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RESPONSE OF COTTON CULTIVAR GIZA 90 TO WATER STRESS AND NPK LEVELS

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ABSTRACT

The present investigation was carried out at Shandaweel Agricultural Research Station during 2004 and 2005 seasons to study the effect of water stress and fertilizers application levels on growth and seed yield as well as components of the Egyptian cotton cultivar Giza 90 (*Gossypium barbadense* L.). A split plot design with four replications was used. The main plots was assigned to water stress treatments (irrigation every two weeks, every three weeks and every four weeks). NPK fertilizers levels i.e., (45 kg N +15 kg P_2O_5) (60 kg N + 22.5 kg P_2O_5 + 24 kg K_2O) and (75 kg N + 30 kg P_2O_5 + 48 kg K_2O/feddan) were assigned to the sub plots. The combined data revealed that irrigation every two weeks significantly increased plant height at harvest, number of fruiting branches/plant, location of first fruiting node, number of open bolls/plant, boll weight, seed cotton yield/plant and feddan. With respect to NPK fertilizer treatments, the results indicated that plant height at harvest, number of fruiting branches/plant, number of open bolls/plant, seed cotton yield/plant and feddan increased significantly by increasing fertilizers levels up to 75 kg N + 30 kg P_2O_5 + 48 kg K_2O/feddan. However, Location of first fruiting node was not affected by NPK fertilizer treatments. The interaction between irrigation intervals and NPK levels had significant effect on plant height at harvest, boll weight, seed cotton yield/plant and feddan, while, location of first fruiting node and number of open bools/plants were not affected. The highest values of these traits were obtained from the irrigation every two weeks and NPK levels of 75 kg N + 30 kg P_2O_5 + 48 kg K_2O/feddan.

INTRODUCTION

Irrigation and fertilizers application are the most important aspects of cotton (*Gossypium barbadense* L.) production. In Egypt, the reduction in cotton yield is the first problem facing the cotton producers, possibly due to many factors such as water supply, fertilizers application and pest control management. Several studies were carried out in this field but the problem was more difficult because it concerned with social and economic behavior of Egyptian farmers.

Chaudhry (1969) found that irrigation intervals (8, 15, 22 and 29 days) influenced plant height, numbers of branches/plant and number of node at the first sympodium, Gomaa *et al.,* (1981) indicated that decreasing irrigation intervals significantly increased both boll number and weight, number of sympodia and seed cotton yield. Guinn *et al.,* (1981) indicated that water deficit decreased plant height and number of branches per plant. Ali (1990) found that irrigation every 15 days produced the highest seed cotton yield per feddan, number of open bolls per plant and boll weight more than the irrigation every 10 or 20 days. Radin *et al.,* (1992) indicated that plant height, boll weight and seed cotton yield were significantly increased in favor of reducing irrigation intervals. Ibrahim and Moftah (1997) indicated that plant height, number of branches and bolls per plant decreased significantly by extending the irrigation frequency intervals to 28 days while the position or number of fruiting branches/plant were not significantly affected. El-Shahawy and Abd El-Malik (1999) found that close irrigation intervals (every two weeks) resulted in higher number of sympodia, number of open bolls, boll weight and seed cotton yield. Final plant height reached the maximum with the intermediate interval (irrigation every three weeks). Close irrigation intervals delayed maturation in terms of raising nodel position of the first sympodia. El-Shahawy *et al.,* (2000) found that irrigation intervals every two weeks increased plant height, number of sympodial branches, number of open bolls/plant, boll weight and seed cotton yield. They added that node location of the first sympodium was not affected by irrigation intervals. Ziadah *et al.,* (2000) found that irrigation intervals 15/15 days (d) during vegetative and fruiting stages significantly increased

plant height at harvest, number of fruiting branches/plant, boll weight, number of open bolls/plant, seed cotton yield/plant and seed cotton yield/fed in both seasons compared to the other tested irrigation treatments. Ali (2002) found that plant height, number of sympodia/plant increased significantly as irrigation intervals decreased up to two weeks, while, number of open bolls/plant, boll weight and seed cotton yield/plant and seed cotton yield/feddan were significantly influenced by irrigation intervals in favour of the close irrigation (every two weeks). El-Sayed (2005) and Hamed (2007) found that irrigation every two weeks increased final plant height, number of fruiting branches, number open bolls/plant, boll weight and seed cotton yield/plant and seed cotton yield/feddan, while position of the first sympodium was not affected by irrigation intervals.

