965).

(V) Statistical analysis: Data of morphological, flowering and yield characteristics were statistically analyzed and the means were compared using the Least Significant Difference test (L.S.D) at 5% levels according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

(I) Effect of salt water on Salicornia seed germination: Data presented in Table 2 indicated that the optimal germination of seeds of Salicornia occurred in distilled water treatments. Salinity increments inhibited germination of seeds. The smallest decrease in germination was obtained from T3 treatment. There was no seed could germinate in T4 solutions.

Also, Table (2) illustrates the percentage germination of seeds incubated for 20 days in salt solutions ranging from T0 to T3. These data indicate that the germination of seeds were decreased with increasing of water salinity.

Table (2): Effect of salt water levels on Salicornia germination characteristics during 2017 and 2018 seasons at 25 C^{o}

Charach. Treatment	Germination %	
	2017	**2018**
T0	85.0	86
T1	69.0	70.0
T2	46.0	47.0
T3	35.0	36.0
T4	0.0	0.0
L.S.D. at 5 %	2.00	

T0 control (Nile water); T1 (salt water 9000 ppm); T2 (salt water 18000 ppm);
T3 (salt water 24000 ppm) and T4 (salt water (36000 ppm).

(II) Effect of irrigation by salt water levels on growth characteristics of Salicornia plants during different plant stages:

- At 80 days of plant age: Data in Table (3) indicated that increasing levels of irrigation water salinity i.e.,(0, 9000, 18000, 24000 and 36000 ppm) significantly increased plant height cm, root length cm, Num. of leaves /plant, Num. of branches /plant, Root fresh and dry weights g/plant, shoots fresh and dry weights g/plant when compared with the control (irrigated with river water) at 80 days of plant age during 2017 and 2018 seasons. It could be noticed that that the level of 18000 ppm of salt water gave the highest values of estimated or measured characteristics, i.e., plant height, root length, number of leaves/plant, number of branches and shoot dry weight. Since, these parameters gave respectively the values of 70.1, 67.98

for plant height; 17.16 and 16.28 for root length; 23.00, 22.00, for leaves number ; 23.66,21.00, for number of branches;85.74,80.39 for roots fresh weights;197.75,190.69 for shoots fresh weights and 101.11,92.74 for shoots dry weights during 2017 and 2018 seasons, respectively. Also, it could be noticed that the level of 24000 ppm salt water ranked the second significantly increasing in the assigned treatments. In addition, the most pronounced results is that the salt water increased in ascending order the fresh and dry weights of treated plants to reach its maximum with T4 i.e., 36000 ppm of water salt. These results confirm the fact that salinity led to more accumulation for dry matter including sources of salinity absorbed from soil by the growing Salicornia plants In context shoots fresh and dry weight g/plant gave the highest value with 36000 ppm salt water, followed by 24000 ppm salt water, followed by 18000 ppm salt water, followed by 9000 ppm salt water when compared with the control treatment at 80 days after sowing during 2017 and 2018 seasons.

In this respect the obtained increase of these traits with salt water levels could attributed to the alleviate of salt water by Salicornia plants by increasing its ability to accumulated salt in different parts during plant growth and development. These results are in agreement with those working on alleviation of salt water by Salicornia and other plants,(Tobe, et al (2004), Song, et al (2008) and Singh *et al*., (2014).

