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# An Accommodation Method for Statistical Analysis of the Insignificant Interactions Between Effects of Nitrogen, Potassium and Mepiquat Chloride on Cotton Yield

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**Abstract:** We always work to set as many bolls as possible to produce maximum lint yields (the reproductive part), but this needs to develop sufficient plant structure (vegetation) to support the boll load. Field experiment was conducted at the Agricultural Research Center, Giza, Egypt, during the 1999 and 2000 growing seasons with the objective of studing the effect of nitrogen (N) fertilizer at the rates of 95 or 143 kg N $ha^{-1}$ and foliar application of potassium (K) at the rates of 0.0, 319, 638 or 957 g K $ha^{-1}$, applied twice; 70 and 95 d after planting and the plant growth regulator (PGR) Mepiquat Chloride (MC) applied twice; 75 d after planting at the rates of 0.0 or 48 g active ingredient (ai) $ha^{-1}$ and 90 d after planting at 0.0 or 24 g ai $ha^{-1}$ on yield of Egyptian cotton (*Gossypium barbadense* cv. Giza 86). Results revealed that seed cotton yields $plant^{-1}$ and seed cotton and lint yield $ha^{-1}$, have been increased due to the higher N rate and use of foliar application of K and MC. However, applying N at 143 kg $ha^{-1}$ combined with foliar application of K at 957 g K $ha^{-1}$ along with MC at 48+24 g ai $ha^{-1}$ has improved cotton growth and yield. Also, an accommodation method for statistical analysis of the insignificant interactions between treatments has been carried out depending on the LSD values.

**Key words:** An accommodation method · cotton yield · mepiquat chloride · nitrogen · potassium

## INTRODUCTION

The world's overpopulation, occurring at the end of the 20th Century, has resulted in a wide gap between production and consumption in most of the field crops. Soil fertility and crop management are the two most important factors of the modern agricultural activity. Managing the balance of vegetative and reproductive growth is the essence of managing a cotton crop. It is well known from numerous fertilizer experiments that the yield of field crop has been strongly dependent on the supply of mineral nutrients such as nitrogen (N), which has been used in crop cultivation for full exploitation of the genetic potential [1]. Mineral nutrient supply strongly affects leaf area and the rate of photosynthesis and, thus, the ability of the plant to deliver photosynthates to the sink sites [2]. Who also stated that the positive effect of mineral nutrient supply on a number of sink organs results, not only from an increase in mineral nutrient supply, but also from an increase in the photosynthate supply to the sink sites or from hormonal effects. Reddy *et al.* [3], in a pot experiment under natural environmental conditions with 20-d old cotton plants receiving 0, 0.5, 1.5 or 6 mM $NO_3^-$, found that net photosynthetic rates, stomatal conductance and transpiration were positively correlated with leaf N concentration. Additionally, with a dynamic crop like cotton, excessive N serves to delay maturity, promote vegetative tendencies and usually results in lower yields [4]. Therefore, errors made in N management that can impact the crop can cause either deficiencies or excesses. If a deficiency of N is developing in a cotton crop, it is not particularly difficult to diagnose and correct. Excess N fertility levels, which can be damaging to final crop productivity, are more difficult to detect and to correct.

The importance of potassium (K) fertilization in Egyptian agriculture has arisen since the completion of the High Dam that resulted in the deposition of the suspended Nile silt in the upstream of the formed lake. This Nile silt was a source of enriching the Egyptian soils with K-bearing minerals during the seasonal floods [5]. However, continuous crop removal without replenishment can lead to an irrepairable damage of the soil fertility. A deficiency in K may affect varied processes such as

