EFFECT OF ROW WIDTH, HILL SPACING AND NITROGEN LEVELS ON SEED COTTON YIELD OF GIZA 83 COTTON CULTIVAR

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Abstract

Two field experiments were carried out at Mallawi Agricultural Research Station, Middle Egypt, during 1993 and 1994 seasons using the Egyptian cotton Giza 83 (G.barbadense L.) to study the effect of row width, hill spacing, i.e. plant population, by planting cotton on the two sides of row at spacing of 70, or 90 cm between rows with 25, 30 and 35 cm between hills, compared with 60 cm between rows and 20 cm between hills, under two nitrogen levels (60 and 80 kg N/fed.). The experimental design was split plot with four replications.

The results indicated that : number of fruiting branches/plant, number of open bolls/plant, boll weight and plant yield increased by decreasing plant density (53.333) plants/fed.). Plant stand at picking increased by narrow spacing between hills, while percentage of plants survival increased in case of wider planting. The highest seed cotton yield/fed. was obtained by planting cotton on the two sides of row 90 cm width and 30 cm between hills (62.222 plants/fed.). Nitrogen level had no significant effect on boll weight and plant stand at picking, while number of fruiting branches/plant, number of open bolls/plant, plant yield and seed cotton yield/fed. increased by raising nitrogen level up to 80 kg/fed.

INTRODUCTION

Plant population per unit area has an important role in determining cotton production. Planting cotton in twin rows 60 cm apart on beds 120 cm apart produced highest seed cotton yield and saved about 19.1% of water supply compared with conventional method of planting cotton on ridges 60 cm apart, (Ali *et al.*, 1996). In addition, Shalaby *et al.* (1989) reported that the highest seed cotton yield/fed. and its components were detected from mechanical planting of cotton at variable row spacings of 40-80 cm than hand or mechanical planting of cotton at regular spacins of 60

cm between ridges. In this connection, Shalaby and Sakr (1981), Hussein *et al.* (1983), El-Shinnawy and Ghaly (1985), Yasseen *et al.* (1990) and Radwan (1992) stated that number of fruiting branches/plant tended to increase by decreasing plant density. Number of bolls/plant increased by wider planting spaces or decreasing plant density as shown by Shalaby and Sakr (1981), Hussein *et al.* (1983), El-Shinnawy and Ghaly (1985), Yasseen *et al.* (1990) and Radwan (1992). On the other hand, Hefni *et al.* (1978) reported that number of open bolls/plant were not significantly affected by hill spacing. Boll weight was not significantly affected by hill spaces or row width as cleared by Hefni *et al.* (1978) and El-Shinnawy and Ghaly (1985). Hussein *et al.* (1983), El-Shinnawy and Ghaly (1985) and Radwan (1992) stated that plant yield increased by decreasing plant density. Number of harvested plants per unit area increased by decreasing hill spacing or row width as found by Hussein *et al.* (1983) and El-Shinnawy and Ghaly (1985), while, percentage of harvested plants to the theoretical number at planting decreased by increasing plant density (Hussein *et al.*, 1983). Regarding seed cotton yield per unit area, Hefni *et al.* (1978), Makram *et al.* (1982), Hussein *et al.* (1983) and El-Shinnawy and Ghaly (1985), stated that seed cotton yield per unit area increased by closer spacing.

Nitrogen fertilization is an important factor for growth and yield of cotton plant. Yasseen *et al.* (1990) and Radwan (1992) reported that number of fruiting branches/plant was not significantly affected by raising nitrogen level up to 80 or 90 kg/fed. Hefni *et al.* (1978) and Radwan (1992), under late planting, revealed that boll weight and number of bolls/plant increased by raising nitrogen level up to 60 kg/fed. Yasseen *et al.* (1990) and Radwan (1992) found that raising nitrogen level more than 60 kg/fed. did not significantly affect plant yield. Abd-El-Gawad *et al.* (1985) noted that neither plant stand nor boll weight were significantly affected by raising nitrogen level up to 60 kg/fed. Seed cotton yield per unit area increaserd by increasing nitrogen level as shown by Hefni *et al.* (1978), 45 kg/fed., Ghaly *et al.* (1987) 70 kg/fed. and Radwan (1992) 60 kg/fed.

The present study aimed to investigate the yield and its components of Giza 83 cotton cultivar as affected by Distances between rows and hills, i.e. plant population, Nitrogen fertilization level, and Interaction (plant density x nitrogen level).

