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EFFECT OF POTASSIUM FERTILIZATION UNDER TWO PLANTING DATES ON YIELD, YIELD COMPONENTS AND SOME TECHNOLOGICAL AND CHEMICAL PROPERTIES OF GIZA 80 COTTON CULTIVAR

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Abstract

Two field experiments were carried out at Sids Agricultural Research Station, during 1996 and 1997 seasons, to study the effect of two planting dates (March, 15th and April, 15th) and three levels of potassium fertilizer (0,24 and 48 kg K_2O/fed) on yield components, and quality of fiber and seed.

The resuls revealed that early planting increased number of fruiting branches/plant, nuumber of total and open bolls/plant, seed cotton yield, fiber fineness and fiber strength, but it decreased plant height and position of first fruiting node and earliness percentage. On the other hand, it had no effect on boll weight, seed index, lint percentage, oil and protein percentages in cotton seeds.

Potassium application increased number of fruiting branches/plant, number of total and open bolls/plant, boll weight, seed cotton yield, earliness percentage, lint percentage, seed index, micronaire reading, Pressley index, oil and protein percentages, while it deceased the position of first fruiting node.

The level of 24 kg K_2O/fed., is considered to be suitable amount for cotton production under the conditions of the experiment. The interaction did not exert any significant effect on all characters under study.

INTRODUCTION

Sowing date is considered the most important factor among the different factors which influence growth and yield of cotton. In Egypt, many investigations showed that early sowing had a favourable effect on yield of seed cotton compared with late sowing. Also, many workers studied the effect of sowing date on cotton plant such as Shalaby and Shaker (1980) and Shafshak *et al.*, (1987), who found that the yield and its components increased in early planting. Regarding the growth of cotton plant, Yassen (1986) and Abdel-Rahman (1989) mentioned that number of fruiting branches, number of open bolls/plant, boll weight, lint percentage and seed index gradually decreased from early to late sowing. Concerning the fiber quality, Shalaby and Shaker

(1980), and Shafshak *et al.,* (1987), reported that fiber fineness and fiber strength increased in early cotton planting. However, Nagib (1990), reported that fiber fineness and fiber strength were not affected by sowing dates

Potassium is one of the most important elements in plant nutrition, its effect on; enzyme activation, water relation, energy relations, translocation of assimilates nitrogen uptake, protein and starch synthesis. Meanwhile many workers studied the effect of potassium application,(Darwish 1991, Abdel-Aal *et al.* 1995, Abdel-Aal *et al.* 1995, Abou-Zaid *et al.* 1997 and Hegazy and Genaidy, 1998), observed positive response of cotton plants to potassium application.

The aim of this investigation is to study the effect of two planting dates and potassium fertilization rates on yield and yield components, some fiber properties and some chemical constituents of Giza 80 Egyptian cotton cuultivar.

MATERIALS AND METHODS

Two field experiments were conducted at Sids Agricultural Research Station (Beni-suef Governorate) at two successive seasons (1996 and 1997).

Mechaincal and chemical analysis of the experimental soil is shown in Table 1. The experimental plot was 4x3 meters, contained five ridges (4 m, long and 60 cm, width) with a distance of 20 cm between hills and 8-10 seeds per hill, thinned to two seedlings. Each experiment was arranged in split plot design with four replicates, where planting date was allocated in main plots and potassium levels represented the subplots. The first planting date was on March, 15^{th}, while the second planting date was on April, 15^{th}, during the two studied seasons. All normal cultural practices were followed as recommended for cotton production. Potassium fertilizer was added in three rates, zero, 24 and 48 kg K_2O/fed., as potassiuum sulphate (48% K_2O), after thinning in one dose. In order to estimate growth and yield, five hills were chosen randomly from each plot and the following characters were recorded at harvest stage (before first picking):

1. Growth characters: Plant height (cm), position of first fruiting node, and number of fruiting branches/plant (sympodial branches).

2. Yield and Yield components: Number of total and open bolls/plant, bolls weight (gm), it means (seed cotton yield /boll) (gm), seed index (gm.), it means weight of 100 seeds (gm), seed cotton yield / feddan in Kentars (Kentar=157.5 kg), and lint percentage.

