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Research Article

Response of Egyptian cotton to N-fertilizer levels and Splitting under late sowing

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Abstract: Two field experiments were carried out at Sakha Agricultural Research Station at Kafr El-Sheikh Governorate, during 2017 and 2018 seasons to study the effect of different N-fertilizer levels and fertilizers splitting on growth, yield, its components and fiber quality of Giza 94 cotton cultivar in late sowing. Each experiment was laid out in the experiment design was a split-plot with four replications. The main plots involved three N-fertilizer levels i.e., **A-** 75 kg N/fed., **B-** 60 kg N/fed.and **C-** 45 kg N/fed. While, the subplots were allocated to three splitting fertilizers i.e., **1-** two equal parts, **2-** Three equal parts and **3-** Four equal parts. The results indicated that **1-** The levels of N-fertilizer had significant effect on plant height at harvest and no. of sympodia/plant, seed cotton yield and its components in 2017 and 2018 seasons. **2-** The splitting fertilizers had a significant effect on some growth (plant height in second season 2018 and no. of sympodia/plant in first season 2017), earliness parameters (first sympodial position and days to the first opened boll) in both seasons, seed cotton yield in in second season 2018. **3-** The interaction between N-fertilizer levels and splitting fertilizers treatments had significant effect on plant height, earliness percentage (first sympodial position, no. days to the first flower) in 2017 and 2018 seasons. **4-** The levels of N, splitting fertilizers and interaction had an insignificant effect on fiber all fiber properties**.**

Keywords: Cotton, Late sowing, N-fertilizer, Splitting, Growth, Yield and Quality.

INTRODUCTION

The suitable sowing date and nutrients play a vital role in cotton production, where the early sowing date is one of the most important management factors involved in producing high yielding and quality (Dong *et al.*, 2006). Applying different sowing dates expose the cotton plants to different temperature responses, which affecting the optimum requirements of the whole plant, (Woodward and Sheely, 1983). Boquet *et al.*, (2003) cleared that the excessive plant height at late planting date was partly responsible for lower yield as the crop used a larger portion of its energy budget for vegetative growth and the excess plant height caused lodging. Seed cotton yield/fed. Was significantly decreased with delayed planting. Late planting of cotton crop shows very vegetative and difficult to manage resulting in lower seed cotton yield as well (Ali *et al.*, 2009).

The second one provides the cotton plants with one of the major feeding nitrogen. Nitrogen forms are the most important plant nutrients limiting plant growth and consequently yield. In this respect Anjum *et al.* (2007) revealed that increased nitrogen to cotton may result in more accumulation of photosynthetic assimilates that resulted in higher fruit weight. Several studies were done to evaluate the response of cotton to different N levels, Emara and Abdel-Aal (2017)found that the final plant height, no. of fruiting branches/plant, no. of bolls/plant, boll weight, seed index, lint percentage and seed cotton yield/plant and /fad. increased with increasing rates of N applied. Emara *et al.*, (2016) revealed that the high N fertilizer level did not exhibit significant effect on seed index, lint presenting and fiber properties. Said (2011) studied splitting applied of N fertilizers, he found that no. of open bolls, boll weight and seed cotton yield/fed, tended to be increased as no. of partitioning fertilizers was increased. These results may be due to the low

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leaching of such fertilizers. Moreover, splitting may help cotton plants to face its requirement through the different stages of growth. Elhamamsey *et al*. (2016) revealed that the maximum no. of bolls/plant, boll weight and seed cotton yield/fed., were obtained with splitting of fertilization rates to 4 equal partitions, compared with splitting of fertilization rates to 3 or 2 equal partitions.

Therefore, this investigation was carried out to study the effect of different N-fertilizer levels and fertilizers splitting on growth, earliness, yield, its components and fiber quality in late sowing of Giza 94 cotton cultivar in Kafr El-Sheikh condations.

