Effect of Spacing and Nitrogen Levels on Yield and Fiber Properties of Cutting Planted Cotton

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ABSTRACT

Two field experiments were conducted at the Experimental Farm of the Faculty of Agriculture (Saba Basha), Alexandria University, during 2000 and 2001 seasons to study the effect of spacing between root stem cuttings and nitrogen levels on yield, yield components and fiber properties of the Egyptian cotton variety Giza 70 . The obtained result revealed that the number of vegetative and fruiting branches/plant, seed cotton yield and yield components were significantly affected by plant spacing, nitrogen levels. The interactions between both factors were significant in the two seasons.

The root stem cuttings method (50 cm apart) under application of 60 kg N/fad recorded the highest mean values of the number of vegetative branches, total number of bolls, number of picked bolls, and seed cotton yield/plant. The root stem cuttings (40 cm apart) gave the highest mean values of number of fruiting branches/plant and seed cotton yield/fad with application of the same nitrogen level, 60 kg /fad., in the two seasons. The fiber length parameters, micronaire reading and elongation (%) were not significantly affected by the two studied factors. Only, the fiber bundle strength was significantly affected by the two studied factors in both seasons.

INTRODUCTION

Egyptian cotton has a good reputation all over the world for its superior lint quality. Egypt was the main cotton exporter of both long and extra-long cotton. In 1961 the Egyptian cotton area was about 2 million faddans producing more than ten million kantars, of which 7.5 million kantars were exported. However, in the last years, the area decreased to about half million faddans producing about 4 million kantars in 2000/2001 (Egyptian Cotton Gazette 2001). The decrease in cotton area is due to two main problems: 1) the Egyptian cotton is a long season crop and 2) the high increase of production inputs costs.

Recently, cotton propagation by plant cuttings was tried in Egypt to solve the first problem. Kamel et al (1960) and El-Shazly (1991) showed the possibility and advantages of growing cotton by cuttings. Shindy Bakr (1995), stated that several advantages could be attained by following this method: 1) higher yield and yield components amounting to 50 % than direct seeded plants. 2) early maturity with better lint quality. 3) saving more planting seed for more oil and cake for food and feed. 4) low pesticide cost. 5) ease of varietal purity and growing "Hybrid Cotton" with all its merits.

The root stem cuttings gave higher yield and yield components, nearly one month earlier maturity than direct seed planting method (Sorour *et al*, 1992).

On the other hand, balanced fertilization with nitrogen and other nutrient elements could solve the second problem.Though, the production inputs costs could be minimized by controlling the usage of nitrogen fertilizers and pesticides and this will increase the cotton farmers income.

The present investigation was conducted to study. the effect of some planting methods; such as planting by root stem cuttings and the conventional direct seeding method with different plant spacing. Besides, the effect of nitrogen level and their interaction on the vegetative growth characters, yield, and yield components as well as the cotton fiber properties in Giza 70 cotton cultivar.

MATERIAL AND METHODS

Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture, (Saba Basha), Alexandria University in 2000 and 2001 seasons to study the effect of spacing in direct seeding method (20 cm apart) and root stem cuttings (30, 40 and 50 cm apart) as well as nitrogen level (0, 30, 60, 90 and 120 kg N/fad) and their interactions on vegetative growth, yield and yield components and fiber properties in Giza 70 cotton variety (*Gossypium barbadense* L.).

Root stem cuttings of Giza 70 c.v. were taken from the field of cotton after the second picking at the end of November 1999 season and middle of December in 2000 season. They were arranged in bundles containing 50 cuttings (about 40 cm in length), stored under ground and covered with moist pure sand until the sowing date in next season. The two experiments were carried out in a split plot design with four replicates. The spacing treatments were randomly arranged in the main plots and the nitrogen levels in the sub-plots. The sub-plot was 5 ridges, 70 cm a part and 6 m. long, with total size of 21 m^2. The obtained data were subjected to proper statistical analysis according to Snedecor and Cochran (1976)

Planting dates were 31 and 28 March in 2000 and 2001 seasons, respectively. Root stem cuttings were irrigated again after 7 days from planting, then seeds and root stem cuttings were irrigated as usual. According to plant need.

