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EFFECT OF PLANTING DATES AND RATES OF NITROGEN AND POTASSIUM FERTILIZATION ON GROWTH AND PRODUCTIVITY OF GIZA 96 COTTON VARIETY

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ABSTRACT: Two field experiments were conducted at Sakha Agricultural Research Station at Kafr El-Sheikh Governorate, Egypt, during the growing seasons of 2018 and 2019 to study the effect of planting dates and rates of nitrogen and potassium fertilization on growth and productivity of Giza 96 cotton variety to preparing the optimal agricultural recommendation for it. The experiment design was a split plot with four replications. The main plots had two planting dates (Early at 15th April and Late at 15th May) and the sub plots had four rates of nitrogen and potassium fertilization (125% from the recommended dose for nitrogen (N) + potassium (K), 100 % N + K, 75% N + K, 50% N + K). (The recommended dose 60kg Nitrogen/fed. + 24 kg Potassium/fed.) The most important results obtained could be summarized as follows: Planting dates had a significant effect on growth, yield and its components and fiber properties. Early planting date significantly increased No. of fruiting branches /plant, No. of open bolls /plant, boll weight, seed cotton yield/fed. and gave good fiber properties. The rates of nitrogen and potassium fertilization had significant effect on growth traits, yield and yield components while did not exhibit any significant effect on fiber properties. The rate 100% N+K (60 kg N+24kg K) significantly increased No. of fruiting branches /plant, No. of open bolls /plant, boll weight, seed index and seed cotton yield/fed. The interaction between planting dates and rates of nitrogen and potassium fertilization had significant effect on growth, yield and its components while did not exhibit any significant effect on lint % and fiber properties. Generally, early planting in combination with the rate100% N+K (60 kg N+24kg K) significantly increased number of fruiting branches /plant, number of open bolls /plant, boll weight, seed index and seed cotton yield/fed and gave high productivity of Egyptian cotton variety Giza 96.

Key words: Cotton, Planting dates, Fertilizer, Nitrogen, Potassium, Growth, Yield and fiber properties.

INTRODUCTION

Planting cotton in a suitable time leads to forming the first fruiting branch at a lower node on the stem and only an optimum height, increasing no. of bolls and yield of cotton, escaping from leaf and boll-worms and aphids at the end of the season and picking early. Boquet *et al.* (2003) showed 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. Hamoda (2006) found that late sown plants grew faster than early sown ones. Boll weight, no. of open bolls/plant and seed cotton yield/fed. increased in early planting date. Arshad *et al.,* (2007) reported that early planting produced 23% more open bolls and 18% more cotton yield. Bange *et al.,* (2008) indicated that early sown cotton produces taller plants with higher

number of branches, number of bolls and yield. Emara *et al.,* (2015) found that early planting date significantly increased seed cotton yield/fad. due to the increase of number of open bolls/plant and boll weight. However, Emara (2012) indicated that sowing date gave significant effects on upper half mean length and micronaire reading in favour of early planting. While, did not exhibit any significant on uniformity index and strength. Deshish *et al.,* (2015) indicated that all fiber properties studied were improved due to early planting of cotton.

Nitrogen is one of the most important element in cotton plants. Moderate levels of nitrogen fertilization may produce a higher yield and quality, but higher levels may result in excessive of vegetative growth with a lower yield and quality. Through cotton agronomy programs, many traits are usually assigned to determine the optimum nitrogen levels fertilization must apply for every new promising hybrid cotton and commercial varieties. In this respect, several studies were done to evaluate the response of cotton plants to different nitrogen levels. Hamed (2006) indicated that the plant height, no. of fruiting branches/plant, no. of open bolls/plant and seed cotton yield/plant significantly increased by increasing nitrogen levels. Ibrahim (2008) found that plant height, no. of fruiting branches/plant, no. of open bolls/ plant, boll weight, seed index, seed cotton yield/fed., fiber length, fiber strength and micronaire values increased significantly by increased NPK fertilizers levels at 80 kg N +30 kg P205 +48 kg k20/fed. Policepatil *et al.,* (2009) revealed that increased NPK fertilization to cotton may result in more accumulation of photosynthetic assimilates that resulted in higher fruit weight. El-Shahawy and Hamoda (2011) found that plant height, no. of sympodia /plant, first sympodial position, no. of open bolls /plant, boll weight, seed index and seed cotton yield/fed. increased by increasing nitrogen levels and also found that the studied treatments did not exhibit any significant effect on all fiber properties Hamoda *et al.,* (2014) found that the final plant height, No. of fruiting branches/plant, No. of bolls/plant, boll weight, seed index and seed cotton yield/fad. increased with increasing rates of NPK applied.. Elhamamsey *et al.,* (2016) and Emara *et al.,* (2016) revealed that the high NPK fertilizer level did not exhibit significant effect on seed index, lint percentage and fiber properties. Emara and Abdel-Aal (2017) found that the plant height, No. of fruiting branches/plant, No. of bolls/plant, boll weight, seed index, seed cotton yield/ fed. increased with increasing rates of NPK applied.

