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SODICITY AND BORON TOLERANCE EVALUTION FOR MYOPORUM PORUM, CHAFF FLOWER AND BERMUDA GRASS ORNAMENTAL PLANTS .

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ABSTRACT

This study was carried out in Antoniadas Research Branch, Alexandria, Egypt during seasons 2006 / 2007 and 2007 / 2008 to evaluate three ornamental plants to sodicity and boron. Four levels of sodicity and boron concentrations were used with irrigation water having the following adjusted Sodium Adsorption Ratio : 0 , 4.5 , 9 , 27 SAR_{adj}, Boron concentration : 0 , 1.5 , 3.6 PPm .Myoporum and chaff flower cuttings were prepared . Bermuda grass was seeded in the perminant pots directly . The plants were irrigated with normal water for month, then they were irrigated with sodicity and boron containing water to the end of the experimental season .Some characteristics were chosen and measured, i.e plant height, number of leaves of myoporum and chaff flower only. Fresh weight and dry weight of shoots were determined . Also the covering area of Bermuda grass was measured .

The results showed the following :

1- Soil salinity was increased due to the addition of sodicity and boron containing irrigation water .

2- The deterious effect of sodicity and boron concentration on plants grown in calcareous soil was greater than in sandy soil except in case of Bermuda grass .

3- The RYQ of myoporum was 100% when myoporum plants were irrigated with zero (control) in calcareous and in sandy soils. Also at 4.5 and 9 SAR_{adj} in sandy soil myoporum was 140% and 128% respectively .

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4- The RYQ of chaff flower was 100% when the plants were irrigation with normal water only . The RYQ value was decreased to 56.01 and 88.93 for plants grown in calcareous and sandy soils at .... 27 .... SAR , respectively .

5- The RYQ of bermuds grass was decreased just using sodicity and boron containing water in irrigation, It was 81.57 and 82.75% at 27 SARadj level and 76.85 and 80.87% at 6 B_{ppm} level in irrigation .

Generally, it was concluded that myoporum was more tolerant than Bermuda grass than chaff flower .

INTRODUCTION

No dout that deserts in Egypt have poor quality soils (sandy to sandy calcareous) and waters, thus it becomes necessary to study the tolerance of plants to sodicity and boron containing water and their growth in sandy and sandy-rich in calcium carbonate soils. The great expansion needs establishing green areas and growing ornamental plants .

Three ornamental plants were chosen in this study. Myoporum is used as a hedge in the gardens, chaff flower is used for borders and drawing on lawns, and bermuda grass is used to cover playground and free areas. Myoporum was one of the plants studied by Bernstein *et al.,* (1972) which was little affected by soil salinities of 8m. mhos/cm (NaCl + $CaCl_2$ Salts). Bolanos and Longstreth (1984), found that pressure volume curves for Alternthers philoxeroides (alligator weed) grown in 0 to 400 millimolar NaCl were used to determine water potential (PSI), osmotic potential (PSIS), turgor potential (PSIP) and the bulk elastic modules (epsilon) of shoots at different tissue water contents. Values of PSIP decreased with increasing salinity and tissue PSI was always lower content changed because epsilon increased with salinity .

Ackerson and Younger (1975) showed that average rates of net photosynthesis and root dry matter yield of bermuda grass (cv. Santa) were not affected by growing in culture containing 0 , 40 , 80, 120 or 160 meq NaCl or $CaCl_2$ at 0 , 80 , 160 , 240 or 320 meq K_2SO_4 . On other hand leaf water potential, osmotic potential and top

growth fell with increasing salinity. They suggested that salinity tolerance may be aided by translocation of photosynthate from tops to roots, carbohydrate storage, osmatic adjustment through ionic substitution and redistribution or increased cell sap organic acid content.

The previous studies were often carried out in qualitative manner. The plant tolerance evaluation of flower plants (Diab *et al.*, 1991) was modified to suite the ornamental plants .

The objective of this study was to evaluate tolerance of myoporum chaff flower and bermuda grass ornamental plants to sodicity and boron containing water.

MATERIALS AND METHODS

The present study, was carried-out during two successive seasons of 2006 and 2008 at antoniadas Research Branch, Alexandria, Egypt .

Three plants were used in this study :

1. Myoporum pictum. G. Forst (Myoporum)

2. Alternanthera ammona, L. (Chaff flower)

3. Cynodon dactylon, L. (L.) Pers. (bermuda grass)

Two desert soils were collected from the surface layer (-20cm) of two areas. The first, sandy soil was collected from the 86 kelometer areas west of the Alexandria-Cairo Desert Road and the second, sandy soil rich in calcium carbonate (calcareous soil) from Hawwaria area, 35Km west of Alexandria city (Tables 1 and 2). These experiments were designed as randomized complete blocks in three replicates Snedecor and Cochran (1974) Jackson, (1962).

