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MITIGATION THE HARMFUL EFFECT OF IRRIGATION WATER SALINITY ON *ROSA HYBIRIDA*, CV. CENTRIX BY USING ARGININE AND MAGNETIC IRON

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ABSTRACT: Water scarcity has become a critical challenge in various countries of the world that are suffering from a lack of water resources which led to increasing the need for irrigation water. So, the main purpose of this investigation was to study increasing resistance of *Rosa hybirida* cv. Centrix to irrigation with diluted sea water by using arginine and magnetic iron. The experiment was conducted on Rosa cv. Centrix during the two successive seasons of 2016 and 2017 to evaluate the effects of foliar spraying with arginine at (100 and 200 mg L^{-1}) and soil application with magnetic iron at (4 and 6 g pot^{-1}) were studied combined with irrigation by diluted sea water at three concentrations (5, 10 and 15%) on vegetative growth, floral and chemical parameters. The results showed that plant height, number of branches, number of leaves, leaf area, fresh and dry weights of leaves as well as floral characters such flowering stem length, number of flowers, flower diameter, flower fresh and dry weights were increased at lower levels of salinity of diluted sea water irrigation (5%), and then gradually decreased with increasing irrigation water salinity from 5 to 15% as compared to non-saline water (control). Moreover, relative water content, photosynthetic pigments, reducing sugars, mineral uptake (N, P, K, Mg and Ca %) were negatively affected by salt stress while increasing electrolyte leakage (%), proline and total sugars as well as higher contents of Na^{+}. In contrast to this, arginine or magnetic iron ameliorated all parameters in plants which were irrigated with all diluted sea water concentrations. It could be noticed that the application of arginine at 200 mg L^{-1} or magnetic iron at 6 g pot^{-1} could partially alleviate the harmful effect of salinity stress on plant growth and biochemical constituents of *Rosa* cv. Centrix plant. From the obtained results, it could be recommended that spraying Rosa plants irrigated by diluted sea water with arginine at 200 mg L^{-1} could overcome the deleterious effects of salinity.

Key words: *Rosa hybirida*, salinity stress, Arginine, Magnetic iron.

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INTRODUCTION

Roses (*Rosa hybirda*, L.) belongs to Family Rosaceae and is known as "Queen of Flowers". Roses are one of the most popular and important economical florist crops and universally highly demanded as a cut flower. It is widely utilized in landscape design as a shrub, in beds, in hedges and borders in gardens. In general, roses are sensitive to saline that exceeds 3.0 dS m^{-1}, but some rose cultivars can tolerate up to an EC of 3.5 dS m^{-1} without decrease in yield and quality (Caia, *et al.* 2014).

Irrigation of ornamental plants with saline water decreases growth and size of the plant resulting in shorter stem and smaller green leaves which reduce aesthetic appearance (Valdez-Aguilar *et al.,* 2011). Salt harm to plants is created by a collection of several reasons, inclusive mainly osmotic injury and, specified ion toxicity that influence a diversity of physiological and metabolic operation in plants (Di Baccio *et al.,* 2004). There is a number of disadvantages when irrigation with salt water, such as create a biotic stress and poisonous effects on plants which lead up to a progressive decrease in photosynthesis and respiration rates and deterioration in proteins and nucleic acids (Manai *et al.,* 2014).

Amino acids have a specified role in plant tolerance to stress. Between the amino acids, L-arginine is one of the most functionally varied amino acids in living cells (Liu *et al.,* 2006). It is important in plants as a mean of to the transfer and store of nitrogen and a precursor to the synthesis of other amino acids and polyamines inclusive spermine, putrescine and spermidine (Flores *et al.,* 2008). Polyamines modify various biological operations in plants, inclusive cell division, morphogenesis in phytochrome, growth, discrimination, plant hormone-mediated action, and senescence and it has been proposed that they share in cellular defense against oxidative harm by the inhibition of lipid peroxidation and scavenger of free radicals (Velikova *et al.,* 2000). Foliar application of arginine at 2.5 mM enhances the growth and causes increment the fresh and dry weights, particularly chlorophylls a and b, carotenoids and endogenous plant growth regulators on wheat (El-Bassiouny *et al.,* 2008). Spraying plants with arginine at 2.5 mM alleviate the harmful influence of salinity in lupine (Akladious and Hanafy, 2018).

Overcoming the passive influence of salinity by using magnetic iron (magnetite) is one of the most important agents which affect plant growth. Abd El-Rhman (2017) and El-Basioni *et al.* (2015) indicated that the application of magnetic iron may ameliorate soil structure, increase soil organic material, improve water characteristic cation interchangeability and be more energy and activity which is known as "Magneto biology" that ameliorated water–holding ability and crop nutrition from macro and microelements. In addition, the magnetic operation separates all chlorine, toxic and deleterious gases from soil, which increase salt motion and solubility of nutrients, leading to increase water detention by soil and this helps plant growth and moderation of soil temperature. In this concern, remedy of harmful effects of salinity by magnetite such as those of (Abdel-Fattah, 2014) on Jacaranda who reported that application of magnetic iron at 4 g/pot enhanced vegetative and root growth, increased leaf content of chlorophyll, N, P and K, but decreased Na, Cl, carotenoids and free proline content under salinity stress.

Water deficiency is the greatest crisis confronting mankind in the 21^{st} century and probably beyond. According to the UN, 1.2 billion people presently do not have access to clean drinking water, and one half of the world’s people poverty adequate water refinement (Singh, 2008). Because irrigation of plants needs a lot of water so there is an imperative necessity want to utilize alternate water exporter for irrigating and keeping fresh water, the inclination to use saline water in order for irrigation is the greater tendency. For these reasons, the keeping quality and aesthetic value of *Rosa hybirida*, cv. Centrix and rising its impedance to irrigation with diluted sea water is the major objective of this study. Thus, remediation with arginine and magnetic iron were the main direction for realization the major purpose of this study.

MATERIALS AND METHODS

This experiment was carried out at Agricultural Research Station, Ismailia, Agriculture Research Center, Egypt, during the two successive seasons of 2016 and 2017. The purpose of this study was the keeping quality and aesthetic value of *Rosa hybirida*, cv. Centrix and rising its tolerance to irrigation with diluted sea water by using magnetic iron in soil and foliar application with arginine.

Plant material:

One year old plants of Rose were obtained from the local commercial nursery and transplanted into plastic containers (30 cm diameter), filled with 7 kg loamy sand soil including one plant/bag. All plants were pinched at 35 cm height above the soil surface prior to the starting of treatments. After 30 days from transplanting, plants were divided into four groups, each group contained five treatments. All groups were treated with treatment for the first time before the start of irrigation with diluted sea water by 48 hours and then three-times (every two weeks). Plants were irrigated with 350 ml/pot fresh water or diluted saline water twice per week and salts were washed once every two weeks with fresh water. The commercial fertilizer (20:20:20) was sprayed at 4 g L^{-1} every 15 days throughout the experiment. The chemical and mechanical analysis of experimental medium presented in Table (1) were conducted according to method of (Jackson, 1967).

Experimental design and treatments*:*

The experiment was conducted in a split plot design, the main plot (sea water dilutions four treatments) and the subplot (tremediation five treatments). The experimental treatments were 20 treatments with three replicates, each replicate had three plants.

1. Main plot (Sea water dilutions four treatments):

- Control (fresh water at 0.58 ds m^{-1}).
- Sea water at 5% + fresh water at 95% (3.56 ds m^{-1}).
- Sea water at 10% + fresh water at 90% (7.04 ds m^{-1}).
- Sea water at 15% + fresh water at 85% (10.55 ds m^{-1}).

2. Sub plot (remediation five treatments):

- Control.
- Arginine (L-arginine 99%**)** at 100 mg L^{-1} (Ar).
- Arginine at 200 mg L^{-1}.
- Magnetic iron (Magnetite) at 4 g pot^{-1} (Mag).
- Magnetic iron at 6 g pot^{-1}.

The following data were recorded:

1. Vegetative growth parameters at the end of season:

The plant height (cm), number of the branches/plant, the number of leaves/plant, leaves fresh and dry weight (g/plant) and leaf area (cm^2) were determined according to the method of (Matthew *et al.,* 2002).

2. Floral parameters:

Flowering stem length (cm), number of flowers/plant, flower diameter (cm), flowers fresh and dry weight (g/plant).

3. Relative water content (%) and electrolyte leakage (%):

Relative water content (%) and membrane permeability or electrolyte leakage (%) as they were calculated in leaves according to Ali *et al.* (2014).

4. Chemical analysis:

- Total chlorophyll and carotenoids in leaves contents were specified according to Sumanta *et al.* (2014).
- Proline (mg g^{-1} D.W) was determined according to Tamayo and Bonjoch (2001).
- Total and reducing sugars in leaves (%) was determined according to James, (1995).
- Nitrogen (N) (%) was determined according to the A.O.A.C. (1990).
- Phosphorus (P) (%) was determined as described by Olsen and Sommers (1982).
- Potassium (K) and sodium (Na^+) (%) were determined as described by (Jackson, 1967).

Table 1. Chemical and mechanical analysis of experimental medium.

Mechanical analysis (%)						Chemical analysis	
Sand %	**Silt %**	**Clay %**	**Texture grade**	**Organic matter**	**$CaCO_3$%**	**pH (1:2.5)**	**EC ds m^{-1} (1:5)**
85.1	12.2	2.7	Loamy sand	-	-	7.89	1.11

Available (mg/100 g soil)			Cations (meq/100 g soil)				Anions (meq/100 g soil)			
N	**P**	**K**	**Ca^{++}**	**Mg^{++}**	**Na^{+}**	**K^{+}**	**CO_3^{--}**	**HCO_3^{-}**	**Cl^{-}**	**SO_4^{--}**
1.23	1.99	5.19	0.4	0.25	0.33	0.06	-	0.25	0.46	0.33

Table 2. The chemical analysis of the used fresh water and sea water (collected from the Suez Canal) in Ismailia Governorate.

