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EFFECT OF IRRIGATION INTERVALS AND POTASSIUM FERTILIZER RATES ON YIELD AND SEED QUALITY OF SOME SORGHUM CULTIVARS

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ABSTRACT

This investigation was carried out at El-Serw Agricultural Research Station, Damietta Governorate and Mansura unit Research during 2005 and 2006 seasons to study the purpose was to the effect of irrigation intervals i.e 14, 21 and 28 days and potassium fertilizer rates i.e 0, 24 and 48 Kg K_2O/feddan on yield and seed quality of five grain sorghum cultivars, i.e. Dorado, Giza 113, Giza 15, Shandawheel - 2 and Shandawheel - 6. The experiment was laid out in a split plot design with three replicates. Results showed that prolonging irrigation intervals decreased number of days to 50% heading, panicle weight, panicle grain weight, seed index, grain yield/ feddan and seed quality traits, as well as germination percentage and rate, plumule length, radical length, seedling dry weight, accelerated aging and electrical conductivity of the produced grains in both seasons. Irrigation at 28 days interval caused 30.91% and 30.41% reduction in grain yield per feddan in 2005 and 2006 seasons, respectively, compared with that of 14 days interval. Increasing potassium fertilizer rate up to 48 Kg K_2O/feddan increased all studied traits. Applying potassium at the rate of 48 Kg K_2O/feddan gave 15.31% and 15.32% increase in grain yield/ feddan compared with unfertilized plants in 2005 and 2006 seasons, respectively. Grain sorghum cultivars differed in grain yield and all studied traits in both seasons. Hybrid Shandawheel 6 was superior in grain yield per feddan compared to other tested varieties in both seasons. The interaction effects were significant on almost studied traits in both seasons. Generally, it could be concluded that sowing hybrid Shandawheel- 6 and fertilized with 48 Kg K_2O /feddan plays a prominent role in increasing grain yield/ feddan and quality of produced seeds under irrigation water shortage (14 days interval) in North delta of Egypt.

INTRODUCTION

Grain sorghum, *Sorghum bicolor* (L.) Mench, is a staple food for vast number of people in the world. The demand for food in Egypt is increasing rapidly more than what the production. Accordingly, Egyptian Governorate made to decrease the gab between cereal production and consumption. One of the approaches to increase grain production is to expand the cultivation of cereal crops to new areas. Most of these areas suffer from limited irrigation water. Grain Sorghum is one of the major crops which widely grown in areas when the salinity and drought are common in some countries. Therefore, it is necessary for breeders and agronomists to select high yielding and drought tolerant grain sorghum varieties as well as adequate agriculture practices as fertilization with potassium to increase grain yield under water stress.

Ibrahim (1995), found that grain yield of grain sorghum decreased with increasing water stress. Hassanein (1984a), Hassanein *et al.* (1997), Ragheb and Elnagar (1997), El-Afandi *et al.* (1999) and Qamar-Zaman *et al.* (2003) reported that increasing irrigation intervals decreased grain yield of grain sorghum. Ahmed (2004) found that grain weight/ panicle, grain index

and grain yield decreased as water stress increased. Sajjen *et al.* (2004) and Wandimu *et al.* (2005) found that water deficit significantly reduced rate and percentage of germination, coleoptile, mesocotyle as well as length of radical, and seedling shoot and root.

Potassium is an essential for plants fertilization. Potassium has an important effect for increasing plant tolerance to water stress and activates the enzyme system. Charma and Kumeri (1996) found that grain yield of grain sorghum increased with increasing potassium rate. Ibrahim (1997) found that panicle weight, grain weight per panicle and grain yield per feddan. of grain sorghum significantly increased as potassium fertilizer rate increased.

Concerning varietal differences, Hassanein (1984a), Hassanein (1984b), Hassanein (1985), El-Hawary (1986), Hassanein and Azab (1990) and Hassanein *et a* .(1994) reported that grain sorghum varieties differed in heading date, panicle weight, panicle grain weight, grain yield per feddan, germination rate and percentage, radical and shoot length and seedling dry weight.

In Egypt, studies regarding irrigation intervals and potassium on grain sorghum at North Delta are rare. Therefore, this investigation was aimed to study the effect of irrigation intervals and potassium fertilizer rates on yield and quality of some grain sorghum varieties at North Delta of Egypt.

MATERIALS AND METHODS

A field experiment was carried out at El-Serw Agriculture Research Station, Damietta Governorate in 2005 and 2006 seasons to study the effect of irrigation intervals and potassium fertilization on yield and seed quality of grain sorghum.

A-Irrigation treatments:

Three irrigation treatments were applied, including irrigation every 14 days (control), 21 and 28 days throughout the growing season. The irrigation treatments started 35 days after sowing.

B- Potassium fertilization treatments:

Three potassium fertilizer rates, i.e. 0, 24 and 48 Kg K_2O /feddan were applied in the form of potassium sulphate (48% K_2O). Potassium fertilizer was applied at 35 days after sowing date. .

C- Grain sorghum varieties:

The tested five grain sorghum cultivars were Dorado, Giza 113, Giza 15, Shandwheel - 2 and Shandhweel - 6. Seeds of these cultivars were obtained from Agriculture Research Center, Giza, Egypt.