Potassium is an essential macro-element required in large amounts for normal plant growth and development. Potassium is an important nutrient that has favorable effects on the metabolism of nucleic acids, proteins, vitamins and growth substances. Furthermore, Potassium plays important roles in the translocation of photsynthates, sugars and activation of many enzymes required from sources to sinks Morteza *et al.,* (2005). However, Pettigrew (1999) indicated that the elevated carbohydrate concentrations remaining in source tissue, such as leaves, appear to be part of the overall effect of potassium deficiency in reducing the amount of photosynthetic available for reproductive sinks and thereby producing changes in the yield and quality of cotton. Many studies have shown increased yield and productivity in response to potassium fertilization as reported by Abou-Zaid *et al.*, (2009), Emara and Hamoda (2012), Gomaa *et al.*, (2014), Abdel-Aal *et al.,* (2015) and Emara (2015). The main purpose of this study was to preparing the suitable agricultural managements practices (planting date and rates of nitrogen and Potassium fertilization to Giza 96 cotton variety.

MATERIALS AND METHODS

Two field experiments were conducted at Sakha Agricultural Research Station at Kafr El-Sheikh Governorate, Egypt, during the growing seasons of 2018 and 2019 to study the effect of planting dates and rates of nitrogen and potassium fertilization on growth and productivity of Giza 96 cotton variety. The experiment design was a split plot with four replications. The main plots had two planting dates; (Early at 15th April and Late at 15th May) and the sub plots had four rates of nitrogen and potassium fertilization (125% from the recommended dose for nitrogen (N) + potassium (K), 100 % N + K, 75% N + K, 50% N + K). (The recommended dose equal 60kg Nitrogen/fed. + 24 kg Potassium/fed.). Characters of Giza 96 variety are showed in Table (1).

The sub-plot size was 19.5 m^2 including six rows (5 m long and 0.65 cm width). Cottonseeds were sown after two cuts of Egyptian clover Barseem (*Trifolium alexandrinum* L.,) in 2018 and 2019 seasons. Soil samples was taken in the two seasons before planting to estimate the soil characters using the standard methods as described by Chapman and Parker (1981). The results are shown in Table (2).

Table (1): Characters of the Giza 96 variety.

Genotype name	**Giza 96**
Species	**Barbadense.**
Category	**Extra long staple and extra fine.**
Pedigree	**{Giza 84 x (Giza70 x Giza 51B)} x C62**
Characteristics	**Extra long staple variety characterized by high yielding, earliness, resistance to Fusarium wilt, high lint percentage (%) about 38%.**
Botanical distinguishing characters	**The stem has a length with resistance to lodging and also has a green color mixed by dim red with internodes length ranged from short to medium. The leaves have navicular shape; medium size with medium lobes and leather feel. The node of the first fruiting branch ranged from 7-8, the axillaries buds will activate to give a fruiting branch which ended with one or two bolls. Flower petals has shape like a tubular, the petals is rolling. The boll shape is conical shape with shoulder and many glands. Seed is medium-sized and the fuzz cover about 1/4 to 1/2 from the whole size and fuzz color is gray-greenish.**
Hybrid bred by	**Breeding Res. Section, Cotton Res. Inst., Agric. Res. Center, Giza, Egypt.**

Table (2): Mechanical and chemical analysis of the experiment soil in 2018 and 2019 seasons.

Season	Texture	pH	Organic Matter (%)	EC (m mhos/cm)	Bicarbonate (%)	Available elements (ppm)		
						N	P	K
2018	Clay loam	8.29	1.66	0.66	2.01	22.72	14.70	245.0
2019	Clay loam	8.38	1.81	0.72	2.00	20.32	12.53	230.0

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, Extractable-P, and low to medium in available K. Hills were spaced at 30 cm and seedlings were thinned at 2 plants/hill after 35 day from planting. Phosphorus fertilizer as ordinary superphosphate (15.5% P_2O_5) at the rate of 22.5 kg P2O5/fed. was incorporated during seed bed preparation. Nitrogen fertilizer in the form of ammonium nitrate (33.5% N) at the tested rates was applied in two equal doses, immediately before the first and the second irrigations. Potassium fertilizer in the form of potassium sulphate (48% K2O) at the tested rates was side-dressed in a single dose before the second irrigation. The other standard agricultural practices were followed throughout the two growing 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), number of fruiting branches /plant, number of open bolls/plant, boll weight (g), lint % and seed index (100 seed weight) (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% ± 2 of relative humidity and 21º ± 2 Cº 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). All collected data were subjected to statistical analysis as proposed by Gomez and Gomez (1984) and means were compared by LSD and F test at 5% level of probability.

