J. Agric. Sci. Mansoura Univ., 35 (3): 1993 - 2015, 2009

INTERACTIVE EFFECT OF SOME DIFFERENT SEAWATER DILUTIONS, REMEDIATION TREATMENTS AT DIFFERENT GROWTH STAGES OF CELERY PLANTS ON:
1- VEGETATIVE GROWTH AND QUALITY PARAMETERS.

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ABSTRACT

For facing acute problem of fresh water scarcity in the future, also, the sharing part from the Nile fresh water is 55.5 milliar m^3. This amount cannot be increased. In turn, there is no an increase of the available water for cultivation of newly reclaimed lands or face increasing population So, two pot experiments were conducted in the open field of Agriculture Station, Mansoura University during the two successive winter seasons of 2006-2007 and 2007-2008. To evaluate the growth and quality characteristics of celery (*Apium graveolens* var dulce), cv. Victoria plants, in response to different seawater dilutions and some remediation treatments as well as salinization regime at different periods and their interactions.

Factorial experiment in a randomized complete block design was used with 4 replicates for each treatment. The experiment included 90 treatments: 6 treatments of seawater dilutions with Nile water (Control, 5% seawater, 10% seawater, 15% seawater, 20% seawater, 25% seawater), 5 remediation treatments (without, Calcium 5mM (Ca1), Calcium 10 mM (Ca2), Polymer + Ca1, Polymer + Ca2). and 3 treatments of salinization regime (after 20, 40, 60 days from transplanting).

The results indicated that the effect of increasing the level seawater salinity from 5% up to 25% significantly decreased the mean values of plant growth parameters comparing with the control treatment (fresh water). Also, NO_2-N and NO_3-N concentrations were decreased significantly with increasing salinity levels. However, Vit C and TSS concentrations were increased significantly with increasing water salinity. Soil application with polymer combined with Ca2 was superior for increasing the most values of plant growth parameters, Vit C and TSS concentrations of celery plants following by foliar spraying with solution contains Ca (10 mM). While, both NO_2-N and NO_3-N decreased significantly with addition of remediation treatments. The lowest values were recorded with addition of calcium 10 mM. Also, All plant growth parameters, Vit C and TSS concentrations were significantly increased with decreasing salinization time (60, 40 and 20 days) after transplanting. The highest values were obtained when celery plants irrigated with saline water after 20 days from transplanting. On the other hand, NO_2-N and NO_3-N contents were increased significantly with increasing salinization time. The lowest values were recorded when plants received saline water after 20, following 40 and 60 days from transplanting.

In addition, The highest tolerance to salinity effects (the best vegetative growth parameters) were obtained from the plants which irrigated with seawater dilution at 15% after 60 days from transplanting and treated with polymer + Ca, while the less tolerant plants were the plants which irrigated with seawater dilution after 20 days from transplanting. Also, data indicated that the highest values of Vit C and TSS concentrations were obtained under high salinity level (25% seawater) with addition of polymer + Ca2 and irrigation with saline water after 20 days from transplanting. Meanwhile, NO_2-N and NO_3-N contents were significantly decreased with increasing salinity levels, addition of remediation treatments and irrigation with saline water at early stage of plant growth (after 20 days from transplanting). Also, it reduces the free nitrate in plants of celery which is useful to the health of consumers.

In general, it can be concluded that:

1-The highest tolerance to salinity with best quality was obtained from the plants which irrigated with seawater dilution at 15% (9 dS/m) after 60 days from transplanting and treated with polymer + Ca 10 mM under El-Dakahlia governorate conditions.
2-This treatment can be save about 10-150% of total water used to irrigation celery plants at different growth stages, consequently, it is considered one of ways for facing problem of fresh water scarcity in the future.
Keywords: Celery, Apium graveolens, salt stress, salt tolerance, seawater dilutions, water scarcity, vegetative growth, quality, remediation treatments, Ca application, polymers, PEG, salinization regime, time of salinization, growth stages..

INTRODUCTION

One-third of the world land surface is approximately arid or semi-arid (Liang *et al.*, 1996), facing acute problem of fresh water scarcity, which limits the sustainable development of agriculture in these regions. There is increasing consciousness among agricultural scientists and planners for using seawater (at least diluted) for irrigation of crops (Liu *et al.*, 2003). The high salt ion concentration in seawater is the main limiting factor behind the inappropriateness of seawater for agricultural applications.

Adverse effects of salinity on crop growth from two characteristics: (1) the increased osmotic potential of the soil solution with salinity makes the water in the soil less available for plants and (2) specific of some elements (Na, Cl, B, etc.) present in excess concentrations (Munns, 2005 and Yamaguchi and Blumwald, 2005).

Maas and Grattan (1999) classified celery as moderately sensitive or moderately tolerant to salinity. Celery belongs to division Magnoliophyta (Angiospermae), class Magnoliopsida (dicotyledons), order Apiales, Family Apiaceae, *Apium graveolens* L. var dulce Mill.

Most of the studies showed clearly that, the most of vegetative growth parameters were decreased significantly with increasing salinity (Silva *et al.*, 2003; Tammam, 2003; Irfan and Murat, 2004; Pascale *et al.*, 2005; Maggio *et al.*, 2007; Turan *et al.*, 2007; Silva *et al.*, 2008). Hajer *et al.* (2006) reported the effect of seawater salinity (1500, 2500, and 3500 ppm) on the growth of tomato cultivars. The seedling height increased with time but decreased with increasing salinity level in all cultivars. Seedlings fresh and dry shoot and root weights were decreased with increasing salinity level.

Most of the studies showed clearly that, the application of supplemental Ca alleviated the reduction of growth under saline condition (Cachorro *et al.*, 1994; Dabuxilatu and Lekeda, 2005; Farouk, 2005; Maeda *et al.*, 2005; Yan-Feng *et al.*, 2008). Rubio *et. al.* (2009) reported that salinity decreased total fruit yield and marketable fruit yield by 23% and 37%, respectively. However, increasing Ca^{+2} concentrations in the nutrient solution increased the fruit production and marketable yield.

The effect of synthetic polymers such as polyethylene glycol (PEG) and polyacrylamide for improving the plant growth parameters of the plants under saline condition may be refer to the role played by these substances for minimizing salinity around the root zoon and decrease salt accumulation on soil surface. As the soil conditions help in saving irrigation water, they also help in saving nutrients for the plant nutrition. De Boodt (1992) explained the different uses of synthetic soil conditioners (polymers) as following: 1) Improving soil structure through increasing water stable aggregates, 2) Synthetic soils conditioners are used in tile drainage project in order to improve hydrological characteristics of the soil and minimize silting around the pipes. 3) Soil conditioners enhance germination and emergence of seeds, minimize salinity around the root zone in drip irrigation and decrease salt accumulation on soil surface. As the soil conditioners help in saving irrigation water, they also help in saving fertilizers. Ajwa and Trout (2006) explained the different uses of synthetic polymers improving soil structure, in turn, this effect reflected on the other measured of plant growth parameters and yield for the plants under saline conditions.

The sensitivity of crops to soil salinity often changes from one stage of growth to the next (Maas, 1990; Lutts *et al.*, 1995; Wilson *et al.*, 2000; Zeng *et al.*, 2001; Kadir *et al.*, 2004). Hajer *et al.* (2006) found that tomato plants were more sensitive to soil salinity during the vegetative and early reproductive stages of development than later stages. Ghadiri *et al.* (2006) who reported that the effect of irrigation with seawater at the later stage of barley growth on the length parameter is negligible and sometimes beneficial and positive, whereas the adverse effects on all these factors are severe when irrigation with saline water starts early.

Owing to the previous mentioned knowledge, the major objective of the present study is to evaluate the growth characteristics and quality of celery plants in response to different seawater dilutions and some remediation treatments as well as salinization regime and their interactions under El-Dakahlia governorate conditions.

MATERIALS AND METHODS

This study was carried out in the two successive seasons of (2006:2007) and (2007: 2008). Two pot experiments were conducted in the open field of Agriculture Station, Mansoura. University to study the effect of irrigation with different seawater dilutions at three salinization time of plant growth in combination with some remediation treatments for alleviating the harmful effect of salinity in different aspects in this investigation.

The experimental design and treatments

Factorial experiment in a randomized complete block design was used with 4 replicates for each treatment. The experiment included 90 treatments: 6 treatments of seawater dilutions, 5 remediation treatments and 3 treatments of salinization regime.

I. First factor (seawater dilutions):

1- 0.0% seawater + 100% Nile water (control, 0.53 dS/m).
2- 5% seawater + 95% Nile water (3 dS/m).
3- 10% seawater + 90% Nile water (6 dS/m).
4- 15% seawater+ 85% Nile water (9 dS/m).
5- 20% seawater + 80% Nile water (12 dS/m).
6- 25% seawater + 75% Nile water (15 dS/m).

II. Second factor (remediation treatments):

1- Without
2- Calcium 5mM (Ca1).
3- Calcium 10 mM (Ca2).
4- Polymer + Ca1.
5- Polymer + Ca2.

III. Third factor (salinization regime time):

1- After 20 days from transplanting (20 DAT).
2- After 40 days from transplanting (40 DAT).
3- After 60 days from transplanting (60 DAT).

1 Preparation of pots:

The experiment plastic containers measuring 35 cm diameter and 45 cm height. Each pot was filled with 25 Kg of disturbed clay loam soil. The soil was taken from the upper layer (0-15 cm) of Agric. Exp. Sta., Mansoura Univ. Farm. Some physical and chemical properties of the used soil are shown in Table (1).

Table (1): Physical and chemical analysis of the experimental soil during 2007 and 2008 seasons.

