*J. Plant Production, Mansoura Univ., Vol. 8 (10): 1037 - 1043 , 2017*

# Response of Cotton Plant to Foliar Application with Mepiquat Chloride (Pix) and Kaolin

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## ABSTEACT

One field experiment was carried out on clay soil in 2016 season and repeated in 2017 season in El-Gemmeiza Agricultural Research Station, Agricultural Research Center, El-Gharbiya Governorate, Egypt, to study the effect of seven treatments including foliar application with two rates of mepiquat chloride (pix); 2 and 3cm$^3$/L, two rates of Kaolin (2 and 3g/L), two rates of mepiquat chloride(pix) and Kaolin application in combination (2cm$^3$+2g)/L, (3cm$^3$+3g)/Lthree times (at squaring stage, at the start of flowering and at the top of flowering) and control treatment on leaf chemical composition, plant growth, earliness, fiber quality and yield of Egyptian cotton (*Gossypium barbadense* L.), Giza 86 cultivar. A randomized complete blocks design with 3 replicates was used in both seasons. The important results could be summarized as follow:- The tested treatments had a significant effect on leaves N, P, K, chlorophyll a, b, total chlorophyll and carotenoids contents in the two seasons of study, where foliar application with mepiquat chloride at 3cm$^3$/L in combined with kaolin at 3g/L three times recorded the highest values of these traits in both seasons followed by foliar application with mepiquat chloride alone at 3cm$^3$/L. While, the control treatment produced the lowest values of these traits.Foliar spraying with mepiquat chloride at 3cm$^3$/L in combined with kaolin at 3g/L three times significantly reduced final plant height, followed by foliar application with mepiquat chloride at 3cm$^3$/L three times, foliar application with mepiquat chloride at 2cm$^3$/L in combined with kaolin at 2g/L three times, foliar application with mepiquat chloride at 2cm$^3$/L, foliar application with kaolin at 3g/L three times and foliar application with kaolin at 2g/L three times, while control treatment recorded the tallest plants. Number of fruiting branches/plant did not affect by these treatments. Foliar spraying with mepiquat chloride at 3cm$^3$/L in combined with kaolin at 3g/L three times significantly increased numbers of total flowers and total bolls set/plant, boll setting and earliness percentages followed by foliar application with mepiquat chloride at 3cm$^3$/L. But, the lowest values were obtained from the control treatment.Foliar spraying with mepiquat chloride at 3cm$^3$/L in combined with kaolin at 3g/L three times significantly increased boll weight, number of open bolls/plant, seed cotton yield/plant, seed index and seed cotton yield/fed in the two seasons of study followed by foliar application with mepiquat chloride at 3cm$^3$/L. But, untreated plants produced the lowest values.On the other hand, the tested treatments had insignificant effect on fiber quality (fiber strength and micronaire reading) and lint percentage in both seasons.This study demonstrates that foliar spraying with mepiquat chloride (pix) at 3cm$^3$/L in combined with kaolin at 3g/L three times (at squaring stage, at the start of flowering and at the top of flowering) could be recommended to improve the chemical composition of leaves, vegetative growth traits, earliness, yield/feddan, yield components and fiber quality of Giza 86 cotton cultivar under conditions of El-Gemmeiza location.

## INTRODUCTION

Rank growth in cotton resulting in tall and densely foliated plants, which prevents penetration of solar radiation in the shoots, with negative impacts on yields (Lamas, 2001). To prevent yield loss plant growth regulators are used to manipulate cotton plant architecture. Among plant growth regulators, mepiquat chloride (MC) is most widely used to control plant height. MC inhibits biosynthesis of gibberellic acid. Therefore, cell elongation, foliar area and growth are decreased (Reddy *et al*., 1996). The potential benefits of growth regulators are; improved plant architecture, increased bolls retention in the first positions, early bolls opening, higher quality and higher harvesting efficiency (Souza and Rosolem, 2007). Reddy *et al.* (1990) stated that foliar application with growth regulator resulted in more compact plants, with a ratio of reproductive to vegetative dry matter larger than one, and this ratio has a positive correlation with yield of cotton. Mert and Caliskan (1998) reported that mepiquat chloride reduced plant height and improved earliness and increased seed cotton weight per boll as compared with control, but did not significantly affect fiber characters. El-Shahawy (1999) studied the effect of foliar application with pix on cotton and reported that it increased number of sympodia, number of bolls, percent boll retention, earliness, seed index, lint %, boll weight and yield of seed cotton, while it decreased plant height as compared with control. Siddique *et al*. (2002) observed that foliar spraying with mepiquat chloride significantly reduced plant height and significantly increased the yield. Ali *et al*. (2012) found that foliar spraying with mepiquat chloride significantly increased yield of cotton as compared with untreated treatment.