Experiments were laid out in a split-split plot design with three replicates. Irrigation treatments were allocated in the main plots, the sub plots were assigned to potassium fertilizer rates, and cultivars were allocated in the sub-sub plots. The area of each sub-sub plot was 10.5 m^2 (6 ridges 50 cm apart and 3.5 m long).

Table A: Soil mechanical and chemical analyses of the experimental sites

Characters	Seasons	
	2005	2006
Mechanical analysis		
Sand %	13.12	11.60
Silt %	22.50	21.00
Clay %	64.38	66.40
Textural class	Clay	Clay
Chemical analysis fraction		
Na^+ (mg/100 g)	36.80	37.90
pH	7.90	8.10
Organic matter %	0.82	0.77
Available N ppm	12.0	14.0
Available K ppm	28.0	25.0
Available B ppm	0.50	0.40

Mechanical and chemichal analysis of the experimental soil are show in Table (A).

The experimental soil was well prepared as usual and phosphours was applied prior to the seed bed preparation at the rate of 100 Kg super phosphate (15.5 P_2O_5) per feddan. Sowing took place on 25 and 10 may in 2005 and 2006 seasons, respectively. After 21 days from sowing, seedlings were thinned to one plant per hill. Nitrogen fertilizer at the rate of 100Kg N/ feddan. was applied at two equal splits, the first was applied at 21 day after sowing and the second at 35 days after sowing. All agronomic practices were followed as recommended for grain sorghum production.

Data recorded:

1-Heading date: Number of days from sowing to days when panicles appeared on 50% of plants in each sub-sub plot was recorded.

At harvest time five individual guarded plants were chosen at random from middle ridges of each sub-sub plot and the following data were recorded:

2- Panicle weight

3- Grain weight/ panicle

4- Seed index (mean weight of 1000 grains)

5- Grain yield (ardab/ feddan). At harvest, heads of each sub-sub plots were separated, dried and weighed.

Random sample of 400 seeds were taken from sorghum grains produced from each sub-sub plot and divided to four replicates and germinated under laboratory conditions at 25C°± 2 on stap filter paper in sterilized Petri dishes for 10 days. Germination percentage was performed according to International Seed Testing Association (ISTA, 1985) and defined as the total number of normal seedlings after 10 days. Germination rate defined according to Bartelt, (1937). During the final count, ten normal seedlings from each replicate were taken randomly to measure plumule and radical length. Seedlings were dried then after in hot-air oven at 85C° for 12 hours (Krishnasamy and Seshu, 1990). Accelerated aging test and Electrical conductivity were measured according to (ISTA, 1985).

Data were statistically analyzed according to Gomez and Gomez, (1984) and means were compared using the LSD test. Competitions and statistical analysis were done use the computer facilities and Mstat-c program.

RESULTS AND DISCUSSION

I- Effect of irrigation intervals on yield and quality of grain sorghum cultivars

Data in Tables 1 and 2 show that irrigated sorghum plants every 14 days increased days to 50% heading, panicle weight, grain weight/ panicle, seed index and grain yield per feddan. compared with irrigation every 21 and 28 days intervals in both seasons. Plants irrigated every 21 and 28 days had 13.60 and 31.55% as well as 13.02 and 29.55% reduction in grain yield compared with plants irrigated every 14 days in 2005 and 2006 seasons, respectively. These results are in harmony with those obtained by Ragheb and Elnagar (1997), El-Afandi *et al.* (1999), Qamar-Zaman *et al.* (2003) and Ahmed (2004).

The decrease in grain yield per feddan caused by prolonging irrigation period may be attributed to the role of water stress in hastening panicle initiation and development and head emergence as well as to the inhibitory effect of water stress on photosynthesis rate and dry matter translocated and stored in grains seed index and grain weight per panicle and hence it resulted in a reduction of grain yield per feddan.

Concerning quality traits, data presented in Tables 1 and 2 revealed that grain produced from plants irrigated every 21 days gave the highest values of germination percentage and rate, plumule length, radical length and accelerated aging compared with other irrigation intervals in both seasons, on the other side the highest seedling dry weight and electrical conductivity were recorded with seeds produced from plants irrigated every 14 days compared with the other irrigation intervals in both seasons. These results are in agreement with those of Hassanein (1984 a and b), Hassanein (1985), and Hassanein and Azab (1990), Wondimu *et al.* (2005) and Sajjan *et al.* (2004). The increases in length of radical and plumule at the middle irrigation intervals (21 days) my be attributed to the increasing germination rate under this irrigation treatments caused the longest in radical and plumule length.

II- Effect of potassium fertilizer rates on yield and quality of grain sorghum:

Results presented in Tables 1 and 2 show that plants received 48 Kg K_2O / feddan surpassed those unfertilized by 56.44% and 52.81% in panicle weight, 67.59% and 56.43% in grain weight per panicle, 19.75% and 16.56% in 1000-grain weight and 15.63 and 15.09% in grain yield per feddan in 2005 and 2006 seasons, respectively. These results are in harmony with those of Sharma and Kumari (1996) and Ibrahim (1997).

The increasing in seed yield per feddan due to increasing potassium fertilizer rate might be attributed to the stimulating effect of potassium in increasing rate of photosynthesis and transports of photosynthetic to panicle

which led to the increase of grain weight per panicle and seed index siohigh resulted in the increase of grain yield per feddan.