Table 1. Mechanical and chemical analysis of the experimental soil before sowing.

components	1996	1997
Mechanical analysis		
Coarse sand %	0.80	0.50
Fine sand %	14.16	8.47
Silt %	24.86	28.90
Clay %	60.18	62.13
Textural class	clay	clay
Chemical analysis		
Organic matter %	1.32	1.71
available nitrogen (ppm)	33.10	21.70
available phosphorus (ppm)	5.80	9.00
available potassium (ppm)	203	214.0
$CaCO_3$	2.91	2.27
E.C. (mmhors/cm at 25°C)	0.55	0.68
pH	7.80	7.70

3.Technological properties: Fiber fineness (micronaire reading) and fiber strength (Pressley index) were carried out at the laboratories of the Cotton Technology Research Division, Cotton research institute, Agricultural research center, Giza, Egypt. The test were carried out according to A.S.T.M., (1975). at constant relative humidity of 65±1 °C

4. Seed quality: Oil and protein percentages in seeds were determined according to Chapman and Pratt method (1961) and A.O.A.C. (1970), respectively. Statistical analysis was carried out according to Snedecor and Cochran (1981). Mean copmarison was carried out using L.S.D. at 5%.

RESULTS AND DISCUSSION

1. Growth characters:

Plant height (cm):

The results in Table 2 reveal that plant height was significantly affected by planting date only in the second eason, 1997. However, late sowing date produced taller plants compared with early sowing in both seasons. This increase could be due to hgih air and soil temperature during sowing date. These results are in agreement with those obtained by Nagib (1990), who reported that delaying sowing date increased plant height. Concerning the effect of potassium, the data showed insignificant increase during the two studied seasons. These results might be an indication that potassium increment had little effect on vegetative growth, which are in agreement with those ob-

tained by Abou-Zeid *et al.*, (1997). For the interaction, data in Table 2, showed insignificant effect on plant height in both seasons. This, result indicated that the rate of increase of plant height was the same for both treatments.

Position of first fruiting branch:

It is clear from the results in Table 2, that the position of first fruuiting branch was significantly affected by date of sowing only in 1997 season and by potassium levels in both seasons. The effect was confirmed during the two studied seasons where plants sown at early date showed their position of first fruiting branch at a lower node than that of late sowing date. This effect may be due to the balance between vegetative and fruiting growth, which occurred under the early sowing date. These resultts are in harmony with those obtained by Nagib (1990), who found that early sowing had a lowest node of first sympodial branch .

Potassium application tended to decrease the position of first fruiting node where lower nodes were obtained for fertilized plants. This effect might be an indication that potassium increased the potentiality of fruiting organs. These results are in the same line with those obtained by Abou-Zeid *et al.* (1997).

Number of fruiting branches/plant:

Results in Table 2 revealed that number of fruiting branches /plant was significantly affected by sowing date and potassiuum levels in both seasons . The highest number of fruiting branches/plant was obtained from plant sown at early date. These results indicated that early planting induced fruiting growth, while delaying the sowing date enhanced the vegetative growth. On the other hand, data cleared that there was a positive relation between "K" levels and number of fruiting branchs/plant, where the highest number of fruiting branches/plant was obtained at the highest level of potassium (48 kg K_2O/fed.). The previous results might be an indication that potassium increased the potentiality of the growth fruiting capacity which reflected on this character. These results are in agreement with those reported by Abou-Zeid *et al.*, (1997).

All growth characters were not affected significantly by the interaction between planting date and potassium application.

2. Yield and yield components:

Number of total and open bolls/plant :

Data in Table 3 cleared that nuumber of total and open bolls/plant significantly increasd in early planting in both seasons. This increase may be attributed to the long

Table 2. Effect of planting date and potassium fertilizer on some growth characters of Giza 80 cotton cultivar.

