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AMELIORATING THE INJURIOUS EFFECTS OF SALINITY ON CHERRYGOLD PLANTS USING SOME MICRO-ELEMENTS SPRAY.

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ABESTRACT

A pot experiment was carried out during two successive seasons of 2002/2003 and 2003/2004 on cherrygold plant (*Chrysanthemum carinatum*) at the Experimental Station of Ornamental Plants, Fac. of Agric., Mansoura Univ., This work aimed to study the tolerance of cherrygold plants to salinity stress using 4 levels of salinity (0.0, 2.5, 5 and 10% of sea water) as well as treating with some micro-elements (Fe, Mn, and Zn) 0.15% either solely and/or in combination (2:1:1) as a foliar application added three times to improve the growth, yield and its components, as well as chemical constituents. Relevant data revealed that there were steadily significant reductions in vegetative growth characteristics, inflorescences, yield, and content of N and P while K content was increased due to higher salinity levels. As for micro-elements, concerned results indicated significant increase of plant growth characters due to foliar application with either single and/or in combinations of micro-elements in both seasons.

In addition, relevant results suggested successfully the possibility of foliar application with microelements to improve salinity tolerance of the pot cherrygold plants whereas, salinity caused an alteration of nutrient uptake under salinity conditions. Therefore, the combined treatment of lower level of saline water and spraying with micro-elements may be recommended for improving growth, yield and chemical constituents of cherrygold plants.

INTRODUCTION

(*Chrysanthemum carinatum*) which belongs to family *Asteraceae* is one of a wide spread plants, which is cultivated as an annual flowering plant mainly used as a cut flower (Banerjee and Ali, 2000). It is grown as an ornamental plant for planting in beds and borders and, also, as cut flowers beside its uses as aromatic drug and natural pigment plant. The pigments of *Cherysanthemum* flowers are very important in the food industries as a natural colored materials (Hend and Ezz El-Din, 2002).

Wide culinary uses include spring salad, flavoring home mode beer, soups, cakes, poultry were also reported. Formerly a cosmetic water was made from the leaves. While, dried and powdered flower heads have no medicinal action and used only as a non toxic insecticide for controlling the bedbug, mosquito, cockroach, domestic fly and other pests.

Plant growth is limited with different environmental conditions, one of these condition is salt stress. Salinity is one of the problems facing the agriculture in such areas where, saline water is generally used for irrigation. Thereupon, under deficiency of water, irrigation with saline water is only the available source in many parts of newly reclaimed area (El-Queseni and El-Gayar, 1993).

Undoubtedly, salinity is a world-wide problem which affects plant growth, yield and its composition. Plant growth is limited with different environmental stresses, one of them is salt stress, especially at higher levels in arid and semiarid parts of the world and can be more harmful to plant. This effect is mainly indirect by pulling moisture out of roots and reducing the uptake of water and nutrients. Tip and edge burn of leaves, slow growth, nutrient deficiencies, wilting and eventual death of the plant can occur if the salt level is excessive. Bernstein (1962) and Allison (1964) stated that growth of the plants grown under salinity stress may be checked or totally inhibited due to: (a) osmotic effect on plant roots, (b) the toxic effects of accumulated ions, or (c) the combination of them. Hasegawa *et al.*, (2000) mentioned that salinity affects plant physiology logically through changes of water and ionic status in the cells. Ionic imbalance occurs in the cells due to excessive accumulation of Na^+ and Cl^- and reduced uptake of other mineral nutrients, such as K^+, Ca^{+2}, and Mn^{+2}.

Several workers studied extensively the effect of saline water irrigation on ornamental plants. Cahoon and Stevenson (1986) on *Hibiscus* spp., Risse and Schenk (1990) on azalea, El-Khateeb *et al.*, (1994) on tuberose plants, El-Khateeb and Salim (1994) on *Chrysanthemum frutescens*, Kamel Dawh *et al.*, (1998) on *Tagetes erecta*, Habib (2002) on *Bougainvillea* Ms. Butte and Mansour (2003) on *Cryptostegia grandiflora*.

Thus, it is requisite to improve the salinity tolerance of such plants and consequently, enhancing their ability to tolerate salinity which in turn, increasing the possibility of their successful cultivation in such newly reclaimed areas.

