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Effectiveness of Organic and Inorganic Fertilization in Presence of Some Growth Regulators on Productivity and Quality of Egyptian Cotton

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ABSTRACT

Two separate field experiments were conducted during 2010 and 2011 seasons, at the Research and Experimental Center of the Faculty of Agriculture at Moshtohor, Benha University, Kalubia Governorate, Egypt. The aim to study the effect of organic manure (sheep manure compost) alone or combined with mineral nitrogen fertilizer in the form ammonium nitrate 33.5%N and foliar application with Kinetin (a synthetic cytokinin 5 ppm) or Gibberellic acid (GA_3 100 ppm) alone or mixture sprayed once at the squaring stage on growth attributes, yield and chemical composition of seeds as well as fiber quality of Egyptian cotton (*Gossypium barbadense* L.) Giza 86 cotton cultivar. Each experiment included 12 treatments in every season. A Completely Randomized Block Design (CRBD) with four replicate was used in both seasons. The results could be summarized as follows: The highest ammonifying and nitrifying bacteria counts were in case of sheep manure compost+ammonium nitrate application at a rate of 30 kg N fed^{-1} from each of them and sprayed with kinetin treatment. The application of sheep manure compost at rate of 30 kg N fed^{-1} combined with 30 kg N fed^{-1} mineral and sprayed by kinetin gave the highest values and significantly increased growth characters, yield and yield components, chemical composition of cotton seeds and fiber quality in both seasons. It can be concluded that the application of sheep manure compost at rate of 30 kg N fed^{-1} combined with 30 kg N fed^{-1} mineral and sprayed by kinetin may be the recommended treatment to improve the productivity of Egyptian cotton (Giza 86 variety), under the conditions of the present study.

Key words: Organic manure (sheep manure compost), mineral nitrogen, gibberellic acid, kinetin, growth, yield components, fiber quality, Egyptian cotton

INTRODUCTION

Egyptian cotton (*Gossypium barbadense* L.) is the most important commercial fiber crop in Egypt. Cotton plays a key role in the economic activity. It is the oldest among the commercial crops and is regarded as white gold. Egyptian cotton is preferred around the world because it is long fiber cotton that makes it softer and stronger at the same time. Cotton seed meal is the product remaining once the oil has been removed from seeds and can be contain up to 41% protein (Smith, 1995). Cotton seed meal is used in food products for animal feed due to its high protein and energetic values. So, it is necessary to increase cotton cultivation area and productivity. Cotton is not only the most important fiber crops of the world but also the second best source for plant proteins after soybean and the oil ranking fifth in the world use among edible oils (Sawan *et al*., 2006).

Soil in the Delta and the Nile Valley in Egypt are poor in organic matter and other elements after building the High-dam. Recently, the content of total and soluble nitrogen in the soil ranged between 0.07-0.11% or 13-25 ppm. These values are fairly low (Hamissa and Abdel-Salam, 1999). Therefore, the Egyptian farmers provide the soil by mineral nitrogen. This performance causes on environmental pollution especially under the high ground water due to excessive of leaching of nitrates (Ambergerig, 1993). Furthermore, the aim of this study was minimize mineral nitrogen fertilizer by substituting other sources of nitrogen fertilizer such as organic manure. The physical improvements of applying organic fertilizers to the soil were favourable soil aggregation, buffering against low pH, slow and balanced soil mineralization, favourable water transmission potentials and resistance to erosion. Amendment the soil with organic manures improves their physical, chemical and biological properties and hence the availability of plant nutrients. With regard to organic fertilization and on the way of safe agriculture with minimum pollution effects, the use of natural materials such as organic manures is recommended to substitute the chemical fertilizers. Adeniyan and Ojeniyi (2005) stated that the application of 300 kg ha^{-1} NPK, 7 t ha^{-1} poultry manure and six combinations of reduced level of NPK showed that maize performed better when organic and mineral fertilizers were combined at a reduced quantity. Application of combined use of Organic Based Fertilizer (OBF) and urea at 2 t ha^{-1} OBF and 90 kg ha^{-1} urea was more superior to application of either of the fertilizer alone. Ayeni *et al.* (2008) and Ayeni and Adetunji (2010) indicated that the combined effect of cow dung, poultry manure and swine manure with mineral fertilizers on soil chemical properties. Application of organic manure and nitrogen fertilizers are main factors, which govern the balance between different vegetative and fruiting stage of cotton plant and consequently affected growth, yield, its components and lint quality properties (Battisha, 1998; El-Shazly and El-Masri, 2002; El-Tabbakh, 2002; Yaduvanshi, 2003; Das *et al.*, 2004; Al-Kahal *et al.*, 2007; Attia *et al.*, 2008; Gebaly, 2011).