On the other hand, maintaining soil fertility of the three macronutrients, nitrogen (N), phosphorus (P), and potassium (K) is important in sustaining cotton (*Gossypium barbadense* L.) productivity and profitability. Meanwhile, many workers studied the effect of N, P and K fertilizers on cotton production. In Egypt, Abdallah (1995), found that fertilizing cotton with 60 kg N + 30 kg P_2O_5 + 48 kg K_2O/fed. gave the tallest cotton plants. Ziadah and El-Shazly (1998) stated that foliar spraying with 75 kg N + 30 kg P_2O_5 + 48 kg K_2O/fed. significantly increased plant height in both seasons. Abd El-Malak *et al.,* (1997), mentioned that increased NPK fertilizer level not only increased sympodia branches but also produced the first sympodial branch at lower node on the main stem. Abd El-Aal *et al.,* (1990), Ziadah and El-Shazly (1998). and Mohsin *et al.,* (2004) in Pakistan, mentioned that increased NPK fertilizer level increased number of open bolls/plant, Abd El-Malak and Radwan (1998), Ziadah and El-Shazly (1998) found that increased NPK fertlizer level increased boll weight. The highest seed cotton yield/plant obtained by Ziadah and El-Shazly (1998) at 75 kg N + 30 kg P_2O_5 + 48 kg K_2O/fed. while, the highest seed cotton yield/fed or ha obtained by Abd El-Malak & Radwan (1998) and Ziadah & El-Shazly (1998) in Egypt and Mohsin *et al.,* (2004) in Pakistan, with high NPK fertilizer. The same result was obtained by Mohsin *et al.,* (2004), in Pakistan, with NPK rate of 150 kg N + 75 kg P_2O_5 + 60 kg K_2O/ha.

The objective of this study was to examine the effect of water strees and NPK fertilizer levels on the productivity of Giza 90 cotton variety

MATERIALS AND METHODS

Two field experiments were carried out at Shandaweel Agricultural Research Station in 2004 and 2005 seasons to study the effect of water stress and NPK fertilizers and their interaction on growth, seed cotton yield and yield components of cotton cultivar Giza 90. Cotton seeds were sown (20 cm between hills) at the last week of March in both seasons. Thinning was done 30 days after sowing leaving two plants per hill. Mechanical and chemical analysis of the experimental soil are presented in Table 1.

Table 1: Mechanical and chemical analysis of soil samples at 0-30 cm depth from the surface in 2004 and 2005 seasons.

Soil characteristics	2004	2005
Texture	Loamy sand	Loam
Calcium carbonate %	1.39	1.24
Organic matter %	0.948	1.02
PH (1:2:5 suspension NPK)	7.30	7.20
Total N (ppm)	795	702
Available P (ppm)	9.9	9.4
Available K (ppm)	386	448

The experimental design was split plot with four replications. The main plots were assigned for the three irrigation intervals, i.e., every two, three or four weeks, which resulted in 11, 8 and 6 number of irrigations in each season. NPK fertilizers treatments were (45 kg N + 15 kg P_2O_5), (60 kg N + 22.5 kg P_2O_5 + 24 kg K_2O) and (75 kg N + 30 kg P_2O_5 + 48 kg K_2O/feddan). NPK treatments were adapted to the sup-plots. The area of experimental plot was 19.5 m^2 (5 m length and 3.9 m width) included 6 rows at 65 cm a part. Plots were isolated by deep channels of 2 m width to avoid the effect of lateral movement of irrigation water.

Phosphorus fertilizers was added in the form of calcium super phosphate (15% P_2O_5) before the first irrigation in each season. Nitrogen fertilizer was added in the form of ammonium nitrate

(33.5%). It was applied a split application, the first was added before the second irrigation and the second was applied before the third irrigation. Potassium fertilizers was in the form of potassium sulphate (48% K_2O) and applied before the fourth irrigation. The best cultural practices, i.e., hand weeding or pest control were applied as recommended for cotton production in Shandaweel farm. Five guarded hills; each hill contain two plants, were randomly chosen from the three inner rows to study the following characters:

Growth trails: This included, plant height at harvest (cm), number of fruiting branches/plant and location of first fruiting node.