Table (3): Effect of irrigation by salt water levels on some growth characteristics of Salicornia plants at 80 days of plant age during 2017 and 2018 seasons

Charach. / Treatment	plant height, cm		Root length, cm		Num. of leaves /plant		Num. of branches/plant		Roots (fresh weight)g/plant		Shoot (fresh weight) g/plant		Shoots Dry weight g/plant	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T0	42.18	40.15	11.331	10.22	18.33	16.33	9.00	8.66	52.21	46.12	109.21	100.69	61.23	42.25
T1	61.11	55.36	15.41	13.39	22.66	20.66	14.33	12.33	68.58	66.54	115.41	110.48	57.02	51.89
T2	70.10	67.98	17.16	16.28	23.00	22.00	23.66	21.00	85.74	80.39	197.75	190.69	101.11	92.74
T3	63.70	60.78	15.91	14.74	21.33	20.33	18.00	17.66	79.15	72.78	260.14	250.78	141.12	112.84
T4	55.52	52.61	14.98	13.58	22.00	19.66	17.33	16.33	82.62	78.69	321.95	310.69	180.86	186.38
LSD 5%	1.22	1.33	1.11	1.55	0.66	1.25	0.33	2.62	1.49	1.56	1.45	2.33	1.36	1.58

T0 control (Nile water); T1 (salt water 9000 ppm); T2 (salt water 18000 ppm); T3 (salt water 24000 ppm) and T4 (salt water (36000 ppm).

- At 120 days of plant age: In Table (4)data clearly indicate that plant height cm/plant, root length cm/plant were increased with irrigation of salt water levels i.e., (9000, 18000 ,24000 and 36000 ppm) when compared with the control (Nile water) at 120 days of plant age during 2017 and 2018 seasons. The highest values of those traits were9000 ppm from salt water which gave 89.90, 82.66 , 21.11,19.71 stem height and root length respectively, during 2017 and 2018 seasons, followed by 18000 ppm salt water followed by 24000 ppm salt water, followed by 36000 ppm salt water when compared with the control, it gave lowest value at 120 days of plant age during both seasons. In the same time number of leaves/plant decreased with application of salt water levels when compared with the control during first and second seasons. Number of branches /plant, roots fresh weight (g)/plant, shoots fresh weight (g)/plant and shoots dry weights (g)/plant significantly increased with application of 36000 ppm salt water followed by 24000 ppm salt water, followed by 18000 ppm salt water followed by 9000 ppm salt water when compared with the control (Nile water) at 120 days of plant age during 2017 and 2018 seasons.

Salicornia from halophytes, it grows as saltresistant or salt-tolerant plants which can grow in moderate to high saline soil by utilizing salinity for their growth, Greenway & Munns (1980). Halophytes can be obligatory halophytes, preferential halophytes, supporting halophytes, accidental halophytes, obligatory halophyte (Salicornia brachiata) require salinity for survival as well as optimum growth. The halophyte Salicornia brachiataRoxb belongs to the Amaranthaceous family.

Table (4): Effect of irrigation by salt water levels on some growth characteristics of Salicornia plants at 120 days of plant age during 2017 and 2018 seasons

Charach. / Treatment	plant height, cm		Root length, cm		Num. of leaves /plant		Num. of branches/plant		Roots (fresh weight) g/plant		Shoot (fresh weight) g/plant		Shoots Dry weight g/plant	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T0	69.24	65.22	17.10	15.12	31.00	27.00	12.00	10.00	190.11	171.22	199.71	192.59	98.16	90.11
T1	89.90	82.66	21.11	19.71	24.33	21.33	14.33	11.33	191.32	182.42	289.11	271.69	151.48	132.41
T2	83.22	79.18	20.17	18.68	29.66	25.66	25.66	23.66	199.41	189.78	352.45	335.47	181.52	160.98
T3	75.51	70.39	19.11	16.19	24.33	21.00	27.00	25.00	205.61	200.69	471.87	452.89	245.60	210.30
T4	71.69	65.36	14.91	13.48	23.00	22.33	29.66	27.66	217.45	210.37	690.71	668.69	380.76	351.82
LSD 5%	1.64	1.55	1.36	2.15	1.00	1.66	1.00	0.33	1.75	1.78	2.32	3.15	1.42	1.36

T0 control (Nile water); T1 (salt water 9000 ppm); T2 (salt water 18000 ppm);
T3 (salt water 24000 ppm) and T4 (salt water (36000 ppm).

