

IRRIGATION MANAGEMENT AND THE PRODUCTION OF SORGHUM UNDER CALCAREOUS SOIL

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ABSTRACT

In general, irrigation by surface methods is the most common to supply crops with frequent application of water. Pressurized irrigation systems have been introduced in Egypt to develop new irrigation technology suited to limited water supply as well as to specific topographic and soil conditions. In this study, a field experiment was carried out in the Agricultural Experimental Station of the Desert Research Center, Maryut, Alex. Governorate during the two successive seasons of 2006 and 2007. Five methods of irrigation were studied: , gated pipe (GP), surface drip irrigation, one line of drippers for one line of plants (D1:1), surface drip irrigation, one line of drippers for two lines of plants (D1:2), sub surface drip irrigation, one line drippers for one line of plants (SD1:1) and sub-surface drip irrigation, one line of drippers for two lines of plants (SD1:2). The irrigation methods were conducted under three water quantities (100%, 70% and 50%) of reference ET_0 calculated by modified Penman-Montieth equation, with two soil water depletion levels (30% and 50%) of available water. The statistical analysis revealed highly significant increases in all the studied parameters with increasing water quantities. The maximum fresh weights i.e. 41.73, 41.51 and 39.66 ton/fed./ were obtained with SD1:1, D1:1 and GP, respectively under water quantity 100% (Q1) and soil water depletion 30% (D1), in the year 2006 while the maximum dry masses of 8.23, 8.2 and 7.9 ton/fed. Respectively were achieved under SD1:1, D1:1 and GP with Q1 and D1. In 2007, the maximum fresh masses were, 42.55, 41.85 and 40.53 under D1:1, SD1:1 and GP, while the maximum dry weights were 8.4, 7.98 and 7.27 ton/fed respectively. under D1:1, GP and SD1:1 with Q1 and D1. The study showed that water use efficiency decreased by increasing quantity of the applied water.

KW: WUE, Evapotranspiration, Sub-Surface Drip Irrigation (SDI), Drip Irrigation (DI), Gated Pipe (GP), Soil depletion.

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INTRODUCTION

Water is the most limiting factor for plant production in arid and semiarid regions ,and when the source of water is limited, the demand for water increases and water management will become an essential practice used by farmers .The relationships between yield and water consumption were established and the preferred irrigation programs to be used with surface irrigation were developed(**Tekinel et al.,1999**), (**Fischbach and Somerholder1971**) found that an automatic surface irrigation system with gated pipe (GP) and reused system can be very efficient in applying irrigation water (91.9% efficiency) .Micro irrigation has been developed rapidly since the early 1960 .Some advantages of micro irrigation include improved water management and yield, ,greater control of applied water resulting in less water and nutrient loss through deep percolation. (**Phene et al., 1987**) demonstrated that significant yield increases in tomatoes were achieved with the use of high frequency subsurface drip irrigation (SDI) and precise fertility management. (**Hutmacher et al.,1996**) demonstrated that yield of alfalfa production increased upon using SDI system buried at a depth of 0.7m .Cotton yield has also been improved using SDI system (**Smith et al.,1991**) and (**Ayars et al.,1998**).Water use efficiency has been significantly improved through the use of subsurface drip irrigation SDI (**Phene et al.1986b**).The objective of this study is to improve water management ,irrigation efficiency and water use efficiency with gated pipe (GP), surface drip irrigation (DI) and subsurface drip(SDI) irrigation systems.

MATERIALS AND METHODS

Afield experiment was carried out in Maryout Agricultural Research Station (محطة التجارب الحقلية بمريوط), south west of Alexandria (elevation 12.75 m, latitude 31° 22 N and Longitude 29°27 E) during the two successive seasons 2006 and 2007.

The study was conducted under splot splot design with three replicates to evaluate the influence of pressurized irrigation systems (gated pipe, surface and subsurface drip irrigation) and water management practices

represented by the applied water depth and water distribution uniformity on

- 1- Consumptive use,
- 2- Water use efficiency,
- 3 production of sorghum represented by yield and yield components under calcareous soil condition.

1 Soils of the studied area.

The area of study was represented by a soil profile from which five depths were sampled i.e. (0 – 20, 20 – 40, 40 – 60, 60 – 80 and 80 – 100 cm). The soil samples were air dried, ground and sieved through a 2 mm screen to get the fine part of soil which is kept for analysis.

The chemical and physical properties of the collected soil samples were determined according to the standard methods outlined in the following:

- Particle size distribution by the pipette method as described by **(Klute, 1986)**.
- Particle density (dp) according to **(Richards, 1954)**.
- Bulk density (db) by soil cores method according to **(Richards, 1954)**.
- Porosity was calculated using the equation. $\text{Porosity}\% (n) = \left(\frac{dP - db}{dP} \right) \times 100$.
- Calcium carbonate content was determined by Collin's calcimeter according to **Richards (1954)**.
- PF curves and soil moisture retention at 0.33 (corresponding to soil field capacity) and 15 bar (corresponding to soil wilting point) were determined in the undisturbed soil cores using the pressure cooker and pressure membrane, respectively, according to Singh (1980) and results obtained are presented in Table (2).
- The filtration rate was determined by using the double ring infiltrometer as described by Kohneke (1980).
- Cationic and anionic composition, p^H and EC of the soil saturation extract were determined according to Richards (1954)

- Soil organic matter content was determined according to the method of Walkley and Black (Jackson, 1967)

- Cation exchange capacity was determined using NaOAc_ NH₄OAc according **Richards (1954)**. Exchangeable cations were extracted using NH₄ OAc method (**Jackson, 1973**) .and determined as outlined **by Black (1965)**

- Data set out in Tables (1, 2, 3 and 4) reveal that the studied soil is generally loamy - textured except for the surface (0-20 cm) and deepest (80-100cm) layers which are of a sandy –loam texture. Total calcium carbonate content increased slightly with depth and ranged from 28.5 % to 30.1%. Also, the soil bulk density increased with depth and varied between 1.42 and 1.57 g/cm³.