Future climate in the Mediterranean growing regions will be characterized by severe summer conditions, with elevated temperature, lower water availability and elevated solar irradiance (visible and ultraviolet). Therefore, it is crucial to develop short-term autonomous adaptation measures, both by economic and environmental sustainability reasons. Foliar kaolin clay particles (KL) application had a significant positive effect on leaf temperature, stomatal conductance, intrinsic water use efficiency, photosynthetic pigments, net photosynthesis and yield. Thus, kaolin proved to be effective in alleviating the negative effects of summer stress, photosystem II functioning and yield. Thus, KL clay particles could be a valuable tool as a summer stress alleviator (Correia *et al*., 2012).

Kaolin is mineral composed of aluminum silicate ($Al_4Si_4O_{10}(OH)_8$) of fine grain, white color, flat, porous, and non-expanding, dissolving in water and chemically inert at a wide range of pH (Harben 1995). Other properties of kaolin particle film are the difficult of pests develop resistance to it (Liu and Trumble, 2004), does not show phytotoxic effects, and lasts longer than most insecticides on the plants (Sugar *et al.,* 2005), being non-toxic to humans, and relatively safe to natural enemies (Delate and Friedrich, 2004).

Laurie *et al.* (1994) suggested that Kaolin enhanced cuticle transpiration but not transpiration via

stomata and to mitigate environmental stresses, such as sunburn damage, heat stress and the negative effects of water deficiency as well as protect crops from insect pests and suppress diseases Kaolin could be used as an effective natural antitranspirant (Kahn and Damicone, 2008).

Therefore, this study was carried out to study the effect of using mepiquat chloride(pix) and to evaluate the benefits of Kaolin as foliar spraying with concern to chemical composition, growth traits, boll setting, yield components, yield and fiber traits of Egyptian cotton (*Gossypium barbadense,* L.), cultivar Giza 86.

## MATERIALS AND METHODS

One field experiment was carried out on clay soil in 2016 season and repeated in 2017 season in El-Gemmeiza Agricultural Research Station, Agricultural Research Center, El-Gharbiya Governorate, Egypt, to study the effect of seven treatments including foliar application with two rates of mepiquat chloride (pix); 2 and 3$cm^3$/L, two rates of Kaolin (2 and 3g/L), two rates of mepiquat chloride(pix) and Kaolin application in combination (2$cm^3$+2g)/L, (3$cm^3$+3g)/Lthree times (at squaring stage, at the start of flowering and at the top of flowering) and control treatment on leaf chemical composition, plant growth, earliness, fiber quality and yield of Egyptian cotton (*Gossypium barbadense* L.), Giza 86 cultivar.

A- randomized complete blocks design with three replications was used in the two seasons of study, where the following seven treatments were evaluated:

1- Untreated plants (control treatment).
2-Foliar spraying with 2 $cm^3$ mepiquat chloride /L.
3- Foliar spraying with 2g Kaolin/L.
4- Foliar spraying with 2 $cm^3$ mepiquat chloride /L +2g Kaolin/L.
5- Foliar spraying with 3 $cm^3$ mepiquat chloride /L.
6- Foliar spraying with 3g Kaolin/L.
7- Foliar spraying with 3 $cm^3$ mepiquat chloride /L+ 3g Kaolin/L.

Foliar application was carried out three times (at squaring stage, at start of flowering and at the top of flowering).

Soil analysis for the two sites was carried out according to Chapman and Pratt (1978). The results are shown in Table 1.