Four levels of sodicity water and water containing boron were used in irrigation water as follows : 0 , 4.5 , 9.0 , 27.0 SAR_{adj} 0 , 1.5 , 3.6 B_{ppm}.

Table 1 : Chemical properties of studied soils

Soil	Ec	Cations meq / L				Anions meq / L					
	dsm^{-1}	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	$CaCO_3$ %	pH
Sandy	1.2	0.6	0.35	0.6	0.05	-	0.1	0.35	0.35	1.5	7.2
Carbonate - rich soil	2.9	6.1	4.50	12.3	11.26	-	0.4	19.90	3.80	3.9	7.8

Table 2 : Phyical properties of studied soils .

Soil	Particle size distribution, (%)					Soil
	F.C.	Coure sand	Fine sand	Silt	Clay	Texture
Sandy	7.5	14.5	79.4	4.3	1.8	Sandy
Carbonate-rich soil	22.4	5.9	35.1	51.0	8.0	siltyloam

Preparation of plants for experiments

Myoporum

Myoporum pictum cuttings for the first season were planted in November 2006, repotted in March 2007 and harvested in October 2007, At the second season cuttings were planted on November 2007, repotted on March 2008 and harvested in October 2008. The cuttings were planted in 15cm diameter pots containing loamy soil. After one month, the plants were repotted into 25 cm diameter pots containing 3.75 kg sandy or 3.5 kg calcareous soil. They were irrigated with normal water for a month, after finial transplanting then the plants were irrigated with sodicity and boron containing water .

Chaff flower

Plant cuttings were taken from mother plants on Ferbruary 15th, 2006 at first season and harvested in last October 2007. Cuttings for the second season were taken from mother plants on February 2007 and harvested on last October 2008. The cuttings were planted in 10cm diamter pots containing loamy soil. After one month, the rooted cuttings were repotted into a 15 cm diameter pots containing 825g sandy or 650 g calcareous soil. The plants were irrigated with normal water for one month of after finial transplanting, then the plants were irrigated with sodicity and boron containing water levels .

Bermuda grass

One gram seeds of bermuda grass were sown on sandy (4.65kg) or calcareous (3.5kg) soil in 30cm diameter pots on April 7th, 2006 The pots were watered daily with normal water. After one month of seed sowing, seedlings were irrigated with different levels of sodicity and boron containing water. Every 20 days, the plant heights were measured the seedlings were mowed at 2cm level from soil surface and the cuttings were weighted after every mowing even end July, 2006 . The second season started on April 23th, 2007 and continued even end July, 2007 .

The three plants were fertilized with N,P,K and foliar fertilizer as described in Diab *et al.*, (1991).

The plants were irrigated after one month of transplanting with sodicity and boron containing water to soil field capacity. The sandy soil pots were irrigated with 300ml every two days and the calcareous soil pots were irrigated with one litre every 6 days .

Determinations and Measurments

The following parameters were measured weekly starting at sodicity and boron containing water additions. Plant height in myoporum and chaff flower. In bermuda grass, the plant heights were measured before mowing every 20 days. Number of leaves were recorded in all plants except Bermuda grass in which covering area was measured. At the end of experiments, fresh weight was determined. The plants were dried at 65°C for 48 hours to determine the dry weight. The soils were analyzed to salinity in soil saturation extract by measuring the electrical conductivity (EC) in dsm^{-1} units .

Plante valuation to sodicity and boron containing water tolerance:

The authers suggested a method for evaluation of ornamental plants to sodicity and boron containing water tolerance. The method is based upon three characteristics and every character represents a percentage of the quality of every plant as follows :

		%
1. Plant height	(H)	20
2. Vegetative dry weight	(W1)	40
3. Number of branches or	(B)	40
(Covering area in Bermuda grass (c))		100

The evalution is based also upon the percentage of the status of the plant in the treatment to the status of the plant in the control. The relative yield quality (RYQ) is calculated as follows

$$RYQ = \left(\frac{(H)_t}{(H)_c} \times \frac{QH}{100} \times 100\right) + \left(\frac{(W_1)_t}{(W_1)_c} \times \frac{QW_1}{100} \times 100\right) + \left(\frac{(B)_t}{(B)_c} \times \frac{QB}{100} \times 100\right)$$

It is needed to change $\frac{(C)_t}{(C)_c}$ instead of $\frac{(B)_t}{(B)_c}$, also changing QC instead of QB in the case of Bermuda grass.