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respiration, photosynthesis, chlorophyll development and can also affect water content of leaves [6]. Who also indicated that potassium increased the photosynthetic rates of crop leaves, carbon dioxide ($CO_2$) assimilation rates and facilitates carbon movement. Potassium nutrition has pronounced effects on carbohydrate partitioning by affecting either phloem export of photosynthates (mainly sucrose) or growth rate of sink and/or source organs. Furthermore, K has an important role in the translocation of photosynthates from sources to sinks [7]. Potassium deficiencies can limit the accumulation of crop biomass. This has been attributed to (i) a reduction in the partitioning of assimilates to the formation of leaf area, or (ii) a decrease in the efficiency with which the intercepted radiation has been used for the production of above-ground biomass [8]. Pettigrew [9] stated that the elevated carbohydrate concentrations remaining in source tissue, such as leaves, appeared to be part of the overall effect of K deficiency in reducing the amount of photosynthates available for reproductive sinks and thereby produced changes in lint yield and fiber quality seen in cotton.

In spite of using high-yielding cultivars and the best agronomic practices, yield levels could not be substantially increased. Excess of vegetative growth, poor bud development, shedding of fruiting forms and growth imbalance between the source and sink are responsible for the unpredictable behaviour of the crop. Several approaches have tried-out to break this yield plateau, among them the application of plant growth regulators (PGR's), particularly Mepiquat Chloride (MC) that has received greater attention recent years. The advantage of PGR's has been that they give producers the flexibility to modify plant growth to suit current growing conditions in order to maximize benefits [10]. Thus, MC as a PGR can be recommended to manage the vegetative development of cotton plants in order to offset the effect of excessive water irrigation or N by decreasing both overall plant height and length of lateral branches [11] and thus enhance reproductive organs by allowing plants to direct more energy towards the reproductive structure [12]. Nuti *et al.* [13] stated that, MC, which is applied to cotton to control vegetative growth, is thought to cause a shift in partitioning of photo-assimilates from vegetative to reproductive growth. Redistribution of assimilates between vegetative and reproductive growth may be one means by which yields can be increased. Zhao and Oosterhuis [14] stated that, compared with the untreated control, MC application improved leaf photosynthetic rate and increased lint ield.

The objective of this study was to evaluate the effects of N fertilization rate, foliar K application and MC application on the yield of cotton with the aim to identify production treatments that may improve the yield. Also, an accommodation method for statistical analysis of the insignificant interactions between treatments is being suggested.

## MATERIALS AND METHODS

Field experiment was conducted at the Agricultural Research Center, Ministry of Agriculture in Giza (30° N', 31° 28'E and 19 m altitude), Egypt using the cotton cultivar 'Giza 86' (*Gossypium barbadense* L.) in 1999 and 2000. The soil type in both seasons was clay loamy. Textural properties according to Kilmer and Alexander [15] and chemical characteristics according to Chapman and Pratt [16] of the soil in both seasons are illustrated in Table 1. Each experiment included 16 treatment combinations of: (i) Two N rates (95 and 143 kg N $ha^{-1}$) were applied as ammonium nitrate with lime ($NH_4NO_3$+$CaCO_3$, 33.5% N) at two equal doses, 6 and 8 weeks after planting. Each application (in the form of pinches beside each hill) was followed immediately by irrigation. (ii) Four K rates (0, 319, 638 and 957 g K $ha^{-1}$) were applied as potassium sulfate ($K_2SO_4$, 48-50% $K_2O$) as a foliar spray, 70 and 95 days after planting (during square initiation and boll development stage). The solution volume applied was 960 l $ha^{-1}$. (iii) Two rates from the PGR, 1,1-dimethylpiperidinium chloride (Mepiquat Chloride 'MC' or 'Pix' with ai 50 g $l^{-1}$) was

