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PRODUCTIVITY OF TWO SORGHUM HYBRIDS (*Sorghum bicolor* L. Moench) UNDER DIFFERENT LEVELS OF IRRIGATION WATER SALINITY AND SULFER APPLICATION IN SOUTH SINAI

Elafendy, K. T. [1] ; A. M. Abdelghany [2] ; I. A. Ashour [3] and A. M. Talaat
(1) Plant production Dept., Desert Res. Center , Cairo, Egypt.
(2) Agron. Dept., Fac. Agric., Ain ShamsUniversity, Cairo,Egypt.
(3) Soil Conservation Dept., Desert Res. Center , Cairo, Egypt.
(4) Dept.,of soil chemistry and physics. Desert Res. Center,Cairo, Egypt.

ABSTRACT

Seeds of (Mena and Horus) sorghum hybrids were sown on 1st June in 2001 and 2002 seasons at Ras Sedr Experimental Station – Desert Research Center (DRC) – South Sinia Governorate. Three different wells containing three different levels of saline water (2970, 4580 and 9350 ppm) were used in irrigation. Sulfur fertilizer was added at rates of 150, 300 and 450 kg / fed. Results revealed that grain yield reduced by 14.2% with water salinity 4580 ppm and by 34.5% when salinity increased to 9350 ppm. On the other hand, fodder yield decreased only by 3.1 and 10.8% at the same levels of salinity respectively. These findings illustrate that fodder yield was less affected by salinity while the dramatic affect of salinity was observed in grain yield. Hybrid Horus show superiority in salinity tolerant compared with Mena hybrid. All recorded characters of Horus hybrid showed significant increasing more than Mena hybrid. Superiority of Horus reached a percentage of 18.4% and 5.5% for grain and fodder yields respectively. Grain yield increased by 39.34% and 12.02% , while fodder yield increased by 8.89% and 6.00% as sulfur fertilizer increased from 150 to 300 kg/fed. and 450 kg/fed, respectively. The greatest grain and fodder yields were obtained of hybrid Horus under the lowest salt concentration (2970 ppm). The most pronounced values of growth and yield were observed when the maximum sulfur fertilizer (450 kg/fed) and water contained the lowest salt conc. (2970 ppm)were used. The higher grain yield was obtained of Horus hybrid received 450 kg S/fed. It is noticeable that the reduction occurred in fodder yield of hybrid Horus applied with 450 kg/fed due to increasing salt concentration up to 4580 ppm and 9350 ppm was little (8.1 and 6.5% respectively) and could be acceptable under condition of Ras Sedr, whereas, water available always contain high salt concentration, this little reduction may not cause economical losses in fodder yield. On the other hand, reduction occurred in grain yield was detectable (8.1 and 23.7% respectively) when high salt concentration (4580 and 9350 ppm) were used.

Keywords : Grain-sorghum ; Salinity ; Hybrid ; Sulfur-fertilization ; Fodder-sorghum

