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THE ROLE OF IRRIGATION INTERVALS AND PLANT POPULATION IN COTTON PRODUCTIVITY

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ABSTRACT

Two field experiments were conducted at Sakha Agriculture Research Station during 1997 and 1998 seasons using the Egyptian cotton cultivar Giza 87 (*Gossypium barbadense* L.). The aim of this investigation was to study the effect of irrigation intervals and plant population density on growth, earliness and seed cotton yield and its components. A split plot design with four replications was used. The main plots were assigned to irrigation intervals (every two weeks, every three weeks and every four weeks). Each sub-plot consisted of six ridges, 5 m in length and 60 cm. apart were allocated to the three plant population densities i.e., 70000, 56000 and 46666 plants/fed.

The combined data clarified that irrigation interval every two weeks increased final plant height, number of main stem internodes, both sympodial and monopodial branches, total dry weight, number of open and unopen bolls, boll weight, lint % and seed cotton yield (kintar/fed., while it decreased main stem internodal length and percentage of plant losses. Also, the same treatment induced delay in maturation as it increased number of days to both first open flower and boll as well as decreased earliness percentage irrespective to higher values of boll set and fewer shedding percentage. Node location of the first sympodium and seed index did not affect by irrigation intervals. On the other hand, increasing plant population density from 46,666 up to 70,000 plants/fed., generally increased final plant height main stem internodal length, number of unopen bolls; percentage of plant losses and seed cotton yield (kintar/fed.), while it decreased number of main stem internodes, both sympodial and monopodial branches, total dry weight and number of open bolls. Although higher plant density (70,000 plant/fed.) raised node location of first sympodium and increased shedding percentage associated with lower boll set, it enhanced maturation by reducing number of days to both first open flower and boll as well as increasing earliness percentage. Plant population density failed to exert any significant effect on boll weight, lint % and seed index. The interaction between irrigation intervals and plant population density did not affect all characters studied herein.

Seasonal consumptive use in cubic meters per feddan and water use efficiency were decreased as either irrigation intervals increased or plant population density decreased in both seasons.

INTRODUCTION

The potential effects of irrigation interval and plant population density are two of the most important factors, yet more information required concerning its effects on cotton yield, maturity and other growth characters. Also, there is a need for more precise irrigation schedule to suit the actual cotton water use efficiency as well as water consumptive use through full season. However, the recent recommendation of irrigation frequency is every two weeks after the second irrigation for well drained soils (Cotton Extension Service, 1996). Hamilton *et al*. (1956) found that frequent irrigation increased plant growth and yield. Bruce and Romkens (1965) reported that the production of total fruiting points (squares) exhibited the same or greater sensitivity to soil water deficient as vegetative growth. Rijks (1965) found that cotton plants grown with low water supply (140 mm) produced fewer nodes, fewer fruiting branches, lower magnitudes of boll retention percentage, lower lint yield (kg/ha) and fewer fruiting forms, but retained a high percentage of squares. Chaudhry (1969) indicated that closely spaced irrigation delayed the appearance of first flower. Abd El-Kader (1980) found that yield earliness was slightly affected by number of irrigations. Gomaa *et al*. (1981) indicated that decreasing irrigation intervals significantly increased both boll number and weight, number of sympodia and seed cotton yield, but decreased earliness. Kater Hake *et al*. (1989) revealed that frequent irrigation reduced internode elongation. Radin *et al*. (1992) reported that plant height, number of vegetative branches, main stem internodal length, boll weight, lint percentage and seed cotton yield were significantly increased in favour of reducing irrigation intervals. El-Shahawy and Abd El-Malik (1999) found that irrigation cotton every two weeks resulted in higher number of main stem internodes, monopodia, sympodia, aborted sites, boll retention, total dry weight, number of open bolls, boll weight, lint percentage, seed index and seed cotton yield. While final plant height and main stem internodal length reached the maximum with irrigation every three weeks. Also, they stated that irrigation every two weeks raised nodal position of the first sympodium, increased number of days to first open flower and boll and decreased earliness percentage.

