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## Effect of the First Irrigation Time and Fertilization Treatments on Growth, Yield, Yield Components and Fiber Traits of Cotton

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**Abstract:** The field experiments were conducted during 2004 and 2005 seasons to study the effect of three first post planting irrigation times and ten fertilization treatments on growth, yield, yield components and fiber traits in cotton. The times of first post planting irrigation in a separate experiment were 20, 30 and 40 days from planting irrigation time in both seasons 2004 and 2005. A completely randomized block design with four replicate was used for each time of first irrigation. Each experiment of the first irrigation included ten of fertilizers treatments. Application the first irrigation after 40 days from planting resulted in the highest values of all growth characters. However, application of the first irrigation after 30 days from planting gave the highest values of all yield and yield components, except boll weight which recorded highest values with application the first irrigation after 20 days from planting. On the other hand, the lowest values of all growth, yield and yield components were recorded by application of the first irrigation after 20 days from planting in the two seasons, except boll weight which recorded the lowest values with application the first irrigation after 30 days from planting in the two seasons. Application the first irrigation after 40 days from planting gave the highest values of fiber strength and fiber length uniformity ratio (%). On the other hand, the lowest values of fiber strength and fiber uniformity ratio (%) were recorded by application the first irrigation after 20 days from planting over the two seasons. Maximum means of all studied characters were produced from fertilizing cotton plants with organic fertilizer + bio-fertilizer + 66% from recommended NPK in both seasons. On the contrary, the lowest values were obtained from plots received Bio-fertilizer alone, except fiber quality which the lowest values were obtained from plots received organic fertilizer alone. It can be concluded that applying first irrigation after 30 days from planting date and applying to soil bio-fertilizer (EM) at rate 5 L/fed., organic-fertilizer at rate 20 kg N/fed., in addition to application of 2/3 NPK from recommended may be maximize the productivity of cotton.

**Key words:** Irrigation time, growth, yield, cotton

### INTRODUCTION

Two field experiments were conducted during 2004 and 2005 seasons to study the effect first irrigation times and fertilizer treatments on growth, yield, yield component and fiber traits on cotton. First irrigation times is the most important that affecting growth, yield and its components and fiber quality of cotton crop. In this concern, Abou-El-Nour *et al.* (2001) reported that applying the first irrigation after 21 days from sowing date increased the number of open bolls/plant, boll weight, seed cotton yield/fed and earliness percentage. Applying the first irrigation after 36 days from sowing date increased plant height, length of inter-node and node number of the first branch, while it decreased the number of fruiting branches/plant at harvest. Ali (2002) stated that delaying the first irrigation significantly decreased plant height and leaf area.

Delaying the first irrigation also significantly delayed the maturity, decreased number of open bolls per plant, boll weight, seed cotton yield per plant and per fed. The first irrigation at 4 weeks after sowing date gave the best result and highest bolls. The maximum reduction in seed cotton yield per fad was 20% when the first irrigation was applied after 7 weeks from the sowing date while, the minimum was 5.4% when the first irrigation was done after 3 weeks as compared with the first irrigation applied after 4 weeks. EL-Menshawi *et al.* (2006) found that application the first irrigation after 28 days from sowing gave the tallest plants and the highest number of nodes per plant, however highest number of open bolls per plant, boll weight and seed cotton yield/fed. were obtained when the first irrigation was applied at 21 days after sowing. While, all fiber properties were not significantly affected by the date of the first irrigation.

Application of bio-fertilizer, organic fertilizer and the optimum levels of nitrogen, phosphorus and potassium fertilizers are main factors, which govern the balance between different vegetative and fruiting stage of cotton plant and consequently affected growth, yield, its components and lint quality properties (Dahatonde, 1996; Battisha, 1998; El-Tabbakh, 2002; Yaduvanshi, 2003; Das *et al.*, 2004).

For the aforementioned problems, this investigation was carried out to study effect of the first irrigation and fertilizer treatments on growth, yield and yield components and fiber characters in variety Giza 89.

**MATERIALS AND METHODS**

These experiments were conducted in private field at Shobrahour village, EL-Sinbelaween District, Dakahlia Governorate, during 2004 and 2005 seasons to study the effect of the first irrigation time and fertilizer treatments on growth, yield, yield components and fiber traits in Egyptian cotton variety Giza 89.

This study included three times of first post planting irrigation in a separate experiment. The times of first post planting irrigation were 20, 30 and 40 days from planting irrigation time in both seasons 2004 and 2005.