With regard to the cotton plants grown in fertile soil, well watered and suitable environment produces excessive vegetative growth. Excessive growth reduces seed cotton yields and encourages attach of insect-pests. Sawan *et al.* (2000) indicated that number of fruiting branches $plant^{-1}$ and number of open bolls $plant^{-1}$ were significantly increased by application of kinetin. Kassem *et al.* (2009) show that No. of fruiting branches $plant^{-1}$, No. of open bolls $plant^{-1}$, seed cotton yield fed^{-1}, leaves content of chlorophyll a, b, a+b and carotene were significantly increased by application of kinetin. Abdel Aal *et al.* (2011) reported that significant increase in total dry weight $plant^{-1}$, number of open bolls $plant^{-1}$, boll weight, seed index and seed cotton yield fed^{-1} due to foliar application of pix at the rate of 1 ml L^{-1} twice at start of flowering and 30 days later compared to untreated plants which produced the lowest values in the two seasons. Gebaly (2011) found that the application of sheep manures at rate of 30 kg N fed^{-1} combined with 30 kg N fed^{-1} mineral and sprayed by kinetin gave the highest some growth characters, seed cotton yield, yield components, chemical composition of leaf and cotton seed in both seasons.

For the aforementioned problems, this investigation was carried out to study effect of organic manure (sheep manure compost) alone or combined with mineral nitrogen fertilizer and foliar application with Kinetin (K) or Gibberellic acid (GA_3) alone or mixture on growth attributes, yield and chemical composition of seeds as well as fiber quality in variety Giza 86.

MATERIALS AND METHODS

Two field experiments were carried out in the Agricultural Research and Experimental Center, Faculty of Agriculture at Moshtohor, Kalubia Governorate, Benha University, during 2010 and

2011 seasons to study the effect of organic manure (sheep manure compost) alone or combined with mineral nitrogen fertilizer in the form ammonium nitrate 33.5% N and foliar application with Kinetin (a synthetic cytokinin 5 ppm) or Gibberellic acid (GA_3 100 ppm) alone or mixture sprayed once at the squaring stage on growth attributes, yield and chemical composition of seeds as well as fiber quality of Egyptian cotton (*Gossypium barbadense* L.) Giza 86 cotton cultivar. The experiments were laid out in a clay soil, its physical and chemical properties are shown in Table 1. Particle size distribution was estimated according to Jackson (1973). While, chemical analysis was determined according to Black *et al.* (1982). Each experiment included 12 treatments in every season which are follows:

- 60 kg N fed^{-1} mineral the recommended N rate
- 60 kg N fed^{-1} mineral+gibberellic acid
- 60 kg N fed^{-1} mineral+kinetin
- 60 kg N fed^{-1} mineral+gibberellic acid+Kinetin
- 60 kg N fed^{-1} organic in the form sheep manure compost
- 60 kg N fed^{-1} organic+gibberellic acid
- 60 kg N fed^{-1} organic+kinetin
- 60 kg N fed^{-1} organic+gibberellic acid+kinetin
- 30 kg mineral+30 kg organic
- 30 kg mineral+30 kg organic+gibberellic acid
- 30 kg mineral+30 kg organic+kinetin
- 30 kg mineral+30 kg organic+gibberellic acid+kinetin

A Completely Randomized Block Design (SRBD) with four replicate was used in both seasons. Plot area was 10.5 m^2 (5 ridges, 3.5 m long and 60 cm a part). Distance between hills was 25 cm leaving two plants $hill^{-1}$ at thinning time (after five weeks from sowing). The previous crop was Egyptian clover in both seasons. Cotton seeds were sown according to the usual dry method on 19th and 18th April in 2010 and 2011 seasons, respectively. Sheep manure compost was produced by the sheep hold in the Faculty and prepared as traditionally done by the farmers. The chemical analysis of sheep manure compost is shown in Table 2. The organic manure (sheep manure