Regarding quality of seed sorghum, data presented in Tables 1 and 2 revealed that seeds produced from plants fertilized with 24 Kg K_2O / feddan recorded an increase of germination percentage by 6.84 and 5.07%, germination rate by (11.11 and 10.34%)and plumule length by (11.03 and 8.70%) compared with those produced from unfertilized plants with potassium (0 Kg K_2O / feddan) in 2005 and 2006 seasons, respectively. In this trend, seeds produced from plants received 48 Kg K_2O / feddan gave the highest radical length (10.71 and 10.94 cm) and seedling dry weight (0.129 and 0.129 g) as well as accelerated aging (78.33 and 77.47%) compared with seeds produced from other potassium treatments in 2005 and 2006 seasons, respectively. On the other hand, seeds produced from plants received 24 Kg K_2O / feddan gave the highest electrical conductivity, but the highest electrical conductivity (0.026 and 0.024 *Umhos/g)* were recorded with grains produced from unfertilized with potassium in 2005 and 2006 seasons, respectively. The increase in quality characters, i.e. germination percentage and rate, plumul and radical length and seedling dry weight might be attributed to the increase of dry matter accumulation and potassium stored in seeds. While potassium fertilizer had important role in potassium activation of enzymes in plant tissues. These enzymes include (synthetases, oxidoreductases, dehydrogenases and trasvererses). Increasing matter in seeds by enzymes enhancing germination rate and seedling growth, hence, the quality of seed increased by potassium fertilization.

III-Varietal variation:

Data in Tables 1 and 2 show clearly that the studied grain sorghum cultivars differed in measured all characters in both seasons. Cultivars Dorado and Shandwheel - 2 had the latest heading date, but variety Shandwheel - 6 and Giza 15 had the earlier heading date compared with the other tested cultivars in both seasons. Hybrid Shandwheel 6 exceeded other cultivars in panicle weight, panicle grain weight and grain yield per feddan (17.51 and 19.06 ardab) in 2005 and 2006 seasons, respectively. Also, this cultivar gave the highest germination percentage (87.72 and 89.22%), germination rate (0.620 and 0.627), radical length (11.53 and 11.56cm) and seedling dry weight (0.137 and 0.131 g) compared with the other examined cultivars in 2005 and 2006 seasons, respectively. In the same line, variety Giza 15 gave the highest seed index (32.13 and 38.67 g), plumule length (10.65 and 10.70 cm), accelerated aging (77.50 and 77.31%) and electrical conductivity (0.034 and 0.029 *Umhos/ g)* as well as with other cultivars treatments in 2005 and 2006 seasons, respectively. These results are in agreement with those of Hassanein (1984a), Hassanein (1984b), Hassanein (1985), El-Hawary (1986), Hassanein and Azab (1990), Mangombe et al (1996) and Sajjen *et al* (2004). The superiority of hybrid Shandawheel 6 in grain yield may attributed its superiority in germination percentage and rate , panicle weight and panicle grain weight which led to the increase in grain yield per feddan of this variety.

Table 1: Effect of irrigation intervals and potassium fertilizer rates on days to 50% heading, panicle weight, panicle grain weight), 1000-grains weight, grain yield and germination percentage of the tested grain sorghum cultivars in 2005 and 2006 seasons.

Treatment	days to 50% heading		Panicle Wight (g)		Panicle grain weight (g)		1000-grains weight (g)		Grain yield (ardab/ fed.)		Germination percentage	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
A- Irrigation												
I_1 (14 days)	79.20	82.45	116.93	130.94	80.37	104.61	35.66	39.06	18.83	20.51	84.77	87.90
I_2 (21 days)	77.88	80.80	102.39	122.15	66.16	87.58	32.40	36.54	16.26	17.64	92.40	93.97
I_3 (28 days)	75.12	79.15	87.96	107.30	54.16	75.01	24.97	34.39	12.89	14.45	74.77	76.63
LSD 0.05%	0.36	0.36	1.33	1.67	1.19	1.19	0.41	0.72	0.07	0.07	3.26	0.92
B- Potassium												
K_1 (0 Kg)	74.63	79.30	80.35	95.02	49.40	69.15	27.70	0.910	14.39	16.21	80.87	83.13
K_2 (24 Kg)	77.10	80.73	101.24	120.17	68.54	89.88	32.16	33.82	16.45	18.02	86.40	87.87
K_3 (48 Kg)	80.47	82.37	125.70	145.20	82.79	108.17	33.17	36.75	16.95	18.58	84.67	87.50
LSD 0.05%	0.39	0.32	1.30	1.39	1.14	1.34	0.54	39.4	0.07	0.06	2.89	0.78
C- Varieties												
V_1 (Dorado)	80.67	82.67	87.10	101.08	56.28	81.25	29.82	36.18	15.17	16.85	83.72	87.00
V_2 (Giza 113)	78.89	80.50	99.96	114.43	65.16	80.16	31.98	37.42	15.95	17.48	83.61	85.11
V_3 (Giza 15)	73.03	79.42	91.70	121.75	66.45	85.42	32.13	38.67	14.56	16.27	78.78	82.28
V_4 (Shand. 2)	80.75	82.36	110.29	125.63	74.26	93.78	30.46	34.00	16.80	18.33	86.06	87.22
V_6 (Shand. 6)	73.67	79.06	123.09	137.73	82.32	104.72	30.65	37.04	17.51	19.06	87.72	89.22
LSD 0.05%	0.45	0.52	1.71	2.15	1.25	1.54	0.74	0.65	0.09	0.09	4.05	0.96
A B	*	**	**	**	**	**	**	**	**	**	*	**
A C	*	*	**	*	*	*	**	N.S	**	**	*	**
B C	**	*	**	**	**	**	**	**	**	**	*	*
A B C	*	**	**	**	**	**	**	**	**	**	*	**

Table 2: Effect of irrigation intervals and potassium fertilizer rates on Germination rate, plumule length, radical length, seedling dry weight, accelerated aging and electrical conductivity of the tested grain sorghum cultivars in 2005 and 2006 seasons.