Nitrogen fertilization was applied in the form of ammonium nitrate $NaNO_3$ (33.5% N) in two equal doses, the first dose before the second irrigation and the second dose was applied before the third irrigation. All field plots were treated with the normal treatments of cotton production and pest control program was followed.

The studied characters were :

A-The vegetative growth characters:

1-Germination and sprouting percentage. 2- Plant hight. 3- Number of vegetative and fruiting branches/plant. 4- Days to first open flower and boll/plant.

B-Yield and yield components :

1-Total number of bolls/plant. 2- Number of picked bolls/plant. 3- Boll weight. 4- Seed cotton yield/plant. 5- Seed cotton yield/faddan.

Vegetative characters and yield components were studied on 10 guarded plants from each plot and the seed cotton yield/fad was calculated from the seed cotton yield of each plot.

C- The fiber properties :

1- Length parameters. 2-Bundle strength and elongation. 3- Fineness and maturity as a Micronaire reading.

RESULTS AND DISCUSSION

Vegetative growth characters :

1. Germination and sprouting percentage :

Direct seeding method (20 cm apart) recorded the highest germination percentage compared with root stem cuttings (30, 40 and 50 cm apart) planting method during both seasons (Table 1).

On the contrary, nitrogen level and the interaction between planting treatments and nitrogen levels had no significant effect on this trait during both seasons of study. These results may be due to that nitrogen fertilization was applied after full germination and sprouting. In general these results are in agreement with those of Shindy Bakr *et al* (1995).

2. Plant height (cm) :

Planting treatments and nitrogen levels significantly affected plant height. The direct seeding method (20 cm apart) recorded the highest mean values of plant height (158.63 and 160.36 cm) and the lowest mean values of the same trait (141.06 and 140.38 cm) were obtained from root stem cuttings (50 cm apart) in 2000 and 2001 seasons.

Application of 120 kg N/fad gave the highest plant height (184.64 and 182.72 cm), while, non N/fad registered the lowest plant height (87.74 and 87.06 cm) in 2000 and 2001 seasons, respectively.

The interaction between planting treatments and nitrogen levels was significant for the plant height in both seasons. Direct seeding method (20 cm apart) under application of 120 kg N/fad possessed the highest mean values of the plant height compared with root stem cuttings (50 cm apart) planting method with application of non N/fad which gave the lowest mean values for the same character in both seasons. These results are in accordance with those of Abo-Zeid et al (2001), Makram *et al* (1997) and Abd El-Malik *et al* (1997).

3. Number of vegetative and fruiting branches/plant :

Significant differences in the number of vegetative and fruiting branches /plant due to planting treatment and nitrogen level and their interaction were found.

Table 1. Mean values of some vegetative growth characters of Giza 70 cotton variety as affected by planting treatment, nitrogen level and their interaction during 2000 and 2001 seasons.

Treatments	Characters											
	Germination and sprouting (%)		Plant height (cm)		No. of vegetative branches/plant		Number of fruiting branches/plant		Days to first open lower/ plant (days)		Days to first open boll/plant (days)	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Planting treatment (A)												
Direct seeding 20 cm	95.10 a	94.03 a	158.63 a	160.36 a	1.11 c	1.07 c	13.90 d	13.75 d	123.02 a	122.21 a	175.32 a	174.21 a
Root stem cutting 30 cm	86.08 b	85.12 b	156.55 a	152.86 b	3.23 ab	2.85 b	22.16 c	22.72 c	108.60 b	110.86 b	160.95 b	161.80 b
Root stem cutting 40 cm	86.32 b	85.26 b	152.96 b	151.66 b	3.34 a	2.95 a	32.32 a	31.35 a	108.46 b	108.78 c	160.51 b	161.26 c
Root stem cutting 50 cm	85.18 b	84.67 b	141.06 c	140.38 c	3.14 b	2.90 a	30.27 b	30.22 b	107.75 c	108.45 d	160.40 b	157.75 d
Nitrogen level (B)												
Non Nfad	87.74 a	87.06 a	103.85 e	104.81 e	2.30 c	2.02 d	20.20 d	18.04 e	108.55 d	108.46 r	160.71 c	153.16 e
30 kg Nfad	87.48 a	87.86 a	126.73 d	186.96 d	2.66 b	2.21 c	23.27 c	21.34 d	110.02 c	110.13 d	161.96 c	161.37 d
60 kg Nfad	87.60 a	87.76 a	166.60 c	166.60 c	3.00 a	2.66 a	26.86 a	29.66 a	112.77 b	112.77 c	164.95 b	164.10 c
90 kg Nfad	87.63 a	87.11 a	178.24 b	175.70 b	3.04 a	2.73 a	25.40 b	27.22 b	114.16 a	114.61 b	166.70 a	166.13 b
120 kg Nfad	87.79 a	87.26 a	184.64 a	182.72 a	3.56 b	2.52 b	24.04 c	26.94 c	114.94 a	116.74 a	167.17 a	166.00 a
Interaction												
A x B	N.S.	N.S.	**	**	**	**	**	**	**	**	**	**