A Completely Randomized Block Design with four replicate was used for each time of first irrigation. Each experiment of the first irrigation included ten of fertilizers treatments as: F1-organic-fertilizer, F2-Bio-fertilizer, F3-organic fertilizer + bio-fertilizer, F4-organic-fertilizer + 1/3 from recommended NPK, F5-Bio-fertilizer + 1/3 from recommended NPK, F6-organic-fertilizer + bio-fertilizer + 1/3 from recommended NPK, F7-organic-fertilizer + 2/3 from recommended NPK, F8-Bio-fertilizer + 2/3 from recommended NPK, F9-organic-fertilizer + bio-fertilizer + 2/3 from recommended NPK and F10-Recommended NPK. organic fertilizer were produced from the cattle manure and applied at the rate of (20 N kg/fed.), while the bio-fertilizer Effective Micro-organisms (EM) at rate of 5 L/fed added with post planting irrigation. The experiments were laid out in a clay loam soil, its physical and chemical properties are shown in Table 1. Every plot was consists of five ridges, 7.0 m in length and 0.6 m in width (21 m<sup>2</sup> = 1/200 fed.) organic fertilizer and calcium super phosphate (15.5% P<sub>2</sub>O<sub>5</sub>) were applied during soil preparation. Cotton seeds were sown according to the usual dry method on 20th, 25th March in the first and second seasons, respectively. The other normal agricultural practices of growing cotton were kept the same as practice in the area as recommended by Ministry of Agriculture.

Table 1: Mechanical and chemical analysis of the experimental sites during 2004 and 2005 seasons

Soil contents	Season	
	2004	2005
<b>Mechanical analysis</b>		
Sand (%)	21.74	21.58
Silt (%)	29.39	30.10
Clay (%)	47.00	46.55
Organic matter	1.87	1.77
Texture	Clay loam	Clay loam
<b>Chemical analysis</b>		
Available N (ppm)	37.50	35.00
Available P (ppm)	4.00	5.00
Available K (ppm)	91.00	110.00
pH	7.76	7.70
EC (mmhos cm <sup>-1</sup> 25°C)	3.00	3.40

**Studied characters:**

**Vegetative traits:**

- Plant height (cm).
- Leaf Area Index (LAI): As the ratio of total leaf area per plant to the area of the land covered by the plant.

$$\text{Leaf Area Index (LAI)} = \frac{\text{Leaf area / plant}}{\text{The area of plant from the soil}}$$

**Yield and yield components traits:**

- Number of days to first flower opening was measured by counting number of days from planting to opening first flower on the labeled plants.
- Number of opened bolls per plant.
- Boll weight (g).
- Seed cotton yield Kentar/fed.

This trait was measured as the total seed cotton of each plot at harvest time, determined in kg/plot and sort seed cotton yield per plot×200 were [(1/200) = 21 m<sup>2</sup>] determined in kg/plot and then converted to Kentar/fed. (1 Kentar = 157.5 kg seed cotton).

**Fiber traits:** Measurements of lint properties were done in the international center for cotton testing and organization using High Volume Instrumentation (HVI) equipment.

- Fiber length.
- Fiber fineness.
- Fiber strength.
- Uniformity ratio (%).

**Statistical analysis:** All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the completely randomized plot design

(Gomez and Gomez, 1984), by means of MSTAT-C Computer software package. Then the combined analysis for the three times of the first post planting irrigation was done in each season according to the methods of Gomez and Gomez (1984). The treatment means were compared using the Newly Least Significant Differences (NLSD) according to Waller and Duncan (1969).

**RESULTS AND DISCUSSION**

**Effect of first irrigation time:** The statistical analysis of obtained results manifest that all growth characters i.e., plant height cm and Leaf Area Index (LAI) exhibited significant effect by first irrigation time in the two seasons. Noteworthy, application the first irrigation after 40 days from planting resulted in the highest values of all growth characters. On the other hand, the lowest values of all growth character were recorded by application the first irrigation after 20 days from planting in the two seasons (Table 2). These finding are in agreements with those obtained by Abou El-Nour *et al.* (2001) and Ali (2002).

From obtained data, all yield and its components i.e., number of fruiting branches per plant, number of opened bolls per plant, boll weight (g) and seed cotton yield Kentar/fed significantly affected due to the first irrigation time in the two seasons. Application the first irrigation after 30 days from planting gave the highest values of all

yield components, except boll weight which recorded the highest values with application the first irrigation after 20 days from planting. On the other hand, the lowest values of all yield component were recorded by application the first irrigation after 20 days from planting, except boll which weight recorded the lowest values with application the first irrigation after 30 days from planting in the two seasons (Table 2 and 3). The results are in partially conformable with those observed and discussed by Coker and Oosterhuis (2001) and Ogunwole *et al.* (2003).

