

# Effect of Saline Irrigation Water on The Landscaping Potentials of *Pelargonium zonale*, L. Plant.

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## ABSTRACT

The present work was carried out at the Flower and Ornamental Plants Research Gardens, Faculty of Agriculture, Alexandria University, Egypt during the years 2009,2010 and 2011.

The aim of this study was to evaluate the effects of saline water irrigation on the parameters that affect the landscaping potentials of a local variety of *Pelargonium zonale*, L. (Red) plants and also surveying the common landscaping uses of it in the green areas in Alexandria city.

Different saline water treatments (1,2,4,6,8,10 and 12 ds/m) were applied to *Pelargonium zonale*, L. plants besides the control treatment.

Generally, increasing saline water level significantly decreased all the vegetative growth parameters (plant height, plant diameter, stem diameter, number of main branches/plant and number of leaves/plant) , compared with the control treatment.

Also, saline water treatments resulted in significant reductions in the aesthetic and landscape uses of the plants (growth shape, plant condition, number of inflorescences /plant and flower intensity and quality), besides they delayed the flowering time.

*Pelargonium zonale*, L. plant showed tolerance to saline water level till 6 ds/m.

Severe damage occurred to plants starting from September when they irrigated by the high saline concentrations i.e. 8, 10 and 12 ds/m.

Surveying the landscaping uses of the plant in the green areas showed a wide range of various uses i.e; in low or raised beds, around trees trunks, in borders, on side of paths and walkways and in containers...etc.

It can be generally recommended that *Pelargonium zonale*, L. plants can tolerate saline irrigation water treatments up to 6ds/m and still having good landscaping potentials and values.

## INTRODUCTION

Landscaping plays an important role in delivering good outcomes for development; it provides shade, color and softens the appearance of built structures as well as buffering the adverse impacts of development.

For landscape plants, aesthetic appearance is more important than maximum growth. Therefore, evaluation of salinity tolerance of landscape plants should consider

the visual appearance along with plant growth response when irrigated with saline water.

*Pelargonium zonale*, L. (family *Geraniaceae*) is one of the famous and favorite ornamental plants originated in South Africa, then introduced to Europe. The plant is used in the garden in different positions in beds, borders, pots, wall gardens or hanging baskets and can also be mixed with other plants.

The usage of low quality water in irrigation is one of the main sources to save water. Water quality decreases by increasing its salts content, but using saline water such as seawater, waste water, and wells water for irrigation is being required, because of water lack, especially in arid and semi-arid regions (Kandeel and Elwan, 1992).

The objectives of the present work were to study the effects of saline irrigation water on the parameters that affected the landscaping potentials of *Pelargonium zonale*, L. and also to survey the common uses of it in landscaping green areas in Alexandria city.

## MATERIALS AND METHODS

The present work was carried out at the Flower and Ornamental Plants Research Gardens, Faculty of Agriculture, Alexandria University, Egypt during the years 2009 and 2010.

Geranium cuttings of a local cultivar (Red) were taken on November 2009 from the mother plants in uniform length with an average of 15 cm and then planted in 30cm diameter pots after one month (on December) the rooted cuttings were transplanted to 15cm pots. After another month (on January 2010) from transplanting, plants were finally transplanted to 30 cm diameter pots (one plant/pot).

The chemical analysis of used soil cleared that it was containing 4.49, 9.78, 3.7, 6.9, 16.5 and 4.6 meq/l of potassium, sodium, magnesium, calcium, chloride and bicarbonate, respectively. The electric conductivity (EC) and pH values (1:2.5 soil: water) were 1.82 dsm<sup>-1</sup> and 7.73, respectively.

Sodium chloride without purification (contents: NaCl 98.5%, KIO<sub>3</sub> 30-70% and Humidity 0.3%) produced by Egyptian Salt and Mineral Company was

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used to prepare the stock solution of the salinity (Abbass, 1992).

Eight concentrations of irrigation water salinity were used namely, control (tap water) of EC 0.475 ds/m, 1,2,4,6,8,10 and 12 ds/m.