Seasons	O.M %	$CaCO_3$ %	Coarse sand%	Fine Sand%	Silt %	Clay %	Texture class	EC** dS/m	pH*
2007	1.79	2.86	1.93	22.72	21.95	53.40	Clay	0.63	7.92
2008	1.86	1.95	1.85	21.93	22.12	54.10	Clay	0.68	8.03

Table 1: continue

S.p %	Available (ppm)			meq/100g soil					
	N	P	K	Ca^{++}	Mg^{++}	Na^{+}	Cl^{-}	SO_4^{--}	HCO_3^{-}
66	43	3.72	325	1.61	0.98	0.58	0.61	1.17	1.45
68	46	3.66	370	1.73	1.05	0.63	0.66	1.27	1.55

*Soil suspension (1:2.5)   ** Soil extraction (1:5)

2 Method of planting:

Celery (*Apium graveolens* var dulce), Family: Apiaceae, seed of Celery cv. Victoria plants were sown in field of nursery in the fourth week of September 2006 and 2007 seasons respectively, then transplantation into pots in the first week of December with observance existence two plants in every pot. Irrigation with saline water concentrations of seawater from shore Gamisa city was done with the other treatments under investigation.

3. Salinity treatments:

Saline solutions at a rate of (0.5, 3, 6, 9, 12 and 15 dS/m) were prepared by seawater dilutions by using Nile water (fresh water). The irrigation treatments were applied at 65% of soil field capacity. For all salinity treatments the pots were irrigated with Nile water every two weeks in order to prevent the accumulation of salts. Some chemical properties of the used seawater and Nile water are shown in Table (2).

Table (2): Chemical analysis of the used seawater and Nile water (fresh water) during 2007 and 2008 seasons.

Seasons		PH	EC dS/m	meq/L.							
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Co_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}
Sea water	2007	6.36	52	170.74	118.02	214.81	16.43	0.00	260.11	111.93	147.96
	2008	6.43	55	175.86	122.74	223.40	18.00	0.00	270.51	116.40	163.09
Nile water	2007	6.67	0.52	2.09	1.12	1.87	0.12	0.00	2.46	1.08	1.66
	2008	6.73	0.54	2.17	1.16	1.95	0.12	0.00	2.55	1.13	1.72

4. Salinization time:

After the cultivated plants in the same time in all pots for 90 treatments, the salinization regime as follow:

A. In the first 30 treatments, irrigation with fresh water from transplanting date for 20 days then was done and irrigation with seawater dilutions (Control, 5% seawater, 10% seawater, 15% seawater, 20% seawater, 25% seawater) and treated with remediation treatments (without, Calcium 5mM (Ca1), Calcium 10 mM (Ca2), Polymer + Ca1, Polymer + Ca2) up to the time of harvesting plants.

B. In the second 30 treatments, Nile water was used for irrigation from transplanting date up to 40 days and then irrigation with seawater dilutions (Control, 5% seawater, 10% seawater, 15% seawater, 20% seawater, 25% seawater) and treated with remediation treatments (without, Calcium 5mM (Ca1), Calcium 10 mM (Ca2), Polymer + Ca1, Polymer + Ca2), till the harvesting time of plants.

C. In the third 30 treatments, which were irrigated with fresh water from transplanting date for 60 days and then irrigation with seawater dilutions (Control, 5% seawater, 10% seawater, 15% seawater, 20% seawater, 25% seawater) and treated with remediation treatments (without, Calcium 5mM (Ca1), Calcium 10 mM (Ca2), Polymer + Ca1, Polymer + Ca2), till harvesting time of the plants.

5. The remediation treatments.

There were 5 remediation treatments in which can be described as following:

- Control treatment which was untreated with remediation treatments.
- Calcium chloride was obtained from El-Gamhoria Co.; Egypt in a pure powder it was prepared as stock solution at rate of (5 and 10 mM Ca^{++}) and used as foliar application once a week with irrigation with saline water.
- Polymer obtained from El-Gamhoria Co. as polyethylene glycol (PEG 6000) at 200 mg/l was added to the soil with irrigation water twice a week.

6. Sampling date:

After 120 days from transplanting of celery plants on March (at harvest), 6 plants were randomly taken from each treatment to determine the following characteristics:

I. Vegetative growth characteristics:

1. Number of leaves/plant.
2. Blade length.
3. Leaf stalk length.
4. Plant fresh weight (Plant yield).

5. Plant dry weight. 6. Leaf area (cm^2/ plant): It was calculated according to the method mentioned by (Koller, 1972).

II. Quality parameters:

1. Carbohydrates: It was determined by using the method described by Dubois (1956).
2. Vitamin C (Ascorbic acid): Which was determined by using the indophenols method (2, 6 dichlorophenol indophenol) as described by Ranganna (1979).
3. Total soluble solids (TSS): were determined using a hand refractometer.
4. Nitrate and Nitrite:Which was determined by using methods of Singh (1988).

Statistical analysis:

The obtained data were subjected to statistical analysis as factorial experiment in a randomized complete block design with four replicates in the both growing seasons. All data were statistically analyzed according to the procedure outlined by Snedecor and Cochran (1967). The treatment means were compared using LSD according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1- Vegetative growth characteristics

1.1. Effect of seawater dilutions:

Concerning the effect of irrigation with saline water, data in Table (3) indicated that, increasing the level of seawater dilutions from 5% to 25% significantly decreased the mean values of plant growth parameters comparing with the control treatment (fresh water).

1.2. Effect of remediation treatments:

Referring, the effect of an application of remediation treatments; it's evident from the same Table that the soil application with polymer combined with Ca2 significantly increased the mean values of most plant growth parameters of celery plants following by foliar spraying with Ca (10 mM).

1.3. Effect of salinization regime time:

Regarding the effect of salinization regime, data in Table (3) showed that, all plant growth parameters were significantly increased with increasing salinization time (20, 40 and 60 days) after transplanting. Thus, the highest values of these parameters were recorded for the plants irrigated with seawater dilution after 60 days from transplanting.

1.4. Effect of interactions:

With respect to the interaction affect between seawater dilutions and addition of remediation treatments on the growth parameters of celery plants, data presented in Table (4) show that foliar spraying with Ca or soil addition of polymer + Ca combined with irrigation with saline water at the dilution rates of 5, 10, 15, 20 and 25% seawater significantly increased the mean values of all growth parameters of celery plants compared to the untreated plants.

Generally, the results indicated that the most growth parameters of celery plants irrigated with seawater dilution at 10% (6 dS/m) and treated with polymer+ Ca gave the best interactions.

Table (3): Effect of seawater dilutions, remediation treatments and salinization regime time on plant growth parameters during 2007 and 2008 seasons.

Characters / Treatments	No. of leaves/ plant		Leaf area (cm)		Blade length (cm)		leaf stalk length (cm)		Fresh weight (plant yield) (g)		Dry weight /plant (g)	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
Seawater dilutions												
Control	30.9	30.8	115.8	112.4	27.2	27.1	20.6	20.4	619.6	593.2	64.0	54.6
5%	27.8	27.5	125.7	124.9	24.6	24.4	17.4	17.3	582.5	579.1	56.9	63.7
10%	25.7	25.7	111.8	107.7	21.0	20.7	16.0	15.8	448.0	432.3	56.4	54.5
15%	24.1	24.4	96.9	93.3	20.6	20.5	14.8	14.7	346.7	342.3	47.6	47.2
20%	22.8	22.9	81.0	75.2	18.1	18.0	13.7	13.5	286.2	282.6	40.6	40.1
25%	21.4	21.4	42.7	39.1	16.3	16.5	11.5	11.6	160.7	156.1	24.2	23.6
LSD at 5 %	1.26	1.26	9.56	9.21	0.69	0.69	0.59	0.59	39.13	38.20	0.61	0.60
Remediation treatments												
Without	24.8	24.8	89.0	80.8	20.2	20.2	15.0	14.7	334.7	329.7	43.9	43.5
Ca1 (5mM)	25.6	25.6	96.6	101.0	21.1	21.3	15.5	15.8	391.4	413.6	48.8	46.9
Ca2 (10mM)	25.5	25.2	102.3	86.9	21.4	21.0	15.8	15.3	420.2	374.9	52.1	54.2
Polymer + Ca1	25.8	25.9	110.6	91.9	21.6	22.1	15.8	16.3	429.4	422.2	55.2	51.1
Polymer + Ca2	25.7	25.7	111.2	100.0	22.2	21.5	16.3	15.6	460.8	447.5	56.5	54.6
LSD at 5 %	NS	NS	9.30	8.40	0.63	0.63	0.54	0.53	35.72	34.87	0.57	0.56
Salinization regime time												
20 DAT	23.7	23.4	73.9	60.4	17.0	16.9	14.1	14.0	315.7	300.3	42.3	40.2
40 DAT	26.2	26.5	103.4	94.5	21.8	21.7	15.8	15.6	412.8	403.2	51.6	50.4
60 DAT	26.4	26.4	125.4	121.4	25.0	25.0	17.1	17.1	493.3	489.3	58.9	58.7
LSD at 5 %	0.89	0.88	7.13	6.51	0.49	0.49	0.42	0.40	27.67	27.01	0.44	0.43

DAT: days after transplanting

Concerning, the interaction effect between seawater dilutions and salinization regime (Table, 5), the most suitable regime for irrigation of celery plants with saline water levels was after 60 days from transplanting for minimizing the effect of salinity on plant growth parameters following by 40 days and finally after 20 days from transplanting. In this connect, the highest values of all growth parameter were realized for all plants irrigated with saline water after 60 days from transplanting, while, the lowest one was obtained due to irrigation with saline water after 20 days from transplanting.

Also, in the same Table, data indicated that some plant growth parameters significantly were increased when plants irrigated with saline water after 60 days with addition of different remediation treatments. However this interaction had no significant effect on No. of leaves and blade length in both seasons.

Table (4): Interaction effect between seawater dilution and different remediation treatments on plant growth parameters of celery plants during 2007 and 2008 seasons.

