



Faculty of Agriculture  
Department of Agronomy



**EFFECT OF FOLIAR SPRAYING OF NANO AND ORDINARY  
APPLICATION OF MINERAL (N P K) FERTILIZERS ON THE  
GROWTH ,YIELD , YIELD COMPONENTS AND FIBER PROPERTIES  
OF TWO EGYPTIAN COTTON (*Gossypium barbadense L*) CULTIVARS**

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### 5- SUMMARY

The current study was conducted at Sakha Agricultural Research Station Farm, to evaluate in comparison studies, the impact of foliar spraying with nano-NPK fertilizer and traditional foliar application of mineral NPK, as well as in combination mixed treatments between them on Egyptian cotton (*Gossypium barbadense* L.) cultivars Giza 94 (long-staple) and Giza 96 (extra-long-staple).

Two field trials were carried out each of one cultivar during 2018 and 2019 growing seasons, for studying the different nine fertilizer treatments as follows:

- T1- 100% CS-NPK- nano-composite fertilizer (fol. appl.).
- T2- 100% RR. traditional- NPK fertilizer (fol. appl.) (control)
- T3- 100 % RR. traditional- NPK fertilizer (soil appl.).
- T4- 75% fol. appl. nano-NPK + 25% traditional NPK (soil appl.).
- T5- 50% fol.appl.nano-NPK + 50% traditional NPK (soil appl.).
- T6- 25% fol.appl. nano-NPK + 75% traditional NPK (Soil appl.)
- T7- 75% fol.appl. trad. NPK + 25% trad.NPK(soil appl.)
- T8- 50% fol.appl. trad. NPK + 50% trad. NPK (soil appl.).
- T9- 25% fol.appl. trad. NPK +75% trad. NPK (soil appl.).

The main obtained results were summarized as follows:

#### **1.Dynamic light scattering analysis(DLS):**

The DLS pattern of suspension of NPK nano-particles synthesized with CS-PMAA for foliar application of G.94 (LS) cotton cv. and G.96 (ELS) cotton cv. with the chitosan-NPK-nanoparticles composite were characterized by TEM, Zeta potential and Size distribution, the results showed that size distribution was from 166.9-1473.0 nm and zeta potential was 40.7 (mV) and Z- average size 1024.0 (dnm) and polydisperse index (PDI) Chitosan nanoparticles, suspension was 0.853, indicating that

## ***5. Summary***

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synthesized particles are good and uniform, sizes with spherical shape, and in nanoscale.

### **2.Effect on growth parameters:**

There were significant differences among the nine studied fertilizer testaments. Application of 100% nano-NPK fertilizer gave the tallest cotton plants at both two growth stages, 100 and 120 DAS of cotton cv. G. 94 (LS) in both seasons 2018 and 2019..

Addition of fertilizer (nono or mineral or coordination of both) has increased plant height and more enhanced when nano-fertilizer mixed with the traditional ones, even at a lower applications rate. The same trend was observed in G. 96 (ELS) cotton cultivar with few exceptions in seasons or growth stages.

Results on growth parameters also showed that No. of sympodial branches significantly affected by different fertilizer treatments in 2019 season only, while in 2018 season the differences among fertilizer treatments were not significant. Application of 100% nano-NPK fertilizer resulted in the highest number of sympodia per plant at 100 and 120 DSA and the lowest ones were found in mixed combination of traditional NPK treatment (T7, T8 and T9) compared with control. The number of effective reproductive sympodia produced is a good indicator as it is the major yield determinant.

Tatal leaf area/plant LA (dm<sup>2</sup>) and leaf area index (LAI) as growth parameter was significantly affected by different fertilizer treatments at 100 and 120 DAS in both seasons of the two cultivars. The highest mean values of total leaf area/plant and LAI were in favor of 100% nano-NPK fertilizer treatment (T1). The magnitude of LA and LAI as important growth parameter due to its related to plant metabolic prossesses (Photosynthesis)

Results on growth parameters also exhibited that total of both fesh and dry weights per plant was significantly affected by different fertelizer

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## ***5. Summary***

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treatments. The highest mean values of either fresh or dry weights were resulted from the treatment received 100% nano-NPK fertilizer (T1), this treatment was ranked first among all studied treatments. As well as the fertilizer treatments involved nano-NPK mixed in combinations with traditional mineral NPK (T4, T5 and T6) were came out directly after (T1) and surpassed the control. G.94 (LS) and G. 96(ELS) gave the same trend in both seasons with few exceptions due to its sensitivity of each cotton cultivar to internal and external microenvironmental surrounded of cotton plants.

The other growth parameters like No. of leaves per plant was not significantly affected by different fertilizer treatments in 2018 growing seasons for both cotton cultivars at 100 and 120 DAS. While there were significant differences among treatments in 2019 season. No doubts that all the above mentioned growth parameters were increased with any given additional fertilizer supplements as (nano or mineral or coordination of both).