Tap water was listed as a source of irrigation of the young plants for a month starting from their final transporting date. After this period the salinity treatments were commenced weekly at two times during February till April and at three times from May till November. A half liter (500ml) of the salinity of *Pelargonium zonale*, L. plants irrigation water was used per plant. The plants were fertilized with a complete fertilizer of 20:20:20 at a rate of one gram per liter, 500ml per each pot weekly (Siktberg, 2006).

Surveying plant uses was carried out on the opened green area of Alexandria city at 2011. The experimental design was randomized complete block design with eight treatments arrayed in replicates and four plants were used for each treatment (plot). The following data were recorded: plant length, plant diameter, cover percentage, stem diameter, number of main branches per plant, number of leaves per plant, leaf area, number of inflorescences per plant, flowering date, growth shape, plant condition, flower intensity, flower quality and exchange of soil construction.

## RESULTS AND DISCUSSION

### I- Effect of saline irrigation water on the landscaping potentials of *Pelargonium zonale*, L. plants:

Data in Tables (1,2) show that increasing the salinity level of the irrigation water treatments significantly decreased all the measured growth parameters i.e. plant height, plant diameter, stem diameter, number of main branches/plant and number of leaves per plant. Furthermore, salinity reduced visual and landscaping characters (number of inflorescences/plant, flower quality and intensity and retarded flowering date). This reduction was gradually increased as salinity level increased.

Plants showed good growth performance and tolerance to salinity till 3840 ppm. (6 ds/m), while increasing the concentrations of water salinity more than 8 ds/m caused a damage of the plants leading to death after five months from starting of the treatment (in September 2010).

These results were probably due to that high salt concentrations inhibit enzymes by impeding the balance of forces controlling the protein structure besides salinity decrease carbohydrates and some natural growth hormones, thereby inhibiting plant growth (Mazher *et al.* 2007).

Also, saline conditions disrupt several physiological processes in plants photosynthesis and carbohydrate accumulation leading to reduction in growth (Burns and Caesar, 1990).

The reduction in plant characters under salt stress might also be due to slowing down and inhibiting of cell division and meristematic activity of plants as reported by Bolus *et al.* (1972). Also this inhibition cause reduction in cell elongation as mentioned by Rye *et al.* (1963) and Nieman (1995).

In addition to the accumulation of salt ions especially sodium and chloride ions in the growing media which has as indirect effect on the plant growth. Sodium ions causes a degradation of soil structure which lead to water logging and poor plant growth (GreenWay, 1973).

These results are in harmony with those obtained by Nooh and Haikal (1992) and Khalil (1999) on *Pelargonium graveolens* and *Santolina chamaecyparissus*, Alshammary *et al.* (2004) on turfs, Niu *et al.* (2007) on herbaceous perennials and groundcovers, Zapryanova and Atanassova (2009) on *Tagetes patula* and *Ageratum mexicanum* and Abd El Aziz *et al.* (2011) on *Matthiola incana*.

### II- Survey on the practical applications on the use of *Pelargonium zonale*, L. plants:

From the survey, it was found that the most common landscape uses were planting *Pelargonium zonale*, L. plants in low beds having different shapes (rectangular, circular and triangular) and in different locations (on edges of lawns or in the middle or spaced from the edge) alone or mixed with other plants with or without edging, in raised beds, around trees trunks, in borders, on sides of paths and walkways and in plant containers.

Reaching the most suitable garden design is by knowing the number of plants in square meter. Also through the plant structure (plant height and plant diameter) the suitable planting density could be calculated.

Several researchers stated and reported the uses of different perennials as groundcover in flower beds, edging, in borders, screens, hanging baskets, containers and window boxes beside its aesthetic value by providing color and texture to the landscape garden. Those scientists are; Nooh, 1981, Gilman and Howe (1999), Bridwell (2003), McNaughton (2004), Schutzi (2005), Mikolajski (2008) and Erler (2011).