* Significant at 0.05% level of probability.

** Significant at 0.01% level of probability.

N.S. Not significant.

Means followed by the same letter within each column are not significantly different at 0.05% level of probability.

The root stem cuttings method (40 cm apart) gave the highest mean values of both number of vegetative branches/plant (3.34 and 2.95) and fruiting branches/plant values (32.32 and 31.35) compared with direct seeding method (20 cm apart) in 2000 and 2001 seasons, respectively.

Application of 90 kg N/fad possessed the highest mean values of vegetative branches (3.04 and 2.73/plant), whereas, application of 60 kg N/fad gave the highest mean values for number of fruiting branches/plant (28.86 and 29.66) in 2000 and 2001 seasons, respectively.

Root stem cuttings (50 cm apart) planting method with application of 60 kg N/fad showed the highest number of vegetative branches/plant, meanwhile, root stem cuttings (40 cm apart) under application of 60 kg N/fad recorded the highest number of fruiting branches/plant in both seasons.

The attained results confirmed the fact that the number of fruiting branches per plant is positively corresponded with the plant spacing. Similar results were stated by Abd El-Malik and El-Shahawy (1999), Darwish and Hegab (2000) and El-Beily *et al* (2001).

4. Days to first open flower and open boll/plant :

The studied planting treatments, nitrogen levels and their interactions significantly influenced the period of days to first open flower and open boll/plant in the two seasons. Root stem cuttings method (50 cm apart) gave the shortest period meanwhile, the conventional direct seeding method gave the longest period for those traits in both seasons (Table 1).

Also, application of non N/fad recorded the shortest periods of the same traits in the two seasons.

The same planting treatment, root stem cuttings (50 cm apart) with no application of nitrogen gave the shortest period of the in both seasons. The longest periods of the same traits were obtained using direct seeding method (20 cm apart) with application of 120 kg N/fad in the two seasons. These findings match with those outlined by Abd El-Malik and El-Shahawy (1999), Darwish and Hegab (2000) and Darwish (2001).

Yield and yield components :

1. Total number of bolls/plant :

Root stem cuttings (50 cm apart) planting method gave the highest total number of bolls/plant (70.47 and 68.77), about three times the total number given by the direct seeding planting method for both seasons, respectively (Table 2).

Application of 60 kg N/fad in the first season and 90 kg N/fad in the second season gave the highest mean values (63.22 and 65.63 boll/plant) of this trait, respectively.

Table 2. Mean values of yield and yield components of Giza 70 cotton variety as affected by planting treatment, nitrogen level and their interaction during 2000 and 2001 seasons.