	EC ds m^{-1} (1:5)	pH (1:2.5)	Anions (meq L^{-1})				Cations (meq L^{-1})			
			CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}	Ca^{++}	Mg^{++}	Na^{+}	K^{+}
Sea water	70.5	8.22	-	2.5	622.5	150	87.2	114.0	562.5	11.3
Fresh water	0.58	8.06	-	1.25	1.0	1.0	0.8	0.2	2.05	0.2

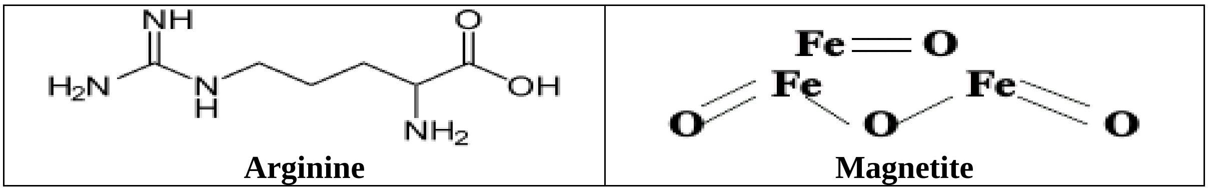

Fig 1. Chemical structure of arginine ($C_6H_{14}N_4O_2$) and magnetite (Fe_3O_4).

- Calcium and magnesium were determined using Inductively coupled Spectrometry Plasma (ICP) Model Ultimate-Jobin Yvon.

Statistical analysis:

The collected data were subjected to statistical analysis of variance technique by means of the CoStat Computer Software version 6.303. The means were compared by Duncan's Multiple Range Test (DMRT; $P \leq 0.05$) (Gomez and Gomez (1984).

RESULTS

1. Vegetative growth parameters:

Data presented in Tables (3 & 4) showed that *Rosa hybirida*, L. cv. Centrix plant height (cm), number of branches/plant, number of leaves, leaf area, as well as fresh and dry weights of leaves were increased at low levels of salinity of diluted sea water irrigation (5%), then gradually decreased with increasing irrigation water salinity from 5 to 15% as compared to non-salinized (control). The lowest values of the vegetative growth parameters resulted from the high irrigation water salinity (15%) in both seasons. The highest mean values occurred with 5% saline water comparing with the other salinity concentrations for plant height, number of branches, leaf area, number of leaves, leaves fresh and dry weights during the two seasons respectively.

Referring to, the remediation treatments, data in the same tables indicated that all remediation treatments increased vegetative growth compared with control treatment. The obtained results revealed that Rosa plants which received arginine at 200 mg L^{-1} gave significantly the highest values of plant height (46.33 & 51.79 cm), number of branches (4.95 & 5.18 branch/plant), leaf area (65.41 & 66.76 cm^2), number of leaves (31.19 & 33.36 leave/plant), leaves fresh weight (16.00 & 16.57g/plant) and leaves dry weight (5.27 & 5.42 g/plant) for both seasons respectively (Tables 3 & 4).

Regarding the effect of interactions between saline irrigation water and either arginine or magnetic iron on vegetative growth parameters, data presented in the same tables indicated that treatments with arginine or magnetic iron supplementary with saline irrigation at 5% led to significant increase in the vegetative growth. The highest values were with the treatment of arginine at 200 mg L^{-1} additional with 5% saline water, then arginine 200 mg L^{-1} with

Table 3. Effect of irrigation with diluted seawater and remediation treatments and the interaction between them on plant height (cm), number of branches and leaf area (cm^2 $leaf^{-1}$) of Rosa cv. Centrix in the two seasons.

Sea water dilutions / Remediation treatments	1st season					2nd season				
	Control	5%	10%	15%	Mean	Control	5%	10%	15%	Mean
Plant height (cm)										
Control	41.89^{c-e}	43.44^{cd}	23.67^{f}	22.00^{f}	32.75^{d}	42.67^{fg}	49.00^{de}	32.10^{i}	31.67^{i}	38.86^{d}
Ar. at 100 mgL^{-1}	46.22^{a-c}	46.55^{a-c}	43.56^{cd}	37.44^{e}	43.44^{b}	51.33^{cd}	52.56^{b-d}	49.00^{de}	35.33^{hi}	47.06^{bc}
Ar. at 200 mgL^{-1}	49.67^{ab}	51.89^{a}	44.45^{b-d}	39.33^{de}	46.33^{a}	57.56^{ab}	60.50^{a}	50.00^{c-e}	39.10^{gh}	51.79^{a}
Mag. at 4 g pot^{-1}	45.00^{b-d}	45.28^{b-d}	41.89^{c-e}	26.33^{f}	39.63^{c}	51.00^{c-e}	52.00^{cd}	46.00^{ef}	34.67^{hi}	45.92^{c}
Mag. at 6 g pot^{-1}	46.89^{a-c}	47.56^{a-c}	42.70^{c-e}	37.33^{e}	43.64^{b}	52.56^{b-d}	55.00^{bc}	48.56^{de}	37.78^{h}	48.47^{b}
Mean	45.93^{a}	46.94^{a}	39.27^{b}	32.49^{c}		51.02^{a}	53.84^{a}	45.13^{b}	35.71^{c}	
No. of branches										
Control	3.67^{g-i}	4.00^{fg}	3.11^{kl}	2.78^{l}	3.39^{e}	3.85^{j-m}	4.11^{h-k}	3.22^{n}	2.67^{o}	3.46^{e}
Ar. at 100 mgL^{-1}	4.67^{de}	4.78^{cd}	4.33^{ef}	3.33^{i-k}	4.28^{c}	4.75^{ef}	5.00^{de}	4.29^{g-j}	3.58^{l-n}	4.41^{c}
Ar. at 200 mgL^{-1}	5.67^{b}	6.11^{a}	4.44^{de}	3.59^{h-j}	4.95^{a}	6.00^{ab}	6.33^{a}	4.33^{f-i}	4.07^{h-k}	5.18^{a}
Mag. at 4 g pot^{-1}	4.45^{de}	4.60^{de}	3.78^{gh}	3.25^{jk}	4.02^{d}	4.52^{f-h}	4.67^{e-g}	3.96^{i-l}	3.45^{mn}	4.15^{d}
Mag. at 6 g pot^{-1}	5.11^{c}	5.56^{b}	4.00^{fg}	3.56^{h-j}	4.56^{b}	5.33^{cd}	5.67^{bc}	4.00^{i-l}	3.67^{k-m}	4.67^{b}
Mean	4.71^{b}	5.01^{a}	3.93^{c}	3.30^{d}		4.89^{a}	5.16^{a}	3.96^{b}	3.49^{c}	
Leaf area (cm^2 $leaf^{-1}$)										
Control	57.78^{l}	62.11^{i}	49.13^{p}	46.71^{q}	53.93^{e}	58.27^{n}	62.77^{k}	49.36^{s}	47.87^{t}	54.57^{e}
Ar. at 100 mgL^{-1}	66.90^{e}	69.47^{d}	62.40^{i}	53.00^{n}	62.94^{c}	68.83^{f}	69.89^{e}	62.96^{j}	53.13^{q}	63.70^{c}
Ar. at 200 mgL^{-1}	71.56^{b}	73.15^{a}	62.96^{h}	53.99^{m}	65.41^{a}	72.26^{b}	74.84^{a}	63.08i	56.85^{o}	66.76^{a}
Mag. at 4 g pot^{-1}	64.58^{g}	65.33^{f}	58.44^{k}	50.54^{o}	59.72^{d}	64.94^{h}	65.62^{g}	59.93^{m}	51.74^{r}	60.56^{d}
Mag. at 6 g pot^{-1}	69.72^{d}	70.87^{c}	60.58^{j}	53.07^{n}	63.56^{b}	69.97^{d}	71.53^{c}	61.64^{l}	53.61^{p}	64.19^{b}
Mean	66.11^{b}	68.19^{a}	58.70^{c}	57.46^{d}		66.85^{b}	68.93^{a}	59.39^{c}	52.64^{d}	

Mean values followed by the same letters are not significantly different at the $P<0.05$ according to Duncan's multiple range test (Duncan, 1955).

Table 4. Effect of irrigation with diluted seawater and remediation treatments and the interaction between them on number of leaves/plant, fresh and dry weight of leaves (g/plant) of Rosa cv. Centrix in the two seasons.

