EFFECT OF MINERAL AND BIO-FERTILIZERS ON THE PRODUCTIVITY AND FIBER QUALITY OF GIZA 80 COTTON VARIETY

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ABSTRACT:

This study was carried out at Sids Agricultural Research Station, Beni-Suef Governorate, during 2006 and 2007 seasons. The work was designed to study the effect of different rates of mineral NPK fertilizers (60N, 22.5 P_2O_5 and 24 K_2O kg/fed., respectively), three biofertilizers (Rhizobacterien, phosphorien and potassyomage) and their interactions on some growth characters, yield and its components and some fiber properties of Giza 80 cotton cultivar.

The obtained results could be summarized as follows:-

* Use of mineral and biofertilizer had a significant effect on all growth and yield characters in both seasons except seed index in second season and fiber properties except micronair reading in both seasons.
* Usa of mineral fertilizers alone recorded the highest average of plant height, boll weight (first season), No. of sympodial branches/plant and seed cotton yield/fed., in the two seasons.
* Use of 75% mineral fertilizers with Rhizobacterin, phosphorien and potassyomage recorded the best averages of position of first sympodial node and seed cotton yield/fed. While, use 50% mineral fertilizer with all biofertilizer gave the highest values of No. of open bolls/plant, boll weight (second season) and seed cotton yield /plant.
* Use of 75% mineral (P) plus phosphorien led to increase boll weight (second season) and seed index.
* Use of biofertilizers alone significantly decreased all characters under study in both seasons.

Key words: Cotton, Mineral, Bio-Fertilizers and Productivity.

INTRODUCTION

Cotton is the most important fiber crop all over the world as it is woven into fabrics, either alone or combined with other fibers. There is a demand for Egyptian cotton by foreign countries due to its excellent quality, which is world wide documented. This quality in fact is the results of an extremely favorable whether condition, a highly fertile soil and above all the local varieties and intimate knowledge of technichians including breeders, agronomist and spinning technology.

Nitrogen, phosphorus and potassium nutrients are considered the major three essential macro-nutrients in plant nutrition. **Mengel and Kirkby (1987)** mentioned that nitrogen has many functions in plant life, like protein synthesis, nucleic acids formation and it an important constituent of protoplasm, enzymes, the biological catalytic agents, which speed up life, processes. The most essential functions of phosphorus are in energy storage and transfer, and added that potassium is important in germination of seeds and fruits as well as cell division and the development for meristematic tissues.

Recently, efforts were devoted to minimize the use of mineral fertilizers, for cotton in order to optimize production cost and to protect environment against pollution without compromising the seed cotton yield. In this concern, biofertilizers were successfully used to minimize the dependence on chemical fertilizers **(Ishac, 1998 and Kassem and Hassouna, 2004)**. Biofertilizers are products containing living cells of different types of microorganisms, which have the ability to convert nutrient elements from unavailable to available through biological processes **(Feibo and Omar, 1998 and Hedge *et al*., 1999).**

Regarding, the effect of biofertilization on cotton, many investigators proved the favourable role of biofertilizers on improving all cotton growth and yield parameters of them **Hamissa *et al*. (2000), El-Shazly and Darwish (2001), Abou-Zaid *et al*. (2002). and El-sayed and El-Menshawi (2005)** for growth characters, **Prasad and Prasad (1994), Galal (2003) and Zohry (2005)** for yield components and **Khune *et al*. (1989) and Sobh *et al* (2000)** for seed cotton yield. However**, Galal (2003) and El-Sayed and El-Menshawi (2005)** reported that fiber properties of cotton were not significantly affected by biofertilization.

Several workers reported that the application of phosphate solubilizing bacteria (PSB) increase the efficiency of phosphatic fertilizers through solubilizing the fixed P by organic acids produced by organic bacteria. **Koreish *et al* (2001)** found significant yield response in fababean and wheat seed inoculation with (PSB).Similar effect was reported by**Abou-Zaid *et al* (2002) in cotton. Hamissa *et al* (2000) and El Sayed and El-Menshawi (2005)** found that, application of biofertilizers significantly increased plant height, boll weight, seed cotton yield/plant and No. of open bolls/plant and seed cotton yield/fed.