Where $(B)_t$ or $(B)_c$ is the branches number in treatment or control.

$(C)_t$ or $(C)_c$ is the covering area in treatment or control.

QB is the percentage of the number of the branches character.

QC is the percentage of the covering area character.

RESULTS

Effect of irrigation with sodicity and boron containing water on the Growth of Myoporum Plant

Plant characteristics

Sandy soil : The data in Table (3,4) showed that the plant height increased due to the increase in irrigation with sodicity water level until 4.5 SAR_{adj}. The plant height was gradually decreased with increasing boron in irrigation.

The number of leaves of Myoporum plants was increased due to addition of SAR_{adj} than control. Also it was gradually decreased with increasing bran in irrigation with sodicity water.

The branches number of Myoporum plants were increased by using sodicity in irrigation water until 27 SAR_{adj} than control but the branches number were gradually decreased with increasing boron in irrigation water.

The fresh weight of shoots was in decreased with increasing sodicity and decreased by using boron in watering.

Dry weight of shoots per plant took same trend of the fresh weight of shoots. The plant dry weight was decreased from 85.01 at

Table (3) : Effect of irrigation with sodicity water on vegetative growth of myoporum plants grown in sandy and calcareous(cal.) soils .

Treatments ,SAR_{adj}	Plant height, Cm		Leaves No/plant		Branches, No/ plant		Fresh weight of shoots, g/plant		Dry weight of shoot, g/plant	
	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.
First season (2006 / 2007)										
0	47.67	59.67	168.33	196.67	16.67	23.33	145.87	201.13	43.8	67.09
4.5	59.33	56	373.33	333.33	29	24	264.13	172.17	85.01	58.97
9	58.33	52.33	296.67	246.67	23.33	20	217.03	146.4	65.95	49.80
27	52.33	49.33	296.67	216.67	22.67	16.33	179	135.27	56.83	45.68
$L.S.D_{0.05}$	9.16		112.42		13.26		83.74		30.66	
Second season (2007 / 2008)										
0	50.36	59.66	169.34	197.77	17.66	24.20	146	211	42.99	66.19
4.5	60.30	57.33	370	330	30.41	24	260	170	88.60	55.67
9	58.70	54.11	297	240.98	25	21	218	145	66.71	48.38
27	55.23	50.20	290	239.15	23.20	15.90	178	133	54.36	45.63
$L.S.D_{0.05}$	9.21		112.96		12.15		78.16		33.11	

Table (4) : Effect of irrigation with boron containing water on the Vegetative growth of myoporum plants growth in sandy and calcareous(cal.) soils .

Treatments B_{ppm}	Plant height, Cm		Leaves, No/plant		Branches, No/ plant		Fresh weight of shoots, g/plant		Dry weight of shoot, g/plant	
	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.
First season (2006 / 2007)										
0	59	59.67	336.67	388.67	24.67	34.67	241.3	349.87	71.17	92.55
1.5	53.67	58.67	266.67	303.33	21.33	24.67	206.9	201.13	62.84	82.28
3	52.67	58	263.33	246.67	17.67	23.33	180.65	171.67	56.96	67.09
6	47.67	50.67	168.33	196.67	16.67	22.67	145.87	1600	43.8	64.96
$L.S.D_{0.05}$	14.10		116.29		6.76		155.68		37.42	
Second season (2007 / 2008)										
0	50.67	68	226.67	296	22.60	30	194	244.7	52.99	76.52
1.5	50.33	57.30	223.3	103.67	16.31	24.31	131	143.17	35.73	42.56
3	51	50	122.67	186	13.67	20.40	87.85	132.73	18.26	38.6
6	39.33	36.30	88.33	150	10	22.11	36.87	51	8.88	8.68
$L.S.D_{0.05}$	15.83		112.9		12.15		78.161		33.11	

4.5 SAR_{adj} to 56.83 at 27 SAR_{adj}. The Dry weight of shoots was decreased gradually with increasing borne in irrigation water.

$CaCO_3$ – rich soil : date in Tables (3.4) showed that Myoporum plant height was gradually decreased from 59.67cm in control to 49.33 at 27 SAR_{adj} and 50.67 at 6 Bppm.

Number of leaves was reduced gradually from 4.5 SAR_{adj} to 27 SAR_{adj} but by irrigation with boron containing water was reduced gradually from control level (0) to 6 B_{ppm}. The reduction in leaves number was significant at 6 B_{ppm} in comparison to its number of branches was also reduced gradually with irrigation with boron containing, by irrigation sodicity water number of branches was also reduced gradually with increased of levels .