Sea water dilutions / Remediation treatments	1st season					2nd season				
	Control	5%	10%	15%	Mean	Control	5%	10%	15%	Mean
No. of leaves/plant										
Control	15.00^{g-i}	18.50^{fg}	10.67^{jk}	8.67^{k}	13.21^{e}	17.33^{fg}	20.67^{ef}	11.33^{ij}	9.33^{j}	14.67^{e}
Ar. at 100 mgL^{-1}	25.00^{de}	25.33^{d}	21.33^{ef}	12.00^{i-k}	20.92^{c}	27.00^{cd}	28.33^{bc}	23.67^{de}	12.67^{h-j}	22.92^{c}
Ar. at 200 mgL^{-1}	43.00^{ab}	45.11^{a}	22.33^{de}	14.33^{h-j}	31.19^{a}	45.17^{a}	47.44^{a}	24.83^{c-e}	16.00^{gh}	33.36^{a}
Mag. at 4 g pot^{-1}	23.67^{de}	24.11^{de}	17.67^{f-h}	10.67^{jk}	19.03^{d}	25.33^{cd}	26.33^{cd}	19.00^{fg}	11.67^{h-j}	20.58^{d}
Mag. at 6 g pot^{-1}	29.00^{c}	40.11^{b}	18.00^{f-h}	12.33^{i-k}	24.86^{b}	31.67^{b}	43.89^{a}	19.33^{fg}	15.00^{g-i}	27.47^{b}
Mean	27.13^{b}	30.63^{a}	18.00^{c}	11.60^{d}		29.30^{b}	33.33^{a}	19.63^{c}	12.93^{d}	
Leaf fresh weight (g)										
Control	10.67^{j}	11.31^{i}	7.73^{m}	6.80^{n}	9.13^{e}	10.50^{n}	11.17^{k}	7.93^{s}	5.70^{t}	8.83^{e}
Ar. at 100 mgL^{-1}	14.25^{e}	13.16^{f}	11.09^{ij}	8.63^{l}	11.78^{c}	14.45^{f}	15.30^{e}	11.36^{j}	9.76^{q}	12.72^{c}
Ar. at 200 mgL^{-1}	19.86^{b}	21.66^{a}	11.85^{h}	10.64^{j}	16.00^{a}	20.85^{b}	22.77^{a}	12.40^{i}	10.26^{o}	16.57^{a}
Mag. at 4 g pot^{-1}	12.47^{g}	12.78^{fg}	10.72^{j}	8.43^{l}	11.10^{d}	12.93^{h}	13.50^{g}	10.57^{m}	8.98^{r}	11.50^{d}
Mag. at 6 g pot^{-1}	15.30^{d}	17.25^{c}	10.75^{j}	9.20^{k}	13.12^{b}	15.84^{d}	19.49^{c}	10.85^{l}	10.24^{p}	14.11^{b}
Mean	14.51^{b}	15.23^{a}	10.43^{c}	8.74^{d}		14.91^{b}	16.45^{a}	10.62^{c}	8.99^{d}	
Leaf dry weight (g)										
Control	3.20^{k}	3.48^{i}	2.42^{p}	2.01^{r}	2.78^{d}	3.23^{l}	3.73^{i}	2.46^{r}	1.80^{s}	2.81^{e}
Ar. at 100 mgL^{-1}	4.81^{e}	3.91^{h}	3.44^{j}	2.63^{o}	3.70^{c}	5.09^{e}	3.83^{h}	3.55^{k}	2.93^{p}	3.85^{c}
Ar. at 200 mgL^{-1}	6.88^{b}	7.69^{a}	3.45^{j}	3.04^{m}	5.27^{a}	6.95^{b}	8.13^{a}	3.60^{j}	2.98^{o}	5.42^{a}
Mag. at 4 g pot^{-1}	5.32^{d}	3.96^{g}	3.04^{m}	2.45^{p}	3.69^{c}	5.40^{d}	4.05^{g}	3.02^{n}	2.51^{q}	3.75^{d}
Mag. at 6 g pot^{-1}	5.52^{c}	4.49^{f}	3.12^{l}	2.67^{n}	3.95^{b}	5.75^{c}	4.87^{f}	3.19^{m}	2.93^{p}	4.19^{b}
Mean	4.71^{b}	5.15^{a}	3.09^{c}	2.56^{d}		4.92^{b}	5.28^{a}	3.16^{c}	2.63^{d}	

Mean values followed by the same letters are not significantly different at the $P<0.05$ according to Duncan's multiple range test (Duncan, 1955).

non-saline water, followed by magnetic iron at 6 g pot^{-1} additional with 5% saline water.

2. Floral parameters:

Concerning the effect of irrigation with saline water, data in Tables (5 & 6) indicated that flowering stem length, number of flowers, flower diameter, flower fresh and dry weights were increased at lower levels of salinity of diluted sea water irrigation (5%), then progressively decreased with increasing irrigation water salinity to higher than 5% as compared to control. The dilution of sea water at 5% and fresh water (control) significantly enhanced all floral parameters compared to the other salinity levels. The highest values were realized for the plants irrigated with 5% sea water dilution. Meanwhile the lowest values were obtained from the plants irrigated with 15% sea water dilution in both seasons.

It is observed from Tables (5 & 6) that the plants treated with arginine and magnetic iron significantly improved floral quality traits of Rosa cv. Centrix plants compared to control in two seasons. Arginine at 200 mg L^{-1} and magnetic iron at 6 g pot^{-1} significantly surpassed all parameters compared to other treatments. The longest flowering stem length (46.87 & 48.83cm), flower diameter (5.83 & 6.27 cm), the highest number of flowers (5.71 & 6.14 flowers/plant), flower fresh weight (5.31 & 5.53 g/flower) and flower dry weight(1.013 & 1.075 g/flower) were obtained with treatment of arginine at 200 mg L^{-1} in the two seasons, respectively.

With respect to the effect of interaction between irrigation with sea water dilutions and remediation treatments on floral measurements, data in the same tables showed significant effects on all floral measurements when remediated Rosa plants with arginine and magnetic iron additional with saline irrigation at 5%. The best quality of flowering, flowering stem length (59.00 & 61.00 cm), flower diameter (7.15 & 7.55 cm), number of flowers (7.67 & 8.00 flower/plant), flower fresh weight (6.87 & 6.97 g/flower) and flower dry weight (1.401 & 1.435 g/flower) were obtained when using arginine at 200 mg L^{-1} supplementary with saline irrigation at 5% in two seasons, respectively.

3. Relative water content (%) and electrolyte leakage (%):

Data presented in Table (7) indicated that leaf relative water content was significantly decreased with increasing water salinity except for the 5% saline irrigation. The highest value was realized for the plants irrigated with 5% sea water dilution (83.18 & 84.15%, respectively) in two seasons. Meanwhile, the electrolyte leakage % markedly increased with increasing water salinity, the highest value was (12.04 & 12.24%) when irrigated Rosa plants by 15% sea water in the first and second seasons, respectively.

It is well observed from data in the same Table, that the plants treated with arginine or magnetic iron significantly decreased electrolyte leakage, meantime relative water content was increased. The high relative water content was obtained when Rosa plants were treated with arginine at 200 mg L^{-1}, however, the same treatment recorded the lowest value in membrane permeability.

With respect to the interactions between saline irrigation water and either arginine or magnetic iron on the leaf relative water content and electrolyte leakage**,** data presented in Table (7) showed that all remediation treatments combined with irrigation with sea water dilution had significant effects on leaf relative water content and electrolyte leakage. The lowest value of electrolyte leakage was recorded for plants irrigated with 5% sea water and treated with arginine at 200 mg L^{-1} as a foliar application. Also, the same treatment recorded the highest value of leaf relative water content in two seasons.

4. Chemical analysis:

Total chlorophyll and carotenoids:

It could be clearly shown from data presented in Table (8) that the highest total

Table 5. Effect of irrigation with diluted seawater and remediation treatments and the interaction between them on the flowering stem length (cm), flower diameter (cm) and number of flowers/plant of Rosa cv. Centrix in the two seasons.

Sea water dilutions / Remediation treatments	1st season					2nd season				
	Control	**5%**	**10%**	**15%**	**Mean**	**Control**	**5%**	**10%**	**15%**	**Mean**
					Flowering stem length (cm)					
Control	33.89^{kl}	37.67^{hi}	29.33^{op}	27.67^{p}	32.14^{e}	34.98^{j}	38.00^{hi}	30.00^{mn}	28.33^{n}	32.83^{e}
Ar. at 100 mgL^{-1}	45.79^{e}	47.29^{e}	38.75^{h}	31.32^{mn}	40.79^{c}	46.14^{e}	48.00^{d}	39.33^{h}	33.00^{kl}	41.62^{c}
Ar. at 200 mgL^{-1}	55.00^{b}	59.00^{a}	40.67^{g}	32.82^{lm}	46.87^{a}	58.33^{b}	61.00^{a}	42.00^{g}	34.00^{jk}	48.83^{a}
Mag. at 4 g pot^{-1}	42.23^{g}	44.00^{f}	34.62^{jk}	30.00^{no}	37.71^{d}	44.33^{f}	45.00^{ef}	35.00^{j}	31.67^{lm}	39.00^{d}
Mag. at 6 g pot^{-1}	50.00^{d}	52.00^{c}	36.00^{ij}	32.33^{lm}	42.58^{b}	52.11^{c}	53.20^{c}	37.00i	33.81^{jk}	44.03^{b}
Mean	45.38^{b}	47.99^{a}	35.87^{c}	30.83^{d}		47.18^{b}	49.04^{a}	36.67^{c}	32.16^{d}	
					Flower diameter (cm)					
Control	4.67^{n}	5.00^{k}	3.60^{r}	3.00^{s}	4.07^{e}	4.72^{m}	5.33^{j}	3.72^{p}	3.36^{q}	4.28^{e}
Ar. at 100 mgL^{-1}	6.00^{e}	5.74^{g}	5.25^{j}	4.50^{o}	5.37^{c}	5.95^{f}	6.17^{e}	5.36^{ij}	4.32^{n}	5.45^{c}
Ar. at 200 mgL^{-1}	6.50^{b}	7.15^{a}	5.35^{i}	4.32^{p}	5.83^{a}	7.35^{b}	7.55^{a}	5.45^{hi}	4.74^{m}	6.27^{a}
Mag. at 4 g pot^{-1}	5.90^{f}	5.60^{h}	4.89^{m}	3.99^{q}	5.10^{d}	5.53^{h}	5.72^{g}	5.00^{l}	4.10^{o}	5.09^{d}
Mag. at 6 g pot^{-1}	6.25^{c}	6.17^{d}	4.95^{l}	4.67^{n}	5.51^{b}	6.33^{d}	6.67^{c}	5.22^{k}	4.91^{l}	5.78^{b}
Mean	5.80^{b}	6.00^{a}	4.81^{c}	4.10^{d}		5.98^{b}	6.29^{a}	4.95^{c}	4.29^{d}	
					No. of flowers/plant					
Control	3.00^{m}	4.67^{h}	2.67^{n}	2.67^{n}	3.25^{e}	3.33^{gh}	5.00^{de}	3.00^{h}	2.89^{h}	3.56^{d}
Ar. at 100 mgL^{-1}	5.67^{e}	5.33^{f}	4.67^{h}	3.33^{kl}	4.75^{c}	5.67^{b-d}	6.00^{bc}	5.04^{de}	3.67^{f-h}	5.09^{b}
Ar. at 200 mgL^{-1}	7.11^{b}	7.67^{a}	4.67^{h}	3.39^{k}	5.71^{a}	7.56^{a}	8.00^{a}	5.00^{de}	4.00^{fg}	6.14^{a}
Mag. at 4 g pot^{-1}	5.00^{g}	5.11^{g}	3.75^{j}	3.11^{lm}	4.24^{d}	5.33^{c-e}	5.55^{b-d}	4.11^{fg}	3.22^{gh}	4.55^{c}
Mag. at 6 g pot^{-1}	6.33^{c}	6.00^{d}	4.00^{i}	3.33^{kl}	4.92^{b}	6.15^{bc}	6.44^{b}	4.44^{ef}	3.56^{f-h}	5.14^{b}
Mean	5.29^{b}	5.89^{a}	3.95^{c}	3.17^{d}		5.61^{a}	6.20^{a}	4.32^{b}	3.47^{c}	