Microelements are essential for numerous physiological processes in the plant. They participate in most of the enzymatic reactions and they, also, play an important role indirectly through the synthesis of several growth regulators. Positive results on growth and flowering characters were obtained by many investigators. Tarraf *et al.*, (1994) found that the growth, plant height, number of main branches, fresh and dry weight of herb and oil yield of *Rosmarinus officinalis* increased by foliar application of Fe, Zn, or Mn at the level of 50 ppm. Jacoub (1995) on *Ocimum basilicum*, concluded that spraying Zn, Fe, or Mn at the rate of 50 and 100 ppm, significantly increased their vegetative growth. El-Kady (1997) reported that micronutrient treatments significantly increased plant height, leaf area, dry weight/plant and total photosynthetic pigments in the leaves of sunflower plant. Mostafa *et al.*, (1997) on *Chrysanthemum* plants found that the highest increases in stem length, stem diameter and stem dry weight were favored due to application of Fe and Zn together. With regard to micronutrients, recently, foliar application has taken place as a useful method to overcome soil stress conditions that reduce the availability of these micronutrient elements in many ornamental plants. Microelemnts are needed in relatively very small quantities for good plant growth, their deficiencies cause great disorders in the physiological and metabolic processes of the plant (Kanwer and Dhingra, 1962). Abd El-Salam (1999) on fennel and Khattab and Omer (1999) on caraway indicated that spraying plants with micronutrients (Zn, Mn, and Fe) caused a highly significant increase in plant growth, fruits yield, volatile oil content and the major oil constituents of caraway (Carvon). Also, Refaat and Balbaa (2001) found that spraying lemongrass plants with microelements (Zn, Mn, and Fe) was beneficial for increasing plant height, essential oil percentage and oil yield.

Therefore, the present trial, was performed to study the effect of the treatment with foliar application of micronutrients (Fe, Mn and Zn) either solely or in combinations on improving salinity tolerance of the winter annual grown plant cherrygold with different levels of salinity (% sea water) under the Egyptian conditions.

MATERIALS AND METHODS

The present study was conducted at the Experimental Station of the Fac. of Agric., Mansoura Univ. during the two successive seasons of 2002/2003 and 2003/2004. Before planting, both physical and chemical analysis for the soil under investigation were undertaken according to Jackson (1973) and corresponding data are presented in (Table 1).

Table 1: Soil physical and chemical characters.

Properties	2002/2003	2003/2004
Sand %	35.5	35.0
Silt %	21.0	22.0
Clay %	43.5	43.0
Texture	Clay loam	Clay loam
pH (1 : 2.5 suspension)	8.2	8.5
EC (1 : 2.5 extracts) dSm^{-1}	2.3	2.5
Calcium carbonate %	23.0	25.0
Organic matter %	1.2	1.0
Total nitrogen mg/100g soil	42.0	40.0
P mg/100g	1.8	1.7
K mg/100g	23.0	25.0
Ca mg/100g	504.0	500.0
Mg mg/100g	40.0	42.0
Fe ppm	5.0	4.5
Mn ppm	6.	5.5
Zn ppm	1.0	0.9
Cu ppm	3.0	3.2

Uniform seedlings of cherrygold plants were individually planted on Sept., 25^{th} in both seasons, in 30 cm diameter earthenware pots filled with a clay loam soil as in Table 1. After three weeks, the plants were treated by the different saline water concentration. Four levels of salinity at the rate of 0.0, 2.5, 5, and 10% sea water, obtained from Mediterranean sea, Gamasa region, Dakahlia Governorate (EC=51.56, dSm^{-1}=32998.4ppm about 33000 ppm) were applied with each treatment of foliar application of microelements which were foliar sprayed as 4 treatments with 3 replicates each of which included 36 plants as follows:

a-Water Salinity:

1-The control treatment (irrigation with tap water).
2-Irrigation with tap water salinized with 25 ml sea water/1L (825 ppm).
3-Irrigation with tap water salinized with 50 ml sea water/1L (1650ppm)
4-Irrigation with tap water salinized with 100 ml sea water/1L (3300ppm)

The pots were irrigated with water (7 days from planting) and, then, the plants were equally irrigated either with tap (in the control treatment) or with one of the different concentrations of sea water when needed to maintain soil moisture at 65-70% of field capacity until the end of the experiment. The chemical analysis of sea water shown in (Table 2)..

Table 2: Sea water analysis (ppm)

Na	Mg	K	Ca	S	Cl	Br
10770	1290	380	412	905	19400	65

b- Microelements:

1-C0= Control (untreated plants).
2-Fe-EDTA 13% Fe at the rate of 2 g/L (EDTA i.e. Ethylene diamine tetra acetic acid).
3-Zn-EDTA 13% Zn at the rate of 1g/L.
4-Mn-EDTA 13% Mn at the rate of 1g/L.
5-Spraying plants with mixture of (Fe EDTA 1g/L, Zn EDTA 0.5 g/L and Mn EDTA 0.5 g/L) ratio (2:1:1).