MATERIALS AND METHODS

Two field experiments were conducted at Mallawy Agricultural Research Station, Middle Egypt, durign 1993 and 1994 seasons. Giza 83 cotton cultivar was used

in this study. Seven plant densities under two nitrogen levels were studied in a split plot design with four replications, where the main plots were alloted for distances between rows and hills, i.e. plant density and distribution, while nitrogen levels occupied the sub-plots.

The main treatments were as follows:

No	Distances between		Planting system	No. of theoretical plants/fed.
	Rows (cm)	Hills (cm)		
1	60	20	On the south side of rows	70.000
2	70	25	On the two sides of rows	96.000
3	70	30	On the two sides of rows	80.000
4	70	35	On the Two sides of rows	68.571
5	90	25	On the two sides of rows	74.666
6	90	30	On the Two sides of rows	62.222
7	90	35	On the two sides of rows	53.333

The size of each sub-plot was (7.2 x 4 m) 28.8m2 and the two outer rows were used as a belt.

Yield components were estimated from ten representative plants in each sub-plot excluding the two outer rows. Nitrogen was added as ammonium nitrate (33.5%) in two equal doses before the second and third irrigations. Sowing dates

Table 1. Mechanical and chemical analysis of the soil.

Mechanical analysis	Season		Chemical analysis	Season	
	1993	1994		1993	1994
Clay %	20.2	24.2	Available N (ppm)	23.0	20.0
Silt %	72.0	72.0	Available P (ppm)	10.0	11.0
Sand %	7.8	3.8	Available K (ppm)	280.0	290.0
Texture	Clay loam	Clay loam	pH (1:2.5)	7.9	8.0
Organic matter %	1.07	1.11			

One feddan = 4200 m2

One kentar of seed cotton yield = 157.5 kilogram.

were on 29 th and 23rd March in 1993 and 1994 seasons, respectively and thinned at 2 plants/hill after 35 days from sowing. The other agricultural practices were carried out as recommended for cotton production.

The studied characters included : Number of fruiting branches/plant, Number of open bolls/plant, Boll weight (gm), Seed cotton yield/plant (gm), Number of plants/fed. at picking, Percentage of plants survival to the theoretical number (%), and Seed cotton yield/fed. (kentar).

Statistical analysis was peformed according to Snedecor and Cochran (1971). The mechanical and chemical analysis of the experimental soil is presented in Table (1).

RESULTS AND DISCUSSION

1. Effect of plant density :

Data in Table (2) show that that number of fruiting branches/plant significantly increased by decreasing plant density. This may be due to the low competition between plants in case of lower densities. Similar results were noted by Shalaby and Sakr (1981), Hussein *et al* (1983), El-Shinnawy and Ghaly (1985) and Radwan (1992).

Number of open bolls/plant significantly increased with decreasing plant population (Table 2). The highest number of open bolls/plant was obtained from lower plant population, i.e. 53333 plants/fed, while the lowest one was detected from higher plant population, i.e. 96000 plants/fed. These results are in harmony with those obtained by Shalaby and Sakr (1981), Hussein *et al.* (1983), El-Shinnawy and Ghaly (1985), Shalaby *et al.* (1989) and Radwan (1992).

From Table (2), it is clear that boll weight significantly increased by wider spacing or lower density in the two seasons. Hefni *et al.* (1978) and El-Shinnawy and Ghaly (1985) reported that boll weight was not significantly affected by plant densities.

Results in Table (2) show that planting cotton on the two sides of row 90 cm width and 35 cm between hills (53333 plants/fed) produced the highest plant yield in the two seasons. The increase in yield components per plant in wider planting spacing may be attributed to the more open canopy that allows better light and air

penetration and therefore increasing metabolism in plant tissuses. Similar trend was obtained by Hussein *et al.* (1983), Shalaby *et al.* (1989) and Radwan (1992).

Data given in Table (2) clear that number of harvested plants/fed significantly decreased by planting cotton at wider spacing in the two seasons. These results are in agreement with those obtained by Hussein *et al.* (1983).

Regarding percentage of surviving plants to theoretical number at sowing, Table (2) clearly indicate that closer spacing reduces this trait. Also in case of planting cotton on the two sides of row, percentage of surviving plants gradually increased as plant population decreased. Similar results were obtained by Hussein *et al.* (1983).

Table 2. Effect of plant density on yield and yield components in 1993 and 1994 seasons.