**Table 1. Chemical analysis of the experimental soil sites.**

| Properties | Season | |
|---|---|---|
| | 2016 | 2017 |
| pH | 8.0 | 7.9 |
| EC mmhos/ cm | 0.54 | 0.33 |
| Organic matter % | 1.42 | 1.60 |
| Total N (mg/100g) | 49.7 | 56.0 |
| Available N (ppm) | 28.7 | 29.9 |
| Available P (ppm) | 11.1 | 12.5 |
| Exchangeable K (ppm) | 306 | 333 |
| Available Fe (ppm) | 11.0 | 11.3 |
| Available Mn (ppm) | 2.9 | 3.1 |
| Available Zn (ppm) | 0.90 | 1.00 |
| Available Cu (ppm) | 3.0 | 3.4 |

The experimental plot area was 14 $m^2$ (5 rows, 4 m long and 70 cm apart). Sowing took place on 8th April in hills 25 cm apart leaving two plants/hill at thinning time in both seasons. Phosphorus fertilizer was added at the rate of 22.5 kg $P_2O_5$ /fed as calcium super phosphate (15.5 % $P_2O_5$) during land preparation. Nitrogen fertilizer at a rate of 45 kg N / fed as ammonium nitrate (33.5 % N) was applied in two equal doses, immediately before the first and the second irrigations. Potassium fertilizer in the form of potasin-f was applied as foliar application three times at the rate of 500$cm^3$/fed. The previous crop was Egyptian clover (berseem). Normal agricultural practices were followed during the two growing seasons.

**Studied characters:**

**1- Leaves chemical composition:**

In 2017 season, after seven days from the third foliar application, a representative leaf sample (10 leaves) was taken from the upper 4th leaf on the main stem from each plot to determine the following **chemical analysis:**

1-Nitrogen, phosphorus and potassium concentrations in leaves were determined according to Chapman and Pratt (1978).
2- Chlorophyll a, chlorophyll b, total chlorophyll (a+b) and carotenoids contents in leaves were determined according to A.O.A.C. (1995).

In both seasons, plants of five guarded hills were taken at random from each sub-plot at harvest to study the following traits:

B- Growth traits; plant height (cm) and number of fruiting branches/plant.
C- Earliness traits: numbers of total flowers and total bolls/plant, boll setting percentage and earliness percentage.
D- Seed cotton yield and its components; number of open bolls/plant, boll weight (g), seed cotton yield/plant, lint percentage and seed index (g). The yield of seed cotton per feddan was estimated as the weight of seed cotton in kilogram picked twice from each sub- plot, then converted to yield per feddan in kentar (One kentar = 157.5 kg).
F- Fiber properties; micronaire reading and Pressley index were determined for the representative samples at the laboratories of cotton Research Institute according to A.S.T.M. (1975).

The obtained data were subjected to statistical analysis according to Le Clerg *et al*., (1966) and L.S.D. values at 5% level were used for comparison between means.

## RESULTS AND DISCUSSION

Averages of nitrogen, potassium, phosphorus, chlorophyll (a), (b), total chlorophyll and carotenoids concentrations in cotton leaves as influenced by the tested treatments in 2017 season are shown in Table 2.

The differences among the tested treatments in nitrogen, potassium, phosphorus, chlorophyll (a), (b), total chlorophyll and carotenoids concentrations in cotton leaves were significant, in favor of foliar spraying with mepiquat chloride at 3$cm^3$/L in combined with kaolin at 3g/L three times followed by foliar application with

mepiquat chloride at 3cm$^3$/L. However, untreated plants produced the lowest values of these traits.

The positive effect of foliar application with mepiquat chloride at 3cm$^3$/L in combined with kaolin at 3g/L three times on photosynthesis pigments may be due to:

1- The high uptake of nitrogen, phosphorus and potassium in cotton leaves due to this combination, where the chlorophyll synthesis process is related to nitrogen (Pandy and Sinha, 1978). Potassium (K) plays vital role in photosynthesis, translocation of photosynthates from sources to sinks, protein synthesis, control of ionic balance, activation of plant enzymes, inhibitory of ROS (Reactive Oxygen Spices) production during photosynthesis and NADPH oxidase, regulation of plant stomata and water use and many other processes. (Marschner, 1995; Reddya *et al*., 2004 and Cakmak, 2005).

