RESULTS AND DISCUSSION

FIRST EXPERIMENT

EFFECT OF NUMBER OF SEEDS PER HILL AND THINNING DATE ON GROWTH, YIELD, EARLINESS AND FIBER CHARACTERS OF LATE PLANTED COTTON

I- Effect of number of seeds per hill on:

A- Number of emergened hills and growth characters of cotton plant

1- Number of emergened hills per feddan:

Results in Table 3 indicated that under late cotton planting number of seeds per hill had a significant effect on number of emergened hills per unit area.

Number of emergened hills/fed. increased gradually with increasing number of seeds/hill in the two seasons.

In 1989 season, it is clear that the difference between plants sown with 5 and 15 seeds/hill was significant whereas the differences between the other treatments, namely, 5 and 10 or 10 and 15 were not significant.

In 1990 season, number of emergened hills/fed. gradually and significantly increased by increasing number of seeds per hill up to 15 seeds/hill. Generally, maximum number of emergened hills/fed. was obtained by sowing 15 seeds per hill.

Table 3: Effect of number of seeds per hill on number of emerged hills and growth characters of cotton plant in 1989 and 1990 seasons.

Treatments (No. of seed/hill)		No. of emergened hills/fed. (1000 hills)		Plant height at harvest cm		Node Number of first sympodia		No. of fruiting pranches/plant	
		1989	1990	1989	1990	1989	1990	1989	1990
5 seeds		33.52	32.16	81.8	91.3	7.90	7.50	15.67	11.13
10 ..		34.24	33.52	78.9	87.0	8.23	7.75	15.58	12.33
15 ..		34.92	34.96	82.3	90.1	8.18	7.54	15.75	11.92
L.S.D.	0.05	1.12	0.92	n.s	n.s	n.s	n.s	n.s	n.s
	0.01	n.s	1.36	n.s	n.s	n.s	n.s	n.s	n.s

This result could be ascribed to the heavy cover of the hill which retards the seedlings emergence above the soil surface, in the case of sowing few seeds per hill. The increase in emerged hills due to increasing number of seeds per hill is in agreement with the results obtained by Baker (1977), Abdel-Malak (1980) and Shalaby and Saker (1981).

On the other hand, El-Sourady et al (1979a) found that seeding rate had no significant effect on seedlings emergence.

2- Plant height (cm):

Data in table 3 revealed that, under late planting date, plant height at maximum growth was not significantly affected by number of seeds per hill, in the two seasons. The shortest cotton plants were obtained by planting 10 seeds per hill in both seasons but without any significant difference compared with planting 5 or 15 seeds/hill. Similar results were obtained by El-Sourady et al (1979a), whereas Abdel-Malak (1980) found an increase in plant height with the increase in seeding rate.

The lack of response of cotton plant height to number of seeds/hill may be due to the delayed planting where the high temperature encourages emergence and growth of cotton seedlings regardless number of seedlings/hill.

3- Node number of first sympodia:

Results in table 3 showed that number of seeds per hill had no significant effect on number of first sympodia in both

seasons. This indicates that there was no pertinance between node number of first sympodia and number of seeds per hill. This result did not coincide with the findings of Abdel-Malak (1980) and Shalaby and Saker (1981) who found that node number of first sympodia increased with the increase in seeding rate.

This contradictory result my be due to the late planting date (on May, 1st and April, 25th in the two successive seasons) which may reduce plant response to cultural treatments.

4- Number of fruiting branches per plant:

Number of fruiting branches per plant was not significantly affected by number of seeds per hill. However the maximum number of fruiting branches per plant was obtained by planting 15 and 10 seeds per hill, in 1989 and 1990, respectively as shown in table 3. This result disagreed with those reported by Shalaby and Saker (1981) who found that number of branches per plant increased with the reduction of number of seeds/hill to 5 seeds.

This contradictory result may be due to the delayed planting.

B- Seed cotton yield and its components:

1- Number of total bolls per plant:

Data presented in Table 4 indicated that under late cotton planting number of seeds per hill had no significant effect on number of bolls /plant in both seasons. It was clear that number of bolls/plant increased gradually by

decreasing number of seeds per hill to 5 seeds/hill in 1989 season and to 10 seeds/hill in 1990 season. However, these increases were not significant. The increase in number of bolls/plant by decreasing seed number/hill may be attributed to the low competition between plants for, nutrients, water which contributes to high amount of metabolite formation and this in turn is used in boll formation.

Similar results were reported by many investigators (Baker, 1977; Abdel-Malak, 1980; and Shalaby and Saker, 1981). It is worth mentioning here that the lack of response of cotton plants to number of seeds/hill may be due to the late planting date where the climatic conditions encourage a favourable plant growth.

2- Number of open bolls per plant:

Results in Table 4 showed that under late planting date number of open bolls per plant was not significantly affected by number of seeds per hill. However, it is clear that number of open bolls/plant was associated with number of total bolls/plant in both seasons. Also, it is clear that percentage of open bolls/plant to total bolls/plant were, 63.5% and 62.9% and 61.5% in 1989 season and 54.3%, 46.1% and 53.9% in 1990 season by sowing 5, 10 and 15 seeds per hill, respectively. These results indicated that there was no relevence between number of open bolls and seed number/hill. The reduction in percentage of open bolls/plant was very

Table 4 : Effect of number of seeds per hill on seed cotton yield and its components in 1989 and 1990 seasons.

Nuaber of Seeds per hill	No. of total bolls/plant		No. of open bolls/plant		Seed cotton yield/boll gm.		Seed cotton yield/plant gm.		Lint percentage %		Seed index gm.		Percentage of surviving plants at picking %		Seed cotton yield/fed. (Kentar)*		Lint cotton yield/fed. (Kentar)**	
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
5 seeds	11.05	19.67	7.02	10.68	2.36	2.32	16.50	23.34	39.7	38.2	8.94	9.01	66.61	65.50	4.52	6.32	5.66	7.21
10 ,,	10.98	21.78	6.91	10.03	2.36	2.14	15.90	20.68	40.3	38.1	8.88	9.12	68.43	78.76	4.77	6.75	6.00	8.35
15 ,,	9.93	20.88	6.11	11.26	2.42	2.11	14.13	23.25	40.0	37.9	8.78	8.82	80.64	78.04	5.11	7.25	6.14	8.41
L.S.D. 0.05	n.s	n.s	n.s	n.s	n.s	n.s	1.75	n.s	n.s	n.s	n.s	n.s	10.07	11.51	n.s	n.s	n.s	n.s
L.S.D. 0.01	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s

* One kentar seed cotton = 157.5 kg.
** One kentar of lint cotton = 50 kg.

high and varied between 36.5% and 53.9%, in the two seasons, which means that some of the produced bolls failed to achieve full maturity and to open. This may be due to short season of growth due to late planting and/or the attack of boll worms.

Results obtained by Abdel-Malak (1980) and Shalby and Saker (1981) showed that number of open bolls/plant was reduced with increase in seeding rate.

3- Seed cotton yield per boll (gm):

Data shown in Table 4 demonstrate that, under late planting date, number of seeds per hill had no significant effect on boll weight in both seasons. It was clear that boll weight decreased gradually but insignificantly by increasing number of seeds per hill in 1990 season. It could be concluded that planting with 5,10 and 15 seeds/hill produced the same seed cotton yield per boll. It is worth noting that the differences observed in this trait were too slight and had no any specific trend and were fluctuating from one season to the other. The highest value of seed cotton yield/boll was recorded with 15 seeds/hill in 1989, but with 5 seeds/hill in 1990.

It could be concluded that seed cotton yield/boll may be considered as a genetical factor which is rarely affected by cultural practices.

Similar result was also reported by Shalaby and Saker (1981), whereas Baker (1977) found that boll weight was

reduced with the increase in seeding rate.

4- Seed cotton yied per plant (gm):

Number of seeds per hill significantly affected seed cotton yield per plant in 1989 season (Table 4). Results indicated that sowing 15 seeds per hill reduced seed cotton yield/plant by 1.77 and 2.37gm compared with 10 and 5 seeds/hill, respectively. The difference in seed cotton yield/plant between sowing 10 and 5 seeds per hill was not significat.

The reduction in seed cotton yield/plant by increasing number of seeds/hill could be attributed to the high competition between seedlings in the early stage of growth which contributes to low number of total and open bolls/plant.

In 1990 season, no specific trend was observed for the effect of seed number/hill on seed cotton yield per plant as shown in 1989 season. However, it could be concluded that under late cotton planting, the highest seed cotton yield per plant was obtained by planting 5 seeds/hill in both seasons.

Similar findings were obtained by Abdel-Malak (1980) and Shalaby and Saker (1981)who found that seed cotton yield/plant was incraesed with the decrease in seeding rate.

5- Lint percentage(%):

The present results showed that, under late cotton planting, lint percentage was not significantly affected by number of seeds/hill in both seasons (Table 4). There was no

relevence between number of seeds/hill and lint percentage.

Lint percentage could be considered as a genetical character which is not affected by seed number/hill.