INTRODUCTION

Sorghum grain is used primarily as a livestock feed but it is also utilized in manufacture of starch, alcohol, dextrose sugar, edible oil and gluten. Sorghum is also used for pasture, silage fodder and green feeding purposes. Sorghum is one of the most important food crops in the semiarid tropics, as it can be grown successfully under dry and hot conditions that are unsatisfactory for other cereals . Sorghum has undergone a substantial modification in adaptation, morphology and performance since it was first introduce as a forage crop. The full extent of sorghum's adaptation may not as yet be fully realized in new reclaimed areas of production, because of lack of experience with crop and associated uncertainties, there is less incentive to try sorghum. Interest have been concentrated on sorghum since sorghum grows well on a wide variety of soil types. Sorghum can be grown successfully on soil too alkaline for most other crops. One of the major problems in new reclaimed area is the low quality of irrigation water due to salinity. Salinity delayed germination and reduce germination percentage (Suchato *et al*, 1995 and Macharia *et al*, 1995), also, shoot length, root dry matter, root hair number / radicle were decreased as salinity increased (Hassanein and Azab, 1990 and Khan *et al*, 1990). Significant reductions in plant height (Azhar and McNeilly, 1989), leaf number, leaf area, dry weight of leaves, leaf growth (Yang *et al*, 1990), and fresh and dry biomass production (Fernandes *et al*, 1994). under such salinity circumstance, yield / plant decreased linearly with increasing salinity ranging from 8.65 to 46.18%, whilst hybrids that showed the least percentage decrease in yield at all salinity levels accumulated low level of sodium and high levels of potassium (Roa *et al.*, 1988 and Richter *et al*, 1995). Therefore, continued improvement in sorghum may elevate its status as a food in region considered low out yielded potentials areas. There were significant differences between tolerant and susceptible genotype sorghum (Fouman and Hervan, 1992). Tolerance was evaluated at emergence and seedlings stages by seedlings emergence rate, whereas, variation was found in sorghum hybrids and cultivars (Pang *et al*, 1994). Because of variation in sorghum hybrids in salt tolerance, it was found that at 8 ds/m sorghum produced only 65% of dry matter produced under normal conditions (Richter *et al.*, 1995). Greater salt tolerance hybrids indicated the presence of mechanism controlling transport from medium to shoots, also, species and cultivars with higher RGR were less tolerant of salinity than those of with lower RGR (Petrov-Spiridonov and Rybkina, 1990). The traits most affected by salinity were grain yield, number of grain /spike, shoot dry weight, harvest index (Igartua *et al*, 1995), whereas, increasing salt concentration decreased alpha-amylase and protease activity, the rate of reserve protein mobilization and amino acids content (Khan *et al*, 1989). Also leaf nitrate reductase activity decreased with increasing in salinity levels (Kumari and Pillai, 1993). Giving sulfur fertilizers increased grain and stover yields, whereas, yields were highest at the highest rate of 60 kg S /ha. Total uptakes of N, P, K, S, and Mg were generally increased by applied sulfur (Deshmukh *et al.*, 1992; Dhanoji *et al.*, 1994 and Denic *et al.*, 1996).

Grain sorghum is a potential crop for moderately saline areas, having been identified as fairly tolerant to salinity, and shown to contain intraspecific variability for that trait. For calcareous soils, high in $CaCO_3$, elemental sulfur may prove beneficial; its biochemical oxidation may decrease soil pH and solubilize $CaCO_3$ to make soil conditions favourable for plant growth. Agronomist try to overcome the reduction occurred because of using saline water in irrigation , that is mean, the percentage of reduction should be as low as possible, in addition, the limit of salinity used which cause an economical losses in yield should be considered, that may help agronomists to take decisions concerning cultivation of such crop under condition of Ras-Sedr region.Therefore, this investigation proposed to study response of some new released sorghum hybrids to sulfur fertilization irrigated with saline water in calcareous soil at Ras Sedr region, South Sinia Governorate.

MATERIALS AND METHODS

Plant materials

Seeds of two different sorghum hybrids (Mena and Horus) were used in the present investigation. Seeds were sown on 1st June in 2001 and 2002 seasons at Ras Sedr Experimental Station, Desert Research Center (DRC), South Sinia Governorate. Physical and chemical properties of the experimental soil were determined at three different depths (0-20 , 20-40 and 40-60 cm) before sowing (Table 1). Manure was applied to soil surface at rate of 20 m^3 / feddan before plowing. Sulfer fertilizer was broadcasting in each experimental plot according to the treatments. The fertilizer mixed thoroughly with the upper 15 cm of the soil one month before cultivation. All other agricultural practices were applied as recommended in the experimental region.

Table (1) : Physical and chemical properties of experimental soil at Ras Sedr

Physical properties

Depth (cm)	Particle size distribution %				Texture	db (g/cm^3)	Total CaCO3%
	CS	FS	ST	CL			
0-20	9.22	65.83	8.01	16.94	S.L.	1.57	47.20
20-40	11.99	55.92	19.33	12.76	S.L.	1.50	48.57
40-60	10.43	66.75	7. . 1	15.71	S.L.	1.60	47.27

Chemmical properties

Depth (cm)	pH	Ec dsm^{-1}	Ca^{++}	Mg^{++}	Na^+	K^+	$HCO3^-$	Cl^-	cEc
0-20	7.8	6.00	18.14	6.21	35.4	0.71	1.35	32.8	8.10
20-40	8.1	6.50	24.01	9.31	32.0	0.51	1.32	39.2	10.01
40-60	7.9	7.10	40.99	9.51	24.1	0.29	1.21	52.0	7.22

Experimental treatments

Saline irrigation water:

Three different levels of saline water(2970, 4580 and 9350 ppm) pumped from three different wells and the pumped water was transferred through canals to each main plot. Chemical analysis of water pumped from these three wells were determined (Table 2).The dominant cation is Na^+ , meanwhile Cl^- is the dominant anion. According to FAO (1990), the SAR values classify well water into three different groups which were : moderately saline, highly saline and very highly saline for wells 1 , 2 and 3 respectively.