Table 1: Textural and chemical properties of soil samples

| Season | 1999 | 2000 |
|---|---|---|
| Textural properties | | |
| Clay (%) | 43.0 | 46.5 |
| Silt (%) | 28.4 | 26.4 |
| Fine sand (%) | 19.3 | 20.7 |
| Coarse sand (%) | 4.3 | 1.7 |
| Soil texture | Clay loam | Clay loam |
| Chemical properties | | |
| Organic matter (%) | 1.8 | 1.9 |
| Calcium carbonate (%) | 3.0 | 2.7 |
| Total soluble salts (%) | 0.1 | 0.1 |
| pH (1:2.5) | 8.1 | 8.1 |
| Total nitrogen (%) | 0.1 | 0.1 |
| Available nitrogen (mg $kg^{-1}$ soil) | 50.0 | 57.5 |
| Available phosphorus (mg $kg^{-1}$ soil) | 15.7 | 14.2 |
| Available potassium (mg $kg^{-1}$ soil) | 370.0 | 385.0 |
| Total sulphur (mg $kg^{-1}$ soil) | 21.3 | 21.2 |
| Calcium (meq $100g^{-1}$) | 0.2 | 0.2 |

Table 2: A summary of treatments

| Treatment | | | | Treatments | | | |
|---|---|---|---|---|---|---|---|
| N rate (kg $ha^{-1}$) | K rate (g $ha^{-1}$) | MC rate (g $ha^{-1}$) | Treatment no. | N rate (kg $ha^{-1}$) | K rate (g $ha^{-1}$) | MC rate (g $ha^{-1}$) | Treatment no. |
| 95 | 0 | 0 | 1 | 143 | 0 | 0 | 9 |
| | | 48+24 | 2 | | | 48+24 | 10 |
| | 319 | 0 | 3 | | 319 | 0 | 11 |
| | | 48+24 | 4 | | | 48+24 | 12 |
| | 638 | 0 | 5 | | 638 | 0 | 13 |
| | | 48+24 | 6 | | | 48+24 | 14 |
| | 957 | 0 | 7 | | 957 | 0 | 15 |
| | | 48+24 | 8 | | | 48+24 | 16 |

introduced from BASF, 6700 Ludwigshafen, Germany were foliar applied (75 days after planting at 0 or 48 g ai $ha^{-1}$, 90 days after planting at 0 and 24 g ai $ha^{-1}$) where the solution volume applied was also 960 l $ha^{-1}$. The K and MC were applied to the leaves with uniform coverage using a knapsack sprayer. The pressure used was 0.4 kg $cm^{-2}$, resulting in a nozzle output of 1.43 l $min^{-1}$. The application was carried out between 9.0 and 11.0 h. A summary of all treatments is shown in Table 2.

A randomized complete block design with four replications was used. Seeds were planted on April 3, 1999 and April 20, 2000. Plot size was 1.95 X 4 m including three ridges (beds) (after the precaution of border effect was taken into consideration). Hills were spaced 25 cm apart on one side of the ridge, with seedlings thinned to two plants/hill, six weeks after planting. This provided a plant density of 123,000 plants $ha^{-1}$. Total irrigation amount during the growing season (surface irrigation) was about 6,000 $m^3$ $ha^{-1}$. The first irrigation was applied three weeks after planting, with the second three weeks later. Thereafter, the plots were irrigated every two weeks until the end of the season (October 11, 1999 and October 17, 2000, respectively), with total of nine irrigations. On the basis of soil test results, phosphorus (P) fertilizer was applied at the rate of 24 kg P $ha^{-1}$ as calcium superphosphate during land preparation. The K fertilizer was applied at the rate of 47 kg K $ha^{-1}$ as potassium sulfate before the first irrigation (the recommended level for semi-fertile soil). Fertilization (P and K), along with pest and weed management was carried out during the growing season, according to local practice performed at the experimental station.

In both seasons, ten plants were randomly taken from the center ridge of each plot to determine the seed cotton yield in g $plant^{-1}$. First hand picking was made on 20 and 26 September and final picking on 11 and 17 October in season 1999 and season 2000, respectively. Total seed cotton yield of each plot (including ten plant sub samples) was ginned to determine seed cotton and lint yield (kg $ha^{-1}$).