Treatments: Seawater dilutions	Remediation Treatments	No. of leaves /plant 2007	No. of leaves /plant 2008	Leaf area (cm) 2007	Leaf area (cm) 2008	Blade length (cm) 2007	Blade length (cm) 2008	leaf stalk length (cm) 2007	leaf stalk length (cm) 2008	Fresh weight (plant yield) (g) 2007	Fresh weight (plant yield) (g) 2008	Dry weight /plant (g) 2007	Dry weight /plant (g) 2008
Control	Without	29.1	30.3	122.8	119.7	28.4	29.1	20.7	20.0	590.6	583.0	58.1	54.8
	Ca1 (5mM)	28.7	28.7	106.0	129.3	27.1	27.0	21.2	21.2	578.4	597.1	61.4	53.4
	Ca2 (10mM)	31.6	30.0	105.4	108.6	27.2	27.3	21.2	20.7	613.6	561.6	53.8	59.7
	Polymer + Ca1	31.9	33.0	111.7	103.4	26.1	26.4	19.9	20.0	634.8	633.0	54.2	53.8
	Polymer + Ca2	31.9	32.0	133.3	101.1	27.1	25.5	20.0	20.1	653.8	591.3	56.4	50.9
5%	Without	26.7	27.3	95.7	98.2	21.7	21.0	16.3	16.0	401.7	413.2	47.2	49.2
	Ca1 (5mM)	27.0	28.9	114.3	130.6	24.4	24.7	16.5	17.6	525.8	593.9	56.5	53.0
	Ca2 (10mM)	27.2	29.3	128.8	107.7	25.2	24.4	17.5	16.2	605.2	490.7	65.8	67.7
	Polymer + Ca1	29.1	26.4	132.1	128.0	25.7	25.9	18.3	18.9	638.3	627.7	70.1	64.7
	Polymer + Ca2	29.1	25.7	153.2	160.3	25.8	26.2	18.6	18.0	741.4	769.8	78.0	80.1
10%	Without	24.6	25.3	90.0	90.4	19.6	19.3	14.6	14.2	335.7	336.1	43.9	44.0
	Ca1 (5mM)	25.7	26.1	103.3	117.5	19.8	19.6	15.4	15.4	441.0	455.0	55.1	52.6
	Ca2 (10mM)	25.9	25.7	118.4	99.2	20.3	19.9	15.6	15.0	464.0	421.1	59.8	60.1
	Polymer + Ca1	26.0	26.0	120.9	114.1	22.5	22.4	16.9	17.4	494.2	489.7	60.8	58.3
	Polymer + Ca2	26.3	25.7	124.8	117.3	22.7	22.3	17.6	17.0	505.1	459.6	61.5	56.1
15%	Without	23.6	23.5	83.6	80.6	18.7	18.6	13.8	13.6	299.3	297.1	42.5	42.2
	Ca1 (5mM)	23.8	24.4	92.3	101.6	20.5	20.3	14.5	14.5	345.0	351.2	45.0	45.8
	Ca2 (10mM)	24.1	24.3	99.9	94.9	20.8	20.4	14.6	15.4	345.7	332.2	47.7	50.2
	Polymer + Ca1	24.1	24.2	102.0	88.3	21.1	22.2	15.3	15.6	359.2	337.1	50.8	43.8
	Polymer + Ca2	25.0	25.6	106.3	101.2	21.8	21.0	15.6	14.6	384.4	394.1	51.7	53.2
20%	Without	21.6	21.8	61.7	57.1	17.2	17.3	12.9	13.5	208.5	204.1	31.1	30.4
	Ca1 (5mM)	22.0	23.5	76.9	91.7	17.9	18.5	13.1	14.2	274.7	343.4	37.9	36.9
	Ca2 (10mM)	23.1	20.8	84.2	68.1	18.1	18.1	14.5	12.8	306.7	267.3	42.3	49.8
	Polymer + Ca1	23.6	24.0	85.5	81.9	18.8	18.6	13.2	14.4	308.3	304.9	43.0	41.8
	Polymer + Ca2	23.9	24.2	95.6	77.5	18.8	17.6	14.5	12.5	332.7	293.4	48.4	41.1
25%	Without	21.0	20.5	38.7	38.6	15.6	15.6	11.0	11.1	145.4	145.0	22.3	22.5
	Ca1 (5mM)	21.0	22.0	38.7	35.5	16.0	17.3	11.6	11.9	146.4	141.0	22.4	25.8
	Ca2 (10mM)	22.1	21.3	40.1	42.8	17.0	16.1	11.7	11.5	146.4	176.8	22.4	21.6
	Polymer + Ca1	21.0	22.0	47.6	35.5	16.0	17.3	11.6	11.9	182.6	141.0	26.7	21.6
	Polymer + Ca2	22.1	21.3	47.6	42.8	17.0	16.1	11.7	11.5	182.6	176.8	26.7	25.8
LSD at 5%		2.81	2.81	21.33	20.60	1.55	1.54	1.32	1.31	87.49	85.41	1.33	1.30

DAT: days after transplanting

Regarding to the effect of interaction among irrigation with seawater dilutions, some remediation treatments and salinization regime on plant growth parameters (Tables, 6 and 7). Data showed a significant effect on some growth parameters of celery plants while, such effect of these treatments had no significant effect on blade length. In this connect, the highest tolerant to salinity concentration was obtained from which irrigated with seawater dilution at 15% after 60 days from transplanting and treated with polymer+Ca, less tolerant plants were obtained from the plants which irrigated with seawater dilution after 20 days from transplanting.

From the results mentioned previously, it can be concluded that, the inhibitory effect of irrigation with saline water on plant growth parameters under investigation may be due to increasing osmotic pressure of soil solution which decrease water absorption by root system. This was accompanied by a reduction in nutrient uptake, metabolic processes, merestimatic activity and/or cell elongation leading to a decrease in all parameters of plant growth.

Table (5): Effect of both interactions (seawater dilutions x salinization regime) and (salinization regime x remediation treatments) on plant growth parameters of celery plants during 2007 and 2008 seasons.

Treatments / Characters		No. of leaves /plant		Leaf area (cm)		Blade length (cm)		leaf stalk length (cm)		Fresh weight (plant yield) (g)		Dry weight /plant (g)	
Seawater dilutions	Salinization Time	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
Control	20 DAT	28.9	27.7	107.0	101.3	28.4	28.5	22.1	21.4	630.0	602.5	56.1	54.2
	40 DAT	29.9	34.5	108.2	104.6	25.9	25.6	19.8	20.0	568.1	527.7	51.3	47.5
	60 DAT	30.0	30.1	132.8	131.3	27.2	27.1	19.9	19.8	660.9	649.5	63.4	62.4
5%	20 DAT	26.0	25.5	88.5	84.1	22.3	22.2	16.2	15.9	492.1	479.3	52.9	51.3
	40 DAT	28.4	29.1	140.7	140.7	24.8	24.7	18.0	17.9	612.8	645.0	68.8	69.0
	60 DAT	29.1	28.0	149.1	150.0	26.6	26.5	18.2	18.2	642.6	612.8	70.4	70.5
10%	20 DAT	23.6	23.5	66.9	61.5	13.5	13.4	13.4	13.2	320.7	285.0	41.6	36.8
	40 DAT	26.6	26.7	117.5	111.9	23.1	22.7	16.8	16.4	456.5	439.4	57.7	54.9
	60 DAT	26.9	27.0	148.5	149.7	26.4	26.1	17.8	17.7	566.8	572.5	69.2	69.8
15%	20 DAT	22.5	22.7	43.5	43.1	13.1	13.0	11.6	11.6	173.2	171.8	26.0	25.8
	40 DAT	24.3	24.7	95.7	97.0	22.8	22.9	15.5	15.5	373.4	374.8	49.9	50.6
	60 DAT	25.5	25.8	142.6	140.0	25.8	25.6	17.3	17.0	493.6	480.5	63.3	61.5
20%	20 DAT	21.3	21.2	40.1	39.1	11.5	11.3	11.6	11.5	153.4	152.5	24.3	24.1
	40 DAT	22.5	22.8	78.7	76.9	19.5	19.3	13.0	12.6	294.4	292.0	41.5	41.2
	60 DAT	24.7	24.6	113.6	109.8	23.5	23.5	16.3	16.3	410.8	403.3	51.8	50.8
25%	20 DAT	20.0	19.9	37.8	33.3	13.2	13.1	9.9	10.0	125.0	110.9	21.3	18.9
	40 DAT	21.9	21.4	37.0	36.2	14.9	14.9	11.4	11.2	142.0	140.2	21.5	21.3
	60 DAT	22.5	22.9	49.8	47.7	20.8	21.4	13.4	13.5	215.0	217.3	27.9	28.2
LSD at 5%		2.18	2.20	16.34	15.96	1.28	1.27	1.02	1.01	67.77	66.16	1.02	1.00
Salinization time X Remediation treatments													
20 DAT	Without	25.9	26.0	65.87	53.4	15.7	15.8	13.7	13.2	251.3	242.4	35.2	34.2
	Ca1 (5mM)	22.6	22.6	93.79	88.4	17.8	17.8	14.2	14.2	360.2	354.7	47.2	46.8
	Ca2 (10mM)	25.8	25.7	99.96	96.13	20.9	20.7	14.7	14.5	392.7	392.1	47.9	47.8
	Polymer+ Ca1	26.5	26.3	93.43	75.52	21.2	21.1	15.8	15.9	378.7	363.0	53.4	50.8
	Polymer+ Ca2	23.2	22.9	103.62	100.53	24.0	24.1	16.4	16.5	355.6	356.1	46.9	46.6
40 DAT	Without	27.0	27.6	135.36	131.46	25.1	24.8	14.7	14.5	526.3	521.7	63.7	63.1
	Ca1 (5mM)	25.0	24.7	64.09	52.88	17.0	16.8	14.1	13.9	275.6	257.9	36.1	34.0
	Ca2 (10mM)	25.1	24.5	99.77	91.68	17.9	17.8	15.6	15.2	394.3	378.0	49.3	47.6
	Polymer+ Ca1	26.4	26.5	67.12	54.39	21.4	21.3	16.9	16.6	504.1	489.0	59.0	57.7
	Polymer+ Ca2	27.7	28.4	121.52	116.06	25.0	25.2	17.3	17.3	326.1	307.3	42.4	39.6
60 DAT	Without	23.7	23.2	108.79	98.03	23.2	23.0	13.9	13.9	467.8	460.9	55.2	54.4
	Ca1 (5mM)	25.9	26.2	78.84	65.79	16.6	16.4	16.4	16.4	494.4	498.6	57.4	57.8
	Ca2 (10mM)	27.1	27.3	126.36	123.15	22.4	22.2	17.1	17.0	347.1	331.0	44.4	42.4
	Polymer+ Ca1	24.0	24.0	111.94	98.46	25.4	25.5	16.2	15.9	486.2	466.2	57.9	55.0
	Polymer+ Ca2	26.0	26.6	139.23	135.83	25.7	25.8	17.9	18.0	549.1	595.4	66.4	71.4
LSD at 5%		N.S	N.S	15.91	14.56	N.S	N.S	N.S	N.S	61.87	60.91	1.00	0.98

DAT: days after transplanting

The results of effect of salinity levels on plant growth parameters were in agreement with those obtained by Silva *et al.* (2003) on cowpea, Tammam (2003) on broad bean, Irfan and Murat (2004) on cucumber, Pascale *et al.* (2005) on cauliflower and broccoli, Hajer *et al.* (2006) on tomato, Maggio *et al.* (2007) on eggplant, Turan *et al.* (2007) on bean and Silva *et al.* (2008) on young umbo plants.