Sulfer fertilizer: Sulfur powder was added at rate of 150, 300 and 450 kg/fed.

Hybrids:

Two different hybrids (Mena and Horus) were used. These hybrids produced by High Tech Company and characterized with grain productivity, also, vegetative mass remain green and palatable for animal at harvest. Therefore, these hybrids are using in agriculture for both grain and forage and were released in Egypt recently at 1999. Their productivity should be investigated under saline irrigation water and calcareous soil.

Data recorded

Samples of five plants each replicate were taken after 75 days from sowing to monitor sorghum plants growth under the investigated treatments.

Table (2) : Chemical analysis of wells water (average of 2001-2002)

Well No	Salt Conc. ppm	pH	Na^+	K^+	Ca^{++}	Mg^{++}	$CO3^-$	$HCO3^-$	Cl^-	SO4	SAR
1	2970	7.8	21.96	0.61	18.27	4.16	0.00	0.29	34.3	13.19	6.35
2	4580	7.8	40.00	2.60	20.00	24.00	0.00	0.30	52.5	33.80	8.53
3	9350	7.9	85.00	3.80	35.00	24.50	0.00	0.50	123.0	43.30	13.70

The following characters were determined:

1- Plant length (cm).
2- Stem diameter (mm).
3- No. of green leaves / plant.
4- No. of stem internodes.
5- Fresh weight of stem and sheets (g).
6- Dry weight of stem and sheets (g).
7- Fresh weight of green blades (g).
8- Dry weight of green blades (g).

At harvest, the following characters were determined:

1- Panicale length (cm).
2- Panicale diameter (mm).
3- 1000 grains weight (g).
4- Grain yield (kg/fed.).
5- Fodder yield (kg/fed.).

Statistical analysis :

Experimental treatments were arranged in split-split blocks design with four replicates,where, irrigation treatment was applied in main plots , hybrids in sub-plot and sulfur fertilization treatments in sub-sub plot. Collected data were subjected to the proper statistical analysis according to Snedecor and Cochran (1969). L.S.D. at level of 5% was used for means comparison according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect of Irrigation water salinity on growth and yield:

All growth and yield characters significantly affected by salinity of irrigation water (Table3). The lowest water salinity level used in irrigation (2970 ppm) gave the greatest values of growth and yield characters, whilst, the greatest water salinity (9350 ppm) gave the lowest values of growth and yield characters. Values of plant length (cm), stem diameter (mm), No. of green leaves / plant , No. of stem internodes, fresh weight of (stem+sheet), dry weight of (stem+sheet), fresh weight of green blades, dry weight of blades, panicale length (cm), panicale diameter(mm), 1000 grain weight(g), grain yield kg/fed. and fodder yield kg/fed. were significantly reduced by percetage of 11.7 & 22.0%, 8.6 & 12.1%%, 0.8 &19.1%, 11.2 &19.4%, 14.2 & 25.1%, 15.9 & 28.6%, 17.1 & 28.3%, 13.5 & 21.9%, 3.3 & 22.6%, 6.4 & 11.0%, 7.7 & 18.0%, 14.2 & 34.5% and 3.1 & 10.8% when salinity of irrigation water increased from 2970 ppm to 4580 ppm and 9350 ppm , respectively . These values show oscillated response due to salinity of irrigation water, whereas, some character showed little affect and others showed greater affect due to water salinity. These findings illustrate that fodder yield was less affected by salinity while the dramatic affect of salinity was observed in grain yield. Panicale characters (length and diameter) which reduce No. of spicklets and flowers per plant, and less grain filling capacity (1000 seed weight) contribute in reducing grain yield as affected by salinity. Increasing soluble salt concentration in soil water will increase the risk of drought injury. In arid regions salts accumulate in the surface horizon, such soil contain a concentration of neutral soluble salts sufficient to seriously interfere with the growth of most plants. When the soil solution of saline soils which contain large amount of dissolved salts is brought into contact with plant cell, it will cause a shrinkage of protoplasmic lining. This shrinkage is termed plasmolysis and can cause the cell to collapse and die (Khan *et al*, 1992).