Several experimental results indicated that increasing intrarow spacing increased number of monopodia, sympodia (Abd El-Malik, 1976; Nikolov, 1981, El-Shahawy *et al.,* 1993 as well as Abd El-Malik and El-Shahawy, 1999), final plant height (Kerby *et al.,* 1990), number of days to first open boll (Yasseen, 1986) and flower (El-Shahawy *et al.,* 1993), number of open bolls, boll weight and lint % (Abd El-Fattah, 1979 and El-Shahawy *et al.,* 1999) while it decreased number of days to first flower.

MATERIALS AND METHODS

Two field experiments were carried out at Sakha Agricultural Research Station in 1997 and 1998 seasons to study the effect of irrigation intervals, plant population density and their interaction on growth, earliness, seed cotton yield and yield components of the new cotton cultivar Giza 87. Cotton seeds were planted in the last week of March in hills and the plots were irrigated immediately after sowing. The preceding crop was rice crop in the two seasons. Plants thinned at two plants per hill after 40 days from planting. 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. Intrarow row spacings of 20, 25 and 30 cm that is corresponded 70000, 56000 and 46666 plants/fed. were occupied the sub-plots. Each sub-plot consisted of six ridges, 5 m. in length and 60 cm apart. To avoid the effect of lateral movement of irrigation water, sub-plots were separated by cross chanals of 2 m width. Nitrogen in the form of ammonium nitrate 33.5% N (60 kg/fed.) was applied in two equal doses before the second and the third irrigation, respectively. 100 kg P_2O_5 per feddan was added during land preparation. All other cultural practices were done as normally recommended in cotton production. Chemical and physical analysis of the soil, monthly air temperature and relative humidity in both seasons are shown in Table 1 and 2 respectively. Five guarded hills (10 plants) were randomly chosen from the four inner rows to study the following characters:

A) Growth characters: final plant height (cm), number of main stem internodes, main stem internodal length, number of sympodia and number of monopodia.

B) Earliness measurements: Node location of the first sympodium, boll set percentage, shedding percentage, days to both first open flower and boll, and earliness percentage: $\frac{\text{First pecking x 100}}{1^{st} + 2^{nd}\text{ pecking}}$

C) Seed cotton yield components: Number of open bolls, number of unopen bolls, boll weight (g), lint percentage and seed index (g/100 seeds). Percentage of plant losses at the end of season and seed cotton yield (kintar/fed.) were estimated for cotton plants of the four inner rows of each plot. The statistical and combined analysis of the two seasons were done and performed according to Little and Hills (1978). The differences between means were tested according to Duncan's Multiple Range Test (1955).

Consumptive use of water (Cu) and water use efficiency (W.U.E.) were also estimated as follow:

The amount of consumptive use is assumed to be equal to the difference between both soil moisture content at 48 hours after irrigation just before the next irrigation field capacity and wilting point. The quantities of consumptive use were calculated for the four soil depth i.e. 0-15, 15-30, 30-45 and 45-60 cm) according to (Israelson and Hanson, 1962) as follows:

$$U = \frac{\theta_2 - \theta_1}{100} \times Bd \times \frac{D}{100} \times 4200.$$

Where:

U = Amount of consumptive use

θ_2 = Soil moisture percentage after irrigation.

θ_1 = Soil moisture percentage before irrigation.

Bd = Bulk density in gm/cm^3.

D = Depth of soil sample

Water use efficiency (W.U.E.) was calculated according to the following formula (Vites, 1965):

$$W.U.E. = \frac{\text{Seed cotton yield (kg / fed.)}}{\text{Consumptive use (m}^3\text{ / fed.)}}$$

Table 1: The chemical and physical analysis of the soil for the two locations (two seasons) according at 30 cm depth of the soil.

Character	1997	1998	Character	1997	1998
Soil structures	Clay	Clay	Available N ppm	20.00	20.50
pH	8.10	8.00	Available P ppm	10.50	10.80
EC mmoh/cm 25ºC	3.60	3.40	Available K ppm	820.00	800.00
Organic matter %	1.71	1.85			

Table 2: Monthly air temperature and relative humidity in 1997 and 1998 seasons.