Table (6): Interaction effect among seawater dilutions, remediation treatments and salinization time on plant growth parameters of celery plants during season of 2007.

Treatments \ Characters		No. of leaves / plant			Leaf area (cm^2)			Blade length (cm)			leaf stalk length (cm)			Fresh weight (plant yield) (g)			Dry weight /plant (g)		
		20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60DAT
Control	Without	28.0	29.0	34.7	131.0	104.4	133.8	30.7	26.5	28.0	24.7	18.9	18.7	614.1	576.8	662.1	60.0	51.9	62.7
	Ca1 (5mM)	27.3	28.7	30.0	87.5	116.3	115.9	29.0	25.6	26.6	22.4	20.3	20.8	594.3	546.9	594.0	73.4	47.7	61.8
	Ca2 (10mM)	29.3	30.7	34.7	70.1	110.0	136.8	29.9	24.4	27.2	21.7	21.1	20.8	765.0	463.9	611.7	50.5	53.2	57.6
	Polymer+ Ca1	30.3	29.7	35.7	94.3	101.8	141.3	26.0	25.3	27.0	20.6	19.5	19.8	554.8	660.2	689.4	47.4	54.5	60.9
	Polymer+ Ca2	31.0	30.0	34.7	158.6	104.4	134.7	26.5	27.8	27.0	21.1	19.3	19.3	621.8	592.5	747.2	50.6	46.7	73.8
5%	Without	24.7	26.7	28.3	52.8	106.6	129.4	18.8	20.8	25.5	15.1	15.6	18 2	300.3	411.2	493.7	34.0	50.2	57.8
	Ca1 (5mM)	24.7	27.7	28.3	76.2	134.6	136.1	21.1	25.2	27.0	16.0	16.2	17.2	361.7	547.2	668.5	49.2	61.0	71.5
	Ca2 (10mM)	26.0	27.0	29.7	77.2	131.3	138.4	23.7	25.1	26.8	15.4	18.2	18.8	486.8	601.8	615.1	68.0	70.1	61.5
	Polymer+ Ca1	26.3	29.3	29.3	101.8	150.1	158.4	24.8	26.0	26.8	16.0	18.3	18.7	598.7	633.6	794.6	83.0	70.7	74.5
	Polymer+ Ca2	28.3	29.3	31.7	131.9	160.9	192.2	23.3	26.8	26.9	17.8	19.8	20.1	713.0	637.6	774.4	74.3	72.3	89.8
10%	Without	21.0	25.3	26.0	59.7	101.3	103.7	11.5	21.9	25.6	11.5	15.1	17.1	274.4	360.8	369.9	37.5	47.8	45.8
	Ca1 (5mM)	23.0	26.0	26.7	59.9	101.9	141.7	12.9	20.7	25.9	12.9	15.2	18.1	285.5	362.9	636.0	34.4	74.8	73.4
	Ca2 (10mM)	24.0	26.0	27.3	62.6	110.4	143.8	13.6	21.9	25.3	13.7	16.5	16.4	314.9	401.5	525.9	37.4	50.5	75.3
	Polymer+ Ca1	24.3	26.7	27.3	62.3	127.1	161.2	13.5	26.0	27.9	13.6	17.8	17.9	279.4	540.3	586.3	53.2	63.1	63.1
	Polymer+ Ca2	25.7	27.0	29.0	86.5	142.1	191.7	16.1	24.9	27.1	15.3	19.2	19.7	449.1	617.1	716.1	43.7	49.2	87.8
15%	Without	20.7	23.7	24.7	38.5	85.0	106.4	11.1	20.6	24.3	11.2	13.8	16.4	146.3	302.4	370.7	22.6	42.5	48.8
	Ca1 (5mM)	21.3	24.0	25.7	38.6	87.0	141.4	13.0	21.7	26.9	11.7	15.0	16.9	158.3	355.0	496.4	22.6	45.9	63.0
	Ca2 (10mM)	22.3	24.7	25.3	41.2	99.3	154.9	13.3	23.3	25.8	11.6	16.0	18.5	159.1	367.2	510.8	23.7	49.2	64.6
	Polymer+ Ca1	22.7	25.3	25.7	47.0	101.7	141.1	13.0	24.4	25.9	11.1	16.1	16.6	195.7	380.9	521.6	28.9	53.4	66.9
	Polymer+ Ca2	24.0	25.3	26.3	52.6	103.6	167.6	15.1	24.0	26.2	12.3	16.7	17.9	206.9	461.3	568.3	32.3	57.9	72.4
20%	Without	20.0	20.7	24.0	26.2	66.9	83.2	10.3	19.6	21.6	10.0	13.6	16.0	91.1	245.9	288.5	15.3	34.2	38.2
	Ca1 (5mM)	20.7	21.0	24.7	36.9	64.8	114.9	13.8	19.0	23.6	11.1	11.9	15.2	136.3	243.3	407.2	21.2	35.9	51.6
	Ca2 (10mM)	20.7	23.0	24.3	37.9	87.7	116.9	11.6	19.6	23.1	13.0	13.7	17.0	152.5	340.8	426.9	23.4	41.7	53.6
	Polymer+ Ca1	22.7	23.3	24.7	38.6	83.4	119.3	10.1	18.9	24.7	11.6	12.2	16.1	155.6	362.2	453.4	23.7	46.2	53.2
	Polymer+ Ca2	22.7	24.3	25.7	60.6	89.5	131.8	11.7	20.2	24.5	12.5	13.8	17.2	231.5	288.9	477.8	37.8	50.5	61.6
25%	Without	19.3	20.3	22.0	26.4	27.2	40.8	12.0	15.9	19.0	9.4	11.6	12.1	81.5	171.2	183.4	13.9	22.8	28.8
	Ca1 (5mM)	19.7	20.3	23.0	34.0	27.2	40.2	12.3	14.0	21.7	9.3	11.7	14.0	115.6	116.9	168.7	17.3	18.8	22.0
	Ca2 (10mM)	20.7	22.3	23.3	34.0	40.2	50.8	14.6	15.4	20.8	10.8	11.0	13.3	115.6	116.9	168.7	17.3	18.8	22.0
	Polymer+ Ca1	19.7	21.7	23.0	47.9	40.2	63.4	12.3	14.0	21.7	9.3	11.7	14.0	147.7	154.9	283.1	22.2	27.8	36.0
	Polymer+ Ca2	20.7	22.3	23.3	47.9	40.2	63.4	14.6	15.4	20 8	10.8	11.0	13.3	147.7	154.9	283.1	22.2	27.8	36.0
LSD at 5%			4.87			36.41			NS			2.28			151.5			0.04	

Table (7): Interaction effect among seawater dilutions, remediation treatments and salinization time on plant growth parameters of celery plants during season of 2008.