Table 1: Mechanical and chemical analysis of the experimental sites during 2010 and 2011 seasons

	Season	
Soil characteristics	2010	2011
Mechanical analysis		
Coarse sand (%)	5.40	5.70
Fine sand(%)	17.30	18.50
Silt (%)	25.60	24.20
Clay (%)	51.70	51.60
Texture	Clay	Clay
Chemical analysis		
PH (1:2.5 suspension)	8.14	8.23
OM (%)	1.99	2.05
Total N (%)	0.112	0.125
Total P (%)	0.211	0.213
Total K (%)	0.632	0.635
EC (dSm-1)	1.81	1.80

Table 2: Some characteristics of the farm yard manure (sheep manure compost) used in the study

	Season	
Characteristic	2010	2011
Moisture (%)	30.50	30.10
Organic matter (%)	34.60	35.28
Organic carbon (%)	16.99	16.90
pH (1:5)	8.11	8.08
EC (1:5)	4.85	4.62
Total N (%)	1.95	1.99
Total P (%)	0.52	0.58
Total K (%)	0.92	0.96
C/N ratio	17:1	16:1

compost) and calcium super phosphate (15.5% P_2O_5 at the rate of 150 kg fed^{-1}) were applied in the soil before sowing seed cotton. Nitrogen fertilizer rates were applied in two equal doses, immediately before the first and the second irrigations. The other normal agricultural practices of growing cotton were kept the same as practice in the area as recommended by Ministry of Agriculture.

Preparation of sheep manure compost: Cotton stalks and sheep manure were used as raw material for compost production, compost heaps were constructed by building several layers of shredded cotton stalks one over the other in an area of 1.25×1.25 m^2. Approximately equal parts of the air dried sheep manure were distributed on the surface of each layer and moistened either with water or diluted culture of *Phanerochaete chrysosporium* (inoculum) and moisture was maintained at 60% for 20 weeks.

Preparation of inoculum: Effective fungal strain of *P. chrysosporium* was obtained from Department of Microbiology, Faculty of Agriculture, Fayoum University, Egypt. The fungal strain *P. chrysosporium* was grown on Potato Dextrose Agar (PDA) (DIFCO Manual, 1976) for 7 days at 39°C before inoculation. Spore suspensions were prepared by washing the agar surface with 10 mL sodium acetate buffer (50 mM pH 4.5) and 0.1% tween 80. Fungal spores were resuspended in the same volume of water and diluted with water to the ratio of 1:50 (v:v) for compost heaps inoculation.

Studied characters

Microbiological analysis: After 40, 70 and 100 days from sowing, rhizosphere soil samples of the developed plants were taken. Soil samples were microbiologically analyzed:

- Ammonifying bacteria were counted by using the medium described by Allen (1959)
- Nitrifying bacteria were counted by using the medium described by Black *et al.* (1982)

Growth characters: Three samples were taken from each experimental plot at 90, 120 and 150 days after sowing to study the growth attributes. Each sample included four plants of two guarded hills of the middle rows and carefully uprooted and was immediately transferred to the laboratory to determine the following growth attributes:

- Dry weight plant^{-1} (g)
- Leaf area plant^{-1}(LA), the disc method was used according to Johnson (1967)

$$\text{LA plant}^{-1}\ (\text{dm}^2) = \frac{\text{Leaf dry weight plant}^{-1} \times \text{disc area}}{\text{Disc dry weight}}$$

- Leaf Area Index (LAI) was calculated as follows:

$$\text{LAI} = \frac{\text{Leaf area plant}^{-1}}{\text{Plant ground area}}$$

Yield and yield components: At harvest, ten guarded plants from each experimental unit were chosen randomly taken the central row and the following traits were estimated plant height (cm), No. of fruiting branches plant^{-1}, No. of open bolls plant^{-1}, boll weight (g), seed index(g), lint (%) and seed cotton yield plant^{-1} (g). Seed cotton yield (kentar fed^{-1}) was estimated as the weight of seed cotton yield (kg) picked from the three middle rows in each experimental unit collected from two picks, then converted to yield fed^{-1} in kentar (1 Kentar = 157.5 kg seed cotton).

Chemical analysis: Leaves content of chlorophylls, samples of the upper fourth leaves were collected at 20 days after the spraying of growth regulators to determine leaves content of chlorophyll a, b and a+b as well as carotenoids (AOAC, 1990).

