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EFFECT OF SALINITY STRESS AND WATER MAGNETIZATION ON GROWTH OF GUINEA GRASS (*PANICUM MAXIMUM*)

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Abstract:-A field experiment was carried out at the open site of King Abdulaziz University agricultural nursery in Jeddah during the year 2013, in order to examine the effects of salt stress and water magnetization on growth of (Guinea grass). Split plot design fitted in randomized complete plots with three replicates was used. The main plots were represented by magnetization treatment (magnetized + non magnetized sea water), while the subplots were represented by salt treatment. Six salt concentrations (10, 20, 30, 40, 50 and 60%) were made by mixing sea water with fresh water, plus control fresh water (0%). Seven plots (six salt concentrations + control) were irrigated after passing the water through the magnetization device, whereas the other set of seven plots were irrigated directly by drip irrigation. The results showed that water magnetization reduced the deleterious effects of salt stress on shoot height, number of branches, number of leaves, stem diameter, leaf area, dry weight, fresh weigh and moisture content compared to the salt concentrations without magnetization. Also, the results revealed that salinity resulted in reduced plant growth values with increasing salt concentration compared to control fresh water in both magnetization treatments. The study highlighted the effective use of magnetic technology to reduce the negative effects of saline irrigation water on plant growth.

Keywords:*Guinea grass*, Magnetic technology, Saline water, Vegetative growth.

INTRODUCTION:

Water is one of the most abundant compounds on the ground and 2/3 of the ground level was surrounded by water, but in most part of the world lack (shortage) of water is a factor which is limits the production of the agricultural products. Therefore water deficit is considered the single most important a biotic stress that limits crop production in arid and semi arid areas such as Middle east, Gulf area and in particular kingdom of Saudi Arabia which is a vast arid desert covering the major part of the Arabian peninsula . Long spell of drought and competing water demands in most parts of Saudi Arabia have put enormous pressure on water resources. Steps need to be taken to conserve but the quantity and quality of water and appropriate strategies will have to be developed to avoid risk to future water supplies (ANRA, 2008).

Salinity may disrupt nutrient acquisition by plants by reduction in nutrient availability by completion with major ions (i.e. Na+ and Cl-) in the substrate (Flowers and Colmer, 2008). Although saline soils occur in humid regions in areas affected by sea water, the most extensive occurrence is in arid and semi arid regions, where rainfall is not sufficient to wash and transport salts away from the plant root zoon. In such saline regions, cultivation of crop plants could mainly be achieved either after washing of excess salts by repeated flooding with fresh water or by introducing plants adapted to such saline conditions (Heikal et al., 1982; Hajar et al., 1993 and Howladar, 2010). Since sufficient amounts of fresh water are not always available the second alternative seems to be more applicable.

The ionic composition of seawater is dominated by Na and Cl ions; it also contains in abundance ions essential to plant growth, i.e. K, Mg, Ca, SO4; and it is buffered towards alkalinity (pH 8.5) and also usually contains trace elements (Fe, Mn, Zn...) and organic matter: the latter contains a certain amount of the total nitrogen where nitrogen fixation in the saline soil is at a low level (Al-Zahrani, 1990). The presence of the ions has consequences, however, for the free energy of water. As the salt concentration increases in any solution, the water becomes less and less accessible to plants (Harvey, 1966); therefore, a plant must produce an osmotic potential lower than that of the soil solution to take up water to its tissues (Larcher, 1980).

Generally, using different magnetized irrigation water sources, soil salinity, soluble cations and anions were significantly decreased by using magnetized water (Ahmed and Bassem, 2013). Aladjadjiyan (2002) reported that exposure the seed to a 150 mT magnetic field stimulated shoot development and led to increase of the germination, fresh weight and shoot length of maize plants. Magnetic water has found to have pronounced effect on plant productivity. Aladjadjiyan and Ylieva (2003) reported some beneficial effects of magnetically treated irrigation water particularly for saline water and recycle water, on yield and water productivity of clearly and snow pea plants under controlled environment conclusion. Yokatani et al. (2001) indicated that magnetic fields have a highly stimulating effect on cell multiplication, growth and development. Many studies reported that magnetic field had a positive effect on the number of flowers and total yield of the pea (Podlesny et al., 2005), seed germination percentage and nutrient uptake of strawberry (Fragaria x ananassa cv. Camarosa) (Esitken and Turan, 2003). Moon and Chung (2000) said that application of a magnetic field to irrigation water was shown to increase plant nutrient content. Maheshwari and Grewal (2009) indicated that the effects of magnetic treatment varied with plant type and the type of irrigation water used, and there were statistically significant increases in plant yield and water productivity. Turker et al. (2007) found an inhibitory effect of the magnetic field on root dry weight of maize plants, but there was a beneficial effect of magnetic field on root dry weight of sunflower plants. Hozayn and Amira (2010) found that, irrigation with magnetized water induced positive significant effect on the percent of increase in seed of chickpea, straw and biological yields per plant as compared with tap water. Irrigation with magnetized water significantly improvement the growth, yield and yield components and chemical constituents of lentil (Lens esculenta) plant (Amira and Hozayn, 2010). Muraji et al. (1992) reported about an enhancement in root growth of maize by exposing the maize seedling to magnetic fields of 500 gauss. Magnetic field affected the various characteristics of plant like and chlorophyll quantities (Reina et al., 2001). An increase in nutrient uptake by magnetic treatment was also observed in tomatoes by Duarte Diaz et al. (1997).