Month	1997 season				1998 season			
	Air temp. ºC		R.H. %		Air temp. ºC		R.H. %	
	Max.	Min.	7: 30	13: 30	Max.	Min.	7: 30	13: 30
March	18.4	8.0	66.0	44.0	18.0	9.3	70.0	48.7
April	21.5	9.0	62.5	38.5	25.0	12.0	74.7	50.0
May	29.0	13.0	66.0	35.3	28.0	17.0	72.0	46.0
June	32.3	18.3	68.5	44.0	32.7	21.0	77.0	62.5
July	32.0	19.0	68.0	48.0	32.4	20.0	80.0	53.0
Aug.	30.5	18.0	71.0	52.0	33.8	22.0	79.0	47.4
Sept.	31.0	16.0	74.0	48.0	33.0	20.0	73.0	46.0
Oct.	29.4	12.8	71.0	42.0	28.5	17.0	70.5	40.0

Data presented above were taken and calculated as an average per month (cited after Sakha Weather Station).

Table 3: Sequence of irrigation intervals in 1997 and 1998 seasons.

Irrigation sequence	Irrigation intervals					
	Every two weeks		Every three weeks		Every four weeks	
	1997	1998	1997	1998	1997	1998
Sowing irrigation	March, 28	March, 26	March, 28	March, 26	March, 28	March, 26
First irrigation	April, 22	April, 21	April, 22	April, 21	April, 22	April, 21
Second irrigation (after the 1st N-dose)	May, 6	May, 5	May, 13	May, 12	May, 20	May, 19
Third irrigation (after the 2nd N-dose)	May, 20	May, 19	June, 3	June, 2	June, 17	June, 16
Fourth irrigation	May, 3	June, 2	June, 24	June, 23	July, 15	July, 14
Fifth irrigation	June, 17	June, 16	June, 15	July, 14	August, 12	August, 11
Sixth irrigation	July, 1	June, 30	August, 5	August, 4	Sept., 9	Sept., 8
Seventh irrigation	July, 15	July, 16	August, 26	August, 25	-	-
Eighth irrigation	July, 29	July, 30	-	-	-	-
Ninth irrigation	August, 12	August, 13	-	-	-	-
Tenth irrigation	August, 26	August, 27	-	-	-	-

RESULTS AND DISCUSSION

(A) Growth characters:

The combined data presented in Table 4 showed that irrigation intervals had a marked effect on all growth characters. Generally, cotton plants irrigated every two weeks throughout the season gave taller 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. The reverse trend was detected with prolonging irrigation intervals up to four

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weeks. The pronounced reduction in vegetative growth in favour of prolonged irrigation intervals suggests a differential sensitivity existed between the plant water deficient required to inhibit growth and that required to cause stomatal closure which may affect assimilate translocation and accumulation (Hsiao, 1973). Similar results were obtained by Hamilton *et al*. (1956), Kater Hake *et al*. (1989) Radin *et al*. (1992) and El-Shahawy as well as Abd El-Malik (1999).

From the presented data in Table 4, final plant height and main stem internodal length were significantly increased by increasing plant density from 46666 up to 70000 plant/fed. The reverse trend was true regarding to number of main stem internodes, sympodial and monopodial branches besides total dry matter per plant. These findings may be explained on the bases that excessive shade of crowded plants (high densities) may increase gibberelin content in plant tissues that cause cell elongation (Warening and Philips, 1970, and Makram *et al.,* 1994). These results are in agreement with those obtained by Nikolove (1981), Kerby *et al*. (1990), El-Shahawy *et al*. (1993) and Abd El-Malik and El-Shahawy (1999).

(B) Earliness measurements:

The combined data given in Table 5 cleared that irrigation intervals exerted a highly significant effect on this group of traits, whereas early maturation was gained as irrigation intervals increased from two up to four weeks based on fewer number of days to both first open flower and boll but with higher percentage of the first picking. These results could be ascribed on the bases that plants grown with low water supply produced fewer nodes, fewer fruiting branches and fewer fruiting forms, but retained a high percentage of squares. Since growth of fruiting branches was also restricted by water deficit, a high percentage of bolls were located at the first fruiting position, illustrating the importance of high fruit set from early flowers for water-limited situations (Mauney and Stewart, 1986). Similar results were obtained by Chaudhry (1969), Abd El-Kader (1980), Kerby *et al*. (1990) and El-Shahawy and Abd El-Malik (1999).