The seedlings were sprayed four times, at five days intervals with the Chelated microelement compound. Plants were fertilized with 2.5 g ammonium sulfate (20.6% N), 3.5g calcium super phosphate (15.5% P_2O_5) and 1.25 g potassium sulfate (48% K_2O) per pot after 3 weeks from transplanting date.

The experimental design was factorial experiment in complete randomized block design with three replicates, each replicate contained fifteen pots. All the plants received normal agricultural practices, whenever they were needed. Sample of plants of each treatment was taken at flowering stage to study growth characters. Plant height (cm), dry weight (g) per plant, number of branches per plant, diameter of stem, number of flowers per plant, hill circumference (mm), fresh and dry weight of flowers (g) per plant, yield of seeds (kg) per fed. The shoots were chemically analyzed in order to determine the chemical constituents of cherrygold plants.

Data of the present study were statistically analyzed and the differences between the means of the treatments were considered significantly when they were more than least significant differences (LSD) at the levels of 5% using CoStat (Version 6.303, CoHort, USA, 1998-2004).

RESULTS AND DISCUSSION

1- Vegetative growth parameters:

1-1- Effect of saline irrigation water:

Data presented in Table (3) indicated that there was significant reduction in all vegetative growth parameters, i.e. plant height (cm), dry weight (g/plant), number of branches/plant and stem diameter (cm) resulting due to using all saline water treatments. Raising the salt concentration had an adverse effect on the vegetative growth of cherrygold plants.

Table (3): Effect of salinity and micro-elements on some growth parameters of cherrygold plants in the two seasons of 2002/2003 and 2003/2004.

Treatments		1st season				2nd season			
		Plant height (cm)	Dry wt. (g/plant)	No. of branches /plant	Diameter of stem (cm)	Plant height (cm)	Dry wt. (g/plant)	No. of branches /plant	Diameter of stem (cm)
Salinity levels									
0.0 S		119.12	282.44	17.11	1.95	119.98	288.08	17.26	1.97
2.5% S		115.07	252.29	15.19	1.54	114.49	257.62	15.92	1.67
5.0% S		101.88	237.47	11.37	1.08	105.83	242.41	11.87	1.18
10% S		99.83	227.33	9.27	0.78	102.61	233.70	9.83	0.88
LSD 5%		1.201	0.075	0.059	0.465	2.515	1.779	0.482	0.021
Micro-elements									
Co		105.11	220.48	12.91	1.25	105.51	228.86	13.20	1.32
Fe		104.85	247.03	13.04	1.51	108.66	254.34	13.91	1.46
Zn		107.93	251.00	13.51	1.31	112.51	270.11	13.73	1.45
Mn		108.28	225.40	12.87	1.17	109.94	237.81	13.32	1.38
Mix		118.71	305.51	13.84	1.47	117.01	286.14	14.43	1.51
LSD 5%		1.273	7.836	0.115	0.491	1.327	7.317	0.394	0.032
Interaction SxM									
0.0 S	Co	115.55	252.90	16.73	1.80	113.65	261.45	17.04	1.88
	Fe	112.50	279.70	16.81	2.43	116.90	286.90	17.76	2.01
	Zn	116.60	283.30	17.20	1.86	122.65	302.75	16.10	1.99
	Mn	122.00	258.05	16.91	1.60	120.20	272.20	17.13	1.92
	Mix	128.95	338.25	17.91	2.04	126.50	317.10	18.27	2.07
2.5% S	Co	112.25	222.85	14.96	1.50	109.00	231.20	15.20	1.58
	Fe	110.75	249.70	14.92	1.63	113.55	257.00	16.13	1.71
	Zn	112.50	253.40	15.61	1.56	116.50	272.95	16.54	1.69
	Mn	118.35	227.70	14.70	1.31	115.25	239.80	15.32	1.59
	Mix	121.50	307.80	15.76	1.71	118.15	287.15	16.40	1.76
5.0% S	Co	97.25	208.00	11.06	0.99	100.60	216.45	11.38	1.06
	Fe	98.80	234.35	11.24	1.13	103.05	241.90	12.02	1.21
	Zn	103.30	238.80	11.74	1.06	107.55	256.80	12.11	1.19
	Mn	98.00	213.00	10.98	1.03	103.80	224.80	11.34	1.16
	Mix	112.05	293.20	11.85	1.21	114.15	272.10	12.48	1.26
10% S	Co	95.40	198.15	8.90	0.69	98.80	206.35	9.19	0.77
	Fe	97.35	224.35	9.20	0.83	101.15	231.55	9.73	0.89
	Zn	99.30	228.50	9.49	0.76	103.35	247.95	10.16	0.92
	Mn	94.75	202.85	8.90	0.73	100.50	214.45	9.47	0.86
	Mix	112.35	282.80	9.85	0.91	109.25	268.20	10.58	0.96
LSD 5%		2.545	NS	0.230	0.981	2.653	NS	0.788	NS