Results were analyzed as a factorial experiment in a randomized complete block design for the studied characters each season and the combined statistical analysis for the two seasons, following the procedure outlined by Snedecor and Cochran[17]. The Least Significant Difference (LSD) test method, at 5% level of significance was used to verify the significance of differences among treatment means and the interactions to determine the optimum combination of N, K and MC.

## RESULTS AND DISCUSSION

Results from the analysis of variance for yield (combined data of the two seasons) are presented in Table 3.

**Effects of main treatments on yield:** Seed cotton yield $plant^{-1}$, as well as seed cotton and lint yield $ha^{-1}$, were significantly increased (by as much as 12.8, 12.8 and 12.3%, respectively) when raising N-rate (Table 4). Causes of these yield increases were due to increased boll numbers and boll weight. This was attributed to the fact that N was an important nutrient controlling new growth and preventing abscission of squares and bolls and is also essential for photosynthetic activity [18]. Perumai [19] stated that, N-mediated integration of growth and development led to a favorable canopy environment for productivity (square formation and seed cotton yield). Zhao and Oosterhuis [20] indicated that, with cotton, low N supply at the reproductive stage decreased leaf area, leaf net photosynthetic rate and chlorophyll content. They also, indicated that, fruit abscission of N deficient plants increased and lint yield decreased. Similar results were obtained by Ram *et al.* [21].

Table 3: Mean squares for combined analysis of variance for yield in cotton during 1999 and 2000

| Source | df | Seed cotton yield (g plant$^{-1}$) | Seed cotton yield (kg ha$^{-1}$) | Lint yield (kg ha$^{-1}$) |
|---|---|---|---|---|
| Year | 1 | 147.21** | 1415571.4** | 332917.8** |
| Replicates within years | 6 | 40.27* | 404859.0* | 50458.4* |
| Treatments | 15 | 75.94** | 714189.8** | 83868.9** |
| Nitrogen (N) | 1 | 456.74** | 4325402.3** | 500162.5** |
| Potassium (K) | 3 | 132.53** | 1223590.9** | 145491.8** |
| Mepiquat Chloride (MC) | 1 | 261.15** | 2504937.5** | 294768.0** |
| N×K | 3 | 3.47 | 31778.5 | 3934.8 |
| N×MC | 1 | 0.17 | 1463.4 | 298.6 |
| K×MC | 3 | 4.19 | 36432.4 | 4632.6 |
| N×K×MC | 3 | 0.18 | 1879.3 | 209.1 |
| Treatments×Year | 15 | 2.50 | 24239.8 | 3070.9 |
| Error | 90 | 14.36 | 135377.4 | 16752.8 |
| SD | | 3.79 | 367.90 | 129.4 |
| CV % | | 12.04 | 12.00 | 12.0 |

*Significant at p = 0.05, **Significant at p = 0.01

Table 4: Effect of N-rate and foliar application of K and MC on yield in cotton combined over two seasons 1999 and 2000

| Treatment | Seed cotton yield (g plant$^{-1}$) | Seed cotton yield (kg ha$^{-1}$) | Lint yield (kg ha$^{-1}$) |
|---|---|---|---|
| N rate (kg ha$^{-1}$) | | | |
| 95 | 29.58$^{b}$ | 2882.3$^{b}$ | 1020.0$^{b}$ |
| 143 | 33.36$^{a}$ | 3250.0$^{a}$ | 1145.0$^{a}$ |
| LSD (0.05) | 1.33 | 128.9 | 45.4 |
| K rate (g ha$^{-1}$) | | | |
| 0 | 28.61$^{b}$ | 2792.5$^{b}$ | 988.2$^{b}$ |
| 319 | 31.51$^{a}$ | 3068.6$^{a}$ | 1083.4$^{a}$ |
| 638 | 32.51$^{a}$ | 3163.0$^{a}$ | 1115.2$^{a}$ |
| 957 | 33.25$^{a}$ | 3240.7$^{a}$ | 1143.1$^{a}$ |
| LSD (0.05) | 1.88 | 182.3 | 64.1 |
| MC rate (g ha$^{-1}$) | | | |
| 0 | 30.04$^{b}$ | 2926.3$^{b}$ | 1034.5$^{b}$ |
| 48+24 | 32.90$^{a}$ | 3206.1$^{a}$ | 1130.5$^{a}$ |
| LSD (0.05) | 1.33 | 128.9 | 45.4 |
| SD | 3.79 | 367.9 | 129.4 |
| CV % | 12.04 | 12.0 | 12.0 |