**Table 1. Means of plant height (cm) of *Pelargonium zonale* L. as affected by different saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	9.94	11.97	13.19	14.41	16.25	18.37	20.56	23.88
640 (1 ds/m)	9.94	11.78	12.81	14.03	15.69	16.81	18.94	22.56
1280 (2 ds/m)	9.97	11.72	12.69	13.72	15.38	16.71	18.37	20.37
2560 (4ds/m)	9.81	11.75	12.81	13.94	15.38	16.37	17.75	18.87
3840 (6 ds/m)	9.87	11.94	12.62	13.59	14.35	15.31	16.12	16.75
5120 (8ds/m)	9.91	11.72	12.50	12.96	13.29	13.56	14.50	-
6400 (10 ds/m)	9.81	11.94	12.59	12.95	13.27	-	-	-
7680 (12 ds/m)	9.84	11.81	12.50	12.74	12.87	-	-	-
L.S. D. (0.05)	N.S	N.S	0.32	0.61	0.91	1.51	1.79	1.55

**Table 2. Means of plant diameter (cm) of *Pelargonium zonale* L. as affected by different saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	9.31	12.91	16.06	22.16	24.00	26.12	29.19	34.78
640 (1 ds/m)	9.41	12.91	16.19	19.16	20.03	21.18	24.59	29.50
1280 (2 ds/m)	9.69	12.60	15.50	16.34	16.84	17.65	19.47	24.00
2560 (4ds/m)	9.10	11.94	14.56	15.13	15.69	16.40	17.41	18.97
3840 (6 ds/m)	9.22	11.35	12.19	12.53	12.94	13.40	14.19	15.07
5120 (8ds/m)	9.35	11.31	11.75	12.00	11.79	12.37	11.75	-
6400 (10 ds/m)	9.19	11.41	11.87	12.04	11.96	-	-	-
7680 (12 ds/m)	9.25	11.31	11.56	11.60	11.60	-	-	-
L.S. D. (0.05)	N.S	0.53	0.82	0.93	0.92	1.26	1.62	3.14

**Table 3. Means of cover percentage(%) of *Pelargonium zonale* L. as affected by different saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	0.68	1.31	2.03	3.85	4.52	5.36	6.69	9.50
640 (1 ds/m)	0.69	1.31	2.05	2.88	3.15	3.52	4.76	6.92
1280 (2 ds/m)	0.73	1.24	1.88	2.09	2.23	2.45	2.97	4.52
2560 (4ds/m)	0.64	1.12	1.66	1.80	1.93	2.11	2.38	2.82
3840 (6 ds/m)	0.66	1.01	1.16	1.23	1.31	1.41	1.58	1.78
5120 (8ds/m)	0.68	1.00	1.08	1.13	1.09	1.20	1.08	-
6400 (10 ds/m)	0.66	1.02	1.11	1.13	1.12	-	-	-
7680 (12 ds/m)	0.66	0.97	1.05	1.05	1.05	-	-	-
L.S. D. (0.05)	N.S	0.10	0.19	0.24	0.25	0.36	0.60	1.50

**Table 4. Means of stem diameter (mm) of *Pelargonium zonale* L. as affected by saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	5.16	5.69	6.37	7.44	8.25	9.31	10.12	10.12
640 (1 ds/m)	5.37	5.62	6.25	7.12	7.69	8.44	9.00	9.00
1280 (2 ds/m)	5.5	6.37	6.56	7.12	7.69	8.31	8.62	8.62
2560 (4ds/m)	5.75	5.87	6.44	7.00	7.06	7.12	7.12	7.12
3840 (6 ds/m)	5.56	5.81	6.37	6.75	6.87	6.87	6.87	6.87
5120 (8ds/m)	5.44	5.69	6.00	6.44	6.44	6.44	6.42	-
6400 (10 ds/m)	5.81	6.37	7.00	7.31	7.31	-	-	-
7680 (12 ds/m)	5.50	6.00	6.37	6.56	6.56	-	-	-
L.S. D. (0.05)	N.S	N.S	0.84	0.70	0.77	0.69	0.74	0.82

**Table 5. Means of Number of main branches per plant of *Pelargonium zonale* L. as affected by saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	0	0	0.44	1.50	1.50	2.31	3.00	4.00
640 (1 ds/m)	0	0	0.19	1.56	1.20	2.44	2.75	3.87
1280 (2 ds/m)	0	0	0.19	1.62	1.69	2.31	2.69	3.31
2560 (4ds/m)	0	0	0.19	1.50	1.50	2.25	2.44	2.75
3840 (6 ds/m)	0	0	0.25	1.5	1.56	2.12	2.12	2.42
5120 (8ds/m)	0	0	0.12	1.31	1.42	1.37	1.67	-
6400 (10 ds/m)	0	0	0.12	0.25	0.71	-	-	-
7680 (12 ds/m)	0	0	0.31	0.50	0.75	-	-	-
L.S. D. (0.05)			N.S	0.36	0.23	0.24	0.18	0.20