S= salinity M= micronutrient - Co= control Fe= iron Zn= zinc Mn= manganese Mix=Fe+Zn+Mn - * NS= insignificant

In both seasons, the mean values recorded for the different growth parameters were decreased steadily as the salt concentration was increased. This reduction was increased due to salinity level upto 10%, since it recorded a reduction of 99.83, 227.33, 9.27 and 0.78 in the 1st season. While, corresponding averages were 102.61, 233.70, 9.83 and 0.88 in the 2nd season, respectively. These results are in agreement with those previously reported by El-Khateeb *et al.*, (1989) on *Chrysanthemum carinatum* plants.

These results may be ascribed to the high osmotic pressure of soil solution which restricted the absorption of water by plant root and/or to the toxic effects of certain ions in soil solution. Besides, salinity has been shown to reduce the synthesis of DNA, RNA and protein in many plants which might lead to disturbance in metabolic activities, cell division and elongation and the activities of the mitochondria and chloroplasts were reduced. This explanation may agree with conclusions stated by Ghallab and Nesiem (1999), El-Fouly *et al.*, (2001) and Salem *et al.*, (2002).

1-2- Effect of trace elements:

It was evident from the data presented in Table (3) that spraying plants with iron, manganese or zinc significantly increased the vegetative growth i.e. plant height (cm), dry weight (g/plant), number of branches/plant and stem diameter (cm) in both seasons. Micro-elements mixtures (Fe+Mn+Zn), also, added as foliar application favoured the vegetative growth of cherrgold plants. Relevant data averaged 118.71, 305.51, 13.84 and 1.47 in the 1st season. While, corresponding averages were 117.01, 268.14, 14.43 and 1.51 in the 2nd season, respectively. The positive effects of foliar application on plant height, number of branches and fresh and dry weight of plant were, also, recordd by several investigators including, El-Sherbeny (1999) on *Trigonella foenumgraceum*, Gamal El-Din *et al.* (1997) on *Cympopgon citratus* and Morsy (1999) on *Thymus vulgaris* plants. This favorable effect on growth of cherrygold plants might be due to the enhancement of most of the metabolic processes as a result of micronutrients foliar application.

On the other hand, this decreasing effect of salt stress and the promoting one of the trace elements on vegetative growth can be explained as the accumulation of salt ions in the growing media increased osmotic pressure and depressed water absorption which, in turn, negatively affected the activity of meristematic cell to divide and elongate (Bolus *et al.*, 1972 and Greenway, 1973). Also, the latter positive effect based on the active role of Fe and Zn ions in chlorophyll and IAA synthesis, respectively, in plant tissues as well as Mn ion in biosynthesis of proteins (Khmara, 1984). Accordingly, the addition of such trace-elements in the proper mixture may promote cell division and/or elongation of stem tissues causing to an increase in vegetative growth.

1-3- Effect of interaction between saline irrigation water and micro-elements:

Regarding the effect of interaction, it was significant for plant height and number of branches/plant. However using any of micro-elements decreased the harmful effect of salinity on vegetative characters. The mixture of microelements was the superior treatment in this regard. Similar results were found by Ramadan (1996) on guar. He reported that under high salinity levels of irrigation water spraying plants with micro-elements (Fe, Mn and Zn) solely or in combinations at certain levels greatly overcome the harmful effect of salinity on plant growth.

The enhancing effect of combined treatment of mixture of micro-elements and the low or moderate saline water level (2.5 or 5%) on vegetative growth of cherrygold plant might be attributed, to some extent, to some of trace elements, i.e. Fe, Mn and Zn which reduced the harmful effect of salt stress due to their enhancing effect on the metabolic process (anabolism) leading to more vegetative growth, consequently more plant weight. But the highest level of salinity (upto 10%) might disturb water and essential nutrients absorption. This reduction might inhibits the most physiological processes in addition to the toxic effect of certain ions which may be accumulated causing adverse effect on plant growth.