Mean values followed by the same letters are not significantly different at the P<0.05 according to Duncan's multiple range test (Duncan, 1955).

Table 6. Effect of irrigation with diluted seawater and remediation treatments and the interaction between them on the flower fresh and dry weight (g/flower) of Rosa cv. Centrix in the two seasons.

Sea water dilutions / Remediation treatments	1st season					2nd season				
	Control	**5%**	**10%**	**15%**	**Mean**	**Control**	**5%**	**10%**	**15%**	**Mean**
					Flower fresh weight (g)					
Control	3.67^{m}	4.00^{k}	3.27^{o}	2.27^{r}	3.30^{e}	3.93^{n}	4.20^{k}	2.88^{s}	2.35^{t}	3.34^{e}
Ar. at 100 mgL^{-1}	5.00^{f}	5.33^{e}	4.24^{j}	3.00^{p}	4.39^{c}	5.24^{f}	5.70^{e}	4.73^{j}	3.26^{q}	4.73^{c}
Ar. at 200 mgL^{-1}	6.50^{b}	6.87^{a}	4.48^{i}	3.38^{n}	5.31^{a}	6.75^{b}	6.97^{a}	4.79^{i}	3.60^{o}	5.53^{a}
Mag. at 4 g pot^{-1}	4.80^{h}	4.95^{g}	3.81^{l}	2.96^{q}	4.13^{d}	5.00^{h}	5.13^{g}	4.00^{m}	3.10^{r}	4.31^{d}
Mag. at 6 g pot^{-1}	6.15^{d}	6.26^{c}	4.00^{k}	3.00^{p}	4.85^{b}	6.27^{d}	6.35^{c}	4.15^{l}	3.54^{p}	5.08^{b}
Mean	5.22^{b}	5.48^{a}	3.96^{c}	2.92^{d}		5.44^{b}	5.67^{a}	4.11^{c}	3.17^{d}	
					Flower dry weight (g)					
Control	0.703^{ij}	0.896^{e-h}	0.483^{kl}	0.396^{l}	0.620^{d}	0.747^{n}	0.864^{k}	0.540^{s}	0.420_{t}	0.643^{e}
Ar. at 100 mgL^{-1}	0.953^{d-f}	1.085^{cd}	0.780^{g-i}	0.528^{kl}	0.837^{c}	1.008^{g}	1.172^{e}	0.890^{j}	0.583^{q}	0.913^{c}
Ar. at 200 mgL^{-1}	1.241^{a-c}	1.401^{a}	0.824^{f-i}	0.585^{jk}	1.013^{a}	1.317^{b}	1.435^{a}	0.905^{i}	0.644^{o}	1.075^{a}
Mag. at 4 g pot^{-1}	0.915^{e-g}	1.011^{de}	0.701^{ij}	0.510^{kl}	0.784^{c}	0.962^{h}	1.060^{f}	0.753^{m}	0.552^{r}	0.832^{d}
Mag. at 6 g pot^{-1}	1.174^{bc}	1.270^{ab}	0.736^{h-j}	0.520^{kl}	0.925^{b}	1.210^{d}	1.305^{c}	0.782^{l}	0.631^{p}	0.982^{b}
Mean	0.997^{a}	1.133^{a}	0.705^{b}	0.508^{c}		1.059^{b}	1.167^{a}	0.774^{c}	0.566^{d}	

Mean values followed by the same letters are not significantly different at the P<0.05 according to Duncan's multiple range test (Duncan, 1955).

Table 7. Effect of irrigation with diluted seawater and remediation treatments and the interaction between them on electrolyte leakage (%) and relative water content (%) of Rosa cv. Centrix in the two seasons.

Remediation treatments \ Sea water dilutions	1st season					2nd season				
	Control	5%	10%	15%	Mean	Control	5%	10%	15%	Mean
					Electrolyte leakage (%)					
Control	10.11^{g}	8.57^{i}	13.25^{b}	13.98^{a}	11.47^{a}	10.65^{g}	8.58^{j}	13.51^{b}	13.99^{a}	11.68^{a}
Ar. at 100 mgL^{-1}	6.26^{l}	6.06^{m}	7.82^{j}	11.84^{d}	7.99^{c}	6.33^{o}	6.25^{p}	7.99^{k}	11.93^{d}	8.12^{c}
Ar. at 200 mgL^{-1}	5.34^{p}	5.15^{q}	7.22^{k}	10.74^{f}	7.11^{e}	5.41^{s}	5.21^{t}	7.62^{l}	10.82^{f}	7.27^{e}
Mag. at 4 g pot^{-1}	6.40^{l}	6.39^{l}	9.11^{h}	11.40^{c}	8.57^{b}	6.91^{m}	6.78^{n}	9.42^{h}	12.74^{c}	8.96^{b}
Mag. at 6 g pot^{-1}	5.72^{n}	5.51^{o}	8.59^{i}	11.22^{e}	7.76^{d}	5.74^{q}	5.55^{r}	8.72^{i}	11.74^{e}	7.94^{d}
Mean	6.76^{c}	6.34^{d}	9.20^{b}	12.04^{a}		7.01^{c}	6.47^{d}	9.45^{b}	12.24^{a}	
					Relative water content (%)					
Control	70.00^{l}	80.63^{f}	56.37^{q}	55.56^{r}	65.64^{e}	71.52^{j}	80.87^{e}	57.04^{n}	54.17^{o}	65.90^{e}
Ar. at 100 mgL^{-1}	81.13^{e}	82.25^{c}	74.17^{i}	65.45^{o}	74.99^{c}	78.91^{f}	82.40^{c}	75.36^{h}	62.64^{l}	74.83^{c}
Ar. at 200 mgL^{-1}	82.40c	87.04^{a}	76.72^{h}	66.67^{m}	78.21^{a}	82.25^{c}	89.23^{a}	77.89^{g}	67.62^{k}	79.25^{a}
Mag. at 4 g pot^{-1}	77.88^{g}	81.63^{d}	71.82^{k}	62.86^{p}	73.55^{d}	78.13^{g}	82.00^{cd}	72.03^{j}	60.00^{m}	73.04^{d}
Mag. at 6 g pot^{-1}	78.09^{g}	84.33^{b}	73.56^{j}	66.15^{n}	76.29^{b}	81.63^{d}	86.23^{b}	73.24^{i}	67.37^{k}	77.12^{b}
Mean	77.90^{b}	83.18^{a}	70.53^{c}	63.34^{d}		78.49^{b}	84.15^{a}	71.11^{c}	62.36^{d}	

Mean values followed by the same letters are not significantly different at the P<0.05 according to Duncan's multiple range test (Duncan, 1955).

Table 8. Effect of irrigation with diluted seawater and remediation treatments and the interaction between them on total chlorophyll and carotenoids (mg g^{-1} F.W) of Rosa cv. Centrix in the two seasons.

Remediation treatments \ Sea water dilutions	1st season					2nd season				
	Control	5%	10%	15%	Mean	Control	5%	10%	15%	Mean
					Total chlorophyll (mg g^{-1} F.W.)					
Control	0.630^{k}	0.608^{n}	0.561^{s}	0.533^{t}	0.583^{e}	0.625^{ef}	0.612^{f-h}	0.589^{i}	0.492^{j}	0.580^{e}
Ar. at 100 mgL^{-1}	0.694^{e}	0.680^{f}	0.633^{j}	0.578^{q}	0.646^{c}	0.661^{c}	0.660^{c}	0.628^{ef}	0.595^{hi}	0.636^{c}
Ar. at 200 mgL^{-1}	0.865^{a}	0.723^{b}	0.636^{i}	0.588^{o}	0.703^{a}	0.755^{a}	0.713^{b}	0.640^{de}	0.602^{g-i}	0.678^{a}
Mag. at 4 g pot^{-1}	0.668^{g}	0.640^{h}	0.614^{m}	0.576^{r}	0.625^{d}	0.651^{cd}	0.646^{cd}	0.613^{f-h}	0.593^{i}	0.626^{d}
Mag. at 6 g pot^{-1}	0.717^{c}	0.712^{d}	0.623^{l}	0.583^{p}	0.659^{b}	0.710^{b}	0.701^{b}	0.616^{fg}	0.598^{g-i}	0.656^{b}
Mean	0.715^{a}	0.673^{b}	0.613^{c}	0.572^{d}		0.680^{a}	0.666^{b}	0.617^{c}	0.576^{d}	
					Carotenoid (mg g^{-1} F.W.)					
Control	0.365^{ce}	0.315^{fg}	0.310^{g}	0.213^{h}	0.301^{d}	0.373^{f}	0.319^{j}	0.277^{s}	0.231^{t}	0.300^{e}
Ar. at 100 mgL^{-1}	0.408^{ab}	0.347^{d-f}	0.313^{fg}	0.231^{h}	0.325^{c}	0.403^{c}	0.337^{h}	0.295^{l}	0.280^{q}	0.329^{c}
Ar. at 200 mgL^{-1}	0.434^{a}	0.433^{a}	0.376^{b-d}	0.235^{h}	0.369^{a}	0.435^{a}	0.385^{e}	0.301^{k}	0.283^{o}	0.351^{a}
Mag. at 4 g pot^{-1}	0.384^{bc}	0.334^{e-g}	0.318^{fg}	0.230^{h}	0.317^{c}	0.394^{d}	0.332^{i}	0.288^{n}	0.279^{r}	0.323^{d}
Mag. at 6 g pot^{-1}	0.427^{a}	0.359^{c-e}	0.360^{c-e}	0.233^{h}	0.345^{b}	0.428^{b}	0.362^{g}	0.290^{m}	0.281^{p}	0.340^{b}
Mean	0.404^{a}	0.357^{b}	0.335^{c}	0.229^{d}		0.407^{a}	0.347^{b}	0.290^{c}	0.271^{d}	