Many investigators came to similar findings (Baker, 1977; El-Sourady et al, 1979a; and Abdel-Malak, 1980).

6- Seed index (weight of 100 seeds in gm):

Data illustrated in Table 4 demonstrate that under delayed cotton planting number of seeds per hill had no significant effect on seed index in both seasons. Increasing number of seeds per hill to more than 5 seeds did not exert any significant difference in seed index. Such result indicates clearly that this trait is mainly a genetical one which is rarely affected by cultural treatments.

Similar results were also reported by Baker (1977), El-Sourady et al (1979a) and Abdel- Malak (1980).

7- Percentage of survivng plants at picking:

Data presented in Table 4 showed that plant stand, expressed as percentage of surviving plants at picking, was significantly affected by seeding rate in both seasons. It is clear that sowing 15 seeds per hill caused a significant increase in percentage of surviving plants at picking compared with sowing 10 or 5 seeds/hill, in 1989 season. While, in 1990 season, sowing 10 and/or 15 seeds per hill significantly increased percentage of surviving plants compared with sowing 5 seeds per hill. It could be concluded that even under late cotton planting the highest number of

plants at picking was obtained by planting 10 or 15 seeds/hill. Planting 5 seeds/hill caused a marked reduction in plant stand where one third of the plants was lost.

This result coinsides with those obtained by Baker (1977), Abdel-Malak (1980) and Shalaby and Saker(1981) who found that number of plants at picking was increased with the increase in seeding rate.

8- Seed cotton yield per feddan (in kentar):

Data in Table 4 revealed that, under delayed planting, number of seeds per hill had no significant effect on seed cotton yield per fed. in both seasons. However, seed cotton yield per fed. was insignificantly increased by increasing number of seeds/hill in both seasons. It is clear that sowing 15 and 10 seeds increased seed cotton yield by, 13.1 and 5.5% in 1989 season and 14.7 and 6.8% in 1990 season compared with sowing 5 seeds per hill. These increases, however, did not reach the 5% level of significance.

It could be concluded that using 15 seeds/hill is preferable for producing a higher cotton yield compared with 5 or 10 seeds/hill. The present result is mainly due to the effect of a higher seed number/hill on cotton stand at picking.

It was evident that increasing seed number/hill significantly increased cotton stand which in turn positively affected seed cotton yield/fed.

it is worth noting that using 15 seeds/hill requires a

seeding rate of 50 kg/fed. which is lower than the amount of seeds practically distributed from the Ministry of Agriculture to the cotton growers (60 kg seeds per fed.).

Similar results were obtained by El-Okkia (1973) and Abdel-Malak (1980) who found that seeding rate had no significant effect on seed cotton yield.

On the other hand, Khalifa (1967), Baker (1977), El-Sourady et al (1979a) and Shalaby and Saker (1980) found that seed cotton yield increased with the increase in seeding rate.

It is worthy to note that the lack of response of seed cotton yield to number of seeds/hill is mainly due to the late planting of cotton which ensured a high germination of seeds and guaranteed the growth of emerged seedlings due to the fovourable climatic condition compared with early planting.

9- Lint cotton yield per fed. (in kentar):

Lint cotton yield per fed. of late planted cotton was not significantly affectec by seeding rate as shown in Table 4. However, increasing number of seeds/hill from 5 to 10 and 15 seeds increased the lint cotton yield by 0.34 and 0.58 kentar in 1989 and by 1.14 and 1.20 kentar in 1990 season. It is clear that this character tended to increase by increasing seeding rate in both seasons. Generally, it is clear that lint yield showed a similar trend of response to number of

seeds/hill as that recorded with seed cotton yield. This result is mainly due to the fact that lint percentage was not affected by number of seeds/hill.

Results reported by Baker (1977) showed also similar trend where he found that the highest lint yiled was obtained with 48kg seeding rate/fed., which is equivalent to 15 seeds/hill in the present investigation.

C- Effect of number of seeds per hill on earliness characters:

1- Days to first flower appearance:

Number of days from planting to first flower opening was not significantly affected by number of seeds per hill in both seasons (Table 5). Such result indicates that there was no pertinence between number of seeds per hill and earliness in cotton flowering, probably due to late cotton planting. Similar findings were obtained by El-Sourady et al (1979a), whereas Abdel-Malak (1980) and Shalaby and Saker (1981) found that decreasing seeding rate reduced number of days to first flower.

2- Days to first boll opening:

Data in Table 5 indicate that number of seeds per hill had no significant effect on number of days from planting to first boll opening. This result is logical since number of seeds per hill did not affect flowering date. Many investigators came to similar findings (El-Sourady et al.

Table 5 : Effect of number of seeds per hill on earliness characters in 1989 and 1990 seasons.

No. of seeds per hill		Days to first flower appearance		Days to first boll apening		Percentage of first picking yield to total yield %	
		1989	1990	1989	1990	1989	1990
5 cm		81.3	81.8	130.7	131.3	62.9	57.1
10 cm		81.1	81.9	130.9	131.8	61.8	56.1
15 cm		81.6	82.3	131.3	131.8	63.3	56.1
L.S.D.	0.05	n.s	n.s	n.s	n.s	n.s	n.s
	0.01	n.s	n.s	n.s	n.s	n.s	n.s

1979a). On the other hand, Abdel-Malak (1980)and Shalaby and Saker (1981)found that number of days to first boll opening increased with the increase in seeding rate.

3- Earliness percentage: (percentage of first picking yield to total seed cotton yield):

results presented in Table 5 showed that earliness, expressed as the percentage of first picking yield to total yield was not significantly affected by number of seeds per hill in both seasons. It is clear that no specific trend was observed for the effect of number of seeds per hill on this character in both seasons. This means that under late cotton planting there was no relevence between number of seeds/hill and earliness percentage in cotton.

The result is quite expected since number of seeds/hill did not significantly affect flowering and bolling dates.

Similar results were also reported by Shalaby and Saker (1981), whereas Abdel-Malak (1980) found that percentage of first picking decreased with the increase in seeding rate.

D- Effect of number of seeds per hill on fiber characters:

1- Length parameters:

Data shown in Table 6 demonstrate that under late planting date fiber length, expressed as 2.5% or 50% span length was not significantly affected by seeding rate. There was a slight increase in 50% span lenght in 1990 season but such increase did not reach the 5% level of significance. Also, uniformity ratio was not significantly affected by

Table 6 : Effect of Number of seeds per hill on fiber characters in 1989 and 1990 seasons.

Number of seeds per hill	Length paramters						Fiber strength (gm/tex)		Fiber fineness (micronaire reading)	
	2.5 % S.L. m.m		50% S.L. m.m		Uniformity ratio (%)					
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
5 seeds	29.7	28.4	14.4	14.4	48.4	50.3	9.1	9.4	3.56	3.84
10 ,,	29.2	28.8	14.1	14.5	48.4	50.2	9.4	9.2	3.60	3.74
15 ,,	29.7	28.8	14.2	14.7	47.7	51.0	9.3	8.9	3.75	3.81
L.S.D. 0.05	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s
L.S.D. 0.01	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s

increasing seeding rate in both seasons.

2- Fiber strength: (gr/tex)

Data in Table 6 indicated that number of seeds per hill had no significant effect on fiber strength in both seasons.

3- Fiber fineness (micronaire reading):

Results presented in Table 6 showed that fiber fineness was not significantly affected by seeding rate in both seasons. In 1989 season it was clear that increasing seeding rate increased micronaire reading but such increase was below the 5% level of significance.

The present results indicate that fiber properties of cotton are mainly governed by the genetical constitution of the cotton variety. In addition, late cotton planting reduced markedly the response of cotton plant to cultural treatments compared with early planted cotton. It could be concluded that fiber characters were not affected by number of seeds/hill. These results are in agreement with those obtained by Baker (1977), El-Sourady et al (1979a) and Abdel-Malak (1980).

II- Effect of thinning date on:

A- Growth characters of cotton plant:

1- Plant height (cm):

Data in Table 7 indicated that under late planting thinning date had no significant effect on cotton plant height. However, there was a gradually decrease in plant height by delaying thinning date up to 35 days in both

Table 7 : Effect of thinning date on some growth characters of cotton plant in 1989 and 1990 seasons.

No. of days from planting to thinning	Plant height at at harvest cm		Node number of first sympodia		No.of fruiting branches/plant	
	1989	1990	1989	1990	1989	1990
20 days	84.8	90.8	7.9	7.5	17.0	12.1
25 ,,	81.1	90.3	8.1	7.6	15.7	11.8
30 ,,	79.2	88.8	8.1	7.7	15.2	11.6
35 ,,	79.0	87.9	8.3	7.7	14.8	11.7
L.S.D. 0.05	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
L.S.D. 0.01	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

seasons, but, these differences were not that great to reach the 5% level of significance.

This trend could be due to the severe competition between plants in a very limited spot as a result of delayed thinning and this in turn contributed to less vegetative growth.These results coincide with the findings of El-Bayoumy (1971), Imam (1984), Shahine (1986) and Ghaly et al (1987).

it is worthly to note that the insignificant effect of thinning date on cotton plant height may be due to the delayed planting which reduces the response of cotton plant to cultural treatments.