Treatments	Characters									
	Total number of bolls/plant		Number of picked bolls/plant		Boll weight (gm)		Seed cotton yield/plant (gm)		Seed cotton yield/ fad (kentar)	
	2000	2001	2000	2001	2000	2000	2001	2000	2001	2001
Planting treatment (A)										
Direct seeding 20 cm	21.51 d	22.18 d	15.51 d	16.17 d	2.45 a	2.41 a	38.60 d	50.60 d	6.82 d	7.90 d
Root stem cutting 30 cm	54.83 c	55.96 c	46.42 c	48.85 c	2.47 a	2.42 a	122.94 c	120.60 c	13.25 b	13.32 b
Root stem cutting 40 cm	65.28 b	55.36 b	52.67 b	57.66 b	2.43 a	2.43 a	137.91 b	139.08 b	14.66 a	14.74 a
Root stem cutting 50 cm	70.47 a	68.77 a	58.36 a	61.50 a	2.40 a	2.41 a	148.02 a	155.30 d	11.11 c	12.42 c
Nitrogen level (B)										
Non N/fad	36.35 e	35.31 e	30.03 e	30.48 e	2.11 c	2.16 e	63.97 e	67.38 e	6.52 e	6.80 e
30 kg N/fad	48.35 d	47.13 d	38.56 d	40.29 d	2.33 b	2.24 d	90.22 d	93.92 d	9.25 d	9.13 d
60 kg N/fad	63.22 a	63.56 b	56.11 a	55.88 a	2.58 a	2.50 c	153.68 a	156.00 a	15.21 a	15.70 a
90 kg N/fad	62.05 b	65.63 a	50.45 b	55.16 b	2.67 a	2.65 a	138.14 b	135.53 b	14.78 b	15.54 b
120 kg N/fad	54.60 c	53.62 c	41.07 c	48.40 c	2.60 a	2.55 b	117.17 c	123.25 c	11.56 c	13.26 c
Interaction										
A x B	**	**	**	**	N.S.	N.S.	**	**	**	**

* Significant at 0.05% level of probability.
** Significant at 0.01% level of probability.
N.S. Not significant.
Means followed by the same letter within each column are not significantly different at 0.05% level of probability.

The root stem cuttings (50 cm apart) planting method under application of 60 kg N/fad in the.first season and 90 kg N/fad in the second season showed the highest number of total boll/plant. The attained results are in agreement with those of Sorour *et al* (1992) and Shindy Bakr *et al* (1995).

2. Number of picked bolls/plant :

The number of picked bolls/plant followed the same trend and were significantly affected by the two studied factors and their interaction in both seasons.

Root stem cutting method (50 cm apart) under application of 60 kg N/fad gave the highest mean values of the same trait in 2000 and 2001 seasons. Sorour *et al* (1992) and El-Shahawy and Darwish (2001) came to the similar conclusion.

3. Boll weight :

No significant effect was found due to planting treatment and the interaction between planting treatment and nitrogen level for the boll weight in both seasons. On the contrary, Sorour *et al* (1992) and Shindy Baker *et al* (1995) found a significant differences between direct seeding and root stem cuttings in this trait.

Whereas, nitrogen level had a significant effect on the same character. Application of 120 kg N/fad in the first season and 90 kg N/fad in the second season gave the highest mean values of the boll weight (2.60 and 2.65 gm), respectively.

4. Seed cotton yield/plant :

The highest mean values of seed cotton yield/plant (148.02 and 155.30 gm) were obtained using root stem cutting method (50 cm apart) in both seasons of 2000 and 2001, respectively.

Application of 60 kg N/fad gave the highest mean values (153.68 and 156.00 gm/plant) for the same character in the two seasons, respectively.

Root stem cutting method (50 cm apart) under application of 60 kg N/fad recorded the highest mean values of seed cotton yield/plant (212.90 and 214.90 gm) in both seasons, 2000 and 2001, respectively (Table 4). Meanwhile, direct seeding method (20 cm apart) with non application of N/fad gave the lowest mean values (26.84 and 38.57 gm) for the same trait in 2000 and 2001 seasons, respectively (Table 4).

5. Seed cotton yield/fad :

Seed cotton yield/fad was significantly varied due to planting treatment and nitrogen level. The interaction between both planting treatment and nitrogen level was significant in the two seasons. Root stem cutting method (40 cm apart) gave the highest mean values (14.66 and 14.74 kentar/fad), compared with the direct seeding method (20 cm apart) which recorded the lowest mean values (6.82 and 7.90 kantar/fad) in 2000 and 2001 seasons, respectively.

Table 3. Mean values of the fiber properties of Giza 70 cotton variety as affected by planting treatment, nitrogen level and their interaction during 2000 and 2001 seasons.

