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MANAGEMENT OF SUCCESSFUL INTERACTION BETWEEN IRRIGATION WATER SALINITY AND FERTILIZATION TREATMENTS AND ITS EFFECT ON SALICORNIA PLANTS CULTIVATED UNDER GREENHOUSE CONDITIONS

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Abstract

Increasing soil salinization and the growing scarcity of fresh water dictate the need for a creative solution to attain sustainable crop production. To accomplish this aim, the domestication of inherently salt tolerant plant species with economic value is proposed as a straightforward methodology.

In this view, two pot experiments were carried out in seasons 2017 and 2018 at greenhouse in Mariout district at Northwestern coast of Egypt near the city of Alexandria to study evaluation of fodder production with high nutritional value for Salicornia plants under salinity levels of irrigation water using different diluted seawater treatments (SW) combined with well water (WW) i.e.,(100% SW, 50% SW, 25% SW and 100%WW) to achieve the irrigation water salinity levels as follows: (51, 30, 17 and 2.43dS m^{-1}) in marginal or non arable soil with five fertilization treatments such as (control, algae extract foliar application, algae extract soil application, NPK +Micronutrients (MN) soil application and NPK+ micronutrients (MN) + algae extract soil application) on growth characteristics and nutrient contents of Salicornia plants (*Salicornia bigelovii L.*). The results revealed that, the growth characteristics i.e. plant height, fresh weight, dry weight and moisture content significantly increased with all fertilization treatments, particularly in the treatment of (NPK+ micronutrients (MN) + algae extract soil application) associated with all levels of irrigation water salinity especially with (17 dSm^{-1}) level. Analytical data of Salicornia plant samples indicated that decreasing the salinity content in irrigation treatments increased N and P contents. However K content was responding and highly significant with irrigation water salinity (30 dS m^{-1}) level under all fertilization treatments. Concerning Ca and Mg contents, there were slightly variations found with fertilization and irrigation treatments but were not significant. Whereas, data cleared that Na content tended to decline the values gradually with irrigation water salinity levels from (51dSm^{-1} up to 2.43 dSm^{-1}). Where, the highest value for Na, Fe and Mn contents was obtained by irrigation water salinity level (30 dSm^{-1}) with (NPK+ micronutrients (MN) + algae extract soil application) treatments. Moreover, these results showed that Zn significantly affected by irrigation water salinity level (30 dSm^{-1}) with fertilization treatment (NPK+ micronutrients (MN) + algae extract soil application) which noted the supreme.

It can be concluded that, in order to obtain a good fodder crop with a high nutritional value and highly quality, it is advised to pay attention to balanced fertilization of micro and macronutrients (MN) in the presence of algae added as soil application together with irrigation salinity water level, especially at 17 dSm^{-1} and 30 dSm^{-1} in Mariout district at Northwestern coast of Egypt.

***Keywords*:** Salicornia, irrigation, fertilization, salinity, growth, nutrients content.

Introduction

Two main problems faces the world, soil salinity and water scarcely. Where, soil salinity is one of the important abiotic factors causes a degradation in soil quality which can occur due to natural causes or from misuse in arid and semi-arid areas. This leads to an inhibit in plant growth and productivity because it causes a lowering of plant water potentials, specific ion toxicities and nutrient deficiencies, or ionic imbalances (Omami, 2005 and Benzarti *et al.*, 2014).

Furthermore, Pimentel *et al.* (2004) mentioned that about 10 million hectares of agricultural land in the world are destroyed every year due to the accumulation of salts. This rate can be accelerated by climate change, increasing irrigation with low water quality, and poor drainage. In this concern, Bartels and Sunkar, (2005) and Jamil *et al.* (2011) added that, by 2050, more than 50% of the arable land in the world will be salinized. Where, the common cations associated with this problems are Na^+, Ca^{++} and Mg^{++} while the common anions are Cl, SO_4 and HCO_3 (Omami, 2005 and Yossif, 2017).

With respect to the second, defected and degraded water quality problem, the FAO report (2016) mentioned that the total water per capita lowers each year and by 2025, 1800 million people are expected to be living in countries or regions with "absolute" water scarcity (< 500 m^3/ year /capita), and two-thirds of the world population could be under stress conditions (between 500 and 1000 m^3/ year / capita).

In this context, Flowers,(1999) clarified that Egypt is one of the important countries that suffers from feed shortage and salinity problems especially in the North Costal area of delta, because of the risk of tidal of seawater incursions into River Nile and causes soil salinity. This uncultivated land can be exploiting by non-traditional crops without entering to the cropping system such as Salicornia.