The soil reaction is moderately alkaline; where soil pH ranged from 7.5 to 7.7. Electrical conductivity of soil paste extract indicates that soil is slightly saline, where EC_e values varied from 2.8 at (40-60cm depth) to 3.9 dSm⁻¹ at the surface layer. The soil saturation extract showed that Na⁺ and Ca²⁺ were the dominant cations while Cl⁻ was the dominant anion followed, by SO₄²⁻ and HCO₃⁻.

Table (1) Some soil physical properties of the studied soil:

Soil depth (cm.)	Particle size distribution %				Textural class	Bulk density g.cm ⁻³	Particle density g.cm ⁻³	Porosity%	Infiltration Rate	
	Coarse sand	Fine sand	Silt	Clay					cm.h ⁻¹	class
0-20	3.10	49.10	32.10	19.40	S.L.	1.42	2.28	37.72	4.35	Moderate
20-40	3.60	44.00	30.30	22.10	L.	1.44	2.26	36.28		
40-60	4.00	42.40	29.60	24.00	L.	1.57	2.25	30.22		
60-80	2.90	40.10	30.90	25.10	L.	1.56	2.3	32.17		
80-100	1.60	37.50	34.30	26.60	S.L.	1.56	2.3	32.17		

S.L =sandy loam

L = loamy

Table (2): Soil moisture retention curve (pf) (w/w %) of the studied soil.

Soil depth (cm.)	Moisture retention (bar)								Available soil water (%)	Available soil water (mm/m)
	0.001	0.10	0.33	0.66	1.00	5.00	10.00	15.00		
0-20	50.42	27.38	26.32	23.37	20.65	17.24	15.11	13.23	13.09	185.8
20-40	50.49	27.51	26.61	23.29	20.72	17.31	15.22	13.47	13.14	189.2
40-60	50.54	28.11	27.23	23.41	20.83	17.35	15.37	14.03	13.20	207.2
60-80	50.63	28.26	27.43	23.83	20.75	17.51	15.43	14.21	13.22	206.2
80-100	50.63	28.26	27.43	23.83	20.75	17.51	15.43	14.21	13.22	206.2

Table (3): Some chemical properties of the soil under study

Soil depth (cm.)	Organic matter %	pH (soil water suspension)	EC _c dS /m	Cations (m mol L ⁻¹)				Anions (m molcL ⁻¹)			
				Na+	K+	Ca ²⁺	Mg ²⁺	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻
0-20	0.63	7.6	4.09	22.7 3	1.3 2	10.5 3	6.21	0	2.73	29.67	8.49
20-40	0.32	7.6	3.48	20.0 4	1.4 4	8.32	5.02	0	2.75	25.53	6.54
40-60	0.49	7.5	3.09	18.7 4	1.5 9	6.68	3.89	0	4.46	21.49	4.95
60-80	0.58	7.6	3.28	21.1 5	1.0 0	7.51	3.10	0	4.22	22.92	5.62
80-100	0.33	7.7	3.47	23.5 2	0.6 0	8.40	2.14	0	3.36	24.77	6.53

Table (4): CaCO₃ content, CEC and exchangeable Cations of the soil under study

Soil depth (cm.)	CaCO ₃	CEC c molc kg ⁻¹	Exchangeable Cations (c molc kg ⁻¹)			
			NA ⁺	K ⁺	Ca ²⁺	Mg ²⁺
0-20	28.50	20.06	7.15	1.42	8.36	2.93
20-40	28.90	19.42	7.11	1.31	8.13	2.87
40-60	29.80	19.62	7.48	1.37	7.87	2.9
60-80	29.90	20.24	8.07	1.23	8.21	2.71
80-100	30.10	20.24	8.07	1.23	8.21	2.71

2- Meteorological data.

Data in Table(5) through the summer season (Jun to Oct.) indicates that the average maximum air temperature value ranges between 27.00c° and 31.2c° while the minimum temperature value ranges from 17c° in Oct to 24.4c° in September .

The relative humidity is nearly high and reaches its maximum value in July 70.0 %

The sunshine hours vary from 12.00h in July to 9.2h in October while the wind velocity ranges from 2.81 m/ sec in October to 3.92 m/sec in July.

The total rainfalls occurred through September and October months were 5.58 and 59.94 mm, respectively

Table (5): Meteorological data of Maryut area as average of 30 years

Element	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
Max. Tep.	17.50	17.50	22.50	25.00	27.50	30.00	30.00	32.50	30.00	27.50	23.00	20.00	25.25
Min. Tep.	7.50	7.50	12.50	12.50	15.00	20.00	22.50	22.50	20.00	17.50	14.00	10.00	15.13
Avg. Tep.	12.50	12.50	17.50	17.50	21.25	25.0	26.25	27.50	25.00	22.50	18.50	15.00	20.19
Mean RH	70.00	70.00	60.00	60.00	60.00	60.00	70.00	70.00	70.00	70.00	70.00	70.00	66.67
Wind speed (m/sec)	3.97	3.97	4.10	3.87	3.60	3.60	3.92	3.60	3.28	2.81	3.04	3.69	3.62
Sunshine(hour)	6.60	7.60	8.30	9.20	10.40	11.90	12.00	11.30	10.40	9.20	7.40	6.50	9.23
Rs (MJ/m2/d)	11.60	15.00	18.80	22.40	25.30	27.90	27.80	25.70	22.20	17.70	12.90	10.90	19.85
G (MJ/m2/d)	0.35	0.00	0.70	0.18	0.35	0.53	0.18	0.18	0.35	0.35	0.56	0.49	0.00
Ra - G	4.75	6.72	8.87	12.11	14.05	15.97	15.32	15.32	12.86	9.10	5.95	4.39	10.55
Total rain (mm)	50.00	25.00	15.00	5.00	1.00	0.00	0.00	0.00	1.00	10.00	20.00	35.00	162.0
S =Kpa / oC	0.095	0.95	0.116	0.126	0.165	0.189	0.199	0.215	0.189	0.165	0.126	0.110	0.149

RH: relative humidity %

Ra: net radiation at the crop surface ($\text{MJ.m}^{-2}.\text{day}^{-1}$)

G: soil heat flux density ($\text{MJ.m}^{-2}.\text{day}^{-1}$)

S: slope of the saturation vapor pressure curve (1.08:1.34) average 1.26

Rs: solar radiation in equivalent evaporation (mm/day)

3- Irrigation systems.