Planting date	K_2O	Plant height (cm)		Position of first fruiting node		No. of fruiting banches/plant	
		1996	1997	1996	1997	1996	1997
March 15th	0	91.3	92.87	9.2	9.5	10.1	11.3
	24	94.0	93.5	8.4	9.0	11.1	13.8
	48	96.3	95.7	8.5	9.3	12.0	14.8
Mean		93.2	94.0	8.7	9.3	11.0	13.3
April 15th	0	95.3	117.3	9.5	10.3	9.7	10.3
	24	97.0	120.0	8.5	9.6	10.6	12.3
	48	102.3	122.5	8.8	9.8	11.0	12.5
Mean		98.2	119.9	8.9	9.9	10.4	11.7
Means of	0	93.3	105.1	9.4	9.9	9.9	10.8
potassium	24	95.5	106.8	8.5	9.3	10.9	13.1
levels	48	99.5	109.1	8.6	9.6	11.5	13.7
L.S.D.at 0.05							
Planting date	A	N.S.	10.51	N.S.	0.37	0.41	1.08
"k" level	B	N.S.	N.S.	0.3	0.56	0.57	1.36
"p" x "k"	AxB	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

period of vegetative growth which has been achieved by early planting and consequently enhances boll formation and maturation. These results are in agreement with those obtained by Shalaby and Saker (1980) and Abou-Zied *et al.*, (1997).

Regarding the effect of potassiuum levels, it could be noticed that the application of potassium up to 48 kg K_2O/fed., significantly increased number of total and open bolls /plant where the highest number was obtained at the highest level of potassiuum (48 kg K_2O/fed.), as compared with the lowest level of potassium (control treatment). These results could be due to the role of K_2O which affects respiration and carbohyrate metabolism, and association with protein synthesis and water relation in plant (Champman and Pratt, 1961). Similar results were obtined Abou-Zeid *et al.* (1997), who reported that potassium application increased number of total and open bolls/plant.

Boll weight (gm)

Boll weight showed significat increase during the two studied seasons as a result of the use different levels of potassium (Table 3). Plants reccived 48 kg K_2O/fed., produced heavier bolls when compared with the control plants in both seasons. The same trend was obtained by Abou-Zeid *et al.* (1997), who reported that "K" application had a significant effect on boll weight. Table (1) clears that the amount of available potassium in the soil was not enough to provide cotton plants by their requirements from this element. Therefore, soil application of potassium fertilizer is expected to impact a positive response to the cotton plant uptake of this element which increased the boll weight. At the same time no significant differences were obtained in boll weight as a result of planting date, but early planting produced heavier bolls as compared with late planting. These results are in agreement with the work previously reviewed of El-Akkad *et al.*, (1981) and Shafshak *et al.*, (1987). The data also showed that, the interaction had no significant effect on boll weight.

Seed index (gm)

Data in Table 3 revealed that date of sowing hd no effect on seed index in both seasons. However, late sowing data tended to produce heavier seeds. In this respect Hammouuda (1984), stated that late sowing produced heavier seeds.

For the potassium levels. it appears that K level of 48 kg K_2O/fed. decreased significantly seed index as compared to check plant. The results might be due to the fact that potassium enhanced seed formation and maturation of cotton fiber and subsequently decreased seed weight. Also, Abou-Zeid *et al.*, (1997), reported that potassium application had significant effect on seed index. The interaction data showed insignificant effect on seed index.

Seed cotton yield

Results of seed cotton yield, Table 4, show that planting date had significant effect on seed cotton yield where, the earlier planting surpassed the later one. The percentages of the increase of seed cotton yield owing to early planting date were 10.47 and 10.68% for first and second seasons, reapectively. This increase might be due to the effect of early planting date on increasing both number of total and open bolls/plant and boll weight. The same trend was obtained by Shafshak *et al.*, (1987) and Nagib (1990). Concerning potassium rates, data in Table 4, revealed that increasing potassium rates significantly increased seed cotton yield compared with control treatment. The highest value of seed cotton yieled was obtained when plants received 48 kg K_2O/fed. The percentage of increase reached 18.8 and 15.26% when the Plants

Table 3. Effect of planting date and potassium fertilizer on yield components of Giza 80 cotton plants cultivar.

