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CULTIVATION OF GRAIN SORGHUM UNDER SALINE CONDITIONS IN SOUTH SINAI GOVERNORATE

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ABSTRACT

Two field experiments were carried out during 1998 and 1999 seasons at Beer Abou-Kalam Experimental Farm, Tour Sinai, South Sinai Governorate, Egypt. The investigation aimed to study the effect of different irrigation intervals (3, 6, 12 and 15 days) with underground saline water (about 2800 ppm) and nitrogen fertilizer rates (0, 60, 90 and 120 kg N/fed.) on yield and its related characters as well as grain chemical composition of grain sorghum [*Sorghum bicolor* (*L*.) Moench] cultivar Giza-15. The following results were obtained :

Prolonging irrigation intervals from 6 up to 15 days decreased significantly, at both seasons, 100-grain weight, grain and biological yields per feddan as well as the harvest index. Such depressive effect was increasingly prominent with increasing the period of water withholding. A similar tendency could be noticed regarding total carbohydrate and crude protein contents in grain, leading to a reduction in the yield of each constituent per feddan.

The present results have shown that yield and its components as well as the chemical composition of grains were significantly decreased by increasing N application rates to 90 and 120 kg N/fed. Due to the ineffective role of higher N doses in substituting for yield losses under water stress conditions, it could be concluded that medium nitrogen fertilizer rate (60 kg N/fed.) connected with a narrow irrigation intervals (i.e., irrigating every 3 days) are most favourable and economical for cultivating grain sorghum under the saline conditions of South Sinai.

INTRODUCTION

In arid and semi-arid agronomic regions of the world, alternative sources of irrigation water such as saline wastewater from industrial sources, underground water and agricultural drainage water, will become increasingly important as effective management strategies for their use are developed (Ulery and Ernst, 1997). In Egypt, there has been an increasing interest to cultivate the surrounding desert area which characterized mostly with low rain full, insufficient fertile land and high salinity levels in soil and irrigation water. South Sinai, in fact, is suffering from both salt-affected soils along with saline underground water used for irrigation. Many plant species, including crop plants, grow overall the world under such unfavourable conditions with a reasonable degree of success. Among them is *Sorghum bicolor L*. This species is known to be a rain-dependant crop in Asia and Africa (Harlan, 1971). Responses of grain sorghum to different ecological factors were investigated before and considered as water deficit tolerant plant (Hajar *et al*., 1997) and moderately tolerant to salinity (Mass and Hoffman, 1977 and Francois *et al*., 1984). However, previous studies have demonstrated that sorghum respond to salinity differently at various stages of growth. For example, Mass *et al*. (1986) showed that sorghum was most sensitive to salinity during the vegetative stage and least sensitive during maturation. They concluded that saline water could be applied after flowering without reducing yields, provided that nonsaline water is used during vegetative and early reproductive growth. Further studies (Ulery and Ernst, 1997) indicated that sorghum grain yield and plant height are reduced by saline water applied during the emergence, vegetative and reproductive growth stages, but were not affected by saline irrigation applied during the grain-filling stage. On the other hand, results documented on the response of sorghum to the applied N under variable stress conditions are inconsistent, ranging from positive effects (Ragheb and El-Nagar, 1997) to negative or no response (Goh and Haynes, 1986).

Owing to the conflicting results reported on this subject and to the shortage of available information about crop management under saline conditions, the present work was carried out to study the response of sorghum to both nitrogen fertilizer rates and irrigation intervals under saline conditions of South Sinai region.