2- Node number of first sympodia:

Results in Table 7 showed that under late planting thinning date had no significant effect on the node number of first sympodia in both seasons. It could be concluded that delaying thinning did not affect the node number of first sympodia. Similar results were also obtained by Shahine (1986), whereas Imam (1984)found that node number of first sympodia was reduced by early thinning.

3- Number of fruiting branches per plant:

Results in Table 7 indicated that, when cotton was planted too late, thinning date had no significant effcet on number of fruiting branches per plant in both seasons.

It is clear that number of fruiting branches per plant tended to decrease as thinning date was delayed but with insignificant differences. This trend is expected because

delaying thinning led to shorter plants which in turn restricted the capacity of plant to bear more fruiting branches. Many investigators came to similar conclusion (El-Bayoumy, 1971; Imam, 1984; Shahine, 1986; and Ghaly and El-Banna, 1988).

B- Seed cotton yield and its components:

1- Number of total bolls per plant:

Data in Table 8 show that under late planting date number of total bolls per plant was not significantly affected by thinning date in both seasons. It is clear that number of total bolls per plant was insignificantly decreased with delaying thinning date in the second season only. The decrease in number of total bolls/plant as a result of delaying thinning may be attributed to the decrease in fruiting branches number at delayed thinning. In addition the severe competition between seedlings before thinning led to a reduction metabolic efficiency.The amount of metabolites were lower in late thinned plants to produce a great number of bolls compared with early thinned plants.

This result coincides with those obtained by Shahine (1986) and Abou-Zaid et al (1989) who found that number of total bolls/plant increased due to early thinning.

2- Number of open bolls per plant:

Data in Table 8 indicated that, under late cotton planting, maximum number of open bolls per plant was obtained by thinning after 20 days from planting in both seasons. In

Table 8 : Effect of thinning date on seed cotton yield and its components in 1989 and 1990 seasons.

Days from planting to thinning	No. of total bolls/plant		No. of open bolls/plant		Seed cotton yield/boll gm.		Seed cotton yield/plant gm.		Lint pecentage %		Seed index gm.		Percentage of surviving plants at picking %		Seed cotton yield/fed. (Kentar)*		Lint cotton yield/fed. (Kentar)**	
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
20 days	10.76	22.31	7.03	12.29	2.37	2.07	16.28	25.36	40.5	38.9	8.90	9.07	80.04	78.24	5.26	7.16	6.87	8.77
25 ,,	10.01	20.52	6.34	10.54	2.25	2.14	14.12	22.22	39.9	38.0	8.96	9.04	79.86	75.19	5.03	6.68	6.05	7.77
30 ,,	11.14	20.24	6.37	9.96	2.26	2.21	15.54	21.52	39.9	37.8	8.83	8.87	68.53	74.81	4.73	6.71	5.82	7.72
35 ,,	10.70	20.17	6.97	9.32	2.34	2.33	16.10	20.59	39.6	37.6	8.79	8.76	59.14	68.14	4.18	6.54	4.99	7.56
L.S.D. 0.05	n.s	n.s	n.s	1.50	n.s	0.19	n.s	3.00	n.s	n.s	n.s	n.s	2.51	n.s	0.66	n.s	1.04	n.s
L.S.D. 0.01	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	3.40	n.s	n.s	n.s	n.s	n.s

* One kentar seed cotton = 157.5 kg.
** One kentar lint cotton = 50 kg.

1989 season, the differences were insignificant, while they were significant in the second one. Delaying thinning date up to 25,30 and 35 days reduced number of open bolls/plant by 14.2,19.0 and 24.2% compared with thinning after 20 days, respectively.

The present result indicate the importance of early thinning due to its important role in reducing competition between seedlings before thinning, particularly under late planting date where cotton seedlings grow more quickly than under early planting. The decrease in number of open bolls with delaying thinning is in accordance with the findings of El-Bayoumy (1971),Imam (1984), Shahine (1986), Ghaly et al (1987) and Abou-Zaid et al (1989).

On the other hand, Ghaly and El-Banna (1988) found that number of open bolls/plant was not affected by thinning date.

3- Seed cotton yield per boll (gm):

Results in Table 8 showed that under late planting date boll weight was significantly affected by thinning date in the second season only, where the maximum boll weight was obtained with thinning after 35 days. The increase in seed cotton yield per boll with delayed thinning was due to the clear reduction in number of open bolls/plant which may lead to the increase in boll weight.

The present results are not in agreement with those obtained by Imam (1984) and Ghaly and El-Banna (1988) who found that early thinning increased boll weight.

4- Seed cotton yield per plant (gm):

The effect of thinning date on seed cotton yield per plant is illustrated in Table 8. It is clear that the differences in seed cotton yield/plant due to thinning date were not significant in the first season, while they were significant in the second one. Delaying thinning date in 1990 season to 25,30 and 35 days reduced seed cotton yield per plant by 12.4, 15.1 and 18.8% compared with thinning after 20 days from planting, respectively. The corresponding reductions due to late thinning in 1989 season were 13.3, 4.6 and 1.1% respectively. The highest seed cotton yield/plant was obtained from plants thinned at 20 days after planting. This result was expected since number of open bolls per plant showed similar response. Similar results were found by Imam (1984), Shahine (1986) and Ghaly et al (1987), Whereas Abou-Zaid et al (1989) found that thinning after 30 days produced higher seed cotton yield/plant compared with thinning after 20 or 40 days.

5- Lint percentage (%):

Data in Table 8 indicated that under delayed planting thinning date had no significant effect on lint percentage in both seasons. Slight increases in lint percentage were observed due to early thinning. Such increases were below the 5% level of significance. These results are in agreement with those obtained by Imam (1984).

6- Seed index (gm):

In both seasons, thinning date had no significant effect on seed index (Table 8). Such result indicates that both lint percentage and seed index are mainly governed by genetical constitution of the cotton variety. Imam (1984) reported also similar results.

7- Percentage of surviving plants at picking:

Results in Table 8 showed that considerable differences were recorded in percentage of surviving plants at picking among the different thinning dates in both seasons. In 1989 season, results indicated highly significant differences in plant stand at picking, but in 1990 season, the differences, which showed a similar trend, failed to reach the 5% level of significance. Generally, plant stand at picking increased by early thinning. Thinning after 20 days increased percentage of surviving plants by 0.18, 11.51 and 10.90% in 1989 season, and 3.03, 3.43 and 10.10% in 1990 season compared with thinning after 25,30 and 35 days, respectively. It is worthy to note that thinning early contributed to produce strong seedlings which maintained their growth until the picking time. It could be concluded that under late cotton planting thinning early after 20 days from sowing, gave the highest number of plants at picking. These results are not in agreement with those obtained by Ghaly et al (1987) who found that late thinning increased plant stand at picking. This contradictory result may be due to the difference in planting date.

8- Seed cotton yield per feddan (in kentar)

Data in Table 8 revealed that seed cotton yield per feddan was significantly affected by thinning date in 1989 season, where the highest seed cotton yield was obtained by thinning after 20 days from planting. Similarly in 1990 season, the highest seed cotton yield was obtained by thinning after 20 days but without significant differences among thinning dates.

These results indicated that under late planting (1^{st} may or 25^{th} April) early thinning, i.e., after 20 days from planting, increased seed cotton yield/fed. by 4.4, 10.1 and 20.5% in 1989 season and by 6.7, 6.3 and 8.7% in 1990 season, compared with thinning after 25,30 and 35 days, respectively. The present results are mainly due to the negative effects of delaying thinning date on yield components and plant stand at picking.

It was quite evident that a great part of emergened hills failed to continue their growth and were lost during the season and had no contribution to cotton yield, in case of thinning after 35 days.In addition number of open bolls/plant as well as seed cotton yield per plant recorded the lowest values with late thinned plants.

The present results indicate clearly that under late cotton planting early thinning after 20 days from planting proved advantageous as for as seed cotton yield is concerned.

Similar results were also obtained by El-Bayoumy (1971), Matthews and Beeden (1972), Imam (1984), Shahine (1986) and Ghaly and El-Banna (1989). On the other hand, Abou-Zaid (1989) reported that thinning after 30 days produced the highest seed cotton yield.

9- Lint yield per feddan (in kentar):

Results in Table 8 indicated that data on lint cotton yield followed the same pattern of response as that of seed cotton yield. In 1989 season, lint yield was significantly increased by early thinning, where thinning after 20 days increased lint yield by 12.5, 15.3 and 27.4% compared with thinning after 25,30 and 35 days, respectively. In 1990 season lint yield was insignificantly increased due to early thinning after 20 days by, 11.4, 12.0 and 13.8% compared with thinning after 25, 30 and 35 days, respectively. These results show that delaying thinning caused a considerable reduction in lint yield under late cotton planting. Similar results were obtained by Shahine (1986).