Fresh and dry weights of shoots per plant were decreased with increased. SAR_{adj} and B_{ppm} levels. The trend in the first season was similar to trend in the second season .

Effect of Irrigation with Sodicity and Boron Containing water of Chaff Flower plant

Plant characteristics

Sandy soil : Data in Tables (5,6) showed that the plant height was decreased when plants were irrigated with sodicity and boron containing water levels. Number of branches and leaves were decreased with increased SARadj and Bppm levels. Also fresh weight and dry weight per plant were decreased from 4.5 to 27 SAR_{adj} and 0, 1.5 to 6 B_{ppm} .

$CaCO_3$ – rich soil : The data in Tables (5,6) showed that the plant height was decreased when the plants were irrigated with 0 , 4.5 , 9 , 27 SAR_{adj} and 0 , 1.5 , 3.6 B_{ppm} .

Number of branches and leaves per plant were decreased at 4.5 , 9 , 27 SAR_{adj} and 0 , 1.5 , 3.6 B_{ppm} . Also fresh and dry weights were decreased at 0 , 4.5 , 9 , 27 SAR_{adj} and 0 , 1.5 , 3 , 6 B_{ppm}.

Table (5) : Effect of water sodicity on growth of chaff flower plants grown in sandy and calcareous (cal.) soils.

Treatments SAR_{adj}	Plant height, Cm		Leaves No/plant		Branches, No/ plant		Fresh weight of shoots, g/plant		Dry weight . of shoot, g/plant	
	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.
					First season (2006 / 2007)					
0	17	11	21	30	40	30	3.29	5.28	1.21	2.96
4.5	13.67	12.67	27	22.33	35	38	6.83	12.74	2.69	2.96
9	10.67	10.67	16.33	18.33	26	35.67	4.83	5.28	2.1	2.90
27	9.67	7	12.67	13	15.67	34.33	2.98	4.21	2.05	1.92
$L.S.D_{0.05}$	9.38		16.99		17.99		7.091		2.66	
					Second season (2007 / 2008)					
0	18	12	22	31	42	31	4.22	6.28	1.52	2.99
4.5	14.17	13.71	28	23.26	36	39	7.21	6.28	2.95	2.98
9	10.78	10.61	18.21	19.12	28	36	4.46	13.83	2.61	2.95
27	9.12	8	11.40	12.20	16	35	3.01	5.11	2.5	1.98
$L.S.D_{0.05}$	9.91		17.01		18		7.53		2.69	

Table (6) : Effect of irrigation with boron on vegetative growth of chaff flower plants grown in sandy and calcareous (cal.) soils.

Treatments B_{ppm}	Plant height, Cm		Leaves .No/plant		Branches, No/ plant		Fresh weight of shoots, g/plant		Dry weight of shoot, g/plant	
	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.
First season (2006 / 2007)										
0	17	11	40	30	21	30	3.29	5.28	1.21	2.96
1.5	10.67	10.83	30.33	39.30	33	30	7.47	8.27	2.72	4.33
3	10.33	7.67	25.33	26	25.67	16.67	3.31	7.8	2.37	3.59
6	8	6.83	9	24.35	13	13.32	3.25	4.32	1.44	1.62
$L.S.D_{0.05}$	7.096		15.89		14.69		2.10		0.97	
Second season (2007 / 2008)										
0	18	12	41	30	22	33	3.32	5.48	1.41	2.99
1.5	11.56	11.75	31.40	30.41	34	32	8.26	9.20	2.80	4.54
3	11.43	7.60	26.23	27.30	27.12	17.16	4.36	7.99	2.47	3.75
6	9	6.90	10	25.50	14.30	14.23	3.72	5.30	1.66	1.90
$L.S.D_{0.05}$	8.02		16.86		15.13		2.56		0.97	

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Effect of sodicity Irrigation water on Growth of bermuda Grass Plant :

Plant Chracteristics

Sandy soil : Data in Tables (7,8) showed that the plant height was decreased when plant were irrigated with 27 SAR_{adj} but the plant height was gradually decreased with increased B_{ppm} levels in irrigation water .

Establishment rate (area covered) was not affected by the addition of sodicity and boron containing irrigation water .

The fresh weight of cutted herbs was decreased gradually with increasing sodicity and boron in irrigation water . The decrease in fresh weight of herbs was reduced from 34.03 to 25.81g per pot when sodicity and boron containing in irrigation water was changed from control to 27 SAR_{adj} and 0 to 6 B_{ppm}. Dry weight would be decreased gradually as it was expected with increasing SAR_{adj} and B_{ppm} in irrigation water . The plant dry weight was decreased from 13.16g and 2.72g at 4.5 SAR_{adj} and 1.5 B_{ppm} to 9.75g and 1.44 at 27 SAR_{adj} and 6 B_{ppm} .