MATERIALS AND METHODS

Two field experiments were carried out at Sakha Agricultural Research Station at Kafr El-Sheikh Governorate, Egypt, during 2017 and 2018 seasons to study the effect of different N-fertilizer levels and fertilizers splitting on growth, earliness, yield, its components and fiber quality in late sowing of Giza 94 cotton cultivar.

The experiment design was a split plot with four replications. The main plots were assigned to the three N-levels treatments namely i.e.; A- 125% of recommended N rate (75 kg N/fed.), B- Ther ecommended N rate (100%), i.e. (60 kg N/fed.) and C- 75% of the recommended N rate (45 kg N/fed.). While, the sub-plots were allocated to three splitting fertilizers i.e., 1- Two equal parts before the second and third irrigation (SP2), 2- Three equal parts before the second, the third and the fourth irrigation (SP3) and 3- Four equal parts before the second, third, fourth and fifth irrigations (SP4).

The sub-plot size was 19.5 m^2 including six rows (5 m long and 0.65 cm width). The distance between hills was 25 cm. Seeds of Egyptian long staple cotton cultivar Giza 94 (*Gossypiumbar badense, L.*) were planted on 22 and 24 May., after two cut of Egyptian clover (*Trifolium alexandrinum, L.*) in 2017 and 2018 seasons, respectively. Soil samples was taken in the two seasons before planting cotton to estimate the soil characters using the standard methods as described by Chapman and Parker (1981). The results are shown in Table (1).In both seasons, the soil texture was clay loam, low content of organic matter, low calcium carbonate and non-saline. The soils of the two seasons were low in total N and medium in Extractable-P, available K.

Table (1): Mechanical and chemical analysis of the experiment soil in 2017 and 2018 seasons

Season	Texture	pH	Organic Matter (%)	Clay (%)	Sand (%)	EC (m mhos/cm)	Bicarbonate (%)	Available elements (ppm)		
								N	P	K
2017	**Clay loam**	7.89	1.62	45.2	25.1	2.49	2.40	24.08	15.81	247.0
2018	**Clay loam**	8.28	1.70	47.5	22.4	2.46	2.20	24.10	13.90	235.0

Phosphorus in the form of superphosphate (15.5% P_20_5). Nitrogen fertilizer in the form of ammonium nitrate (33.5% N). Potassium in the form of potassium sulphate (48% K_2O). The other standard agricultural practices were followed throughout the two growing seasons.

In both seasons, five representative hills (10 plants/sub-main plot) were taken at random in order to study the following traits; plant height at harvest (cm), no. of sympodia/plant, first sympodial position in nodes, days from sowing to the first flower, as well as to the first open boll, No. of open bolls/plant, boll weight (g), seed cotton yield/plant (g), lint percentage and seed index (g). The yield of seed cotton in kentars/fed. was estimated from the three inner ridges, (One kentar = 157.5 kg.).Samples of lint cotton under different treatments were tested at the C.R.I. laboratories to determine fiber properties according to A.S.T.M. (2012).Analysis of variance of the obtained data of each season was performed. The measured variables were analysed by ANOVA using M Stat-C statistical package (Freed, 1991). Mean comparisons were done using least significant differences (L.S.D) method at 5% level of probability to compare differences between the means (Snedecor and Cochran, 1988).

RESULTS AND DISCUSSION

The results of growth traits, earliness parameters, yield, its components and fiber parameters as affected by to different N-fertilizer levels and fertilizers splitting and their interactions on Giza 94 cotton cultivar during 2017 and 2018 seasons in late sowing are shown in Tables (2 to 5).

A- Growth traits:

The results of growth traits as affected by to different N-fertilizer levels and fertilizers splitting and their interactions during 2017 and 2018 seasons were shown in Table (2).