Treatment	Germination rate		Plumule length (cm)		Radical length (cm)		Seedling dry weight (g)		Accelerated aging (%)		E.C. (Umhos/ g)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
A- Irrigation												
I_1 (14 days)	0.585	0.604	8.99	9.29	10.04	10.12	0.135	0.137	82.82	82.20	0.031	0.027
I_2 (21 days)	0.699	0.711	12.36	12.64	12.14	12.46	0.119	0.132	84.37	53.92	0.020	0.019
I_3 (28 days)	0.506	0.540	8.48	8.54	7.03	7.30	0.110	0.110	58.53	59.62	0.029	0.023
LSD 0.05%	0.005	0.005	0.20	0.67	0.15	0.34	0.002	0.006	0.65	1.23	0.008	0.001
B- Potassium												
K_1 (0 Kg)	0.558	0.580	9.33	9.65	8.43	8.75	0.109	0.113	71.90	72.34	0.026	0.024
K_2 (24 Kg)	0.620	0.640	10.36	10.49	10.06	10.19	0.126	0.126	75.52	75.83	0.025	0.023
K_3 (48 Kg)	0.612	0.635	10.15	10.33	10.71	10.49	0.129	0.129	78.30	77.47	0.024	0.022
LSD 0.05%	0.006	0.007	0.18	0.42	0.20	0.33	0.003	0.004	1.35	1.10	0.008	0.001
C- Varieties												
V_1 (Dorado)	0.594	0.610	8.77	8.05	9.03	9.32	0.115	0.116	74.86	75.11	0.023	0.021
V_2 (Giza 113)	0.589	0.614	10.56	10.63	8.28	10.25	0.117	0.121	73.33	74.11	0.030	0.026
V_3 (Giza 15)	0.599	0.615	10.65	10.70	9.84	11.53	0.117	0.123	77.50	77.31	0.034	0.029
V_4 (Shand. 2)	0.601	0.625	9.86	10.15	10.00	8.45	0.121	0.122	74.03	74.75	0.023	0.021
V_5 (Shand. 6)	0.620	0.627	9.86	10.23	11.53	11.56	0.137	0.131	76.47	74.89	0.018	0.017
LSD 0.05%	0.012	0.010	0.24	0.50	0.25	0.45	0.005	0.006	1.92	1.49	0.011	0.001
A B	**	**	**	**	**	**	*	N.S	**	**	N.S	**
A C	**	**	**	*	**	**	**	*	**	N.S	N.S	**
B C	*	*	**	*	**	*	*	N.S	**	N.S	N.S	N.S
A B C	N.S	*	**	*	**	**	**	N.S	**	N.S	N.S	N.S

V- Interaction effects:

A-Irrigation × potassium

Data recorded in Tables 3 and 4 show clearly that increasing potassium fertilizer rate up to 48 Kg K_2O / feddan increased values of all studied traits under the three irrigation intervals in both seasons. At the highest water stress (irrigation every 28 days), application potassium at the rate of 48 Kg K_2O / feddan gave the highest values of heading date, panicle weight, panicle grain weight, seed index, grain yield per feddan of produced seeds and quality traits namely germination rate and percentage, plumule length, radical length, seedling dry weight and accelerated aging in both seasons. On the other hand, the highest electrical conductivity was found with unfertilized plants with potassium at the irrigation every 14 days intervals in both seasons. These results suggested that increasing potassium rate alleviated the inhibitor effect of water on growth and yield components of grain sorghum.

B- Irrigation × cultivars

Results presented in Tables 5 and 6 indicated that prolonging irrigation period reduced all studied traits of all grain sorghum varieties used in both seasons. At irrigation every 15 days intervals, hybrid Shandawheel - 2 gave the highest number of days to 50% heading compared with other treatments in both seasons. Meanwhile, the lowest number of days to 50% heading was found with cultivar Giza 15 when irrigated every 28 days intervals in 2005 and 2006 seasons, respectively. At all tested irrigation intervals, hybrid Shandawheel - 6 gave the highest values of panicle weight, panicle grain weight, grain yield per feddan, and seedling dry weight compared with other treatments in both seasons, but when irrigated every 21 days intervals, it gave higher germination rate and percentage as well as radical length compared with the other cultivars in both seasons. The highest 1000- grain weight and electrical conductivity were recorded with cultivar Giza 15 when irrigated every 15, 21 and 28 days intervals, compared to the other used varieties in both seasons. Also, cultivars Giza 15 when irrigated every 21 days intervals gave the longest plumule length in both seasons. In this way, irrigated cultivar Dorado gave the highest accelerated aging compared with the other treatments in both seasons.

The superiority of hybrid Shandawheel - 6 in grain yield per feddan under the lowest moisture due to prolonging in irrigation interval may be due to its superiority in panicle weight and panicle grain weight under the longest period of irrigation, which led to the increase in grain yield under increasing water deficit.