$CaCO_3$ rich soil : Data in Tables (7.8) cleared that the bermuda grass height was decreased from 26cm in control to 21 in 27 SAR_{adj} except at 4.5 , 9 SAR_{adj} the plant height decreased was started directly just the boron containing water in irrigation . Establishment rate (area covered) was not affected by the addition of sodicity and boron containing irrigation water .

Fresh and dry weight of cutted herbs were affected also by the addition of sodicity and boron in containing water . Although the effect appeared in first level of sodicity and boron . The decrease was started at 9 SAR_{adj} and 1.5 B_{ppm}.

VI : Sodicity and boron containing in irrigation water VS. Salinity in soil saturation extract :

Tables (9,10,11,12) show the effect of irrigation the ornamental plants used in this study with four sodicity and boron levels. The Data showed that no significant difference in the salinity of soil saturation extract between sandy and calcareous soil for every plant due to the irrigation control. Data generally showed also that the gradual increase in sodicity and boron containing of irrigation water caused gradual increase in soil salinity .

Table (7) : Effect of irrigation with sodicity water on vegetative growth of bermuda grass plants grown in sandy and calcareous (cal.) soils.

Treatments SAR_{adj}	Plant height, Cm		Area covered/pot, cm^2		Fresh weight of shoots, g/plant		Dry weight of shoot, g/plant	
	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.
First season (2006 / 2007)								
0	25	34.33	704.33	702.7	34.03	36.36	14.11	14.63
4.5	30.33	27.33	699.3	701	34	35.87	13.16	14.15
9	33	34.33	697.7	701	29.09	32.91	11.97	13.2
27	24.67	21	696.2	639.2	25.81	28.18	9.97	12.05
$L.S.D_{0.05}$	6.62		8.3		15.58		0.06	
The second season (2007 / 2008)								
0	27.21	28.11	705.61	704.5	35.20	37.30	15.12	15.80
4.5	34	30.41	700.23	708	34.36	36.70	12.10	15.00
9	36	37.23	698.6	707	30.19	33.15	11.98	12.30
27	25.63	23.20	697.5	641	26.99	29.20	10.90	11.29
$L.S.D_{0.05}$	7.20		9.11		16.15		7.15	

Table (8) : Effect of irrigation with boron containing water on the vegetative growth of bermuda grass plants grown in sandy and calcareous (cal.) soils .

Treatments SAR_{adj}	Plant height, Cm		Area covered/pot, cm^2		Fresh weight of shoots, g/plant		Dry weight of shoot, g/plant	
	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.	Sandy	Cal.
	First season (2006 / 2007)							
0	25.67	34.33	696.2	639.2	40.97	40.94	14.37	17.32
4.5	25.33	26	685.67	692.6	34.03	40.85	13.16	15.63
9	19.33	23	633	682.7	32.07	46.59	11.25	14.19
27	19	19.33	625.33	531.8	28.36	36.36	9.75	13.99
$L.S.D_{0.05}$	3.54		155.27		2.55		9.0	
	Second season (2007 / 2008)							
0	27.17	35.12	697.31	640.4	44.17	42.15	15.31	18.27
4.5	26.15	27.20	686.61	696.11	35.4	40.99	13.27	16.61
9	30.32	20.85	642	680.32	33.6	47.20	12.33	15.20
27	19.32	19.85	629.3	550	29.30	38.07	10.21	13.90
$L.S.D_{0.05}$	4.10		157		2.90		9.80	

Table (9) : Effect of irrigation with water sodicity on soil salinity of saturation extract and on the relative yield quality of Myoporum plants .

Irrigation	Ec,dsm^{-1}		Relative yield quality % calculated	
SAR_{adj}	Ec_e (cal.)	Ec_e (sandy)	Cal.	Sandy
0	0.617	0.101	100	100
4.5	0.905	0.107	87.63	140
9	0.934	0.117	81.48	128.681
27	0.997	0.127	71.76	69.59

* Irrigation water added .

** Soil saturation extract determined in the end of the plant season .

*** The differences between Ec_e in sandy and calcareous soil were insignificant .

Table (10) : Effect of irrigation with water containing boron on soil salinity of saturation extract and on the relative yield quality myoporum plants .