Oil and protein percentage were determined in the seeds by the method described by AOAC (1990).

Technological characters of fiber: Samples of lint were collected from each treatment at each replicate to determine the following characters at the laboratories of Cotton Research Institute, ARC, under standard conditions of test:

- Fiber fineness (micronaire reading), it was determined by Micronaire Instrument as reported by ASTM (1986)
- Fiber strength (Pressley index), it was determined by Pressley Instrument as reported by ASTM (1986)

Statistical analysis: All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the completely randomized plot design (Gomez and Gomez, 1984), by means of MSTAT-C Computer software package (Michigan State University, 1983). LSD test at 0.05 level was used for comparison between treatments means.

RESULTS AND DISCUSSION

Effect of different soil application on microbial populations: Data in Table 3 show that microbial counts increased with the increasing of growth period to reach their maximum values at 70 days followed by at 100 days and 40 days, respectively and this was obvious in all treatments. The highest ammonifying and nitrifying bacteria counts were in case of sheep manure compost+ammonium nitrate application at a rate of 30 kg N fed^{-1} from each of them and sprayed with kinetin treatment and this trend was observed at all growth periods. On the other hand,

Table 3: Ammonifiers and Nitrifiers counts in rhizosphere soil of cotton plants at 40, 70 and 100 days after sowing (counts x 10^2/g dry weight of soil) in 2010 (S_1) and 2011 (S_2) seasons

	Ammonifiers						Nitrifiers					
	40		70		100		40		70		100	
Bacterial groups												
treatments	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
60 kg N fed^{-1} M	34	36	45	47	42	43	7.0	7.2	9.2	9.8	8.1	8.4
60 M+GA_3	35	37	46	48	43	44	7.2	7.3	9.3	9.9	8.3	8.5
60 M+K	36	38	47	49	45	46	7.3	7.5	9.5	10.5	8.4	8.7
60 M+GA_3+K	35	37	46	48	44	45	7.2	7.4	9.4	10.2	8.3	8.5
60 kg N fed^{-1} O	38	39	46	48	43	44	7.6	7.8	9.3	9.9	8.2	8.5
60 O+GA_3	38	40	47	49	44	45	7.7	7.9	9.4	10.5	8.4	8.7
60 O+K	39	41	49	50	46	46	7.8	7.9	9.6	10.9	8.5	8.8
60 O+GA_3+K	39	40	48	49	45	45	7.7	7.8	9.4	10.6	8.3	8.7
30 M+30 O	50	53	62	63	59	60	12.1	13.2	16.9	17.5	15.1	15.3
30 M+30 O+GA_3	52	54	63	64	60	61	13.3	14.2	17.2	17.9	15.3	15.4
30 M+30 O+K	54	55	64	65	62	63	14.5	15.3	17.5	18.5	15.5	15.6
30 M+30 O+GA_3+K	53	54	63	64	61	62	13.4	14.2	17.3	18.1	15.3	15.4

M: Mineral, GA_3: Gibberellic acid, K: Kinetin, O: Organic

ammonifying and nitrifying bacteria showed the lowest counts in case of ammonium nitrate application at a rate of 60 kg N fed^{-1} alone. Sorensen and Jensen (1995) reported that soil texture affects the microbial activities and based on the results, it appears that microbial biomass is influenced by soil texture.

Adeniyan and Ojeniyi (2005) stated that the application of 300 kg ha^{-1} NPK, 7 t ha^{-1} poultry manure and six combinations of reduced level of NPK showed that maize performed better when organic and mineral fertilizers were combined at a reduced quantity. Application of combined use of Organic Based Fertilizer (OBF) and urea at 2 t ha^{-1} OBF and 90 kg ha^{-1} urea was more superior to application of either of the fertilizer alone. Ayeni *et al.* (2008) and Ayeni and Adetunji (2010) indicated that the combined effect of cow dung, poultry manure and swine manure with mineral fertilizers on soil chemical properties.

