

STUDIES ON THE USE OF MINERAL AND BIO NITROGEN FERTILIZER WITH SOME OF GROWTH REGULATORS ON GROWTH AND YIELD OF COTTON VARIETY GIZA 80

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Abstract

Two field experiments were carried out at Sids Agricultural Research station, Beni-suef Governumberrate in 2008 and 2009 seasons, to study the response of growth, fruiting and yield of the Egyptian cotton cultivar Giza 80 (*G. barbadense* L.) to organic manure (sheep manures) alone or combined with mineral nitrogen fertilizer and foliar application with Kinetin and Gebirline GA₃. The treatment included the control treatment, one concentration of each of kinetin (5 ppm) and GA₃ (100 ppm) which sprayed at the squaring stage obtained could be summarized as follows:

The combined application of 30 kg N / fed. as sheep manures along with 30 kg mineral N / fed. as ammonium nitrate significantly increased plant height, Number of fruiting branches / plant, Number of open bolls / plant, boll weight in the form of seed cotton yield (feddan), seed index and chemical composition of leaf as compared with the control. (ammonium nitrate) in both seasons. Generally, the application of sheep manures at rate of 30 kg N / fed combined with 30 kg N / fed. (ammonium nitrate) and sprayed by Kinetin gave the highest cotton yield and yield components in both seasons. The studied treatments had insignificant effect on earliness % and fiber quality in both seasons.

Key words: Organic manure, Sheep, mineral N, growth regulators, kinetin, GA₃, Growth, yield and yield components, Elements %, oil, protein..

INTRODUCTION

Nitrogen is one of the most important nutrients for plants. The application of N fertilizer was found to be profitable up to the recommended rate (60 kg / fed.) which increase plant height, number of fruiting branches, number of open bolls / plant, boll weight, lint % and cotton yield (Abuldahab *et al.*, 2000).

Losses of nitrogen fertilizers are not only impacts to the environment but also are great economic losses. Therefore, efforts should be devoted to avoid or minimize these losses.

Egyptian soil became 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 % and 13 -30 ppm. These values are low. Therefore, the Egyptian farmers provide the soil by mineral nitrogen. This performance cause on

environmental pollution especially under the high ground water due to excessive of leaching of nitrates (Ambergerig, 1993).

Therefore, the aim of this study was to minimize mineral nitrogen fertilizer by substituting other sources of nitrogen fertilizer such as nitrogen bio-fertilizer and organic manure.

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, (Khalil *et al.*, 2000).

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.

Organic manures are the alternative sources that can supply macro and micronutrients in adequate quantities, besides improving the physical properties of the soil caused a reduction to soil PH (Mehana 1998), increasing water holding capacity and improving soil structure as soil granulation buffering physical and soil aeration.

Amendment the soil with organic manures improves their physical, chemical and biological properties and hence the availability of plant nutrients.

Therefore, the objective of this study was to find out the effect of organic manures or combined with mineral nitrogen fertilizer on leaf chemical composition, growth, earliness and yield of Giza 80 cotton cultivar.

MATERIALS AND METHODS

Two field experiments were carried out at Sids experimental Station of Agricultural Research Center, Beni-Suef Governorate, Egypt during 2008 and 2009 seasons to study the effect of the combination of organic manures (sheep manures) with mineral N fertilizer (ammonium nitrate) besides the applications of Kinetin (a synthetic cytokinin 5 ppm) and Gibberlic acid (GA_3 100 ppm) sprayed once at the squaring stage. Using the Egyptian cotton cultivar, Giza 80 (*Gossypium barbadense* L.).

Plot area was 12 m² (5 ridges, 4 m long) and 60 cm a part). Distance between hills were 25 cm leaving two plants per hill at thinning time (after five weeks from sowing). Sowing date was an the last week of March in both seasons. A randomized complete block design with four replicates was used in both seasons, where the following eight treatments were evaluated:

1. The recommended N rate (60 kg of mineral N / fed. as ammonium nitrate)
2. 60 kg of mineral N / fed. + GA₃ (100 ppm).
3. 60 kg of mineral N / fed. + Kinetin (5 ppm).
4. 60 kg N / fed. In the form sheep manure + GA₃ (100 ppm).
5. 60 kg N / fed. As sheep manure + Kinetin (5 ppm).
6. 30 kg N / fed. of mineral N / fed. + 30 kg N / fed. As sheep manure.
7. 30 kg N / fed of M mineral N / fed. + 30 kg N / fed. As sheep manure + GA₃ (100 Ppm).
8. 30 kg N / fed. Of M mineral N / fed + 30 kg N / fed. As sheep manures + Kinetin (5 Ppm).