MATERIALS AND METHODS

Two field experiments were conducted at Beer Abou-Kalam Experimental Farm, Tour-Sinai, South Sinai Governorate, Egypt during the two successive seasons of 1998 and 1999. The aim was to study the effect of different irrigation intervals with underground saline water (about 2800 ppm) and nitrogen fertilizer rates on grain yield and its related characters as well as the chemical composition of sorghum grains. Each experiment included 16 treatments which were the combination of four irrigation intervals (3, 6, 12 and 15 days) and four nitrogen levels (0, 60, 90 and 120 kg N/fed.). The experimental design was split-plot in four replications. The irrigation intervals were arranged in the main plots, whereas the nitrogen rates were assigned in the sub-plots which was 10.5 m^2 (3 x 3.5 m) and consisted of 5 ridges (3.5 m in length and 0.6 m apart). The texture of soil was sandy in both seasons. Another experimental site, at the same location, was chosen in the second season to avoid salt-accumulation effects. The mechanical and chemical analysis of the experimental soil sites as well as the chemical analysis of the underground water used for irrigation were performed according to Jackson (1958), Chapman and Prati (1961) methods. Results of the analysis are presented in Tables (1 - 3).

Seeds of sorghum [*Sorghum bicolor* (*L*.) Moench] cultivar Giza-15 were sown on 10^{th} and 15^{th} May in the first and second season, respectively. Organic manure and calcium superphosphate (15.5 % P_2O_5) were added during soil preparation at the rate of 25 m^3 and 150 kg superphosphate/fed., respectively. Nitrogen fertilizer was added in the form of ammonium nitrate (33.5 % N) in two equal portions after 20 and 40 days from sowing. The normal agricultural practices for growing grain sorghum were followed as recommended in the region.

At harvest time, after 120 days from sowing, the outer two rows were left to eliminate any border effects and the remaining ones were used for determining the yield and its components i.e. grain and biological yields/fed., 100-grain weight and harvest index. Total carbohydrate content in the harvested grains was determined using the method adopted by Dubois *et al*., (1956). Crude protein was measured on dry weight basis according to the method described by A.O.A.C. (1982), then total carbohydrate and protein yield per feddan were calculated. Results of both seasons were subjected to the statistical analysis of variance according to the procedures of Gomez and Gomez (1984), the treatment means were compared by using L.S.D. test at 5 % level of significance.

Table (1) : Mechanical analysis of the soil at Beer-Abou-Kalam Experimental Station, Tour Sinai, South Sinai Governorate (Mean of two seasons).

Depth (cm)	Particle size distribution %				Texture class
	Coarse sand	Fine sand	Silt	Clay	
0 – 30	50.2	32.7	9.1	8.0	Sand
30 – 60	43.1	40.0	10.5	6.4	Sand

Table (2) : Chemical analysis of the soil at Beer Abou-Kalam Experimental Station, Tour Sinai, South Sinai Governorate (Mean of two seasons).

Depth (cm)	E.C. mmhos /cm.	pH	Macro-nutrients (meq/100 g soil)			Micro-nutrients (ppm)				O.M %	$CaCO_3$ %
			K	Na	Mg	Fe	Mu	Zn	Cu		
0-30	5.57	8.4	0.37	21.1	0.49	1.7	1.2	1.0	Traces	0.88	14.3
30-60	5.92	8.9	0.43	22.4	0.43	1.5	1.1	1.1	Traces	0.76	12.7

Table (3) : Chemical analysis of irrigation water at Beer Abou-Kalam Experimental Station, Tour Sinai, South Sinai Governorate (Mean of two Seasons).

Salinity		pH	Cations (meq/L)				Anions (meq/L)			Adj. SAR
E.C. mmhos/cm	Ppm		Na^+	K^+	Ca^{++}	Mg^{++}	Cl^-	SO_4^{--}	$HCO_2^- + CO_3^{--}$	
3.66	2842	8.1	9.3	0.6	3.5	1.1	9.0	4.1	1.4	9.1