Growth characters: Dry weight $plant^{-1}$, leaf area $plant^{-1}$ and leaf area index at 90, 120 and 150 days after sowing were significantly affected by fertilizer treatments in both seasons (Table 4). The highest values were obtained from the combination of 30 kg N mineral+30 kg N organic (sheep manure compost) with one spray kinetin. On the contrary, the lowest values of dry weight $plant^{-1}$, leaf area $plant^{-1}$ and leaf area index at 90, 120 and 150 days after sowing were recorded in plants fertilized with recommended dose of mineral N fertilizer (60 kg N fed^{-1}) in both seasons compared with those fertilized with all other treatments. Generally, the results indicated that leaf area $plant^{-1}$ and leaf area index increased gradually by advancing plant age till reaching its maximum values at 150 days age. These results for dry weight $plant^{-1}$ may be due to the increases in both numbers of vegetative and fruiting branches by the combination of 30 kg N mineral+30 kg N organic. Abdel Aal *et al.* (2011) reported that significant increase in total dry weight $plant^{-1}$ due to foliar application of pix at the rate of 1 ml L^{-1} twice at start of flowering and 30 days later compared to untreated plants which produced the lowest value in the two seasons.

Table 4: Effect of nitrogen fertilizer sources and growth regulators on some growth characters of cotton plants at 90,120,150 days from planting in 2010 and 2011 seasons

	Dry weight plant^{-1}			Leaf area plant^{-1} (LA) dm^2			Leaf area index (LAI)		
Treatments	90	120	150	90	120	150	90	120	150
2010									
60 kg N fed^{-1} M	64.00	95.33	102.00	23.33	30.67	32.67	3.11	4.09	4.36
60 M+GA_3	67.00	98.33	105.33	25.33	32.33	34.33	3.38	4.31	4.58
60 M+K	70.33	101.00	106.67	26.33	33.33	36.33	3.51	4.44	4.84
60 M+GA_3+K	69.00	99.33	107.00	26.00	33.67	35.67	3.46	4.49	4.76
60 kg N fed^{-1} O	64.33	96.33	102.33	23.67	32.00	34.33	3.16	4.24	4.58
60 O+GA_3	67.33	99.00	106.00	25.33	33.00	35.67	3.38	4.40	4.76
60 O+K	69.33	101.33	107.67	25.33	34.67	36.33	3.38	4.62	4.84
60 O+GA_3+K	69.33	100.00	107.33	24.67	34.00	35.67	3.29	4.53	4.76
30 M+30 O	66.33	97.33	103.67	23.67	32.67	34.00	3.16	4.36	4.53
30 M+30 O+GA_3	70.00	100.33	106.67	24.67	35.00	36.33	3.29	4.67	4.84
30 M+30 O+K	73.33	103.67	109.67	26.67	36.66	37.67	3.55	4.89	5.02
30 M+30 O+GA_3+K	71.33	100.67	107.67	26.33	35.33	36.33	3.51	4.71	4.84
LSD at 5%	1.47	1.04	1.07	1.08	1.19	1.05	0.14	0.16	0.14
2011									
60 kg N fed^{-1} M	67.00	97.67	104.33	25.67	31.66	33.66	3.42	4.22	4.49
60 M+GA_3	69.00	100.67	106.67	26.66	33.66	35.33	3.55	4.49	4.71
60 M+K	72.67	101.67	108.67	27.66	35.33	36.66	3.69	4.71	4.89
60 M+GA_3+K	71.33	100.67	107.67	26.66	34.00	35.66	3.55	4.53	4.76
60 kg N fed^{-1} O	67.33	98.33	104.67	26.00	32.66	34.66	3.46	4.36	4.62
60 O+GA_3	69.33	100.33	107.67	26.66	34.33	36.33	3.55	4.58	4.84
60 O+K	71.00	102.67	109.33	27.66	35.66	37.66	3.69	4.76	5.02
60 O+GA_3+K	72.33	101.33	108.33	26.66	35.00	36.66	3.55	4.67	4.89
30 M+30 O	68.67	99.00	105.33	26.33	33.66	35.66	3.51	4.49	4.76
30 M+30 O+GA_3	72.67	102.00	108.67	26.66	35.33	37.33	3.55	4.71	4.98
30 M+30 O+K	75.33	106.00	111.67	28.66	37.00	39.33	3.82	4.80	5.24
30 M+30 O+GA_3+K	72.67	102.33	110.00	27.33	34.66	36.66	3.64	4.62	4.89
LSD at 5%	1.25	1.10	1.07	0.76	0.85	1.01	0.10	0.11	0.14