Treatments	Characters	No. of leaves/ plant			Leaf area (cm^2)			Blade length (cm)			leaf stalk length (cm)			Fresh weight (plant yield) (g)			Dry weight /plant(g)		
		20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT
Control	Without	28.7	33.4	28.6	119.1	104.6	135.3	31.8	26.8	28.6	22.2	19.2	18.5	577.7	522.8	648.5	56.0	47.1	61.0
	Ca1 (5mM)	27.1	28.2	30.8	143.0	104.3	140.5	29.5	25.0	26.5	21.9	21.0	20.7	714.6	448.5	628.1	49.8	52.2	58.0
	Ca2 (10mM)	31.2	28.0	30.9	88.8	119.3	117.8	29.9	24.9	27.2	22.2	19.7	20.3	565.6	527.0	592.2	69.3	45.7	64.1
	Polymer+ Ca1	26.3	42.3	30.3	63.6	111.4	135.1	26.3	26.4	26.5	20.2	19.8	19.8	535.6	669.3	694.1	46.1	54.9	61.1
	Polymer+ Ca2	25.1	40.8	30.0	92.2	83.4	127.7	25.1	24.7	26.6	20.7	20.0	19.6	618.8	470.8	684.5	50.1	37.2	67.1
5%	Without	26.4	27.3	28.1	50.8	113.4	130.5	17.8	20.3	25.0	15.3	14.8	18.1	298.1	438.1	503.5	34.9	53.4	58.9
	Ca1 (5mM)	25.7	31.2	29.8	102.9	160.3	128.7	23.1	25.2	25.8	15.5	19.2	18.1	608.2	601.4	572.2	34.4	65.6	59.9
	Ca2 (10mM)	28.1	29.5	30.3	69.3	130.5	123.2	21.3	24.9	27.0	15.7	16.8	16.1	324.5	612.9	534.6	66.3	69.8	66.4
	Polymer+ Ca1	23.4	29.5	26.4	73.9	146.3	163.7	23.5	26.8	27.4	15.5	20.4	20.7	483.1	752.5	647.5	48.8	70.0	73.8
	Polymer+ Ca2	23.8	28.1	25.1	123.7	153.2	203.9	25.4	26.2	27.1	17.7	18.3	18.1	682.7	820.3	806.5	70.3	77.9	92.7
10%	Without	21.0	28.2	26.6	63.1	95.7	112.4	11.0	21.4	25.5	11.0	14.3	17.2	272.0	342.5	393.7	37.3	44.9	48.8
	Ca1 (5mM)	22.3	26.6	29.4	50.7	112.8	189.0	12.7	20.5	25.6	12.7	15.5	18.0	262.9	374.9	727.2	35.0	48.5	73.4
	Ca2 (10mM)	25.9	25.3	26.0	56.1	98.5	142.9	13.1	21.4	25.2	13.3	15.9	15.9	268.9	387.8	606.6	36.3	50.6	88.7
	Polymer+ Ca1	22.9	27.8	27.3	74.3	123.6	144.4	16.5	24.1	26.7	15.5	17.1	19.5	396.4	533.5	539.2	46.8	62.4	65.2
	Polymer+ Ca2	25.6	25.8	25.6	63.5	128.6	159.9	13.4	25.9	27.5	13.7	19.2	18.1	224.7	558.2	596.0	27.4	65.9	74.5
15%	Without	20.9	23.9	25.7	38.2	103.2	100.5	11.0	20.8	24.1	11.1	13.6	16.1	141.3	400.0	350.0	21.9	56.4	45.5
	Ca1 (5mM)	20.7	25.8	26.7	50.9	83.6	170.4	13.0	21.5	26.5	11.5	15.0	17.0	202.5	280.3	570.7	22.9	49.3	62.2
	Ca2 (10mM)	22.1	25.3	25.5	39.0	101.3	144.5	13.0	23.2	24.9	11.4	16.0	18.6	152.7	365.3	478.7	31.8	40.1	73.6
	Polymer+ Ca1	23.3	24.4	24.9	40.1	84.9	140.1	15.0	24.8	26.7	12.7	17.1	16.9	163.0	345.5	503.0	23.0	44.6	60.9
	Polymer+ Ca2	26.7	24.0	26.2	47.1	112.0	144.4	12.9	24.3	25.9	11.4	15.9	16.4	199.5	482.8	500.2	29.5	61.3	65.5
20%	Without	19.8	21.4	24.1	24.7	66.4	80.1	10.6	19.9	21.5	10.2	13.4	16.9	88.3	248.8	275.2	14.8	36.3	36.3
	Ca1 (5mM)	21.3	23.8	25.5	63.2	87.1	124.8	13.6	18.9	23.1	12.5	13.7	16.4	253.2	311.5	465.5	20.9	32.5	51.4
	Ca2 (10mM)	19.6	19.8	22.9	35.7	62.2	106.3	11.8	19.1	23.5	11.8	11.9	14.8	134.0	232.4	435.6	41.0	44.2	60.5
	Polymer+ Ca1	22.5	24.2	25.3	32.0	93.3	120.3	11.2	20.4	24.3	12.3	13.2	17.7	129.0	344.3	441.3	19.6	46.5	54.7
	Polymer+ Ca2	22.5	24.8	25.3	39.8	75.4	117.4	9.5	18.1	25.2	10.9	10.9	15.8	158.0	323.2	399.0	24.3	45.2	50.7
25%	Without	18.7	21.6	21.2	24.5	47.0	44.3	12.4	15.0	19.5	9.7	11.4	12.2	76.8	176.3	181.8	13.1	28.0	24.4
	Ca1 (5mM)	20.5	22.3	23.2	42.5	28.8	35.4	14.7	15.7	21.5	11.0	11.1	13.6	136.5	120.1	166.5	16.6	21.2	36.3
	Ca2 (10mM)	19.9	20.5	23.4	28.5	38.3	61.7	11.9	14.1	22.4	9.3	11.2	13.9	102.3	142.1	286.0	24.4	18.0	21.6
	Polymer+ Ca1	20.5	22.3	23.2	42.5	28.8	35.4	14.7	15.7	21.5	11.0	11.1	13.7	136.5	120.1	166.5	24.4	18.0	21.6
	Polymer+ Ca2	19.9	20.5	23.4	28.5	38.3	61.7	11.9	14.1	22.4	9.3	11.2	13.9	102.3	142.1	286.0	16.6	21.2	36.3
LSD at 5%		4.87			35.67			NS			2.26			148.27			0.039		

The stimulatory effect of remediation treatments used on all plant growth parameters could be explained on the base of role played by calcium ions for competition against sodium ions, consequently protect the cell membrane from the adverse effects of salinity. Moreover, calcium plays an important role in the water transport of plants growing under salt stress and help in osmotic adjustment and growth via the enhancement of compatible organic salutes accumulation. This result is in harmony with that found by Cachorro *et al.* (1994) on bean, Dabuxilatu and Leleda (2005) on soybean and cucumber, Farouk (2005) on pea, Maeda *et al.* (2005) on tobacco and Yan-Feng *et al.* (2008) on Jerusalem artichoke and Rubio *et al.* (2009).

The effect of synthetic polymers such as polyethylene glycol for improving the plant growth parameters of the plants under saline condition may be refer to the role played by these substances for minimizing salinity effect around the root zone and decrease salt accumulation on soil surface. As the soil conditions help in saving irrigation water, they also help in saving nutrients for the plant nutrition. These results are in harmony with those obtained by De Boodt (1992), Zahow and Amerhein (1992), and Ajwa and Trout (2006) explained the different uses of synthetic polymers improving soil aggregates and structure, consequently, this in turn improve the plant growth parameters and yield for the plants under saline conditions.

Concerning the effect of salinization time on plant growth parameters, these results are in agreement with those obtained by Passam and Kakouriotis (1994), Lutts *et al.* (1995), Wilson *et al.* (2000), Zeng *et al.* (2001), Kadir *et al.* (2004) and Ghadiri *et al.* (2006).

2. Celery quality:

2.1 Effect of seawater dilutions:

Concerning the effect of irrigation with seawater dilutions, data at Table (8) reveal that, carbohydrate concentration, ascorbic acid and total soluble solid significantly increased with increasing water salinity. The highest value was obtained under high salinity level at 15% seawater dilution. However, NO_2-N and NO_3-N were decreased significantly with increasing salinity levels.

2.2. Effect of remediation treatments:

Referring, the effect of remediation treatments, data in the same Table indicated that, all remediation treatments used specially polymer which mixed with calcium or calcium 10 mM (only spraying) increased carbohydrate concentration, Vit C and TSS concentrations of celery plants compared to untreated plants in both seasons. While, both NO_2-N and NO_3-N decreased significantly with addition of remediation treatments. The lowest values were recorded with addition of calcium 10 mM.

2.3. Effect of salinization regime:

As for the effect of salinization time, data presented in Table (8) showed that, Vit C and TSS under study were significantly increased with decreasing salinization time from 60 to 40 and 20 days after transplanting. While, carbohydrate contents increased significantly with increasing salinization time. On the other hand, NO_2-N and NO_3-N decreased significantly with decreasing salinization time. The lowest values were recorded when plants received saline water after 20 days from transplanting during the two growing seasons.

Table (8): Effect of seawater dilutions, remediation treatments and salinization regime on some quality parameters of celery plants during 2007 and 2008 seasons.

Characters / Treatments	Vitamin C (mg/100gFW)		TSS (%)		No_2-N (ppm)		No_3-N (ppm)		Carbohydrate (%)	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
Seawater dilutions										
Control	5.78	5.75	5.48	5.45	3.51	3.62	320.98	330.86	1.94	1.90
5%	7.35	7.38	5.97	5.97	3.25	3.35	293.62	304.40	2.33	2.28
10%	8.32	8.33	6.32	6.36	2.90	2.99	255.80	263.66	2.11	2.10
15%	9.34	9.36	6.67	6.65	2.56	2.64	221.64	228.39	2.05	2.01
20%	10.42	10.42	6.66	6.62	2.17	2.24	187.00	192.69	1.77	1.73
25%	11.20	11.17	7.15	7.20	1.86	1.92	157.33	161.93	1.47	1.45
LSD at 5%	0.21	0.21	0.14	0.14	0.004	0.004	2.73	2.82	0.05	0.05
Remediation treatments										
Without	7.79	7.78	6.43	6.42	2.88	2.94	257.33	264.24	1.87	1.81
Ca1 (5mM)	8.52	8.56	6.29	6.34	2.65	2.70	233.44	238.28	1.94	1.89
Ca2 (10mM)	9.09	9.08	6.44	6.45	2.54	2.59	222.89	227.35	1.97	1.92
Polymer + Ca1	9.11	9.14	6.27	6.26	2.77	2.83	245.39	250.32	1.96	1.90
Polymer + Ca2	9.16	9.12	6.43	6.41	2.70	2.75	237.93	242.74	2.00	1.94
LSD at 5%	0.19	0.19	0.13	0.13	0.004	0.004	2.49	2.54	0.05	0.05
Salinization regime										
20 DAT	10.19	10.16	6.78	6.79	2.56	2.66	226.17	236.12	1.66	1.60
40 DAT	9.15	9.16	6.42	6.41	2.74	2.85	241.98	251.74	1.93	1.86
60 DAT	6.86	6.89	5.91	5.92	2.82	2.94	250.04	260.28	2.24	2.16
LSD at 5%	0.15	0.15	0.10	0.10	0.003	0.003	1.93	2.01	0.04	0.04

DAT: days after transplanting.

2.4. Effect of interactions:

Data presented in Table (9) show that, celery plants irrigated with salinity levels at 5, 10, and 15 % of seawater dilutions plus polymers combined with calcium, had no significant effect on the mean values of Vit C, while, carbohydrate concentrations were increased significantly during both seasons. On the other hand, both NO_2-N and NO_3-N significantly decreased with application of remediation treatments and increasing water salinity. The lowest values of NO_2-N and NO_3-N were recorded for the plants irrigated with seawater at a rate of 25% and treated with Calcium 10 mM as foliar application.