C- Effect of thinning date on earliness characters:

1- Days to first flower appearance:

Results showed that under late planting date number of days to first flower opening was not significantly affected by thinning date in both seasons (Table 9). Although there was a slight increase in this trait with delaying thinning in 1989 season only. This increase did not reach the 5% level of significant.

Table 9 : Effect of thinning date on earliness characters in 1989 and 1990 seasons.

No. of days from planting to thinning	No. of days to first flower appearance		No. of days to first boll opening		Percentage of first picking yield to total yield %	
	1989	1990	1989	1990	1989	1990
20 days	80.6	81.8	130.3	131.1	64.2	57.8
25 ,,	81.4	82.1	131.1	131.7	63.9	55.2
30 ,,	81.4	81.7	131.1	131.9	61.3	57.6
35 ,,	81.8	82.4	131.3	131.8	61.3	56.0
L.S.D. 0.05	n.s.	n.s.	n.s.	n.s.	2.0	n.s.
L.S.D. 0.01	n.s.	n.s.	n.s.	n.s.	2.7	n.s.

It could be concluded that thinning date did not significantly affect days of first flower appearance.

The present result did not agree with the result obtained by Imam (1984) and Shahine (1986) who found that early thinning led to earlier appearance of flowers. This contradiction may be due to the late planting of cotton in the present study.

2- Days to first boll opening:

Results in Table 9 showed that thinning date had no significant effect on days to first boll opening in both seasons. However, there was a slight increase in number of days to first boll opening by delaying thinning in the first season, but this increase did not reach the 5% level of significance. It is clear that there was no pertinence between thinning date and number of days to first boll opening.

These results did not agree with those obtained by Imam (1984) and Shahine (1986) who found that early thinning induced early boll opening. This contradiction may be due to the late planting of cotton in the present investigation which reduced plant response to cultural treatments.

3- Percentage of first picking yield to total yield:

Data in Table 9 indicated that percentage of first picking yield to total yield was significantly decreased by late thinning in 1989 season only, where the highest percentage of first picking was obtained by thinning after 20

and 25 days. In 1990 season, percentage of first picking yield was not significantly affected by thinning date, and results had no specific trend.

Imam (1984) and Shahine (1986) found that thinning early increased the percentage of first picking yield.

D- Effect of thinning date on fiber characters:

1- Lenght parameters:

Results in Table 10 revealed that fiber lenght expressed as 2.5% span lenght was not significantly affected by thinning date. While fiber lenght expressed as 50% span length was significantly increased by early thinning in the second season only, where thinning after 20 or 25 days from planting gave the maximum lenght.

Uniformity ratio was significantly increased by early thinning in 1989 season only, where, maximum value was obtained by thinning after 20 days from planting.

Imam (1984) found that early thinning positively affected fiber lenght, whereas Shahine (1986) reported that thinning date had no significant effect on fiber characters

2- Fiber strength (gm/tex):

Results in Table 10 showed that thinning date had no significant effect on fiber strength in both seasons. It appears that this trait is mainly governed by genetical factors. Similar results were reported by Shahine (1986). On the other hand, Imam (1984) found that fiber strength was reduced due to late thinning.

Table 10 : Effect of thinning date on fiber characters in 1989 and 1990 seasons.

No. of days from planting to thinning	Length paramters						Fiber strength (gm/tex)		Fiber fineness (micronaire reading)	
	2.5 % S.L. m.m		50% S.L. m.m		Uniformity ratio (%)					
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
20 days	29.8	28.9	14.7	14.8	49.8	50.9	9.2	9.1	3.57	3.82
25 ,,	29.6	29.1	14.2	14.8	47.8	50.7	9.3	9.4	3.50	3.78
30 ,,	29.3	28.4	14.0	14.3	47.5	50.3	9.5	9.1	3.74	3.81
35 ,,	29.4	28.4	14.0	14.3	47.5	50.0	9.2	9.1	3.73	3.78
L.S.D. 0.05	n.s	n.s	n.s	0.4	1.4	n.s	n.s	n.s	n.s	n.s
L.S.D. 0.01	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s

Table 12 :Effect of distance between hills on some growth charaters of Giza 83 cotton plants in 1989 and 1990 seasons

Distance btween hills cm		Plant height at Picking cm		Node number of first sympodia		No.of fruiting branches per plant	
		1989	1990	1989	1990	1989	1990
15 cm		71.1	83.8	8.34	8.71	8.65	8.75
20 cm		72.3	89.9	8.33	8.58	8.88	8.65
25 cm		72.5	94.2	8.26	8.25	9.36	9.02
30 cm		76.0	93.9	8.30	8.08	10.31	9.95
L.S.D.	0.05	n.s	6.7	n.s	0.41	0.84	0.61
	0.01	n.s	n.s	n.s	n.s	n.s	0.93

plant density (Hefni et al, 1978; Abdel-Fattah, 1979; El-Sourady et al 1979a; Hussein et al, 1983; and El-Shinnawy et al, 1984a).

2- Node number of first sympodia:

Results in Table 12 showed that position of first sympodia was not significantly affected by distance between hills in 1989 season.In 1990 season, it is clear that node number of first sympodia was significantly decreased as distance between hills increased, where the lowest node number was obtained by planting at 30cm between hills. It could be conclueded that widening the distance between hills encouraged cotton plants to produce the first sympodia at lower node. The lack of response of cotton plants to distance between hills as indicatedin 1989 season my be due to the delaying of cotton planting.

Similar results as in 1990 season were obtained by Ali (1977), Saker (1978), Shalby and Saker (1981) and Imam (1984) who found that node number of first sympodia was decreased as distance between hills increased.

On the other hand, result obtained by Abdel-Fattah (1979), Yasseen (1979), Hussein et al (1983), El-Shinnawy and Ghaly (1985) and Shahine (1986)showed that distance between hills had no significant effect on position of first sympodia.

3-Number of fruiting branches per plant:

Results presented in Table 12 indicated that number of

fruiting branches per plant was significantly affected by distance between hills in both seasons. Increasing distance between hills up to 30cm increased number of fruiting branches per plant by, 9.2, 13.9 and 16.1% in 1989 season and by 9.3, 13.1 and 12.1% in 1990 season, compared with sowing at 25,20 and 15cm between hills, respectively, The increases in 1990 season were highly significant. It could be concluded that under late cotton planting increasing distance between hills up to 30cm caused a considerable increase in number of fruiting branches. This increase may be attributed to the optimal utilization of sun light as well as water and nutrients by cotton plants and this contributed to activate photosynthesis process in plants, resulting in high amounts of metabolites accumulation. Most of this metabolites are used in branches production.

Many investigators came to similar conclusion (El-Banna, 1969; El-Bayoumy, 1971; Ali, 1977; Saker, 1978; Abdel-Fattah et al 1980; Shalaby and Saker, 1981; Hussein et al 1983; Imam, 1984 and Nikolov, 1988).

B- Seed cotton yield and its components:

1- Number of total bolls per plant:

It is clear that number of total bolls/plant under late cotton planting was gradually increased by increasing distance between hills as illustrated in Table 13. These increases were insignificant in 1989, while in the second season they were highly significant. The highest number of

bolls/plant was obtained by sowing at 30cm in both seasons, being 7.83 and 12.58 bolls in 1989 and 1990 season, respectively.

On the other hand, the lowest number of bolls per plant was obtained by sowing at 15cm in both seasons, being 6.48 and 3.13 bolls in 1989 and 1990 season, respectively. It is clear that number of total bolls per plant followed the same trend of response as that of number of fruiting branches per plant to distance between hills in both seasons. The increase in number of bolls per plant due to widening spaces between hills may be atributed to the high amounts of metabolites produced by plants and utilized in producing plant organs namely, fruiting branches and bolls.

Similar results were also obtained by El- Banna (1969). El-Bayoumy (1971), Ali (1977), Saker (1978), Abdel-Fattah (1979), Yasseen (1979), Shalaby and Saker (1981), Rao (1982), El-Shinnawy et al (1984a). Imam (1984) and Nikolov (1988). On the other hand, Shahine (1986) found that distance between hills had no significant effect on total number of bolls/plant

2- Number of open bolls per plant:

Data in Table 13 indicated that under late cotton planting distance between hills had a significant effect on number of open bolls per plant in both seasons. Results indicated that number of open bolls per plant was significantly increased as distance between hills was

Table 13 : Effect of distance between hills on seed cotton yield and its components in 1989 and 1990 seasons.