2- Flowering Characters:

2-1- Effect of saline irrigation water:

It is evident from the data presented in Table (4) that saline water treatments significantly decreased cherrygold flower characters compared to unsalinized control plants. In both seasons, plants irrigated with tap water (control) gave the highest values of flowering characters. While, raising the salt concentration resulted in a gradual reduction in these parameters, since the highest salt concentration (10% sea water) gave the lowest values of 17.09, 29.83, 388.66 and 94.19 for number of flowers/plant, hill circum (mm), fresh weight of flowers/plant (g) and dry weight of flowers/plant (g)m in the first season, respectively. While, these flowering parameters averaged 18.32, 28.91, 449.76 and 100.69 in the second season, respectively. In general, a gradual decrease in the flowering characters was observed as salinity level increased. This result may be due to the presence of chloride ions in the cell sap which greatly induced plant respiration (salt respiration) leading to depression of carbohydrates synthesis within plant tissues, consequently reflected on low production per plant as salinity level increased in the medium (Abbas, 1992). These results are in agreement with those found by El-Sayed (1991) and Abd El-Kafie (1995).

2-2- Effect of micro-elements:

Concerning the effect of micronutrients, data presented in Table (4) show that flowering characters was greatly affected by micronutrients application compared to control, however the application of micro-elements mixtures was superior to other treatments since the rate of micro-elements mixtures (2Fe+1Zn+1Mn) recorded the highest values for such flowering characters if compared with those tabulated for the unsprayed plants. Corresponding values were 21.4, 38.03, 422.93 and 120.38 for No. of flowers/plant, hill circum (mm), fresh weight of flowers/plant (g) and dry weight of flowers/plant (g), in first season, respectively. While, these flowering parameters averaged 22.48, 36.41, 507.65 and 132.79 in the second season, respectively. These results are in accordance with those reported by El-Sherbeny *et al.*, (1988) on *Ocimum basilicum* and Morsy (1999) on *Thymus vulgaris*. Moreover, this favorable effect of micro-elements tested could be attributed to their important functions in plant physiological processes which lead to activate cell division and elongation and consequently plant growth as previously indicated.

2-3- Effect of interaction between saline irrigation water and micro-elements:

The present results revealed that the combined treatments of saline irrigation water and trace elements as shown in Table (4) affected these growth traits, however, this effect did not reach the level of significance at 5% due to No. of flowers/plant in any of the two seasons. However, the mixture of Fe+Mn+Zn at the ratio of 2:1:1 surpassed the other microelements treatments each alone as the favorable effect on flowering characters was concerned.

3- Seed yield:

3-1- Effect of saline irrigation water:

Data presented in Table (5) reveal that all the studied characteristics of cherrygold yield and its components were generally decreased with increasing salinity level. In both seasons, plants irrigated by tap water (control) gave the highest values of 9.34 and 10.15 g/plant in the first and second seasons, respectively.

However, raising the salt concentration resulted in a gradual reduction in the total yield. The highest salt concentration (10%) gave the lowest values of 7.90 and 8.70 g/plant in 1st and 2nd seasons, respectively. The reduction in seed yield may be due to the inhibitory effect on vegetative growth. Everado *et al.*, (1975) suggested that the inhibitory effect of salinity on plant growth might be due to the reduction in cell division and/or the inhibition of both cell elongation and activity of meristematic tissues which, may be attributed to a decrease in the activity levels of auxins and gibberellins within the plant, and /or an increase in the activity of growth inhibitors (Ghazi, 1976). Other explanations were proposed by Yassen *et al.*, (1987) and St. Arnaud and Vincent (1990), who mentioned that the decrease in plant growth under saline conditions was probably due to the insufficient uptake of water and nutrients, as well as sodic toxicity. Also, the reduction in plant growth was observed by Mansour (2003) on *Cryptostegia grandiflora* plants irrigated with water containing high salinity levels. He attributed this reduction to the disturbance in natural hormones synthesis including a reduction in activity of cytokinins.

3-2- Effect of micro-elements:

Data presented in Table (5) show that application of micronutrients significantly increased cherrygold yield either by application of each element alone or the mixture of them to untreated plants. It was observed that the method of foliar spray with microelement mixtures (Fe+Mn+Zn) recorded the highest yield (9.09 and 10.46 g/plant) during the two seasons, respectively. Microelements are needed in relatively very small quantities for good plant growth. Their deficiencies cause great disorders in the physiological and metabolic processes of the plant (Kanwer and Dhingra, 1962). The effect of interactions between salinity levels of irrigation water and micro-elements was also indicated in the same Table (5). No significant increasing effect of these interactions on cherrygold seed yield in the two seasons was detected.