Concerning, the time of first irrigation effect on fiber characters. First irrigation times had insignificantly effect on fiber length at 2.5% and fiber fineness in the two seasons. It can be noticed that fiber strength and fiber length uniformity ratio (%) had significant effect due to first irrigation times in the two growing seasons. Noteworthy, application the first irrigation after 40 days from planting gave the highest values of fiber strength and fiber length uniformity ratio (%). On the other hand, the lowest values of fiber strength and fiber length uniformity ratio (%) were recorded by application the first irrigation after 20 days from planting over the two seasons (Table 3). These findings were in general agreement with those obtained by El-Menshawi *et al.* (2006).

Such increase in all growth characters and yield and its components due to application the first irrigation after 30 days from sowing is mainly reflected to its effect in balance moisture in the root zone which led to highest

Table 2: Means of plant height cm, Leaf Area Index (LAD), number of fruiting branches per plant, number of opened bolls per plant and boll weight as affected by first irrigation time and fertilization treatments in 2004 and 2005 seasons

Treatments	Plant height		Leaf area index (LAI)		No. of fruiting branches per plant		No. of opened bolls per plant		Boll weight (g)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
<b>First irrigation time</b>										
1-20 days	107.80	112.00	4.20	4.16	13.28	12.78	13.58	13.67	2.54	2.50
2-30 days	109.90	123.70	4.67	4.81	13.71	13.92	17.40	17.05	2.23	2.23
3-40 days	124.90	124.60	4.99	5.05	13.70	13.67	17.00	15.20	2.24	2.38
F-test	**	**	**	**	*	**	**	**	**	**
New LSD 5%	1.00	1.27	0.04	0.06	0.28	0.24	0.53	0.55	0.15	0.12
New LSD 1%	1.29	1.79	0.07	0.10	-	0.34	0.75	0.78	0.25	0.20
<b>Fertilization</b>										
1-F1	94.50	102.20	3.98	4.11	12.60	12.44	11.14	10.98	1.96	1.96
2-F2	93.70	100.50	3.86	3.94	12.34	12.01	10.73	9.90	1.85	1.82
3-F3	99.50	102.90	4.22	4.19	12.95	12.75	12.66	11.56	2.15	2.10
4-F4	105.70	111.00	4.56	4.63	13.41	12.87	15.65	15.77	2.35	2.29
5-F5	104.10	108.10	4.50	4.40	13.56	13.62	15.15	14.04	2.27	2.23
6-F6	114.00	122.00	4.80	4.78	13.82	13.99	17.35	16.18	2.41	2.42
7-F7	127.30	134.60	5.03	5.12	14.06	14.07	19.20	17.98	2.59	2.67
8-F8	125.50	133.60	4.88	4.86	13.90	14.07	18.61	17.34	2.47	2.54
9-F9	139.80	144.60	5.39	5.40	14.63	14.39	20.98	20.02	2.72	2.86
10-F10	137.80	141.90	4.97	5.28	14.33	14.26	15.50	19.32	2.64	2.79
F-test	**	**	**	**	**	**	**	**	**	**
New LSD 5%	1.03	1.25	0.10	0.14	0.25	0.34	0.44	0.87	0.16	0.15
New LSD 1%	2.09	1.71	0.15	0.21	0.34	0.45	0.58	1.15	0.31	0.24
<b>Interaction A×B</b>										
F-test	**	**	**	**	NS	NS	NS	NS	NS	NS

\*: Significant, \*\*: Highly Significant, NS: Non Significant

Table 3: Means of seed cotton yield span length at 2.5%, fiber fineness, fiber strength and uniformity % as affected by first irrigation time and fertilization treatments in 2004 and 2005 seasons