C- Potassium × cultivars

Results in Tables 7 and 8 indicated that increasing potassium fertilizer rate from 0 to 24 or 48 Kg K_2O/ feddan increased values of all recorded traits of all tested grain sorghum cultivars in both seasons. Fertilized cultivar Dorado by 48 Kg K_2o / feddan increased number of days to 50% heading. Also hybrid Shandawheel - 6 when received 48 Kg K_2O / feddan gave the highest panicle weight, panicle grain weight, grain yield per feddan, radical length, seedling dry weight and accelerated aging in both seasons.

Table 3: Effect of interaction between irrigation intervals and potassium fertilization on days to 50% heading, panicle weight, panicle grain weight, 1000-grain weight, grain yield and germination percentage in 2005 and 2006 seasons.

Irrigation	Days to 50% heading			Panicle Wight (g)			Panicle grain weight (g)			1000-grain weight (g)			Grain yield (ardab/ fed.)			Germination %		
	Potassium																	
	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3
2005																		
I_1	76.30	79.10	82.20	93.21	115.35	142.24	62.72	79.68	98.50	33.75	35.84	37.39	18.33	18.99	19.77	80.90	89.60	83.80
I_2	74.95	77.50	81.20	81.30	101.57	124.31	49.63	67.15	81.70	28.01	33.25	35.92	14.65	16.79	17.36	90.00	94.50	92.70
I_3	72.65	74.70	78.06	66.54	86.78	110.56	35.73	58.59	68.17	21.33	27.38	28.19	10.80	13.55	14.32	71.70	75.10	77.50
LSD 0.05%	0.68			2.52			1.97			0.93			0.10			5.01		
2006																		
I_1	80.70	82.55	84.10	108.21	129.54	155.07	84.41	104.51	124.92	36.46	33.67	31.34	20.18	120.63	20.74	84.90	91.00	87.80
I_2	79.20	80.65	82.55	96.07	122.15	148.23	66.66	90.35	105.77	38.77	36.55	34.93	16.13	18.33	19.08	91.50	96.00	94.40
I_3	78.00	79.00	80.45	80.77	108.83	132.30	56.38	74.77	93.88	41.96	39.40	36.89	12.31	13.11	15.93	73.00	76.60	80.30
LSD 0.05%	0.65			2.41			2.32			N.S.			0.11			1.32		

Table 4: T Effect of interaction between irrigation intervals and potassium fertilization on germination rate, plumule length, radical length), seedling dry weight, accelerated aging and electrical conductivity in 2005 and 2006 seasons.

Irrigation	Germination rate			Plumule length (cm)			Radical length (cm)			Seedling dry weight(g)			Accelerated aging %			E.C. (*umhos/g*)		
	Potassium																	
	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3
2005																		
I_1	0.569	0.609	0.578	8.17	9.80	8.99	9.23	10.70	10.19	0.122	0.147	0.137	80.15	84.75	83.55	0.029	0.031	0.033
I_2	0.651	0.743	0.703	11.74	12.57	12.77	10.83	12.37	13.22	0.107	0.120	0.130	81.40	84.45	87.25	0.022	0.020	0.019
I_3	0.455	0.508	0.555	8.07	8.70	8.68	5.24	7.13	8.74	0.099	0.111	0.119	54.15	57.35	64.10	0.027	0.025	0.035
LSD 0.05%	0.015			0.31			0.34			0.006			2.34			N.S.		
2006																		
I_1	0.561	0.623	0.599	8.56	10.06	9.24	9.53	10.40	10.44	0.126	0.145	0.139	79.10	83.60	83.90	0.026	0.027	0.028
I_2	0.661	0.755	0.717	12.05	12.83	13.03	11.07	12.78	13.53	0.112	0.122	0.131	81.55	84.40	85.80	0.020	0.0018	0.0018
I_3	0.489	0.542	0.589	8.33	8.58	8.71	5.65	7.40	8.86	0.101	0.112	0.116	56.65	59.50	62.70	0.025	0.0023	0.0021
LSD 0.05%	0.012			0.733			0.576			0.007			1.90			0.001		

Table 5: Effect of interaction between sorghum cultivars and irrigation intervals on days to 50% heading, panicle weight, panicle grain weight, 1000-grain weight, grain yield and germination percentage in 2005 and 2006 seasons.