Table (4): Effect of salinity and micro-elements on some flowering parameters of cherrygold plant in the two seasons of 2002/2003 and 2003/2004.

Treatments		1st season				2nd season			
		No. of flowers/ plant	Hill circum (mm)	F.W. of flower (g/plant)	D.W. of flower (g/plant)	No. of flowers/ plant	Hill circum (mm)	F.W. of flower (g/plant)	D.W. of flower (g/plant)
Salinity levels									
0.0 S		22.09	37.67	423.27	129.05	23.25	37.47	484.32	136.78
2.5% S		20.12	35.69	404.35	109.07	21.25	36.00	462.82	116.78
5.0% S		19.07	34.78	399.07	104.13	20.28	34.87	459.72	111.37
10% S		17.09	29.83	388.66	94.19	18.32	28.91	449.76	100.69
LSD 5%		**0.044**	**1.160**	**0.561**	**0.182**	**0.087**	**0.925**	**1.803**	**1.359**
Micro-elements									
Co		18.34	32.56	387.39	94.30	19.50	33.15	419.36	102.43
Fe		19.35	34.14	400.04	108.41	20.38	33.85	445.94	110.99
Zn		20.33	33.64	409.88	115.96	21.33	33.73	488.35	125.41
Mn		18.55	34.10	398.96	106.50	20.20	34.43	459.48	110.41
Mix		21.40	38.03	422.93	120.38	22.48	36.41	507.65	132.79
LSD 5%		**0.074**	**1.604**	**6.831**	**1.845**	**0.131**	**0.793**	**10.229**	**1.859**
Interaction SxM									
0.0 S	Co	20.90	36.20	409.10	114.15	22.15	36.25	439.40	124.25
	Fe	22.00	37.90	414.45	128.45	22.85	38.30	465.30	131.00
	Zn	22.75	34.90	430.75	135.85	23.72	34.65	508.70	145.40
	Mn	20.80	37.75	418.75	126.65	22.40	38.15	477.25	130.25
	Mix	24.00	41.60	443.30	140.15	25.15	40.00	530.95	153.00
2.5% S	Co	18.75	34.25	386.75	94.50	19.85	34.20	419.45	104.25
	Fe	19.90	35.85	402.20	108.40	20.95	36.15	446.15	110.75
	Zn	20.90	32.85	410.50	116.15	21.80	35.05	488.60	125.25
	Mn	19.20	35.70	399.25	106.40	20.85	36.35	459.70	110.60
	Mix	21.85	39.80	423.05	119.90	22.80	38.25	500.20	133.05
5.0% S	Co	17.95	32.25	381.85	89.50	18.85	34.85	414.40	97.05
	Fe	18.70	33.85	396.70	103.45	19.90	34.15	441.00	105.85
	Zn	19.95	35.85	405.35	111.15	20.95	35.10	483.50	120.50
	Mn	17.85	34.15	393.80	101.60	19.60	34.15	454.80	105.55
	Mix	20.90	37.80	417.65	114.95	22.10	36.10	504.90	127.90
10% S	Co	15.75	27.55	371.85	79.05	17.15	27.30	404.20	84.15
	Fe	16.80	28.95	386.80	93.35	17.80	26.80	431.30	96.35
	Zn	17.70	30.95	392.90	100.70	18.85	30.10	472.60	110.50
	Mn	16.35	28.80	384.05	91.35	17.95	29.05	446.15	95.25
	Mix	18.85	32.90	407.70	106.50	19.85	31.30	494.55	117.20
LSD 5%		**0.147**	**NS**	**NS**	**NS**	**0.262**	**1.586**	**NS**	**NS**

S= salinity M= micronutrient - Co= control Fe= iron Zn= zinc Mn= manganese Mix=Fe+Zn+Mn - NS= insignificant

4- Minerals content:

4-1- Effect of saline irrigation water:

Relevant data in Table (5) show the percentages of nitrogen, phosphorus and potassium in shoots of cherrygold plants as affected by salinity levels in water irrigation. In both seasons, the data reveal that there was a significant reduction in nitrogen and phosphorus percentage as a result for using all saline water treatments. Raising the level of salinity of irrigation water significantly reduced the N and P percentages and the decreases were in proportion to the increase in the salinity level. However, the concentration of K show an opposite trend in both seasons since data revealed that concentrations of K gradually increased in the shoots as salinity levels of irrigation water increased. Generally, it can be concluded that irrigating cherrygold plants with saline water at the different levels of salinity decreased the content of N and P and increased the content of K in shoots.