RESULTS AND DISCUSSION

The results of growth traits as affected by planting dates, rates of nitrogen and potassium fertilization and its interaction of cotton during 2018 and 2019 seasons were shown in Table (3). Data showed that planting dates had a significant effect on plant height at harvest and number of fruiting branches /plant in 2018 and 2019 seasons. Late planting date had significantly increased plant height compared with early planting. However, early planting date had significantly increased number of fruiting branches /plant. This effect may be due to the balance between vegetative and fruiting growth, which occurred under the earlier date, than late one. Similar results were obtained by Emara *et al.,* (2016), Emara (2012), Emara *et al.,* (2015).

Also data in Table (3) indicate that rates of nitrogen and potassium fertilization had significant effect on growth traits (plant height and number of fruiting branches /plant) in both seasons. The high rate 125% N+K rate significantly increased plant height while, the rate 100% N+K significantly increased number of fruiting branches /plant in both seasons as compared with the other treatments. The positive response due to the high rate 125% N+K on growth is 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 plant dry weight (Hearn, 1981). These results are in harmony with those obtained by Elhamamsey *et al.,* (2016), Emara *et al.,* (2016) and Emara and Abdel-Aal (2017), which found that plant height and number of fruiting branches/plant were significantly increased by increasing

NPK rate. Data in Table (3) indicate that the interaction between planting dates and rates of nitrogen and potassium fertilization treatments had significant effect on plant height and number of fruiting branches /plant in 2018 and 2019 seasons. Late planting date and high rate 125% N+K gave tallest plant height in both seasons, while in early planting date with high rate 100% N+K gave good value of number of fruiting branches /plant as compared with the other treatments.

The results of yield and its components as affected by planting dates, rates of nitrogen and potassium fertilization and its interaction of cotton during 2018 and 2019 seasons were shown in Table (4). Data cleared that early planting date were significantly increased number of open bolls/plant, boll weight, seed index and seed cotton yield/fad. in both seasons, while lint percentage were insignificantly affected by planting dates. This could be attributed to the increase in the number fruiting branches /plant and the well-built plants, which were shorter and had lower fruiting node than the late planting, which were etiolated. This in turn might have had increased the amounts of available photosynthates for boll development and hence increased No. of open bolls/plant and boll weight. The seed cotton yield/fad. was increased in favor of early sowing as a result of increasing number of open bolls/plant and boll weight. These results are in harmony with those obtained by Emara *et al.,* (2016), Emara *et al.,* (2015) and Deshish *et al.,* (2015).

Table (3): Effect of planting dates, rates of nitrogen and potassium fertilization and its interaction on growth of cotton during 2018 and 2019 seasons.

Treatments		Plant height at harvest (cm)		No. of fruiting branches /plant	
Planting dates (A)	Rates of N+k fertilization (B)	2018	2019	2018	2019
Early	125% N+K	147.67	148.03	13.80	13.87
	100% N+K	144.00	146.00	14.97	14.93
	75% N+K	143.00	144.83	12.53	12.70
	50% N+K	141.00	143.73	12.53	12.33
Mean		143.92	145.65	13.46	13.46
Late	125% N+K	155.00	155.80	11.37	11.73
	100% N+K	153.00	152.73	11.87	11.93
	75% N+K	151.00	151.77	10.67	10.63
	50% N+K	147.00	146.33	10.60	10.30
Mean		151.50	151.66	11.13	11.15
General means of rates of N+K fertilization (B)	125% N+K	151.33	151.92	12.59	12.80
	100% N+K	148.50	149.37	13.42	13.43
	75% N+K	147.00	148.30	11.60	11.67
	50% N+K	144.00	145.03	11.57	11.32
F test for	A	*	**	**	**
L.S.D. at 5% for	B	0.36	0.22	0.16	0.13
	A x B	0.60	0.41	0.31	0.27

Table (4): Effect of planting dates, rates of nitrogen and potassium fertilization and its interaction on yield and its components of cotton during 2018 and 2019 seasons.