Where, it is a halophytes that capable to survive under scarcely of water and saline soil environments due to physiological adaptations (Rhee *et al.*, 2009 and Smillie, 2015). Where plants may exclude salts from their tissues, many of these excluders restrict entry to the aerial portion whilst hyper accumulating elements within roots (Thurman, 1981), so cultivation of Salicornia plants could plays an important role for salinity and water control, moreover, there is no any competition for land or water use between conventional profitable crops and salt tolerant plants as

Salicornia in saline areas (Akinshina *et al.*, 2016). Generally Salicornia could be used for food, and forage production in marginal soils (Panta *et al.*, 2014; Ventura *et al.*, 2015 and Pessarakli, 2015) and it can be used as renewable feedstock for alternative energy production (Akinshina *et al.*, 2016). Some species of them can be used in traditional medicines such as Salicornia herbacea. We can increase productivity of Salicornia by addition of essential nutrients (Rhee *et al.*, 2009).

Macro- and Micro-nutrients applications are necessary for improving yield and quality (Prajapati and Modi, 2012; Torres-Oliver *et al.*, 2014 and Tavakoli *et al.*, 2014). Microalgae is a rich source of major and minor nutrients, amino acids, vitamins, cytokinins, auxin, and abscicic acid like growth promoting substances (Uysal *et al.*, 2016; El-Sayed *et al.*, 2018 and El-Nasharty *et al.*, 2019). It has been reported to be environmentally friendly approach (Faheed and Fattah, 2008). It could be used as a source of good agriculture practice or organic agriculture briefness of environment (Uysal *et al.*, 2015).

The main objective of this study was to evaluate the effect of the irrigation water salinity and some fertilization treatments on plant growth and nutrients content of Salicornia plants under greenhouse conditions in Mariout district at Northwestern coast of Egypt.

Materials and Methods

A pot experiment was carried out in 2017 and 2018 at International Training Centre, in Mariout district at Northwestern coast of Egypt near the city of Alexandria. In order to investigate the effect of irrigation water salinity with different contents of diluted seawater in marginal or non-arable soil to exploitation this soil and improve its growth characterizes as well as chemical composition on *Salicornia bigelovii* L. through some fertilization treatments for this purpose, a plastic pots (3Kg) were filled by surface soil samples (0-30 cm) collected from desert area of the North western Coast and introduced for analysis according to Chapman and Pratt (1978). Physical and chemical properties are shown in Table (1).The Salicornia transplants were collected from the same area and cultivated in 3/2017 and 3/2018, thinned to a constant number of 3 plants. After 50 days from planting, four levels of irrigation water salinity (EC) as follows: (S1=51,S2= 30, S3=17 and S4=2.43 dSm^{-1}) where obtained by use mixing seawater (SW) and well water (WW) as follows: (100% SW, 50% SW, 25% SW and 100% WW) The plants irrigated at 60 - 80% of water holding capacity with this treatments. Some chemical properties of sea, well water and their mixture were analyzed according to Chapman and Pratt (1978) where pH and HCO_3 arranged in the ascending order levels from irrigation water salinity (51 $dS\ m^{-1} < 30\ dS\ m^{-1} < 17\ dSm^{-1} < 2.43 dSm^{-1}$).

However, as the general for the rest properties (E.C, Cl, SO_4, K, Ca, Na, Mg, Mn, Zn, and Cu) the opposite was true except for Fe.

Five fertilization treatments were used as follow: (I) control; (II) Algae extract as soil application at a rate of 1gm/pot/week; (III) Algae extract as foliar application at a rate of 1gm/L/2weeks; (IV) 1gm /pot/week of NPK (20: 20: 20) + 1 gm/ pot/ week of chelated MN (Fe+Mn+Zn+Cu) as soil application and (V) 1gm /pot/week of NPK (20 : 20 : 20) + 1gm/ pot/week of chelated MN (Fe+Mn+Zn+Cu) + 1gm/pot/week of algae extract as soil application. These fertilization treatments were applied in combination with the four levels irrigation water salinity.

At the end of the two experiments (October, 2017 and 2018) Plants were harvested, for morphological characteristics and analyzed according to Chapman and Pratt (1978).

The experimental design was split plot with 3 replicates for each treatment. Data were subjected to statistical analysis according to Snedecor and Cochran, (1981).The least significant differences (LSD) was used the means to compare.