Varieties	Days to 50% heading			Panicle Wight (g)			Panicle grain weight (g)			1000-grain weight (g)			Grain yield (ardab/ fed.)			Germination %		
	Irrigation																	
	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3
	2005																	
V_1	82.33	81.25	78.42	99.04	86.92	75.35	73.84	51.56	43.63	34.39	30.43	24.65	17.94	15.12	12.46	81.67	93.33	76.17
V_2	80.33	79.25	77.08	109.66	102.20	88.01	76.87	64.94	53.67	37.37	33.46	25.55	19.08	16.20	12.56	86.17	91.00	73.67
V_3	75.00	72.92	71.17	107.41	90.27	77.44	67.36	57.01	44.99	38.47	34.64	26.82	18.12	15.53	10.03	79.00	88.67	68.67
V_4	82.75	81.83	77.67	158.97	109.91	91.98	89.48	74.62	58.68	34.29	31.10	25.99	19.29	16.62	14.47	88.67	93.83	75.67
V_5	75.58	74.17	79.25	159.05	122.66	107.03	82.67	82.67	69.84	33.78	32.34	25.82	19.73	17.87	14.93	88.33	85.17	79.67
LSD 0.05%	0.77			2.97			2.67			1.28			0.16			6.99		
	2006																	
V_1	83.83	82.75	81.42	108.94	105.31	88.99	99.39	73.98	70.39	38.58	36.37	33.58	19.78	16.90	13.88	87.50	94.50	79.00
V_2	81.33	80.58	79.58	126.77	116.92	99.62	92.17	80.58	67.73	41.80	37.70	32.76	20.58	17.69	14.16	87.17	92.83	75.33
V_3	80.08	78.75	77.42	130.89	121.86	112.51	96.70	85.76	73.81	42.18	38.07	37.77	19.88	17.30	11.52	85.50	90.67	70.67
V_4	84.67	83.00	82.42	137.55	129.09	110.30	113.33	92.31	75.72	36.16	33.58	32.26	20.98	18.05	16.03	89.67	95.67	76.83
V_5	80.33	78.92	77.92	150.55	137.57	125.08	121.48	105.26	87.42	38.60	36.98	35.56	21.34	19.19	16.64	89.67	96.67	81.33
LSD 0.05%	0.60			3.73			2.67			1.57			0.15			1.66		

Table 6: Effect of interaction between sorghum cultivars and irrigation intervals on germination rate, plumule length, radical length, seedling dry weight, accelerated aging and electrical conductivity in 2005 and 2006 seasons.

Varieties	Germination rate			Plumule length (cm)			Radical length (cm)			Seedling dry weight (g)			Accelerated Aging (%)			E.C. (*Umhos/g*)		
	Irrigation																	
	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_3	I_3
	2005																	
V_1	0.580	0.599	0.502	6.48	11.55	8.28	8.43	11.74	6.90	0.127	0.116	0.101	80.00	87.58	57.00	0.027	0.021	0.023
V_2	0.575	0.677	0.516	9.85	12.78	9.08	11.25	8.31	5.28	0.128	0.118	0.105	83.00	82.67	54.33	0.038	0.019	0.051
V_3	0.598	0.680	0.518	10.12	13.30	8.53	12.02	11.51	6.01	0.136	0.114	0.101	83.17	83.33	66.00	0.041	0.030	0.032
V_4	0.584	0.712	0.508	9.08	11.98	8.52	8.70	13.24	8.05	0.136	0.114	0.114	82.00	85.67	54.42	0.028	0.018	0.022
V_5	0.589	0.725	0.485	9.41	12.17	8.00	9.78	15.88	8.892	0.148	0.135	0.128	85.62	82.58	60.92	0.022	0.015	0.017
LSD 0.05%		0.022			0.41			0.43			0.009			3.32			N.S.	
	2006																	
V_1	0.593	0.712	0.526	6.94	11.58	8.63	8.73	12.03	7.18	0.130	0.120	0.098	79.00	86.50	59.83	0.025	0.019	0.020
V_2	0.592	0.701	0.548	10.14	13.15	8.60	11.39	13.55	5.80	0.132	0.123	0.108	82.58	83.50	56.42	0.031	0.028	0.018
V_3	0.609	0.686	0.554	10.31	13.62	8.18	12.11	13.08	6.49	0.138	0.120	0.112	82.92	84.92	64.08	0.033	0.029	0.026
V_4	0.612	0.721	0.543	9.28	12.38	8.80	8.33	8.79	8.23	0.136	0.116	0.113	82.17	83.83	58.25	0.026	0.021	0.017
V_5	0.616	0.735	0.530	9.77	12.44	8.48	10.05	10.83	8.80	0.148	0.130	0.117	84.33	80.83	59.50	0.020	0.019	0.013
LSD 0.05%		0.018			0.87			0.87			N.S.			2.56			0.002	

Table 7: Effect of interaction between the tested sorghum cultivars and potassium fertilization on days to 50% heading, panicle weight, panicle grain weight, 1000-grain weight, grain yield and germination percentage in 2005 and 2006 seasons.

Varieties	Days to 50% heading			Panicle Weight (g)			Panicle grain weight (g)			1000-grain weight (g)			Grain yield (ardab/ fed.)			Germination %		
	Potassium																	
	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3
	2005																	
V_1	78.50	80.42	83.08	74.18	86.43	100.96	46.62	59.40	62.82	27.06	30.80	31.61	13.39	16.69	16.23	83.33	86.76	81.17
V_2	76.70	78.83	81.67	88.85	100.25	112.77	46.70	70.61	78.18	26.99	33.48	35.92	14.94	16.30	16.61	80.33	85.17	85.33
V_3	70.67	72.50	75.92	62.49	90.58	122.64	44.34	58.03	86.99	27.95	34.19	33.79	12.97	15.01	15.70	72.33	82.00	82.00
V_4	77.92	80.83	83.50	86.96	107.73	136.17	52.30	73.35	97.14	28.93	30.93	32.32	15.34	17.28	17.76	82.67	88.33	86.67
V_5	69.92	72.92	78.17	91.26	121.18	165.84	56.85	81.31	108.82	28.34	31.40	32.19	16.12	17.95	18.46	85.67	89.33	88.17
LSD 0.05%	0.88			2.90			2.55			1.21			0.13			6.46		
	2006																	
V_1	80.83	82.93	84.25	81.94	103.05	118.26	67.84	81.81	94.11	34.44	36.40	37.70	15.26	17.40	17.89	84.17	87.83	89.00
V_2	79.08	80.25	82.17	193.13	116.05	134.12	55.87	81.84	102.96	34.22	37.74	42.30	16.58	17.67	18.18	81.33	86.67	87.33
V_3	78.08	79.33	80.83	88.58	122.09	154.58	64.21	84.80	107.25	36.56	37.79	41.67	14.56	16.66	17.58	79.50	83.67	83.67
V_4	81.17	82.33	83.58	102.50	120.88	153.58	77.12	93.70	101.53	29.51	35.04	37.45	16.95	18.83	19.28	83.67	90.00	88.00
V_5	77.33	78.33	81.00	108.93	138.80	156.47	80.73	107.43	126.01	34.38	36.78	39.98	17.67	19.54	19.96	87.00	91.17	89.50
LSD 0.05%	0.71			3.11			3.00			1.45			0.14			1.75		

