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Research Article

Effect of Different N-fertilizer Levels and Fertilizers Splitting on Growth and Productivity of Giza 94 Cotton Cultivar

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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, earliness, yield, its components and fiber quality of Giza 94 cotton cultivar. Each experiment was laid out in the experiment design 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 most important results obtained could be summarized as follows:** 1) the levels of N-fertilizer had significant effect on growth, earliness parameters, seed cotton yield and its components in 2017 and 2018 seasons. 2) The splitting fertilizers had a significant effect on some growth, earliness parameters, seed cotton yield and its components in both seasons. 3) The interaction between N-fertilizer levels and splitting fertilizers treatments had significant effect on no. of sympodia/plant, earliness percentage in 2017 and 2018 seasons. While, did not exhibit significant effect on the other traits under study in both seasons. 4) The levels of N and splitting fertilizers had an insignificant effect on fiber all fiber properties. **Conclusion:** Generally, from results obtained revealed that the high N-fertilizer level (60 kg N/fed.) or (75 kg N/fed.) with splitting it to three or four equal dosses a must for obtaining high productivity of the cotton Giza 94 variety under this study.

Keywords: Cotton, N-fertilizer, Fertilizers Splitting, Growth, Yield, Earliness and Quality.

INTRODUCTION

The suitable sowing date and nutrients play a vital role in cotton production, where the planting cotton before end of March leads to the formation of vegetative growth, earliness and fruiting capacity therefore, increasing the yield and quality. Early sowing produced 23% more open bolls and 18% more cotton yield Arshad *et al.*, (2007). Emara *et al.*, (2015) found that early sowing significantly increased no. of sympodia/plant, lint percentage, seed index and seed cotton yield/fed. However, several reports have indicated that early sown cotton produces taller plants with higher no. of branches, no. of bolls and yield (Bange *et al.*, 2008). These findings are also supported by other researchers Abdul Wahab *et al.*, (2014) where they found that early planting date significantly increased seed cotton yield/fed. Due to the increase of no. of open bolls/plant, boll weight, seed cotton yield/plant and no. of plants/fed. at harvest. The planting date treatments did not exhibit significant effect on lint percentage.

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, Seadh *et al.*, (2012) and 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

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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 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.

The main objective of this investigation was to study the effect of different N-fertilizer levels and fertilizers splitting on growth, earliness, yield, its components and fiber quality 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 seasonsto study the effect of different N-fertilizer levels and fertilizers splitting on growth, earliness, yield, its components and fiber quality 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- The recommended 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 fifthirrigations (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 (*Gossypium barbadense, L.*) were planted on 25 and 21 April., 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, earliness percentage, 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 laboratories of the Cotton Technology Research Division, Cotton Research Institute in Giza to determine fiber properties, under controlled conditions of 65% $^{\pm 2}$ of relative humidity and $21^{o\pm 2}$ C^o temperature. Fiber length and uniformity index, fiber strength and Micronaire reading were determined on digital Fibrograph instrument 630, Pressley instrument and Micronaire instrument 675 respectively, according to A.S.T.M. (2012) at the C.R.I. laboratories.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 ($P \leq 0.05$) 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 splittingand their interactions on Giza 94 cotton cultivar during 2017 and 2018 seasons are shown in Tables (2 to 6).

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).

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	149.33	152.00	15.63	14.23
	Three equal parts	151.66	154.00	15.90	14.36
	Four equal parts	153.33	156.00	15.96	14.53
Mean 75 kg N/fed.		**151.44**	**154.00**	**15.83**	**14.37**
60 kg N/fed.	Two equal parts	146.33	148.33	14.60	14.10
	Three equal parts	147.66	150.66	14.83	14.46
	Four equal parts	150.00	152.66	15.80	14.50
Mean 60 kg N/fed.		**148.00**	**150.55**	**15.07**	**14.35**
45 kg N/fed.	Two equal parts	143.33	148.66	13.76	13.90
	Three equal parts	145.00	149.00	13.90	13.96
	Four equal parts	145.66	149.33	14.16	14.00
Mean 45 kg N/fed.		**144.66**	**149.00**	**13.94**	**13.95**
General of (B)	Two equal parts	146.33	149.66	14.66	14.07
	Three equal parts	148.11	151.22	14.87	14.26
	Four equal parts	149.66	152.66	15.31	14.34
L.S.D. at 5%	A	**3.33**	**1.09**	**0.19**	**0.22**
	B	**1.05**	**1.11**	**0.16**	**0..08**
	A x B	**N.S**	**N.S**	**0.28**	**0.15**

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 (151.44 and 154 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 (15.83 and 14.37) in 2017 and 2018 seasons, respectively.

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 Seadh *et al.*, (2012) 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 and no. of sympodia/plant) in both seasons.

The splitting fertilizers four equal parts before the second, third, fourth and fifth irrigations significantly increased plant height (149.66 and 152.66 cm) and no. of sympodia/plant (15.31 and 14.34) in 2017 and 2018 seasons, respectively, 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) and improved nutrients use efficiencies Raju *et al.*, (2008).