Mean values followed by the same letters are not significantly different at the P<0.05 according to Duncan's multiple range test (Duncan, 1955).

chlorophyll and carotenoids content was extracted from the leaves of the control plants and then progressively reduced by increasing irrigation level of water salinity. The lowest values were registered from plants irrigated with the highest level of the sea water salinity (15% diluted) in both seasons. On the other hand, treated plants with arginine and magnetic iron resulted in increasing the total chlorophyll and carotenoids contents during the two seasons comparing with the control.

From the mentioned results it could be concluded that there was a clear effect of irrigation with saline water on the leaf pigment contents (total chlorophyll and carotenoids). It can be observed that the high levels of salinity irrigation water (10 and 15% diluted) induced a significant reduction in the contents of the total chlorophyll as compared with control plants. The total chlorophyll content of the plant leaves exhibited a little increase when irrigation with the lowest sea water salinity (5%).

Plants treated with arginine at 200 mg L^{-1} or magnetic iron at 6 g pot^{-1} gave the highest values in total chlorophyll and carotenoids contents under control or 5% salinity (Table, 8).

Proline (mg g^{-1} D.W.):

Proline content in leaves was steeply increased with increasing saline irrigation water as presented in Table (9). The lowest values of these parameters were recorded from plants irrigated with the non-saline water or the lowest salinity in diluted seawater (5%) in both seasons. Also, plants gave the highest response to accumulating proline in the leaves when treated with either arginine or magnetic iron. Data showed that plants remediated with arginine or magnetic iron gave the highest values in proline content comparing with control under all salinity concentrations. The highest value was when spraying Rosa plants with arginine at 200 mg L^{-1} and irrigated with 15% sea water.

Total and reducing sugars (%):

A positive response from irrigation with diluted seawater was recorded for total sugars content with increasing irrigation saline water during the two seasons (Table, 9). Additionally, the same trend was observed when arginine and magnetic iron were applied. This increment clearly appeared when the combination between salinity and arginine or magnetic iron occurred. The highest total sugars (14.55 & 14.87%) occurred with arginine at 200 mg L^{-1} additional with 15% saline water in comparison with the other salinity concentrations during the two seasons, respectively. In contrast, spraying plants with arginine at 200 mg L^{-1} supplementary with saline irrigation at 5% sea water gave the highest values in reducing sugars content (1.697 & 1.749%) in both seasons, respectively. Generally, all remediation treatments significantly increased total and reducing sugars comparing with control in the two seasons.

Mineral elements (%):

It was noticeable that there was a gradual decrease in plant % of N, P, K, Mg^{++} and Ca^{++} with the increasing in saline water concentration (Tables, 10 & 11) combined with a gradual increase in Na^{+} in leaves during the two seasons. The low levels of diluted sea water (5%) caused a significant increase in N, P, K, Mg^{++} and Ca^{++}%.

Arginine and magnetic iron at both concentrations significantly increased the leaves % of N, P, K, Mg^{+} and Ca^{++} elements, while decreased Na^{+} under all salinity levels compared with the other treatments during the two seasons (Tables10 & 11). Under 5% saline water, the highest values of N and K % were obtained when applied arginine at 200 mg L^{-1} (1.99 & 1.94% for N and 3.93 & 3.77% for K) in the first and second seasons, respectively. While the same treatment increased P % in leaves of plants under non-salinity (Table 10). Spraying with arginine at 200 mg L^{-1} significantly increased the leaves contents of Mg^{++} and Ca^{++} under either non-saline water or 5% salinity during the two seasons Table (11). Treatments of arginine at 200 mg L^{-1} and magnetic iron at 6 g pot^{-1} significantly decreased the plant % of Na^{+} under all saline irrigation water as illustrated in Table (11). The lowest values of Na^{+} % (0.23 & 0.27%) were obtained when applied arginine at 200 mg L^{-1} additionally with saline irrigation at 5%.

Discussion

The obtained results showed that the plant height, branch number, fresh and dry weights of leaves, leaf area as well as floral parameters of *Rosa hybirida,* cv. Centrix "were gradually decreased with increasing salinity levels. These are an agreement with Ahmad *et al.* (2013) and Rehman *et al.* (2014). The negative effect of salinity on plant growth is attributed to inhibition of cell

Table 9. Effect of irrigation with diluted seawater and remediation treatments and the interaction between them on proline (mg g^{-1} D.W), total sugars and reducing sugars (%) of Rosa cv. Centrix in the two seasons.

Sea water dilutions / Remediation treatments	1st season					2nd season				
	Control	5%	10%	15%	Mean	Control	5%	10%	15%	Mean
					Proline (mg g^{-1} D.W.)					
Control	3.24^{q}	3.64^{p}	3.66^{p}	3.84^{o}	3.60^{e}	3.00^{p}	3.48^{o}	3.52^{o}	3.86^{n}	3.47^{e}
Ar. at 100 mgL^{-1}	4.18^{j}	4.24^{i}	4.28^{h}	4.42^{g}	4.28^{c}	4.52^{j}	5.00^{i}	5.52^{h}	5.78^{g}	5.21^{c}
Ar. at 200 mgL^{-1}	5.02^{d}	6.94^{c}	7.54^{b}	7.72^{a}	6.81^{a}	7.40^{c}	7.48^{c}	8.04^{b}	9.18^{a}	8.03^{a}
Mag. at 4 g pot^{-1}	3.98^{n}	4.02^{m}	4.06^{l}	4.14^{k}	4.05^{d}	3.90^{n}	4.20^{m}	4.30^{l}	4.42^{k}	4.21^{d}
Mag. at 6 g pot^{-1}	4.42^{g}	4.58^{f}	4.72^{e}	4.72^{e}	4.61^{b}	5.80^{g}	5.90^{f}	6.22^{e}	7.02^{d}	6.24^{b}
Mean	4.17^{d}	4.68^{c}	4.85^{b}	4.97^{a}		4.92^{d}	5.21^{c}	5.52^{b}	6.05^{a}	
					Total Sugars (%)					
Control	7.08^{t}	9.22^{o}	10.13^{j}	11.36^{e}	9.45^{e}	7.93^{s}	9.81^{n}	10.27^{j}	11.70^{e}	9.93^{e}
Ar. at 100 mgL^{-1}	8.23^{r}	9.38^{m}	10.62^{h}	12.33^{c}	10.14^{c}	8.87^{q}	9.99^{l}	10.80^{h}	12.45^{c}	10.53^{c}
Ar. at 200 mgL^{-1}	9.05^{p}	9.81^{k}	10.98^{f}	14.55^{a}	11.10^{a}	9.77^{o}	10.11^{k}	11.08^{f}	14.87^{a}	11.46^{a}
Mag. at 4 g pot^{-1}	7.27^{s}	9.30^{n}	10.54^{i}	11.75^{d}	9.72^{d}	8.32^{r}	9.87^{m}	10.67^{i}	12.08^{d}	10.24^{d}
Mag. at 6 g pot^{-1}	8.47^{q}	9.77^{l}	10.87^{g}	13.36^{b}	10.62^{b}	8.96^{p}	10.00^{l}	10.99^{g}	13.55^{b}	10.88^{b}
Mean	8.02^{d}	9.50^{c}	10.63^{b}	12.67^{a}		8.77^{d}	9.96^{c}	10.76^{b}	12.93^{a}	
					Reducing Sugars (%)					
Control	0.772^{s}	1.116^{l}	0.831^{q}	0.795^{r}	0.878^{e}	0.864^{q}	1.187^{k}	0.842^{r}	0.819^{s}	0.928^{e}
Ar. at 100 mgL^{-1}	1.350^{f}	1.407^{d}	1.158^{k}	0.986^{o}	1.225^{c}	1.455^{g}	1.499^{d}	1.177^{l}	0.996^{p}	1.282^{c}
Ar. at 200 mgL^{-1}	1.584^{b}	1.697^{a}	1.208^{i}	1.455^{c}	1.486^{a}	1.710^{b}	1.749^{a}	1.219^{j}	1.487e	1.541^{a}
Mag. at 4 g pot^{-1}	0.945^{p}	1.376^{e}	1.054^{n}	1.058^{m}	1.108^{d}	1.082^{n}	1.461^{f}	1.067^{o}	1.087^{m}	1.174^{d}
Mag. at 6 g pot^{-1}	1.271^{h}	1.583^{b}	1.174^{j}	1.336^{g}	1.341^{b}	1.344^{i}	1.620^{c}	1.187^{k}	1.355^{h}	1.376^{b}
Mean	1.184^{b}	1.436^{a}	1.085^{d}	1.126^{c}		1.291^{b}	1.503^{a}	1.098^{d}	1.149^{c}	

Mean values followed by the same letters are not significantly different at the P<0.05 according to Duncan's multiple range test (Duncan, 1955).