Three irrigation systems were used to irrigate the grown plant. The system consists of a diesel pump (18m³/h, flow rate), it takes water from open subsurface tank (75m³) capacity through two filter units, the first one is a screen (130 meshes) and the other is a gravel filter.

The filtration system is controlled, by safety valve, relief valve, four control valves, pressure regulator unit, flow meter unit, air tank (balloon) unit, 6.4 mm pressure meter.

The manifold is 50 – mm PVC pipeline with 50 mm end plug for flushing. The drippers (emitters) were with a flow rate of 4L/h (GR) installed in 16 mm polyethylene laterals.

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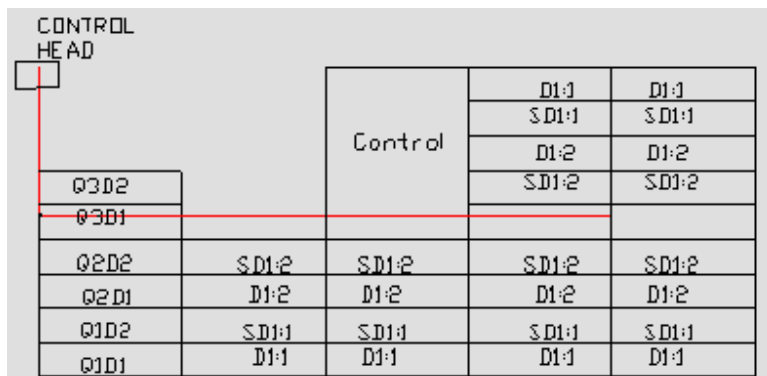


Fig (1): The irrigation system and treatments.

3-1 - Surface drip irrigation (two techniques)

- a) One line of drippers (GR 4 l / hr and the distance between drippers is 50 cm) for one line of plants (D1:1).
- b) One line of drippers for two lines of plants (D1:2).

3- 2 - Subsurface drip irrigation.

- a) One line of drippers (GR 4 l / hr and the distance between drippers is 30 cm) for one line of plants (SD1:1).
- b) One line of drippers for two lines of plants (SD1:2).

3- 3 – Gated pipes (GP).

160 mm in diameter aluminum pipes were used with gates located at 70 cm spacing .The one gate discharge is 0.5L/s

The system consists of a diesel pump (18m³/h, flow rate), it takes water from open subsurface tank (c75m³) capacity through two filter units , the first one is a screen (130 mesh) and the other is a gravel filter .

4- Measuring of discharge (Q).

According to **Awady, (1978)** the discharge was measured by a direct method using volume and time. This is one of the simplest and most accurate methods, the equation is $Q = v / t$

Where

Q = discharge in (L/h)

V = volume in (liter)

t = time (hour)

RESULTS AND DESCUTION

1- Effect was studied of soil water depletion on fresh and dry masses (ton/fed.) of first and second cuts of the sorghum plants grown in the two studied seasons.

2- Results in illustrated graphically in Figs. 2 and 3 indicate that irrigation under 30% soil water depletion resulted in significantly higher values for fresh and dry weights of the sorghum plants in both cuts of both the two seasons of cultivation These results agree with those of **Byer and. Mcphphrsoh (1975),.Eck(1986)and Hawell et al. (1995)**

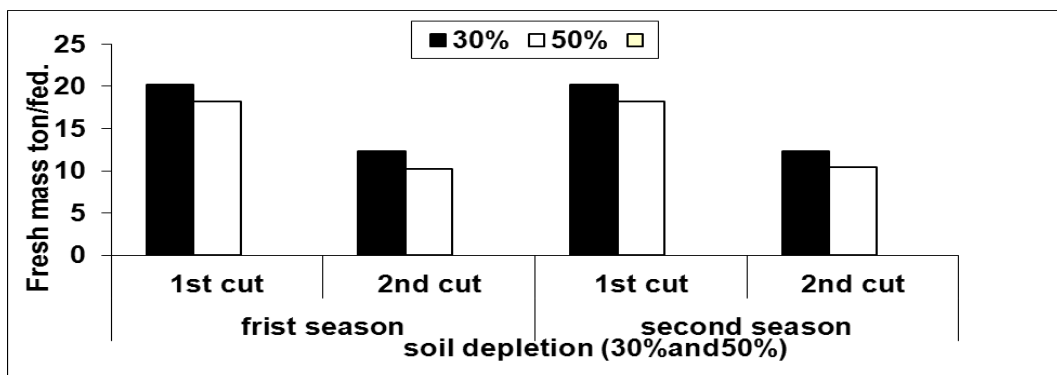


Fig (2): Effect of soil water depletion on fresh mass (ton/fed.) of first and second cuts of the sorghum grown in the two studied seasons