A-1- Effect of N-fertilizer levels:

Data in Table (2) showed that N-fertilizer levels had a significant effect on plant height at harvest and no. of sympodia/plant in 2017 and 2018 seasons. N rate (75 kg N/fed.) had significantly increased plant height (155.00 and 157.88 cm) in 2017 and 2018 seasons, respectively compared with to other hand. However, N rate (75 kg N/fed.) had significantly

increased no. of sympodia/plant (12.90 and 12.84) in 2017 and 2018 seasons, respectively.

While, the lowest values plant height at harvest (148.88 and 154.22 cm) and no. of sympodia/plant (12.54 and 12.66) in 2017 and 2018 seasons, respectively from N rate (45 kg N/fed.)

Table (2): Cotton growth traits as affected by N levels and splitting doses treatments as well as their interactions during 2017 and 2018 seasons

Characters		Plant height at harvest (cm)		No. of sympodia/plant	
Seasons / Treatments		2017	2018	2017	2018
N-levels (A)	Splitting doses(B)				
75 kg N/fed.	Two equal parts	154.00	156.33	12.90	12.73
	Three equal parts	154.00	157.66	13.00	12.90
	Four equal parts	157.00	159.66	12.80	12.90
Mean 75 kg N/fed.		**155.00**	**157.88**	**12.90**	**12.84**
60 kg N/fed.	Two equal parts	152.00	154.00	13.10	13.33
	Three equal parts	153.33	155.33	12.93	13.20
	Four equal parts	154.00	158.00	13.06	13.26
Mean 60 kg N/fed.		**153.11**	**155.77**	**13.03**	**13.26**
45 kg N/fed.	Two equal parts	149.66	154.33	13.00	12.76
	Three equal parts	148.66	154.33	12.33	12.66
	Four equal parts	148.33	154.00	12.30	12.56
Mean 45 kg N/fed.		**148.88**	**154.22**	**12.54**	**12.66**
General of (B)	Two equal parts	151.88	154.88	13.00	12.94
	Three equal parts	152.00	155.77	12.75	12.92
	Four equal parts	153.11	157.22	12.72	12.91
L.S.D. at 5%	A	**1.23**	**0.73**	**0.10**	**0.22**
	B	**N.S**	**1.16**	**0.18**	**N.S**
	A x B	**N.S**	**N.S**	**0.31**	**0.15**

The positive response due to the high N rate on growth mainly related to the followings; N plays an important role in synthesis, distributing and accumulating the important substances responsible for growth and reflected greatly on dry weight plant (Hearn, 1981). These results are in harmony with those obtained by Emara *et al.*, (2016) found that plant height and no. of fruiting branches were significantly increased by increasing NPK rate.

A-2-Effect of fertilizers splitting:

Results presented in Table (2) indicate that fertilizers splitting had significant effect on growth traits (plant height in second season 2018 and no. of sympodia/plant in first season 2017.

The splitting fertilizers four equal parts significantly increased plant height (157.22) in 2018 season and no. of sympodia/plant (13.00) in 2017 season, as compared with the other two splitting fertilizers. All values of mentioned characters tended to be increased, as number of partitioning fertilizers was increased. This return to, splitting fertilizers may decrease the leaching and to face the requirements of cotton plant during the different stages of growth Said (2011).

A-3-Effect of interaction:

Results presented in Table (2) indicate that interaction between different N-fertilizer levels and fertilizers splitting treatments had insignificant effect on plant height in 2017 and 2018 seasons and significant effect on no. of sympodia/plant in both seasons. Level of 60 kg N/fed. + splitting fertilizers two equal parts gave produced heavier no. of sympodia/plant (13.10 and 13.33) in 2017 and 2018 seasons, respectively as compared with the other treatments.

B- Earliness parameters:

The results of earliness as affected by different N-fertilizer levels and fertilizers splitting and their interactions in late sowing during 2017 and 2018 seasons are shown in Table (3).