RESULTS AND DISCUSSION

1. Effect on yield and its attributes :

Data presented in Table (4) clearly show that prolonging the intervals between successive irrigations from 6 up to 15 days led, at both seasons, to a consistent significant decline in 100-grain weight, grain and biological yields/fed. and consequently the harvest index. Such depressive effect was increasingly prominent with increasing the period of water withholding. So, grain yield/fed. was decreased than those irrigated every 3 days by about 18 %, 50 % and 59 % in the first season; 8%, 38 % and 56 % in the second one for irrigating sorghum plants every 6, 12 and 15 days, respectively. These results might correspond with the findings of El-Bagoury *et al*., (1984), Ragheb and El-Nagar (1997). The reduction in sorghum grain yield as a result of extending the irrigation intervals could be attributed mainly to the harmful effect of water deficit on growth of sorghum plants (Hajar *et al*., 1997), the reduction in ion uptake (Tanguiling *et al*., 1987) and/or the inhibition of photosynthetic activity (Kramer and Boyer, 1995). In support of such explanation, Eck and Musick (1979) showed that in sorghum, nutrient uptake was suppressed as soon as dry matter accumulation was inhibited. Thus, the final concentration of nutrient elements in the tissue depended on whether the decrease in uptake was greater or less than the decrease in dry matter accumulation. The expected result of ion uptake ceasing is the impairment of N metabolism and the translocation of photosynthate from leaf to grain (Jordan, 1993).

Table (4) : Effect of irrigation intervals and nitrogen fertilizer rates on grain sorghum plants grown under saline conditions in South Sinai.

Irrigation intervals in days	First season: Nitrogen fertilizer rates kg/fed.				Mean	Second season: Nitrogen fertilizer rates kg/fed.				Mean
	0	60	90	120		0	60	90	120	
100 grain weight (g)										
3	2.58	2.92	2.42	1.98	2.48	2.69	2.97	2.12	1.98	2.44
6	2.16	2.53	2.15	1.85	2.17	2.21	2.88	1.95	1.86	2.23
12	1.89	2.30	1.82	1.74	1.94	1.98	2.23	1.79	1.65	1.91
15	1.68	1.83	1.58	1.53	1.66	1.57	1.75	1.47	1.45	1.2
Mean	2.08	2.4	1.99	1.78		2.11	2.46	1.83	1.74	
L.S.D.	I = 0.3	N = 0.6	I X N = 0.5	I = 0.2	N = 0.3	I X N = 0.7				
Grain yield (kg/fed.)										
3	279	320	273	199	267.8	300	335	240	200	268.8
6	210	280	210	184	221	283	309	205	190	246.8
12	104	190	127	112	133.3	198	220	134	112	166
15	95	129	109	104	109.3	112	134	120	103	117.3
Mean	172.8	229.8	149.8	149.8		223.3	249.5	174.8	151.3	
L.S.D.	I = 25.7	N = 20.9	I X N = 50.4		I = 20	N = 23	I X N = 53.2			
Biological yield (kg/fed.										
3	935	1527	1221	978	1145.3	842	1395	1236	985	1114.5
6	819	1249	928	843	959.8	782	1083	997	895	939.3
12	703	889	718	702	753	675	944	886	753	814.5
15	675	785	744	682	721.5	642	879	824	672	754.3
Mean	783	1062.5	902.8	801		735.3	1075.3	985.8	826.3	
L.S.D.	I = 105	N = 98		I X N = 26		I = 60	N = 83	I X N = 56		
Harvest index										
3	0.3	0.22	0.22	0.2	0.24	0.36	0.24	0.19	0.2	0.25
6	0.26	0.22	0.23	0.22	0.23	0.36	0.29	0.21	0.21	0.27
12	0.15	0.21	0.18	0.16	0.18	0.29	0.23	0.15	0.15	0.21
15	0.14	0.16	0.15	0.15	0.15	0.17	0.15	0.15	0.15	0.16
Mean	0.21	0.2	0.2	0.18		0.3	0.23	0.18	0.18	
L.S.D.	I = 0.05	N = 0.02		I X N = 0.02		I = 0.05	N = 0.03	I X N = 0.04		

I = Irrigation intervals, N = Nitrogen rate, L.S.D. at 5 % level of significance.

Table (5) : Effect of irrigation intervals and nitrogen fertilizer rates on grain chemical composition of sorghum plants grown under saline conditions in South Sinai.