Results and Discussion

Results of some physical and chemical properties of the experimental soil are tabulated in Table (1) where the soil, classified as sandy, characterized by alkalinity, low organic matter and very high calcium carbonate as well as TSS with reduction in majority of Macro- and Micro-Nutrients. The implication of this result confirmed a decrease in soil fertility (Nofal *et al.*, 2011).

The data representing the effect of four levels of irrigation water salinity and five fertilization treatments alone or in combined on some growth characteristics and nutrient contents of Salicornia plants cultivated under greenhouse conditions were illustrated in Table 2 and 3 as follows.

(i) Effect on growth characteristics:

The growth characteristics as affected by irrigation water salinity and fertilization are presented in Table (2). However, all growth characteristics i.e. plant height, fresh and dry weight revealed that, there were significant differences between fertilization treatments on Salicornia plants with respect to plant height and fresh weight, and the significantly increased in different degrees by addition of all fertilization treatments compared with control . In case of (NPK+MN+ algae soil application), the results showed the maximum plant height (30.7 cm) and fresh weight (12.97g/plant), respectively.

Furthermore, the irrigation water salinity level ($17 dSm^{-1}$) recorded the highest rates of plant height (32.36 cm) and fresh weight (15.15g/ plant).

Under all irrigation water salinity levels, with fertilization treatment of (NPK+MN + algae soil application), the obtained data exhibited that the highest significant plant height and fresh weight, was happened followed by (algae soil application) treatment ,relatively to a control which recorded the lowest values. However, applying irrigation water salinity level ($17 dSm^{-1}$) with (NPK+MN+ algae soil application) treatments presented both the highest plant height (37.6 cm) and fresh weight (19.81 g/plant) where this value tended to decrease with increasing the substitution of Seawater instead of Well water. In this respect, Ventura *et al.*, (2011), reported that, total yield of leafy vegetables in Salicornia gradually declined with increasing percentage of SW above 50% in the irrigation water. Also, Ashour and Mekki (2006) found that enhancing salinity level up to 50% in irrigation water associated with the reduce of the fresh weight of the halophytic grasses. This phenomenon may be due to the low plant growth which it's adversely affected of a specific ion content exceeds their thresholds and become toxic.

Concerning the dry weight in Table (2), the results presented give evidence that addition of fertilizers treatments significantly increased Salicolrnia dry weight compared with the untreated plants. The mean value of fertilized treatment by algae as foliar application was reached the highest (2.57g/plant) followed by NPK+ MN (2.49g/plant) and the treatment of algae as soil application recorded (2.43g/plant) compared to the control (1.71 g/plant). On the other hand, applying irrigation water salinity level (17dSm^{-1}) recorded the maximum mean of dry weight (2.77g/plant) followed by applying irrigation water salinity level (2.43dSm^{-1}) which reached (2.54 g/plant) and eventually, the irrigation water salinity level (51dSm^{-1}) achieved (1.63 g/plant). The results indicated that the interaction of algae foliar application plus the irrigation water salinity level (17 dSm^{-1}) significantly recorded the highest dry weight of Salicornia plants (3.8 g/plant). In this regard, salinity improved the growth and dry weight of glasswort (*Salicornia herbacea* L.) with enhancing salinity level as indicated by Amiri *et al.* (2010), within the optimum salinity ranged from 100 to 300 mM (NaCl and Na_2SO_4) during plants irrigated with half strength Hoagland's nutrient solution for six months but the depression was occurred with further enhancing in salinity.

These results confirmed by Khan *et al.*, (2000). However, Daoud *et al.*, (2001) cleared that an increase of dry matter production of most species of halophytic forage plants is a relevant to low and moderate salinity. Moreover, Yousif *et al.* (2010) indicated that numerous halophyte species are not only able to tolerant salinity, but also their growth is often stimulated by NaCl.

Regarding to the moisture content in Table (2), the results revealed that moisture content increased by adding all fertilization treatments, while increasing the ratio of irrigation water salinity significantly declined moisture content of Salicornia plant. On the other side, (NPK+ MN + algae soil application) treatment gave the highest mean of moisture content (10.79 gm/plant).

(ii) Effect on nutrients content

According to the obtained results in Table (3) we have seen that increasing the ratio of irrigation water salinity significantly decreased N and P contents to 1.03 and 0.06% with level (51 dSm^{-1}), respectively. However, fertilization treatments significantly increased N and P percent compared with the control.

Concerning the effect of (NPK+ MN+ algae soil application), the results showed that this treatment gave a significant highest content of N and P (1.55, 0.11 %) respectively, followed by (NPK+ MN) comparison with the control treatment.