Effect of hybrid variation on sorghum growth and yield:

Results demonstrated in Table (3) show that both hybrids used in this investigation varied in their tolerant to salinity, whereas, superiority of Horus reached a percentage of 18.4% and 5.5% for grain and fodder yields respectively. At experimental conditions hybrid Horus is more suitable than hybrid Mena. All growth characters recorded (stem length, stem diameter, No. of green leaves /plant, No. of stem internodes, fesh and dry weight of stem + sheet and fresh and dry weight of blades) increased causing increasing in biomass produced by Horus hybrids more than Mena hybrid , consequently, fodder yield increased. Also the increasing biomass may enhance photosynthesis and translocation , these photosynsate accumulate in grain causing an increament in grain yield. Since productivity is the final sum of reaction between genotype and environment conditions, plants performe differently in same environmental conditions according to their differences in genotype. At such environmental conditions in experimental site i.e. unfertile soil, saline irrigation water and high temperature of desert causing high evapotranspiration, genotype is consider a break point in plant productivity.

Table (3) :Growth and yield of sorghum plants as affected by salinity of irrigation water, hybrid and sulfur application.

Treatments	Growth characters								Yield characters				
	Plant length (cm)	Stem diameter (mm)	No of Green leaves /plant	No of Stem inter-nodes	Fresh weight of stem + heets (g)	Dry weight of stem + heets (g)	Fresh weight of green blades (g)	Dry weight of green blades (g)	Panicale length (cm)	Panicale diameter (mm)	1000 grain weight (g)	Grain yield (kg/fed)	Fodder yield (kg/fed)
Salinity(ppm)													
2970	81.4	11.6	7.65	7.74	38.6	9.42	13.37	5.62	16.22	35.45	33.8	810.4	1400.3
4580	71.9	10.6	7.71	6.87	33.1	7.74	11.08	4.86	15.68	33.19	31.2	695.6	1356.3
9350	63.5	10.2	6.24	6.24	28.9	6.73	9.59	4.39	12.56	31.54	27.7	531.2	1248.7
LSD (5%)	2.25	0.27	0.36	0.33	0.82	0.22	0.13	0.12	0.89	1.09	0.74	5.75	11.90
Hybrid													
Mena	69.0	10.6	7.26	6.65	32.1	7.63	10.39	4.76	13.94	32.73	29.8	621.8	1299.6
Horus	75.5	11.0	7.15	7.25	34.9	8.29	11.76	5.16	14.86	34.06	32.0	736.3	1370.5
F- test	S	S	S	S	S	S	S	S	S	S	S	S	S
Sulfur (kg/fed)													
150	64.4	10.2	6.46	6.53	28.5	7.35	9.71	3.87	12.20	30.89	27.4	515.2	1235.0
300	74.1	10.8	6.97	6.92	34.2	8.01	11.42	5.29	14.96	33.87	31.6	717.9	1344.8
450	78.2	11.4	7.40	7.41	37.9	8.52	12.91	5.71	16.03	35.37	33.8	804.2	1425.5
LSD (5%)	0.54	0.14	0.16	0.12	0.48	0.09	0.32	0.08	0.16	0.40	0.42	3.50	7.00

Effect of sulfur application on growth and yield:

Decline in productivity of sorghum as affected by salt and low fertile soil conditions is expected, applying sulfur fertilization is recommended to overcome such reduction. Data presented in Table (3) show that all characters recorded increased consequently as sulfur fertilizer increased. Promising growth characters and grain and fodder yields were noticed as the maximum amount of sulfur fertlizer (450 kg /fed.) was used. Grain yield increased by 39.34% and 12.02% , while fodder yield increased by 8.89% and 6.00% as sulfur fertilizer increased from 150 to 300 kg/fed. and 450 kg/fed, respectively. Sulfur is often associated with minerals which show deficiencies because of leaching in sandy soils. These deficiencies can usually be corrected by applying sulfur fertilizers. The effect of sulfur on increasing plant growth and yield my be due to one or more of the following reasons; 1) Reducing soil pH values through its oxidation to sulphuric acid by soil microorganisms, 2) Reducing soil salinity through increasing the solubility of ions along with increasing the infiltration rate of the soil, consequently, more soluble salts will have the chance to be moved downward by the following irrigation (Alawi *et al.*, 1980 and El-Maghraby *et al.*, 1996) . As a result of reducing soil pH and EC values, the plants will have better environmental conditions to grow under relatively low stress conditions. 3) Increasing nutrients availability to the plant (Walace and Mueller 1978). The highly content of CaCo3 and totall solubale salts as well as specific ions affect either Na^{+} or Cl^{-} ions in this soil leding to minimize the productivity of such soil. So using elemental sulfur as a soil amendment was considered to control the harmful effects of saline.