Treatments		No. of open bolls/plant		Boll weight (g)		Lint %		Seed index (g)		Seed cotton yield (Ken./fad.)	
Planting dates (A)	Rates of N+K fertilization (B)	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Early	125% N+K	18.60	16.57	2.44	2.40	38.30	38.67	9.77	9.80	7.60	7.50
	100% N+K	19.57	18.70	2.63	2.61	38.50	38.54	9.80	9.95	8.97	8.73
	75% N+K	16.70	15.60	2.35	2.27	38.65	38.82	9.60	9.70	7.37	7.13
	50% N+K	15.27	13.73	2.03	2.09	38.75	38.93	9.55	9.53	6.62	6.20
Mean early sowing		17.53	16.15	2.36	2.34	38.55	38.74	9.68	9.75	7.64	7.39
Late	125% N+K	12.33	12.00	1.69	1.66	38.35	38.60	9.42	9.60	5.40	5.27
	100% N+K	13.83	13.23	1.77	1.72	38.61	38.70	9.45	9.65	6.13	5.87
	75% N+K	12.83	12.40	1.88	1.78	38.67	38.91	9.20	9.51	6.67	6.53
	50% N+K	12.63	12.23	1.65	1.61	38.80	38.96	9.15	9.33	5.70	5.53
Mean late sowing		12.91	12.47	1.75	1.69	38.61	38.79	9.31	9.52	5.98	5.80
General means of rates of N+K fertilization (B)	125% N+K	15.47	14.28	2.06	2.03	38.33	38.64	9.60	9.70	6.50	6.38
	100% N+K	16.70	15.97	2.20	2.16	38.56	38.62	9.63	9.80	7.55	7.30
	75% N+K	14.77	14.00	2.12	2.03	38.66	38.87	9.40	9.61	7.02	6.83
	50% N+K	13.95	12.98	1.84	1.85	38.78	38.95	9.35	9.43	6.16	5.87
F test for	A	**	**	*	*	N.S	N.S	*	*	**	**
L.S.D. at 5% for	B	0.36	0.44	0.08	0.06	N.S	N.S	0.14	0.19	0.25	0.36
	A x B	0.49	0.52	0.21	0.18	N.S	N.S	0.29	0.41	0.34	0.49

The results in Table (3) show that rates of nitrogen and potassium fertilization had a significant effect on number of open bolls/plant, boll weight, seed index and seed cotton yield/feddan, while insignificant effect on lint % in both seasons. The highest values of number of bolls/plant, boll weight and seed cotton yield/feddan were produced from the rate 100% N+P while the lowest values of number of bolls/plant, boll weight and seed cotton yield/feddan were obtained from the rate 50% N+P in both season. The positive response to the rate 100% N+P with regard to 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, P and K content and consequently increase photosynthesis, assimilates accumulation and plant dry weight and the higher number of open bolls/plant and heavier bolls. The boll weight increases due to the high NPK level mainly attributed to increase photosynthetic activity of cotton plants and consequently increase accumulation of metabolites with direct impact on boll weight. These results are in accordance with those outlined by Hamoda *et al.,* (2014), Elhamamsey *et al.,* (2016) and

Emara and Abdel-Aal (2017). Data in Table (3) indicate that the interaction between planting dates and rates of nitrogen and potassium fertilization had significant effect on number of bolls/plant, boll weight, seed index and seed cotton yield/feddan while had insignificant effect on lint % in both season. Early planting and the rate 100% N+K gave high number of bolls/plant, boll weight and seed cotton yield/feddan as compared with the other treatments.

Data in Table (5) shown that effect of planting dates, rates of nitrogen and potassium fertilization and its interaction of cotton during 2018 and 2019 seasons on fiber parameters (upper half mean length, uniformity index, fiber strength and micronaire reading). The results in Table (4) indicate that planting dates had significant effect on fiber properties while, rates of nitrogen and potassium fertilization and the interaction between factors did not exhibit any significant effect on fiber properties under study in both seasons. This may be attributed to the realization that these characteristics were less affected by the environmental factors. These results are in accordance with those outlined by Elhamamsey *et al.,* (2016) and Emara *et al.,* (2016).

Table (5): Effect of planting dates, rates of nitrogen and potassium fertilization and its interaction on fiber properties yield and its components of cotton during 2018 and 2019 seasons.