### **3.Effect on yield parameters:**

Seed cotton yield in kentars/ feddan was significantly affected by fertilizer treatments of both cotton cultivars G. 94 and G. 96. in 2018 and 2019 growing seasons. Application of 100% nano-NPK fertilizer (T1) gave the highest seed cotton yield of the two cotton cultivars in 2018 and 2019 growing seasons. Also the fertilizer treatments involved nano-NPK mixed in coordination with NPK traditional mineral fertilizer (T4, T5 and T6) gave higher seed cotton yields compared to control treatment The lowest seed cotton yields were produced from the fertilizer treatment were only restricted of mineral NPK fertilizer.

There were significant difference among the nine studied fertilizer treatments for lint cotton yield(kentars/feddan) of G.94 long-staple and G.96 extra-long staple cotton cultivars in 2018 and 2019 growing seasons. The

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## ***5. Summary***

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highest lint yields were resulted from the fertilizer treatment was received 100% nano-NPK(T1) or mixed in combinations nano with traditional mineral-NPK fertilizer, T4 and T5 which surpassed the control treatment.

Regarding seed cotton and lint cotton yields per plant as the yield parameters were not significantly affected by different fertilizer treatments in 2018 growing season of the two cotton cultivars (G.94 and G. 96).While, there were significant differences among fertilizer treatments were found during 2019 season with regard to the yield parameters per plant. Application 100 % nano-NPK fertilizer (T1) and nano–NPK mixed in combination with mineral NPK gave significant higher plant yields in the treatments (T4, T5 and T6) compared with the control. With few exceptions the rest fertilizer treatments (T7, T8 and T9) involved mineral NPK only gave lowest yield/ plant and were close or at par with control in 2019 season for both cultivars.

The other yield parameters such as lint percentage, there were significant differences among fertilizer treatments, only in 2019 growing season, while in 2018 season the differences were not significant and all values of lint percentage in both season were at par with control treatment and somewhat tended in favor nano–NPK fertilizer treatments.

Regarding the seed index yield parameter, there were significant differences among nano–NPK fertilizer and mineral NPK ones or the coordination of both in 2018 season of cultivar G.96 (ELS). However, higher values of seed index were in favor of nano-NPK fertilizer (T1, T4, T5 and T6) in both seasons compared with control treatment.

With regard to, boll weight (seed cotton weight/boll and lint cotton weight/boll) as yield parameters were not significantly affected by different fertilizer treatments in both season of the two cotton cultivars; G. 94 and G.96. However, the highest seed cotton weight/boll and lint weight/boll (gm) were resulted from 100% nano-NPK fertilizer (T1) and nano-NPK

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## ***5. Summary***

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coordinated with mineral NPK treatments (T4, T5 and T6) in both 2018 and 2019 growing seasons compared with control treatment. The other rest fertilizer treatments with traditional mineral (T7, T8 and T9) gave the lowest ones which were at par or slightly on par of control treatment).

The other yield parameter such as number of flowers, No. of total bolls setting and No. of opened bolls per plant were significantly affected by different fertilizer treatments in both seasons with an exception of yield parameter of No. of total bolls setting/plant of G. 94 cv. No. of opened bolls/plant of G. 96 cv. in 2018 season were not significant. Higher values of the above mentioned yield parameters were increased with any given additional fertilizer supplements as (nano or mineral or Coordination of both) comparing to control fertilizer treatment.

Regarding the yield parameter; earliness of crop maturity was significantly affected by different fertilizer treatments. The highest values of earliness percentages were resulted from the application of 100% nano-NPK fertilizer (T1) as well as fertilizer treatments involved nano-NPK mixed in combination with traditional mineral NPK (T4, T5 and T6) in 2018 season compared with control of both G.94 and G. 96 cotton cultivars. While the traditional mineral NPK fertilizer (T7, T8 and T9) slightly increased the earliness of crop maturity comparing to control in 2018 season of G. 94 and in 2019 season of G.96 cultivar.

Regarding chlorophyll content of the cotton leaves as physiological parameter, which is an important index of plant growth. Results on chlorophyll(a) ( $\text{mg}/\text{dm}^2$ ) indicated that there were insignificant differences among fertilizer treatments of both G. 94 and G. 96 cotton cultivars in both seasons 2018 and 2019 at growth stages of 100 and 120 DAS. No constant trend was clear in chlorophyll content in the leaves however, some higher values of chlorophyll content were in favor of fertilizer treatments involved nano-NPK or nano-coordinated of mineral NPK fertilizer. It is also clear

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## ***5. Summary***

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from the results that chlorophyll (a, b and total) content is always higher at 100 DAS than at 120 DAS in both season of the two cotton cultivars.