**Table 6. Means of Number of leaves per plant of *Pelargonium zonale* L. as affected by saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	4.85	6.37	7.31	9.25	11.00	12.62	14.75	18.12
640 (1 ds/m)	4.81	5.50	6.69	8.06	9.37	10.69	11.62	14.25
1280 (2 ds/m)	5.37	7.31	8.75	9.94	10.50	10.81	10.94	13.31
2560 (4ds/m)	4.93	6.37	7.37	9.00	10.25	11.19	12.56	13.25
3840 (6 ds/m)	5.25	6.69	7.62	8.81	9.75	9.75	9.69	10.65
5120 (8ds/m)	5.44	6.75	8.06	9.87	10.00	10.04	10.17	-
6400 (10 ds/m)	4.19	5.44	6.81	8.62	9.25	-	-	-
7680 (12 ds/m)	5.06	6.19	7.5	8.62	10.04	-	-	-
L.S. D. (0.05)	N.S	N.S	N.S	N.S	N.S	0.33	0.27	0.23

**Table 7. Means of Number of inflorescence per plant of *Pelargonium zonale* L. as affected by saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	0	0	0.69	1.06	0.94	0.81	2.00	2.69
640 (1 ds/m)	0	0	0.69	1.06	1.12	0.81	2.06	2.56
1280 (2 ds/m)	0	0	0.44	0.81	0.69	0.63	1.06	1.00
2560 (4ds/m)	0	0	0.44	0.94	0.94	0.56	0.63	1.00
3840 (6 ds/m)	0	0	0.37	0.58	0.75	0.31	0.38	0.46
5120 (8ds/m)	0	0	0.56	0.6	0.08	0.13	0	-
6400 (10 ds/m)	0	0	0.13	0	0	-	-	-
7680 (12 ds/m)	0	0	0.06	0	0	-	-	-
L.S. D. (0.05)			0.28	0.13	0.23	0.34	0.31	0.22

**Table 8. Means of plant condition of *Pelargonium zonale* L. as affected by saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	8.75	9.00	9.00	9.00	9.00	9.00	9.00	9.00
640 (1 ds/m)	8.75	9.00	8.75	8.62	8.37	8.37	8.5	8.00
1280 (2 ds/m)	8.87	8.62	8.25	8.00	7.87	7.87	7.62	7.25
2560 (4ds/m)	8.87	7.87	7.87	7.87	7.62	7.50	6.62	6.37
3840 (6 ds/m)	8.87	7.25	7.25	7.00	6.50	6.12	4.75	4.62
5120 (8ds/m)	9.00	7.25	5.87	4.40	3.25	2.94	1.62	-
6400 (10 ds/m)	9.00	6.37	5.25	4.00	2.87	-	-	-
7680 (12 ds/m)	9.00	6.12	5.00	4.00	3.12	-	-	-
L.S. D. (0.05)	N.S	0.51	0.63	0.80	0.89	1.34	1.06	0.96

**Table 9. Means of growth shape of *Pelargonium zonale* L. as affected by saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	0	0	0	0	1.75	2.87	6.12	7.49
640 (1 ds/m)	0	0	0	0	2.00	3.50	5.12	8.00
1280 (2 ds/m)	0	0	0	0	2.12	3.37	4.00	6.00
2560 (4ds/m)	0	0	0	0	2.06	3.37	3.30	4.47
3840 (6 ds/m)	0	0	0	0	2.06	2.62	2.62	4.00
5120 (8ds/m)	0	0	0	0	1.85	1.00	1.00	-
6400 (10 ds/m)	0	0	0	0	0.72	-	-	-
7680 (12 ds/m)	0	0	0	0	0.82	-	-	-
L.S. D. (0.05)					0.76	0.91	0.83	0.64