Table 10. Effect of irrigation with diluted seawater and remediation treatments and the interaction between them on nitrogen, phosphor and potassium (%) of Rosa cv. Centrix in the two seasons.

Sea water dilutions / Remediation treatments	1st season					2nd season				
	Control	5%	10%	15%	Mean	Control	5%	10%	15%	Mean
					N (%)					
Control	1.51^{h}	1.32^{k}	1.28^{l}	0.90^{q}	1.25^{e}	1.50^{i}	1.37^{l}	1.32^{m}	0.95^{r}	1.29^{e}
Ar. at 100 mgL^{-1}	1.68^{f}	1.71^{e}	1.42^{j}	1.08^{o}	1.47^{c}	1.61^{f}	1.66^{e}	1.37^{l}	1.13^{p}	1.44^{c}
Ar. at 200 mgL^{-1}	1.84^{b}	1.99^{a}	1.61^{g}	1.23^{m}	1.67^{a}	1.82^{b}	1.94^{a}	1.52^{h}	1.30^{n}	1.65^{a}
Mag. at 4 g pot^{-1}	1.61^{g}	1.67^{f}	1.42^{j}	1.04^{p}	1.44^{d}	1.52^{h}	1.54^{g}	1.40^{k}	1.09^{q}	1.39^{d}
Mag. at 6 g pot^{-1}	1.75^{d}	1.80^{c}	1.46^{i}	1.12^{n}	1.53^{b}	1.73^{d}	1.79^{c}	1.48^{j}	1.18^{o}	1.55^{b}
Mean	1.68^{b}	1.70^{a}	1.44^{c}	1.07^{d}		1.64^{b}	1.66^{a}	1.42^{c}	1.13^{d}	
					P (%)					
Control	0.229^{h}	0.370^{f}	0.208^{i}	0.154^{k}	0.240^{d}	0.220^{k}	0.344^{h}	0.203^{l}	0.148^{n}	0.229^{d}
Ar. at 100 mgL^{-1}	0.393^{e}	0.393^{e}	0.333^{g}	0.158^{k}	0.319^{b}	0.382^{e}	0.371^{ef}	0.324^{i}	0.150^{n}	0.307^{b}
Ar. at 200 mgL^{-1}	0.506^{a}	0.488^{b}	0.246^{h}	0.186^{j}	0.357^{a}	0.499^{a}	0.472^{b}	0.240^{j}	0.179^{m}	0.348^{a}
Mag. at 4 g pot^{-1}	0.372^{f}	0.371^{f}	0.233^{h}	0.155^{k}	0.283^{c}	0.363^{fg}	0.350^{gh}	0.228^{jk}	0.148^{n}	0.272^{c}
Mag. at 6 g pot^{-1}	0.450^{c}	0.433^{d}	0.234^{h}	0.168^{k}	0.321^{b}	0.430^{c}	0.410^{d}	0.229^{jk}	0.158^{n}	0.307^{b}
Mean	0.390^{b}	0.411^{a}	0.251^{c}	0.164^{d}		0.379^{b}	0.389^{a}	0.245^{c}	0.157^{d}	
					K (%)					
Control	2.46^{d}	2.00^{e}	1.95^{ef}	1.68^{f}	2.02^{c}	2.85^{d}	2.35^{f}	2.01^{g}	1.61^{h}	2.21^{d}
Ar. at 100 mgL^{-1}	3.02^{c}	3.04^{c}	2.36^{d}	1.86^{ef}	2.57^{b}	3.24^{c}	3.27^{c}	2.58^{e}	1.92^{g}	2.75^{bc}
Ar. at 200 mgL^{-1}	3.48^{b}	3.93^{a}	2.40^{d}	1.91^{ef}	2.93^{a}	3.58^{b}	3.77^{a}	2.71^{de}	1.98^{g}	3.01^{a}
Mag. at 4 g pot^{-1}	2.99^{c}	3.01^{c}	2.34^{d}	1.81^{ef}	2.54^{b}	3.18^{c}	3.21^{c}	2.55^{e}	1.88^{g}	2.71^{c}
Mag. at 6 g pot^{-1}	3.11^{c}	3.17^{c}	2.39^{d}	1.99^{e}	2.66^{b}	3.30^{c}	3.36^{c}	2.65^{e}	1.91^{g}	2.81^{b}
Mean	3.01^{a}	3.03^{a}	2.29^{b}	1.85^{c}		3.23^{a}	3.19^{a}	2.50^{b}	1.86^{c}	

Mean values followed by the same letters are not significantly different at the P<0.05 according to Duncan's multiple range test (Duncan, 1955).

Table 11. Effect of irrigation with diluted seawater and remediation treatments and the interaction between them on magnesium, sodium and calcium (%) of Rosa cv. Centrix in the two seasons.

Sea water dilutions / Remediation treatments	1st season					2nd season				
	Control	5%	10%	15%	Mean	Control	5%	10%	15%	Mean
					Mg (%)					
Control	0.167^{n}	0.209^{i}	0.161^{o}	0.124^{t}	0.165^{e}	0.211^{e-g}	0.169^{h-j}	0.164^{i-k}	0.135^{k}	0.170^{c}
Ar. at 100 mgL^{-1}	0.245^{e}	0.234^{f}	0.176^{l}	0.139^{r}	0.199^{c}	0.229^{c-e}	0.241^{cd}	0.184^{g-i}	0.148^{jk}	0.200^{b}
Ar. at 200 mgL^{-1}	0.297^{a}	0.284^{b}	0.200^{j}	0.159^{p}	0.235^{a}	0.279^{ab}	0.300^{a}	0.205^{e-g}	0.161^{i-k}	0.236^{a}
Mag. at 4 g pot^{-1}	0.223^{g}	0.221^{h}	0.171^{m}	0.135^{s}	0.188^{d}	0.217^{d-f}	0.220^{d-f}	0.175^{h-j}	0.100^{l}	0.177^{c}
Mag. at 6 g pot^{-1}	0.265^{c}	0.263^{d}	0.188^{k}	0.151^{q}	0.217^{b}	0.250^{c}	0.253^{bc}	0.195^{f-h}	0.156^{i-k}	0.214^{b}
Mean	0.239^{b}	0.242^{a}	0.179^{c}	0.142^{d}		0.237^{a}	0.237^{a}	0.185^{b}	0.139^{c}	
					Na (%)					
Control	0.49^{i}	0.91^{de}	0.81^{ef}	1.65^{a}	0.96^{a}	0.60^{ij}	0.93^{ef}	0.87^{fg}	1.91^{a}	1.08^{a}
Ar. at 100 mgL^{-1}	0.34^{jk}	0.32^{k}	0.72^{fg}	1.36^{b}	0.69^{c}	0.38^{kl}	0.35^{l}	0.78^{gh}	1.35^{c}	0.71^{c}
Ar. at 200 mgL^{-1}	0.26^{k}	0.23^{k}	0.59^{h}	0.98^{cd}	0.52^{e}	0.29^{l}	0.27^{l}	0.67^{hi}	1.13^{d}	0.59^{d}
Mag. at 4 g pot^{-1}	0.47^{i}	0.43^{ij}	0.92^{d}	1.55^{a}	0.84^{b}	0.51^{j}	0.49^{jk}	0.99^{e}	1.62^{b}	0.90^{b}
Mag. at 6 g pot^{-1}	0.31^{k}	0.29^{k}	0.62^{gh}	1.06^{c}	0.57^{d}	0.33^{l}	0.30^{l}	0.70^{hi}	1.21^{d}	0.63^{d}
Mean	0.37^{d}	0.44^{c}	0.73^{b}	1.32^{a}		0.42^{d}	0.47^{c}	0.80^{b}	1.44^{a}	
					Ca (%)					
Control	2.75^{fg}	2.23^{i}	2.21^{i}	1.55^{l}	2.18^{d}	2.68^{i}	2.18^{n}	2.08^{o}	1.49^{t}	2.11^{e}
Ar. at 100 mgL^{-1}	3.08^{e}	2.88^{ef}	2.42^{hi}	1.75^{j-l}	2.53^{c}	3.00^{f}	3.08^{e}	2.41^{l}	1.70^{r}	2.55^{c}
Ar. at 200 mgL^{-1}	4.21^{b}	4.62^{a}	2.66^{fg}	1.95^{j}	3.36^{a}	4.05^{b}	4.08^{a}	2.58^{j}	1.86^{p}	3.14^{a}
Mag. at 4 g pot^{-1}	2.77^{fg}	2.89^{ef}	2.39^{hi}	1.68^{kl}	2.43^{c}	2.76^{h}	2.77^{g}	2.38^{m}	1.52^{s}	2.36^{d}
Mag. at 6 g pot^{-1}	3.41^{d}	3.78^{c}	2.58^{gh}	1.80^{jk}	2.89^{b}	3.23^{d}	3.66^{c}	2.53^{k}	1.78^{q}	2.80^{b}
Mean	3.24^{a}	3.28^{a}	2.45^{b}	1.75^{c}		3.14^{b}	3.15^{a}	2.39^{c}	1.67^{d}	

Mean values followed by the same letters are not significantly different at the $P<0.05$ according to Duncan's multiple range test (Duncan, 1955).

division and enlargement, decrease in cell size (Ayala and O'Leary, 1995). In the present study, the stimulatory influence of low diluted sea water irrigation (5%) on plant height resulted from the useful effects of low concentration of chloride on much physiological operations as photosynthesis and enzymes activity and osmoregulators, which allows cell enlargement at low water availability caused by the existence of ions specially Na+ and Cl^- (Khan *et al.*, 1997) and raised of calcium uptake, which plays a crucial role in improving plant growth under saline stress (Cramer *et al.*, 1987).