- **At 150 days of plant age:** As shown in Table (5) the applied treatments i.e. the irrigation levels with salt water at 9000, 18000, 24000, 36000 ppm and normal water =Nile water, 200 ppm as control obviously affected plant height, root length, leaves number, branches number, fresh weight of roots and shoots and dry weight of shoots at 150 days of plant age during 2017 and 2018 seasons. Actually, plant height, root length and number of leaves /plant reached the highest values with 9000 ppm salt water followed by 18000 ppm salt water, followed by 24000 ppm salt water followed by 36000 ppm salt water when compared with the control at 150 days of plant age during 2017 and 2018 seasons. Meanwhile, Num. of branches /plant and root weight (g) per plant significantly increased with different applied treatments and reached the highest value with 36000 ppm salt water followed by 24000 ppm, 18000 ppm and 9000 ppm salt water at 150 days of plant age during 2017 and 2018 seasons. In the same time shoot fresh weight g/plant, shoot dry weight g/plant reached the highest value with salt water at 24000 ppm followed by 36000 ppm, followed by 18000 ppm, followed by 9000 ppm salt water when compared with the control (Nile water, 200 ppm) at 150 days of plant age during 2017 and 2018 seasons.

In general salt water with different levels, affected growth characteristics of Salicornia plants at 150 days after sowing during 2017 and 2018 seasons.

In this respect, the alleviation of salt water on growth behavior of Salicornia plants could be attributed to tolerance of the plant to salts and accumulation of salts in different plant parts during plant growth and development.

Table (5): Effect of irrigation by salt water levels on some growth characteristics of Salicornia plants at 150 days of plant age during 2017 and 2018 seasons

Charach. / Treatment	plant height, cm		Root length, cm		Num. of leaves /plant		Num. of branches/plant		Roots (fresh weight) g/plant		Shoot (fresh weight) g/plant		Shoots Dry weight g/plant	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T0	91.07	85.11	26.05	21.56	18.00	16.33	13.00	11.33	205.98	195.18	1310.11	1250.22	710.11	660.47
T1	98.18	91.55	29.11	23.69	23.33	24.66	11.66	10.66	217.60	199.69	1770.21	1620.39	910.47	885.17
T2	83.98	82.26	22.16	20.58	26.66	24.00	22.33	20.33	221.71	211.37	2351.91	2152.48	1205.70	1165.05
T3	81.24	75.38	19.91	18.87	21.66	22.66	26.00	23.00	315.82	295.58	2813.41	2375.92	1727.81	1406.16
T4	79.52	72.81	19.71	18.47	23.00	21.33	27.33	24.66	342.11	322.94	2670.21	2311.87	1490.79	1335.61
LSD 5%	1.39	1.47	1.69	1.80	0.66	1.33	1.00	1.66	1.00	2.05	6.59	5.36	7.39	8.39

T0 control (Nile water); T1 (salt water 9000 ppm); T2 (salt water 18000 ppm); T3 (salt water 24000 ppm) and T4 (salt water (36000 ppm).

- **At 180 days of plant age:** Data shown in Table (6) indicated that, salt water irrigation levels i.e., 9000, 18000, 24000 and 36000 ppm significantly increased plant height, root length, number of leaves/plant, number of branches, fresh weight of roots g/plant, fresh weight of shoots g/plant and dry weight of shoots g /plant when compared with control treatment (river water) at 180 days of plant age during 2017 and 2018 seasons. Salt water at 9000 ppm irrigation level gave the highest value followed by 18000, followed by control followed by 24000 and 36000 ppm saltwater , with plant height, root length at 180 days of plant age during 2017 and 2018 seasons. Also, in the same time number of leaves were increased with 18000 ppm of saltwater irrigation level followed by 9000 ppm, followed by 24000 ppm, followed by 36000 ppm when compared with the control (Nile water) at 180 days of plant age during 2017 and 2018 seasons. While number of branches /plant reached the highest value with salt water, followed by 36000 ppm, followed by 18000 ppm , followed by 9000 ppm salt water irrigation water when compared with the control at 180 days of plant age during 2017 and 2018 seasons. In addition, root fresh weight g/plant reached the highest value with 36000 ppm salt water followed by other salt water levels at 180 days of plant age during first and second seasons. Furthermore, shoots fresh weight g/plant and shoots dry weight g /plant significantly increased with 24000 ppm salt water, followed by 18000 ppm salt water, followed by 36000 ppm salt water, followed by 9000 ppm salt water when compared with the control at 180 days of plant age during 2017 and 2018 seasons.