Irrigation	Ec, dsm^{-1}		Relative yield quality % calculated	
SAR_{adj}	Ec_e (cal.)	Ec_e (sandy)	Cal.	Sandy
0	0.617	0.170	100	100
1.5	0.754	0.143	83.68	88.09
3	0.940	0.163	75.36	78.51
6	0.973	0.171	71.2	67.81

* Irrigation water added .

** Soil saturation extract determined in the end of the plant season .

*** The differences between Ec_e in sandy and calcareous soil were insignificant .

Table (11) : Effect of irrigation with water sodicity on soil salinity of saturation extract and on the relative yield quality of chaff flower .

Irrigation	Ec,dsm^{-1}		Relative yield quality % calculated	
SAR_{adj} *	Ec_e (cal.)	Ec_e (sandy)	Cal.	Sandy
0	0.424	0.278	100	100
4.5	0.499	0.337	91.77	116.06
9.0	0.738	0.396	83.03	103.27
27	0.973	0.587	56.01	88.93

* Irrigation water added .

** Soil saturation extract determined in the end of the plant season .

*** The differences between Ec_e in sandy and calcareous soil were insignificant .

Table (12) : Effect of irrigation with water containing boron on soil salinity of saturation extract and on the relative yield quality of chaff flower .

Irrigation*	Ec,dsm^{-1}		Realtive yield quality % calculated	
B_{ppm}	Ec_e (caL.)	Ec_e (sandy)	CaL	Sandy
0	0.424	0.191	100	100
1.5	0.590	0.219	118.20	139.33
3	0.596	0.337	84.69	133.92
6	1.10	0.439	52.07	81.77

* Irrigation water added .

** Soil saturation extract determined in the end of the plant season .

*** The differences between Ec_e in sandy and calcareous soil were insignificant .

The increase in salinity in calcareous and in sandy soil, respectively was as follows :

62 and 0.101 (in contro) and 997 and 13 cin 27 SAR_{adj}, 0.62 and 0.11 (in contro) and 0.97 and 17 cin B_{ppm} with myoporum plants (Tables 9,10), 0.42 and .28 dsm^{-1} (in contro) and 0.97 and 0.58 dsm^{-1} (in 27 SAR_{adj},) 0.42 and .19 dm^{-1} (in contro) and 1.10 and 0.44 in 6 B_{ppm}, with chaff flower table (11,12), 0.15 and 0.13 dsm^{-1} (in control) and 0.56 and .20 dsm^{-1} (in 27 SAR_{adj}) Also 0.25 and 0.12 dsm^{-1} (in control) and 0.33 and .16 dsm^{-1} (in 6 B_{ppm} with bermuda grass (Tables 13,14).

DISCUSSION

The evaluation of ornamental plants to sodicity and boron containing in water are the main objective of the present work. As described in Diab *et al.*, 1991, the evaluation was depended on the threshold salinity level and the slope of the line which represents the relation between soil salinity and yield. The data obtained are introduced in Tables (9, 10, 11, 12, 13, 14) to evaluate sodicity and boron containing in water tolerance for myoporum, chaff flower and bermuda grass, respectively .

Table (9) showed that the threshold salinity for Myoporum plants was 0.62 and ./0 dsm^{-1} soil saturation extract (zero = control) levels in irrigation water in calcareous and sandy soils . Also threshold salinity for moporum plants was 0.11 and 0.12 dsm^{-1} in sandy soil saturation extract (4.5 and 9 SAR_{adj}) levels in irrigation water . This means that Myoporum growth was not reduced until 0.62 dsm^{-1} in calcareous soil and until (control SAR_{adj} in water while the reducton at 0.13 dsm^{-1} soil saturation extract in sandy soil and until 9 SAR_{adj} in water . Beyond these points (threshold salinity), there were gradual decrease in relative yield . The effect of $CaCO_3$ is clear in reducing myoporum yield even threshold salinity while it is not clear beyond this point . At 12.37 and 18.52 dsm^{-1} in calcareous soil extract (adout 4.5 and 9 SAR_{adj}) in irrigation water, the myoporum relative yield was 80% which may consider this value permissible for application (Shainberg and Ostar, 1978)

Table (10) showed that the threshold sodicity and boron containing water for myoporum plants was 0.62 and 0.11 dsm^{-1} in soil

saturation extract (control B_{ppm}) levels in irrigation water in calcareous and sandy soils. This means that Myoporum plants yield was starting yield reduction just the salinity rises in soil saturation extract than 0.62 and 0.11 dsm^{-1} the myoporum pictum yield was also decreased gradually with rising Boron in irrigation water .