Sheep manures were analyzed before applying the treatments according to nitrogen content. Therefore, sheep manures which contain 60 kg N /fed. were 2381 and 2913 kg/fed in the first and second seasons, respectively.

The 30 kg N / fed. In Sheep manures were 1190 and 1456 kg / fed in the first and second seasons, respectively.

Soil and manure analyses were made according to A.O.A.C. (1975), (Tables 1 and 2).

All plots were fertilized by recommended doses of the other major nutrients for the local district, nitrogen (60 kg N / fed.) and calcium superphosphate 15.5 % P₂O₅ at the rate of 150 kg / fed.). Potassium sulfate fertilizer was not added because the soil content was enough as shown in Table (1). The previous crop was Egyptian clover (*Trifolium alexandrinum* L). Normal agricultural practices were followed during the two growing seasons.

The chemical analysis of some traits were carried out thorough both seasons which were,

1. Leaves content of chlorophyll, in 2008 and 2009 seasons, samples of the upper fourth leaves were collected at 15 days after the application of growth regulators to determine leaves content of chlorophyll a, b and a + b and carotenoids besides leaf nutrient elements contents (N, P and K) (A.O.A.C. 1975).

Table 1. Physical and chemical properties of soil in 2008 and 2009 seasons.

Properties	Value 2008	Value 2009
Sand %	14.38	16.30
Silt %	35.15	36.50
Clay %	45.12	42.20
CaCo ₃	2.20	1.90
Textural class	Clay loam	Clay loam
PH	7.82	7.30
E.C. (dsm ⁻¹)	1.1	0.98
O.C. %	0.60	0.50
O.M. %	0.92	0.90
Total soluble N (Ppm)	40.00	39.08
Soluble cations (Ppm)		
Ca ⁺⁺	1880	1540
Mg ⁺⁺	480	526
Na ⁺	633	564
K ⁺	488	425
P	17.13	15.50
Soluble anions (meq l ⁻¹)		
Co ₃ ⁻	0.00	0.00
Hco ₃ ⁻	3.16	3.20
Cl ⁻	3.25	2.90
So ₄ ⁼⁼	3.69	3.45

Table 2. Analysis of the organic manures (sheep manures) which used in the two seasons.

Properties	Value	Value
	2008	2009
PH (1:10 organic manures water) *	8.36	8.15
E.C. (1:10 organic manures water)	7.50	7.95
o.M. % **	35.01	36.05
Organic carbon %	18.90	18.65
Total N %	2.52	2.06
C : N ratio	1 : 14.8	1 : 15.2
P %	0.65	0.55
K %	20.60	20.75
Ca %	22.30	22.70
Mg %	2.33	2.38
Na %	12.01	12.50
Fe (Ppm)	36	42
Mn (Ppm)	2.9	3.5
Zn (Ppm)	5.6	6.0
Cu (Ppm)	6.0	6.42

* Optimizing of micronutrient fertilizer use project, National Research Center, Unit of Mariut.

** Organic matter (O.M) = organic carbon x 1.724.

- Oil and protein percentage were determined in the seeds by the method described by A.O.A.C (1975).
- Plant growth parameters, (final plant height (cm) and number of fruiting branches per plant).
- Yield and yield components i.e. boll weight (gm), number of open bolls per plant seed cotton yield (kentars per feddan)***, Earliness %, lint percentage and seed index.
- Fiber properties, micronaire reading and Pressley index were determined for the representative samples

The obtained data were subjected to statistical analysis according to Gomez and Gomez (1984) and L.S.D. values at 5 % level of significant were used for comparison between means.