Treatments	Seed cotton yield (Kentar/fed.)		Span length at 2.5%		Fiber fineness (micronaire value)		Fiber strength (g/tex)		Uniformity (%)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
<b>First irrigation time</b>										
1-20 days	9.01	8.96	31.66	31.71	4.41	4.35	41.47	41.51	86.27	86.64
2-30 days	10.39	10.32	31.70	31.71	4.36	4.32	42.01	41.98	86.60	86.66
3-40 days	10.00	10.19	31.72	31.77	4.30	4.31	42.25	42.29	87.11	87.36
F-test	**	**	NS	NS	NS	NS	**	**	**	**
New LSD 5%	0.30	0.44	-	-	-	-	0.12	0.07	0.34	0.16
New LSD 1%	0.39	0.63	-	-	-	-	0.19	0.11	0.51	0.24
<b>Fertilization</b>										
1-F1	6.25	6.43	30.34	30.60	4.16	4.10	40.33	40.18	85.59	85.95
2-F2	5.94	5.91	30.65	30.64	4.28	4.20	42.13	40.74	85.75	86.28
3-F3	7.23	7.87	31.20	31.12	4.45	4.38	41.98	40.93	86.13	86.40
4-F4	9.69	8.92	31.21	31.63	4.28	4.28	41.34	41.55	86.33	86.55
5-F5	8.55	8.59	31.77	31.69	4.30	4.35	42.30	42.08	86.46	86.94
6-F6	10.72	9.85	32.09	31.95	4.50	4.48	42.45	42.16	86.85	86.71
7-F7	12.25	12.38	32.18	32.04	4.33	4.34	40.92	42.50	87.17	87.13
8-F8	11.68	11.32	32.30	32.30	4.33	4.41	43.38	42.96	87.25	87.48
9-F9	13.02	13.74	32.74	32.69	4.51	4.50	43.57	43.81	87.61	87.86
10-F10	9.69	13.22	32.48	32.61	4.43	4.26	40.72	42.38	87.45	87.57
F-test	**	**	**	**	**	**	**	**	**	**
New LSD 5%	0.48	0.53	0.08	0.11	0.04	0.07	0.16	0.25	0.38	0.34
New LSD 1%	0.63	0.70	0.10	0.15	0.07	0.14	0.22	0.34	0.51	0.46
<b>Interaction A×B</b>										
F-test	NS	NS	**	**	**	**	**	**	NS	NS

\*\* : Highly Significant, NS: Non Significant

Table 4: Means of plant height, Leaf Area Index (LAI) and lint percentage as affected by the interaction between first irrigation times and fertilization treatments in 2004 and 2005 seasons

Treatments	Time of the first irrigation																	
	Plant height (cm)						Leaf area index (LAI)						Lint percentage (%)					
	2004			2005			2004			2005			2004			2005		
	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40
	(days)																	
1-F1	90.5	80.8	112.3	91.7	102.2	112.5	3.62	4.13	4.19	3.81	4.27	4.26	38.70	39.33	39.86	38.79	39.91	40.00
2-F2	89.7	79.9	111.5	87.7	102.1	111.7	3.57	4.02	4.01	3.60	4.05	4.16	39.00	40.00	41.98	39.07	40.15	42.20
3-F3	92.3	91.3	114.8	89.8	104.1	114.8	3.95	4.18	4.53	3.87	4.34	4.37	37.97	39.06	39.88	37.98	39.42	39.90
4-F4	95.3	104.3	117.4	107.5	107.4	118.2	4.33	4.81	4.55	4.01	4.85	5.03	38.11	39.21	39.84	38.15	39.29	39.97
5-F5	93.1	104.6	114.7	101.8	107.5	115.0	4.08	4.33	5.11	3.75	4.59	4.88	37.92	38.92	39.88	37.99	39.28	39.93
6-F6	99.3	120.8	122.0	120.4	123.8	121.7	4.49	4.86	5.06	4.16	5.05	5.13	37.76	38.81	39.00	37.80	38.89	39.09
7-F7	123.6	126.8	131.6	126.2	142.0	135.5	4.36	5.16	5.57	4.61	5.15	5.59	37.81	38.90	39.33	37.83	38.95	38.40
8-F8	119.2	123.7	133.5	129.5	138.1	133.2	4.53	4.84	5.27	4.22	5.15	5.22	37.65	38.61	38.97	37.68	38.57	39.00
9-F9	141.1	134.1	144.3	133.8	155.9	144.1	5.05	5.28	5.83	4.88	5.34	6.00	37.33	38.19	38.68	37.58	38.11	38.70
10-F10	133.8	132.4	147.1	131.7	154.4	139.7	4.03	5.12	5.77	4.68	5.33	5.83	37.40	38.23	38.77	37.60	38.17	38.81
F-test	**			**			**			**			**			**		
New LSD 5%	2.9			2.4			0.15			0.21			0.15			0.22		
New LSD 1%	3.8			3.1			0.20			0.28			0.20			0.28		

\*\* : Highly Significant

production in the metabolism processes such as moisture and nutrients in the root zone and easy absorption of the other elements, to yield and yield component traits. The present findings are in complete conformity with those reported by Ali (2002).