NaCl is a dual stressor, as it challenges osmotic regulation and sodium is toxic to enzyme systems. Salt marsh halophytes cope with salt by excluding entry into roots, sequestering salts intracellularly (leading to succulence), and excreting salt via glands, usually on leaf surfaces. One succulent, Batismaritima, continually drops its older salt-laden leaves, which are then washed away by the tide.

Table (6): Effect of irrigation by salt water levels on some growth characteristics of Salicornia plants at 180 days of plant age during 2017 and 2018 seasons

Charach. / Treatment	plant height, cm		Root length, cm		Num. of leaves/plant		Num. of branches /plant		Roots (fresh weight) g/plant		Shoot (fresh weigh) g/plant		Dry weight of shoots g/plant	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T0	86.11	81.22	21.06	19.69	16.00	14.33	12.66	10.00	121.78	115.25	710.78	670.74	310.87	282.71
T1	92.71	87.12	23.44	22.78	21.33	18.66	13.33	11.66	139.69	132.78	760.39	712.59	325.33	291.25
T2	86.12	81.36	20.90	19.85	23.66	21.00	21.00	19.33	130.34	124.69	890.87	835.34	451.39	410.66
T3	76.38	72.78	19.69	17.50	20.00	18.33	23.66	20.33	161.39	152.87	899.33	841.27	461.36	435.91
T4	76.42	71.39	20.11	17.60	19.33	17.66	22.33	21.66	175.65	164.39	851.25	798.65	436.87	410.50
LSD 5%	1.39	1.55	1.25	1.69	1.00	1.33	0.66	1.00	2.36	2.25	2.13	3.65	4.36	4.87

T0 control (Nile water); T1 (salt water 9000 ppm); T2 (salt water 18000 ppm); T3 (salt water 24000 ppm) and T4 (salt water (36000 ppm).

III-Effect of irrigation by salt water levels on yield and yield components of Salicornia plants:-

Data in Table (7) indicate that, different salt water levels i.e., 9000 ppm, 18000 ppm, 24000 ppm and 36000 ppm significantly increased Salicornia economic yield /plant, biological yield /plant and number of seeds / g with increasing salt water levels during 2017 and 2018 seasons. In this respect, the level of 36000 ppm salt irrigation water showed the highest value when compared with the control during both seasons.

In this respect, the obtained increased in yield and yield components could be considered beneficial but would also be ecologically relevant (Khan *et al.* 2000).Increases succulence of plant so that ions accumulate in vacuoles; but ions accumulation decreased with more increases in salinity (Khan *et al.* 2001).

Table (7): Effect of irrigation by salt water levels on some growth characteristics of Salicornia plants at 180 days of plant age during 2017 and 2018 seasons

Charach. / Treatment	Economic yield (kg/plant)		Biological yield (kg/plant)		Number of seeds/g	
	2017	2018	2017	2018	2017	2018
T0	8.245	9.240	30.15	40.15	55.00	56.33
T1	10.475	10.420	45.15	46.39	50.33	51.66
T2	11.452	11.230	50.26	52.16	49.66	48.00
T3	12.302	12.378	53.18	56.59	48.00	47.33
T4	14.102	14.568	69.25	72.39	46.33	46.00
LSD 5%	0.635	0.525	2.125	3.26	2.00	1.33

T0 control (Nile water); T1 (salt water 9000 ppm); T2 (salt water 18000 ppm); T3 (salt water 24000 ppm) and T4 (salt water (36000 ppm).