*** kentar per feddan = 157.5 kg seed cotton.

RESULTS AND DISCUSSION

1. Effect of plant growth parameters

A. *Plant height*

Data in Table (3) showed that the highest value of plant height was obtained from the combination of 30 kg N / fed. as mineral and 30 kg N / fed. as sheep manure with one spray Kinetin in both seasons. While, the lowest value of plant height was recorded in plants fertilized with recommended dose of mineral N fertilizer (60 kg N / fed.) in both seasons, compared with those fertilized with all other treatments.

Generally, this increase may be due to the positive role of cytokinins which stimulate cell division and enlarge the cell contains. In this respect, El-shahawy and Abd El-Malik (1999) found that with higher N level (80 kg N / fed.) cotton plants were more efficient to get higher final plant height. Beside, the released of other macro and micro-elements from sheep manure which improved plant growth.

B. *Number of fruiting branches / plant*

Concerning to Number of fruiting branches / plant, the data presented in Table (3) indicated that these character increased by application of sheep manure in combination with mineral N fertilizer and with spraying of Kinetin in both seasons.

In this connection, it should be mention that there was a positive effect of Kinetin on Number of fruiting branches / plant as compared with Gibberellic acid (GA3). Accordingly, cytokinin is quite effective in retarding the abscission response in cotton (Cothren, 1999). Several studies indicated that number of fruiting branches / plant was significantly increased by application of Kinetin (Sawan et al., 2000 and Kassem et al., 2009).

2. Seed cotton yield and its components

1. *Number of open bolls / plant*

Table (3) show the effect of treatments under study on seed cotton yield / fed. and its components in the two seasons.

Data in Table (3) show that the tested treatments of sheep manures and mineral N. fertilizer gave a significant effect on Number of open bolls / plant in the two seasons. The highest Number of open bolls / plant was observed in treatments which with 30 kg N / fed. of sheep manures and 30 kg N / fed. (ammonium nitrate) with spraying with Kinetin.

Increasing Number of open bolls / plant as a result of application of organic manure (sheep manure) is probably due to increasing the uptake of N and other nutrients from which released from organic manures. These results are in agreements with those obtained by El-shahawy and Abd El-Malik (1999).

On the other hand, several studies indicated that Number. of open bolls / plant was significantly increased by application of Kinetin. These results are in agreements with those obtained by Sawan *et al.*, 2000. Also, spraying cotton plants with 50 ppm GA₃ increased Number of open bolls / plant and Number. of fruiting branches / plants. These results are in agreement with those obtained by Eid and El-Aggory (1985). This might be due to the effect of both growth regulators on the increase of cell number and size which increased boll production.

2. Boll weight

The data in Table (3) show that the tested treatments gave significant effects on boll weight in the first season. This only increase in boll weight may be due to N induced increase in mineral uptake.

A reference to Table (5), it is obvious that chlorophyll was increased as a result of application of sheep manures compared with the application of 60 kg mineral N/fed (control). Therefore, increasing chlorophyll a pigment which responsible for photo-synthesis increased photosynthesis process and consequently enhanced flowering and boll retention (Kler *et al.*, 1989).

3. Seed cotton yield

The data in Table (3) show that there was increase in seed cotton yield kentar / fed. in the first and second seasons by the application of Kinetin or GA₃ beside the application of sheep manure. The highest value of seed cotton yield / fed. was obtained from the combination of 30 kg as sheep manures with 30 kg mineral N / fed. and spraying with Kinetin in both seasons.

Generally, there was a significant increase among all treatments in both seasons. However, treatments that received sheep manures at the rate of 30 kg N / fed. with 30 kg mineral N / fed and sprayed Kinetin achieved highest seed cotton yield which recorded 10.66 kentar / fed. and 9.72 kentar / fed. in the first and second season, respectively, This treatment might be as a result of increasing boll number and boll

weight due to releasing more macro and micro elements from organic manures. Besides, the positive effect of Kinetin on growth and yield production. On the other hand, the control treatment achieved 8.59 and 7.24 kantar / fed. in the first and second season, respectively. In this respect Kassem *et al* (2009) found that foliar application of Kinetin significantly affected on seed cotton yield per feddan. Also Eid and El-aggory (1985) indicate that GA₃ foliar application at 50 ppm increased cotton yield.