Treatments		Upper half mean		Uniformity index		Fiber strength (Presley units)		Micronaire reading	
Planting dates (A)	Rates of N+K fertilization (B)	2018	2019	2018	2019	2018	2019	2018	2019
Early	125% N+K	36.90	36.87	88.62	88.70	12.27	11.99	4.20	4.23
	100% N+K	37.00	37.23	88.75	88.70	12.65	12.04	4.25	4.27
	75% N+K	36.54	36.60	87.78	87.93	12.35	11.92	4.15	4.37
	50% N+K	36.25	36.10	87.70	87.73	12.25	11.70	4.13	4.10
Mean early sowing		36.67	36.70	88.21	88.27	12.38	11.91	4.18	4.24
Late	125% N+K	35.94	35.70	87.45	87.13	11.50	11.98	4.12	4.10
	100% N+K	36.00	35.53	87.10	86.93	11.60	11.78	3.98	3.87
	75% N+K	35.54	35.30	86.65	86.40	11.75	11.79	3.92	4.07
	50% N+K	35.48	34.63	86.14	86.37	11.47	11.52	3.87	4.03
Mean late sowing		35.74	35.29	86.84	86.71	11.58	11.77	3.97	4.02
General means of rates of N+K fertilization (B)	125% N+K	36.42	36.29	88.04	87.92	11.89	11.99	4.16	4.17
	100% N+K	36.50	36.38	87.93	87.82	12.13	11.91	4.12	4.07
	75% N+K	36.04	35.95	87.22	87.17	12.05	11.86	4.04	4.22
	50% N+K	35.87	35.37	86.92	87.05	11.86	11.61	4.00	4.07
F test for	A	*	*	**	**	*	*	*	*
L.S.D. at 5% for	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 recommendations package, which seemed to be useful for increasing the cotton yield production and the best fiber quality. It could be concluded the early planting in combination with the rate 100% N+K fertilizer (60 kg N/fad and 24kg/fed.) obtaining the high productivity of Egyptian cotton (Giza 96).

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تأثير مواعيد الزراعة ومعدلات التسميد النتروجينى والبوتاسى على نمو وانتاجية صنف القطن جيزة 96

الدسوقى الدسوقى دشيش، سعيد عبد التواب فرج حمودة، عزة عبد السلام الهنداوى

قسم المعاملات الزراعيه – معهد بحوث القطن – مركز البحوث الزراعية – الجيزة – مصر

الملخص العربي

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بسخا، محافظة كفر الشيخ خلال موسمي النمو 2018 و2019 وذلك بهدف دراسة تاثير مواعيد الزراعه ومعدلات التسميد النتروجينى والبوتاسى وتاثيرهم علي نمو وإنتاجية صنف القطن جيزة 96 لاعداد التوصيات الفنيه له وقد أجريت التجربة باستخدام تصميم القطع المنشقة مرة واحدة فى أربع مكررات حيث وضعت مواعيد الزراعة (المبكرة 15 أبريل، المتأخرة 15 مايو) فى القطع الرئيسية في حين وضع معدلات التسميد الازوتي والبوتاسي في القطع الشقية وكان كالاتي: (125 % ، 100% ، 75% و50 % من الموصي به من الازوت والبوتاسيوم (الموصى به 60 كجم نتروجين +24 كجم بوتاسيوم/فدان) وتتلخص أهم النتائج المتحصل عليها فيما يلى:

1- **اثرت مواعيد الزراعة معنويا على صفات النمو ومحصول القطن الزهر ومكوناته وصفات التيله حيث اعطت الزراعه المبكره زيادة معنويه لعدد الافرع الثمرية، عدد اللوز / نبات، وزن اللوزه و محصول القطن الزهر/ فدان كما اعطت افضل القيم لصفات التيله.**
2- **اثرت معدلات التسميد النتروجينى والبوتاسى معنويا على صفات النمو والمحصول ومكوناته بينما لم توثر معنويا على صفات التيله حيث اعطى المعدل 100% من النتروجين والبوتاسيوم (60 كجم نتروجين/ فدان + 24 كجم بوتاسيوم / فدان) زيادة معنوية فى صفات عدد الافرع الثمرية، عدد اللوز/ نبات، وزن اللوزه و محصول القطن الزهر / فدان.**
3- **أعطى التفاعل بين مواعيد الزراعه ومعدلات التسميد الازوتى والبوتاسى تاثير معنوى على صفات النمو والمحصول ومكوناته بينما لم يوثر معنويا على صفات التيله وعموماً فان الزراعة المبكرة مع التسميد بالمعدل 100% من النتروجين والبوتاسيوم (60 كجم نتروجين/ فدان + 24 كجم بوتاسيوم/ فدان) ادى لزيادة معنويه فى عدد الافرع الثمرية، عدد اللوز / نبات، وزن اللوزه و محصول القطن الزهر / فدان واعطى اعلى انتاجيه لصنف القطن المصرى جيزه 96.**

السادة المحكمين

أ.د/ وجدى محمد عمر عمران مركز البحوث الزراعية

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