Planting date	K_2O	No. of total bolls/pant		No. of open bolls/pant		Boll weight (gm)		Seed index (gm)	
		1996	1997	1996	1997	1996	1997	1996	1997
March 15 th	0	12.9	15.2	10.4	12.4	2.69	2.98	11.80	9.80
	24	13.6	17.3	12.2	14.2	2.85	3.29	11.62	9.50
	48	15.0	18.3	13.5	15.6	3.00	3.43	11.20	9.30
Mean		13.8	16.9	12.4	14.1	2.85	3.23	11.81	9.47
April 15 th	0	11.1	12.8	9.9	10.2	2.56	2.90	11.95	10.40
	24	12.5	14.7	11.5	12.2	2.81	3.23	11.67	9.90
	48	13.3	15.7	12.4	13.7	2.91	3.32	11.52	9.70
Mean		12.3	14.4	11.6	12.0	2.76	3.16	11.71	10.00
Means of	0	12.0	14.5	10.4	11.4	2.63	2.94	11.8	10.10
potassium	24	13.1	16.5	12.9	13.2	2.83	3.26	11.65	9.70
levels	48	14.1	17.5	13.4	14.7	2.96	3.37	11.36	9.50
L.S.D.at 0.05									
Planting date	A	0.74	1.35	0.47	0.65	N.S.	N.S.	N.S.	N.S.
"k" level	B	0.84	1.83	1.86	1.17	0.11	0.13	0.30	0.23
"p" x "k"	AxB	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

were sown on March 15th and April 15th, respectively. The differences of seed cotton yield obtatined among plants received 24 kg K_2O/fed., or 48 kg K_2O/fed., were not significant. Therefore, 24 kg K_2O/fed., is considered to be the best rate for seed cotton yield production . Increasing seed cotton yield as affected by 24 kg K_2O/fed., application may be attributed to positive effect of potassium on increasing the fruiting capacity of the cotton plant especially when accompanied with lower soil content of available potassium Table 1. These results are in line with those obtained by Abdel-Aal *et al.* (1995) and Abou-Zeid *et al.* (1997). Data also showed that the interaction between sowing date and postassium application had on effect on this character in both seasons. In general, the highest seed cotton yield was obtained from plants sown at early date and received 48 kg K_2O/fed.

Table 4. Effect of planting date and potassium fertilizer on yield and lint percentage of Giza 80 cotton plants cultivar.

Planting date	K_2O	Seed cotton yield (ken/fed)		Lint percentage %	
		1996	1997	1996	1997
March 15th	0	10.28	10.68	38.25	39.70
	24	11.69	11.88	39.50	41.10
	48	12.19	12.28	39.77	41.37
Mean		11.39	11.61	39.17	40.54
April 15th	0	9.27	9.63	37.60	39.03
	24	10.64	10.69	38.40	40.17
	48	11.04	11.14	38.62	40.53
Mean		10.31	10.49	38.21	39.91
Means of	0	9.78	10.16	37.92	39.36
potassium	24	11.17	11.29	38.90	38.95
levels	48	11.62	11.71	39.19	40.95
L.S.D.at 0.05					
Planting date	A	0.56	0.96	N.S.	N.S.
"k" level	B	0.90	1.08	0.78	0.30
"p" x "k"	AxB	N.S.	N.S.	N.S.	N.S.

Lint percentage

Data in Table 4 clear that lint percentage was significantly affected by potassium application where, the highest value was obtained from the highest rate 48 kg K_2O/fed., in both seasons. These results are in agreement with data obtained by Gamalat *et al.* (1994).

3. Technological properties:

It is clear from Table 5, that fiber properties (micronaire and Pressley), were significantly affected by planting date in both seasons. These fiber properties tended to increase in early planting date when compared with late one. This increase could be due to the fact that early planting help the fibers to have high maturity. These results are in agreement with those obtained by Shalaby and saker (1980) and Shafshak *et al.* (1987).

Table 5. Effect of planting date and potassium fertilizer on fiber fineness, fiber strength, oil percentage and protein percentage of Giza 80 cotton plants cultivar.