Effect of salinity and sorghum hybrids interaction:

It is noticable that Horus hybrid irrigated with water contained lowest salt conc. (2970 ppm) gave higher values of all studied characters (Table 4). These findings were found with the higher salt concentration used (4580 ppm and 9350 ppm). The greatest values of grain and fodder yields were obtained of hybrid Horus under the lowest salt concentration used. While the lowest values were that of both Mena hybrid irrigated with water contained 9350 ppm salt.Most of interaction between salinity and hybrids gave non-significant values except those of plant length, No of stem internodes, dry weight of stem + sheets and yields of grain and fodder. Salt tolerante genotypes use energy to exclude or sequester salt, thereby maintaining a reasonably low salt concentration in the cytoplasm of their cells. Use of energy for this purpose will ultimately cost the plant in the form of lower yields.

Effect of salinity and sulfur interaction:

Increasing sulfur fertilizer to the maximum level used in this investigation show significant enhancement in all growth and yield characters at all level of salinity used. However, the most pronounced values of growth and yield traits were observed with adding the maximum sulfur fertilizer (450 kg/fed) and irrigated with water contained the lowest salt conc. (2970 ppm). Such treatment gave the highest growth parameters if compared with other treatments, accordingly, the greatest grain and fodder yield were obtained when such treatment was applied (Table 5).

Table (4): Growth and yield of sorghum plants as affected by interaction between salinity of irrigation water and hybrids

Treatment		Growth characters								Yield characters				
Salinity (ppm)	Hybrid	Plant length (cm)	Stem diameter (mm)	No. of Green leaves /plant	No. of Stem inter-nodes	Fresh weight of stem + sheet (g)	Dry weight of stem + sheet (g)	Fresh weight of blades (g)	Dry weight of blades (g)	Panicale length (cm)	Panicale diameter (mm)	1000 grain weight (g)	Grain yield (kg/fed)	Fodder yield (kg/fed)
2970	Mena	76.8	11.3	7.42	7.29	37.5	8.89	5.42	15.90	34.65	33.1	773.1	1381.3	12.81
	Horus	86.0	11.9	7.89	8.19	39.8	9.95	5.82	16.53	36.24	34.5	847.7	1419.3	13.93
4580	Mena	69.7	10.5	6.74	6.65	31.8	7.60	4.67	14.01	32.70	29.8	628.5	1345.0	10.64
	Horus	74.2	10.8	7.15	7.08	34.3	7.87	5.04	14.82	33.69	32.7	762.7	1367.5	11.32
9350	Mena	60.6	10.0	6.08	6.00	27.1	6.39	4.18	11.90	30.83	26.5	463.8	1172.6	9.14
	Horus	66.3	10.4	6.40	6.48	30.7	7.06	4.61	13.23	32.25	28.9	598.6	1324.8	10.03
LSD (5%)		2.48	NS	NS	0.27	NS	0.23	NS	NS	NS	NS	NS	6.19	13.03

Table (5) : Growth and yield of sorghum plants as affected by interaction between salinity of irrigation water and sulfur application.

Treatment		Growth characters								Yield characters				
Salinity (ppm)	Sulfur (Kg/fed)	Plant lenght (cm)	Stem diameter (mm)	No. of Green leaves /plant	No. of Stem inter-nodes	Fresh weight of stem + sheet (g)	Dry weight of stem + sheet (g)	Fresh weight of blades (g)	Dry weight of blades (g)	Panicale length (cm)	Panicale diameter (mm)	1000 grain weight (g)	Grain yield (kg/fed)	Fodder yield (kg/fed)
2970	150	76.4	10.84	6.96	7.31	35.1	8.70	4.24	13.60	32.12	29.75	617.6	1301.6	11.02
	300	81.9	11.58	7.74	7.65	38.8	9.46	5.99	17.03	36.40	34.75	868.5	1416.0	13.82
	450	86.0	12.41	8.26	8.26	42.1	10.10	6.62	18.01	37.82	36.95	945.1	1483.3	15.26
4580	150	61.9	10.16	6.64	6.47	27.4	7.31	3.90	12.46	30.79	27.85	498.5	1249.7	9.52
	300	74.8	10.69	6.90	6.87	34.1	7.70	5.22	14.88	33.50	31.70	771.3	1360.0	10.66
	450	79.1	11.06	7.28	7.26	37.7	8.19	5.44	15.90	35.13	34.20	817.0	1459.1	12.85
9350	150	55.0	9.77	5.78	5.80	22.9	6.05	3.47	10.55	29.75	24.50	429.5	1153.8	8.59
	300	65.8	10.20	6.26	6.22	29.6	6.85	4.64	12.96	31.71	28.25	513.7	1258.4	9.55
	450	69.6	10.74	6.67	6.70	34.0	7.27	5.07	14.17	33.16	30.40	650.3	1334.0	10.61
LSD (5%)		0.94	0.24	0.26	NS	0.64	0.17	0.55	0.14	0.26	0.70	NS	6.07	12.13