The aim objective of this investigation was to study the effect of NPK fertilizer, some biofertilizers and their interactions on growth, yield and its component and fiber properties of Giza 80 cotton cultivar.

MATERIALS AND METHODS

Two field experiments were conducted in Sids Agricultural Research Station, Beni-Suef Governorate, during 2006 and 2007 seasons using Giza 80 Egyptian cotton cultivar (*Gossypium barbadens L.*). The effect of mineral fertilizers as 60 kg N, 22.5kgP2O5 and 24kg K2O/fed., alone or combined with three biofertilizers (Rhizobacterien, phosphorien and potassyomage) on some growth characters, yield and its components and some fiber properties was investigated in both seasons.

The experiment was designed in a complete randomized block design with four replications. The plot size was 26 m^2 including 8 rows, 5 m long and 65 cm width.

Treatments were based on the assumption of the possibility of serving biofertilizers to complement the need of cotton plants from mineral N, P and K. Therefore, 75% or 50% of each of mineral N, P and K were combined with N, P and K biofertilizers. These treatments combinations were compared with complete mineral NPK fertilization as a control and NPK biofertilizers only treatment as follows:

T1- 100% mineral N, P, K, fertilizers only (control).
T2- 75% mineral N fertilizer +seed inoculation with Rhizobacterien +100% mineral P, K.
T3- 50% mineral N fertilizer + seed inoculation with Rhizobacterien +100% mineral P, K.
T4-75% mineral P fertilizer + seed inoculation with phosphorien +100% mineral N, K.
T5-50% mineral P fertilizer + seed inoculation with phosphorien + 100% mineral N, K.
T6- 75% mineral K fertilizer + seed inoculation with potassyomage+ 100% mineral N, P.
T7- 50% mineral K fertilizer + seed inoculation with potassyomage +100% mineral N, P.
T8- 75% mineral N, P, K fertilizer + biofertilizers N, P, K.
T9- 50 % mineral N, P, K fertilizer + biofertilizers N, P K.
T10- Seed inoculation with Rhizobacterin, Phosphorien and Potassyomage.

Nitrogen (60 kg N/fed.) using ammonium nitrate (33.5%N) was splited and side dressed before the first and second irrigations. Potassium (24 kg K_2O/fed.) using potassium sulfate (48% K_2O) was also splited and side dressed before the first and second irrigations. Phosphorous (22.5kg P_2O_5/fed.) as superphosphate (15.5% P_2O_5) was broadcasted. (During seed bed preparation). The three biofertilizers used in this study were produced by Department of Microbiology, Soil, Water and Environment Institute, ARC. Concerning the bio-fertilizers inoculation, Arabic gum was melted in amount of warm water and added to each of the previous three biofertilizers. Cotton seeds were added to the mixture of biofertilizers and gum, carefully mixed and spread over plastic sheet far from direct sun for a short time. The sowing dates were 21 and 23 of March in the two seasons, respectively.
The preceding crop was maize in both seasons. All other cultural practices were carried out during the growing seasons as recommended in cotton fields. Soil samples were taken in the two seasons before planting cotton to estimate some soil properties according to the method of **Page *et. al*. (1982)** as shown in Table (1).

Table (1): Soil chemical analyses (upper 30cm) of the experimental sites in both seasons.

Characters	2006	2007
PH	8.3	7.8
Available N (PPm)	25	10
Available P (PPm)	15.5	17
Available K (PPm)	280	296
EC (mmohs) / cm	0.55	0.4

Studied characters

The following characters were recorded on ten individual plants randomly taken from each experimental unit in both seasons. Seed cotton yield/fed., in kentar, was determined on the basis of the yield per plot.

A- Growth characters :-

1-Final plant height (cm).
2-Number of sympodial branches/plant
3- Position of the first sympodial node.

B- Yield and yield components.

1- Boll weight (g) as average of 50 random bolls
2- Number of bolls/plant.
3- Seed index as weight of 100 seeds in (g).
4-Lint percentage (%).
5-Seed cotton yield /plant (g).
6-Seed cotton yield /feddan. (Kentar = 157.5 kg).