Yield and yield component: This included, number of open bolls/plant, average boll weight in grams, Average seed cotton yield in grams/plant, and seed cotton yield in kentars/faddan: Seed cotton yield/plot in kilograms was recorded and transformed to kentars/faddan (one kentar; 157.5 Kg).

Separate and combined statistical analysis of the two seasons was made and performed according to Little and Hills (1978). The mean values were compared at 5% level of significance by the L.S.D. according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Growth traits:

Combined analysis of 2004 and 2005 seasons (Table 2) show that plant height at harvest, number of fruiting branches/plant, location of first fruiting node were increased as irrigation intervals were decreased. Irrigation every two weeks gave the tallest plants due to shorter internodes with higher node number in addition to more number of monopodia and sympodia which in turn maximized total dry matter of plants. These results may be due to the sufficient water irrigation supply which was necessary to provide the cotton plants with its requirement of water to activate vital processes such as metabolism which reflected on growth (Chandhry, 1969, Radin *et al.*, 1992, Ibrahim & Moftah, 1997, El-Shahawy & Abd El-Malik 1999, El-Shahawy *et al.*, 2000, Ziadah *et al.*, 2000, Ali 2002, El-Sayed 2005 and Hamed, 2007).

Table 2: Effect of irrigation intervals, NPK levels and their interaction on growth traits in combined analysis of 2004 and 2005 seasons.

	Plant height at harvest			No. of fruiting branches/plant			Location of first fruiting node		
	2004	2005	Comb.	2004	2005	Comb.	2004	2005	Comb.
	A: Irrigation intervals								
2 weeks	138.63	111.08	124.02	18.43	15.07	16.34	6.85	6.97	6.91
3 weeks	128.25	109.42	119.67	17.78	14.25	16.42	6.48	6.98	6.73
4 weeks	117.25	105.67	110.87	15.07	13.72	14.39	5.95	6.82	6.38
F test	*	*	**	*	*	**	*	N.S	**
LSD at 0.05	0.88	0.66	1.27	0.23	0.47	0.64	0.36	N.S	0.50
	B: NPK levels								
45 kg N + 15 kg P_2O_5 + 0 kg K_2O	124.00	102.58	113.29	17.07	13.30	15.18	6.30	6.75	5.62
60 kg N + 22.5 kg P_2O_5 + 24 kg K_2O	128.83	110.50	120.79	16.93	13.92	14.42	6.57	6.93	6.82
75 kg N + 30 kg P_2O_5 + 48 kg K_2O	130.13	112.75	120.48	17.28	15.82	16.55	6.42	7.08	6.58
F test	*	*	**	N.S	*	**	N.S	*	N.S
LSD at 0.05	0.68	1.13	0.59	N.S	0.47	0.30	N.S	0.46	N.S
Interaction (A x B)	133.50	102.50	119.37	18.10	13.60	15.95	6.95	6.85	6.97
	140.50	113.50	128.50	18.15	14.65	16.00	7.05	7.00	7.05
	141.90	117.25	124.20	19.05	16.95	17.07	6.55	7.05	6.70
	124.75	105.25	113.62	18.25	13.80	15.92	6.25	6.85	6.47
	128.75	106.50	123.00	17.75	13.85	16.20	6.45	6.70	6.92
	131.25	116.50	122.37	17.35	15.10	17.15	6.75	7.40	6.80
	113.75	100.00	106.87	14.85	12.50	13.67	5.70	6.55	6.40
	117.25	112.50	110.87	14.90	13.25	14.07	6.20	7.10	6.80
	117.25	104.50	114.87	15.45	15.40	16.55	5.95	6.80	6.25
F test	*	*	**	*	*	N.S	N.S	*	N.S
LSD at 0.05	0.19	1.96	1.03	0.83	0.81	N.S	N.S	0.46	N.S

Yield and yield components:

Table 3 shows that, in combined analysis of 2004 and 2005 seasons, number of open bolls/plant, boll weight, seed cotton yield/plant and feddan were significantly increased by irrigation intervals (irrigation intervals every two weeks).