In addition, a significant effect were noticed in the interaction of irrigation water salinity and fertilization treatments in N and P, where the highest P percent achieved at level of salinity (17 dSm^{-1}) with fertilization treatments of (NPK+MN +Algae soil application), (NPK+MN soil application) and (algae soil application) compared with the other treatments which were 0.12, 0.11 and 0.10 %, respectively. In this concern, Ventura *et al.* (2011) stated with different types of Salicornia plants that there were slight changes in the contents of NO_3 and SO_4 in response to salinity water irrigation. Also, Aghaleh *et al.* (2011) reported that P content in Salicornia plant decreased by increasing salinity level from 0, to 510 mM.

Data presented in Table (3) illustrated that, generally, K was highly significant at salinity level (30 dSm^{-1}) under all fertilization treatments. Moreover (NPK+MN + algae soil application) treatments compound with salinity level (30 dSm^{-1}) seemed to have the superior value of K content (2.65%).In this connection, Khan *et al.* (2001) concluded that the decrease of K content was a relevant characteristic with increased level of salinity up to 1000 mM NaCl in nutrient solution.

On the other side, a slight increase in K and noticeable elevations in Na content were observed by Ventura *et al.* (2011) during the irrigation with various levels of SW. Moreover, Aghaleh *et al.* (2011) suggested that with increasing salinity level of NaCl from 0, to 510 mM, K and P contents in Salicornia plant decreased. However, the opposite was true with Na content. With regard to Ca and Mg content in Table (3), there were slight variations found in fertilization and irrigation water salinity treatments but these differences were not significant. Where, Amiri *et al.* (2010) showed that the content of K, Ca and Mg decreased with increasing salinity, While Ventura *et al.* (2011) indicated that there was no any effect on content of Ca^{2+} and Mg^{2+} ion as related to increase the all levels of irrigation water salinity.

Regarding to Na^{+}, data in Table (3) showed that decreasing the salinity levels from (51 dSm^{-1}) to (2.43 dSm^{-1}) significantly reduced the mean value of Na content in Salicornia plants.

It recorded (7.46, 6.58, 5.84 and 5.76%) with levels of salinity water irrigation (51dSm^{-1}, 30dSm^{-1}, 17dSm^{-1}and 2.43 dSm^{-1}) respectively.

The interaction effect of fertilization and irrigation water salinity levels significantly affected Na content of Salicornia plant, where the lowest value recorded at level (2.43 dSm^{-1}) with (algae extract foliar application) as 5.2% while the highest value was found with irrigation water salinity level (30 dSm^{-1}) with fertilization treatment of (NPK+ MN + algae soil extract) as 8.4%.

These results were agreement with Khan *et al.*, (2001) which they reported with *Salicornia rubra* grown under greenhouse, that, Na and Cl content increased as related to increase the salinity level. They interpretation that, accumulates a large amount of Na and Cl to achieve osmotic balance across the soil, water and plant.

Also, (Parks *et al.*, 2002 and Aghaleh *et al.*, 2011) reported that, Sodium content of Salicornia plant increased by increasing salinity level. Salicornia plant under investigation showed a different responses in nutrients contents with fertilization treatments, in this connection, data in Table (3) revealed that, application of fertilizer treatments significantly ameliorate the Fe and Mn content. In case of NPK+ MN+ algae soil application and algae foliar application, Fe and Mn recorded the mean maximum content 133, 56 ppm, and 126, 33 ppm respectively compared to the control.

Also, the results showed that irrigation water salinity treatments at level (51 dSm^{-1}) gave the highest mean value of Fe (130 ppm) and Mn (47 ppm) and the reverse was true with decreasing the proportion of irrigation water salinity from level (51 dSm^{-1}) to level (2.43 dSm^{-1}).

With regard to the interaction effect of irrigation water salinity levels and fertilization treatments, the (NPK+MN+

algae soil application) under irrigation water salinity level (30 dSm^{-1}) recorded the maximum content of Fe (173 ppm) and Mn (89 ppm), while the content of Fe minimized to 43 ppm at the treatment of irrigation water salinity level (2.43 dSm^{-1}) with control fertilizer. As for Zn and Cu contents, results in Table (3) emphasized that Zn significantly affected by irrigation water salinity at level (30 dSm^{-1}) and fertilization where noted the supreme Zn content (134 ppm) under the treatment of (NPK+ MN + algae soil application), then irrigation water salinity (17 dSm^{-1}) level combined with (NPK +MN soil application) (90 ppm). Also, the same trend was happened with Cu content but the differences were not significant for the fertilization, irrigation water salinity and their interaction.