Table 8: Effect of interaction between sorghum cultivars and potassium fertilization on germination rate, plumule length, radical length, seedling dry weight and accelerated aging in 2005 and 2006 seasons.

Varieties	Germination rate			Plumule length (cm)			Radical length (cm)			Seedling dry weight (g)			Accelerated aging %		
	Potassium														
	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3	K_1	K_2	K_3
	2005														
V_1	0.541	0.631	0.608	8.35	9.53	8.42	8.21	9.13	9.73	0.104	0.121	0.119	70.08	76.33	78.17
V_2	0.561	0.600	0.607	9.69	10.76	11.00	7.19	8.74	8.91	0.110	0.119	0.122	67.08	74.17	78.75
V_3	0.565	0.617	0.615	10.11	10.83	11.02	8.70	10.10	10.73	0.105	0.121	0.124	78.50	77.58	76.42
V_4	0.567	0.629	0.609	9.48	10.07	10.03	8.79	10.28	10.92	0.107	0.129	0.128	71.25	73.50	77.33
V_5	0.556	0.624	0.621	8.73	10.59	10.26	9.25	12.06	13.27	0.120	0.140	0.151	72.58	76.00	80.83
LSD 0.05%		0.019			0.40			0.44			0.008			3.03	
	2006														
V_1	0.556	0.640	0.634	8.53	9.88	8.74	8.46	9.53	9.97	0.106	0.121	0.122	72.67	74.83	77.83
V_2	0.584	0.633	0.623	10.40	10.27	11.23	9.20	10.64	10.90	0.115	0.123	0.126	70.50	74.58	77.42
V_3	0.581	0.633	0.635	10.39	11.08	11.63	9.64	12.20	12.84	0.112	0.126	0.132	74.33	79.00	78.58
V_4	0.593	0.648	0.635	9.80	10.33	10.33	7.55	8.17	9.64	0.112	0.127	0.127	72.25	75.58	76.42
V_5	0.588	0.664	0.648	9.11	10.88	10.70	8.89	10.43	13.36	0.121	0.136	0.138	72.42	75.17	79.08
LSD 0.05%		0.016			0.95			0.73			N.S.			3.48	

However the same variety when fertilized by 24 Kg K_2O/feddan gave the highest germination rate and percentage in both seasons. Also, the application of 48 Kg K_2O / feddan caused the highest seed index of cultivar Giza 113 and plumule length of variety Giza 15 in both seasons.

The interaction effect among irrigation cultivars, potassium fertilizer rates on some grain sorghum varieties had significant effects on number of days 50 % heading, panicle weight (g),panicle grain weight (g), seed index (g), grain yield (ardab/feddan), germination percentage , plumule and radical length (cm) and accelerated aging (%). On the other side, it had no significant effect on electrical conductivity in 2005 and 2006 seasons. It also had significant effects on seedling dry weight (g) in 2005 and germination rate in 2006 seasons, but it had insignificant effects on accelerated aging in 2005 and 2006 seasons.

Generally, it could be recommended that sowing grain sorghum hybrid Shandawheel - 6 and fertilized with 48 Kg K_2O / feddan as a cultural practice plays a prominent role in increasing grain yield/ feddan and quality of produced seeds under irrigation water shortage in North Delta of Egypt.

REFERENCES

Ahmed, A.G. (2004). Effect of nitrogen rates and skipping irrigation on growth and yield of grain sorghum (Sorghum bicolor. L.Moench). Egyptian J. Of Argon.; 26: 63-75.

Bartlett, M. S.(1937). Some samples of statistical method of research in agriculture and applied biology. J. Rcy. Soc. 4:2.

El-Afandi, K. T., E. A. A. Mourad and S. J. Latif (1999). Effect of bio fertilizer and irrigation interval on growth, yield and yield components of some sorghum cultivars under salinity conditions at Wadi Surd, South Sinai. Annals of Agric. Sci. Moshtohor, 37(4): 2135-2145.

El-Hawary, M. A. (1986). Evaluation of salt tolerance in some grain sorghum genotypes. M. Sce. Thesis, Fac of Agric. Al-Azhar Univ.

Gomez, K. A. and A. A. Gomez (1984). Statistical procedures for agricultural research. 2nd Ed. John Whley and Sons.