**Effect of fertilizer treatments:** As shown from Table 2 and 3 with respect to the effect of fertilizer treatments on all growth attributes, yield and its components as well as

fiber quality under study, it was highly significant in the two seasons of this study. Maximum means of all studied characters were produced from fertilizing cotton plants with organic fertilizer + bio-fertilizer + 66% from recommended NPK in both seasons under the circumstance of this study. On the contrary, the lowest values were obtained from plots received Bio-fertilizer alone (F2). Except fiber quality the lowest values were obtained from plots received organic fertilizer alone (F1).

Table 5: Means of span length at 2.5%, fiber fineness as affected and fiber strength by the interaction between first irrigation time and fertilization treatments in 2004 and 2005 seasons

Treatments	Time of the first irrigation																	
	Span length at 2.5%						Fiber fineness (Micronaire value)						Fiber strength (g/tex)					
	2004			2005			2004		2005		2004		2005		2004		2005	
	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40	20	30	40
	(days)																	
1-F1	29.79	30.71	30.52	30.47	30.50	30.82	4.31	4.11	4.06	4.35	4.09	3.88	39.90	40.33	40.43	39.68	40.24	40.63
2-F2	30.54	30.76	30.66	30.65	30.75	30.52	4.47	4.20	4.18	4.47	4.22	3.91	41.91	42.12	42.37	39.76	41.35	41.11
3-F3	31.25	30.94	31.41	31.21	31.19	30.97	4.58	4.38	4.41	4.59	4.37	4.19	41.21	42.18	42.55	40.03	41.55	41.20
4-F4	30.83	31.45	31.36	31.62	31.62	31.66	4.51	4.13	4.19	4.42	4.18	4.25	40.22	41.88	42.25	40.59	41.76	42.31
5-F5	31.52	31.89	31.92	31.61	31.65	31.82	4.51	4.20	4.19	4.50	4.29	4.28	42.17	42.22	42.52	41.62	42.18	42.44
6-F6	32.36	31.91	32.01	31.76	32.03	32.05	4.57	4.51	4.45	4.62	4.51	4.31	42.07	42.61	42.68	41.84	42.22	42.43
7-F7	32.39	32.10	32.05	32.28	31.83	32.01	4.59	4.27	4.15	4.51	4.18	4.34	40.57	40.88	41.30	42.36	42.33	42.80
8-F8	32.55	32.10	32.25	32.34	32.07	32.49	4.57	4.31	4.11	4.59	4.29	4.36	43.25	43.35	43.52	42.84	42.40	43.63
9-F9	32.56	32.69	32.96	32.54	32.72	32.80	4.70	4.51	4.28	4.63	4.42	4.46	42.80	43.85	44.07	43.92	43.54	43.98
10-F10	32.52	32.42	32.52	32.47	32.70	32.67	4.59	4.37	4.34	4.59	4.21	3.98	40.64	40.71	40.82	42.49	42.27	42.40
F-test		**			**			**			**		**		**		**	
New LSD 5%		0.13			0.24			0.05			0.09			0.33			0.53	
New LSD 1%		0.17			0.34			0.06			0.11			0.41			0.72	

\*\* : Highly Significant

Such increase in these traits may be returned to the role of balance NPK to encourage the metabolic processes leading to accumulation of dry matter of cotton during flowering and boll formation. Addition to that organic fertilizer supply of nutrients. Also, the role of the bio-fertilizer in increasing the indigenous level of plant phytohormones like acetic acid (IAA), gibberellic acid (GA) and cytokinins (CK) which promote plant growth cell division, break the apical dominance, encourage the photosynthesis and assimilates accumulation, plant development and consequently the productivity per unit area. These results are in line with those stated by Battisha (1998) and El-Tabbakh (2002).

**Effect of interaction between first irrigation times and fertilizer treatments:** Respecting the effect of the interaction between first irrigation times×fertilizer treatments, it showed at Table 4 and 5 significant effect on plant height cm, Leaf Area Index (LAI), fiber length at 2.5% span length, fiber fineness and fiber strength. These results are in good agreement with those found by Abd Allah (2000).

Concerning, number of fruiting branches per plant, number of opened bolls per plant, boll weight (g), seed cotton yield Kentar/fed. and uniformity ratio (%) had an insignificant effect with the interaction between first irrigation and fertilizers treatments. Abd Allah (2000) came to similar findings.

Results indicated that cotton plants gave the first irrigation after 30 days from planting with organic fertilizer + bio-fertilizer + 66% from recommended NPK significantly increased lint cotton yield Kentar/fed and associated with maximum values.

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