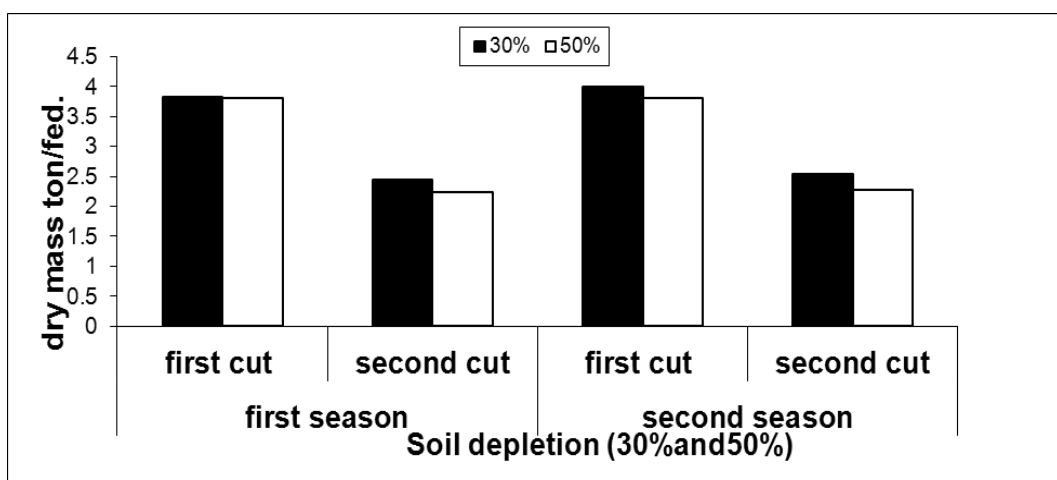


Fig (3): Effect of soil water depletion on dry mass (ton/fed.) of first and second cuts of the sorghum grown in the two studied seasons.

3- Effect of irrigation water quantity on fresh and dry masses (ton/fed.) of first and second cuts of the sorghum grown in the two seasons.

Fig (4 and 5) indicate that water quantities had significant effects on fresh and dry weights of the first and second cuts of the sorghum plants grown in the two seasons. The highest values of yield were noticed under the applied irrigation water quantity (100%) of reference evapotranspiration (ET_0). These results stand in well agreement with those of (Neelan and Rajput, 2007) who found that irrigation levels resulted in significant differences in both years on yield and its component

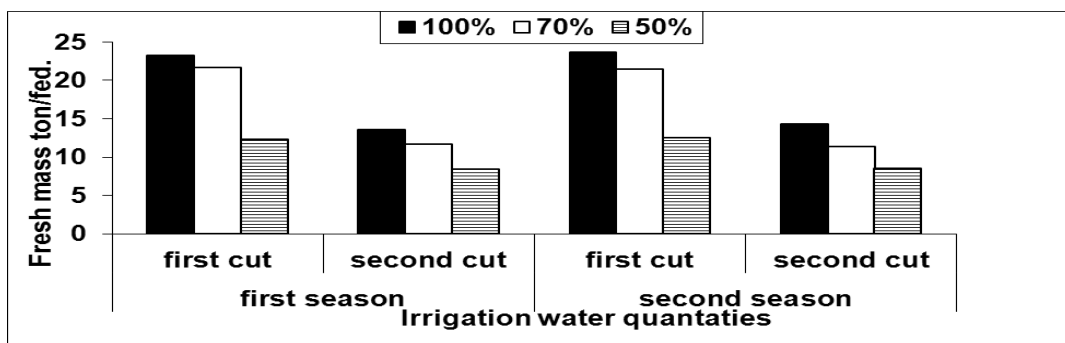


Fig (4): Effect of irrigation water quantity on fresh mass (ton/fed.) of the first and second cuts at the two studied seasons

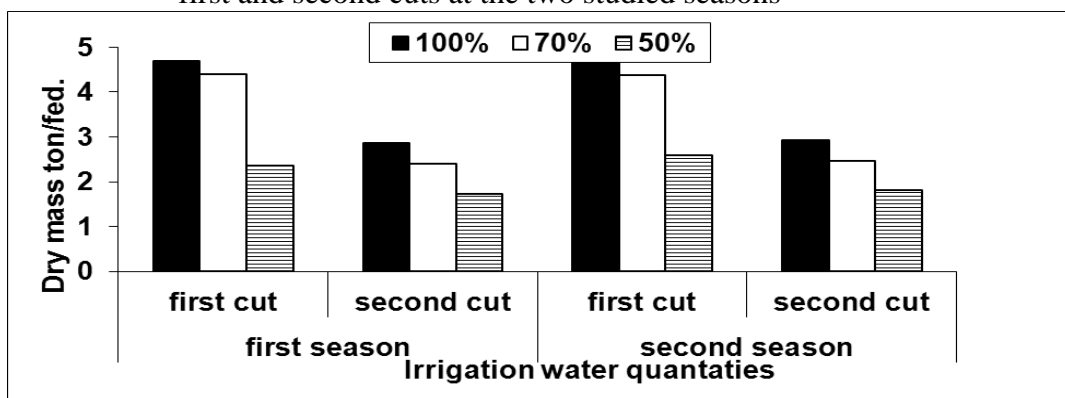


Fig (5): Effect of irrigation water quantity on dry mass (ton/fed.) of the first and second cuts of the sorghum plants in the two studied seasons.

4- Effect of the irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts of the sorghum plants in the two studied seasons.

Fig (6) indicates that non of the used irrigation methods (surface and subsurface drip irrigations) could result in a significant difference on yield. However SD1:1 method resulted in higher fresh weight than GP, D1:2and SD1:2, for first cut in season 2006 .On the other hand, D1:1 resulted in the highest yields in the second season for both the first and second cuts, D1:1 resulted in the highest dry weight for the first cut, where as SD1:1 resulted in the highest dry yield of the second cut. The same results were noticed at the second season .These results agree with those of (Phene et al., 1987) who demonstrated significant yield increases

with the use of high frequency SDI. (Hutmatcher et al., 1996) demonstrated yield increases in alfalfa production using SDI.