Values followed by the same letter in a column are not significantly different from each other at p = 0.05

When K was applied at all three K rates (319, 638 and 957 g k ha$^{-1}$), seed cotton yield plant$^{-1}$ and seed cotton and lint yield ha$^{-1}$ were significantly increased. These increases could be attributed to the favourable effects of K on yield components, i.e. number of opened bolls plant$^{-1}$ and boll weight, leading consequently to higher cotton yield. The role of K is that it could decrease abscission of buds and bolls and hence increase yield. Zeng [22] indicated that, K fertilizer reduced boll shedding. Potassium deficiencies can limit the accumulation of crop biomass. This is attributed to: (i) a reduction in the partitioning of assimilates to the formation of leaf area, or (ii) a decrease of the efficiency with which the intercepted radiation is used for the production of the aboveground biomass [8]. Furthermore, K has an important role in the translocation of photosynthates from sources to sinks [7]. This means that K deficiency during the reproductive period markedly changes the structure of fruit-bearing organs and decreases yield and its quality. Similar results for yield response to K application as in the present study were obtained by Gormus [23].

Generally, the originally available soil nutrients before applying K fertilizer could be sufficient to fulfill the needs of plants to a large extent during the early growth stage. However, during the extended period of flowering

Table 5: Effect of interaction between N rate and foliar application of K on yield combined over two seasons 1999 and 2000

| Character | Seed cotton yield (g plant$^{-1}$) | | Seed cotton yield (kg ha$^{-1}$) | | Lint yield (kg ha$^{-1}$) | |
|---|---|---|---|---|---|---|
| | N rate (kg ha$^{-1}$) | | | | | |
| K rate (g ha$^{-1}$) | 95 | 143 | 95 | 143 | 95 | 143 |
| 0 | 27.04$^{d}$ | 30.18$^{c}$ | 2639.2$^{d}$ | 2945.8$^{c}$ | 936.0$^{d}$ | 1040.3$^{c}$ |
| 319 | 29.73$^{c}$ | 33.28$^{ab}$ | 2896.6$^{c}$ | 3240.5$^{ab}$ | 1025.3$^{c}$ | 1141.5$^{ab}$ |
| 638 | 30.16$^{c}$ | 34.86$^{a}$ | 2935.5$^{c}$ | 3390.4$^{a}$ | 1037.2$^{c}$ | 1193.3$^{a}$ |
| 957 | 31.38$^{bc}$ | 35.11$^{a}$ | 3058.0$^{bc}$ | 3423.3$^{a}$ | 1081.4$^{bc}$ | 1204.7$^{a}$ |
| LSD (0.05) † | 2.66 | | 257.80 | | 90.70 | |

Values followed by the same letter in columns under every character head are not significantly different from each other at p = 0.05, † Accommodation LSD

Table 6: Effect of interaction between N rate and foliar application of MC on yield combined over two seasons 1999 and 2000

| Character | Seed cotton yield (g plant$^{-1}$) | | Seed cotton yield (kg ha$^{-1}$) | | Lint yield (kg ha$^{-1}$) | |
|---|---|---|---|---|---|---|
| | MC rate (g ha$^{-1}$) | | | | | |
| N rate (kg ha$^{-1}$) | 0 | 48+24 | 0 | 48+24 | 0 | 48+24 |
| 95 | 28.11$^{c}$ | 31.04$^{b}$ | 2739.1$^{c}$ | 3025.6$^{b}$ | 970.4$^{c}$ | 1069.5$^{b}$ |
| 143 | 31.96$^{b}$ | 34.75$^{a}$ | 3113.5$^{b}$ | 3386.5$^{a}$ | 1098.5$^{b}$ | 1191.4$^{a}$ |
| LSD (0.05) † | 1.88 | | 182.30 | | 64.10 | |