C- Fiber properties:

The following fiber properties were measured using instrument (HVI).
1-Fiber length (m m.)
2-Fiber elongation (%)
3- Fiber strength (g/tex.)
4- Fiber fineness, (micronair reading).

All fiber properties were done under standerd atmosphere (70° f ±2 and RH65% ±2) at cotton Research Institute, Agricultural Research Center, Giza.

The obtained data were subjected to statistical analysis according to the procedure described by **Snedecor and Cochran (1980).** Significancy of differences among variables was done according to least significant differences test (L.S.D.) at 0.05 level of significance.

RESULTS AND DISCUSSION

Growth characters:

Data in Table (2) show that mineral fertilization alone or combined with biofertilizer had a favorable significant effect on plant height, No. of sympodial branches/plant and position of first sympodial node. Full mineral fertilization with NPK recorded the highest averages of plant height in both season while use of 75% mineral NPK +Bio NPK gave the best values for No. of sympodial branches/plant and position of the first sympodial node in both seasons. The use of biofertilizer alone recorded the lowest averages of plant height, No. of sympodial branches/ plant and the highest average of the first sympodial node.

These results clearly indicate that mineral fertilization, especially with respect to N element had the greatest effect on the growth characters of the cotton plant. Therefore, adding bio-fertilizers besides mineral NPK may be controlled this increase and minimized the vigorous growth phenomenon. These results are in line with those obtained by **Hemissa *et al* (2000), El-Shazly and Darwish (2001) and El-Sayed and El-Menshawy (2005).**

Yield and yield components:

Data in Table (3) reveal that, mineral and biofertilizer significantly affected boll weight, No. of open bolls /plant, lint percentage, seed cotton yield/plant and per feddan in both seasons and seed index (in the first season only). The usage of full mineral fertilizers (control) recorded the highest averages of boll weight (first season) and seed cotton yield / fed in both seasons. while usage of 50% NPK mineral fertilizer and biofertilizer NPK recorded the highest average on No. of open bolls/plant (in both seasons), lint percentage (first season) and seed cotton yield /plant (both seasons). These results are in agreement with those obtained by **Khune *et al*. (1989) and Sobh *et al*. (2000).**

Table 2

Use of 75% mineral fertilizers with NPK biofertilizers gave the best averages of seed cotton yield/fed. in both seasons. Whereas use of biofertilizers alone gave the lowest averages in both seasons. These results are in agreement with those obtained by **Galal (2003), Khune *et al*. (1989) and Sobh *et al*. (2000).** It is evident from Table (3) that the seed cotton /fed was almost, proportional to the amount of added mineral N. in both seasons, treatments (4) and (6) produced as much seed cotton yield /fed., as the control. In these treatments, 100% of mineral N was added where seeds were coated with 75% of mineral N and K in recpechae order. Also, in both seasons, treatment (8) where 75% of mineral NPK was added with complete biofertilization of NPK, produced from the significant point of view as much seed cotton yield/fed. as the control. Also, the comparison between the effect of treatments (2) and (8), where the differences in seed cotton yield/ fed was not significant, clearly indicates that neither biofertilizer P or K played any role in sustaining the seed cotton yield /fed., therefore, the superiorly of either treatment (2) or (8) could be attributed to biofertilization with nitrogen, rather than P or K. The high soil fertility level of the experimental sites from available P and K (Table 1) could be served to explain the less produced effect of mineral or biofertilizers P and K in sustaining the seed cotton yield /fed.

The previous results cleared the complementary role of bio fertilizers when applied with mineral fertilizers. This role could be estimated by about 25% of full mineral NPK fertilizers, where the most of mineral-biofertilizer combinations produced similar treatments, and interfered with those of pure mineral treatment, Therefore, it is possible to reduce the recommended doses of mineral NPK fertilizers by 25% and replaced it by the NPK biofertilizers. This performance will decrease the production costs and minimizes the pollution of the environment. Similar results were obtained by **Khune *et al* (1989) and Sobh *et al* (2000).** However, the mean values of characters were fluctuated from season to season but there was a tendency that bio-fertilizers in combinations with mineral ones improved, most characters similar results were obtained by **Galal (2003).**

Fiber properties:

Data presented in Table (4) show that mineral or biofertilizers and their combinations did not significantly affect almost all fiber properties, except micronair reading in both seasons. This might be due to the fact that these characters are essentially genetically controlled and hence were not significantly affected by agricultural practices or environmental conditions .These results are in line with those obtained by **Galal (2003), Sayed, and El-Menshawi (2005)**.