Hassanein, A. M. (1984a). Effect of sowing date and irrigation intervals on growth and yield of grain sorghum on sand soil. Al-Azhar J. Agric. Res.,1,: 140-152.

Hassanein, A. M. (1984b). Salt tolerance of seventy-three grain sorghum genotypes at germination stage. Bul. Fac. Of Agric. Cairo Univ. 35 (3): 1325-1335.

Hassanein, A. M. (1985). Salt tolerance of fifty-grain sorghum genotypes at seeding stage. Annals Agric. Sci. Agric.,.Ain Shams Univ, Cairo, Egypt. 30 (1), 163-179.

Hassanein, A. M. and A. M. Azab (1990). Test for salt tolerance in grain sorghum. Bull Fac. Of Agric., Cairo Univ., 41 (2): 265-276.

Hassanein, A. M., M. A. El-Hawary, A. M. Azab and G. H. Abedl-Hay (1994). Measurement of drought tolerance in grain sorghum. Egypt J. Appl. Sci., 9 (5): 63-73.

Ibrahim, Y. M. (1995). Response of sorghum genotypes to different water levels created by sprinkler irrigation. Annals of Arid Zon, 34 (4) : 283-287.

Ibrahim, M. M. I. (1997). Effect of salt-fertilizers interaction in relation to yield and nutrient uptake in grain sorghum. M. Sc. Thesis, Fac. Of Agric., Al-Azhar Univ., Egypt.

I.S.T.A. (1985). International rules for Seed Testing, Seed Science and Technol. 13 : 307-355.

Krishnasamy, V. and D.V. Seshu (1990). Phosphine fumigation influence on rice seed germination and vigor. Crop Sci.,30 : 28- 85.

Mangombe, N; L. T. Gono and J. N. Mushonga (1996). Response of sorghum genotypes to drought in Zimbabwe. Drought tolerant crops for southern Africa Proceedings of the SADC/ICRISAT Regional Sorghum and Pearl Millet Workshop, Gabrone, Boswana; 99-104.

Qamara-Zaman, Nazir-Hassain, Hayad and F. U. Kham (2003). Effect of irrigation levels in sorghum. Sarhad J. of Agric. 19 (4) : 515-518.

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

Sharma, P. S. and T. S. Kumari (1996). Effect of potassium under water stress on growth and yield of sorghum in verticals. J. of Potassium Res., 12 (3) : 319-325.

Sajjan, A. S. , K. N. Pawar, M. S. Dhamaleppagol and B. D. B. Birador (2004). Influence of water stress treatments on seed quality of sorghum genotypes. Crop Res. Hisar; 27 (1) : 46-49.

Wondimu-Bayu, N.F.G. Rethman, P.S. Hammes, P.A. Pieterse, J. Grimeek and M-Van-der Linde, (2005). Water stress affected the germination, emergence and growth of different sorghum cultivars. Sinet, Ethiopian J. of Sc., 28(2): 119-128

تأثير فترات الري ومعدلات السماد البوتاسي على محصول وجودة تقاوى بعض أصناف تقاوي الذرة الرفيعة

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أجريت هذة الدراسة بمحطة البحوث الزراعية بالسرو. ووحدة بحوث تكنولوجيا البذور بالمنصورة خلال موسمي ٢٠٠٥ و ٢٠٠٦ لدراسة تأثير ثلاث فترات للري و هي (كل ١٤ ، ٢١ و ٢٨ يوم) وكذلك ثلاث معدلات للتسميد البوتاسي وهي (بدون إضافة ، ٢٤ و ٤٨ كجم بو ٢ أ ٥ / فدان على محصول و بعض صفات الجودة للحبوب الناتجة لخمسة أصناف من الذرة الرفيعة وهي (دورادو، جيزة ١١٥، جيزة ١٣، شندويل ٢، شندويل ٦) و صممت التجربة الحقلية في قطع منشقة مرتين في ثلاث مكررات

و يمكن تلخيص النتائج كما يلي :-

- أدت زيادة فترات الري حتى ٢٨ يوم إلى نقص عدد الأيام حتى طرد ٥٠ % من النورات ، وزن النورة، ووزن حبوب النورة، ووزن الألف حبة، محصول الحبوب للفدان. كذلك نقصت صفات الجودة في البذور المنتجة مثل نسبة ومعدل الإنبات، طول الريشة والجذير، واختبار الشيخوخة، درجة التوصيل الكهربى لمنقوع البذور.
- أدت زيادة التسميد البوتاسي ٤٨ كجم/فدان إلى زيادة معظم الصفات المدروسة (زاد محصول الحبوب بنسبة ١٥,٣١، ١٥,٣٢% خلال الموسمين مقارنة بدون تسميد.
- اختلفت الأصناف فيما بينها في محصول الحبوب وكل الصفات المدروسة وقد سجل الصنف شندويل ٦ أعلى القراءات لمعظم الصفات تحت الدراسة مقارنة بباقي الأصناف.
- كان التفاعل بين عوامل الدراسة معنويا على معظم الصفات المدروسة تحت ظروف الإجهاد الرطوبي (الري كل ٢٨ يوم) والتسميد البوتاسي بمعدل ٤٨ كجم بو ٢ أ ٥ / فدان أعطى الصنف شندويل ٦ أعلى محصول حبوب (١٦,٨٩، ١٧,١٣ أردب/ فدان) مقارنة مع باقي الأصناف الأخرى في موسمي الدراسة .