Values followed by the same letter in columns under every character head are not significantly different from each other at p = 0.05, † Accommodation LSD

and boll setting stage (about 60 days) K fertilizer could not be sufficient to fulfill the needs of plants, which would need additional amounts of nutrients in terms of fertilizers.

Mepiquat Chloride, significantly increased seed cotton yield plant$^{-1}$, as well as seed cotton and lint yield ha$^{-1}$ (by 9.5, 9.6 and 9.3%, respectively), compared to the untreated control. These results may be attributed to the promoting effect of this substance that have beneficial and supplemental affects leading to yield enhancement (boll retention and boll weight). Biles and Cothren [24] have attributed this yield effect to changes in maturity and fruiting distribution due to MC application. Nuti *et al.* [13] stated that, MC, which is applied to cotton to control vegetative growth, is thought to cause a shift in partitioning of photo-assimilates from vegetative to reproductive growth. Redistribution of assimilates between vegetative and reproductive growth may be one means by which yields can be increased. Zhao and Oosterhuis [14] found that, compared with the control, application of MC improved leaf photosynthetic rate and increased lint yield. These results agree with those obtained by Ram *et al.* [21].

**Effects of interactions between treatments on yield:** No significant interactions were found among the variables in the present study (N rates, K rates and MC) with respect to the characters under investigation. Generally, interactions indicated that, the favourable effects accompanied the application of N, spraying of cotton plants with K combined with MC on cotton productivity, were more obvious by applying N at 143 kg ha$^{-1}$, combined with spraying cotton plants with K at 957 g ha$^{-1}$ and also with MC at 48+24 g ai ha$^{-1}$. Regarding insignificant interaction effects, sensible increases were found in seed cotton yield h$^{-1}$ (about 40%) as a result of applying the same combination. This mean that the effects of variables under investigation were additive or perhaps have some synergistic effects. Boman and Westerman [25] found that no significant N x MC rate interactions on yield of cotton cv. Paymaster 404 were noted when it received 0-227 kg N ha$^{-1}$ and sprayed at early flowering with 0, 25 or 50 g MC ha$^{-1}$. In this experiment there are sensible differences between the interactions, i.e. the first order (Tables 5-7) and the second order (Table 8). However, these interactions did not reach the level of significance, which may be due the heterogeneity of the soil. So, an accommodation method for statistical analysis of the insignificant interactions between treatments in factorial experiments was suggested to be considered, depending on the LSD values to verify the significant different between treatment combinations regardless of the insignificance of the interaction effects from the

Table 7: Effect of interaction between K rate and foliar application of MC on yield combined over two seasons 1999 and 2000

| Character | Seed cotton yield (g plant$^{-1}$) | | Seed cotton yield (kg ha$^{-1}$) | | Lint yield (kg ha$^{-1}$) | |
|---|---|---|---|---|---|---|
| | MC rate (g ha$^{-1}$) | | | | | |
| K rate (g ha$^{-1}$) | 0 | 48+24 | 0 | 48+24 | 0 | 48+24 |
| 0 | 27.22[c] | 29.99[b] | 2655.0[c] | 2930.0[b] | 941.1[c] | 1035.3[b] |
| 319 | 29.66[bc] | 33.35[a] | 2891.3[bc] | 3245.8[a] | 1022.0[bc] | 1144.9[a] |
| 638 | 31.00[b] | 34.03[a] | 3014.1[b] | 3311.8[a] | 1064.2[b] | 1166.3[a] |
| 957 | 32.28[ab] | 34.21[a] | 3144.7[ab] | 3336.6[a] | 1110.7[ab] | 1175.5[a] |
| LSD (0.05) † | 2.66 | | 257.8 | | 90.7 | |