Table 3

Table 4

The previous results lead the conclusion that the bio-fertilizers had an important role in reducing the amounts of NPK mineral fertilizers, which could be applied in cotton fields by about 25%, without compromising the yield of seed cotton and the fiber quality, as well.

This performance helps in optimizing the production costs and as well minimize the pollution of the environment particularly the pollution of the soil and water.

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تأثير التسميد المعدنى والحيوى على انتاجية وصفات جودة صنف القطن جيزة٨٠

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اقيمت تجربتان حقليتان فى محطة التجارب والبحوث الزراعية بسدس - محافظة بنى سويف- فى موسمى ٢٠٠٦ ، ٢٠٠٧ بهدف دراسة تأثير اضافة المعدل الموصى به من السماد النيتروجينى والفوسفاتى والبوتاسي (٦٠، ٢٢.٥، ٢٤ كجم ن، فو٢أ، بو٢أ /للفدان) فقط اوعند استبدال جزء منها بالسماد الحيوى (ريزوباكترين، فوسفورين، بوتاسيوماج) او التسميد الحيوى فقط على بعض صفات النمو مثل طول النبات ، عدد الافرع الثمرية ، وظهور اول عقدة ثمرية وبعض صفات المحصول ومكوناته مثل وزن اللوزة، عدد اللوز الكلى للنبات، دليل البذرة ومحصول النبات والفدان وكذلك بعض صفات التيلة.

ويمكن تلخيص اهم النتائج المتحصل عليها فيما يلى:

- كان للسماد الحيوى مع المعدنى تأثيرا معنويا على صفات النمو والمحصول تحت الدراسة فى كلا الموسمين ماعدا دليل البذرة فى الموسم الثانى
- ادى استخدام معاملة الكنترول (تسميد معدنى كامل) الى تفوق فى صفات طول النبات فى الموسم الاول وكذلك عدد الافرع الثمرية/النبات ووزن اللوزة (موسم اول) ومحصول القطن الزهر/فدان.
- ادى استخدام معاملة ٧٥% من السماد المعدنى الكامل مع اضافة ريزوباكترين ،فوسفورين، بوتاسيوماج الى التفوق فى بعض الصفات مثل ظهور اول عقدة ثمرية ومحصول القطن الزهر/فدان بينما ادى استخدام ٥٠% من السماد المعدنى الكامل مع اضافة كل السماد الحيوى الى التفوق فى عدد اللوز/نبات (موسم ثانى) ومحصول القطن الزهر/نبات .
- ادى استخدام ٧٥% من السماد الفوسفاتى مع اضافة الفوسفورين الى زيادة وزن اللوزة فى الموسم الثانى.
- لم يؤثر استخدام السماد الحيوى او المعدنى معنويا على كل الصفات التكنولوجية فيما عدا النعومة والتى تأثرت معنويا بمعاملات التسميد فى كلا الموسمين.
- ادى استخدام السماد الحيوى بمفرده الى انخفاض معنوى فى جميع الصفات تحت الدراسة فى كلا الموسمين.

وتشير هذه النتائج الى إمكانية ترشيد استخدام الاسمدة المعدنيه فى حقول القطن عن طريق إضافة ٧٥% من كميات النيتروجين والفوسفور والبوتاسيوم المشار اليها وهى تعادل(٤٥كجم ن-١٦.٧كجم فو٢ ٥ا- ١٨كجم بو٢ ا/ فدان) بالإضافة الى التسميد الحيوى بتغليف بذور القطن بالأسمدة الحيوية تحت الدراسة ولعل اهمها الريزوباكترين وذلك قد يساهم فى خفض تكاليف الانتاج ويقلل من التأثير الضار على تلوث التربة والمياه.