**Table 2. Effect of foliar application with mepiquat chloride and Kaolin at different rates on cotton leaves chlorophyll a, chlorophyll b, total chlorophyll, carotenoids, nitrogen, phosphorus and potassium concentrations in 2017 season**

| Treatments | Chlorophyll a (mg/g dry w.) | Chlorophyll b (mg/g dry w.) | Total chlorophyll (mg/g dry w.) | Carotenoids (mg /g dry w.) | N % | P % | K % |
|---|---|---|---|---|---|---|---|
| 1-Control | 2.65 | 1.82 | 4.47 | 0.91 | 3.42 | 0.20 | 3.50 |
| 2-2cm$^3$/L mepiquat chloride | 3.67 | 2.76 | 6.43 | 1.26 | 3.45 | 0.3 | 3.54 |
| 3-2g/L Kaolin | 3.43 | 2.52 | 5.95 | 1.19 | 3.40 | 0.26 | 3.52 |
| 4-2cm$^3$/L mepiquat chloride +2g/L Kaolin | 3.77 | 2.73 | 6.50 | 1.41 | 3.35 | 0.32 | 3.57 |
| 5-3cm$^3$/L mepiquat chloride | 3.83 | 2.79 | 6.62 | 1.42 | 3.55 | 0.33 | 3.61 |
| 6-3g/L Kaolin | 3.71 | 2.68 | 6.39 | 1.37 | 3.47 | 0.29 | 3.55 |
| 7-3cm$^3$/L mepiquat chloride +3g/L Kaolin | 3.94 | 2.95 | 6.89 | 1.50 | 3.60 | 0.34 | 3.63 |
| LSD at 5% | 0.04 | 0.04 | 0.05 | 0.04 | 0.03 | 0.02 | 0.04 |

2- The effect of mepiquat chloride (pix) in delaying leaf chlorophyll degradation and increasing its content in cotton leaf which enhances photosynthesis rate,(Gausman *et al*.1981). Mepiquat chloride has been used to improve carbohydrate source-sink relations to enhance efficiency of cotton yield formation (Gwathmey and Clement, 2010).

NPK uptake and total chlorophyll concentration in cotton leaves significantly increased by kaolin foliar application because kaolin reduces leaf temperature due to its cooling effect (Glenn *et al*., 2002). The shading effect of kaolin film application reduce the light available to the leaf by increasing light reflection (Wunsche *et al*., 2004) and such reduction in light may have negative effect on photosynthesis process, fortunately, this negative impact did not occur here in our case, which suppose that the amount of the reflected light due to kaolin foliar application is neglected or little to cause any reverse effect on photosynthesis process.

Anderson (1986) observed a positive effect on the chlorophyll index after the kaolin treatment. A possible explanation for this increase in chlorophyll content may be due to the fact that leaves not treated with kaolin could show a lower light reflectance, suggesting an increased degradation of the photosynthetic pigments because a protection mechanism for high luminosity consists of regulating the loss of chlorophyll by chloroplasts.

**2-Growth traits:**

Means of final plant height, number of fruiting branches/plant at harvest, fiber strength (Pressley index) and micronaire reading as influenced by the tested treatments in 2016 and 2017 seasons are shown in Table 3.

The tested treatments gave significant effect on final plant height and number of fruiting branches/plant at harvest in the two seasons of study (Table 3). Foliar application with mepiquat chloride at 3cm$^3$/L in combined with kaolin at 3g/L three times significantly reduced final plant height followed by foliar application with mepiquat chloride at 3cm$^3$/L three times, foliar application with mepiquat chloride at 2cm$^3$/L in combined with kaolin at 2g/L three times, foliar application with mepiquat chloride at 2cm$^3$/L, foliar application with kaolin at 3g/L three times, foliar application with kaolin at 2g/L three times in descending order, while control treatment recorded the tallest plants. Number of fruiting branches/plant did not affect by these treatments.