With regard to the biochemical analysis of cotton leaf; for leaf nitrogen content (N%), leaf phosphorous content (P%) and leaf potassium content (K%), there were significant differences among fertilizer treatments in leaf content of N%, P%, and K% of both cotton cultivars in 2018 and 2019 growing seasons. Application of 100% nano-NPK fertilizer (T1) gave the highest percent of N and K compared with control treatment. The same trend was observed in case of applications the Coordination of both nano and mineral NPK fertilizer treatments (T4, T5 ad T6) where; its gave higher percent values of content of N and k compared to control treatment of both G.94 and G.96 cotton cultivars in 2018 and 2019 growing season. On the other hand, with regared to leaf P% content, the highest values were found in case of application of recommended dose of traditional mineral NPK fertilizer as soil addition compared with control. Higher values of P% were detected in nano- NPK mixed in combinations with mineral NPK treatments T5 and T6 in both seasons.

Regarding of biochemical analysis of cotton seeds, like seed oil content (oil%), seed protein content (Pr. %) and seed nitrogen content (N%). There were significant differences among fertilizer treatments in biochemical parameters; seed oil content (oil%) seed protein content (Pr.%) and seed nitrogen content (N%). The highest seed oil content was observed in the fertilizer treatment which received 100% nano-NPK fertilizer and the lowest ones were found in the control treatment and the treatments involved traditional NPK fertilizers (T7, T8 and T9). On the other hand, application of fertilizer treatments involved of nano-NPK coordinated with traditional mineral NPK (T4 and T5) gave higher percent of seed oil content in both seasons 2018 and 2019 of the two cotton cultivars compared to control. With regard to seed protein content (Pr%), results indicated that this

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## ***5. Summary***

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biochemical parameter behaved the same trend of seed oil content in both seasons. In the same time results showed that there were higher values of seed nitrogen content (N%) resulted from the fertilizer treatment was received 100% nano-NPK or from nano-coordinated with traditional mineral NPK fertilizer compared to control in both seasons and both two cultivars.

Regarding the studied fiber properties, it is clear that different fertilizer treatments had no significant effect on these fiber properties. However, the results exhibited slightly increase in fiber length (UHM mm) in favor 100% nano-NPK fertilizer (T1) compared with control. Also there were slight increase in fiber length in case of the fertilizer treatments involved nano-NPK mixed with traditional mineral NPK in combinations (T4, T5 and T6) compared with control in 2019 season for both two cultivars. Uniformity index (UI%) was not significantly affected by different fertilizer treatments. However, there were slight increases in uniformity index of the treatment (T1) 100% nano-NPK and the other treatments involved nano-NPK mixed in combinations with traditional mineral NPK (T4, T5 and T6) compared to control in 2018 and 2019 growing seasons of both G.94 and G.96 cotton cultivars.

Regarding fiber strength (g/tex), results showed that there were no significant differences among fertilizer treatments in 2018 and 2019 growing seasons. However nano-NPK fertilizer treatments did not exceed the control in 2018 for both G.94 and G. 96 cotton cultivars.

The same nano-NPK treatment (T1, T4, T5, ad T6) in 2019 season surpassed fiber strength value of control. The rest fertilizer treatments (mineral NPK) gave fiber strength values close at par with control.

With regard to micronaire reading (Mic) data showed that such character was not significantly affected by different fertilizer treatments. The micronaire values of nano-NPK or mineral or coordination of both were at par of control threatment in both seasons and cotton cultivars. Also

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## ***5. Summary***

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maturity ratio (Mat) exhibited the same trend of micronaire values under different fertilizer treatments and all values of maturity were at par of control in 2018 and 2019 seasons of the two cotton cultivars G. 94 and G. 96. Regarding of fiber elongation % during 2018 and 2019 seasons, there were insignificant differences among fertilizer treatments in fiber elongation % which its values were bellow of control treatment in 2018 season while in 2019 the values of fiber elongation % were about close at par with control of G.96 cotton cultivar. Fiber elongation % of G. 94 cotton cultivar were increased in their values in 2019 season and came out on par Of control with few exceptions.

Regarding Yellowness degree (+b) and reflection degree (Rd%), it seems that there was a constant relationship between the above fiber parameters and maturity ratio. It is noticed that fertilizer treatments had higher values of maturity ratio were corresponded with low values of yellowness degree (+b) and also low values of fiber reflection percent (Rb%) which positively reflected in fiber brightness.

### **Conclusions and recommendations:**

According to the findings were obtained from the current study, it could be concluded that foliar application of 100% nano NPK fertilizer at the concentration of (500 ppm N:60ppm P: 400 ppm K), as well as mixed nano with traditional NPK in combinations treatments at different concentrations of both, significantly enhanced growth, yield performance parameters, seed quality parameters and earliness of crop maturity compared to the other fertilizer treatments and control. It could be also recommended that nano fertilizer is the unique better as an alternate source of NPK traditional mineral fertilizer to cotton in the future. Also it could be avoided an excessive applications of traditional mineral NPK fertilizers by farmers, and reduces not only substantial economic and resources losses but also very serious environmental pollution.

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