Data from Table 5 showed that increasing plant density led to a significant increase in node location of first sympodium, shedding percentage and earliness percentage, while accelerated flower and boll opening with lower boll set percentage. These results may be due to that excessive vegetative growth of low plant density normally resulted in higher photothesis rate which in turn causes more boll setting with delay flower and boll formation as well as boll maturation. These results are in agreement with these obtained by Yasseen (1986), El-Shahawy *et al*. (1991) and Darwish *et al*. (1995).

(C) Seed cotton yield and its components:

Combined data in Table 6 showed a prominent effect on this group of criteria except seed index indicating that adequate irrigation (every two weeks) increased significantly number of open and unopen bolls, boll weight, lint % and seed cotton yield (kintar/fed.), while it decreased plant losses

percentage. These findings could explained on the basis that sufficient water supply might promote leaf development which associated with photothensetic activity, translocation of assimilates to various sinks and utilization by different plant organs. (Mauney and Stewart, 1986). Similar results were obtained by Gomaa *et al*. (1981), Radin *et al*. (1992), El-Shahawy *et al*. (193) and El-Shahawy and Abd El-Malik (1999).

Results in Table 6 cleared that increasing plant density up to 70000 plant/fed. significantly increased number of unopen bolls, plant losses percentage and seed cotton yield (kintar/fed.) irrespective to the pronounced reduction in number of open bolls per plant. On the other hand, boll weight, lint % and seed index did not affect by this factor in this study. The increment of seed cotton yield related to higher plant density could be attributed to the remained and suitable number of plants at harvest was accompanied with intermediate growth canopy of this variety helped cotton plants to express its higher yield capacity. These results are in harmony with those obtained by Ali (1977), Abd El-Fattah (1979), Kerby *et al*. (1990) and El-Shahawy *et al*. (1993).

The interaction between irrigation intervals and plant density had any significant effect of all traits studied herein, revealing the parallel effect of each factor under the conditions of this study.

Effect of irrigation intervals and plant density:

Data in Table 7 showed seasonal consumptive use of Giza 87 cotton cultivar in cubic meters per feddan as influenced by irrigation intervals and plant population density during 1997 and 1998 seasons. It is apparent that consumptive use was gradually decreased as irrigation intervals were increased. The results presented above provide a clear differences in water supply due to divergences in number of irrigations among treatments (Table 3).

On the other hand, consumptive use was gradually decreased in favour of plant population density decrease. These reductions in consumptive use due to low plant densities may be a resultant expression of its lower water requirements than higher ones in the same ground area.

It is evident from Table 8 that water use efficiency (WUE) was apparently affected by irrigation intervals and plant population density in both seasons, whereas the reduction in WUE was achieved by the increase of irrigation intervals and decrease of plant density. The above reduction of WUE might be explained on the basis that plant water deficits over a long period of time can maintain an unbalanced vegetative and reproductive growth that imposed in seed cotton yield reduction. Similar results were obtained by Hamilton *et al*. (1965), Gomaa *et al*. (1981) and El-Shahawy and Abd El-Malik (1999).

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دور فترات الرى والكثافة النباتية فى إنتاجية القطن

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أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بسخا فى موسمى 1997 ، 1998 باستخدام صنف القطن المصرى جيزة 87 لدراسة تأثير فترات الرى والكثافة النباتية على النمو والتبكير والمحصول ومكوناته. كان التصميم الإحصائي قطع منشقة فى أربع مكررات حيث خصصت القطع الرئيسية لفترات الرى (كل أسبوعين ، كل ثلاثة أسابيع وكل أربعة أسابيع) فى حين خصصت القطع الشقية ذات الستة خطوط بعرض 60 سم وطول 5 متر للثلاث كثافات نباتية 70000 ، 56000 ، 46666 نبات/فدان. وقد أوضح التحليل الإحصائي المشترك إلى أن الرى كل أسبوعين زاد من طول النبات النهائى وعدد سلاميات الساق الرئيسية وعدد الأفرع الثمرية والخضرية والوزن الجاف الكلى وعدد اللوز المتفتح وغير المتفتح ووزن اللوزة وتصافى الحليج ومحصول القطن الزهر (قنطار/فدان) بينما أنقص طول سلاميات الساق الرئيسية وكذلك النسبة المئوية للفقد فى عدد النباتات. وقد أدت هذه المعاملة أيضا لتأخير النضج حيث زادت من عدد الأيام حتى تفتح أول زهرة وأول لوزة وقللت من النسبة المئوية للتبكير بصرف النظر عن القيم العالية للوز العاقد وانخفاض النسبة المئوية للتساقط. لم يتأثر كل من ارتفاع عقدة أول فرع ثمرى وكذلك معامل البذرة بفترات الرى.