The aim of the present study is to investigate the Effect of different concentrations of sea water treated and untreated magnetically on Growth of Guinea grass (Panicum maximum).

MATERIALS AND METHODS

Study area

This study was carried out during the period 19.3.2013 to 15.07. 2013 in the open field of King Abdulaziz University Nursery in Jeddah.

Experimental design

The experimental design used was split plot design in a randomized complete plots with three replicates. The main plots treatments were represented by water magnetization, while the subplots were represented by salt concentrations treatment. The sea water was mixed with fresh tap water at different percentages to obtain six salt concentrations (10, 20, 30, 40, 50 and 60%), as well as control fresh water (0%). Then water magnetization was made by connecting the salt concentration in tanks of 60 liters capacity with magnetization device to guarantee the magnetization of water on a daily basis. The total experimental units were 14 plots of 2 X2 meter dimensions. Seven plots were magnetized salt concentrations treatments while the other seven plots were non-magnetized salt concentrations. Then seeds of Guinea grass was planted at the rate of 20 kg/hectare and irrigated once every two days by drip irrigation. In order to prevent accumulation of salts, the soil in each plot was leached every ten days with fresh water.

Parameters measured

At the end of experimental period (four months from imposing salinity), height shoot, number of branches, number of leaves, stem diameter, leaf area, fresh weight, dry weight and moisture content were measured.

Data Analysis

Analysis of variance (ANOVA) was done to test the effects of the main treatments. The means were separated with the least significant difference LSD. The data were analyzed using SAS Statistical Analysis Software (SAS System Version 8, 2000).

RESULTS

Analysis of Variance (ANOVA) presented in Table (1) showed that both magnetization and salt concentrations treatments had significant effects on plant growth. In general, Table (2) revealed that plant growth of (Panicum maximum) Guinea grass was significantly reduced with increasing salt concentration compared to the control fresh water. However, magnetizing the salt water reduced the deleterious effects of salt stress on plant growth, resulting in higher shoot height, number of branches, number of leaves, stem diameter, leaf area, dry weight, fresh weigh and moisture content values compared with non-magnetized salt water (Table 3).

Table 1: Analysis of variance for Guinea grass (Panicum maximum) plants shoot height (cm), number of plant leaves; stem diameter (cm), leaf area (cm2), fresh weight (g), dry weight (g) and moisture content (%) irrigated with magnetic and nonmagnetic water.

Source of difference	d.f	Shoot height (cm)	No. of branches /plant	No. of leaves/plant	Stem diameter (cm)	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)	Moisture content (%)
replicate	2	2.16	14.38	37.81	0.005	2.52	6.68	2.81	2.81
Type water	1	192.85**	74.66**	896.09**	0.45**	3121.47**	1461.7**	1396.6**	1396.6**
Error	2	0.21	0.09	6.95	0.002	0.31	4.71	0.27	0.27
concentration	6	829.66**	664.37**	11815.16**	2.12**	5732.06**	44246.51**	4900.51**	4900.51**
Type water * concentration	6	6.19*	3.27	53.81**	0.01**	119.85**	61.06**	68.77**	68.77**
Overall error	24	2.35	2.09	9.99	0.001	2.81	4.65	0.83	0.83

* Significant at 5% level; ** Significant at 1% level; d.f, degrees of freedom

Table 2: Means of Guinea grass (Panicum maximum) plants shoot height (cm), number of plant leaves; stem diameter (cm), leaf area (cm2), fresh weight (g), dry weight (g) and moisture content (%) irrigated with magnetic and nonmagnetic water.

Treatments	Concent-ration (%)	Type of measurement							
		Shoot height (cm)	No. of branches /Plant	No. of leaves/plant	Stem diameter (cm)	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)	Moisture content (%)
Non-magnetic water	0	31±1.63	28.6±1.24	116±2.94	1.66±0.033	86.00±3.49	222.04±1.34	71.65±0.25	67.73± 0.09
	10	27.3±1.69	24. 6±1.24	101.66±6.18	1.49±0.020	61.87±1.31	205.65±2.99	67.17±0.93	67.33± 032
	20	22.6±1.24	20. 3±0.47	80.66±1.69	1.25±0.029	51.63±0.45	194.21±1.99	58.47±1.27	65.31± 6.19
	30	17±1.24	18. 6±2.05	75±2.94	1.02±0.071	41.73±0.91	152.56±1.34	50.49±0.44	66.89± 0.58
	40	14±0.47	12. 3±2.05	50±2.94	0.903±0.012	31.26±0.65	105.83±2.59	46.44±0.81	56.07± 1.70
	50	7.3±1.24	7. 6±2.05	18±3.26	0.616±0.024	19.84±1.10	55.63±1.97	22.15±1.09	61.08± 3.21
	60	0	0	0	0	0	0	0	0
Magnetic water	0	36±1.63	31.6±1.24	121±0.81	1.94±0.04	100.23±1.51	237.25±2.25	90.99±0.42	61.64± 0.52
	10	32.3±0.94	28.6±0.94	118.6±1.24	1.70±0.02	86.40±0.82	224.38±2.43	82.56±0.70	63.18± 0.68
	20	28.6±1.24	24.6±1.24	96±1.63	1.41±0.016	73.54±1.22	210.24±1.18	75.79±0.29	63.94± 0.33
	30	23.3±1.24	20.6±1.24	83.6±3.85	1.273±0.033	66.43±0.52	161.68±1.58	61.16±1.17	62.16± 1.06
	40	18±0.81	14.3±2.05	62±2.44	1.10±0.081	53.51±1.36	114.40±1.65	52.28±1.14	54.28± 1.43
	50	12±1.63	11±0.81	24.6±2.49	0.93±0.026	32.91±1.08	70.50±0.75	33.99±0.83	51.78± 0.89
	60	0	0	0	0	0	0	0	0