The significant decrease in plant height due to these treatments as compared with control especially when used in combination or at high concentration where this reduction increased with increasing mepiquat chloride level up to 3cm$^3$/L or kaolin level up to 3g/L may be attribute to:

1-The primary effect of MC in reducing stem elongation, node formation and leaf expansion (Reddy *et al.* 1990), or to that pix decreased number of leaves/plant and increased leaf absission (Mahmoud *et al.* 1994 a,b) or from the suppression of excessive plant growth by reducing leaf area (Ibrahim and Moftah, 1997).

2-The inhibitory effect of mepiquat chloride on the synthesis of gibberellins which have a role in cell division and cell expansion (Reddy *et al.*, 1992). or to the ability of mepiquat chloride to reduce auxin transport to bud sites caused by increasing cytokinin concentration which restricted transport of auxin to axillary buds and subsequent bud out growth.

**Table 3. Effect of foliar application with mepiquat chloride and Kaolin at different rates on final plant height (cm), number of fruiting branches/plant, Pressley index and micronaire reading in 2016 and 2017 seasons.**

| Treatments | Final plant height (cm) | | Number of fruiting branches/plant | | Pressley index | | Micronaire reading | |
|---|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| 1-Control | 162.00 | 156.93 | 15.19 | 14.68 | 10.6 | 10.1 | 4.8 | 4.9 |
| 2-2cm$^3$/L mepiquat chloride | 124.53 | 127.87 | 14.42 | 14.10 | 10.2 | 10.2 | 4.9 | 4.8 |
| 3-2g/L Kaolin | 144.08 | 139.17 | 15.37 | 14.87 | 10.6 | 10.3 | 4.9 | 4.8 |
| 4-2cm$^3$/L mepiquat chloride +2g/L Kaolin | 114.67 | 122.07 | 14.53 | 14.13 | 10.2 | 10.4 | 4.8 | 4.9 |
| 5-3cm$^3$/L mepiquat chloride | 110.33 | 121.17 | 14.92 | 14.58 | 10.1 | 10.0 | 4.8 | 4.8 |
| 6-3g/L Kaolin | 146.92 | 135.20 | 14.61 | 14.13 | 10.2 | 10.4 | 4.9 | 4.8 |
| 7-3cm$^3$/L mepiquat chloride +3/L Kaolin | 108.53 | 115.24 | 14.94 | 14.43 | 10.2 | 10.5 | 4.8 | 4.9 |
| LSD 5% | 5.45 | 6.04 | NS | NS | NS | NS | NS | NS |

In this concern, the use of plant growth retardant, pix (mepiquat chloride) resulted in a significant reduction in plant height as compared with untreated control plants [Gwathmey *et al.* (1995), Hickey (1995), Roberston and Cothren (1995) and El-Beily *et al*. (2001)]. Pix application resulted in a significant reduction in both plant height and internode length [Reddy *et al*. (1990), (1992) and Ahmed (1994)]. Crozat and Kasemsap (1997) reported that mepiquat chloride application at early flowering significantly decreased vegetative growth and shortened crop duration of cotton. Mepiquat chloride has been used in efforts to improve carbohydrate source-sink relations to enhance efficiency of yield formation in cotton (Gwathmey and Clement, 2010). The original intent of this product was to suppress vegetative growth and reduce plant height. In situations where excess moisture and nitrogen were problems, this compound effectively reduced plant height in most instances (Nuti *et al.,* 2006), but was not necessarily associated with yield increases (Boman and Westerman, 1994). Mepiquat chloride acts as an anti-gibberellic acid compound, thus decreasing cell elongation and usually reducing number of main-stem nodes (Pettigrew and Johnson, 2005), although this is not always the case (Zhao and Oosterhuis, 1999).

**C-Earliness traits:**

Averages of numbers of total flowers and total bolls per plant, percentage of boll setting and earliness percentage as affected by the tested treatments in 2016 and 2017 seasons are shown in Table 4. With regard to the effect of the tested treatments on numbers of total flowers and total bolls per plant, percentages of boll setting and earliness. Results in Table 4 showed that, foliar application with mepiquat chloride at 3cm$^3$/L in combined with kaolin at 3g/l three times significantly increased these traits in consideration followed by foliar application with mepiquat chloride at 3cm$^3$/L. While, the lowest values of these traits were obtained from untreated plants (control treatment).