The results with respect to fertilizers levels show that plant height at harvest and number of fruiting branches/plant increased by increasing significantly fertilizers level up to 60 kg N + 22.5 kg P_2O_5 + 24 kg K_2O/feddan (plant height at harvest) and 75 kg N + 30 kg P_2O_5 + 48 kg K_2O/feddan (number of fruiting branches/plant). While, location of first fruiting node was not affected by NBK fertilizer treatments. Such results may be attributed to the role of NPK fertilizer levels on plant metabolism consequently enhancing growth habits. These results are in agreement with those obtained by Adballah (1995), Abd El-Malak *et al.,* (1997), Ziadah & El-Shazly (1998) and Mohsin *et al.,* (2004).

The interaction involved significantly plant height at harvest and number of fruiting branches/plant. While, location of first fruiting node was not affected by interaction between irrigation intervals and NPK levels. These results may be due to that water irrigation supply in case of the irrigation every two weeks given to cotton plants of Giza 90 cultivar had the sufficient water which led to an increase in total dry weight per plant and fruiting set as a result of increase leaf area and metabolism process. Similar results were obtained by Goma *et al.,* (1981), Guinn *et al.,* (1981), Ali (1990), El-Shahawy & Abd El-Malik (1999), El-Shahawy *et al.,* (2000), Ziadah *et al.,* (2000), Ali (2002), El-Sayed (2005) and Hamed (2007). On the other hand, number of open bolls, boll weight, seed cotton yield/plant and seed cotton yield/feddan were significantly increased by increasing fertilizers levels up to 75 kg N + 30 kg P_2O_5 + 48 kg K_2O/feddan in both seasons. The results may be due to that increasing of P from 15 to 30 kg P_2O_5/fed and K from 24 to 48 K_2O/fed. may increased the efficiency of N application at the high rate of 75 kg N/fed. This means that N is advisable to be applied at more than 60 kg N/fed. The results demonstrated the role of NPK fertilizer in encouraging early appearance of bolls of cotton plants. Similar results were obtained by

Table 3: Effect of irrigation intervals, NPK levels and their interaction on the yield and yield components in combined analysis of 2004 and 2005 seasons.

	No. of bolls/plant			Boll weight			Seed cotton yield/plant			Seed cotton yield (kentar/fed.)		
	2004	2005	Comb.	2004	2005	Comb.	2004	2005	Comb.	2004	2005	Comb.
	A: Irrigation intervals											
2 weeks	20.35	12.42	16.07	2.24	1.86	2.04	45.59	23.19	33.60	12.24	5.49	8.86
3 weeks	17.03	12.23	14.63	2.12	1.85	1.99	36.69	22.63	29.61	11.45	4.54	7.99
4 weeks	14.10	11.78	13.26	2.09	1.75	1.92	29.44	20.54	25.54	10.52	4.06	7.29
F test	*	*	**	*	*	**	*	*	**	*	*	**
LSD at 0.05	0.30	0.25	0.40	0.01	0.03	0.03	1.05	0.27	0.99	0.52	0.58	0.59
	B: NPK levels											
45 kg N + 15 kg P_2O_5 + 0 kg K_2O	16.58	10.77	14.06	2.11	1.79	2.00	34.98	19.29	28.78	11.15	4.45	7.86
60 kg N + 22.5 kg P_2O_5 + 24 kg K_2O	17.35	11.90	14.24	2.13	1.82	1.98	36.95	21.63	28.67	11.26	4.59	7.86
75 kg N + 30 kg P_2O_5 + 48 kg K_2O	17.55	13.77	15.66	2.21	1.85	1.98	38.78	25.44	31.30	11.79	5.06	7.42
F test	*	*	**	*	*	**	*	*	**	*	*	**
LSD at 0.05	0.31	0.26	0.19	0.01	0.03	0.01	1.05	0.27	0.46	0.35	0.42	0.20
Interaction (A x B)	20.45	10.35	14.85	2.19	1.80	2.11	44.78	18.63	3229	11.77	5.58	8.98
	18.35	12.50	15.97	2.14	1.84	1.99	39.27	23.00	32.54	12.39	5.47	8.62
	22.25	14.40	17.37	2.37	1.94	2.02	52.73	27.94	35.96	12.55	5.41	8.98
	14.85	10.60	15.40	2.06	1.85	1.93	30.59	19.61	30.38	11.07	4.59	7.83
	20.20	11.70	13.27	2.25	1.85	2.04	45.45	21.64	27.92	11.07	4.13	7.60
	16.05	14.40	15.22	2.06	1.85	2.00	34.03	26.64	30.54	12.22	4.89	8.55
	14.45	11.35	11.92	2.07	1.73	1.96	29.91	19.63	23.68	10.61	3.19	6.76
	13.50	11.50	13.47	2.01	1.76	1.86	27.13	20.24	25.53	10.33	4.12	7.37
	14.35	12.50	14.37	2.18	1.74	1.91	31.28	21.75	27.39	10.61	4.87	7.74
F test	*	*	N.S	*	*	**	*	*	**	*	*	**
LSD at 0.05	0.54	0.45	N.S	0.01	0.05	0.02	1.35	1.04	0.80	0.61	0.72	0.34