Table (9): Interaction Effect between seawater dilutions and remediation treatments on some quality parameters of celery plants in 2007 and 2008 seasons.

Seawater dilutions	Remediation Treatments	Vitamin C (mg/100gFW) 2007	Vitamin C (mg/100gFW) 2008	TSS (%) 2007	TSS (%) 2008	NO_2-N (ppm) 2007	NO_2-N (ppm) 2008	NO_3-N (ppm) 2007	NO_3-N (ppm) 2008	Carbohydrate (%) 2007	Carbohydrate (%) 2008
Control	Without	4.72	4.75	5.31	5.33	3.71	3.90	335.78	373.95	1.74	1.64
	Ca1 (5mM)	5.58	5.54	5.73	5.81	3.43	3.61	313.89	329.86	1.84	1.79
	Ca2 (10mM)	6.33	6.24	5.40	5.33	3.32	3.49	301.11	316.52	2.27	2.15
	Polymer + Ca1	6.05	6.04	5.27	5.24	3.52	3.70	330.22	347.15	1.84	1.75
	Polymer + Ca2	6.22	6.18	5.67	5.57	3.54	3.72	323.89	340.89	2.00	1.87
5%	Without	6.45	6.52	6.13	6.13	3.42	3.59	326.33	352.04	2.11	2.00
	Ca1 (5mM)	6.97	7.07	5.96	5.99	3.22	3.38	283.22	297.77	2.32	2.21
	Ca2 (10mM)	7.65	7.58	6.13	6.18	3.04	3.19	270.11	283.96	2.55	2.45
	Polymer + Ca1	7.96	8.11	5.70	5.69	3.33	3.50	296.89	312.13	2.22	2.14
	Polymer + Ca2	7.70	7.64	5.91	5.88	3.26	3.42	291.56	306.52	2.47	2.29
10%	Without	7.41	7.32	6.44	6.46	3.04	3.19	268.33	282.43	2.03	1.96
	Ca1 (5mM)	8.03	8.05	6.60	6.68	2.80	2.94	250.78	264.04	1.85	1.79
	Ca2 (10mM)	8.56	8.62	6.20	6.35	2.72	2.86	240.89	253.04	1.92	1.85
	Polymer + Ca1	8.89	8.97	6.40	6.35	2.98	3.14	263.00	276.31	2.30	2.17
	Polymer + Ca2	8.72	8.70	5.96	5.94	2.93	3.09	256.00	268.83	2.45	2.41
15%	Without	8.27	8.27	6.80	6.78	2.75	2.89	237.22	249.84	2.06	1.96
	Ca1 (5mM)	8.91	9.04	6.27	6.32	2.47	2.59	213.89	224.67	2.26	2.15
	Ca2 (10mM)	9.79	9.78	6.80	6.75	2.36	2.48	206.22	216.88	1.82	1.73
	Polymer + Ca1	9.78	9.81	6.82	6.76	2.64	2.77	229.56	241.00	2.05	1.94
	Polymer + Ca2	9.96	9.89	6.67	6.67	2.57	2.70	221.33	232.40	2.06	1.98
20%	Without	9.54	9.40	6.82	6.78	2.34	2.47	202.56	213.16	1.77	1.68
	Ca1 (5mM)	10.39	10.41	6.44	6.36	2.09	2.21	180.33	189.85	1.88	1.78
	Ca2 (10mM)	10.61	10.75	6.51	6.48	2.00	2.10	171.11	179.42	1.73	1.65
	Polymer + Ca1	10.76	10.69	6.69	6.67	2.26	2.37	194.11	156.70	1.89	1.81
	Polymer + Ca2	10.78	10.84	6.82	6.81	2.15	2.26	186.89	196.30	1.57	1.49
25%	Without	10.33	10.41	7.09	7.02	2.03	2.13	173.78	182.62	1.51	1.44
	Ca1 (5mM)	11.23	11.23	6.76	6.86	1.86	1.96	158.56	166.40	1.47	1.39
	Ca2 (10mM)	11.59	11.49	7.58	7.62	1.76	1.85	147.89	155.19	1.51	1.44
	Polymer + Ca1	11.23	11.23	6.76	6.86	1.86	1.96	158.56	166.40	1.47	1.39
	Polymer + Ca2	11.59	11.49	7.58	7.62	1.76	1.85	147.89	155.19	1.42	1.35
LSD at 5%		NS	NS	0.31	0.30	0.009	0.010	6.10	6.40	0.11	0.10

Data in Table (10) indicated that Vit C and TSS significantly increased with increasing salinity levels but they decreased significantly with increasing salinization time. While, carbohydrates content increased significantly with increasing salinization time from 20 to 60 days after transplanting at any level of salinity dilutions. On other words, the highest values of Vit C and TSS were recorded when plants irrigated with 25% seawater dilution and received saline water after 20 days from transplanting.

However, NO_2-N and NO_3-N concentrations decreased significantly with increasing water salinity. The lowest values of NO_2-N and NO_3-N were obtained when plants irrigated with 25% seawater and irrigation with saline water was done after 20 days from transplanting.

Data presented in Table (10) showed that the highest values of Vit. C and TSS were obtained from the plants irrigated with saline water after 2o days and treated with polymer + Ca2 additions. For increasing carbohydrates concentrations, the most suitable time for irrigation with saline water after 60 days from transplanting and treated with different remediation treatments.

Table (10): Effect of both interactions (seawater dilutions x salinization regime) and (salinization regime x remediation treatments) on some quality parameters of celery plants during 2007 and 2008 seasons.

Treatments / Characters		Vitamin C (mg/100gFW)		TSS (%)		NO_2-N (ppm)		NO_3-N (ppm)		Carbohydrate (%)	
Seawater dilutions	Salinization time	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
Control	20 DAT	6.08	6.06	5.83	5.82	3.33	3.57	301.40	322.86	1.86	1.74
	40 DAT	5.85	5.79	5.45	5.40	3.53	3.79	326.33	349.86	1.85	1.74
	60 DAT	5.41	5.40	5.15	5.14	3.65	3.92	335.20	359.55	2.10	1.99
5%	20 DAT	9.55	9.53	6.23	6.24	3.07	3.29	285.80	311.86	2.15	2.03
	40 DAT	6.66	6.76	5.92	5.92	3.31	3.55	293.40	314.45	2.44	2.28
	60 DAT	5.83	5.86	5.75	5.77	3.38	3.62	301.67	323.42	2.41	2.28
10%	20 DAT	10.11	10.04	6.71	6.75	2.74	2.94	239.87	256.97	1.72	1.63
	40 DAT	8.33	8.36	6.19	6.17	2.93	3.14	259.60	278.33	2.15	2.03
	60 DAT	6.52	6.59	6.07	6.15	3.02	3.25	267.93	287.31	2.46	2.38
15%	20 DAT	11.12	11.05	7.13	7.17	2.42	2.59	207.27	221.81	1.61	1.51
	40 DAT	9.73	9.76	6.96	6.90	2.59	2.79	225.13	241.46	2.07	1.95
	60 DAT	7.18	7.26	5.92	5.89	2.66	2.86	232.53	249.30	2.48	2.33
20%	20 DAT	11.85	11.91	7.45	7.41	2.05	2.20	174.73	187.06	1.34	1.28
	40 DAT	11.69	11.69	6.67	6.60	2.19	2.35	189.33	202.95	1.82	1.72
	60 DAT	7.71	7.66	5.85	5.84	2.27	2.43	196.93	211.17	2.14	1.99
25%	20 DAT	12.41	12.33	7.36	7.35	1.75	1.87	147.93	158.68	1.29	1.23
	40 DAT	12.64	12.62	7.36	7.50	1.87	2.00	158.07	168.70	1.28	1.20
	60 DAT	8.54	8.55	6.73	6.75	1.95	2.08	166.00	177.82	1.85	1.73
LSD at 5%		0.36	0.36	0.24	0.24	0.007	0.008	4.72	5.06	0.09	0.08
Salinization time X Remediation treatments											
20 DAT	Without	7.21	7.18	5.63	5.65	2.73	2.90	248.83	268.47	1.80	1.69
	Ca1 (5mM)	10.29	10.32	6.69	6.69	2.91	3.09	257.94	274.21	1.92	1.79
	Ca2 (10mM)	9.78	9.77	6.47	6.47	3.00	3.19	265.22	281.76	2.26	2.10
	Polymer + Ca1	7.22	7.19	5.78	5.76	2.49	2.64	219.17	232.69	1.66	1.56
	Polymer + Ca2	10.48	10.41	7.06	7.01	2.70	2.87	236.22	250.60	1.79	1.67
40 DAT	Without	7.66	7.65	6.43	6.38	2.75	2.93	244.94	260.15	2.15	2.01
	Ca1 (5mM)	6.04	6.10	6.12	6.12	2.39	2.54	209.06	221.72	1.67	1.47
	Ca2 (10mM)	9.66	9.58	6.74	6.75	2.57	2.72	225.67	239.25	1.89	1.76
	Polymer + Ca1	6.68	6.71	6.37	6.38	2.65	2.81	233.94	248.34	2.35	2.20
	Polymer + Ca2	8.73	8.77	5.66	5.73	2.64	2.80	230.83	245.00	1.71	1.61
60 DAT	Without	10.14	10.19	6.86	6.9	2.77	2.94	248.72	263.74	2.05	1.90
	Ca1 (5mM)	7.17	7.26	6.36	6.39	2.89	3.08	256.61	272.25	2.12	2.01
	Ca2 (10mM)	9.75	9.70	6.38	6.37	2.55	2.71	222.94	236.35	1.57	1.48
	Polymer + Ca1	9.83	9.91	6.58	6.60	2.74	2.91	241.33	256.08	2.01	1.89
	Polymer + Ca2	10.35	10.28	6.50	6.45	2.81	2.99	249.50	264.93	2.29	2.14
LSD at 5%		0.33	0.33	0.22	0.22	0.02	0.02	4.27	4.54	0.08	0.07

Data presented in Tables (11 and 12) show the interaction effect among the studied factors on quality parameters. Data showed that increasing salinity levels with addition of different remediation treatments and decreasing salinization time from 60 to 40 and 20 days after transplanting significantly increased Vit C and TSS concentrations. The highest values were obtained under high salinity level, 25% seawater (15 dS/m) with addition of (polymer + Ca 2) and starting irrigation with saline water after 20 days from transplanting. Meanwhile, NO_2-N and NO_3-N content significantly was decreased with increasing salinity levels, addition of remediation treatments and irrigation with saline water at early stage of plant growth (after 20 days from transplanting). Also, data indicated that the highest values of carbohydrate were realized from the plants irrigated with saline water even to

20% seawater dilution combined with remediation treatments specially polymer mixed with Ca after 60 days from transplanting.