Treatments	Characters											
	2.5% span length (mm)		50% span length (mm)		Uniformity ratio (%)		Bundle strength (gm/tex)		Fiber elongation (%)		Micronaire reading	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Planting treatment (A)												
Direct seeding 20 cm	36.95 a	35.72 a	16.54 a	17.31 a	46.74 a	48.53 a	35.70 c	34.38 c	5.52 a	5.64 a	4.28 a	4.31 a
Root stem cutting 30 cm	36.92 a	35.79 a	16.49 a	17.42 a	46.72	48.69 a	35.77 b	34.75 b	5.61 a	5.60 a	4.30 a	4.30 a
Root stem cutting 40 cm	36.97 a	35.75 a	16.47 a	17.35 a	46.53 a	48.45 a	35.78 b	34.78 b	5.56 a	5.62 a	4.32 a	4.31 a
Root stem cutting 60 cm	37.02 a	35.80 a	16.43 a	17.43 a	46.56 a	48.67 a	35.90 a	34.91 a	5.57 a	5.65 a	4.30 a	4.33 a
Nitrogen level (B)												
Non N/fad	36.94 a	35.76 a	16.46 a	17.33 a	46.48 a	48.47 a	35.60 e	34.59 a	5.63 a	5.66 a	4.29 a	4.30 a
30 kg N/fad	36.94 a	35.80 a	16.48 a	17.41 a	46.63 a	48.64 a	35.68 d	30.65 d	5.60 a	5.46 a	4.31 a	4.32 a
60 kg N/fad	36.95 a	35.73 a	16.54 a	17.26 a	46.60 a	48.34 a	.79 c	34.74 c	5.54 a	5.58 a	4.32 a	4.30 a
90 kg N/fad	37.03 a	35.77 a	16.52 a	17.34 a	46.70 a	48.53 a	3.90 b	34.90 b	5.56 a	5.61 a	4.29 a	4.33 a
120 kg N/fad	36.98 a	35.78 a	16.47 a	17.54 a	46.53 a	48.93 a	36.02 a	35.04 a	5.55 a	5.63 a	4.30 a	4.28 a
Interaction												
A x B	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	**	N.S.	N.S.	N.S.	N.S.

* Significant at 0.05% level of probability.
** Significant at 0.01% level of probability.
N.S. Not significant.
Means followed by the same letter within each column are not significantly different at 0.05% level of probability.

Meanwhile, application of 60 kg N/fad gave the highest mean values of the same trait (15.21 and 15.70 kantar/fad) in the same respective seasons (Table 2).

From (Table 4) it could be noticed that root stem cutting method (40 cm apart) with application of 60 kg N/fad had the highest mean values (18.95 and 18.86 kantar/fad) in 2000 and 2001 seasons, respectively. Meanwhile, the lowest mean values of the same trait were obtained using direct seeding method (20 cm apart) with no application of nitrogen (4.64 and 5.18 kantar/fad) in both seasons of 2000 and 2001, respectively. Similar findings were attained by Sorour *et al* (1992), El-Shahawy *et al* (1993), Darwish (2001) and El-Beily *et al* (2001).

Fiber properties :

1. Fiber length parameters :

There were no significant differences in all studied fiber length parameters (2.5% span length, 50% span length and uniformity ration) due to planting treatment, nitrogen level and their interaction in both seasons (Table 3). The attained results were in agreement with those of Sorour *et al* (1992) and Shindy Bakr *et al* (1995).

2. Fiber bundle strength and elongation :

Fiber bundle strength was significantly affected by planting treatment, nitrogen level and their interaction. The highest mean values (35.90 and 34.91 gm/tex) were given by root stem cutting planting method (50 cm apart), and by application of 120 kg N/fad (36.02 and 35.04 gm/tex) in the two seasons of 2000 and 2001, respectively (Table 3).

However, root stem cutting planting method (50 cm apart) under application of 90 kg N/fad recorded the greatest mean values of the same trait (36.00 and 34.78 gm/tex) in 2000 and 2001 seasons, respectively (Table 4).

On the contrary, differences in fiber elongation (%), during the two seasons did not reach the significant level (Table 3).

3. Micronaire reading :

It was found that the planting treatment, nitrogen level their interaction in both seasons were not significantly affected the micronaire reading. These findings were in harmony with those of Rehab *et al* (1991) and Sorour *et al* (1992).