4. Earliness percentage

Data in Table (4) show that the treatments under study gave insignificant effect on earliness percentage in the two seasons. In this respect, El-Shazly and El-Masri (2002) found that earliness % was insignificantly affected by organic manures (pigeon refuse, sheep and rabbit manures).

5. Lint percentage

Results present in Table (4) show that lint % was significantly affected by application of sheep manures with nitrogen fertilizer. Plants received 60 kg mineral N / fed. had lower lint % as compared with other treatments. In this respect Al-Kahal *et al*. (2007) found that the three sources of nitrogen (urea, fresh poultry litter and composted poultry litter) significantly increase lint yield compared with control (60 kg N / fed.).

6. Seed index

Data in Table (4) show that seed index significantly affected by tested treatments, where the highest value was obtained from the combination of sheep manures at the rate of 30 kg N / fed. with 30 kg mineral N / fed. and sprayed by Kinetin followed by the all treatments. The lowest value was obtained from applying sheep manures at the rate of 30 kg N fertilizer / fed. with 30 kg mineral N / fed. without sprayed by Kinetin or GA₃. The increase in seed index may be due to the increase of photosynthetic activity which increase the accumulation of metabolites with direct impact on seed weight. These results are in agreement with those obtained by Al-Kahal *et al*. (2007).

3. Fiber quality

Data in Table (4) show that tested treatments did not exhibit any significant effect on micronaire reading and Pressley index in the two seasons. Similar result was obtained by Al-Kahal *et al.* (2007) who found that application of organic manures at different levels resulted in non significant increase in micronaire reading and Pressley index in both seasons.

4. Effect of leaves content of chlorophyll

Data present in Table (5) revealed that various foliar treatments of Kinetin and GA₃ significantly increased leaves content of chlorophyll a, b and total chlorophyll and carotenoids in comparison with the control. The highest chlorophyll content obtained from the application of organic manure (sheep manures) and 30 kg mineral N fertilizer and sprayed with Kinetin. In this respect AlKahal *et al.* (2007) show that chlorophyll A, b, total chlorophylls and carotene were significantly increased due to application of organic manure.

In this respect, Kassem *et al.* (2009) found that cotton plants treated with various treatments of IAA and Kinetin showed higher leaves content of chlorophyll a, b and total chlorophylls. Also, addition of GA₃ increases of chlorophyll (Zaghlool and Ibrahim, 2006). This increase in chlorophyll a, b, (a + b) and carotene which refer to the application of sheep manures could be attributed to increasing N and K 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 CO₂ assimilation as reported by Greff (1994), where decreases in CO₂ fixation are well documented for N-deficient plants.

5. Leaf nutrients concentration

Table (6) show the effect of sheep manures and mineral N fertilizer Applications on leaf N, P and K content during 2008 and 2009 seasons.

In general application of sheep manures with N. fertilizer increased the concentration of N, P and K in cotton leaves in generally as compared to the control treatment as shown in Table (6). The highest value of leaf N and K content were obtained from applying the combination of 30 Kg N / fed as sheep manures form with 30 kg mineral N / fed. and spraying Kinetin or GA₃ in both seasons While the highest value of leaf P content was obtained from applying the combination of 30 kg N / fed. as sheep manures form with 30 kg mineral N / fed. and spraying with GA₃. In general, the release of GA₃ enhancing the flowering curve which lead to the increase of phosphors absorbed than nitrogen content.