M: Mineral, GA_3: Gibberellic acid, K: Kinetin, O: Organic

Photosynthetic pigments: Data present in Table 5 revealed that various foliar treatments of kinetin and GA_3 significantly increased leaves content of chlorophyll a, b, a+b and carotenoids in comparison with the control (foliar without kinetin and GA_3). The highest chlorophylls content obtained from the application of organic manure (sheep manure compost) at rate 30 kg N+30 kg N mineral and sprayed with kinetin treatment. In this respect Al-Kahal *et al.* (2007) show that chlorophyll a, b, a+b and carotene were significantly increased due to application of organic manure. Kassem *et al.* (2009) show that cotton plants treated with various treatments of IAA and kinetin showed higher leaves content of chlorophyll a, b and total a+b. This increase in chlorophyll a, b, a+b and carotene which refer to the application of sheep manure compost could be attributed to increasing N in leaves. Nitrogen is an essential nutrient in creating plant dry matter as well as many energy rich compounds which regulate photosynthesis. There is an optimal relationship between nitrogen contents in the plant and CO_2 assimilation.

Yield and attributes: Data in Table 6 showed that the studied treatments gave a significant effect on plant height and number of fruiting branches plant^{-1} in both seasons. The highest values of

Table 5: Effect of nitrogen fertilizer sources and growth regulators on photosynthetic pigments (mg g^{-1} FW) of cotton leaves at 120 days from planting in 2010 and 2011 seasons

	Chlorophyll(a)		Chlorophyll(b)		Chlorophylls(a+b)		Carotenoids	
Treatments	2010	2011	2010	2011	2010	2011	2010	2011
60 kg N fed^{-1} M	3.82	3.73	3.22	3.31	7.04	7.04	0.22	0.24
60 M+GA_3	4.28	4.38	3.27	3.34	7.54	7.73	0.33	0.44
60 M+K	4.47	4.58	3.49	3.53	8.17	8.11	0.46	0.55
60 M+GA_3+K	4.35	4.42	3.31	3.39	7.66	7.80	0.38	0.48
60 kg N fed^{-1} O	4.19	4.23	3.24	3.30	7.43	7.55	0.28	0.38
60 O+GA_3	4.38	4.44	3.38	3.48	7.77	7.92	0.42	0.51
60 O+K	4.65	4.85	3.57	3.67	8.21	8.52	0.52	0.62
60 O+GA_3+K	4.43	4.53	3.45	3.57	7.88	8.10	0.43	0.53
30 M+30 O	4.23	4.31	3.25	3.32	7.48	7.62	0.31	0.41
30 M+30 O+GA_3	4.63	4.75	3.52	3.58	8.14	8.33	0.51	0.58
30 M+30 O+K	5.63	5.60	3.80	3.90	9.43	9.50	0.62	0.68
30 M+30 O+GA_3+K	4.85	5.03	3.74	3.82	8.59	8.85	0.59	0.64
LSD at 5%	0.10	0.11	0.07	0.04	0.32	0.12	0.04	0.03

M: Mineral, GA_3: Gibberellic acid, K: Kinetin, O: Organic

Table 6: Effect of nitrogen fertilizer sources and growth regulators on seed cotton yield and yield components in 2010 and 2011 seasons