Results under discussion showed that there is decreasing in water relative content. This is due to limited water availability to the cell extension process as a result of a loss of turgor (Katerji *et al.*, 1997). Ion leakage of rose leaves was significantly increased as a result of salinity application. These results could be explained by the passive effects of salinity on Ca level because Ca is required to enhance membrane stability (Shoresh *et al.*, 2011). These results support the previous results obtained by Tuna *et al.*, (2008) on maize.

In this investigation, the total chlorophyll and carotenoids were markedly decreased when irrigation with the highest sea water salinity (15%). It is due to the inhibitory influence of Cl^- on the activity of Fe-containing enzyme cytochrome oxidase, which in turn may reduce the average of chlorophyll biosynthesis as well as raises chlorophyll degradation (Roos, 2000). In the present study showed that increasing salinity of sea water irrigation was associated with decreasing in N, P, K, Mg and Ca %, while increasing Na in the leaves. This is due to rise Na in soil caused a shortage of other nutrients by obstructing the uptake of nutrients immediately by interfering with the carrier in the root plasma membrane, like K - selective ion canals; and prevent root growth by the osmotic effects of Na and because of the injurious effects of Na on soil structure (Tester and Daveport, 2003). Also, by increasing salinity of sea water irrigation total sugars and proline were increased, but reducing sugars content in leaves was decreased. The wide diversity of physiological and biochemical changes occurs in plants as a response to salinity stress, between them, retention of salt ions in vacuoles and accumulation of low molecular weight solutes in the cytosol reduced the osmotic possibility (Jampeetong and Brix, 2009). Similar results on Roses were obtained by Ali *et al.* (2014) and Niu and Rodriguez (2008).

Our data pointed out that spraying plants by arginine significantly increased plant growth under diluted seawater irrigation compared with control. The application of arginine at 200 mg L^{-1} gave the highest values for vegetative growth and floral parameters. The increase in vegetative growth and floral measurements of plants treated with arginine add. The transformation of arginine to polyamine members that aroused plant to higher cell split. Also, polyamines are precursor of arginine and has played a critical function, in various biological operations, inclusive somatic embryogenesis, cell division, growth, floral initiation, the evolution of flowers and fruits (Davies, 1995). They can also help to a proved membrane and wall properties (Velikova *et al.,* 2000). These results are an agreement with Abdul Qodos (2009) and Akladious and Hanafy (2018) who indicated that arginine is effective to mitigate the harmful effect of salinity stress by improving growth parameters.

Our results indicated that spraying Rosa plants with arginine increases chlorophyll and carotenoids under salinity, these is an agreement with Amin and Ismail (2012), Shalaby *et al.* (2018) and El-Bassiouny *et al.* (2008). The delayed senescence via change the stability and permeability of such membranes and protecting membranes and prevent chloroplast from senescing and thus delaying chlorophyll loss Gonzalez *et al.* (1997).

Data indicated that spraying Rosa plants with arginine at 200 mg L^{-1} caused increasing in N, P, K, Mg and Ca, total and reducing sugars and proline concentration, while reducing Na concentration in leaves. These results are in a harmony with Abdul Qodos (2009) and Hozayn *et al.* (2013). El-Bassiouny and Bekheta (2001) proposed that the major role of all arginine products in plants treated with salt in the long term is to keep a cation-anion equilibrium in plant tissues through stabilizing membrane at high external salinity. The increment of proline content attributed to the rise in its synthesis related to inhibition of its catabolism and/or mechanism for stress toleration (Akladious and Hanafy, 2018). The increase in nitrogen % in plants treated with arginine due to the higher nitrogen to carbon rate, arginine is an amino acid main for storage and transfer form for organic nitrogen in plants (Winter *et al.*, 2015).

Our results indicated that the application of 6 g pot^{-1} significantly increased the plant growth and related characters when irrigated with saline and non saline water. The positive effect of magnetic therapy due to the magnetic properties of some atoms in plant cells and some pigments like chloroplasts (Aladjadjiyan, 2010). Also, magnetic remediation influenced by phytohormone produced leading to improved cell activity and plant growth (Maheshwari, 2009). These results were in harmony with (Abdel-Fattah, 2014) on Jacaranda tree and Ahmed *et al.* (2016) on Acalypha shrub.

The results indicated that the application of magnetic iron at 6 g pot^{-1} increased total chlorophyll, carotenoids and all chemical composition traits under saline and non saline condition. The influence on the cell membrane and cell propagation and cause several changes in soluble sugar, chlorophyll, enzyme activities, protein biosynthesis, and cell metabolism and different cellular functions inclusive gene expression (Aladjadjiyan, 2002 and Atak *et* *al*. 2003). The Increasing N, P and K levels with magnetic treatments due to its effect on adsorption of N, P and K from soil colloidal complex and thus become more available to plants. Furthermore, magnetic remediation enhanced uptake, availability, mobilization and assimilation of these nutrients within the plant system (Maheshwari, 2009). In addition to, magnetic field play about a substantial role in cation uptake ability and have a positive influence on immobile plant nutrient uptake, like Mg and Ca (Esitken and Turan, 2003).

Conclusion:

It can be concluded that spraying *Rosa hybirida*, cv. Centrix plants with arginine or soil application of magnetic iron were highly efficient in alleviating the harmful effect of salt stress under all of diluted sea water concentrations. Also, foliar application of arginine at 200 mg L^{-1} was the highest treatment to increase the resistance of Rosa cv. Centrix to salinity stress with all levels of diluted sea water.

So, it can be recommended that using arginine to alleviate the problems produced by salinity stress.

REFERENCES

Abd El-Rhman, I.E. (2017). Effect of magnetic iron and potassium humate on growth, yield and fruit quality of pomegranate trees in Siwa Oasis, Egypt. Int. J. Environ., 6(3):103-113.

Abdel-Fattah, Gehan, H. (2014). The role of magnetic iron and sodium selenate in minimizing soil salt hazards on growth and quality of *Jacaranda acutifolia* Humb. & Bonpl. seedlings. Sci. J. Flowers & Ornam. Plants, 1(3):187-198.

Abdul Qodos Amira, M.S. (2009). Effect of arginine on growth, yield and chemical constituents of wheat grown under salinity condition. Academic J. plant Sci., 2(4):267-278.

Ahmad, I.; Khan, M.A.; Qasim, M.; Ahmad, R. and Tauseef-Ussamad (2013). Growth, yield and quality of *Rosa hybrida* L. as influenced by NaCl salinity. J. Orna. Plants, 3(3):143-153.

Ahmed Magda, A.; Abdel-Fattah, Gehan H. and Shahin, S. M. (2016). The role of magnetic iron in enhancing the ability of *Acalypha wilkesiana* Müll. Arg. Transplants to tolerate soil salinity. J. Plant Production, Mans. Univ., 7(3):379-384.

Akladious, S. A. and Hanafy, R. S. (2018). Alleviation of oxidative effects of salt stress in white lupine (*Lupinus termis* L.) plants by foliar treatment with L-arginine. J. Anim. Plant Sci., 28(1):165-176.

Aladjadjiyan, A. (2002). Study of the influence of magnetic field on some biological characteristics of *Zea mais*. J. Central European Agri., 3(2):89-94.

Aladjadjiyan, A. (2010). Influence of stationary magnetic field on lentil seeds. Int. Agrophysics, 24:321-324.

Ali, E.F.; Bazaid. S.A. and Hassan, F. A.S. (2014). Salinity tolerance of Taif Roses by gibberellic acid (GA3). Int. J. Sci. and Res., 3(11):184-192.

Amin, M.A. and Ismail, M.A. (2012). Effect of indole butyric, arginine, cyanocobalamine (B12), ascorbic acid and their interactions on growth, yield and some metabolic constituents of sunflower plants. Int. J. Adv. Res. Biol. Sci., 2(12):154–162.

A.O.A.C. (1990). Official Methods of the Analytical Chemist. 15·Ed. Vol. 2. Arlington, Virginia, USA.

Atak, C.; Emiroglu, O.; Alikamanoglu, S. and Rzakoulieva, A. (2003). Stimulation of regeneration by magnetic field in soybeen (*Glycine max* L.) tissue cultures. J. Cell & Mol. Biol., 2:113-119.

Ayala, F. and O'Leary, J. W. (1995). Growth and physiology of *Salicornia bigelovii* Torr. at suboptimal salinity. Int. J. Plant Sci., 156(2):197-205.

Caia, X.; Niub, G.; Starmana, T. and Halla, C. (2014). Response of six garden roses (*Rosa* × *hybrida* L.) to salt stress. Scientia Horticulturae, 168:27–32.

Cramer, G. R.; Lynch, J.; Lauchli, A. and Epstein, E. (1987). Influx of Na^+, K^+, and Ca^{+2} into roots of salt-stressed cotton seedlings. Effect of supplemental Ca^{+2}. Plant Physiol., 79:171-176.

Davies, P.J. (1995). Plant Hormone: Physiology, Biochemistry and Molecular Biology. Kluwer Academic publishers, London, 159 pp.

Di Baccio, D.; Navari-Izzo, F. and Izzo, R. (2004). Seawater irrigation: Antioxidant defence responses in leaves and roots of a sunflower (*Helianthus annuus* L.) ecotype. J. Plant Physiol., 161:1359–1366.

Duncan, D.B. (1955). Multiple range and multiple F tests. Biometrics, 11:1–42.