من ناحية أخرى أدت زيادة الكثافة النباتية من 46666 نبات/فدان حتى 70000 نبات/فدان إلى زيادة الطول النهائى للنبات وطول سلاميات الساق الرئيسية وعدد اللوز غير المتفتح والنسبة المئوية للفقد فى عدد النباتات ومحصول القطن الزهر (قنطار/فدان) بينما قللت عدد سلاميات الساق الرئيسية وكلا من عدد الأفرع الثمرية والخضرية والوزن الجاف الكلى وعدد اللوز المتفتح.

وبالرغم من أن الكثافة النباتية العالية (70000 نبات/فدان) أدت إلى رفع موقع عقدة أول فرع ثمرى وزيادة النسبة المئوية للتساقط مصحوبة بنقص اللوز العاقد إلا أنها أسرعت النضج بإنقاص عدد الأيام حتى تفتح أول زهرة وأول لوزة وزيادة النسبة المئوية للتبكير. ولم تؤثر الكثافة النباتية تأثيرا معنويا على وزن اللوزة وتصافى الحليج ومعامل البذرة. أيضا لم يكن للتفاعل بين فترات الرى والكثافة النباتية آي تأثير معنوى على الصفات المدروسة تحت ظروف هذا البحث. وقد نقصت كلا من الاستهلاك المائى (متر مكعب للفدان) وكذلك كفاءة استخدام الماء مع زيادة فترات الرى أو مع نقص الكثافة النبات

Table 4: Means of some growth characters of Giza 87 cotton cultivar as affected by irrigation intervals and plant population density in 1997 and 1998 seasons.

Treatments / Growth characters	Seasons	Sig.	Irrigation intervals [I] Every two weeks	Every three weeks	Every four weeks	Sig.	Plant population density [P] 70,000 plant/fed.	56,000 plant/fed.	46.666 plant/fed.	I x P Interaction significant
Final plant height (cm)	1997	**	135.90 a	116.20 b	106.95 c	**	129.18 a	119.68 b	110.18 c	N.S.
	1998	**	119.04 a	115.17 b	102.41 c	**	122.20 a	113.01 b	101.41 c	N.S.
	Comb.	**	127.47 a	115.85 b	104.68 c	**	125.69 a	116.35 b	105.80 c	N.S.
Number of main stem internodes	1997	**	27.50 a	22.64 b	18.33 c	**	19.93 c	22.83 b	25.73 a	N.S.
	1998	**	25.90 a	21.79 b	16.91 c	**	17.65 c	21.79 b	25.16 a	N.S.
	Comb.	**	26.70 a	22.22 b	17.62 c	**	18.79 c	22.31 b	25.45 a	N.S.
Main stem internodal length (cm)	1997	**	4.94 c	5.13 b	5.83 a	**	6.48 a	5.24 b	4.28 c	N.S.
	1998	**	4.65 c	5.73 b	6.44 a	**	6.80 a	5.75 b	4.27 c	N.S.
	Comb.	**	4.80 c	5.43 b	6.14 a	**	6.64 a	5.50 b	4.28 c	N.S.
Number of sympodia	1997	**	19.21 a	14.44 b	10.08 c	**	11.08 c	14.58 b	18.08 a	N.S.
	1998	**	17.04 a	13.49 b	8.89 c	**	8.78 c	13.32 b	17.32 a	N.S.
	Comb.	**	18.13 a	13.97 b	9.49 c	**	9.93 c	13.95 b	17.70 a	N.S.
Number of monopodia	1997	*	1.00 a	0.91 a	0.50 b	*	0.56 b	0.76 ab	1.10 a	N.S.
	1998	*	1.40 a	0.87 b	0.73 b	*	0.84 b	0.91 b	1.24 a	N.S.
	Comb.	*	1.20 a	0.89 b	0.62 b	*	0.70 b	0.84 b	1.17 a	N.S.
Total dry matter (g)/plant	1997	**	119.22 a	116.46 b	114.00 c	**	94.96 c	114.15 b	140.57 a	N.S.
	1998	**	115.87 a	112.75 b	109.88 c	**	91.82 c	110.27 b	136.41 a	N.S.
	Comb.	**	117.55 a	114.61 b	111.94 c	**	93.39 c	112.21 b	138.49 a	N.S.