Plant density					Characters						
No. of plants per feddan	Planting method	Hill spacing (cm)	Row width (cm)	Season	No. of fruiting branches /plant	No. of open bolls /plant	Boll weight (gm)	Seed cotton yield/ plant (gm)	Plant stand at picking plant/ fed.	Percentage of survival (%)	Seed cotton yield/fed (kentar)
70000	On the south side of row	20	60	1993	6.86	14.70	1.81	26.24	46125	65.89	7.05
				1994	7.64	16.08	1.74	28.00	48675	69.54	8.07
96000	On the two sides of row	25	70	1993	6.17	11.29	1.69	19.07	60563	64.89	6.25
				1994	7.17	14.38	1.66	23.80	60600	64.93	7.55
80000	On the two sides of row	30	70	1993	6.77	13.52	1.68	22.13	51413	66.10	6.51
				1994	8.06	14.75	1.70	25.02	54788	70.44	7.93
68571	On the two sides of row	35	70	1993	8.51	16.82	1.92	32.17	51375	77.06	7.07
				1994	9.17	17.02	1.89	32.17	53625	80.44	8.20
74666	On the two sides of row	25	90	1993	8.53	13.34	1.75	23.28	52275	70.01	6.92
				1994	8.31	15.42	1.73	26.87	53400	71.52	8.05
62222	On the two sides of row	30	90	1993	8.21	15.38	1.81	27.78	49579	79.68	8.12
				1994	7.56	16.24	1.87	30.81	50550	81.24	8.98
53333	On the south side of row	35	90	1993	9.56	18.22	1.88	34.22	41850	78.47	6.61
				1994	9.37	18.07	1.94	34.95	45488	85.29	8.15
L.S.D.				1993	1.00	2.03	0.05	3.66	4452	8.8	0.65
				1994	1.06	2.70	0.05	4.54	4312	8.2	0.67

Seed cotton yield per feddan was significantly affected by plant density and plant spacing in the two seasons (Table 2). It is clear that planting cotton on the two sides of row 90 cm width and 30 cm between hills (62222 plants/fed) produced the highest seed cotton yield/fed (8.12 and 8.98 kentar/fed in 1993 and 1994 seasons, respectively), while planting cotton on the two sides of row 70 cm width and 25 cm between hills (96000 plants/fed) produced the lowest yield (6.25 and 7.55 kentar/

fed in 1993 and 1994 seasons, respectively). The decrease in seed cotton yield/fed may be due to the higher competition between plants in case of closer spacing that caused decrease in yield components such as number of open bolls/plant and boll weight and consequently plant yield. Opposite results were obtained by Hefni *et al.* (1978) and Hussein *et al.* (1983) who reported that plant density of 93333 plants/fed gave the highest yield. On the other hand, Radwan (1992) found that seed cotton yield was not significantly affected by hill spacing.

2. Effect of nitrogen level :

Number of fruiting branches/plant significantly increased by raising nitrogen level from 60 to 80 kg/fed in 1993 season only. However, the same trend was detected in 1994 season, (Table 3). Yassen *et al.* (1990) and Radwan (1992) reported that this trait was not significantly affected by nitrogen level.

Data in Table (3) show that application of 80 kg N/fed. significantly increased number of open bolls/plant compared with 60 kg/fed in the two seasons. Many investigators reported that the optimum nitrogen level for this trait was, 45-60 kg/fed (Hefni *et al.*, 1978), and 60 kg/fed (Yasseen *et al.*, 1990).

From Table (3) it is clear that boll weight was unaffected by nitrogen level. This result may be due to the fact that this trait is mainly controlled by genetic and climatic factors. Similar results were obtained by Abd El-Gawad *et al.* (1985), while the results obtained by Radwan (1992) indicated that boll weight tended to increase by increasing nitrogen level. It is clear that raising nitrogen level up to 80 kg/fed significantly increased plant yield in the two seasons (Table 3). Yasseen *et al.* (1990) found that plant yield was unaffected by raising nitrogen level from 60 to 90 kg/fed.

Table 3. Effect of nitrogen fertilization levels on yield and its components in 1993 and 1994 seasons.

Characters	1993			1994		
	Nitrogen level Kg N/fed		L.S.D	Nitrogen level Kg N/fed		L.S.D
	60	80		60	80	
No of fruiting branches/plant	7.61	7.98	0.37	8.01	8.35	NS
No. of open bolls/plant	14.37	16.36	1.60	14.76	17.22	1.21
Boll weight (gm)	1.78	1.79	NS	1.79	1.79	NS
Seed cotton yield/plant (gm)	25.29	27.65	1.14	26.60	30.86	3.62
Plant stand at picking (1000 plant/fed)	50.389	50.518	NS	52.232	52.661	NS
Seed cotton yield/fed (kentar)	6.82	7.05	0.61	7.95	8.31	0.35

Results in Table (3) clear that number of harvested plants/fed was not significantly affected by nitrogen level in the two seasons. Similar results were obtained by Abd El-Gawad *et al.* (1985).