Irrigation intervals in days	First season					Second season				
	Nitrogen fertilizer rates kg/fed.				Mean	Nitrogen fertilizer rates kg/fed.				Mean
	0	60	90	120		0	60	90	120	
Crude protein %										
3	10.35	11.22	10.67	10.34	10.65	10.62	11.75	10.73	10.54	10.91
6	9.82	10.25	9.85	9.62	9.89	10.45	10.92	10.35	10.22	10.49
12	9.34	9.82	9.42	9.33	9.48	10.13	10.82	10.42	10.20	10.39
15	9.00	9.55	9.35	9.22	9.28	9.22	9.31	9.13	9.00	9.17
Mean	9.63	10.21	9.82	9.63	10.11		10.70	10.16	9.99	
L.S.D.	I = 0.20 N = 0.18 I X N = 0.12					I = 1.20 N = 0.15 I X N = 0.22				
Total carbohydrate %										
3	76.50	76.90	75.60	75.30	76.08	76.90	77.80	76.20	75.80	76.68
6	75.40	75.80	74.70	73.90	74.95	75.80	76.20	73.70	73.40	74.78
12	74.20	74.90	73.70	73.50	74.08	74.90	75.80	73.50	72.90	74.28
15	73.90	74.40	73.50	73.30	73.78	74.30	74.90	73.20	72.00	73.60
Mean	75.00	75.50	74.38	74.00		75.48	76.18	74.15	73.53	
L.S.D.	I = 0.20 N = 1.20 I X N = 0.40					I = 0.52 N = 0.44 I X N = 1.30				
Protein yield (kg/fed.)										
3	28.88	35.90	29.13	20.58	28.62	31.86	39.36	25.75	21.08	29.51
6	20.62	28.70	20.68	17.70	21.92	29.57	33.74	21.22	19.42	25.98
12	9.71	18.65	11.96	10.45	12.69	20.06	23.80	13.96	11.42	17.31
15	8.55	12.32	10.19	9.58	10.16	10.33	12.48	10.96	9.27	10.76
Mean	16.94	23.89	17.99	14.54		22.95	27.34	17.97	15.29	
L.S.D.	I = 2.69 N = 1.76 I X N = 3.53					I = 0.98 N = 1.82 I X N = 3.64				
Carbohydrate yield (kg/fed.)										
3	213.56	246.08	206.38	149.85	203.96	230.70	260.63	182.88	151.60	206.45
6	158.34	212.24	156.87	135.98	165.85	214.51	235.46	151.09	139.46	185.13
12	77.17	142.31	93.60	82.32	98.85	148.30	166.76	98.49	81.65	123.80
15	70.21	95.98	80.12	76.23	80.63	83.22	100.37	87.07	74.16	86.39
Mean	129.82	174.15	134.24	111.09		169.18	190.80	130.07	111.71	
L.S.D.	I = 3.23 N = 4.31 I X N = 8.63					I = 4.30 N = 3.38 I X N = 6.76				

I = Irrigation intervals. **N = Nitrogen rate.**
L.S.D. at 5 % level of significance.

As sorghum plants in the present investigation were irrigated, throughout the whole growing seasons, with underground saline water and grown in salt-affected soil, though with moderate concentrations, it seems likely that the observed grain yield losses could be partially ascribed to the salt stress effects. According to the salt tolerance categories established by Mass and Hoffman (1977), grain sorghum would be classified as moderately tolerant to salinity. In favour of this classification were the results of Francois *et al*., (1984), and they demonstrated that yield reduction was due primarily to lower weight per head rather than a reduced number of heads. More recent work (Ulery and Ernst, 1997) indicated that sorghum grain yield and plant height are reduced by saline water applied during the emergence, vegetative and reproductive growth stages, but were not affected by saline irrigation applied during the grain-filling stage. Therefore, they concluded that the best treatment for maximizing yield and utilizing saline wastewater is the application of good-quality water early in the season to germinate and establish seedlings, followed by saline water after booting. It could be added that the salt stress effects are possibly due to two reasons-osmotic effects and ion effects (Singh *et al*., 1998), which hamper the general growth of sorghum plants. High concentrations of NaCl have been reported to increase respiration (Hoffman and Phene, 1971). This increased respiration could reduce net photosynthetic fixation which might be the causative factor for decrease in overall growth of the species (Reddy *et al*., 1997). The subsequent effects of reducing normal growth are the depression of grain yield.