The addition of algae to the soil led to reducing the effect of salinity on the plant and improved the ability of the roots to absorb more elements not only macro- but also micro-nutrients for its effect of auxins on root growth, which was reflected on the physiological status of the plant and dry weight (Abdel –Maguid *et al.*, 2004 and El-Sayed *et al.*, 2018). Furthermore, the fertilization with macro and micro-nutrients created a more nutritional balance that was reflected on the plant and its quality (Ziadah and El-Shazly, 1998 and Rezk, *et al.*, 2013).

It can be concluded that the best fertilizer treatment achieved the nutritional balance and improved its quality was (NPK+ MN + algae soil application) with irrigation water salinity, especially the levels of salinity 17 $dSm^{-1}$and 30 dSm^{-1}.

Table 1 : Some physical and chemical properties of the experimental soil (combined of the two seasons).

Character	**Sand (%)**	**Silt (%)**	**Clay (%)**	**Texture**	**pH (1:2.5)**	**EC (1:2.5) dSm^{-1}**	**Organic matter %**	**Calcium Carbonate %**
Value	87	8	5	Sandy	8.2	3.64	0.08	18.8
Nutrients (ppm)	**K**	**Ca**	**Mg**	**Na**	**Fe**	**Mn**	**Zn**	**Cu**
	76	26	136	960	6.4	6.8	2.6	1.3

Table 2 : Means effect of irrigation water salinity and fertilization treatments and their interactions on growth characteristics and moisture content of Salicornia plants (combined analysis of two seasons).

Treatments		**growth characteristics**			**Moisture content (g/plant)**
Irrigation water salinity (S)*	**Fertilization**	**Plant height (cm)**	**Fresh Weight (g/plant)**	**Dry Weight (g/plant)**	
(S1) 51 dSm^{-1}	Control	13.9	2.32	1.73	0.59
	Algae extract Foliar	14.0	2.55	1.63	0.92
	Algae extract Soil	16.2	3.53	1.69	1.84
	NPK Soil +MN	16.3	3.69	1.65	2.04
	NPK Soil +MN+ Algae extract Soil	17.5	3.77	1.45	2.32
(S2) 30 dSm^{-1}	Control	23.8	4.75	1.88	2.87
	Algae extract Foliar	27.0	5.19	2.00	3.19
	Algae extract Soil	34.0	7.39	2.30	5.09
	NPK Soil +MN	30.2	6.70	2.25	4.95
	NPK Soil +MN+ Algae extract Soil	32.8	8.87	2.33	6.54
(S3) 17 dSm^{-1}	Control	25.9	7.88	1.52	6.36
	Algae extract Foliar	30.1	13.95	3.80	10.15
	Algae extract Soil	36.0	18.02	2.91	15.11
	NPK Soil +MN	32.2	16.10	3.11	12.99
	NPK Soil +MN+ Algae extract Soil	37.6	19.81	2.51	17.30
(S4) 2.43 dSm^{-1}	Control	24.6	8.75	1.69	7.06
	Algae extract Foliar	28.4	12.83	2.86	9.97
	Algae extract Soil	34.4	17.14	2.80	14.34
	NPK Soil +MN	30.1	15.86	2.93	12.93
	NPK Soil +MN + Algae extract Soil	35.0	19.42	2.42	17.00
Mean Values of Irrigation water salinity	(S1) 51 dSm^{-1}	15.58	3.17	1.63	1.54
	(S2) 30 dSm^{-1}	29.56	6.58	2.15	4.53
	(S3) 17 dSm^{-1}	32.36	15.15	2.77	12.38
	(S4) 2.43 dSm^{-1}	30.50	14.80	2.54	12.26
Mean Values of Fertilizers	Control	22.05	5.93	1.71	4.22
	Algae extract foliar	24.88	8.63	2.57	6.06
	Algae extract soil	30.15	11.52	2.43	9.10
	NPK Soil +MN	27.20	10.59	2.49	8.23
	NPK Soil + MN + Algae extract Soil	30.73	12.97	2.18	10.79
LSD at 5 % Irrigation water salinity		2.2	1.51	0.63	0.88
LSD at 5 % Fertilization treatments		3.1	1.73	0.75	0.98
LSD at 5 % Interaction of Irrigation water salinity x Fertilization treatments		4.8	3.06	1.10	1.96

*salinity levels as follows: S1=51 dSm^{-1} (100% Seawater), S2= 30 dSm^{-1} (50% Seawater + 50% Well water), S3=17 dSm^{-1} (25% Seawater +75% Well water) and S4=2.43 dSm^{-1} (100% Well Water)

Table 3 : Means effect of irrigation water salinity and fertilization treatments and their interactions on nutrients content of Salicornia plants (combined analysis of two seasons)..