Table (3): Earliness parameters as affected by N levels and splitting doses treatments as well as their interactions during 2017 and 2018 seasons

Characters		First sympodial node		Days to the first flower		Days to the first open boll	
Seasons / Treatments		2017	2018	2017	2018	2017	2018
N-levels (A)	Splitting doses(B)						
75 kg N/fed.	Two equal parts	7.03	7.23	72.36	70.10	122.00	122..73
	Three equal parts	6.76	7.13	72.00	68.80	121.93	122.03
	Four equal parts	7.23	7.26	71.80	68.46	121.66	121.86
Mean 75 kg N/fed.		**7.01**	**7.21**	**72.05**	**69.12**	**121.86**	**122.21**
60 kg N/fed.	Two equal parts	6.86	6.86	71.13	68.70	121.16	121.23
	Three equal parts	7.03	7.13	70.56	67.96	120.86	120.96
	Four equal parts	6.76	7.00	70.80	68.23	120.63	121.16
Mean 60 kg N/fed.		**6.88**	**7.00**	**70.83**	**68.30**	**120.88**	**121.12**
45 kg N/fed.	Two equal parts	6.80	6.86	69.90	66.76	120.00	120.36
	Three equal parts	6.90	7.03	69.80	66.93	120.03	120.10
	Four equal parts	6.83	6.93	69.10	67.50	119.83	119.90
Mean 45 kg N/fed.		**6.84**	**6.94**	**69.60**	**67.06**	**119.95**	**120.22**
General of (B)	Two equal parts	6.90	7.06	71.13	68.52	121.05	121.44
	Three equal parts	6.90	7.10	70.78	67.80	120.94	121.03
	Four equal parts	6.94	6.98	70.56	68.06	120.71	120.97
L.S.D. at 5%	A	**0.10**	**0.05**	**0.28**	**0.26**	**0.35**	**0.15**
	B	**N.S**	**0.07**	**0.22**	**0.21**	**N.S**	**0.21**
	A x B	**0.07**	**0.12**	**0.38**	**0.37**	**N.S**	**0.35**

B-1- Effect of N-fertilizer levels:

The results in Table (3) show that, different N-fertilizer levels treatments had a significant effect on first sympodial position, days to the first flower and days to the first opened boll in both seasons. N rate (45 kg N/fed.) had significantly decreased first sympodial position (6.84 and 6.94), no. of days to the first flower (69.60 and 67.06 days) and no. of days to the first opened boll (119.95 and 120.22 days) in 2017 and 2018 seasons, respectively as compared with to different N-fertilizer levels treatments. While, the highest values first sympodial position (7.001 and 7.21), no. of days to the first flower (72.05 and 69.12 days) and no. of days to the first opened boll (121.86 and 122.21 days) in 2017 and 2018 seasons, respectively from N rate (75 kg N/fed.)

B-2-Effect of fertilizers splitting:

The results in Table (3) show that fertilizers splitting treatments had a significant effect on first sympodial position and days to the first opened boll in second season only (2018), the first flower in both seasons. The only splitting fertilizers four equal parts significantly decreased first sympodial position (6.98) and days to the first opened boll (120.97) in second season (2018), the days to the first flower (70.56 and 68.06 days) in 2017 and 2018 seasons, respectively, as compared with the other two splitting fertilizers.

B-3-Effect of interaction:

Results presented in Table (3) indicate that the interaction between different N-fertilizer levels and fertilizers splitting treatments had significant effect on first sympodial position, no. days to the first flower in 2017 and 2018 seasons, and no. days to the first opened boll in 2018 seasons.

C- Yield and yield components:

The results of yield and its components as affected by different N-fertilizer levels and fertilizers splitting and their interactions in late sowing during 2017 and 2018 seasons are show in Table (4).

C-1- Effect of N-fertilizer levels:

Data in Table (4) cleared that no. of open bolls/plant, boll weight and seed cotton yield/fed. were significantly increased due to the N rate (60 kg N/fed.) in both seasons. The different N-fertilizer levels had insignificant effect on lint percentage and seed index in 2017 and 2018 seasons.