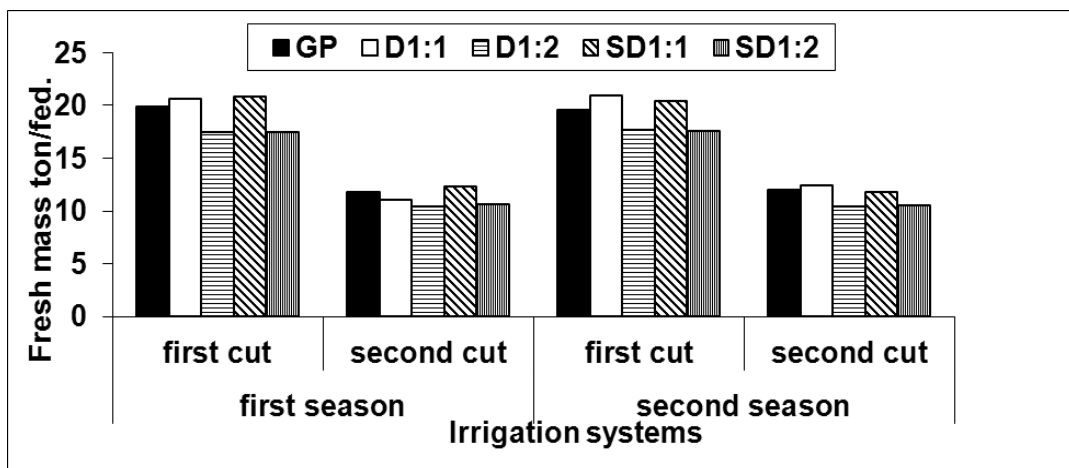


Fig (6): Effect of irrigation system on fresh mass (ton/fed.) of the first and second cuts of sorghum grown in the two studied seasons

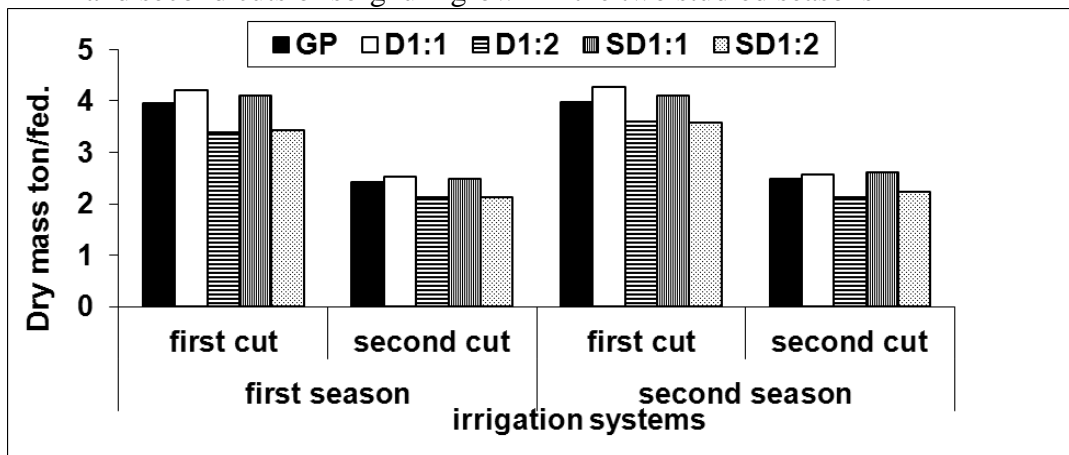
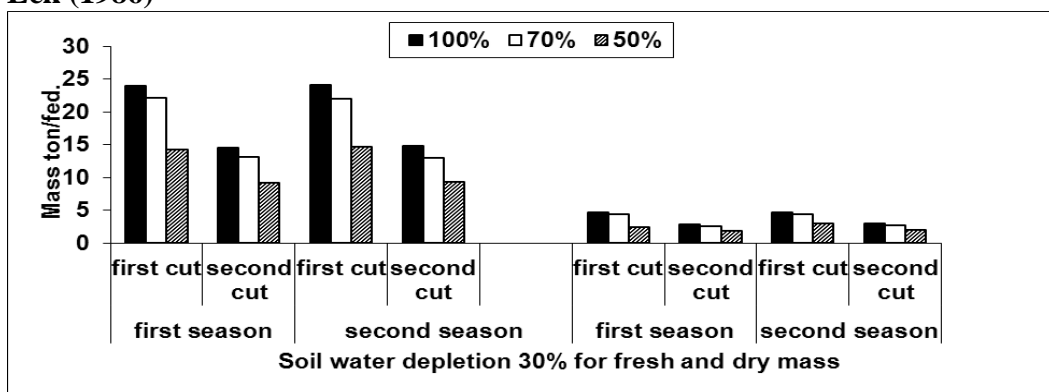


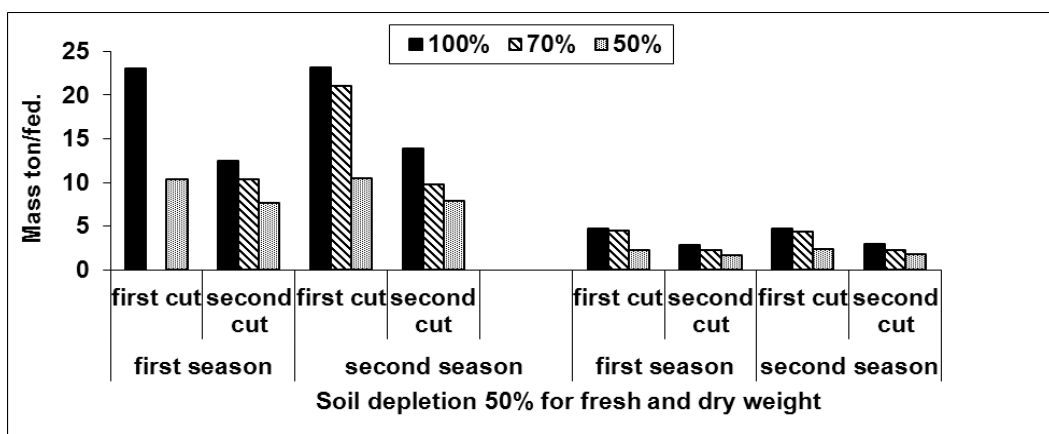
Fig (7): Effect of irrigation system on dry mass (ton/fed.) of the first and second cuts of sorghum grown in the two studied seasons.