Means designated by the same letter are not significantly different at 0.05 level according Duncan's test.
***, ** and N.S indicates P < 0.05, 0.01 and not significant**

Table 5: Means of some earliness measurements of Giza 87 cotton cultivar as affected by irrigation intervals ands plant population density in 1997 and 1998 seasons.

Treatments	Seasons	Sig.	Irrigation intervals [I]			Sig.	Plant population density [P]			I x P
Earliness measurements			Every two weeks	Every three weeks	Every four weeks		70,000 plant/fed.	56,000 plant/fed.	46.666 plant/fed.	Interaction significant
Node location of the first sympodium	1997	N.S	7.29	7.20	7.25	**	7.85 a	7.25 b	6.65 c	N.S.
	1998	N.S	7.86	7.30	7.02	*	7.87 a	7.47 a	6.84 b	N.S.
	Comb.	N.S	7.58	7.25	7.14	*	7.86 a	7.36 a	6.75 b	N.S.
Boll set percentage	1997	**	62.77 a	52.29 b	46.61 c	**	49.16 c	54.24 b	58.28 a	N.S.
	1998	**	58.58 a	55.91 b	53.44 c	**	52.37 c	55.90 b	59.66 a	N.S.
	Comb.	**	60.68 a	540.10 b	50.03 c	**	50.77 c	5.07 b	58.97 a	N.S.
Shedding percentage	1997	**	37.23 c	47.71 b	53.39 a	**	50.84 a	45.76 b	41.72 c	N.S.
	1998	**	41.42 c	44.09 b	46.56 a	**	47.63 a	44.10 b	40.34 c	N.S.
	Comb.	**	39.33 c	45.90 b	49.98 a	**	49.24 a	44.93 b	41.03 c	N.S.
Days to first flower	1997	**	105.63 a	102.74 b	101.79 c	**	98.43 c	104.64 b	108.20 a	N.S.
	1998	**	107.23 a	103.19 b	102.20 c	**	98.81 c	105.16 b	108.66 a	N.S.
	Comb.	**	106.43 a	102.97 b	101.99 c	**	98.62 c	104.90 b	108.43 a	N.S.
Days to first open boll	1997	**	157.79 a	152.96 b	150.99 c	**	147.40 c	154.35 b	1690.00 a	N.S.
	1998	**	157.44 a	153.41 b	152.04 c	**	148.06 c	155.34 b	159.49 a	N.S.
	Comb.	**	157.62 a	153.19 b	151.52 c	**	147.73 c	154.85 b	159.75 a	N.S.
Earliness percentage	1997	**	55.84 c	67.11 b	74.46 a	**	66.30 a	66.27 a	64.84 b	N.S.
	1998	**	56.95 c	68.00 b	71.95 a	**	67.63 a	64.48 b	64.41 b	N.S.
	Comb.	**	56.40 c	67.56 b	73.21 a	**	66.97 a	65.38 b	64.63 b	N.S.

Means designated by the same letter are not significantly different at 0.05 level according Duncan's test.
***, ** and N.S indicates P < 0.05, 0.01 and not significant**

Table 6: Means of seed cotton yield (kintar/fed.) and its components of Giza 87 cotton cultivar as affected by irrigation intervals and plant population density in 1997 and 1998 seasons.