Greater decline was observed in values of all growth and yield characters when sorghum was irrigated with water contiained higher levels of salts (4580 ppm) and (9350 ppm). Meanwhile, increasing amounts of applied sulfur from 150 to 300 and 450 kg/fed under all levels of saline water caused consequent increament in all growth and yield characters. It could be concluded that applying sulfur fertilizer reduced the harmful effects of salt on sorghum plant causing growth to be improved and helps plant to tolerate the bad effects of salinity and therefore, yield under these circumistances increased. Sorghum plants received 450 kg/fed and irrigated with water contained the lowest salt conc. (2970 ppm) gave the maximum grain and fodder yields of 945.1 and 1483.3 kg/fed, respectively. Salinity tolerance is a complex whole plant characteristic with physiological and biochemical functions controlled by numerous gene, moreover, environmental and soil factors heavily influence its expression. Applying sulfur fetilizers enable plant to tolerate salinity since such application enhance growth and help plants to produce more energy needed to overcome the dramatic effects of salinity.

Effect of sorghum hybrid and sulfur fertilizer Interaction:

Horus hybrid shows superiority in all characters studied above Mena hybrid under all levels of sulfur application, however, most of these differences did not reach the level of significance except plant length. No of stem internodes, fresh weight of (stem + sheet) and grain yield kg/fed (Table 6). The higher grain yield was obtained of Horus hybrid received 450 kg S/fed. Horus hybrid is chracterized with higher plant length, and fresh and dry weights of (stem+sheet), therefore, such superiority make Horus hybrid gave higher yield of grain as well if compared with Mena hybrid.

Effect of irrigation water salinity, sorghum hybrid and sulfur fertilizer interaction:

Data presented in Table (7) show that the distinguished growth and yield characters were that of hybrid Horus when fertilized with the maximum sulfur amount used (450 kg/fed) and irrigated with moderatly saline water (2970 ppm). It is noticeable that Irrigation with water contained gradual increasing of salt concentration (4580 ppm) and (9350 ppm) caused all growth and yield characters to be gradually decreased for both hybrids used at all levels of sulfur fertilization. Also gradual increase of sulfur fertilization from 150 kg S/fed to 300 kg/fed and 450 kg s/fed caused gradual increase of growth and yield characters for both hybrid used , that was true at all levels of saline water used to irrigate sorghum plant (2970 , 4580 and 9350 ppm). The reduction occurred when hybrid Horus fertilized with 450 kg S/fed and irrigated with water salinity increased from 2970 ppm to 4580 ppm and 9350 ppm were 8.1% and 23.7% for grain yields and 1.8% and 6.5% for fodder yields, respectively. It is noticeable that the reduction occurred in fodder yields of both hybrids due to increasing salt concentration up to 4580 ppm and 9350 ppm was little and could be neglictable under condition of Ras Sedr, whereas, water available always contain high salt concentration even when maximum sulfur fertilizer (450 kg/fed) was applied, these reductions may not cause economical losses in fodder yield.

Table (6) :Growth and yield of sorghum plants as affected by interaction between hybrid and sulfur application.