The obtained results (Table 4) reveal further that 100-grain weight, grain and biological yields per feddan as well as harvest index were significantly decreased by increasing the level of N fertilization from 60 up to 120 kg N/fed. In this situation, previous reports showed that growth and sorghum grain yield were positively responded to increasing N rates up to 125 kg N/fed. whether cultivated under normal (Barik *et al*., 1998) or water stress conditions (Ragheb and El-Nagar, 1997). The reduction noticed in the present study due to increasing N levels more than 60 kg N/fed. could be attributed mainly to the increase in salinity and osmotic pressure of the soil solution which inhibit the absorption of water and minerals. In accordance with such conclusion, Patel *et al*. (1975) reported that a reduced uptake of nutrient will occur as a result of the salt-induced decrease in growth of sorghum plants. Moreover, El-Saidi (1997) carefully discussed the adverse effects of salinity and indicated that there were three major hazards associated with saline habitats : a) Water stress arising from the more negative water potential (elevated osmotic pressure) of the rooting medium. b) Specific ion toxicity usually associated with either excessive chloride or sodium intake. c) Nutrient ion imbalance when the excess of sodium or chloride leads to a diminished uptake of N, K or P, or to impaired internal distribution of one or another of these ions.

Concerning the interaction between irrigation intervals and nitrogen fertilizer rates, data recorded in the same table clearly show that yield and its components of grain sorghum were significantly decreased by prolonging irrigation intervals under different nitrogen levels applied. The economical yield, at both seasons, was obtained by the application of 60 kg N/fed., and irrigated plants every 3 days.

2. Effect on grain chemical composition :

The results given in Table (5) showed that decreasing the available soil moisture content by delaying the irrigation intervals more than 3 days (i.e. irrigation every 6, 12 and 15 days apart) resulted in generally, at both seasons, a continuous significant decline in total carbohydrate and crude protein percentages of grains, and consequently reduced the yield of each per feddan. Such observations might agree with those reported by El-Baghoury *et al*. (1984) and Kandil *et al*. (2000) on sorghum and maize, respectively. The decrement in such chemical constituents resulting from water shortage along with salt stress effects, as previously pointed out, might be attributed to the reduction in photosynthetic activity (Kramer and Boyer, 1995), the inhibition in translocation of stored assimilates into the grain (Grant *et al*., 1989), the reduced uptake of nutrients (Patel *et al*., 1975) and/or an increase in respiration rates (Hoffman and Phene, 1971) under such unfavourable conditions.

Regarding the effect of nitrogen fertilizer rates, the experimental data (Table 5) showed positive response, at both seasons, as for total carbohydrate and crude protein contents in grains by application of 60 kg N/fed. Increasing N levels more than that tended to significantly decrease such chemical constituents, and hence negatively reflected on carbohydrate and protein yields/fed. The lowering effect of increasing N levels on grain chemical composition may be due to the role of salinity in reducing the uptake of nitrogen and preventing the complete use of nitrogen fertilizer.

Data in the same Table (5) reveal in addition that, under different rates of N supply, extending irrigation intervals up to 15 days tended mostly to decrease significantly protein and total carbohydrate percentages in grains as well as the yield of each per feddan. It is worthy to mention that sorghum plants which were irrigated every 3 days and supplied with 60 kg N/fed. appeared to have grains, at both seasons, with a higher contents of total carbohydrate and crude protein than those of any other treatment studied.

From the above-mentioned results, it appears that the role of increasing N supply is not effective in lessening yield losses under water stress conditions. Therefore, it could be concluded that low nitrogen application rate (60 kg N/fed.) connected with a narrow irrigation interval (i.e. irrigation every 3 days) are most favourable and economical for cultivation grain sorghum under saline conditions of South Sinai.