The slop of the yield reduction lines were 16.32 and 11.91 with calcareous and sandy soils, respectively . Although there were a reduction in relative yield with rising salinity, the growth continued within the season and the highest boron level used in this experiment . Data indicated that Myoporum pictum will produce 100% relative yield with non boron only (control) and beyond this boron the relative yield will decrease in two soils. To produce 80% of relative yield, the boron containing water in irrigation must not exceeds 1.5Bppm with both soils. Show also that *Myoporum pictum* plants are moderately tolerant comparing to the division boundries of Mass and Hoffman .

Table (11) Shows that threshold sodicity and boron containing in water for chaff flower plants was 0.42 and 0.39 dsm^{-1} in calcareous and sandy soil saturation extract in both the soils. This soil salinity was produced when control SAR_{adj} and 9 SAR_{adj} in water irrigation at calcareous and sandy soils . This means that chaff flower yield was startng yield reduction just the salinity rises in soil saturation extract than 0.42 and 0.39 dsm^{-1} . The chaff flower yield was decreased gradually with rising sodicity in irrigation water . The slope of yield reduction line in calcareous soil was more sharp than in sandy soil which menas that deleterious effect of sodicity was higher in calcareous soil .

The data indicated that chaff flower produce 100% relative yield with non sodicity water (control) in calcareous soil but in sandy soil that chaff flower produce 100% relative yield with 4.5 and 9 SAR_{adj} . Data showed also that commercial production may be not more than 80% of chaff flower relative yield if sodicity in irrigation water at 9 SAR_{adj} in calcareous soil and at 27 SAR_{adj} in sandy soil with reduction amounted by 16.97% and 11.08% in sandy and calcareous soils, respectively .

Table (12) showed that the threshold for chaff flower plants was 0.6 and 22 dsm^{-1} in calcareous and sandy soil saturation extract this soil salinity was produced when 1.5 and 3 B_{ppm} was used in water

irrigation . This means that chaff flower yield was starting yield reduction just the salinity rises in soil saturation extract than 0.6 and 0.34 dsm^{-1} . The chaff flower yield was decreased gradually with rising sodicity in irrigation water . The data indicated that chaff flower will produce 100% relative yield with 1.5 and 3 B_{ppm} and beyond this sodicity the relative yield will decrease in the two soils used . Data showed also that commercial production may be not more than 80% of chaff flower relative yield if boron concentration in irrigation water (1.5 and 3 B_{ppm}) in calcareous and sandy soils with yield reduction amounted by 18.23 and 15.31 in sandy and calcareous soils .

Table (13) showed that threshold sodicity and boron containing in water for bermuds grass plants 0.29 and control dsm^{-1} in saturation extract in calcareous and sandy respectively . This soil salinity was produced when zero (control) and 4.5 SAR_{adj} was used in water irrigation. This mean that bermuda grass yield was starting yield reduction just the salinity rises in soil saturation extract than 0.13 dsm^{-1} in sandy and 0.29 dsm^{-1} in calcareous soils the bermuda grass yield was also deceased gradually with rising sodicity in irrigation water . A though there were a reduction in relative yield with rising salinity, the growth continued within the season and highest sodicity level used in this experiment .

Data indicated that bermuda grass will produce 100% relative yield with control only and 4.5 SAR_{adj} beyond this electrical conductivity the relative yield will decrease in the two soils. To produce 80% relative yield, the sodicity in irrigation water must not exceeds 27 SAR_{adj} with both soils. Shows also that bermuda grass plant are moderately tolerant comparing to the division boundries of Mass and Hoffman.

Table (14) showed that the threshold sodicity and boron containing in water for bermuda grass plants was 0.25 and 0.12 dsm^{-1} in soil saturation extract in both soils. This soils salinity was produced when contro (B_{ppm}) was used in water irrigation . This means that bermuda grass yield was starting yield reduction just salinity rises in soil saturation extract than 0.25 and 0.12 dsm^{-1} . The bermuda grass yield was also decreased gradually with rising boron containing in irrigation water. Athough there was a reduction in relative yield with rising salinity, the growth continued within the season and the highest boron level used in this experiment. Data indicated that bermuda grass

Table (13) : Effect of irrigation with water sodicity on soil salinity of saturation extract and on the relative yield quality of bermude grass .

Irrigation *	Ec, dsm^{-1} **		Realtive yield quality % calculated	
SAR_{adi}	Ec_e (cal.)	Ec_e (sandy)	Cal.	Sandy
0	0.153	0.129	100	100
4.5	0.288	0.132	100.34	95.20
9.0	0.357	0.156	94.35	88.90
27	0.562	0.203	81.57	82.75

* Irrigation water added .