**Table 10. Means of flower Intensity of *Pelargonium zonale* L. as affected by saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	0	0	7.46	7.51	7.4	7.44	7.69	7.69
640 (1 ds/m)	0	0	7.12	7.45	7.45	7.62	7.48	7.44
1280 (2 ds/m)	0	0	7.55	7.12	7.25	6.95	6.44	6.30
2560 (4ds/m)	0	0	7.37	6.95	6.95	6.19	5.46	5.52
3840 (6 ds/m)	0	0	7.37	6.31	6.82	4.87	3.54	4.37
5120 (8ds/m)	0	0	6.95	5.82	1.50	0.25	0	-
6400 (10 ds/m)	0	0	2.75	0	0	-	-	-
7680 (12 ds/m)	0	0	1.25	0	0	-	-	-
L.S. D. (0.05)			2.24	0.40	1.57	1.97	1.55	0.58

**Table 11. Means of flower quality of *Pelargonium zonale* L. as affected by saline irrigation water treatments**

Irrigation water salinity (ppm)	Growing period							
	April	May	June	July	August	September	October	November
Control (Tap water)	0	0	8.77	8.40	8.40	8.50	8.50	8.44
640 (1 ds/m)	0	0	8.42	8.30	8.30	8.45	8.45	8.44
1280 (2 ds/m)	0	0	7.87	6.85	7.42	6.37	6.37	6.25
2560 (4ds/m)	0	0	7.57	6.65	6.56	5.47	5.47	5.52
3840 (6 ds/m)	0	0	7.12	6.42	6.12	3.5	3.55	4.37
5120 (8ds/m)	0	0	6.5	6.25	1.62	1.00	0	-
6400 (10 ds/m)	0	0	2.75	0	0	-	-	-
7680 (12 ds/m)	0	0	1.25	0	0	-	-	-
L.S. D. (0.05)			2.18	0.25	1.75	1.92	1.55	0.54

N.s = Not Significant at 0.05 level of probability.

L.S.D= Least significant difference at 0.05 of probability.

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## الملخص العربي

### تأثير الري بالماء المالح على القدرة التنسيقية لنبات الجارونيا العادية

علم الدين نوح، محمود خطاب، عصام قريش، رانيا الطنبولي

بالإضافة إلى ذلك فإن زيادة تركيز ملوحة مياه الري أدت إلى انخفاض معنوي في القدرة الجمالية والتنسيقية لنبات الجارونيا متمثلة في شكل النمو، حالة النبات، عدد النورات/نبات، كثافة الأزهار وجودتها.

أما بالنسبة لإستخدام الجارونيا في تنسيق المساحات الخضراء في مدينة الإسكندرية فقد أظهر الحصر التطبيقي أن لهذا النبات قدرة تنسيقية عالية وإنتشار واسع في التنسيق حيث يزرع إما منفردا في الأحواض بأنواعها والأشكال الهندسية المختلفة و على حواف المسطحات الخضراء ووسطها... أو مختلطا مع نباتات أخرى و غير ذلك. وبصفة عامة يمكن التوصية برى نبات الجارونيا العادية (الصف الأحمري) بماء مالح لا يزيد تركيزه عن 6 ديسى سيمنز/م مع إحتفاظ النبات بقدرة تنسيقية ومظهر جمالي جيد.

أجرى هذا البحث بمحاذيق أبحاث الزهور ونباتات الزينة بكلية الزراعة جامعة الإسكندرية خلال الأعوام 2009، 2010، 2011 بهدف دراسة تأثير عدة تركيزات من ملوحة مياه الري (كنترول(0.470)، 1، 2، 4، 6، 8، 10، 12 ديسى سيمنز/م) على القدرة التنسيقية لصف محلى (أحمر) من نبات الجارونيا العادية، وأيضا حصر التطبيقات العملية لإستخدامه في تنسيق المساحات الخضراء في مدينة الإسكندرية.

هذا وقد أظهرت النتائج المتحصل عليها أن لنبات الجارونيا القدرة على تحمل ملوحة مياه الري حتى 6 ديسى سيمنز/م وأن زيادة تركيز الملوحة عن ذلك يؤدي إلى موت النباتات بعد حوالى خمسة أشهر من بدء المعاملة وأن زيادة ملوحة مياه الري تؤدي إلى نقص معنوي في جميع صفات النمو الخضري (طول النبات وقطره، قطر الساق، عدد الأفرع الرئيسية/نبات، عدد الأوراق/نبات) بالمقارنة بمعاملة الكنترول.