- **Salt concentration in soil during experiment life time:** In Table (8) data indicated that, different salt irrigation water levels i.e., 9000, 18000, 24000 and 36000 ppm salt water)decreased salt concentration(ppm)in soil at 80, 120, 150 and 180 days of plant age during 2017 and 2018 seasons. The control gave the lowest valueforsoil salt concentration at different plant stages during the two growing seasons. Increasing of salt water levels increased different salt accumulations in soil attributed to the salt water percentage during plant life time in both seasons. Meanwhile, Salicornia plants is a good phytoremediator for the salt from the soil. Also, increasing of salt percentage by increasing salt water percentage during plant life time increased growth characteristics for shoots and roots during different stages it were mentioned in Tables 3,4,5,6 and 7. In addition, growing Salicornia plants in salt water levels increased yield and yield components was mentioned in Table 8.In this respect from the abovementioned Salicornia plants it is a good phytoremediator for the salts from the soil because they are able to take up water by maintaining a high osmotic potential through the accumulation of Inorganic ions. increasing salt levels in Salicornia significantly in germination rates, for salinity levels above 50% seawater concentration. Salicornia also, used as traditional medicine treating hypertension, cephalalgia and scurvy In Korea, it is used in the treatment of constipation, obesity, diabetes and cancer Shabala, 2013).Here, the estimated NaCl removal ranged between 2 and 6 ton of salt per hectare per year. It should be commented though that the use of halophytes as a desalinization tool cannot be guaranteed in all cases, as their productivity may be significantly affected not only by salinity but also by other environmental conditions (Shabala, 2013). These accumulated elements in soil and water bodies can cause a risk to humans and other living organisms (Khan *et al.*, 2010). A clean-up of these contaminated soils is needed but challenging, especially in terms of the cost, when conventional salts tools such as soil incineration or washing are used (Sheoran*et al.*, 2011 and Wuana & Okieimen, 2011). The use of hyper-accumulating plants may reduce this cost dramatically. Salicornia is a halophytic plant show an ability to grow in those saline areas and are widely advocated for phytoremediation purposes such as phytoextraction or phytostabalization (Lutts *et al.*, 2004 and Manousaki & Kalogerakis, 2011). Salicornia is mulled to be the right candidate for reclamation of barren lands, salt flats, and sea shores. In short, they can be deemed for seawater agriculture. It is suggested that as global warming threatens to submerge more landmass, and freshwater is depleting, a shift to saline crop might be a viable option (Katschnig *et al.* 2013). Few plants can tolerate excess salt and among them few are edible. In this context, Salicornia seems to be a right candidate for cultivation to produce more harvestable biomass (Singh *et al.*, 2014).

Table (8): Effect of Salt water irrigation levels on salt concentration ppm in soil at different period of experimental time during 2017 and 2018 seasons

Charach. Treatment	Soil Salt concentration(ppm)							
	2017				2018			
	80 days	120 days	150 days	180 days	80 days	120 day	150 days	180 days
T0	10150	8100	6250	1050	12250	8390	6270	2150
T1	10250	8300	5580	1410	12580	9460	6340	2360
T2	10680	9290	6350	2320	13370	10220	8530	3360
T3	10390	8390	6500	2540	13450	10550	8620	3580
T4	10150	8630	6690	3710	13680	10690	8790	3760
LSD 00.5%	15.25	11.36	12.29	10.38	10.12	11.24	11.38	8.37

T0 control (Nile water); T1 (salt water 9000 ppm); T2 (salt water 18000 ppm); T3 (salt water 24000 ppm) and T4 (salt water (36000 ppm).