Treatments			Irrigation intervals [I]				Plant population density [P]			I x P
Seed cotton yield and its components	Seasons	Sig.	Every two weeks	Every three weeks	Every four weeks	Sig.	70,000 plant/fed.	56,000 plant/fed.	46.666 plant/fed.	Interaction significant
Number of open bolls	1997	**	13.60 a	12.50 b	10.90 c	*	11.90 b	12.00 b	13.10 a	N.S.
	1998	**	14.65 a	13.59 b	11.39 c	*	1301 b	13.08 b	14.54 a	N.S.
	Comb.	**	14.13 a	13.05 b	11.15 c	*	12.46 b	12.54 b	13.82 a	N.S.
Number of Unopen bolls	1997	*	1.90 a	1.59 a	0.97 b	*	1.72 a	1.51 a	1.22 b	N.S.
	1998	*	1.64 a	1.31 a	0.81 b	*	1.56 a	1.39 a	0.81 b	N.S.
	Comb.	*	1.77 a	1.45 a	0.89 b	*	1.64 a	1.45 a	1.02 b	N.S.
Boll weight (g)	1997	*	2.10 a	1.92 a	1.57 b	N.S	1.83	1.87	1.89	N.S.
	1998	*	2.00 a	1.89 a	1.68 b	N.S	1.88	1.86	1.99	N.S.
	Comb.	*	2.05 a	1.91 a	1.63 b	N.S.	1.86	1.87	1.94	N.S.
Lint percentage	1997	*	33.89 a	33.59 a	32.41 b	N.S	33.28	33.30	33.30	N.S.
	1998	*	31.43 a	31.40 a	30.94 b	N.S	31.22	31.26	31.29	N.S.
	Comb.	*	32.66 a	32.50 a	31.68 b	N.S.	32.25	32.28	32.30	N.S.
Seed index (g/100 seeds)	1997	N.S	9.64	9.58	9.28	N.S	9.41	9.49	9.60	N.S.
	1998	N.S	9.26	9.28	9.05	N.S	9.34	9.02	9.23	N.S.
	Comb.	N.S	9.45	9.43	9.17	N.S.	9.38	9.26	9.42	N.S.
Plant lasses percentage	1997	**	15.03 c	17.70 b	19.75 a	**	20.76 a	17.46 b	13.76 c	N.S.
	1998	**	15.25 c	18.37 b	20.34 a	**	21.36 a	19.49 b	16.11 c	N.S.
	Comb.	**	15.14 c	18.04 b	20.05 a	**	21.06 a	18.48 b	14.94 c	N.S.
Seed cotton yield (kintar/fed.)	1997	*	8.20 a	7.22 b	5.15 c	**	7.97 a	6.75 b	5.85 c	N.S.
	1998	**	8.95 a	7.81 b	5.71 c	**	8.85 a	7.06 b	6.56 c	N.S.
	Comb.	**	8.58 a	7.52 b	5.43 c	**	8.41 a	6.91 b	6.21 c	N.S.

Means designated by the same letter are not significantly different at 0.05 level according Duncan's test.
***, ** and N.S indicates P < 0.05, 0.01 and not significant**

Table 7: Seasonal consumptive use of cotton in m^3/fed. as affected by irrigation intervals and plant population density during 1997 and 1998 seasons.

Seasons	1997				1998			
Plants population density / Irrigation intervals	70000 plants/fed.	56000 plants/fed.	46666 plants/fed.	Means	70000 plants/fed.	56000 plants/fed.	46666 plants/fed.	Means
14 days (2 weeks)	2965.61	2912.96	2870.87	2916.48	3011.04	2955.91	2907.83	2958.26
21 days (3 weeks)	2600.36	2545.84	2501.77	2549.32	2662.83	2612.59	2571.88	2615.77
28 days (4 weeks)	2495.44	2335.14	2303.56	2344.71	2497.76	2453.92	2414.66	2455.45
Means	2653.80	2597.98	2558.73	2603.50	2723.88	2674.14	2631.46	2676.49

Table 8: Water use efficiency in kilogram seed cotton yield in cubic meter of water as affected by irrigation intervals and plant population density during 1997 and 1998 seasons.

Seasons	1997				1998			
Plants population density / Irrigation intervals	70000 plants/fed.	56000 plants/fed.	46666 plants/fed.	Means	70000 plants/fed.	56000 plants/fed.	46666 plants/fed.	Means
14 days (2 weeks)	0.44	0.40	0.29	0.38	0.47	0.36	0.30	0.38
21 days (3 weeks)	0.40	0.38	0.27	0.35	0.45	0.34	0.29	0.36
28 days (4 weeks)	0.38	0.36	0.24	0.33	0.40	0.36	0.27	0.34
Means	0.41	0.38	0.27	0.35	0.44	0.35	0.29	0.36