CONCLUSION

From the results obtained in this investigation, under condjtions of planting, it could be concluded that the new planting method, root stem cuttings (40 cm apart) and under application of 60 kg N/fad gave the highest seed cotton yield and yield components with good fiber properties in both studied seasons. Hence, this method could be used beside the conventional direct seeding method.

Table 4. Mean values of seed cotton yield/plant and seed cotton yield/fad of Giza 70 cotton variety as influenced by the interaction between planting treatment and nitrogen level during 2000 and 2001 seasons.

		Characters					
		Seed cotton yield/plant (gm)		Seed cotton yield/fad (kentar)		Bundle strength (gm/tex)	
Planting treatment	Nitrogen level (kg/fad)	2000	2001	2000	2001	2000	2001
Direct seeding (20 cm)	0	26.84	38.57	4.64	5.18	35.47	34.39
	30	33.90	45.39	6.34	6.16	35.60	34.52
	60	50.74	48.86	9.26	9.77	35.70	34.60
	90	45.25	60.23	8.52	10.23	35.82	34.75
	120	36.28	5098	5.26	8.20	35.90	34.83
Root stem cuttings (30 cm)	0	63.76	64.29	70.82	7.43	35.61	34.46
	30	104.70	105.16	9.95	9.90	35.70	34.54
	60	158.23	155.86	17.80	18.11	35.78	34.63
	90	147.74	148.34	16.34	16.70	35.90	34.76
	120	135.71	135.60	14.36	14.58	35.85	34.81
Root stem cuttings (40 cm)	0	79.80	80.78	8.34	8.54	35.62	34.47
	30	109.40	109.61	12.35	12.50	35.70	34.58
	60	192.93	194.08	18.95	18.86	35.77	34.70
	90	160.74	161.68	17.92	17.66	35.87	34.82
	120	146.70	149.26	15.78	16.08	35.95	34.85
Root stem Cuttings (50 cm)	0	85.50	55.88	5.28	6.11	35.67	34.48
	30	112.81	115.56	8.25	7.96	35.78	34.60
	60	212.90	214.93	14.86	16.05	35.91	34.74
	90	178.83	179.38	16.35	17.60	36.00	34.87
	120	150.08	180.78	10.83	14.24	35.20	34.84
L.S.D. 0.05		6.03	7.43	6.57	6.13	2.25	2.18
L.S.D. 0.01		8.45	10.42	9.26	8.60	3.17	3.07

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الملخص العربى

تأثير المسافات ومستويات التسميد الآزوتى على المحصول ومكوناته وخواص الألياف للقطن المزروع بالعقلة

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أجريت تجربتان حقليتان بالمزرعة التجريبية لكلية الزراعة (سابا باشا) جامعة الإسكندرية خلال الموسمين ٢٠٠٠، ٢٠٠١ لدراسة تأثير مسافات الزراعة ومستويات التسميد النيتروجيني على المحصول ومكوناته وخواص الألياف لصنف القطن جيزة ٧٠ . أوضحت النتائج المتحصل عليها أن عدد الأفرع الخضرية ومحصول القطن الزهر ومكوناته قد تأثرت معنويا بمسافات الزراعة ومستويات النتروجين والتفاعل بينهما فى كلا الموسمين . سجلت طريقة الزراعة بالعقل الجذر ساقية (على مسافة ٥٠ سم) تحت معدل تسميد ٦٠ كجم أزوت للفدان أعلى القيم المتوسطة لعدد الأفرع الخضرية ؛ العدد الكلى للوزات ؛ عدد اللوزات التى تم جنيها ومحصول القطن الزهر /نبات. أعطت طريقة الزراعة بالعقل الجذر ساقية (على مسافة ٤٠ سم) تحت نفس مستوى التسميد النتروجينى أعلى القيم المتوسطة لعدد الأفرع الثمرية /نبات ومحصول القطن الزهر / فدان فى موسمى الدراسة. لم تتأثر مؤشرات طول الألياف ، قراءة الميكرونير و نسبة استطالة الألياف (٪) معنويا ، وقد تأثرت فقط متانة خصلة الألياف معنويا بالعاملين موضع الدراسة وبالتفاعل بينهما فى كلا الموسمين.