REFERENCES

A.O.A.C. (1982). Official Methods of Analysis 12th ed. Association Official Agricultural Chemists. Washington, D.C.

Barik, A.K.; Mukherjee, A.K. and Mandal, B.K. (1998). Growth and yield of sorghum (*Sorghum bicolor*) and groundnut (*Arachis hypogaea*) grown as sole and intercrops under different nitrogen regimes. Ind. J. Agron., 43 (1) : 27-32.

Chapman, H.D. and Prati, P.F. (1961). Methods of analysis for soil, plant and water. Calif. Univ. Agric. Div. Sci., August, 2nd printing.

Dubois, M.; Gilles, K.A.; Hamilton, J.; Rebers, R. and Smith, E. (1956). Colorimetric method for determination of sugar and related substances. Annals Chem., 28 : 350 – 356.

Eck, H.V. and Musick, J.T. (1979). Plant water stress effects on irrigated grain sorghum. II. Effects on nutrients in plant tissues. Crop Sci., 19 : 592 – 598.

El-Baghoury, H. Olfat; Fayed, T.M.; Hegazy, A.M.; Reiad, Sh. M. and Hegab, M.A.T. (1984). Yield response of sorghum plant to irrigation and nitrogen fertilization in Sinai, Egypt. J. Agron., 9 (1-2) : 103-111.

El-Saidi, M.T. (1997). Salinity and its effect on growth, yield and some physiological processes of crop plants. In: “Strategies for improving salt tolerance in higher plants”. Eds. Jaiwal, P.K., Singh, R.P. and Gulati, A. pp. 111-127. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, Calcutta, and Enfield (USA).

Francois, L.E.; Donovan, T. and Mass, E.V. (1984). Salinity effects on seed yield, growth and germination of grain sorghum. Agron. J., 76 : 741 – 744.

Goh, K.M. and Haynes, R.J. (1986). Nitrogen and agronomic practice. In: R.J. Haynes (ed.), Mineral Nitrogen in Plant-Soil System, pp. 379-468. Academic Press, New York, London, Sydney, Tokyo.

Gomez, K.A. and Gomez, A. (1984). Statistical procedures for agricultural research. John Willey Sons, New York, 1st ed.

Grant, R.F.; Jackson, B.S.; Kiniry, J.R. and Arkin, J.F. (1989). Water deficit timing effects on yield components in maize. Agron. J., 81 : 61-65.

Hajar, A.S.; Khafagi, O.A. and Ibrahim, S.M. (1997). Response of grain sorghum plant (*Sorghum bicolor L.*) to water deficit. Alex. J. Agric. Res. 42 (1) : 37 – 47.

Harlan, S.R. (1971). Genetic resources. I. Sorghum. In : Sorghum in seventies. (Eds. N. Ganga Prasada) New Delhi, Bombay, Calcutta.

Hoffman, G.J. and Phene, C.J. (1971). Effect of constant salinity levels on water use efficiency of bean and cotton. Trans Am. Soc. Agr. Eng., 1103-1106.

Jackson, M.L. (1958). Soil Chemical Analysis, Prentic Hall of Land on private Lim. Indian Private Limited, New Dehli, 251 – 280.

Jordan, W.R. (1993). Whole plant response to water deficits. : An overview. In : H. Taylor, W.R. Jordan, and T.R. Sinclair (eds), Limitations to Efficient Water Use in Crop Production, pp. 289-317. ASA, CSSA and SSSR, Madison, WI.

Kandil, S.A.; Abo-Ellil, A.A. and El-Zeiny, H.A. (2000). Effect of water stress and paclobutrazol application on growth, yield and grain chemical composition of maize. Egypt. J. Appl. Sci., 15 (7): 71-86.

Kramer, P.J. and Boyer, J.S. (1995). Water relations of plants and soils. Academic press, San Diego, New York, Boston, London, Sydney, Tokyo, Toronto, 360-380.