** Soil saturation extract determined in the end of the plant season .

*** The differences between Ec_e in sandy and calcareous soil were insignificant .

Table (14) : Effect of irrigation with water containing boron on soil salinity of saturation extract and on the relative yield quality of bermuda grass .

Irrigation	Ec,dsm^{-1}		Realtive yield quality % calculated	
B_{ppm}	Ec_e (cal.)	Ec_e (sandy)	Cal.	Sandy
0	0.245	0.115	100	100
1.5	0.288	0.141	94.47	95.76
3	0.321	0.149	88.88	82.75
6	0.331	0.156	76.85	80.87

* Irrigation water added .

** Soil saturation extract determined in the end of the plant season .

*** The differences between Ec_e in sandy and calcareous soil were insignificant .

will produce 100% relative yield with non boron (control) and beyond this electrical conductivity the relative yield will decrease in two soils. To produce 80% of relative yield, the boron containing in irrigation water must not exceeds 3 and 6 B_{ppm} in calcareous and sandy soil, respectively. bermuda grass plants are moderately tolerant comparing to the division boundries of Maa and Hoffman (1977) .

Myoporum plants are highly tolerant to sodicity and boron containing in water then bermuda grass than chaff flower in both soils but the reduction in yield is bigger with Myoporum than chaff flower than bermuda grass in calcareous soil and is bigger with Myoporum than chaff flower in sandy soil .

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الملخص العربي

تقييم مقاومة نباتات الزينة
(البزروميا والمتيره والنجيل البلدى) للصوديه والبورون

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أجريت هذه الدراسة بفرع بحوث الزينة بانطونيادس بالإسكندرية – مصر خلال موسمى 2006 / 2007 و 2007 / 2008.
وكان الهدف من هذه الدراسة هو تقييم ثلاثة نباتات زينة هى البزروميا، المتيرة ، والنجيل . استخدمت فى هذه التجارب 4 مستويات من الصودية هى صفر ، 4.50 ، 9 ، 27 SAR adj 4 مستويات بورون هى صفر ، 1.50 ، 3 ، 6 جزء فى المليون التجارب نظام عشوائى كامل فى 3 مكررات .
جهزت عقل البزروميا والمتيرة وزرعت فى أصص صغيرة ثم نقلت لاصص أكبر أما النجيل فقد زرع بذرة فى الأصص مباشرة ورويت بالمياه العادية لفترة بمياه محتويه على صوديوم ومياه محتوية على بورون كل يومين فى الأرض الرملية وكل 6 أيام فى الأرض الجيرية .
أختبر عدد من الصفات منها طول النباتات ، عدد أوراق فى البزروميا والمتيرة فقط ثم قيس الوزن الطازج والجاف كذلك قدرت مساحة التغطية فى النجيل وكانت النتائج كالتالى :
1- زادت ملوحة التربة نتيجة الرى بمياه صودية والمياه المحتوية على بورون .
2- التأثير الضار للصوديوم والبورون على النباتات النامية فى أراضى جيرية كانت أكبر من المنزرعة فى الأراضى الرملية .
3- كانت جودة المحصول النسبى 100% فى نباتات البزروميا عندما رويت بماء الرى العادية ثم انخفضت تدريجيا بعد ذلك فى الأرض الجيرية ولكن فى الأرض الرملية انخفضت عند 27 زيSAR ولكن فى حالة الرى بمياه محتوية على البورون انخفضت عند المستوى الثانى فى الأراضى الرملية والجيرية .
4- كانت جودة المحصول النسبى 100% فى نباتات المتيرة عندما رويت النباتات بمياه عادية وانخفضت بعد ذلك تدريجيا فى الأراضى الجيرية والرملية فى حالة الصودية .
أما فى حالة الأراضى المروية بمياه محتوية على البورون انخفضت فى الأراضى الجيرية بداية من المستوى 3 جزء فى المليون بورون أما الأرض الرملية انخفضت عند مستوى 6 جزء فى المليون بورون .
5- كانت جودة المحصول النسبى 100% فى حالة النجيل عند مستوى مياه الرى العادية فى الأرض الجيرية والرملية وايضا فى الأرض الجيرية عند مستوى رى 4.50 صودية مع زيادة التركيز لكل من الصوديوم والبورون فى مياه الرى انخفضت تدريجيا حتى وصلت إلى 82.75% و81.57 فى الأرض الرملية والجيرية على الترتيب عند مستوى 27 صودية ، 80.87% و 76.85% عند مستوى 6 جزء فى المليون بورون فى ماء الرى وعموما استنتج أن نباتات البزروميا كانت أكثر تحمل للصوديوم والبورون من النجيل والمتيرة .