The highest values of no. of bolls/plant (14.98 and 13.58), were produced from the recommended N rate (60 kg N/fed.), while the lowest values of no. of bolls/plant (13.54 and 12.98) were obtained from the N rate (75 kg N/fed.), in 2017 and 2018 seasons, respectively. The highest values of boll weight (2.65 and 2.54 g), were produced from the N rate (60 kg N/fed.), while the lowest values of boll weight (2.61 and 2.49 g) were obtained from the N rate (45 kg N/fed.), in 2017 and 2018 seasons, respectively. The highest values of seed cotton yield/ fed. (7.25 and 6.84 kentar), were produced from the N rate (60 kg N/fed.), while the lowest values of seed cotton yield/ fed. (6.68 and 6.74 kentar) were obtained from the 125% of the recommended N rate (75 kg N/fed.), in 2017 and 2018 seasons, respectively. The positive response to the medium N level with regard to seed cotton yield and its components might be due to the improvement nutrient availability and increases in nutrients uptake,

the role of these two concentrations to increase leaf N content and consequently increase photosynthesis, assimilates accumulation and plant dry weight and the higher no. of open bolls/plant and heavier bolls. These results are in accordance with those outlined by overall plant growth, seed cotton yield and its components Elhamamsey*et al.*, (2016).

C-2-Effect of fertilizers splitting:

The results in Table (4) show that fertilizers splitting treatments had a significant effect on seed cotton yield/fed. in second season (2018). The fertilizers splitting treatments had insignificant effect on no. of open bolls/plant, boll weight, lint percentage and seed index in 2017 and 2018 seasons.

The only splitting fertilizers (two equal parts) significantly increased seed cotton yield/fed (6.85 kentar) in 2018 season only**.**

Table (4): Cotton yield and yield components as affected by N levels and splitting doses treatments as well as their interactions during 2017 and 2018 seasons

Characters		No. of open bolls/plant		Boll weight (g)		Seed cotton yield (Kentar/fed.)		Lint percentage (%)		Seed index (g)	
Seasons / Treatments		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
N-levels (A)	Splitting doses(B)										
75 kg N/fed.	Two equal parts	13.50	13.00	2.62	2.52	6.83	6.81	38.55	39.52	11.11	11.13
	Three equal parts	13.63	13.06	2..68	2.54	6.74	6.76	39.59	39.59	11.14	11.16
	Four equal parts	13.50	12.90	2.60	2.51	6.48	6.65	39.58	39.61	11.13	11.16
Mean 75 kg N/fed.		**13.54**	**12.98**	**2.63**	**2.52**	**6.68**	**6.74**	**39.57**	**39.57**	**11.13**	**11.15**
60 kg N/fed.	Two equal parts	14.93	13.66	2.63	2.54	7.29	6.87	39.54	39.54	11.17	11.18
	Three equal parts	15.06	13.53	2.65	2.54	7.14	6.85	39.59	39.63	11.12	11.15
	Four equal parts	14.96	13.56	2.66	2.53	7.33	6.80	39.61	39.63	11.15	11.16
Mean 60 kg N/fed.		**14.98**	**13.58**	**2.65**	**2.54**	**7.25**	**6.84**	**39.58**	**39.60**	**11.15**	**11.16**
45 kg N/fed.	Two equal parts	14.53	13.23	2.60	2.48	7.00	6.82	39.53	39.54	11.12	11.14
	Three equal parts	14.33	13.40	2.62	2.50	6.88	6.84	39.54	39.55	11.17	11.10
	Four equal parts	14.93	13.30	2.61	2.48	6.82	6.78	39.53	39.55	11.11	11.09
Mean 45 kg N/fed.		**14.60**	**13.31**	**2.61**	**2.49**	**6.90**	**6.81**	**39.53**	**39.55**	**11.20**	**11.11**
General of (B)	Two equal parts	14.32	13.30	2.62	2.50	7.04	6.85	39.54	39.53	11.13	11.15
	Three equal parts	14.34	13.33	2.68	2.53	6.92	6.81	39.57	39.59	11.15	11.14
	Four equal parts	14.46	13.25	2.65	2.52	6.87	6.74	39.57	39.60	11.13	11.13
L.S.D. at 5%	A	**0.17**	**0.10**	**0.02**	**0.01**	**0.13**	**0.02**	**N.S**	**N.S**	**N.S**	**N.S**
	B	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**0.01**	**N.S**	**N.S**	**N.S**	**N.S**
	A x B	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**0.03**	**N.S**	**N.S**	**N.S**	**N.S**