Treatment		Growth characters								Yield characters				
Hybrid	Sulfur (kg/fed)	Plant lenght (cm)	Stem diameter (mm)	No. of Green leaves /plant	No. of Sem Inter-nodes	Fresh weight of stem + sheet (g)	Dry weight of stem + sheet (g)	Fresh weight of blades (g)	Dry weight of blades (g)	Panicale length (cm)	Panicale diameter (mm)	1000 grain weight (g)	Grain yield (kg/fed)	Fodder yield (kg/fed)
Mena	150	61.8	10.12	6.26	6.28	26.47	7.08	3.70	11.69	30.28	26.3	489.1	1195.6	9.43
	300	70.7	10.62	6.82	6.65	32.88	7.66	5.10	14.52	33.30	30.5	638.7	1309.1	10.84
	450	74.6	11.13	7.16	7.01	37.08	8.14	5.47	15.60	34.50	32.6	739.7	1394.3	12.52
Horus	150	67.1	10.40	6.67	6.78	30.50	7.63	4.04	12.72	31.49	28.4	541.3	1274.5	9.99
	300	77.6	11.03	7.12	7.17	35.47	8.35	5.47	15.40	34.44	32.6	797.0	1380.5	11.99
	450	81.9	11.68	7.65	7.81	38.81	8.91	5.95	16.46	36.25	35.1	870.7	1456.7	13.30
LSD (5%)		0.77	NS	NS	0.17	0.68	NS	NS	NS	NS	NS	NS	4.95	NS

Table (7) : Growth and yield of sorghum plants as affected by interaction between salinity of irrigation water, hybrid and sulfur application.

Treatment			Growth characters								Yield characters				
Salinity (ppm)	Hybrid	Sulfur kg/fed	Plant lenght (cm)	Stem diameter (mm)	No.of Green leaves /plant	No.of Stem Inter-node	Fresh weight of stem + sheet (g)	Dry weight of stem +sheet (g)	Dry weight of blades (g)	Fresh weight of blades (g)	Panicale length (cm)	Panicale diameter (mm)	1000 grain weight (g)	Grain yield (kg/fed)	Fodder yield (kg/fed)
2970	Mena	150	71.1	10.76	6.73	6.91	8.39	33.93	4.11	10.58	13.68	31.34	29.1	611.3	1282.1
		300	76.7	11.25	7.62	7.22	8.94	37.27	5.80	13.06	16.56	35.61	34.4	791.8	1393.3
		450	82.6	11.90	7.91	7.76	9.34	41.31	6.35	14.78	17.45	37.01	35.8	916.3	1468.6
	Horus	150	81.8	10.89	7.20	7.72	9.01	36.28	4.38	11.46	13.53	32.90	30.4	624.0	1321.1
		300	87.0	11.91	7.86	8.08	9.98	40.28	6.18	14.58	17.50	37.19	35.1	945.2	1438.7
		450	89.4	12.93	8.61	8.77	10.87	42.86	6.90	15.75	18.57	38.64	38.1	974.0	1498.1
4580	Mena	150	60.9	9.99	6.47	6.36	7.25	25.45	3.72	9.60	11.85	30.24	26.9	452.4	1224.9
		300	72.4	10.56	6.73	6.67	7.50	33.14	5.09	10.27	14.58	33.21	29.8	694.4	1363.7
		450	75.7	10.95	6.02	6.93	8.06	38.96	5.21	12.15	15.61	34.33	32.7	738.8	1446.5
	Horus	150	62.9	10.34	6.82	6.59	7.37	29.49	4.09	9.44	13.07	31.34	28.8	544.6	1274.6
		300	77.2	10.82	7.08	7.08	7.91	35.01	5.36	11.46	15.19	33.80	33.6	848.3	1358.3
		450	82.4	11.17	7.54	7.59	8.33	38.44	5.68	13.05	16.19	35.93	35.7	895.2	1471.8
9350	Mena	150	53.3	9.56	5.59	5.58	5.60	20.09	3.28	8.12	9.54	29.26	22.9	403.6	1079.9
		300	63.0	10.06	6.11	6.10	6.55	28.24	4.41	9.18	12.42	31.09	27.4	430.0	1170.3
		450	65.4	10.53	6.54	6.34	7.02	32.95	4.86	10.13	13.73	32.15	29.2	557.9	1267.7
	Horus	150	56.7	9.98	6.98	6.03	6.50	25.76	3.68	9.07	11.56	30.24	26.1	455.4	1227.7
		300	68.5	10.35	6.42	6.35	7.16	31.10	4.88	9.93	13.51	32.34	29.1	597.5	1346.6
		450	73.1	10.95	6.80	7.07	7.53	35.13	5.28	11.10	14.61	34.17	31.6	742.8	1400.3
LSD (5%)			1.33	0.34	NS	NS	1.18	0.24	NS	NS	NS	NS	0.40	NS	1.03

On the other hand, reduction occurred in grain yields of same treatments whereas,were dectable especially when high salt concentration (9350 ppm) was used, this may be due to the remarkable dramatic effect of salt upon flowering, pollination, seed fertilization and seed set rather than the bad effects occurred during growth.