Planting date	K_2O	Micronaire Value		Pressley Index		Oil percentage		Protein percentage	
		1996	1997	1996	1997	1996	1997	1996	1997
March 15th	0	4.7	4.8	9.5	9.4	20.30	20.45	28.52	28.73
	24	4.8	4.9	9.7	9.6	20.80	20.89	28.65	28.83
	48	4.8	4.9	9.9	9.8	20.89	20.98	28.80	28.97
Mean		4.8	4.9	9.7	9.6	20.66	20.77	28.65	28.84
April 15th	0	4.4	4.4	9.3	9.2	19.76	19.94	28.44	28.63
	24	4.5	4.6	9.5	9.5	20.28	20.39	28.58	28.75
	48	4.6	4.5	9.4	9.3	20.47	20.77	28.68	28.88
Mean		4.5	4.5	9.4	9.3	20.17	20.36	28.56	28.75
Means of	0	4.5	4.6	9.4	9.3	20.03	20.19	28.48	28.68
potassium	24	4.6	4.6	9.6	9.5	20.36	20.69	28.62	28.79
levels	48	4.7	4.7	9.6	9.5	20.45	20.87	28.74	28.92
L.S.D.at 0.05									
Planting date	A	0.21	0.31	0.26	0.26	N.S.	N.S.	N.S.	N.S.
"k" level	B	N.S.	N.S.	N.S.	N.S.	0.25	0.32	0.06	N.S.
"p" x "k"	AxB	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Also, data from Table 5, show that there was no significant effect of pottassiuum application on fiber quality i.e. micronaire value or Prssley index in both seasons. In this respect Kamprath *et al.*, (1968), Silvertoth *et al.* (1992), and Gamalat *et al.* (1994), reported that increasing potassium fertitizer had no influence on lint properties.

4. Seed quality characters:

Oil percentage in cotton seeds was not affected by pinting date in both seasons, but there was slight increase in favour of early planting date, as shown in Table 5. These results are expected, since early planting gives these components a good chance to complete their fromation.

Also the results in Table 5, show that potassium treatments exerted a significant effect on seed oil percentage in both seasons. The highest values were obtained from plant received the highest K rate. Madrainove (1984), found that seed oil content was increased with increasing K rate from zere to 150 kg K_2O/ha.

Concerning protein content in cotton seeds, Data in Table 5 show that protein in cotton seeds was significantly affected by K treatment in the first season only.

For the effect of date of sowing and the interaction between K levels and date of sowing, results showed insignificant effect on oil and protein in cotton seeds.

In general applying potassium up to 48 kg K_2O/fed., tended to increase slightly oil and protein percentage that untreated plants (control). The maximum values were obtained from plants fertilized with 48 kg K_2O/fed. This might be due to the direct role of such element on protein synthesis. Azab *et al.* (1993), obtained similar results.

Therefore, it could be concluded that potassium fertilizer gave the highest yield and yield components when it was applied at early sowing date while, the reverse was true for the late sowing date.

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تأثير التسميد البوتاسى تحت موعدين للزراعة على بعض صفات المحصول ومكوناته وبعض الصفات التكنولوجية والكيميائية لصنف القطن جيزة ٨٠

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أقيمت تجربتان حقليتان بالمزرعة البحثية لمحطة البحوث الزراعية بسدس بمحافظة بنى سويف فى موسمى ١٩٩٦، ١٩٩٧ بهدف دراسة تأثير كلا من موعدين للزراعة (١٥ مارس ، ١٥ أبريل) مع ثلاثة مستويات للتسميد البوتاسى (صفر ، ٢٤ ، ٤٨ كجم بو٢أ / فدان).

أوضحت النتائج أن الزراعة المبكرة شجعت على زيادة كلاً من عدد الأفرع الثمرية ، وعدد اللوز الكلى والمتفتح على النبات ، ومحصول القطن الزهر بالقنطار / فدان ، وصفات التيلة من متانة ونعومة ، كما أدت إلى إنخفاض موقع أول فرع ثمرى ، بينما ، لم يتأثر معنوياً كلا من وزن اللوزة ، ومعامل البذرة ، وصافى الحليج ،ونسبة الزيت والبروتين فى بذرة القطن .

كما أوضحت النتائج أيضا أن التسميد البوتاسى كان له أثر واضح فى زيادة كلا من عدد الافرع الثمرية ، وعدد اللوز الكلى والمتفتح ، ومتوسط وزن اللوزة ، ومعامل البذرة ، ومحصول القطن الزهر ، ونسبة التبكير ، وصافى الحليج ، ونسبة الزيت والبروتين فى البذرة ، ولم يؤثر معنوياً على صفات تيلة القطن . ولقد أوضحت النتائج أن معدل ٢٤ كجم بو٢أ / فدان هو أنسب معدل مناسب للتسميد البوتاسى للحصول على أعلى محصول من القطن الزهر فى كلا موعدى الزراعة تحت ظروف التجربة.