Distance between hills	No. of total bolls/plant		No. of open bolls/plant		Seed cotton yield/boll gm.		Seed cotton yield/plant gm.		Lint pecentage %		Seed index gm.		Percentage of surviving plants at picking %		Seed cotton yield/fed. (Kentar)*		Lint cotton yield/fed. (Kentar)**	
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
15 cm	6.48	8.13	5.00	7.57	2.44	2.12	11.87	14.58	39.6	38.5	8.48	9.03	80.7	76.7	5.33	6.39	6.65	7.97
20 cm	6.72	9.42	5.32	8.60	2.67	2.14	13.55	18.34	39.0	38.5	8.52	8.96	89.9	83.1	5.69	6.67	6.99	7.95
25 cm	6.98	12.53	5.35	10.53	2.90	2.27	15.23	22.13	39.6	37.6	8.26	9.04	94.1	81.2	5.34	6.21	6.69	7.85
30 cm	7.83	12.58	6.67	10.99	2.88	2.28	18.91	23.32	38.9	37.4	8.65	9.09	90.3	94.0	5.26	6.30	6.44	7.60
L.S.D. 0.05	n.s	2.38	1.11	2.72	0.12	n.s	3.85	4.55	n.s	0.7	0.24	n.s	n.s	n.s	n.s	n.s	n.s	n.s
L.S.D. 0.01	n.s	3.61	n.s	n.s	n.s	n.s	n.s	6.53	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s

* One kentar seed cotton = 157.5 kg.
** One kentar of lint cotton = 50 kg.

increased, where the highest number of open bolls/plant was obtained by sowing at 30 cm which was 6.67 and 10.99 bolls in 1989 and 1990 seasons, respectively.This trend was expected since wider spacing encouraged plants to produce enough vegetative growth and greater number of fruiting branches per plant and consequently number of total and open bolls per plant was increased.

These results are in agreement with the findings of Saker (1978), Yasseen (1979), El-Akkad et al (1983), Hussein et al (1983), El-Shinnawy and Ghaly (1985), Shahine (1986) and Abdel-Aal et al (1989). On the other hand, Hefni et al (1979) found that number of open bolls/plant was not significantly affected by plant density.

3- Seed cotton yield per boll:

Results in Table 13 revealed that, under late cotton planting, boll weight was significantly increased as distance between hills was increased in the first season only. The highest boll weight was obtained by planting at 25 and 30cm between hills, which was 2.90 and 2.88gm, respectiely. In the second season, it is clear that slight increases occured as a result of wide distance,but such increases were below the level of significance, probably due to the late planting. It is clear that increasing distance between hills from 15cm to 20,25 and 30cm increased average boll weight by 9.4, 18.9 and 18.0% in 1989 season and by 0.9, 7.1 and 7.5% in 1990 season, respectively. It could be concluded that increasing the

distance between hills up to 30cm caused a remarkable increase in boll weight. This increase may be due to the high amounts of metabolites translocated to the bolls.

Similar results were found by Sawires (1976), Saker (1978), El-Akkad et al (1981), Rao (1982), Hussein et al (1983), El-Shinnawy et al (1984a) and Imam (1984). On the other hand, some investigators found no relevance between hill distance and boll weight (Ali, 1977; Yasseen, 1979; El-Shinnawy et al 1984b; Shahine, 1986 and Abdel-Aal et al 1989).

4- Seed cotton yield per plant:

Results in Table 13 showed that, under late cotton planting, distance between hills significantly affected seed cotton yield per plant in both seasons. It is clear that, increasing distance between hills from 15cm to 20,25 and 30cm increased seed cotton yield per plant by 12.4, 28.3 and 59.3%, in 1989 season and by 25.8, 51.8 and 59.9% in 1990 season, respectively. These results were expected since seed cotton yield/plant is closely associated with number of open bolls/plant. A greater number of open bolls per plant will certainly produce higher seed cotton yield per plant.This result may be due to the fact that wider spacing reduces the competition among cotton plants for environmental factors and this in turn increased the plant yield.

Similar results were also reported by Saker (1978), Abdel-Fattah (1979), Shalaby and Saker (1981), El-Shaer et al

(1983), El-Shinnawy et al (1984a), Imam (1984), El-Shinnawy and Ghaly (1985), Shahine (1986) and Abdel-Aal et al (1989).

5- Lint percentage:

Data in Table 13 reveal that, under late cotton planting, lint percentage was significantly affected by distance between hills in 1990 season only. The highest value was obtained by growing cotton plants at 15 and/or 20cm. In 1989 season there was no specific trend for this trait due to distance between hills.The increase in lint percentage due decreasing distance between hills is in accordance with those obtained by Marani et al (1974), Saker (1978), El-Akkad et al (1980) and El-Shinnawy and Ghaly (1985).

Other investigators, however, found that lint percentage was not significantly affected by hill distance (El-Banna, 1969; Baker ,1977; Abdel-Fattah, 1979; El-Sourady et al, 1979a; Yasseen, 1979; El-Shaer et al, 1983; Hussein et al 1983; Shahine, 1986 and Abdel-Aal et al, 1989).

6- Seed index:

Results shown in Table 13 indicated that distance between hills had a significant effect on seed index in the first season only. Increasing distance between hills from 15 to 20,25 and 30cm increased seed index. It is clear that the highest value for this trait was obtained by planting at 30cm. In 1990 season, differences among seed index values due to distance between hills were not significant. The lack of response of seed index to population density in the second

season may be due to the delayed planting. The increase in seed index due to widening distance between hills was also observed by Saker (1978) and El-Akkad et al (1980).

On the other hand, other investigators, however, reported that seed index was not significantly affected by distance between hills (El-Banna, 1969; El-Sourady et al, 1979a; Hussein et al 1983, Shahine, 1986 and Abdel-Aal et al, 1989).

7- Percentage of surviving plants at picking:

Results indicated that plant stand at picking was not significantly affected by distance between hills in both seasons in spite of some differences. In the first season, the highest percentage was recorded with 25cm distance being 94.1%, while in the second season the highest percentage was 94.0 recorded with 30cm distance (Table 13).

In both seasons, planting at 15cm between hills markedly reduced percentage of surviving plants at picking, being 80.7 and 76.7% in the first and second season, respectively.

The present result showed clearly that a great loss in cotton plants occurred with dense planting and vice-versa.

Results obtained by Shalaby and Saker (1981), El-Shaer et al (1983), Hussein et al (1983)Abdel-Aal et al (1989) showed that dense sowing increased plant stand at picking.

8- Seed cotton yield per feddan:

Data illustrated in Table 13 reveal that under late cotton planting seed cotton yield was not significantly affected by distance between hills in both seasons. The

highest seed cotton yield was obtained by planting at 20cm (5.59 and 6.67 kentars/fed. in 1989 and 1990 seasons, respectively), but the differences in seed cotton yield/fed. were too low to reach the level of significance. It is clear that at wider spaces the growth characters as well as yield components of cotton plants have been markedly increased, leading to a considerable seed cotton yield increase per plant. Consequently, the decrease in plant density at wider spaces has been compensated by the great increase in yield per plant. For this reason, the differences in seed cotton yield were not significant. In addition, the late planting of cotton on May, 1st and April, 25th in the first and second season, respectively may retard a marked response of cotton plants to population density. It could be concluded that under late planting, sowing cotton plants at 20cm between hills produced the highest seed cotton yield. This may be due to the optimal stand at which the plants utilize the environmental factors at optimum level in addition to the lowest level of competition between plants under such population.

Similar conclusion was obtained by El-Bayoumy (1977), El-Kholany and Sawan (1980), Abdel-Halim et al (1984), Shahine (1986) and -Abdel-Fattah (1989), who found that planting at 20 cm betweenhills produced the highest seed cotton yield. Other investigators, however, found that increasing the population density over 70000/fed. produced

higher yield (Ali, 1977; Abdel-Fattah, 1979; Yasseen, 1979; El-Akkad et al, 1980 and El-Shinnawy et al, 1986).

9- Lint cotton yield:

Data of lint cotton yield followed the same pattern of response to distance between hills as that observed with seed cotton yield in the first season as shown in Table 13. Distance between hills had no significant effect on lint cotton in both seasons. Many investigators came to similar findings (Sawires, 1976; Jain, 1981; Rao, 1982; and Sawan et al, 1985).

C- Earliness characters:

1- Number of days to first flower appearance:

Distance between hills had no significant effect on number of days to first flower appearance in both seasons, as illustrated in Table 14. Such result indicates that with late cotton planting, plant density had no great role on flowering of cotton plant which seems to be governed by other factors. These results are in agreement with those obtained by El-Sourady et al (1979a), El-Shinnawy and Ghaly (1985)and Shahine(1986).

On the other hand, some investigators reported that dense planting delayed first flower appearance (Saker, 1978; Shalaby and Saker, 1981; and El-Shinnawy et al 1984a).

2- Number of days to first boll opening:

Data in Table 14 revealed that, under late planting, number of days to first boll opening was not significantly

Table 14 : Effect of distance btween hills on earliness characters in 1989 and 1990 seasons.

Distance btween hills cm	No. of days to first flower appearance		No. of days to first boll opening		Percentage of first picking to total yield %	
	1989	1990	1989	1990	1989	1990
15 cm	81.7	81.5	130.9	131.5	63.2	59.0
20 cm	81.7	81.8	129.8	131.8	63.9	58.4
25 cm	81.0	81.0	130.0	131.3	65.7	59.1
30 cm	80.8	80.8	130.0	131.2	65.7	61.3
L.S.D. 0.05	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
L.S.D. 0.01	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

affected by distance between hills in both seasons. This result was expected since distance between hills did not affect flowering date. It is clear that there was no relevence between hill distance and earliness in boll opening. Some investigators reported that boll opening was not affected by distance between hills (Yasseen, 1979 and Shahine, 1986). Other investigators, however, reported that first boll opening was earlier with narrow distance between hills (Shalaby and Saker, 1981 and Imam, 1984).