It can be concluded that celery plants grown under saline conditions tend to increase their osmotic pressure of the cells, which attained by salt accumulation and intermediate materials of organic products such as amino acid and ascorbic acid which finally increased the content of Vit C and TSS. Ascorbic acid has effects on many physiological processes including the regulation of growth, differentiation and metabolism of plants (Foyer, 1993). Also, it can be concluded that celery plants grown under salinity conditions tended to accumulate starch and soluble carbohydrates, total, reducing and nonreducing sucrose (Munns and Termatt, 1986; Sallam, 1999).

Concerning, increasing the salinity of the nutrient solution, which, appeared to improve the quality of celery by reducing the accumulation of nitrate, and consequently, increasing their commercial value. The lower accumulation of nitrate observed here in salt treated plants of celery appeared to cause reduction of nitrate uptake due to antagonism with Cl^- (Alam, 1994). Indeed, the decline in nitrate concentration was a re-action to the rise in the content of Cl. Chloride is an osmotic substitute for nitrate in salinized celery, Pardossi *et al.* (1994). Generally, high nitrate levels can be harmful for human consumption, as nitrate can inhibit oxygen transport by the blood, Lyons *et al.* (1994). N as nitrate is changed in relation to salt stress, if referred to the plant as a whole they were significantly lower at the highest concentration of salt in nutrient solution, although under salt stress nitrate reductase activity would be counteracted (Soliman *et al.*1994). This finding may be meaning that the quality of the products is better under salinity conditions (Mizrahi and Pasternak, 1985).

The results of applied salinity levels were in agreement with those obtained by Martignon *et al.* (1994), Leonardi *et al.* (1998), Del Amor *et al.* (1999), Pardossi *et al.* (1999 a, b), Benavides *et al.* (2000), Ibrahim (2002), Malash *et al.* (2002), Wadid (2002), Pascale *et al.* (2003), Farouk (2005), and Koyro (2006).

Addition of different remediation treatments has been corrected the effect of salinity hazard and this can be attributed to the role played by these substance to alleviate the effect of salt stress on celery plants grown under saline condition of this study. Farouk (2005) found that the highest content of ascorbic acid was obtained from plants treated with 5 mM $CaCl_2$ or 50 mg/l Salicylic acid or 50mg/l thiamine grown under high salinity level.

Table (11): Interaction Effect among saline water, remediation treatments and salinization time on some quality parameters of celery plants in season of 2007.

Treatments	Characters	Vitamin C (mg/100gFW)			TSS (%)			NO_2-N (ppm)			NO_3-N (ppm)			Carbohydrate (%)		
		20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT
Control	Without	5.22	4.65	4.30	5.40	5.13	5.40	3.51	3.78	3.84	316.33	341.00	350.00	1.76	1.46	2.00
	Ca1 (5mM)	5.98	5.79	4.96	5.87	5.93	5.40	3.24	3.50	3.56	293.67	320.33	327.67	1.7	1.58	2.23
	Ca2 (10mM)	6.21	7.03	5.76	5.60	4.80	5.80	3.13	3.37	3.47	282.33	305.00	316.00	2.17	2.48	2.15
	Polymer+ Ca1	6.61	5.58	5.97	5.73	5.47	4.60	3.42	3.41	3.73	311.33	335.33	344.00	1.49	2.01	2.01
	Polymer+ Ca2	6.37	6.20	6.07	6.53	5.93	4.53	3.35	3.60	3.66	303.33	330.00	338.33	2.17	1.73	2.09
5%	Without	8.84	5.58	4.93	6.00	6.20	6.20	3.24	3.45	3.55	352.67	310.00	316.33	1.79	2.19	2.36
	Ca1 (5mM)	9.34	6.30	5.27	6.60	5.93	5.33	3.01	3.35	3.30	265.67	288.00	296.00	2.14	2.44	2.37
	Ca2 (10mM)	9.63	6.92	6.41	5.87	6.20	6.33	2.88	3.06	3.19	256.00	272.67	281.67	2.46	2.78	2.42
	Polymer+ Ca1	10.13	7.44	6.30	5.87	6.07	5.17	3.16	3.36	3.46	280.33	301.33	309.00	2.15	2.32	2.18
	Polymer+ Ca2	9.83	7.03	6.24	6.80	5.20	5.73	3.08	3.31	3.39	274.33	295.00	305.33	2.23	2.47	2.72
10%	Without	9.61	6.72	5.89	6.47	6.53	6.33	2.87	3.06	3.18	249.67	273.67	281.67	1.80	2.14	2.15
	Ca1 (5mM)	10.23	7.23	6.61	7.00	6.40	6.40	2.64	2.85	2.92	235.33	254.33	262.67	1.54	1.77	2.25
	Ca2 (10mM)	10.13	8.89	6.66	6.47	5.73	6.40	2.56	2.75	2.85	225.00	244.67	253.00	1.53	2.03	2.20
	Polymer+ Ca1	10.23	9.51	6.92	6.87	6.47	5.87	2.84	3.01	3.10	248.33	266.33	274.33	1.75	2.19	2.96
	Polymer+ Ca2	10.35	9.30	6.51	6.73	5.80	5.33	2.77	2.96	3.06	241.00	259.00	268.00	2.01	2.61	2.72
15%	Without	10.85	7.44	6.51	7.60	6.80	6.00	2.61	2.76	2.87	222.33	242.67	246.67	1.69	2.15	2.35
	Ca1 (5mM)	11.14	8.37	7.23	6.80	6.87	5.13	2.32	2.52	2.57	201.00	215.67	225.00	1.48	2.13	3.15
	Ca2 (10mM)	11.37	10.64	7.36	7.07	6.73	6.60	2.24	2.38	2.46	192.67	208.67	217.33	1.48	1.85	2.13
	Polymer+ Ca1	10.85	11.06	7.44	6.93	7.60	5.93	2.48	2.69	2.75	214.33	233.67	240.67	1.52	2.15	2.47
	Polymer+ Ca2	11.37	11.16	7.35	7.27	6.80	5.93	2.42	2.61	2.66	206.00	225.00	233.00	1.87	2.04	2.28
20%	Without	11.37	10.44	6.82	7.67	6.60	6.20	2.23	2.35	2.46	188.33	205.33	214.00	1.56	1.55	2.19
	Ca1 (5mM)	11.88	11.68	7.61	7.53	6.33	5.47	1.97	2.11	2.20	170.00	181.00	190.00	1.30	2.11	2.23
	Ca2 (10mM)	12.07	11.97	7.80	7.07	6.67	5.80	1.89	2.06	2.07	159.67	173.33	180.33	1.27	1.91	2.01
	Polymer+ Ca1	11.68	12.40	8.20	7.40	6.67	6.00	2.14	2.27	2.36	181.33	197.67	203.33	1.28	2.08	2.30
	Polymer+ Ca2	12.27	11.96	8.10	7.60	7.07	5.80	2.02	2.16	2.25	174.33	189.33	197.00	1.31	1.46	1.95
25%	Without	12.05	11.14	7.80	7.33	7.33	6.60	1.92	2.05	2.12	163.67	175.00	182.67	1.37	1.28	1.87
	Ca1 (5mM)	12.27	13.02	8.41	7.33	6.73	6.20	1.77	1.87	1.96	149.33	158.00	168.33	1.22	1.31	1.87
	Ca2 (10mM)	12.72	13.02	9.03	7.40	8.00	7.33	1.65	1.79	1.84	138.67	149.67	155.33	1.37	1.28	1.87
	Polymer+ Ca1	12.27	13.02	8.41	7.33	6.73	6.20	1.77	1.87	1.96	149.33	158.00	168.33	1.22	1.31	1.87
	Polymer+ Ca2	12.72	13.02	9.03	7.40	8.00	7.33	1.65	1.79	1.84	138.67	149.67	155.33	1.24	1.23	1.80
LSD at 5%		0.80			0.54			0.001			0.001			0.19		

Table (12): Interaction effect among saline water, remediation treatments and salinization time on some quality parameters of celery plants in season of 2008.