5- Effect of interaction between soil water depletion and irrigation water quantity on fresh and dry masses (ton/fed.) of first and second cuts in the two studied seasons

Data of interaction effect between soil water depletion and water quantities on fresh and dry weights at the two studied seasons indicated that, increasing water quantities together with 30% soil water depletion resulted in highly significant increases in both fresh and dry yields of the 1st and 2nd cuts in both the two successive cultivation seasons. On the other hand decreasing applied water quantities with increasing soil water depletion caused fresh and dry weights of the first and second cuts in the two successive seasons to decrease. These results coincide with those of Eck (1986)



Fig(8):Effect of interaction between soil water depletion (30%) and irrigation water quantity on fresh and dry mass (ton/fed.) of the first and second cuts of sorghum grown the two successive seasons.



Fig(9):Effect of interaction between soil water depletion (50%) and irrigation water quantity on fresh and dry mass (ton/fed.) of the first and second cuts of sorghum grown in the two successive seasons.

6- Effect of interaction between soil water depletion and irrigation system on fresh and dry mass (ton/fed.) of the first and second cuts of sorghum grown in the two successive seasons

Data presented in Table (11) and illustrated graphically in Figs. (10) and (11) reveal the interaction effect between soil water depletion and irrigation systems on fresh and dry weights of the first and second cuts in both studied seasons. The interaction between soil water depletion 30% and the SD1:1 system resulted in the maximum values of both fresh weights of the two cuts in the first seasons. However, D1:1 system resulted in the highest fresh weight values of the first and second cuts in the second seasons beside of the highest dry weight of the first and second cuts in the first and second seasons. The results obtained herein are in agreement with those of (Eck, 1986)

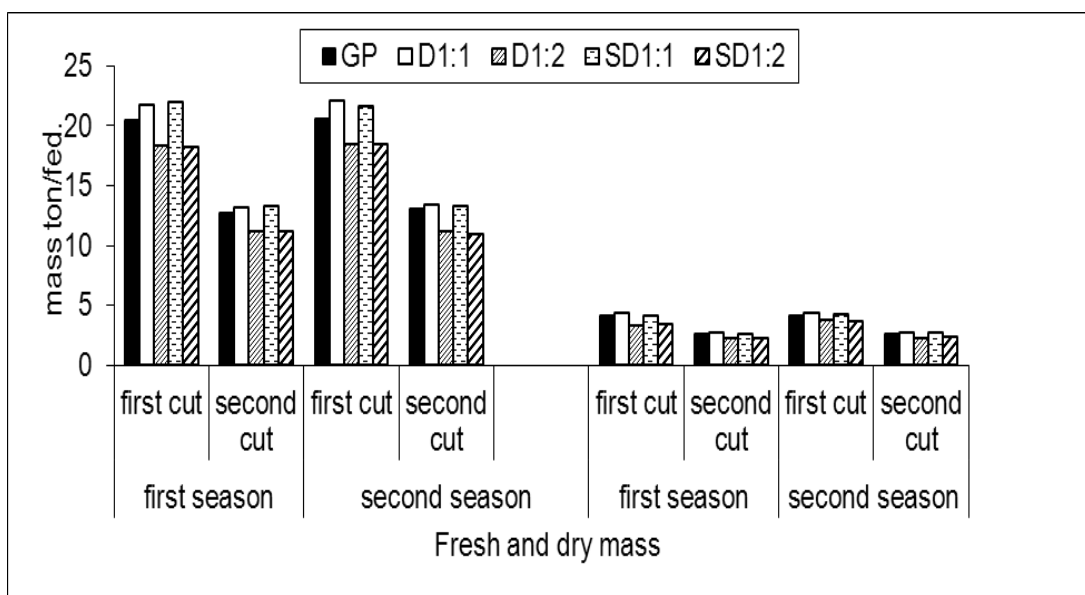


Fig (10): Effect of interaction between soil water depletion (30%) and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts of the sorghum grown in the two seasons

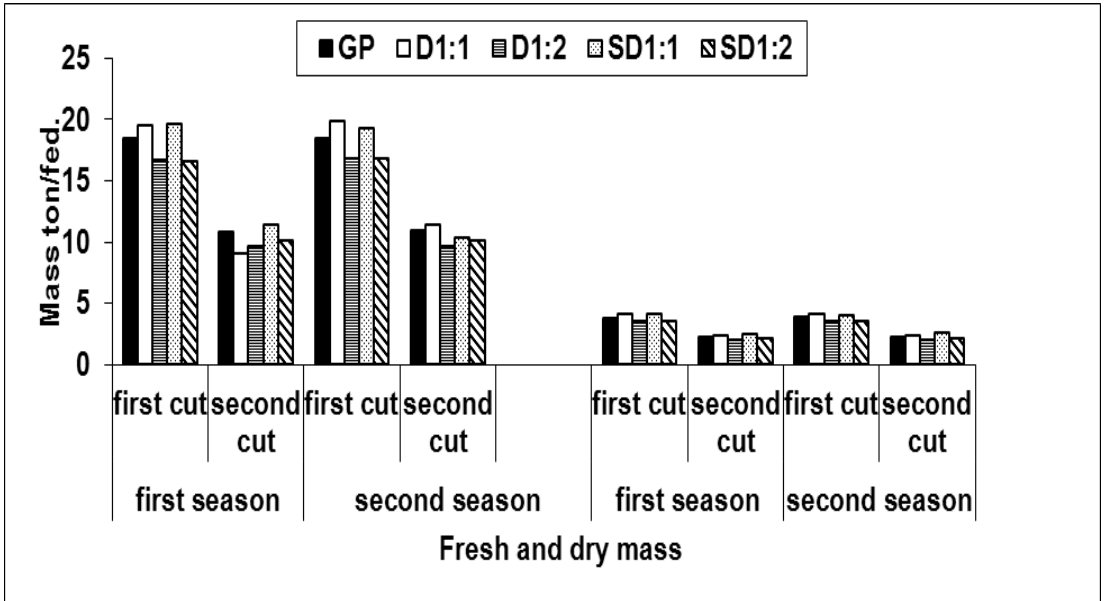


Fig (11): Effect of interaction between soil water depletion (50%) and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts of the sorghum grown in the two seasons

7- Effect of the interaction between irrigation water quantity and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts of the sorghum grown in the two successive seasons

The interaction effects between water quantities and irrigation systems on fresh and dry weights for two cuts in the two seasons are presented in Table(6).The interaction between water quantity applied at 100% ET and the irrigation systems D1:1 and SD1:1 seemed to be of the highest significant effect on fresh and dry weights of the first and second cuts of sorghum grown in both the studied two seasons.