Abd El-Aal *et al.*, (1990), Abd El-Malak & Radwan (1998), Ziadah & El-Shazly (1998) and Mohsin *et al.*, (2004). The interaction involved significantly boll weight, seed cotton yield/plant and feddan. While, number of open bolls/plant was not affected by interaction between irrigation intervals and NPK levels.

It could be concluded that application of 75 kg N + 30 kg P_2O_5 + 48 kg K_2O/feddan and irrigation every two weeks are required for a maximum seed cotton yield from cotton cultivar Giza 90.

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F. S. Hamed

استجابة صنف القطن جيزة ٩٠ للإجهاد المائى ومستويات التسميد NPK

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أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بشندويل فى موسمى ٢٠٠٤ ،٢٠٠٥م لدراسة تأثير الإجهاد المائى (فترات الرى) ومستويات التسميد NPK على النمو والمحصول ومكوناته على صنف القطن المصرى جيزة ٩٠ ، تم تنفيذ التجارب فى تصميم قطع منشقة مرة واحدة فى أربعة مكررات حيث خصصت القطع الرئيسية لفترات الرى (كل أسبوعين ، كل ثلاثة أسابيع ، كل أربعة أسابيع) ، بينما خصصت القطع المنشقة للثلاث مستويات من التسميد NPK وهى (٤٥ كجم ن + ١٥ كجم فو٢أ٥) (٦٠ كجم ن + ٢٢,٥ كجم فو٢أ٥ + ٢٤ كجم بو٢أ) ،(٧٥ كجم ن + ٣٠ كجم فو٢أ٥ + ٤٨ كجم بو٢أ / فدان) . ثم تم إجراء تحليل التباين المشترك للموسمين.

وكانت النتائج كالآتى :-

١- أوضح التحليل المشترك للموسمين أن الرى كل أسبوعين أدى إلى زيادة معنوية لكل من طول النبات ، موقع أول فرع ثمرى ، عدد اللوز المتفتح / نبات ، وزن اللوزة ، محصول النبات الفردى ومحصول القطن الزهر .

٢- بالنسبة للتسميد بـ NPK أدت زيادة التسميد إلى زيادة معنوية لكل من طول النبات ، عدد الأفرع الثمرية /نبات ، عدد اللوز المتفتح / نبات ، محصول النبات الفردى ومحصول القطن الزهر (قنطار/ فدان) بمعدل (٧٥ كجم ن + ٣٠ كجم فو٢أ٥ + ٤٨ كجم بو٢أ / فدان) .

٣- كان التفاعل بين الإجهاد المائى (فترات الرى) ومستويات التسميد بـ NPK تأثير معنوي على طول النبات ، وزن اللوزة ، محصول النبات الفردى ومحصول القطن الزهر (قنطار/ فدان) ، بينما لم يكن هناك تأثير معنوى على موقع أول فرع ثمرى ، عدد الأفرع الثمرية /نبات وعدد اللوز المتفتح /نبات ، وكانت أفضل النتائج فى معظم الصفات من التفاعل بين الرى كل أسبوعين والتسميد بمعدل (٧٥ كجم ن + ٣٠ كجم فو٢أ٥ + ٤٨ كجم بو٢أ / فدان) .