Table (5): Effect of salinity and micro-elements on yield and chemical composition of cherrygold plant in the two seasons of 2002/2003 and 2003/2004.

Treatments		1st season				2nd season			
		Yield of seeds (g/plant)	N%	P%	K%	Yield of seeds (g/plant)	N%	P%	K%
Salinity levels									
0.0 S		9.34	1.46	0.16	1.08	10.15	1.55	0.17	1.14
2.5% S		8.53	1.36	0.15	1.12	9.33	1.44	0.16	1.21
5.0% S		8.12	1.30	0.14	1.25	9.11	1.39	0.16	1.30
10% S		7.90	1.19	0.13	1.37	8.70	1.31	0.15	1.44
LSD 5%		**0.207**	**0.061**	**0.002**	**0.023**	**0.003**	**0.012**	**0.0007**	**0.017**
Micro-elements									
Co		8.16	1.27	0.13	1.08	8.30	1.29	0.15	1.16
Fe		8.26	1.38	0.14	1.18	9.27	1.40	0.15	1.24
Zn		8.42	1.40	0.15	1.19	9.50	1.45	0.16	1.26
Mn		8.44	1.31	0.13	1.22	9.08	1.39	0.16	1.28
Mix		9.09	1.30	0.16	1.34	10.46	1.58	0.18	1.42
LSD 5%		**0.254**	**0.077**	**0.005**	**0.014**	**0.193**	**0.041**	**0.0018**	**0.018**
Interaction SxM									
0.0 S	Co	8.990	1.400	0.138	0.967	9.110	1.420	0.162	1.063
	Fe	9.354	1.510	0.163	1.090	10.116	1.530	0.167	1.130
	Zn	9.240	1.520	0.167	1.097	10.348	1.560	0.176	1.140
	Mn	9.258	1.430	0.145	1.103	9.380	1.510	0.175	1.170
	Mix	9.882	1.450	0.175	1.160	11.286	1.710	0.187	1.217
2.5% S	Co	8.148	1.290	0.129	1.017	8.294	1.310	0.151	1.130
	Fe	8.556	1.410	0.152	1.103	9.286	1.420	0.158	1.153
	Zn	8.420	1.430	0.156	1.123	9.478	1.470	0.167	1.173
	Mn	8.440	1.340	0.134	1.130	9.082	1.400	0.161	1.227
	Mix	9.098	1.320	0.164	1.233	10.518	1.600	0.178	1.357
5.0% S	Co	7.946	1.240	0.124	1.120	8.108	1.260	0.145	1.190
	Fe	7.270	1.350	0.136	1.213	9.060	1.380	0.152	1.273
	Zn	8.218	1.380	0.150	1.213	9.278	1.430	0.162	1.297
	Mn	8.242	1.280	0.127	1.273	8.888	1.350	0.155	1.293
	Mix	8.906	1.260	0.159	1.417	10.232	1.550	0.172	1.447
10% S	Co	7.540	1.130	0.113	1.227	7.694	1.150	0.136	1.273
	Fe	7.854	1.230	0.125	1.333	8.626	1.270	0.140	1.420
	Zn	7.814	1.270	0.139	1.343	8.888	1.350	0.152	1.430
	Mn	7.810	1.170	0.116	1.383	8.488	1.290	0.147	1.447
	Mix	8.460	1.150	0.148	1.553	9.792	1.470	0.163	1.643
LSD 5%		NS	NS	NS	0.051	NS	NS	NS	0.039

S= salinity M= micronutrient - Co= control Fe= iron Zn= zinc Mn= manganese Mix=Fe+Zn+Mn - NS= insignificant

The decrease in N and P and the increase in K contents were in proportion with the level of salinity. These findings are in agreement with those obtained by El-Khateeb *et al.*, (1994) on tuberose as well as El-Khateeb and Salim (1994) on *Chrysanthemum frutescens*.

4-2- Effect of micro-element

As for the effect of micro-element spraying, it is obvious that spraying plants with Fe, Mn and Zn at all levels tested significantly increased minerals content and the rate of increase was raised as concentration was increased Table (5). The micro-elements mixtures (Fe, Mn, Zn) resulted in the highest values of minerals content if compared with those for the unsprayed plants.