Values followed by the same letter in columns under every character head are not significantly different from each other at p = 0.05, † Accommodation LSD

Table 8: Effect of interactions between N rate, foliar application of K and MC on yield in cotton combined over two seasons 1999 and 2000

| N rate (kg ha$^{-1}$) | K rate (g ha$^{-1}$) | MC rate (g ha$^{-1}$) | Seed cotton yield (g plant$^{-1}$) | Seed cotton yield (kg ha$^{-1}$) | Lint yield (kg ha$^{-1}$) |
|---|---|---|---|---|---|
| 95 | 0 | 0 | 25.54[e] | 2490.4[e] | 884.4[e] |
| | | 48+24 | 27.85[de] | 2716.3[de] | 963.2[de] |
| | 319 | 0 | 28.71[de] | 2793.6[de] | 987.6[de] |
| | | 48+24 | 30.36[cd] | 2956.1[cd] | 1046.7[cd] |
| | 638 | 0 | 28.54[de] | 2788.0[de] | 987.6[de] |
| | | 48+24 | 31.62[bcd] | 3077.0[bcd] | 1087.4[bcd] |
| | 957 | 0 | 31.62[bcd] | 3077.4[bcd] | 1086.7[bcd] |
| | | 48+24 | 32.40[bc] | 3160.0[bc] | 1116.2[bc] |
| 143 | 0 | 0 | 28.91[cd] | 2819.7[cd] | 997.8[cd] |
| | | 48+24 | 31.48[bcd] | 3066.3[bcd] | 1080.8[bcd] |
| | 319 | 0 | 33.28[ab] | 3234.7[ab] | 1140.8[ab] |
| | | 48+24 | 34.20[ab] | 3333.4[ab] | 1174.7[ab] |
| | 638 | 0 | 31.45[bc] | 3072.0[bc] | 1082.9[bc] |
| | | 48+24 | 35.08[ab] | 3414.7[ab] | 1202.3[ab] |
| | 957 | 0 | 36.44[a] | 3546.2[a] | 1245.8[a] |
| | | 48+24 | 36.03[a] | 3513.2[a] | 1234.8[a] |
| LSD (0.05) † | | | 3.76 | 364.60 | 128.30 |

Means followed by the same letter in a column are not significantly different from each other at p = 0.05, † Accommodation LSD

ANOVA, to reach a balance between experience and level of statistics as shown in Tables 5-8. It is quite possible that the experimental error could mask the pronounced effects of the interactions.

## CONCLUSIONS

Based on the findings of the present study, it seems rational recommend application of N at a rate of 143 kg ha$^{-1}$, spraying of cotton plants with K twice (at a rate of 957 g K ha$^{-1}$) and application of MC, twice (at a rate of 48+24 g ai ha$^{-1}$, respectively), that has the most beneficial effects of treatments examined in this study on cotton production. Generally, K rate effects were not significant, but were better than untreated plants (control). In comparison to the ordinary cultural practices adopted by Egyptian cotton producers, it is quite apparent that applications such treatments could bring about better impact on cotton productivity. No significant interactions were found between the variables in the present study (N, K and MC) with respect to quantitative characters under investigation. Regarding insignificant interaction effects, sensible increases were found in seed cotton yield h$^{-1}$ (about 40%) as a result of applying the combination of N, K and MC i.e. addition of N at 143 kg ha$^{-1}$ combined with spraying potassium at 957 g k ha$^{-1}$ and MC at 48+24 g ai ha$^{-1}$. An accommodation method for statistical analysis of the insignificant interactions between treatments is suggested to be considered depending on the LSD values, regardless of statistical significance.

The soil fertility could be sufficient to feed the plant to a large extent during its normal growth stage, but from the practical standpoint it could not be sufficient to feed the plant during the stage demand more active requirements during the extended period of flowering and boll setting.

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