3- Percentage of first picking yield to total yield:

Results presented in Table 14 show that, under late planting, earliness, expressed as the percentage of first picking yield to total seed cotton yield was not significantly affected by distance between hills in both seasons. Although, planting at 25 and 30cm increased percentage of first picking, but these increases were too slight to reach the level of significance. It could be concluded that under late planting, plant population density had no great effect on earliness characters of cotton plant. Similar results were obtained by Shahine (1986). On the other hand, Saker (1978) and Shalaby and Saker (1981) found that percentage of first picking yield was increased with dense planting

D-Fiber characters:

1- Fiber length:

Under late cotton planting, length of fiber, estimated

either as 2.5% or 50% span length was not significantly affected by distance between hills in both seasons as shown in Table 15.

It seems that fiber length in cotton is governed by genetical characters. Similar results were reported by El-Sourady et al (1979b), El-Shaer et al (1983) and Hussein et al (1983). Other investigators found that fiber length was increased by widening distance between hills (Imam, 1984 and Shahine 1986).

2- Uniformity ratio :

Data presented in Table 15 show that under late planting date, uniformity ratio decreased significantly as distance between hills was increased in the second season only. In 1990 widening distance between hills from 15 to 25 and 30cm caused a significant decrease in uniformity ratio. Data of 1989 season did not show any significant response of uniformity ratio to distance between hills. Previous results obtained by Shahine (1986) showed similar trend with the second season results, where he reported that uniformity ratio was increased with narrowing distances between hills. On the other hand, El-Sourady et al (1979b) and El-Shaer et al (1983) found that uniformity ratio was not affected by distances between hills.

3- Fiber strength:

Distance between hills had no significant effect on fiber strength in both seasons as shown in Table 15. A

Table 15 : Effect of distance btween hills on fiber characters in 1989 and 1990 seasons.

Distance btween hill cm	Length paramters						Fiber strength (gm/tex)		Fiber fineness (micronaire reading)	
	2.5 % S.L. m.m		50% S.L. m.m		Uniformity ratio (%)					
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
15 cm	29.8	28.8	14.5	14.6	48.8	50.8	8.7	8.9	3.35	3.88
20 cm	29.4	28.5	14.3	14.5	48.5	51.1	8.7	8.9	3.47	3.90
25 cm	29.4	29.1	14.2	14.4	48.4	49.6	8.7	9.0	3.53	4.07
30 cm	29.5	28.7	14.4	14.3	48.7	49.7	8.8	9.2	3.55	3.93
L.S.D. 0.05	n.s	n.s	n.s	n.s	n.s	1.0	n.s	n.s	0.14	n.s
L.S.D. 0.01	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s

slight, but insignificant, increase in this trait was obtained from wide spacing. It is clear that under late planting there was no pertinance between hill distance and fiber strength.

Similar findings were obtained by Baker (1977), Saker (1978), El-Sourady et al (1979a), Yasseen (1979), El-Shaer et al (1983), Imam (1984) and Shahine (1986).On the other hand, El-Banna (1969) found that fiber strength was increased with widening distance between hills.

4- Fiber fineness :

Results illustrated in Table 15 revealed that fiber fineness expressed as micronaire reading, was significantly increased as distance between hills was increased in the first season only. In 1989, widening distance between hills from 15 to 20, 25 and 30cm caused an increase in fiber fineness. These increases were significant between narrow (15 cm) and wide spaces namely 25 and 30cm. The increases in fiber fineness due to widening distance between hills in 1990 season were too small to reach the level of significance.

Results of the first season agree with those reported by Shahine (1986), whereas many investigators found that fiber fineness was not significantly affected by distance between hills (El-Banna, 1969; Saker, 1978; El-Sourady et al, 1979b; Yasseen, 1979; El-Shaer et al 1983; Hussein et al, 1983 and Imam, 1984).

II- Effect of nitrogen fertilization on :

A- Some growth characters of cotton plant :

1- Plant height at harvest (cm) :

Data presented in Table 16 indicated that final plant height was significantly affected by nitrogen fertilization in both seasons. Increasing nitrogen level from 20 to 40, 60 and 80kg N/fed. increased cotton plant height by 2.7, 7.0 and 6.7cm in 1989 and by 3.7, 5.1 and 6.3cm in 1990, respectively.It seems that under late planting, a level of 60kg N/fed. was sufficient to supply cotton plants with their nitrogen requirement to reach maximum height. The increase in plant height of cotton due to increasing nitrogen application may be attributed to the increase in merestemic activity which contributes to the increase in number of nodes in addition to the increase of the internodes length. Nitrogen encourages the merestimic activity in plants and also plays an important role in auxin production which stimulates cell elongation leading to the increase of the internodes.

Similar conclusion was obtained by Hassanein (1970), Basinki et al (1971), Gerard and Reeves (1974), Yasseen (1979), Shafshak et al (1983a), and Ghaly et al (1987). On the other hand, Radwan (1988) found that increasing N level had no significant effect on cotton plant height.

2- Node number of first sympodia :

Node number of first sympodia was significantly affected by nitrogen fertilization (Table 16). This result

Table 16 : Effect of nitrogen fertilization level on some growth characters of Giza 83 cotton plants in 1989 and 1990 sesons .

Nitrogen level kg N/ fed.		Plant height at harvest		Node number of first smpodia		No.of fruiting branches per plant	
		1989	1990	1989	1990	1989	1990
20 kg		69.0	86.7	8.16	8.38	9.04	8.78
40 kg		71.7	90.4	8.20	8.38	9.33	9.17
60 kg		76.0	91.8	8.36	8.21	9.43	9.17
80 kg		75.2	93.0	8.51	8.67	9.41	9.26
L.S.D.	0.05	4.4	5.1	0.20	0.28	n.s.	n.s.
	0.01	n.s.	n.s.	0.27	n.s.	n.s.	n.s.

demonstrates that first sympodium was initiated on lower node by the application of lower N level, in both seasons. It is clear that at 20kg N/fed, the first sympodia was initiated on the node number 8.16 and 8.38 in 1989 and 1990 season, respectively. While with the application of 80kg N/fed. it was initiated on the node number 8.51 and 8.67 in 1989 and 1990 season, respectively.It could be concluded that a low level of nitrogen encouraged the initiation of first sympodia on the lower node.

Many investigators came to similar conclusion (Shafshak et al, 1983a), whereas Yasseen (1979) and Radwan (1988) found that N level had no significant effect on node number of first sympodia.

3- Number of fruiting branches per plant:

Results showed that increasing nitrogen level from 20 to 80 kg/fed. had no significant effect on number of fruiting branches per plant in both seasons (Table 16). It is clear that slight increases in number of fruiting branches per plant occurred as a result of raising nitrogen level up to 80 kg/fed., but such increases were below the level of significance. The lack of response of number of fruiting branches per plant to N level may be due to late planting of cotton in both seasons. Some investigators found that increasing nitrogen level to cotton plant increased number of fruiting branches per plant (Yasseen, 1979; Abdel-Gawad et al, 1984; and Shafshak et al 1983a). On the other

hand,Mahmoud et al (1984) and Radwan (1988) found similar results where they found no relevance between N level and number of fruiting branches per plant.

B- Seed cotton yield and its components:

1- Number of total bolls per plant:

Data in Table 17 showed that nitrogen level had a significant effect on number of total bolls/plant in the first season only. Increasing nitrogen level from 20 to 80 kg/fed. caused increases in number of total bolls/plant. The highest number of bolls per plant was obtained by the application of 80kg N/fed. in the second season, the differences in number of total bolls/plant due to increasing nitrogen level were too small to reach the level of significance. Delaying cotton planting may be responsible for reducing the effect of N level on this important trait. It could be concluded that increasing nitrogen application to cotton plants up to 80 kg/fed. increased number of bolls per plant. This increase may be attributed to the increase in number of fruiting branches per plant as well as the high amounts of metabolites utilized in boll formation. Nitrogen encourages the metabolitic activity in plants and this contributes to the accumulation of high amounts of metabolites which the plants utilize in building fruiting branches and bolls. Many investigators came to similar conclusion (Shafshak et al 1983b; El-Shinnawy et al, 1984b; and Abdel-Halim, 1983). On the other hand, Yasseen (1979) and

Radwan (1988) reported that N level had no significant effect on number of total bolls/plant.