**These two treatments gave the favorable effect due to:**

1- The higher boll setting percentage gave more total bolls set/plant (Table 4).

2-The significant increase in nitrogen, phosphorus and potassium percentages in cotton leaves (Table 2) gave more numbers of flowers (Table 4).

3-The increase in photosynthate supply due to these two treatments gave adequate demand for the new bolls.

4-The greater bolls retention especially on the lower sympodia (York, 1983) or to that the reduction in plant growth which allow better light and air penetration, and therefore dryer microlimate which is more favourable for boll maturation (Makram, 1988).

5-Mepiquat chloride (pix) tended to reduce abscisic acid and ethylene hormones which in turn increases boll retention (EI-Shahawy, 1999).

**Table 4. Effect of foliar application with mepiquat chloride and Kaolin at different rates on number of total flowers/plant, number of total bolls/ plant, boll setting % and earliness % in 2016 and 2017 seasons.**

| Treatments | No. of total flowers/plant | | Number of total bolls/ plant | | Boll setting % | | Earliness % | |
|---|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| 1-Control | 28.02 | 26.79 | 19.33 | 18.75 | 68.99 | 69.99 | 60.12 | 63.94 |
| 2-2cm$^3$/L mepiquat chloride | 31.61 | 30.61 | 23.58 | 22.68 | 74.6 | 74.10 | 81.66 | 84.11 |
| 3-2g/L Kaolin | 31.12 | 29.93 | 22.92 | 22.00 | 73.65 | 73.50 | 64.88 | 67.12 |
| 4-2cm$^3$/L mepiquat chloride +2g/L Kaolin | 31.15 | 30.46 | 24.58 | 23.35 | 78.91 | 76.66 | 82.09 | 80.44 |
| 5-3cm$^3$/L mepiquat chloride | 31.71 | 29.97 | 25.42 | 23.40 | 80.16 | 78.08 | 83.60 | 85.21 |
| 6-3g/L Kaolin | 30.41 | 30.24 | 22.42 | 21.50 | 73.73 | 71.10 | 66.14 | 68.96 |
| 7-3cm$^3$/L mepiquat chloride +3/L Kaolin | 32.01 | 30.89 | 25.70 | 24.70 | 80.29 | 80.03 | 84.00 | 85.36 |
| LSD 5% | 1.79 | 1.50 | 1.05 | 1.39 | 2.87 | 3.90 | 4.81 | 5.90 |

**3- Seed cotton yield/fed and its components:**

Means of number of open bolls/plant, boll weight, seed cotton yield/plant, seed index, lint % and seed cotton yield/fed as influenced by the tested treatments in 2016 and 2017 seasons are shown in Table 5.

The treatments under study had significant effect on number of open bolls/plant, boll weight, seed index, seed cotton yield per plant and yield of seed cotton per feddan in the two seasons of study (Table 5), in favor of foliar spraying with mepiquat chloride at 3cm$^3$/L in combined with kaolin at 3g/L three times followed by foliar application with mepiquat chloride at 3cm$^3$/L. These two treatments achieved the highest seed cotton yield/fed which recorded 11.26 and 11.16 kentars; 10.11 and 10.04 kentars in the first and second seasons, respectively. The increases over the control were 14.90 and 13.88%; 14.76 and 13.96 % in 2016 and 2017 seasons, respectively. But, the control treatment produced the lowest yield per feddan which recorded 9.80 and 8,81 kentars in the first and second seasons, respectively. Lint percentage did not affect by the tested treatments in the two seasons of study.

Foliar spraying with mepiquat chloride (pix) either at the high or low levels produced the highest values of these traits, but the lowest values were produced by control treatment (untreated plants). The increase increase in number of open bolls/plant due to pix application may be due to increasing the percentage of boll retention/ plant, where MC acting was as a reducer to abscisic acid and a stimulator to IAA and cytokinin as reported by Ibrahim and Moftah (1997).In this concern, EI-Shahawy (1999) reported that pix tended to reduce abscisic acid and ethylene hormones which in turn increases boll retention and consequently more open bolls moreover, pix increased number of open bolls and yield of seed cotton.