C-3-Effect of interaction:

Results presented in Table (4) indicate that the interaction between different N-fertilizer levels and fertilizers splitting treatments had insignificant effect on its components in both seasons. However, significant effect on seed cotton yield in 2018 season. The highest values of seed cotton yield/ fed. (6.87 kentar), were produced from the N rate (60 kg N/fed.) + splitting fertilizers (two equal parts), as compared with the other tretments.

D- Fiber quality traits:

Data in Table (5) shown effect of different N-fertilizer levels and fertilizers splitting on and their interactions on fiber parameters (upper half mean length, length uniformity index, fiber strength and micronaire reading) of Giza 94 cotton cultivarin late sowingduring 2017 and 2018 season. The tested treatments gave insignificant effect on fiber parameters under study in during 2017 and 2018 seasons.

Table (5): Cotton fiber parameters as affected by N levels and splitting doses treatments as well as their interactions during 2017 and 2018 seasons

Characters		Upper half mean length (mm)`		Length uniformity index (UI %)		Fiber strength (g/tex)		Micronair reading	
Seasons / Treatments		2017	2018	2017	2018	2017	2018	2017	2018
N-levels (A)	Splitting doses(B)								
75 kg N/fed.	Two equal parts	33.46	34.60	84.36	85.66	9.43	9.36	4.26	4.16
	Three equal parts	33.36	32.56	84.36	84.43	9.36	9.56	4.26	4.16
	Four equal parts	33.36	33.62	84.32	84.58	9.62	9.14	4.17	4.25
Mean 60 kg N/fed.		**33.39**	**33.59**	**84.35**	**84.89**	**9.47**	**9.35**	**4.23**	**4.19**
60 kg N/fed.	Two equal parts	33.36	33.46	84.26	85.40	9.10	9.36	4.33	4.20
	Three equal parts	32.43	33.44	84.80	86.10	9.36	9.13	4.33	4.10
	Four equal parts	33.07	34.15	84.40	85.32	9.34	9.43	4.18	4.19
Mean 45 kg N/fed.		**32.95**	**33.68**	**84.49**	**85.61**	**9.27**	**9.31**	**4.28**	**4.16**
45 kg N/fed.	Two equal parts	32.85	33.72	84.37	85.17	9.48	9.38	4.14	4.21
	Three equal parts	33.43	34.34	84.52	85.61	9.34	9.38	4.25	4.16
	Four equal parts	32.86	33.83	84.42	85.05	9.37	9.32	4.21	4.11
Mean 30 kg N/fed.		**33.05**	**33.96**	**84.44**	**85.28**	**9.40**	**9.36**	**4.20**	**4.16**
General of (B)	Two equal parts	33.22	33.93	84.33	85.41	9.34	9.37	4.24	4.19
	Three equal parts	33.07	33.45	84.56	85.38	9.35	9.36	4.28	4.14
	Four equal parts	33.10	33.87	84.38	84.98	9.44	9.30	4.19	4.18
L.S.D. at 5%	A	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
	B	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
	A x B	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

CONCLUSION

The results obtained in this study could lead us to a package of recommendations, which seemed to be useful for increasing the cotton yield production and the best fiber quality. It could be concluded the (100%) N-fertilizer level (60 kg N/fed.) with splitting it to two equal doses for obtaining high productivity of Giza 94 cotton cultivarin late sowing under Sakha region condition.

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