Mass, E.V. and Hoffman, G.J. (1977). Crop salt tolerance-current assessment. J. Irrig. Drainage Div., ASCE, 103 (IR2) : 115-134.

Mass, E.V.; Poss, J.A. and Hoffman, G.J. (1986). Salinity sensitivity of sorghum at three growth stages. Irrig. Sci., 7 : 1-11.

Patel, P.M.; Wallace, A. and Wallihan, E.F. (1975). Influence of salinity and N-P fertility levels on mineral content and growth of sorghum in sand culture. Agron. J., 67 : 622 – 625.

Ragheb, H.M.A. and El-Nagar, G. (1997). Response of grain sorghum to nitrogen fertilization and irrigation intervals. Assiut J. Agric. Sci., 28 (2) : 145 – 157.

Reddy, M.P.; Rao, U.S. and Iyengar, E.R.R. (1997). Carbon metabolism under salt stress. In : Strategies for improving salt tolerance in higher plants. eds. Jaiwal, P.K., Singh, R.P. and Gulati, A., pp. 176-177. Science Publishers, Inc., USA.

Singh, S.; Thakur, M.; Malik, V.; Goyal, I. and Pundir, C.S. (1998). Influence of NaCl stress on oxalate oxidase activity in germinating seeds of forage sorghum hybrid. Indian J. Plant Physiol., 3 (4) : 317 – 319.

Tanguiling, V.C.; Yambao, A.B.; O'Toole, J.C. and Dedatta, S.K. (1987). Water stress effects on leaf elongation, leaf water potential, transpiration and nutrient uptake of rice, maize and soybean. Plant and Soil, 103 : 155 – 168.

Ulery, A.L. and Ernst, F.F. (1997). Sorghum response to saline industrial cooling water applied at three growth stages. Agron. J. 89 : 392 – 396.

زراعة الذرة الرفيعة للحبوب تحت ظروف الملوحة بمحافظة جنوب سيناء

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اجريت تجربتان حقليتان بمزرعة بئر ابو كلام بمدينة طور سيناء – محافظة جنوب سيناء – خلال عامى ١٩٩٨ ، ١٩٩٩ وذلك بهدف دراسة تأثير فترات الرى المختلفة (الرى كل ٣ ، ٦، ١٢ ، ١٥ يوم) بمياه جوفية تصل درجة ملوحتها الى ٢٨٠٠ جزء فى المليون تحت معدلات اضافة من السماد الازوتى (صفر ، ٦٠ ، ٩٠ ، ١٢٠ كجم ازوت للفدان) على المحصول ومكوناته وكذلك التركيب الكيميائى لحبوب الذرة الرفيعة وتتلخص اهم النتائج فيمايلى :

ادت زيادة فترات الرى من ٦ الى ١٥ يوم فىكلا الموسمين الى حدوث نقص معنوى فى وزن الـ ١٠٠ حبة ، محصول الحبوب والمحصول البيولوجى للفدان وكذلك دليل المحصول ويتعاظم هذا التاثير السلبى بزيادة فترة منع الرى ، لوحظ اتجاه مماثل بخصوص محتوى الكربوهيدرات الكلية والبروتين الخام فى الحبوب مؤديا بذلك الى نقص محصول كل منهما للفدان .

اوضحت النتائج ايضا ان المحصول ومكوناته وكذلك التركيب الكيميائى للحبوب ينخفض معنويا بزيادة معدل اضافة السماد الازوتى عن ٦٠ كجم ازوت للفدان ، وظهر ان المعدل الزائد من السماد الازوتى لم يقلل التأثير السلبى للجفاف على المحصول لذا يمكن استنتاج ان المعدل المنخفض للسماد الازوتى (٦٠ كجم ازوت للفدان) مقترنا بفترات رى متقاربة (كل ٣ ايام) يكون اكثر اقتصادا ونفعا لزراعة الذرة الرفيعة للحبوب تحت الظروف الملحية لمنطقة جنوب سيناء .