Treatments	Plant height (cm)	No. of fruiting branches $plant^{-1}$	No. of open bolls $plant^{-1}$	Boll weight (g)	Seed index (g)	Lint (%)	Seed cotton yield $plant^{-1}$ (g)	Seed cotton yield fed^{-1} (kentar)
2010								
60 kg N fed^{-1} M	157.76	17.33	19.67	2.83	9.98	38.97	24.67	9.27
60 M+GA_3	161.00	20.67	21.33	2.87	10.02	39.30	26.67	9.98
60 M+K	161.33	22.00	23.00	2.95	10.11	39.47	28.00	10.25
60 M+GA_3+K	161.33	22.33	22.33	2.90	10.08	39.03	27.00	10.05
60 kg N fed^{-1} O	158.67	18.33	20.33	2.84	10.01	39.20	25.33	9.38
60 O+GA_3	160.67	21.67	22.33	2.81	10.07	39.40	27.33	10.07
60 O+K	162.33	23.33	23.33	2.96	10.15	39.58	28.33	10.34
60 O+GA_3+K	161.33	22.33	22.33	2.92	10.09	39.46	27.67	10.17
30 M+30 O	159.33	19.33	20.67	2.85	10.02	39.30	25.67	9.48
30 M+30 O+GA_3	161.67	23.33	23.00	2.93	10.10	39.57	28.33	10.21
30 M+30 O+K	164.67	25.33	23.67	3.01	10.21	39.87	31.67	10.55
30 M+30 O+GA_3+K	162.33	24.67	22.67	2.96	10.16	39.63	29.67	10.27
LSD at 5%	1.34	1.16	0.99	0.19	0.02	NS	1.12	0.11
2011								
60 kg N fed^{-1} M	160.00	19.33	20.33	2.90	10.03	39.23	27.00	9.47
60 M+GA_3	162.00	22.00	22.67	2.95	10.12	39.46	27.33	10.06
60 M+K	163.33	22.33	23.33	3.00	10.20	39.66	28.33	10.35
60 M+GA_3+K	162.33	22.33	22.67	2.97	10.15	39.33	27.67	10.12
60 kg N fed^{-1} O	160.67	19.33	20.67	2.92	10.27	39.33	26.67	9.53
60 O+GA_3	162.67	22.67	22.67	2.97	10.12	39.53	28.67	10.19
60 O+K	164.33	24.33	23.67	3.02	10.24	39.73	30.00	10.41
60 O+GA_3+K	163.67	23.67	23.00	2.98	10.15	39.56	29.67	10.25
30 M+30 O	160.67	20.33	21.00	2.93	10.08	39.40	27.67	9.69
30 M+30 O+GA_3	163.33	24.67	23.67	2.98	10.15	39.66	30.00	10.39
30 M+30 O+K	166.00	27.00	24.67	3.09	10.28	39.93	33.33	10.71
30 M+30 O+GA_3+K	164.33	25.67	23.67	3.03	10.20	39.73	30.33	10.43
LSD at 5%	2.11	1.30	1.80	0.02	0.19	NS	1.74	0.10

M: Mineral, GA_3: Gibberellic acid, K: Kinetin, O: Organic, NS: Insignificant

plant height and number of fruiting branches plant^{-1} were obtained from the combination of 30 kg N mineral+30 kg N organic (sheep manure compost) with one spray kinetin in both seasons. Whereas, the lowest values of plant height and number of fruiting branches plant^{-1} were recorded in plants fertilized with recommended dose of mineral N fertilizer (60 kg N fed^{-1}) in both seasons compared with these fertilized with all other treatments. This increase may be due to the positive role of cytokinins which stimulate cell division and enlarge the cell contains. It should be mention that there was positive effect of kinetin on number of fruiting branches plant^{-1} as compared with Gibberellic acid (GA_3). Several studies indicated that plant height and number of fruiting branches plant^{-1} were significantly increased by application of kinetin (Sawan *et al*., 2000; Kassem *et al*., 2009; Gebaly, 2011).

The data of yield and its components i.e., number of open bolls plant^{-1}, boll weight, seed index, lint%, seed cotton yield plant^{-1} and seed cotton yield fed^{-1} as influenced by studied treatments in the two growing seasons are shown in Table 6. The application of sheep manure compost at rate of 30 kg N fed^{-1} combined with 30 kg N fed^{-1} mineral and sprayed by kinetin gave the highest values of No. of open bolls plant^{-1}, boll weight, seed index, lint%, seed cotton yield plant^{-1} and seed cotton yield fed^{-1} while, the lowest values of these traits were recorded in plants fertilized with recommended dose of mineral N fertilizer (60 kg N fed^{-1}) in both seasons. The application of sheep manure compost at rate of 30 kg N fed^{-1} combined with 30 kg N fed^{-1} mineral and sprayed by kinetin significantly increased No. of open bolls plant^{-1}, boll weight, seed cotton yield plant^{-1} and seed cotton yield fed^{-1} by 20.33, 6.36, 28.37 and 13.81% in the first season and by 21.34, 6.55, 23.44 and 13.09% in the second season, respectively compared with recommended dose of mineral N fertilizer (60 kg N fed^{-1}). Increasing number of open bolls plant^{-1} and boll weight as a result of application of organic manure (sheep manure compost) is probably due to increasing the uptake of N and other nutrients from which released from organic manures. Therefore, increase chlorophyll a pigment which responsible for photo-synthesis increased photosynthesis process and consequently enhanced flowering and boll retention (Table 5). Such increase in these traits may be returned to the role of balance N and other nutrients to encourage the metabolic processes leading to accumulation of dry matter of cotton during flowering and boll formation. The role of the kinetin in increasing the indigenous level of plant phytohormones like cytokinins which promote plant growth cell division, break the apical dominance, encourage the photosynthesis and assimilates accumulation, plant development and consequently the productivity per unit area.