CONCLOUSION

Applying of salt water levels i.e., 9000, 18000, 24000 and 36000 ppm of mixed fresh water and compared with Tap water (control) increased Salicornia growth and development of growth performance at different plant stage. In this context, applying of salt levels increased yield and yield components in Salicornia plants and decreased salt percentage in soil. Trials and nutritional assessments on it for human edibility are novel. As outlined in above sections, Salicornia both have its pros and cons as a food candidate. Additional research might better illuminate on its relevance for consumption. In this regard, some significant areas pertaining to it have been discussed.

Also, Salicornia is touted as a ‘secondary vegetable’, ‘famine food’ and ‘plant for future’. Despite multiple evidences of its health benefits it languishes as a mere marsh plant. As food insecurity looms large, such nutrition sources should not be wasted. Further, saline habitats have low agronomic relevance, so this halophyte can be cultivated to make better use of them and as a good indicator for salt stress conditions.

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نمو وإنتاجية نباتات الساليكورنيا كعاشف تحت ظروف الاجهاد الملحى

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المستخلص

أصبح الإجهاد الملحى أكبر تحديا للإنتاج الزراعى والتنمية. تم اجراء تجربتان حقليتان فى مزرعة خاصة بقرية عبده باشا بكفر الدوار بمحافظة البحيرة خلال موسمى النمو الشتوى ٢٠١٧ و٢٠١٨ لدراسة تأثير مستويات الرى بالمياه المالحة ٩٠٠٠ جزء فى المليون،١٨٠٠٠ جزء فى المليون ،٢٤٠٠٠ جزء فى المليون و ٣٦٠٠٠ جزء فى المليون مياة مالحة و(مياه النيل كعينه ضابطه) على نمو وإنتاجية وتراكم الملح في ألاجزاء النباتية المختلفة من نباتات الساليكورنيا المزروعة في صناديق تربة .

أوضحت النتائج أن ارتفاع النبات وعدد الأوراق وعدد الفروع والأوزان الطازجة والجافة للنباتات زادت مع زيادة مستويات الملوحه عند ١٨٠،١٥٠،١٢٠،٨٠ يومًا من عمر النبات خلال مواسم ٢٠١٧ و ٢٠١٨. بالإضافة إلى ذلك زادت خصائص نمو الجذر ، أى طول الجذر ، والأوزان الطازجة والجافة للسيقان مع زيادة مستويات الملوحه عند ١٨٠،١٥٠،١٢٠،٨٠ يومًا من عمر النبات خلال مواسم ٢٠١٧ و ٢٠١٨. تمت زيادة إنتاجية المحصول والبذور مع مستويات الملوحه المختلفة خلال موسمى ٢٠١٧ و ٢٠١٨. وقد أثرت مستويات مياه الرى المالحة المختلفة ، ٩٠٠٠ جزء فى المليون من المياه المالحة و١٨٠٠٠ جزء فى المليون من المياه المالحة و ٢٤٠٠٠ جزء فى المليون و ٣٦٠٠٠ جزء فى المليون) أثرت على نسبة الملوحة فى التربة عند ٨٠ ،١٢٠، ١٥٠ و ١٨٠ يومًا من عمر النبات خلال مواسم النمو ٢٠١٧ و ٢٠١٨. أعطت العينه ضابطه أدنى قيمة فى تركيز الملوحة فى التربة فى مراحل نموالنبات المختلفة خلال موسمى النمو. كذلك أدت زيادة مستويات الملوحه إلى انخفاض تركيز الملح فى التربة بسبب نسبة المياه المالحة الممتصة بواسطة النبات فى موسمى النمو . وكان المعاملة الأكثر فائدة لزيادة المحصول ومكوناته وتقليل مستوى الملوحة فى التربة هى٣٦٠٠٠ جزء فى المليون من الماء المالح خلال الموسمين الأول والثاني للنمو.

الكلمات الداله: نبات الساليكورنيا، الملوحه، المحصول، مراحل النمو.