2- Number of open bolls per plant :

Data presented in Table 17 indicated that, under late cotton planting, nitrogen level had no significant effect on number of open bolls/plant in both seasons. Increasing N level from 20 to 40, 60 and 80 kg/fed. insignificantly decreased number of open bolls/plant by 0.45, 0.40 and 0.52 boll in 1989 season, respectively. While in 1990 season application of 40 kg N/fed., insignificantly increased number of open bolls/plant by 0.16, 0.42 and 0.80 boll compared with 20,60 and 80 kg N/fed., respectively. These increases did not reach to the level of significance.It could be concluded that nitrogen had no great effect on number of open bolls/plant. The delayed planting of cotton seems to retard the role of N on number of open bolls/plant, and even to show negative effect of the high N level on this trait.

These results are in agreement with the findings of Yasseen (1979), Ghaly and Radwan (1987), and El-Halawany and Azab (1989). On the other hand, under optimum planting date, Shafshak et al (1983b), Mahmoud et al (1984) and Abd-El-Halim (1989) found that increasing N level significantly increased number of open bolls/plant.

3- Seed cotton yield per boll (gm) :

Data presented in Table 17 indicated that nitrogen fertilization had significant effect on boll weight in both

seasons. Results showed that increasing nitrogen level to cotton plants up to 60 kg/fed. increased the boll weight, where 60 kg N/fed. produced the highest boll weight in 1989 season. Further increase in nitrogen level did not cause any increase. In the second season, the highest boll weight was obtained by the application of 80 kg N/fed. without significant differences between 60 and 80kg N/fed. It is clear that raising nitrogen level from 20 to 40, 60 and 80 kg/fed. increased average boll weight by 0.14, 0.27 and 0.27gm in 1989 season, and by 0.05, 0.19 and 0.21gm in 1990 season, respectively. Such result indicates that a level of 60kg n/fed. was satisfactory to produce maximum boll weight. It seems that nitrogen level had a great importance in boll formation even under late cotton planting. The increase in boll yield of seed cotton due to increasing nitrogen level may be attributed to the high amounts of metabolites used in boll formation.

Similar conclusion was obtained by Yasseen (1979), El-Shinnawy et al (1984b), Abd-El-Halim (1989) and Ghaly et al (1989). On the other hand, El-Shinnawy et al (1983) and El-Halawny and Azab (1989) found that under late cotton planting N level had no significant effect on boll weight.

4- Seed cotton yield per plant (gm) :

Seed cotton yield/plant was gradually increased as the nitrogen level increased from 20 to 80 kg/fed.but these increases were too shight to reach the level of significance

Table 17 : Effect of nitrogen fertilization level on seed cotton yield and its components in 1989 and 1990 seasons.

Nitrogen level Kg/fed.	No. of total bolls/plant		No. of open bolls/plant		Seed cotton yield/boll gm.		Seed cotton yield/plant gm.		Lint pecentage %		Seed index gm.		Percentage of surviving plants at picking %		Seed cotton yield/fed. (Kentar)*		Lint cotton yield/fed. (Kentar)**	
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
20 kg	6.80	10.69	5.93	9.61	2.55	2.09	14.39	17.51	39.1	38.3	8.63	9.04	87.3	87.9	4.23	5.20	5.22	6.29
40 kg	6.68	10.53	5.48	9.77	2.69	2.14	14.82	19.53	39.3	38.0	8.43	9.05	88.7	83.9	5.51	5.96	6.81	7.39
60 kg	6.98	10.62	5.53	9.35	2.82	2.28	15.06	20.42	39.1	37.5	8.43	8.95	89.6	83.3	5.82	7.14	7.17	8.63
80 kg	7.56	10.82	5.41	8.97	2.82	2.30	15.28	20.89	39.7	38.2	8.43	9.08	89.4	79.9	6.07	7.27	7.56	9.07
L.S.D. 0.05	0.64	n.s	n.s	n.s	0.20	0.15	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	0.79	0.56	0.96	1.04
L.S.D. 0.01	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	1.04	0.76	1.28	1.36

* One kentar seed cotton = 157.5 kg.
** One kentar of lint cotton = 50 kg.

(Table 17).

Raising nitrogen level, from 20 to 40, 60 and 80 kg/fed. increased seed cotton yield per plant by 0.43gm (3.0%), 0.67 gm (4.7%) and 0.89 gm (6.2%) in 1989 and by 2.02 gm(11.0%), 2.91gm (16.6%) and 3.38gm (19.3%) in 1990 season, respectively. This result may be due to the effect of nitrogen level on total number of bolls/plant as well as boll weight.

Many investigators came to similar results (El-Shinnawy et al, 1983; Mohamad et al 1984; Sawan, 1986; Ghaly and Radwan, 1987; Ghaly et al, 1987; and Radwan, 1988).

It is worth noting here that the insignificant effect of N level on seed cotton yield/plant may be due to the delayed planting of cotton.

5- Lint percentage :

Nitrogen fertilization level had no significant effect on lint percentage in both seasons (Table 17). It could be concluded that under late cotton planting, there was no relevence between nitrogen application level and lint percentage. It seems that this trait is governed by the genetical constitution of the cotton variety and other factors.

This result coincides with those obtained by Radwan (1988), Abd-El-Halim (1989) and El-Halawany and Azab (1989). On the other hand, under optimum planting date Yasseen (1979) and Shafshak et al (1983) found that the increase in N level

decreased lint percentage.

6- Seed index :

Nitrogen fertilization level showed no significant effect on weight of 100 seeds, as shown in Table 17. This result was expected since lint percentage was not significantly affected by nitrogen level under late cotton planting in both seasons.

This result is in agreement with the findings of Shafshak et al (1983b), Ghaly and Radwan (1987), Radwan (1988) and Abd-El-Halim (1989). On the other hand, El-Kholany and Sawan (1980) and Hefni and El-Kholany (1981) found that seed index was significantly increased by increasing N level.

7- Percentage of surviving plants at picking :

Results showed that N level had no significant effect on percentage of suriviving plants at picking in both seasons (Table 17). Some differences were observed in percentage of surviving plants but such differences were below the level of significance.

The highest percentage was recorded with 80kg N level in 1989 season being 90.4% but in 1990 season it was 85.4% recorded with 60kg N level.

In both seasons, the lowest survival percentage was recorded with the lowest N level being 87.3 and 81.7% respectively in 1989 and 1990 seasons.

It could be concluded that N slightly increased plant stand at picking. Similar results were also obtained by

El-Shinnawy et al (1983), and Ghaly and Radwan (1987).

8- Seed cotton yield per feddan :

Data illustrated in Table 17 demonstrate that the effect of nitrogen fertilization level on seed cotton yield per feddan was highly significant in both seasons. It is clear that increasing nitrogen level from 20 to 40, 60 and 80 kg/fed. increased seed cotton yield/fed by 30.3, 37.6 and 43.5% in 1989, being 14.6, 37.3 and 39.8 in 1990 season, respectively. In the first season, raising nitrogen level from 20 to 40 kg/fed increased seed cotton yield by 1.28 kentar/fed., this increase was highly significant, while raising nitrgen level from 40 to 60 or 80 kg/fed increased seed cotton yield insignificantly. In the second season, raising nitrogen level from 20 to 40 and 60 kg/fed. increased seed cotton yield by 0.76 and 1.94 kentar/fed., respectively. These increases were highly significant, while raising nitrogen level from 60 to 80 kg/fed increased seed cotton yield insignificantly.

It could be concluded that the optimal nitrogen level for cotton under late planting was 40 and 60 kg/fed in 1989 and 1990 season, respectively. It seems that the reason of the difference in response of cotton plants to nitrogen level in the two seasons was due to the environmental factors. The increase in seed cotton yield as a result of raising nitrogen level may be attributed to the increase in number of bolls per plant as well as the boll weight and seed cotton yield

per plant.

Many investigators obtained an increase in seed cotton yield by increasing nitrogen level to plants (Shakshak et al 1983b; El-Shinnawy et al, 1984b; Mohamad et al 1984; Abd-El-Gawad et al, 1985;, Ghaly and Radwan, 1987; and El-Halawany and Azab, 1989).

Also, under late planting, El-Shinnawy et al (1983), Ghaly et al (1987) and Abd-El-Halim, (1989) found that the increase in N level significantly increased seed cotton yield.

9- Lint cotton yield per feddan :

Results in Table 17 indicated that nitrogen level had a highly significant effect on lint cotton yield in both seasons. It is clear that data on lint cotton yield followed the same pattern of response to N level as that of seed cotton yield. Increasing nitrogen level from 20 to 40, 60 and 80 kg/fed. increased lint cotton yield by 1.59 (30.5%), 1.95 (37.4%) and 2.34 (44.8%) kenter/fed. in 1989 and by 1.1 (17.5%), 2.34 (37.2%) and 2.78(44.2) kenter/fed. in 1990, respectively. The present results are expected since lint cotton yield is closely related to seed cotton yield.

It could be concluded that, under late planting the highest lint cotton yield was produced by plants supplied with 80 kg N/fed., but significant increases were only recorded with 40 and 60kg N/fed. in the first and second season, respectively. Similar results were also reported by

Haward and Hoskinson (1986), Sawan (1986), Radwan (1988) and Mc Connell et al (1989).