Increasing N due to application of organic manures lead to increase protein content (Al-Kahal *et al.*, 2007). In addition, Shafeek and El-Habbasha (2000) concluded that supplied organic manures with necessary nutrient elements and increased the microbial respiration and hence CO₂ output which has reducing PH effect on soil. Furthermore, the slow release of nutrients from organic manures offers balanced soil solution. Stitt (1999) indicated that nitrate (Number₃⁻) induces genes involved in different aspects of carbon metabolism, including the synthesis of organic acid used for aminumber acids synthesis. Also, increasing K level due to application of organic manure also increase protein. Al-Kahal *et al.* (2007) found that application of organic manures with or without N mineral fertilizer increased the concentration of N, P and K in cotton leaves compared with those fertilized by 60 kg N / fed. in the form of mineral

6. Oil and protein % in the cotton seeds

Data in Table (6) show that the tested treatments gave a significant effect on oil and protein % in cotton seeds in the two seasons. Both characters were significantly increased by adding sheep manures combined with mineral N fertilizer and Kinetin or GA₃. These results suggest that high N rate increase aminumber acid synthesis in leaves and this stimulate the accumulation of protein in the seed. Increasing K level due to application of organic manure also increase protein. This could be attributed to the role of K in biochemical pathway in plants of nitrogen.

The interaction between growth regulators (Promoters) as Kinetin and Gebirline (GA₃) on the high rate of nitrogen content led to increasing of boll setting and decrease of square and young boll shedding which reflected the increase of boll number and boll weight.

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دراسات على استخدام التسميد النتروجيني المعدنى والحيوى وبعض منظمات النمو على نمو ومحصول القطن لصنف جيزة 80

سناء جمعه جبالى

قسم بحوث فسيولوجى القطن - معهد بحوث القطن - مركز البحوث الزراعية - جيزة - مصر

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بسدس - محافظة بنى سويف فى موسمى 2008 - 2009 بهدف دراسة إستجابة نمو وإثمار ومحصول القطن صنف جيزة 80 للسماد العضوى (سماد الأغنام) -و مخلوطاً بالسماد النتروجينى المعدنى والرش بمنظمات النمو بالكينتين (5 جزء فى المليون) ، والجبرلين (100 جزء فى المليون) وتم الرش عند بداية الوسواس. شملت الدراسة ثمانى معاملات للأسمدة المعدنية والعضويه والرش بمنظمات النمو والتوافق بينها كالاتى:

١. 60 كجم نتروجين للقدان سماد معدنى (معاملة المقارنة).
٢. 60 كجم نتروجين معدنى للقدان + جبرلين (100 جزء فى المليون).
٣. 60 كجم نتروجين معدنى للقدان + كينتين (5 جزء فى المليون).
٤. 60 كجم نتروجين حيوى للقدان (سماد الأغنام) + جبرلين (100 جزء فى المليون).
٥. 60 كجم نتروجين حيوى للقدان (سماد الأغنام) + كينتين (5 جزء فى المليون).
٦. 30 كجم نتروجين معدنى للقدان + 30 كجم نتروجين حيوى للقدان (سماد الأغنام).
٧. 30 كجم نتروجين معدنى للقدان + 30 كجم نتروجين حيوى للقدان (سماد الأغنام) + جبرلين (100 جزء فى المليون).
٨. 30 كجم نتروجين معدنى للقدان + 30 كجم نتروجين حيوى للقدان (سماد الأغنام) + كينتين (5 جزء فى المليون).

وكان التصميم التجريبي المستخدم هو القطاعات الكاملة العشوائية فى أربعة مكررات.

ويمكن تلخيص النتائج فيما يلى:

١. أدى إستخدام 30 كجم نتروجين للقدان فى صورة سماد الأغنام مع 30 كجم نتروجين معدنى للقدان كقترات أمونيوم إلى زيادة طول النبات وعدد الأفرع الثمرية ، وعدد اللوز المتفتح وكذلك متوسط وزن اللوزة بالإضافة إلى زيادة محصول القطن الزهر (قنطار / فدان) ، والمحتوى الكيماوى للأوراق مقارنة بنباتات القطن التى سمدت ب 60 كجم نتروجين معدنى للقدان.
٢. فى معظم الحالات أدى إستخدام 30 كجم نتروجين معدنى للقدان مع 30 كجم نتروجين حيوى للقدان فى صورة سماد أغنام مع الرش بالكينتين إلى أحسن النتائج بالنسبة للنمو والمحصول ومكوناته والمكونات الكيماوية للورقة والبذرة.
٣. لم تتأثر النسبة المئوية للتبكير وصفات التيلة بالمعاملات خلال موسمى الدراسة.