Treatments \ Characters		Vitamin C (mg/100gFW)			TSS (%)			NO_2-N (ppm)			NO_3-N (ppm)			Carbohydrate (%)		
		20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT
Control	Without	5.20	4.65	4.39	5.40	5.26	5.33	3.84	4.14	4.21	345.77	372.58	382.83	1.57	1.32	1.84
	Ca1 (5mM)	6.03	5.63	4.96	5.97	5.91	5.55	3.53	3.84	3.90	320.32	350.55	358.29	1.60	1.48	2.08
	Ca2 (10mM)	6.13	6.76	5.83	5.53	4.73	5.73	3.41	3.68	3.80	308.62	333.25	345.68	1.98	2.25	1.97
	Polymer+ Ca1	6.65	5.58	5.89	5.71	5.34	4.68	3.75	3.71	4.09	340.31	366.12	376.68	1.37	1.85	1.83
	Polymer+ Ca2	6.32	6.32	5.91	6.51	5.76	4.43	3.67	3.94	4.01	331.57	361.80	370.21	1.95	1.52	1.93
5%	Without	8.79	5.70	5.07	5.93	6.28	6.20	3.55	3.77	3.89	413.06	339.53	345.77	1.60	1.98	2.18
	Ca1 (5mM)	9.47	6.46	5.27	6.68	5.91	5.38	3.29	3.67	3.61	290.14	315.09	323.83	1.95	2.25	2.15
	Ca2 (10mM)	9.52	6.96	6.25	5.97	6.28	6.31	3.14	3.33	3.50	280.53	297.38	308.03	2.28	2.52	2.27
	Polymer+ Ca1	10.32	7.56	6.46	5.89	5.94	5.23	3.46	3.67	3.79	306.84	329.38	337.62	1.98	2.16	2.01
	Polymer+ Ca2	9.57	7.11	6.25	6.73	5.20	5.71	3.37	3.62	3.71	299.88	322.32	334.16	2.04	2.15	2.41
10%	Without	9.50	6.68	5.78	6.64	6.43	6.31	3.14	3.35	3.49	272.25	300.11	308.85	1.68	1.96	1.98
	Ca1 (5mM)	10.12	7.27	6.77	7.00	6.48	6.55	2.87	3.11	3.20	257.67	278.43	287.68	1.42	1.65	2.07
	Ca2 (10mM)	10.21	8.85	6.81	6.64	5.86	6.55	2.80	3.00	3.11	245.44	267.61	276.43	1.38	1.86	2.10
	Polymer+ Ca1	10.23	9.70	6.96	6.82	6.34	5.89	3.11	3.29	3.39	271.88	290.73	299.47	1.55	1.99	2.72
	Polymer+ Ca2	10.16	9.30	6.63	6.63	5.73	5.46	3.04	3.25	3.35	263.32	282.59	292.82	1.86	2.40	2.66
15%	Without	10.85	7.33	6.63	7.60	6.73	6.00	2.86	3.02	3.15	243.47	266.64	269.38	1.55	1.94	2.14
	Ca1 (5mM)	11.25	8.49	7.39	6.88	6.90	5.18	2.53	2.76	2.82	219.62	235.10	246.26	1.37	1.93	2.90
	Ca2 (10mM)	10.87	10.80	7.68	7.09	6.63	6.53	2.46	2.60	2.70	210.37	228.27	238.01	1.35	1.65	1.99
	Polymer+ Ca1	10.74	11.25	7.44	6.91	7.53	5.83	2.70	2.95	3.00	233.50	255.59	262.82	1.37	1.99	2.24
	Polymer+ Ca2	11.56	10.93	7.17	7.37	6.73	5.91	2,66	2.86	2.92	224.26	245.84	255.00	1.71	1.93	2.06
20%	Without	11.21	10.28	6.71	7.62	6.35	6.28	2.45	2.56	2.92	205.50	224.89	234.64	1.43	1.41	2.00
	Ca1 (5mM)	12.04	11.64	7.56	7.43	6.23	5.42	2.15	2.32	2.41	186.57	197.76	208.01	1.20	1.88	2.03
	Ca2 (10mM)	12.30	12.04	7.91	7.09	6.54	5.80	2.07	2.23	2.26	173.91	189.11	196.76	1.20	1.73	1.83
	Polymer+ Ca1	11.76	12.29	8.02	7.33	6.69	6.00	2.35	2.48	2.59	197.85	216.25	222.31	1.15	1.96	2.09
	Polymer+ Ca2	12.22	12.18	8.11	7.60	7.09	5.73	2.21	2.36	2.47	190.15	207.01	215.25	1.22	1.39	1.69
25%	Without	11.92	11.25	8.05	7.31	7.16	6.60	2.10	2.23	2.33	179.10	190.80	199.86	1.30	1.18	1.69
	Ca1 (5mM)	12.24	13.14	8.31	7.46	6.86	6.28	1.94	2.04	2.14	163.71	171.82	183.65	1.12	1.19	1.70
	Ca2 (10mM)	12.64	12.79	9.05	7.25	8.30	7.31	1.80	1.96	2.02	151.37	162.99	169.86	1.30	1.18	1.69
	Polymer+ Ca1	12.24	13.14	8.31	7.46	6.86	6.28	1.94	2.04	2.14	163.71	171.82	183.65	1.12	1.19	1.70
	Polymer+ Ca2	12.64	12.79	9.05	7.25	8.30	7.31	1.80	1.96	2.02	151.37	162.99	169.86	1.15	1.11	1.63
LSD at 5%		0.80			0.54			0.001			0.001			0.17		

CONCLUSION

From the above mentioned results it was noticed that, the highest tolerance to salinity concentration with best quality was obtained from the plants which irrigated with the dilution of 15% seawater + 85 % Nile water (9 dS/m) after 60 days from transplanting and treated with polymer + Ca 10 mM under El-Dakahlia governorate conditions.

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التأثير التفاعلى لبعض التخفيفات المختلفة لماء البحر وإستعمال بعض المواد المعالجة فى فترات نمو مختلفة لنباتات الكرفس على :
١ – صفات النمو الخضرى والجودة .

على فتحى حمايل ، السيد أحمد احمد طرطورة و سمر محمد عبد الحميد
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نظرا لمشكلة ندرة المياه العذبة فى المستقبل ولثبات الجزء الخاص لمصرنا من مياه النيل (٥٥,٥ مليار م٣) وبالتالى ليس هناك مياه عذبة لزيادة المساحة المنزرعة او لزيادة عدد السكان. لذا تم إجراء تجربتى أصص بكلية الزراعة جامعة المنصورة خلال الموسميين الشتويين ٢٠٠٦-٢٠٠٧ ، ٢٠٠٧-٢٠٠٨ فى محاولة للتعرف على تأثير الرى بتخفيفات مختلفة من ماء البحر خلال فترات مختلفة للتمليح مع استخدام بعض المعاملات العلاجية للتغلب على او تقليل التأثيرات الضارة للملوحة على نباتات الكرفس صنف فيكتوريا.

اشتملت التجربة على ٩٠ معاملة تمثل التفاعلات بين ٦ معاملات للرى بماء البحر (كنترول ماء النيل، ٥%، ١٠%، ١٥%، ٢٠%، ٢٥%) و ٥ معاملات علاجية (بدون معاملة، كالسيوم ٥ ملليمول، كالسيوم ١٠ ملليمول، بوليمر + كالسيوم ٥ ملليمول، بوليمر + كالسيوم ١٠ ملليمول) و كذلك ٣ معاملات لوقت التمليح (بعد ٢٠، ٤٠، ٦٠ يوم من الشتل).

تم تحليل النتائج المتحصل عليها تبعا للتحليل الاحصائى (تجربة عامليــة فــى قطاعــات كاملــة العشوائية).

أوضحت النتائج ان:

زيادة تركيز ماء البحر من ٥% الى ٢٥% أدى الى نقص معنوى فى جميــع قياســات النمو الخضرى بالمقارنة مع معاملة الكنترول. أما بالنسبة الى صفات الجودة اوضــحت النتــائج زيادة معنويه فى محتوى النبات من فيتامين C ، المواد الصلبة الكلية مع زيادة تركيز ملوحة المياه بينما كان هناك انخفاض معنوى فى محتوى النبات من النترات والنيتريت مع زيادة الملوحة.

ادت اضافة المعاملات العلاجية إلى زيادة معنوية فى معظم صفات النمــو الخــضرى وفى تركيز كلا من فيتامين C والمواد الصلبة الكلية ، بينما محتوى النترات والنيتريــت انخفــض معنويا فى نباتات الكرفس مع اضافة المعاملات العلاجية مقارنة بالنباتات الغير معاملة واظهــرت المعاملة بالبوليمر مع الكالسيوم (١٠ ملليمول) كإضافة أرضية اعلى قيم لقياسات النمو الخضرى وافضل صفات جودة .

وكانت هناك زيادة معنويه فى قياسات النمو الخضرى مع زيادة عمر النبات قبل التمليح من ٢٠ الى ٤٠ ، ٦٠ يوم بعد الشتل. ومن ناحية اخرى انخفض تركيز كلا من النترات والنيتريت وازداد تركيز فيتامين ج والمواد الصلبة الكلية مع قلة الفترة قبل التمليح من ٦٠ الــى ٤٠ و ٢٠ يوم بعد الشتل.

اوضحت النتائج ان اعلى تحمل للملوحة وجد من النباتات التى تم ريها بماء البحر حتى تركيز ١٥% وذلك بعد ٦٠ يوم من عملية الشتل مع معاملاتها بالبوليمر مع الكالــسيوم كاضــافة ارضيه بينما كانت اقل النباتات تحملا للملوحة تلك التى تم ريها بالماء المالح بعد ٢٠ يــوم مــن الشتل. واوضحت النتائج ايضا ان التفاعل الثلاثى بين عوامل الدراسة ان زيادة تركيز الملوحة مع اضافة المواد العلاجية خاصة البوليمر مع الكالسيوم (١٠ ملليمول) والرى فى مرحلة مبكرة (بعــد ٢٠ يوم من الشتل) ادى لزيادة محتوى النبات من فيتامين C والمواد الصلبة الكلية وتقليل محتــواه من النترات والنيتريت.

انتهت الدراسة الى:

١- ان اعلى تحمل للملوحة مع افضل صفات جودة وجدت مع النباتات التى تــم ريهــا بماء البحر حتى تركيز ١٥% (٩ ديسيمينز/م) وذلك بعد ٦٠ يوم من عملية الشتل مــع معاملاتها بالبوليمر مع الكالسيوم كاضافة ارضيه تحت ظروف محافظة الدقهلية.

٢- استخدام هذه المعاملة يؤدى الى توفير ١٠-١٥ % من اجمالى الماء المستخدم لرى نباتات الكرفس فى فترات نموه المختلفة وبالتالى تعتبر احدى وسائل التغلب على مشكلة المياه فى المستقبل.