The favorable effect of pix either at the high or low levels as compared with untreated plants is mainly due to:

1- The significant increase in number of open bolls and heavier bolls of treated plant lead to significant increase in yield of seed cotton/plant which is considered one of major yield components.
2- Various aspects of the use of pix i.e. high solar radiation can be synchronized with the optimal boll setting period, thus contributing to the total yield increase (Yao *et al*., 1990).

**Table 5. Effect of foliar application with mepiquat chloride and Kaolin at different rates on boll weight(g), number of open bolls/plant, seed cotton yield / plant (g), lint percentage, seed index (g) and seed cotton yield (kentar/ fed) in 2016 and 2017 seasons.**

| Treatments | Boll weight (g) | | No. of open bolls/plant | | Seed cotton yield / plant (g) | | Lint percentage | | Seed index (g) | | Seed cotton yield (kentar/fed) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| 1-Control | 3.11 | 2.98 | 19.33 | 18.75 | 69.11 | 54.87 | 39.70 | 40.77 | 10.56 | 10,90 | 9.80 | 8.81 |
| 2-2cm$^3$/L mepiquat chloride | 3.32 | 3.18 | 23.58 | 22.68 | 76.00 | 66.60 | 39.00 | 39.03 | 10.64 | 10.05 | 10.92 | 9.84 |
| 3-2g/L Kaolin | 3.24 | 3.12 | 22.92 | 22.00 | 70.00 | 63.90 | 40.00 | 40.91 | 10.20 | 11.00 | 10.59 | 9.53 |
| 4-2cm$^3$/L mepiquat chloride +2g/L Kaolin | 3.37 | 3.23 | 24.58 | 23.35 | 76.20 | 70.71 | 39.90 | 40.23 | 10.70 | 10.44 | 11.01 | 9.91 |
| 5-3cm$^3$/L mepiquat chloride | 3.29 | 3.17 | 25.42 | 23.40 | 77.50 | 69.30 | 39.50 | 39.70 | 10.84 | 10.69 | 11.16 | 10.04 |
| 6-3g/L Kaolin | 3.30 | 3.18 | 22.42 | 21.50 | 75.50 | 63.95 | 38.09 | 37.85 | 11.02 | 11.26 | 10.79 | 9.72 |
| 7-3cm$^3$/L mepiquat chloride +3/L Kaolin | 3.46 | 3.28 | 25.70 | 24.70 | 78.92 | 71.31 | 39.40 | 39.73 | 10.83 | 10.65 | 11.26 | 10.11 |
| LSD 5% | 0.12 | 0.10 | 1.05 | 1.39 | 3.01 | 2.38 | NS | NS | 0.21 | 0.48 | 0.55 | 0.49 |

In this regard, pix application increased significantly seed cotton yield/ unit area [Yao *et al*. (1990), Azab *et al.* (1993), Girgis (1993) and El-Beily *et al.* (2001)]. Ali *et al*. (2012) found that foliar spraying with mepiquat chloride significantly increased yield of cotton as compared with untreated plants.

The pronounced effect of the foliar spraying with kaolin may be related to that such treatment showed positive effects on the leaves NPK uptake and photosynthesis pigments (Table 2) vegetative growth aspects (Table 3), producing healthy plants and increasing yield aspects.

In this concern, Glenn *et al*. (2002) found that under high temperature foliar application with kaolin improves $CO_2$ assimilation.

Kaolin is a common clay mineral containing weathered aluminum silicate; inert, water-soluble, and low in cost, it has been applied in agriculture for various purposes such as plant and fruit protection against heat stress and insect attack. Kaolin sprays could be considered as a tool to be used in tropical regions to improve the plant acclimation to high temperature and high radiation levels.

**4-Fiber quality traits:**

The tested treatments had insignificant effect on fiber quality (micronaire reading and Pressley index) in both seasons (Table 3).

## CONCLUSION

It could be concluded that foliar application with mepiquat chloride at 3cm$^3$/L in combined with kaolin at 3g/L three times or foliar application with mepiquat chloride at 3cm$^3$/L three times (at squaring stage, at the start of flowering and at the top of flowering) for producing better leaf chemical composition, growth characters, boll retention, high yield and quality of Egyptian cotton (Giza 86 cultivar), under the conditions of El-Gemmeiza location.