The superiority of seed cotton yield plant^{-1} or fed^{-1} obtained due to the application of 30 kg N organic+30 kg N mineral and sprayed by kinetin was the logical resultant of the increase in the yield components. These results are in line with those stated by Battisha (1998), El-Shazly and El-Masri (2002), El-Tabbakh (2002), Yaduvanshi (2003), Das *et al*. (2004), Al-Kahal *et al*. (2007), Attia *et al*. (2008) and Gebaly (2011). Abdel Aal *et al*. (2011) reported that significant increase in number of open bolls plant^{-1}, boll weight, seed index and seed cotton yield fed^{-1} due to foliar application of pix at the rate of 1 ml L^{-1} twice at start of flowering and 30 days later compared to untreated plants which produced the lowest values in the two seasons.

Oil and protein% in the cotton seed: Data in Table 7 show that the tested treatments gave a significant effect on oil and protein percentage in cotton seeds in the two seasons. Both characters were significantly increased by adding sheep manure compost combined with mineral N fertilizer and spraying with kinetin or GA_3 or mixture. These results suggest that high N rate increase amino acid synthesis in leaves and this stimulate the accumulation of protein in the seed. The

Table 7: Effect of nitrogen fertilizer sources and growth regulators on seed chemical composition and fiber technological characters in 2010 and 2011 seasons

	Oil (%)		Protein (%)		Micronaire reading		Pressley index	
Treatments	2010	2011	2010	2011	2010	2011	2010	2011
60 kg N fed^{-1} M	19.00	19.38	20.71	20.86	4.52	4.52	9.88	9.93
60 M+GA_3	20.35	20.35	21.86	22.10	4.54	4.61	10.22	10.33
60 M+K	20.37	20.57	22.55	22.53	4.62	4.62	10.42	10.37
60 M+GA_3+K	20.18	20.42	22.15	22.47	4.58	4.61	10.27	10.39
60 kg N fed^{-1} O	20.08	20.17	21.45	21.66	4.53	4.56	10.00	10.12
60 O+GA_3	20.25	20.52	22.29	22.52	4.58	4.58	10.32	10.43
60 O+K	20.43	20.69	22.68	22.80	4.72	4.73	10.32	10.32
60 O+GA_3+K	20.28	20.60	22.42	22.64	4.62	4.61	10.35	10.42
30 M+30 O	20.13	20.27	21.55	21.75	4.52	4.56	10.12	10.22
30 M+30 O+GA_3	20.40	20.65	22.62	22.76	4.67	4.67	10.46	10.40
30 M+30 O+K	21.67	21.77	22.83	22.97	4.84	4.88	10.55	10.47
30 M+30 O+GA_3+K	21.46	21.72	22.80	22.87	4.77	4.82	10.42	10.35
LSD at 5%	0.33	0.12	0.11	0.20	0.04	0.05	0.21	0.07

M: Mineral, GA_3: Gibberellic acid, K: Kinetin, O: Organic

increase in cotton seeds oil and protein percentage might be due to the promoting effect of these nutrients on the various chemical constituents of seeds including the oil and protein quantity. Gebaly (2011) came to similar findings.

Technological characters of fiber: The results obtained in Table 7, reveal that lint properties, Micronaire reading and Pressley index were significantly affected by tested treatments in both seasons. Both characters were significantly increased by adding sheep manure compost at rate 30 kg N combined with mineral N fertilizer at rate 30 kg N and spraying with kinetin or GA_3 or mixture.

CONCLUSION

It can be concluded that the application of sheep manure compost at rate of 30 kg N fed^{-1} combined with 30 kg N fed^{-1} mineral and sprayed by kinetin may be the recommended treatment to improve the productivity of Egyptian cotton (Giza 86 variety), under the conditions of the present study.

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