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إنتاجية هجينين من السورجم تحت مستويات مختلفة من ملوحة ماء الري وإضافة الكبريت في جنوب سيناء.

خالد طةالأفندي[1]- أشرف ماهر عبد الغني[2]- إسماعيل علي عاشور[3] - عبد العزيز محمد طلعت[1]
١- قسم الانتاج النباتي- مركز بحوث الصحراء - القاهرة - جمهورية مصر العربية
٢- قسم المحاصيل - كلية الزراعة - جامعة عين شمس - القاهرة - جمهورية مصر العربية
٣- قسم صيانة الأراضي - مركز بحوث الصحراء - القاهرة - جمهورية مصر العربية
٤- قسم كمياء و طبيعة الأراضي - مركز بحوث الصحراء - القاهرة - جمهورية مصر العربية

أستخدم في هذا البحث هجينين من السورجم هما مينا ، حورس وهما من الهجن التي تستخدم في إنتاج الحبوب والعلف الأخضر وزرعت البذور في الأول من يونيو عامي ٢٠٠١ و ٢٠٠٢ بمحطة بحوث رأس سدر - مركز بحوث الصحراء بجنوب سيناء . أستخدمت مياه ثلاثة آبار مختلفة ذات ثلاثة تركيزات مختلفة من الملوحة وهي ٢٩٧٠ ، ٤٥٨٠ ، ٩٣٥٠ جزء في المليون . وثلاثة مستويات من التسميد الكبريتي هي ١٥٠ ، ٣٠٠ ، ٤٥٠ كجم مسحوق كبريت / فدان.

أشارت النتائج إلى تأثر محصول الحبوب بدرجة أكبر من محصول العلف الأخضر بملوحة ماءالري حيث أنخفض بنسبة ١٤,٢% عندما أرتفعت ملوحة ماء الري إلى تركيز ٤٥٨٠ جزء في المليون بينما وصل هذا الإنخفاض إلى نسبة ٣٤,٥% عندما أرتفعت ملوحة الماء الري إلى ٩٣٥٠ جزء في المليون . وفي المقابل انخفض محصول العلف الأخضر بنسبة ٣,١ و ١٠,٨% تحت مستويات الملوحة نفسها على التوالي .

أختلف تحمل الهجن المستخدمة في هذة التجربة لملوحة ماء الري حيث أظهر الهجين "حورس" تفوقاً في تحمل الملوحة . زادت كل الصفات المدروسة الخاصة بالهجين "حورس" زيادة معنوية عن الهجين "مينا" حيث وصل تفوق هذا الهجين إلى نسبة ١٨,٤% ، ٥,٥% لمحصول الحبوب والعلف الأخضر على التوالي . أدى زيادة إضافة سماد مسحوق الكبريت من كمية ١٥٠ كجم إلى ٣٠٠ كجم و ٤٥٠ كجم إلى زيادة محصول البذور بنسبة ٣٩,٣٤% ، ١٢,٠١% وإلى زيادة محصول العلف بنسبة ٨,٨٩% ، ٦,٠٠% على التوالي . كما أدت إضافة أعلى كمية سماد كبريتي ٤٥٠ كجم/ فدان وإستخدام ماء ري يحتوي على أقل تركيز ٢٩٧٠ جزء في المليون إلى تفوق في نمو ومحصول السورجم . كما تميز الهجين "حورس" بارتفاع طول الساق وقطر الساق والوزن الغض والجاف (للساق+الأغلفة) ومحصول العلف الأخضر ومحصول الحبوب إذا ما قورن بالهجين "مينا" تحت كل مستويات التسميد الكبريتي . أنة من الواضح أن الإنخفاض الحادث للهجين حورس تحت مستوى ٤٥٠ كجم كبريت / فدان في محصول العلف الأخضر نتيجة لزيادة ملوحة ماء الري إلى ٤٥٨٠ ، ٩٣٥٠ جزء في المليون كان قليلا (١,٨ و ٦,٥ % على التوالي) ومقبولا تحت ظروف منطقة رأس سدر حيث أن المياة المتوفرة بها نسبة عالية من الأملاح . هذا الإنخفاض القليل قد لا يسبب خسارة إقتصادية واضحة بينما في المقابل كان إنخفاض محصول الحبوب واضحا (٨,١ و ٢٣,٧% على التوالي) خاصة عندما أستخدم ماء ري يحتوي على أعلى تركيز للأملاح (٩٣٥٠ جزء في المليون).