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. High level of 75 kg N/fed. + splitting fertilizers four equal parts gave produced heavier no. of sympodia/plant (15.96 and 14.53) 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 during 2017 and 2018 seasons are shown in Table (3).

B-1- Effect of N-fertilizer levels:

The results in Table (3) show that, different N-fertilizer levels treatments had a significant effect on days to the first flower, days to the first opened boll and earliness percentage in both seasons, and first sympodial position in second season only. N rate (45 kg N/fed.) had significantly decreased no. of days to the first flower (73.36 and 73.80 days), no. of days to the first opened boll (122.34 and 122.50 days) and earliness presenting (82.06 and 81.67%) in 2017 and 2018 seasons, respectively, first sympodial position (6.20) in second season only as compared with to different N-fertilizer levels treatments.

B-2-Effect of fertilizers splitting:

The results in Table (3) show that fertilizers splitting treatments had a significant effect on days to the first flower, the first opened boll in both seasons and earliness percentage in second season only (2018). The only splitting fertilizers four equal parts significantly decreased days to the first flower (74.53 and 74.73 days), the first open boll (123.51 and 123.55 days) in 2017 and 2018 seasons, respectively, While significantly increased earliness percentage (78.51%) in 2018 seasons, as compared with the other two splitting fertilizers.

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		Earliness percentage	
Seasons / Treatments		2017	2018	2017	2018	2017	2018	2017	2018
N-levels (A)	Splitting doses(B)								
75 kg N/fed.	Two equal parts	6.60	6.40	76.36	76.56	125.06	125.50	75.56	75.30
	Three equal parts	6.60	6.46	76.03	76.20	125.10	125.00	75.83	75.36
	Four equal parts	6.43	6.56	75.73	75.96	124.90	124.90	75.96	75.50
Mean 75 kg N/fed.		**6.54**	**6.47**	**76.04**	**76.24**	**125.02**	**125.13**	**75.78**	**75.38**
60 kg N/fed.	Two equal parts	6.20	6.13	74.96	75.30	123.56	123.96	78.56	78.36
	Three equal parts	6.36	6.23	74.56	75.13	123.23	123.43	77.66	77.63
	Four equal parts	6.33	6.26	74.63	74.83	123.60	123.56	77.93	77.36
Mean 60 kg N/fed.		**6.30**	**6.21**	**74.72**	**75.08**	**123.46**	**123.65**	**78.05**	**77.78**
45 kg N/fed.	Two equal parts	6.16	6.13	73.73	74.13	122.60	122.83	80.90	80.53
	Three equal parts	6.20	6.18	73.13	73.86	122.40	122.46	82.43	81.83
	Four equal parts	6.23	6.30	73.23	73.40	122.03	122.20	82.86	82.66
Mean 45 kg N/fed.		**6.20**	**6.20**	**73.36**	**73.80**	**122.34**	**122.50**	**82.06**	**81.67**
General of (B)	Two equal parts	6.32	6.22	75.02	75.33	123.74	124.10	78.34	78.06
	Three equal parts	6.38	6.29	74.57	75.06	123.57	123.63	78.64	78.27
	Four equal parts	6.33	6.37	74.53	74.73	123.51	123.55	78.92	78.51
L.S.D. at 5%	A	N.S	0..05	0.23	0.16	0.24	0.15	0.47	0.34
	B	N.S	N.S	0.32	0.12	0.13	0.16	N.S	0.14
	A x B	N.S	N.S	N.S	N.S	N.S	N.S	0.89	0.25

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 earliness percentage in 2017 and 2018 seasons. The highest values of earliness percentage (82.86 and 82.66%) was produced from N rate (45 kg N/fed.) + splitting fertilizers four equal parts in 2017 and 2018 seasons, respectively.

The interaction between different N-fertilizer levels and fertilizers splitting treatments had insignificant effect on first sympodial position, no. days to the first flower and no. days to the first opened boll in in 2017 and 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 during 2017 and 2018 seasons are shown 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 (75 kg N/fed.) and 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 (18.00 and 15.62), were produced from the recommended N rate (60 kg N/fed.), while the lowest values of no. of bolls/plant (16.65 and 15.35) were obtained from the N rate (75 kg N/fed.), in 2017 and 2018 seasons, respectively. The highest values of boll weight (2.86 and 2.75 g), were produced from the N rate (75 kg N/fed.) or (60 kg N/fed.), while the lowest values of boll weight (2.82 and 2.65 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. (10.48 and 8.48 kentar), were produced from the N rate (75 kg N/fed.) or (60 kg N/fed.), while the lowest values of seed cotton yield/ fed. (10.22 And 8.13 kentar) were obtained from the 75% of the recommended N rate (45 kg N/fed.), in 2017 and 2018 seasons, respectively.

The positive response to the high 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 effect on no. of open bolls/plant and seed cotton yield/fed. in both seasons. The fertilizers splitting treatments had insignificant effect on boll weight, lint percentage and seed index in 2017 and 2018 seasons.