Table (6): Effect of irrigation water quantity and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts at the two successive seasons.

Treatments		Fresh mass (ton/fed.)				Dry mass (ton/fed.)			
Water use	Irri. System	1 st season		2 nd season		1 st season		2 nd season	
		1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut
100 %	GP	23.72	14.63	23.83	14.98	4.79	2.94	4.77	3.01
	D 1:1	25.20	11.54	25.61	15.29	5.06	2.99	5.16	3.08
	D 1:2	21.65	13.00	21.87	13.01	4.20	2.62	4.39	2.61
	SD 1:1	25.14	15.04	25.18	15.09	5.05	3.14	5.05	3.20
	SD 1:2	21.66	13.64	21.71	13.48	4.37	2.76	4.36	2.73
70 %	GP	21.33	11.94	21.41	12.15	4.34	2.44	4.35	2.53
	D 1:1	22.93	12.43	22.96	12.53	4.66	2.55	4.66	2.60
	D 1:2	20.80	10.94	20.82	10.81	4.21	2.25	4.24	2.23
	SD 1:1	22.73	12.49	21.68	10.87	4.62	2.55	4.40	2.62
	SD 1:2	20.61	10.90	20.66	10.59	4.20	2.23	4.20	2.40
50 %	GP	13.39	8.85	13.41	8.92	2.73	1.88	2.80	1.90
	D 1:1	13.77	9.38	14.37	9.49	2.95	2.03	3.00	2.01
	D 1:2	9.98	7.17	10.24	7.32	1.73	1.52	2.14	1.56
	SD 1:1	14.37	9.36	14.41	9.43	2.62	1.72	2.84	2.01
	SD 1:2	9.96	7.29	10.26	7.35	1.71	1.40	2.13	1.57
LSD	0.05	1.64	1.34	1.87	1.42	0.32	0.24	0.41	0.31
	0.01	2.19	1.79	2.49	1.89	0.42	0.32	0.54	0.41

8- Effect of the interaction between soil water depletion, irrigation water quantity and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts of sorghum grown in the two seasons

The results presented in Table (7) indicated that the maximum values of fresh and dry masses were noticed under the interaction between 100%ET and soil water depletion 30% with D1:1 irrigation system.

Table (7): Effect of soil water depletion, irrigation water quantity and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts at two seasons.

Treatments			Fresh mass (ton/fed.)				Dry mass (ton/fed.)			
Depletion	Water quantity	Irri. system	1 st season		2 nd season		1 st season		2 nd season	
			1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut
30 %	100 %	GP	24.14	15.52	24.43	16.10	4.80	3.06	4.79	3.19
		D 1:1	25.82	15.69	26.02	16.32	5.09	3.11	5.16	3.24
		D 1:2	21.97	13.16	22.21	13.26	4.00	2.60	4.38	2.60
		SD 1:1	25.86	15.87	25.87	15.98	5.08	3.15	5.08	3.16
		SD 1:2	21.95	12.92	21.98	12.58	4.32	2.57	4.33	2.50
	70 %	GP	22.00	13.16	22.08	13.27	4.36	2.64	4.37	2.75
		D 1:1	23.50	13.67	23.50	13.72	4.66	2.76	4.66	2.83
		D 1:2	21.11	12.64	21.15	12.43	4.17	2.57	4.20	2.55
		SD 1:1	23.31	13.66	22.17	13.71	4.62	2.75	4.41	2.86
		SD 1:2	20.93	12.49	21.00	11.91	4.16	2.52	4.18	2.86
	50 %	GP	15.35	9.62	15.42	9.76	3.10	1.99	3.11	2.02
		D 1:1	15.82	10.26	16.70	10.31	3.33	2.12	3.36	2.13
		D 1:2	11.80	7.71	11.99	7.77	1.67	1.59	2.42	1.61
		SD 1:1	16.62	10.18	16.91	10.14	2.47	1.76	3.08	2.10
		SD 1:2	11.82	8.03	12.11	8.09	1.66	1.36	2.42	1.68
50 %	100 %	GP	23.29	13.73	23.23	13.87	4.78	2.81	4.75	2.84
		D 1:1	24.59	7.38	25.20	14.25	5.04	2.88	5.16	2.93
		D 1:2	21.33	12.83	21.53	12.76	4.39	2.64	4.41	2.62
		SD 1:1	24.43	14.21	24.48	14.19	5.01	3.13	5.01	3.23
		SD 1:2	21.38	14.37	21.44	14.38	4.41	2.94	4.39	2.96
	70 %	GP	20.65	10.72	20.73	11.03	4.31	2.23	4.32	2.30
		D 1:1	22.36	11.18	22.42	11.33	4.66	2.33	4.66	2.37
		D 1:2	20.49	9.25	20.48	9.18	4.24	1.93	4.27	1.91
		SD 1:1	22.14	11.33	21.19	8.03	4.62	2.36	4.38	2.37
		SD 1:2	20.29	9.32	20.32	9.26	4.23	1.94	4.23	1.94
	50 %	GP	11.43	8.08	11.39	8.09	2.37	1.76	2.48	1.77
		D 1:1	11.71	8.50	12.03	8.66	2.56	1.94	2.64	1.89
		D 1:2	8.15	6.62	8.49	6.86	1.78	1.45	1.86	1.50
		SD 1:1	12.13	8.54	11.92	8.73	2.77	1.68	2.60	1.92
		SD 1:2	8.10	6.55	8.40	6.61	1.77	1.43	1.83	1.46
LSD	0.05		2.32	1.90	2.64	2.01	0.45	0.34	0.57	0.44
	0.01		3.09	2.53	3.52	2.68	0.59	0.46	0.76	0.59