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## استجابة نبات القطن للرش بكلوريد الميبكويت (البكس) والكاولين

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**قسم بحوث الفسيولوجى - معهد بحوث القطن- مركز البحوث الزراعية- الجيزة- جمهورية مصر العربية.**

أجريت تجربتان حقليتان فى أرض طينية بمحطة البحوث الزراعية بالجميزة-مركز البحوث الزراعية- محافظة الغربية خلال موسمى٢٠١٦ و٢٠١٧م لدراسة تأثير الرش الورقى بمعدلين من كلوريد الميبكويت(٣،٢سم$^{٣}$/لتر) ومعدلين من الكاولين(٣،٢جم/لتر)،معدلين منهما معا (٢سم$^{٣}$+٢جم/لتر،٣سم$^{٣}$+٣جم/لتر) مقارنة مع الكنترول على التركيب الكيماوى لأوراق القطن،النمو، التبكير ،المحصول ومكوناته وجودة التيلة للقطن جيزة ٨٦. الرش كان يتم ثلاث مرات (فى مرحلة الوسواس ،عند بداية التزهير،عند قمة التزهير) وتم أستخدم تصميم القطاعات كاملة العشوائية فى ثلاث مكررات.ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي: أعطى الرش الورقى ثلاث مرات باستخدام كلوريد الميبكويت والكاولين معا بمعدل(٣سم$^{٣}$+٣جم/لتر) زيادة معنوية لمحتوى الأوراق من النيتروجين،البوتاسيوم ،الفوسفور ،كلوروفيل أ ،كلوروفيل ب ،الكلوروفيل الكلى و الكاروتينيدات) يليه الرش الورقى ثلاث مرات باستخدام كلوريد الميبكويت بمفرده بمعدل(٣سم$^{٣}$) بينما أقل القيم تم الحصول عليها من معاملة المقارنة فى الموسمين.أعطى الرش الورقى ثلاث مرات باستخدام كلوريد الميبكويت والكاولين معا بمعدل(٣سم$^{٣}$+٣جم/لتر) نقص معنوى لطول النباتات يليه كلوريد الميبكويت بمفرده بمعدل٣سم$^{٣}$ ثم كلوريد الميبكويت والكاولين معا بمعدل(٢سم$^{٣}$+٢جم/لتر) و كلوريد الميبكويت بمفرده بمعدل٢سم$^{٢}$ والكاولين عند المعدل المرتفع بليه المعدل المنخفض بينما لم يتأثر عدد الأفرع الثمرية/النبات معنويا. أعطى الرش الورقى ثلاث مرات باستخدام كلوريد الميبكويت والكاولين معا بمعدل(٣سم$^{٣}$+٣جم/لتر) زيادة معنوية فى صفات عدد الازهار الكلية / نبات ، عدد اللوز الكلى / نبات، النسبة المئوية لعقد اللوزوالنسبة المئوية للتبكير فى الموسمين.أعطى الرش الورقى ثلاث مرات باستخدام كلوريد الميبكوات والكاولين معا بمعدل(٣سم$^{٣}$+٣جم/لتر) زيادة معنوية فى عدد اللوز المتفتح / نبات ،وزن اللوزة، محصول القطن الزهر للنبات، معامل البذرة، محصول القطن الزهر للفدان فى الموسمين ولم تعطى المعاملات المختبرة أى تأثير معنوى على النسبة المئوية للتيلة ومعامل بريسلى وقراءة الميكرونير فى الموسمين.التوصية:توصى الدراسة بالرش الورقى لنباتات القطن بكلوريد الميبكوات (البكس) والكاولين معا بمعدل(٣سم$^{٣}$+٣جم/لتر) ثلاث مرات(فى مرحلة الوسواس ،عند بداية التزهير،عند قمة التزهير) لأعطاءأفضل تركيب كيماوى للورقة ونموعقد جيد مما يؤدى الى زيادة الأنتاجية للقطن المصرى جيزة ٨٦تحت ظروف منطقة الجميزة.