Data presented in Table (3) indicate that increasing nitrogen level up to 80 kg/fed significantly increased seed cotton yield per feddan by 0.68 and 0.36 kentar in 1993 and 1994 seasons, respectively. This results is logical, since both number of open bolls/plant and plant yield were significantly increased by increasing nitrogen level up to 80 kg/fed, while number of harvested plants/fed and boll weight were unaffected. At the same time, analysis of the experiments soils showed that these soils were of low nitrogen content, (Table 1). These results are in general agreement with the findings of Ghaly *et al.* (1987) and Radwan (1992), while, Hefni *et al.* (1978) found that the differences in seed cotton yield/fed between 30, 45 and 60 kg N/fed were not significant.

3. Effect of the interaction :

All the interactions between plant population x nitrogen levels did not reach the 0.05 level of significance. However, the highest seed cotton yield/fed was detected from plant population of 62222 plants/fed, i.e. planting cotton on the two sides of row 90 cm. at hill spacing of 30 cm. and nitrogen level of 80 kg/fed, while the lowest one was produced from plant population of 96000 plants/fed and nitrogen level of 80 kg/fed, (Table 4). These results indicated that plant population of 62222 plants/fed was more responding to the higher nitrogen level of 80 kg/fed to keep the balance between plant growth and fruiting capacity, than the higher plant population of 96000 plants/fed.

Table 4. Effect of number of plants/fed and nitrogen levels interaction on seed cotton yield/fed in 1993 and 1994 seasons.

Season	Nitrogen level kg/fed	Number of plants/fed.						
		70000	96000	80000	68571	74666	62222	53333
1993	60	7.00	6.28	6.25	6.95	6.93	7.84	6.48
	80	7.10	6.22	6.76	7.19	6.91	8.40	6.74
1994	60	7.81	7.64	7.91	8.10	7.95	8.41	7.86
	80	8.33	7.45	7.95	8.29	8.14	9.55	8.43

From this study it is clear that plant populaation of 62222 plants/fed which resulted from row width 90 cm and planting cotton Giza 83 on the two sides at hill spacing of 30 cm and nitrogen level of 80 kg/fed gave the highest seed cotton yield/ fed.

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تأثير مسافات التخطيط ومسافات الجور والتسميد الازوتى على محصول القطن جيزة ٨٣

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اقيمت تجربتان حقليتان بمحطة البحوث الزراعية بملوى خلال موسمى ١٩٩٣، ١٩٩٤ لدراسة تأثير زراعة القطن على مصاطب ٧٠ سم ، ٩٠ سم والزراعة على الريشتين بمسافات جور ٢٥ ، ٣٠ و ٣٥ سم مقارنة بالزراعة العادية (تخطيط ٦٠ سم والزراعة على الريشة القبلية على ٢٠ سم بين الجور) ومعدل التسميد الازوتى ٦٠ ، ٨٠ كجم ن / فدان. وقد اثبتت النتائج مايلى :

١ – زيادة مكونات المحصول (عدد اللوز المتفتح / نبات، متوسط وزن اللوزة ومحصول النبات الفردى)، زيادة معنوية بمسافات الزراعة الواسعة (الزراعة على الريشتين على مصاطب عرض ٩٠ سم والمسافات بين الجور ٣٥سم) بينما انخفض عدد النباتات بالفدان عند الجنى.

٢ – زيادة النسبة المعنوية للنباتات المتبقية عند الجنى فى حالة الزراعة على المسافات الواسعة.

٣ – أعطت الزراعة على الريشتين فى مصاطب عرض ٩٠ سم وبمسافات جور ٣٠ سم أعلى محصول بفارق معنوى عن باقى المعاملات.

٤ – أدى زيادة التسميد الازوتى من ٦٠ الى ٨٠ كجم، / فدان الى زيادة معنوية فى كل من عدد اللوز المتفتح للنبات ومحصول النبات ومحصول الفدان. بينما لم يتاثر عدد الافرع الثمرية ووزن اللوزة وعدد النباتات بالفدان عند الجنى.

٥ – كان التفاعل بين الكثافات النباتية والتسميد الازوتى غير معنوى فى جميع الصفات.

وقد تحقق أعلى محصول من القطن الزهر للفدان عند زراعة القطن على مصاطب عرض ٩٠ سم ومسافات جور ٣٠ سم (٦٢٢٢٢ نبات/فدان) والتسميد الازوتى بمعدل ٨٠ كجم نيتروجين / فدان.