C- Earliness characters :

1- Number of days to first flower appearance :

Results in Table 18 showed that nitrogen level had a significant effect on the period to first flower appearance in 1989 season only. Raising nitrogen level from 20 to 40, 60 and 80 kg/fed. delayed first flower appearance by 0.7, 1.5 and 1.4 days, respectively. Similar trend was noticed in the second season, but the differences in flowering date were too small to reach the level of significance.

Similar results were obtained by many investigators (El-Shinnawy et al,1984b and Radwan, 1988). On the other hand, Shafshak et al (1983a) and Soomro and Warings (1987) found that N level had no significant effect on flowering date. It is worth mentioning here that the lack of response of flowering date to N level in the second season may be due to the late planting.

2- Number of days to first boll opening :

Nitrogen fertilization had a significant effect on the period to first boll opening in both seasons (Table 18). Increasing nitrogen level from 20 to 40, 60 and 80 kg/fed delayed the period to first boll opening by 1.4, 2.9 and 2.9 days in 1989 and by 0.9, 1.4 and 1.4 days in 1990, respectively. The present results are logical since high nitrogen level delayed flowering date.

Table 18 : Effect of nitrogen fertilization on earliness characters in 1989 and 1990 seasons.

Nitrogen level	No. of days to first flower appearance		No. of days to first boll opening		Percentage of first picking yield to total yield %	
	1989	1990	1989	1990	1989	1990
20 kg	80.4	80.8	128.4	130.5	65.5	61.6
40 kg	81.1	81.3	129.8	131.4	65.1	58.4
60 kg	81.9	81.3	131.3	131.9	64.0	60.2
80 kg	81.8	81.8	131.3	131.9	63.9	58.2
L.S.D. 0.05	0.7	n.s.	0.8	1.0	n.s.	n.s.
L.S.D. 0.01	1.0	n.s.	1.1	n.s.	n.s.	n.s.

This result is in agreement with those obtained by Yasseen (1979), Shafshak et al (1983a) and Radwan (1988).

3- Percentage of first picking yield to total yield :

Data in Table 18 indicate that nitrogen fertilization level had no significant effect on percentage of first picking yield to total seed cotton in both seasons.

It was observed that raising nitrogen level from 20 to 80 kg/fed. decreased percentage of first picking yield . However, these differences were not significant. The present results indicate that a high supply of nitrogen encourages vegetative growth which in turn delays boll opening and maturity. Similar conclusion was obtained by Shafshak et al (1983a) and Abd-El-Halim (1989) who found no relevance between percentage of first picking yield to total seed cotton yield. On the other hand, Mohamed et al (1984), Radwan (1988) and Mc Connell et al (1989) found that increasing N level reduced percentage of first picking yield to total yield.

It is worthy to note that the insignificant effect of N level on this trait may be due to the delayed planting date which in turn retarded the effect of N on cotton maturity.

D- Fiber characters :

1- Fiber length :

results in Table 19 indicate that nitrogen level had no significant effect on length of cotton fiber estimated as 2.5% span length.

Table 19 : Effect of nitrogen fertilization on fiber characters in 1989 and 1990 seasons.

Nitrogen level Kg/fed.	Length paramters						Fiber strength (gm/tex)		Fiber fineness (micronaire reading)	
	2.5 % S.L. m.m		50% S.L. m.m		Uniformity ratio (%)					
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
20 kg	29.6	28.5	14.4	14.3	48.6	50.3	8.7	9.0	3.50	3.98
40 kg	29.8	29.0	14.5	14.6	48.8	50.5	8.8	8.9	3.39	3.99
60 kg	29.4	28.6	14.2	14.3	48.4	50.1	8.9	8.9	3.48	3.83
80 kg	29.2	29.0	14.2	14.6	48.7	50.2	8.7	9.1	3.51	3.98
L.S.D. 0.05	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s
L.S.D. 0.01	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s

Similarly, length estimated as 50% span length was not significantly affected by nitrogen level in both seasons. It is clear that there was no pertinence between nitrogen fertilization level and fiber length. This may be due to that fiber length is governed by genetical make up of the cotton cultivar.

This result agrees with the findings of Palomo and Davis (1984), York and Tucker (1985), Sawan (1986) and Radwan (1988). On the other hand, Shafshak et al (1983c) found that the increase in N level significantly increased fiber length.

2- Uniformity ratio :

Nitrogen fertilization level had no significant effect on uniformity ratio in both seasons as shown in Table 19. Results showed that there was no relevance between nitrogen level and uniformity ratio which seems to be mainly a genetical character. Many investigators came to similar results (Radwan, 1988).

On the other hand, Shafshak et al (1983c) reported that uniformity ratio significantly increased with the increase in nitrogen level .

3- Fiber strength (gm/tex):

Data in Table 19 reveal that the strength of cotton fiber was not significantly affected by nitrogen level in both seasons.

This indicates that there is no relation between nitrogen fertilization level and fiber strength. This result

coincides with those obtained by Yasseen (1979), Shafshak et al (1983c), Palomo and Davis (1984), York and Tucker (1985) and El-Halawany and Azab (1989). On the other hand, Sawan (1986) found that fiber strength increased in one season out of two with the increase in N level, whereas Radwan (1988) recorded a decrease in fiber strength with the increase in N level.

4- Fiber fineness (micronaire reading):

Nitrogen fertilization level had no significant effect on fiber fineness in both seasons (Table 19). It could be concluded that fiber characters are mainly governed by the genetical factors.

Similar results were found by many investigators (Yasseen, 1979; Shafshak et al, 1983c Sawan, 1986; Radwan, 1988; and El-Halawany and Azab, 1989).

E- Effect of the interaction between distance between hills and nitrogen fertilization level on the studied characters :

The effect of interaction between distance between hills and N level on all studied characters was not significant in both seasons except on number of total bolls/plant in 1989 season and number of open bolls/plant in 1989 season. The significant interaction effects are presented here.

1- Number of total bolls per plant :

Results in Table 20 indicate that in 1989 season number of total bolls per plant was significantly affected by the interaction between distance between hills and nitrogen

Table 20 : Effect of interaction between distance between hills and nitrogen fertilization level on number of total and open bolls per plant (1989 season).

Treatments		Characters	
Distance between hills cm	Nitrogen level kg N/fed.	No. of total bolls per plant	No. of open bolls per plant
15 cm	20 kg	6.23	5.17
	40 kg	6.57	5.43
	60 kg	6.07	5.23
	80 kg	7.07	4.77
20 cm	20 kg	7.17	7.10
	40 kg	6.33	5.40
	60 kg	6.27	3.90
	80 kg	7.10	4.87
25 cm	20 kg	6.33	5.07
	40 kg	6.30	4.77
	60 kg	7.30	6.20
	80 kg	7.97	5.37
30 cm	20 kg	7.47	6.37
	40 kg	7.50	6.30
	60 kg	8.27	6.77
	80 kg	8.10	6.23
L.S.D	0.05	1.29	0.82
	0.01	n.s	1.12

fertilization level. It is clear that when cotton was planted at 25cm between hills, nitrogen level significantly affected number of total bolls per plant, whereas with the other distance no significant effect was detected for nitrogen fertilization level. The highest number of bolls per plant was 8.27 which was recorded for cotton plants sown at 30cm between hills and supplied with 60kg N/fed., and the lowest one was 6.07 obtained from that sown at 15cm between hills and fertilized with 60kg N/fed.

2- Number open bolls per plant :

Data in Table 20 showed that number of open bolls/plant in 1989 was significantly affected by distance between hills and nitrogen fertilization level interaction. It is clear that when cotton plants were sown at 20 or 25or 30cm between hills, nitrogen level significantly affected number of open bolls/plant. However, the highest number of open bolls per plant was 7.10 which was obtained from plants sown at 20cm between hills and given 20kg N/fed., and the lowest number of open bolls/plant was 3.90 which was obtained by sowing at 20cm between hills and fertilizing with 60kg N/fed.

Similar results were obtained by Hefni et al (1978), whereas El-Shinnawy et al (1984b) found no significant interaction on this trait

SUMMARY

A STUDY ON THE OPTIMAL AGRONOMIC PRACTICES FOR LATE PLANTED EGYPTIAN COTTON

Two field experiments were carried out and repeated during 1989 and 1990 seasons at Bahtim Agricultural Research Station, Agricultural Research. Center, located in Kalubia Governorate in South Delta.

The first experiment: aimed to investigate the effects of seeding rate, thinning date and their interaction on growth, yield and its components, earliness and fiber properties of the late planted cotton.

The experiment included 12 treatments which were the combination of 3 seeding rates and 4 thinning dates. Seeding rates were 5,10 and 15 seeds per hill. These numbers indicate the need of about 16.7, 33.3 and 50kg seed/fed., respectively.

Thinning dates were 20, 25, 30 and 35 days from planting.Planting date was 1st of May in the first season and 25th of April in the second one. A split plot design was used with 4 replications. The main plots were devoted to number of seeds per hill and sub-plots to thinning date. The sub-plot area was 12.6$m^2$and cotton was planted on ridges 60cm apart and seeds were placed in hills 20cm apart.