Treatments		%						ppm			
Irrigation water salinity (S)*	Fertilization	N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
(S1) 51 dSm^{-1}	Control	0.49	0.02	1.70	0.44	0.077	7.3	117	31	54	15
	Algae extract foliar	1.02	0.05	1.45	0.37	0.057	7.9	110	35	63	11
	Algae extract soil	1.05	0.07	1.30	0.44	0.065	7.1	119	47	47	15
	NPK +MN soil	1.23	0.08	1.30	0.41	0.064	7.3	142	53	71	13
	NPK+MN + Algae extract soil	1.34	0.10	1.45	0.33	0.055	7.7	164	69	78	10
(S2) 30 dSm^{-1}	Control	0.64	0.03	2.00	0.43	0.058	5.8	85	24	35	17
	Algae extract foliar	1.05	0.07	2.15	0.46	0.060	6.4	163	44	63	15
	Algae extract soil	1.12	0.09	1.70	0.41	0.059	6.1	106	22	40	14
	NPK +MN soil	1.30	0.10	1.85	0.41	0.053	6.2	76	22	66	13
	NPK+MN + Algae extract soil	1.39	0.10	2.65	0.46	0.077	8.4	173	89	134	14
(S3) 17 dSm^{-1}	Control	0.70	0.05	1.80	0.44	0.060	5.8	76	20	33	14
	Algae extract foliar	1.12	0.08	1.80	0.41	0.051	5.9	109	30	39	13
	Algae extract soil	1.20	0.10	1.70	0.42	0.059	6.3	89	21	33	10
	NPK +MN soil	1.40	0.11	1.55	0.42	0.060	5.8	122	57	90	14
	NPK+MN+ Algae extract Soil	1.71	0.12	1.70	0.39	0.052	5.4	89	35	72	11
(S4) 2.43dSm^{-1}	Control	0.70	0.05	1.85	0.42	0.054	6.0	43	29	23	12
	Algae extract Foliar	1.10	0.07	1.65	0.39	0.046	5.2	122	24	28	13
	Algae extract Soil	1.24	0.09	1.55	0.39	0.054	5.9	73	16	24	10
	NPK +MN Soil	1.50	0.10	1.85	0.40	0.051	5.5	99	31	79	13
	NPK+MN+ Algae extract Soil	1.76	0.13	1.88	0.40	0.072	6.2	104	31	87	13
Mean Values of Irrigation water salinity	(S1) 51 dSm^{-1}	1.03	0.06	1.44	0.40	0.06	7.46	130	47	63	13
	(S2) 30 dSm^{-1}	1.10	0.08	2.07	0.43	0.06	6.58	121	40	68	15
	(S3) 17 dSm^{-1}	1.23	0.09	1.71	0.42	0.06	5.84	97	33	53	12
	(S4) 2.43 dSm^{-1}	1.26	0.09	1.76	0.40	0.06	5.76	88	26	48	12
Mean Values of Fertilizers	Control	0.63	0.04	1.84	0.43	0.06	6.23	80	26	36	15
	Algae extract foliar	1.07	0.07	1.76	0.41	0.05	6.35	126	33	48	13
	Algae extract soil	1.15	0.09	1.56	0.42	0.06	6.35	97	27	36	12
	NPK+MN soil	1.36	0.10	1.64	0.41	0.06	6.20	110	41	77	13
	NPK+MN + Algae extract Soil	1.55	0.11	1.92	0.40	0.06	6.93	133	56	93	12
LSD at 5 % Irrigation treatments		0.06	0.01	0.08	NS	NS	0.4	21	12	17	NS
LSD at 5 % Fertilization treatments		0.07	0.01	0.09	NS	NS	0.6	25	15	14	NS
LSD at 5 % Interaction of Irrigation water salinity x Fertilization treatments		0.19	0.02	0.11	NS	NS	0.7	28	17	16	NS

*salinity levels as follows: S1=51 dSm^{-1} (100% Seawater), S2= 30 dSm^{-1} (50% Seawater + 50% Well water), S3=17 dSm^{-1} (25% Seawater +75% Well water) and S4=2.43 dSm^{-1} (100% Well Water)

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