Table (8): Average WUE for sorghum crop (dry weight kg/m³)

WQ	D	GP	D1:1	D1:2	SD1:1	SD1:2
Q1	D1	3.32	3.86	3.19	3.73	3.61
	D2	3.55	4.18	3.68	3.97	3.99
Q2	D1	4.29	4.84	4.39	4.86	4.48
	D2	4.23	5.1	4.54	5.12	4.62
Q3	D1	4.17	4.91	3.38	4.59	3.4
	D2	3.6	4.28	3.17	4.38	3.2

Data presented in Table (8) reveal that mean values of water use efficiency seemed to be dependent on quantity of the irrigation water, type of the irrigation system and soil water depletion percentage. Application of the irrigation water at 70% of ET resulted in higher values of WUE than the other applied quantities i.e. 100% and 50% of ET did , where , irrigation at 50% depletion of the available water resulted in higher values of WUE under the all used irrigation systems and all rates of the applied water except when irrigation water was applied at its lowest ratio i.e. 50% of ET .Also the irrigation system SD1:1 resulted in the highest mean values of WUE , as compared with the other studied systems . However the interaction between water applied at a rate of 70% of ET and 50% depletion of available water under D1:1 irrigation system seemed to be of the highest effect on average value of WUE.

CONCLUSION

The crop yield is significantly affected by both of applied water quantity and soil water depletion where it was found that decreasing quantity of the applied water significantly decreased crop yield. Centray to that, crop yield in creases by decreasing soil available water depletion. On the other hand, variation in irrigation water system did not significantly affect crop productivity.

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الملخص العربي

خدمة الري وانتاجية السورجم تحت ظروف الاراضى الجيرية

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الري السطحي هو أكثر طرق الري المستخدمه لامداد المحصول باحتياجاته المائية انتشارا وشيوعا على مستوى مصر ولكن مع الزيادة المستمرة للسكان وزيادة الفجوة الغذائية ومع ندرة المياه كان لا بد من الاتجاه الى تطوير الري وادخال تقنيات حديثة تمكن من الاستخدام الامثل لنقطة المياه وامداد المحصول بالاحتياجات الفعلية من المياه دون اهدار وكذلك عدم تعريض المحصول لشد رطوبى يؤثر على انتاجيته لذلك اجريت تلك الدراسة بمحطة بحوث مريوط بمحافظة الاسكندرية التابعة لمركز بحوث الصحراء خلال عامى ٢٠٠٦ و٢٠٠٧ حيث تم اختبار ٥ تقنيات للري

١- الري بالانابيب المبوبة GP

٢- الري بالتنقيط السطحي D

أ- خط رى لكل خط نبات D1:1

ب- خط رى لكل خطين نبات D1:2

٣- الري بالتنقيط تحت سطحى SD

ا-خط رى لكل خط نبات SD1:1

ب-خط رى لكل خطين نبات SD1:2

١- مركز بحوث الصحراء – المطرية – القاهرة ٢- قسم الهندسة الزراعية – كلية الزراعة – جامعة بنها

أوضحت نتائج التحليل الإحصائي زيادة عالية المعنوية في جميع المعايير موضع الدراسة بزيادة كمية مياه الري المضافة. تم الحصول علي أعلى ققيم للوزن الطازج وهي ٤١.٧٣ ، ٤١.٥١ ، ٣٩.٦٦ طن / فدان مع المعاملات ، SD1:1 ، D1:1 ، GP علي الترتيب وكذلك عند إضافة ١٠٠ % من الإحتياجات المائية وعند إستنفاد ٣٠ % من الماء الميسر في التربة وذلك خلال عام ٢٠٠٦ في حين أن أعلى قيم للوزن الجاف وهي ٨.٢٣ ، ٨.٢٠ ، ٧.٩ طن / فدان تم الحصول عليها بإتباع المعاملات SD1:1 ، D1:1 ، GP تحت ١٠٠ % من الإحتياجات المائية وعند استنفاد ٣٠ % من الماء الميسر. وخلال عام ٢٠٠٧ كانت أعلى ققيم للوزن الطازج هي ٤٢.٥٥ ، ٤١.٨٥ ، ٤٠.٥٣ طن / فدان وذلك للمعاملات SD1:1 ، D1:1 ، GP علي الترتيب في حين أن أعلى ققيم للوزن الجاف وهي ٨.٤ ، ٧.٩٨ ، ٧.٢٧ طن / فدان تم التوصل إليها في ظل المعاملات SD1:1 ، D1:1 ، GP تحت ١٠٠ % من الإحتياجات المائية وعند استنفاد ٣٠ % من الماء الميسر. كذلك أوضحت الدراسة أن كفاءة استخدام الماء WUE تقل بزيادة كمية الماء المضاف.

التوصيات

تمت الدراسة تحت ثلاث كميات من المياه ١٠٠%-٧٠% و ٥٠% من كمية المياه المحسوبة من معادلة بنمان مونتيث المعدلة مع نسبتي استنفاد ٣٠% و ٥٠% من الماء الميسر المتاح بمنطقة الجزورز وأظهرت النتائج أن

١- يتأثر إنتاج المحصول معنويا بكل من كميات المياه ونسبة الاستنفاد، حيث انه بنقص كمية المياه يحدث نقص معنوي في المحصول . على العكس من ذلك يزيد المحصول بنقص نسبة الاستنفاد ، في حين اناختلاف نظم الري لم يكن له تأثير معنوي على انتاجية المحصول