El- Bassiouny H.M.S. and Bekheta M.A. (2001). Role of putrescine on growth, regulation of stomatal aperture, ionic contents and yield by two wheat cultivars under salinity stress. Egyptian. J. Physiol. Sci, 2-3:235-258.

El-Basioni, S.M.; Hassan, H. M. and Rashad, R. T. (2015). Effect of Magnetic Iron Oxide Combined with some Additives on the Yield of Groundnut, Wheat and Nutrient Availability in Sandy Soil. Egypt. J. Soil Sci., 55(4):441- 452.

El–Bassiouny, H.M.; Mostafa, H.A.; El–Khawas, S.A.; Hassanein, R.A.; Khalil, S.I. and Abd El–Monem, A.A. (2008). Physiological responses of wheat plant to foliar treatments with arginine or putrescine. Aust. J. Basic & Appl. Sci., 2(4):1390-1403.

Esitken, A. and Turan, M. (2003). Alternating magnetic field effects on yield and plant nutrient element composition of strawberry (*Fragaria ananassa* cv. Camarosa). Soil and plant Sci., 54:135-139.

Flores, T.; Todd, C.D.; Tovar-Mendez, A.; Dhanoa, P.K.; Correa-Aragunde, N.; Hoyos, M.E.; Brownfield, D.M.; Mullen, R.T.; Lamattina, L. and Polacco, J.C. (2008). Arginase-negative nutants of Arabidopsis exhibit increased nitric oxide signaling in root development. Plant Physiol., 147:1936–1946.

Gomez, K.A. and Gomez A.A. (1984). Statistical Procedures for Agriculture Research. John Wiley and Sons, Inc, New York.

Gonzalez–Aguilar, G.A.; Zacarias, L.; Mulas, M. and Lafuente, M.T. (1997). Temperature and duration of water dips influence chilling injury, decay and polyamine content in Fortune mandarins. Postharvest & Biol. Technol., 12:61- 69.

Hozayn, M.; Abd El-Monem, A.A.; Ebtihal, M.; Abd El-hamid, E.M. and Abdul Qo1dos, Amira M.S. (2013). Amelioration of salinity stress in mungbean (*Vigna radiata* L.). plant by soaking in arginine. J. Appl. Sci. Res., 9(1):393-401.

Jackson, M.L. (1967). Soil Chemical Analysis. Prentice-Hall, India, 144-197.

James, C.S. (1995). Analytical Chemistry of Food, p.117-120. Blackie Academic & Professional, London.

Jampeetong, A. and Brix, H. (2009). Effect of NaCl salinity on growth, morphology, photosynthesis and proline accumulation of *Salvia natans*. Aquat. Bot., 91:181-186.

Katerji, N.; Van Hoorn, J.W.; Hamdy, A.; Mastrorilli, M. and Mou Karzel, E. (1997). Osmotic adjustment of sugar beets in response to soil salinity and its influence on stomatal conductance, growth and yield. Agri. Water Manage, 34(1):57-69.

Khan, M.S.A.; Hamid, A.; Satohuddin, A.B.M.; Quasem, A. and Karim, M. A. (1997). Effect of sodium chloride on growth, photosynthesis and mineral ions accumulation of different types of rice

(*Oryza sativa* L.). J. Agro. Crop Sci., 179:149-161.

Liu, J.; Nada, K.; Honda, C.; Kitashiba, H.; Wen, X.; Pang, X. and Moriguchi, T. (2006). Polyamine biosynthesis of apple callus under salt stress: importance of the arginine decarboxylase pathway in stress response. J. Experimental Botany, 57(11):2589–2599.

Maheshwari, L.B. (2009). Magnetic Treatment of Irrigation Water: Evaluation of its Effects on Vegetable Crop Yield and Water Productivity. Ph.D. Thesis, University of Western Sydney, School of Environ. and Agriculture.

Manai, J.; Kalai, T.; Gouia, H. and Corpas, F.J. (2014). Exogenous nitric oxide (NO) ameliorates salinity induced oxidative stress in tomato (*Solanumn lycopersicon*) plants. J. Soil Sci. Plant Nutr., 14:433-446.

Matthew, E.O.; Douglas, A.L. and Isaacs, R. (2002). An inexpensive accurate method for measuring leaf area and defoliation through digital image analysis. J. Econ. Entomol., 95:1190-1194.

Niu, G. and Rodriguez, D.S. (2008). Effect of saline water irrigation on growth and physiological responses of three rose rootstocks. Hortscience, 43(5):1479–1484.

Olsen, S.R. and Sommer, L.E. (1982). Phosphorus. in: Page, A.L.; R.H. Miller and D.R. Keeney (Eds). Methods of Soil Analysis. Part 2 Amer. Soc. Agron. Madison, Wisc., USA.

Rehman, A.U.; Riaz, A.; Iqbal, M.; Shafi, J. and Ahmad, W. (2014). Responses of different morphological attributes of *Rosa hybrida* L. cv. Kardinal to saline water irrigation. Environ. & Ecology Res. 2(1):21-26. http://www.hrpub.org.

Roos, W. (2000). Ion mapping in plant cells-methods and applications in signal transduction research. Planta, 210:347-370.

Shalaby Magda, A.F.; Ahmed, M.A and Khater, M.A. (2018). Physiological responses of some barley cultivars to foliar treatments with arginine under water stress conditions. Middle East J. Agri. Res., 7(3):1102-1123.

Shoresh, M.; Spivak, M. and Bernstein, N. (2011). Involvement of calcium-mediated effects on ROS metabolism in the regulation of growth improvement under salinity. Free Radical Biol. & Medicine., 51(6):1221-1234.

Singh, R. (2008). Worldwide water crisis. J Membrane Sci., 313:353–354.

Sumanta, N.; Haque, C.I.; Nishika, J. and Suprakash, R. (2014). Spectrophotometric analysis of chlorophylls and carotenoids from commonly grown fern species by using various extracting solvents. Res. J. Chem. Sci., 4(9):63-69.

Tamayo, P.R. and Bonjoch, N.P. (2001). Free Proline Quantification. Handbook of Plant Ecophysiology Techniques. Published by Kluwer Academic Netherlands, Chapter 22:365–382.

Tester, M. and Daveport, R. (2003). Na+ tolerance and Na+ transport in higher plants. Annals of Bot., 91:305-327.

Tuna, A.L.; Kaya, C.; Dikilitas, M. and Higgs, D. (2008). The combined effects of gibberellic acid and salinity on some antioxidant enzyme activities, plant growth parameters and nutritional status in maize plants. Environmental and Experimental Botany, 62(1):1–9.

Valdez-Aguilar, L.A.; Grieve, C.M.; Razak-Mahar, A.; McGiffen, M.E. and Merhaut, D.J. (2011). Growth and ion distribution is affected by irrigation with saline water in selected landscape species grown in two consecutive growing-seasons:

spring-summer and fall-winter, HortScience, 46:632-642.

Velikova, V.; Yordanov, I. and Edreva, A. (2000). Oxidative stress and some antioxidant systems in acid rain-treated bean plants. Protective role of exogenous polyamines. J. Plant Sci., 151:59-66.

Winter, G.; Todd, C.D.; Trovato, M.; Forlani, G. and Funck, D. (2015). Physiological implications of arginine metabolism in plants. Erschienen in: Frontiers in Plant Sci., 6:534.

تقليل التأثير الضار لملوحة ماء الري علي نبات الورد باستخدام الأرجينين والحديد الممغنط

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أجريت هذه التجربة خلال موسمين ٢٠١٦ و٢٠١٧ بمحطة البحوث الزراعية بالإسماعيلية. بهدف تقييم تأثير الرش الورقي بالأرجينين بتركيز ١٠٠ و ٢٠٠ مللي جرام /لتر والإضافة الأرضية للحديد الممغنط بمعدل ٤ و ٦ جرام /أصيص والري بمياة البحر المخففة بثلاثة تركيزات (٥، ١٠، و ١٥٪) علي النمو الخضري والزهري والصفات الكيماوية لنبات الورد صنف "سنتركس".

أظهرت النتائج أن التركيز المنخفض من المياة المالحة (٥٪) أدي إلي تحسن صفات النمو الخضري (ارتفاع النبات، عدد الفروع، عدد الأوراق، مساحة الورقة، والوزن الطازج والجاف للأوراق) والصفات الزهرية (طول الساق الزهرية، عدد الأزهار،قطر الزهرة،الوزن الطازج والجاف للأزهار) ثم تنخفض تدريجياً جميع الصفات المذكورة مع زيادة تركيز ملوحة مياة الري بالمقارنة بالكنترول. وكان للاجهاد الملحى تأثير سلبى على كلا من المحتوي النسبي للماء في الأوراق، الكلوروفيل والسكريات المختزلة، النيتروجين، الفسفور، البوتاسيوم، الماغنسيوم والكالسيوم). في حين أدت الملوحة إلي زيادة نفاذية الأغشية، البرولين،السكريات بالإضافة إلي الصويوم.

أدي استخدام الأرجينين أو الحديد الممغنط الي تحسين جميع الصفات المدروسة في النباتات التي تروي بكافة تركيزات مياة البحر المخففة. ويمكن ملاحظة أن تطبيق الأرجينين بتركيز ٢٠٠ مللي جرام /لتر أو الحديد الممغنط بمعدل ٦ جرام /أصيص يمكن أن يخفف من التأثير الضار لإجهاد الملوحة على نمو النبات والمكونات الكيميائية لنبات الورد. من النتائج المتحصل عليها يمكن التوصية برش نباتات الورد المروية بمياة البحر المخففة بتركيز ٥٪ بالارجينين بتركيز ٢٠٠ مللي جرام/لتر للتغلب علي التأثير الضار للملوحة.