4-3- Effect of interaction between saline irrigation water and micro-elements:

Also, it was clear that application of micro-elements, especially trace element mixtures (Fe+Mn+Zn) reduced the harmful effect of saline water treatments. Results of the present study may be assessed on the basis that micro-elements could cover the depression caused by salinity and might have given increment in their contents. These results are confirmed by those of El-Fouly *et al.*, (2001). Under high salinity levels, spraying plants with micro-elements solely or in combinations caused pronounced increases in N, P and K contents in both seasons. The highest values of these components may be due to the inadequacy of osmotic regulation induced by imbalance uptake of nutrients presented in the soil. In addition, spraying cherrygold plant with micro-elements reduced the undesirable effect of salinity, in this case, through improving growth and nutrient status of plants, as well.

CONCLUSION

Results of the present study show that cherrygold plants (*Chrysanthemum carinatum*) could tolerate salinity to some extent, since highest salinity concentration of 10% sea water caused a reduction in the vegetative growth, flowering characters, yield and its components. Similarly, higher salinity concentrations caused a remarkable decrease in nitrogen and phosphorus contents of cherrygold shoots, while, potassium was increased. As spraying with micro-elements was concerned, it was found that application of these elements i.e. Fe, Mn, and Zn favoured the growth, flowering and yield of cherrygold plants in both seasons of the study, especially when these elements were sprayed as mixtures. It was, also, worthy to note that spraying micro-elements solely or in mixtures could cover the depression caused by salinity. Accordingly, it could be concluded that spraying cherrygold plants with such micro-elemnts may reduce the undesirable effect of salinity through improving growth and nutrient status of plants, as well. Spraying Fe, Mn, and Zn at the rate of 2:1:1 as mixture could be recommended for cherrygold plants to overcome, greatly, the harmful effect of salinity under similar conditions of the present study.

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تخفيف التأثيرات الضارة للملوحة علـى نباتـات المارجريـت باسـتخدام الـرش بالعناصر الصغرى.

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أجري هذا البحث في مشتل التجارب بقسم الزينة بكلية الزراعـة – جامعـة المنـصورة خـلال الموسمين المتتاليين ٢٠٠٢/٢٠٠٣ ، ٢٠٠٣/٢٠٠٤. بهدف دراسة مدى تحمل نباتات المارجريت للإجهـاد الملحي الناتج عن الري بمستويات مختلفة من ماء البحر (صفر، ٢,٥، ٥، ١٠%) واستخدام بعض العناصر النادرة (الحديد + المنجنيز + الزنك) (٠,١٥%) بنسبة (٢ : ١ : ١) كل منها منفردا أو خليط منهـا وكـذلك تأثير التفاعل بين هذه العوامل على النمو الخضري والزهري والمحصول وكذا التركيب الكيمـائي لنباتـات المارجريت. ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

- أدت معاملات ملوحة ماء الري إلى حدوث نقص معنوي في صفات النمو والمحصول وكذا نقـص فـي محتوى كل من النيتروجين والفوسفور وزيادة محتوى البوتاسيوم في الأوراق والسيقان. وكانـت نـسب الزيادة والنقص تتناسب مع مستوى الملوحة في ماء الري في كل من موسمي الدراسة.
- قد أثبتت الدراسة أن رش النباتات بالمعاملة المنفردة سواء للعناصر الصغرى أو خلـيط منهـا أدى إلـى تشجيع النمو الخضري والزهري والمحصول وكذلك المحتوى الكيميائي في الأوراق وسيقان النباتات، إلا أن رش النباتات بالنسب السابقة بخليط العناصر الصغرى أدى إلى حدوث زيادات معنوية أفـضل فـي معظم صفات النمو الخضري للنباتات وكذلك المحصول الكلي ومكوناته.
- من ناحية أخرى أدى رش النباتات خاصة عند استخدام خليط العناصر الصغرى إلى زيادة في مدى تحمل النباتات للملوحة وأيضا إلى رفع درجة تحملها لملوحة ماء الري. وقد كانت أفضل معاملات التفاعل فـي هذا المجال هي استخدام المستوى الأقل من الملوحة مع الرش بالمستوى الأعلى من مخلـوط العناصـر الصغرى (الحديد + المنجنيز + الزنك) على النمو والمحصول الكلي للبذور ومكوناتـه وكـذا التركيـب الكيميائي لنباتات المارجريت تحت الظروف التي أجريت بها الدراسة.