The only splitting fertilizers (three equal parts) and (four equal parts) significantly increased no. of bolls/plant (17.53 and 17.48) and seed cotton yield/ fed. (10.41 and 8.41 kentar) in 2017 and 2018 seasons, respectively, 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) and improved nutrients use efficiencies Raju *et al.*,(2008). Therefore, maximum of yield at harvest Gawade *et al.*, (2014), where any deficiency of nutrients during the stages of flowering and fruiting may reduce cotton boll retention, which results in decreased yield Miley *et al.*,(1969).

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 seed cotton yield and its components in both seasons.

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	16.50	15.13	2.85	2.74	10.45	8.41	39.68	39.85	11.31	11.29
	Three equal parts	16.60	15.23	2.87	2..75	10.50	8.52	39.84	39.71	11.39	11.35
	Four equal parts	16.60	15.33	2.87	2.76	10.50	8.51	39.84	39.85	11.42	11.37
Mean 75 kg N/fed.		**16.56**	**15.23**	**2.86**	**2.75**	**10.48**	**8.48**	**39.79**	**39.80**	**11.37**	**11.34**
60 kg N/fed.	Two equal parts	17.96	15.53	2.84	2.73	10.43	8.43	39.89	39.90	11.36	11.33
	Three equal parts	17.96	15.70	2.87	2..74	10.48	8.47	39.88	39.89	11.37	11.34
	Four equal parts	18.06	15.63	2.87	2.75	10.48	8.50	39.91	39.92	11.39	11.36
Mean 60 kg N/fed.		**18.00**	**15.62**	**2.86**	**2.74**	**10.46**	**8.46**	**39.89**	**39.90**	**11.37**	**11.34**
45 kg N/fed.	Two equal parts	17.50	15.56	2.81	2.63	10.16	8.01	39.84	39.84	1136	11.34
	Three equal parts	17.56	15.53	2.82	2.68	10.25	8.22	39.86	39.87	11.33	11.30
	Four equal parts	17.93	15.46	2.82	2.66	10.25	8.18	39.84	39.85	11.31	11.28
Mean 45 kg N/fed.		**17.66**	**15.52**	**2.82**	**2.65**	**10.22**	**8.13**	**39.84**	**39.85**	**11.33**	**11.31**
General of (B)	Two equal parts	17.32	15.41	2.83	2.70	10.35	8.28	39.80	39.86	11.34	11.32
	Three equal parts	17.37	15.48	2.85	2.72	10.41	8.41	39.86	39.82	11.36	11.33
	Four equal parts	17.53	15.47	2.85	2.72	10.41	8.40	39.86	39.87	11.37	11.34
L.S.D. at 5%	A	**0.13**	**0.11**	**0.1**	**0.01**	**0.11**	**0.09**	**N.S**	**N.S**	**N.S**	**N.S**
	B	**0.14**	**0.04**	**N.S**	**N.S**	**0.03**	**0.06**	**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**	**N.S**	**N.S**

D- Fiber quality traits:

Data in Table (5) has shown effect of different N-fertilizer levels and fertilizers splitting and their interactions on fiber parameters (upper half mean length, length uniformity index, fiber strength and micronaire reading) during 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	33.40	33.73	84.43	83.46	9.70	9.13	4.10	4.23
	Three equal parts	33.90	33.63	84.70	84.13	9.56	8.66	4.10	4.36
	Four equal parts	33.43	33.83	84.56	84.66	9.83	8.80	4.16	4.36
Mean 60 kg N/fed.		**33.58**	**33.73**	**84.56**	**84.08**	**9.70**	**8.86**	**4.12**	**4.32**
60 kg N/fed.	Two equal parts	33.73	32.43	85.16	83.53	9.73	9.33	4.03	4.13
	Three equal parts	32.96	33.10	84.26	84.90	9.56	9.16	4.13	4.26
	Four equal parts	33.16	33.10	84.63	86.06	9.13	9.56	4.23	4.10
Mean 45 kg N/fed.		**33.28**	**32.88**	**84.68**	**84.83**	**9.47**	**9.35**	**4.13**	**4.16**
45 kg N/fed.	Two equal parts	33.60	33.66	84.70	84.53	9.40	9.46	4.16	4.20
	Three equal parts	33.30	34.10	84.06	85.80	9.43	9.53	4.10	4.20
	Four equal parts	32.70	34.20	83.76	84.93	9.33	9.80	4.03	4.13
Mean 30 kg N/fed.		**33.20**	**33.99**	**84.17**	**85.09**	**9.39**	**9.60**	**4.10**	**4.18**
General of (B)	Two equal parts	33.58	33.27	84.76	83.84	9.61	9.31	4.10	4.19
	Three equal parts	33.39	33.61	84.34	84.94	9.52	9.12	4.11	4.27
	Four equal parts	33.10	33.71	84.32	85.22	9.43	9.39	4.14	4.20
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 N-fertilizer level (75 kg N/fed.) or (60 kg N/fed.) with splitting it to four or three equal dosesfor obtaining high productivity of Giza 94 cotton cultivar under Sakha region condition at Kafr El-Sheikh Governorate.

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