Effect of irrigation water salinity:

Means of the shoot height, number of branches, number of leaves, leaf area, fresh weight, dry weight and moisture content under the 7 irrigation water salinity levels were presented in Table (2). All studied traits under the effect of irrigation exposed with different concentration of sea water (Table 2) showed significantly decreased in all studied traits under the magnetic and the non-magnetic irrigation water.

Effect of Magnetic irrigation water:

Magnetic water significantly increased the shoot height under any irrigation water salinity levels. The average height of the plant shoots irrigated with non-magnetized seawater was (17.19 cm), while magnetized seawater improved plant growth to an average (21.47 cm) (Table 3). Also, the positive effects of the magnetic field on the number of branches and number of leaves were detected. The data of Table (3) showed significant increasing in number of branches (18.71) and number of leaves (72.28) under water salinity treated with magnetic field more than under the non-magnetized irrigation water, (16.04) and (63.04), respectively. As well as, stem diameter and leaf area significantly increased under the magnetized water compared with the non-magnetized water in all salinity levels.

Also, fresh and dry weights of the shoot and root systems of Guinea grass (Panicum maximum) plants significantly increased under the magnetic water than the non-magnetic water (Table 2). While, the moisture content significantly decreased under the magnetic water than the non-magnetic water. These results indicated the positive effect of using magnetic water in reducing the adversely effect of the saline irrigation water of Guinea grass (Panicum maximum) plants.

Table 3: The average growth functions of Guinea grass (Panicum maximum) plants irrigated with magnetic and nonmagnetic water.

Growth functions	Shoot height (cm)	No. of branches/ Plant	No. of leaves/ plant	Stem diameter (cm)	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)	Moisture content (%)
Non-Magnetic water	17.19 b*	16.04 b	63.04 b	0.99 b	41.76 b	133.69 b	45.15 b	55.45 a
Magnetic	21.47 a	18.71 a	72.28 a	1.19 a	59.01 a	145.49 a	56.68 a	51.002 b
LSD	0.61	0.41	3.5	0.06	0.74	2.88	0.70	1.3

*Means of the same letter are not significantly different according to L.S.D. at $p \leq 0.05$.

DISCUSSION

Salinity becomes a problem when enough salts accumulate in the root zone to negatively affect plant growth. The effects of the water salinity on the growth functions of Guinea grass (Panicum maximum) in this study were confirmed with the results of Greenway and Munns (1980), Sibi and Fakiri (2000), Reda Tazi et al. (2001), Belkhodja and Bidai (2004), Berrichi et al. (2010) and (Grewal and Maheshwari (2011).

The positive effects of exposed irrigation saline water to magnetic on growth functions of Guinea grass (Panicum maximum) in this study were confirmed on plant growth and development (De Souza et al., 1999; Martínez et al., 2000), on tree growth (Ruzic et al., 1998), on the ripening of fruits and vegetables (Boe and Salunke, 1963) and on crop yield (Pietruszewski, 1993); some review papers also mention a number of controversial, early results (Findlay and Hope, 1976; Frey, 1993). Dandan and Yan (2013) indicated that magnetized saline solution increased the salt resistance of wheat and promoted the growth and development of wheat. Aladjadjiyan (2002) observed that the magnetic field stimulated the shoot development of maize and led to an increase in germinating energy, fresh weight and shoot length. Harichand et al., (2002) reported that exposure of magnetic field increased plant height, seed weight per spike and yield of wheat (Triticum aestivum). Abou El-Yazied1 et al. (2011) reported that magnetized water gave significant increases in transplant stem length, stem diameter, leaf area and fresh and dry weight than those in the control treatment which grew by untreated seeds and irrigated by ordinary (untreated water) water of Tomato (Lycopersicon esculentum Mill) cv. Castlrock seeds. Atak et al. (2003) and Yaycili and Alikamanoglu (2005) concluded that magnetized water increased the shoot growth and the fresh weight in soybean and paulownia organ cultures. Racuciu et al. (2006) noted higher growth in maize plants, and relatively more length was recorded in the seedlings established from treated seeds.

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