THE EFFECT OF MEPQUIAT CHLORIDE APPLICATION ON THE PRODUCTIVITY OF COTTON PLANTS

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Abstract

Two field experiments were conducted at Sids Agricultural Research Station during 1997 and 1998 seasons to study the response of cotton plant cv. Giza 80 to the application of plant growth retardant, i.e., mepquiat chloride (0.100, 150, 200, and 250 cm² /fed.), sprayed once at the start of flowering. The results revealed, that the application of mepquiat chloride reduced plant height and length of internodes, tended to increase number of open bolls per plant significantly, increased seed cotton yield (in kentars / feddan), while seed index, lint percentage and lint micronaire reading and Pressley index were not significantly affected. The application of mepquiat chloride exerted a significant increase in pherol contents in leaves and oil content in seeds, while protein content in seeds was not significantly affected.

INTRODUCTION

It is obviously known that plant growth regulators may be comparable in function to some genes in plant chromosomes because they can turn metabolic processes on or off like genes do. The advantage of growth regulators is that they give producers the flexibility to modify plant growth to suit current growing conditions in order to maximize benefits (Landivar et al., 1995).

Mepquiat chloride, a growth regulator that has been widely used to reduce vegetative growth to allow plants to direct more metabolic energy towards the reproductive structure, (Fletcher et al., 1994). It inhibits the synthesis of the plant hormone gibberellic acid (GA), (Wahdan, 1990 and Mahmoud et al., 1994). The application of mepquiat chloride results in a shorter and a more compact plants because of shorter main stem, length of internode and number of sympodia per plant, (Azab et al., 1988; Hodges et al., 1991; Fernandez et al., 1991; Ebelher et al., 1996; Hart et al., 1996 and Kassem, 1999). On the other hand Abdul-Al et al., 1986, Azab et al., 1988; Sawan and
EFFECT OF MEPIQUAT ON COTTON

Saker, 1990; Fatma, 1994 and Fletcher et al., 1994, found that mepquat chloride application increased number of open bolls per plant, boll weight and seed index. Eid et al., 1986; Malik et al., 1988; Saeed 1989, Wahdan, 1990; Hart et al., 1996 and Kassem 1999 stated that earliness, lint percentage and seed index were not affected by mepquat chloride application. Azab et al., 1988; Sawan and Saker, 1990; Fatma, 1994 and Kassem, 1999, reported that mepquat chloride application had no effect on micronaire reading and Pressley index. Abdel-Al et al., 1986 and Azab et al., 1988, found that mepquat chloride application had no clear effect on oil and protein contents. Mepquat chloride application to cotton plants increased seed cotton yield per feddan (Abdel-Al et al., 1986; Azab et al., 1988; Kerby et al., 1988; Weir and Constable, 1989; Sawan and Saker, 1990; Livingston et al., 1992; and Munier et al., 1995).

MATERIALS AND METHODS

Two field experiments were conducted at Sids Agricultural Research Station using Giza 80 cotton variety (G. barbadense). Cotton seeds were sown on April and March 22 in 1997 and 1998 seasons, respectively. Five concentrations of mepquat chloride (1,1-dimethyl-piperidinum -chloride commercial name is ROQUAT™ the active ingredient is 250 g/L) zero, 100,150, 200, 250 cm³ / 500 liter water/feddan, were sprayed once at the start of flowering (after 90 days from sowing).

A complete randomized block design, with four replicates was used, with a plot area of 12m². The rate of N application was 60 kg N/ feddan. Normal cultural practices were followed throughout the growing seasons. The following plant characters were studied.

A- Growth characters, yield, its components and earliness:

These included: plant height, average length of inter-node, number of nodes per main stem, number of sympodia per plant, number of open bolls per plant, average of boll weight, seed cotton yield per feddan in kentars. (1 kentar=157.5 kg), earliness percentage, lint percentage and seed index.

B- Fiber quality: micronaire reading and Pressley index.

C- Chemical constituents: The determinations were done during 1998 only. A random sample of the top fourth node leaves were taken after 15 days from mepquat chloride spraying, to determine the following chemical constituents, besides the seed...
oil and protein contents: Carbohydrate contents: total soluble sugars and reducing sugars, were determined according to Cerning, (1975) and A.O.A.C., (1965), respectively. poly phenol: were determined according to A.O.A.C., (1965). Total phenol: were determined according to Simons and Ross (1971). Seed oil content: was determined according to A.O.A.C., (1975). Seed protein content: was determined using the method described by A.O.A.C., (1965).

Data were subjected to statistical analysis outlined by Snedecor and Cochran (1981). The least significant difference (LSD) was used for means comparisons.

RESULTS AND DISCUSSION

A- The effect of mepiquat chloride on growth, yield characters and earliness:

The data illustrated in Tables 1 and 2 revealed that the application of the plant growth retardant mepiquat chloride as a foliar spray on cotton plant at the start of flowering stage exerted significant influences on all plant growth characters in both seasons.

Plant height and average length of inter-nodes were significantly reduced by mepiquat chloride application. The decrease in plant height was due mainly to the reduction in length of inter-node. The action of mepiquat chloride on growth inhibited is mainly due to its effects on lowering the diffusible auxin level in the plants (Kuraishi and Muir, 1963), cell elongation was inhibited, resulting in reduction of growth in height and width, (Azab et al., 1988; Fernandez et al., 1991 and Mahmoud et al., 1994). Application of mepiquat chloride was also reported as may cause a competitive interaction with gibberellic acid (Wahdan, 1990). Similar results were obtained by Malik et al., (1988); Saeed (1989) and Hart et al., (1996). Mepiquat chloride tends to decrease the leaf area, which enhances light penetration into the canopy. The leaves are generally smaller but thicker.

Number of fruiting branches was considerably affected by spraying mepiquat chloride. It seems from results obtained, that number of fruiting branches tended to decrease by higher concentrations of mepiquat chloride. Kerby et al., (1989) and McCarty et al., (1990), obtained similar results.
Table 1. Effect of mepiquat chloride on yield, yield components and lint quality in 1997 season.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant Height (cm)</th>
<th>Plant per plant</th>
<th>Fruit branches per plant</th>
<th>Nodes/main stem</th>
<th>Internode length (cm)</th>
<th>No. open bolls/plant</th>
<th>Boll weight (gm)</th>
<th>Seed cotton per plant (gm)</th>
<th>Seed cotton per fed. (gm)</th>
<th>Early lintliness (%)</th>
<th>Lint index %</th>
<th>Seed index</th>
<th>Micronaire</th>
<th>Pressley index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>125</td>
<td>13.75</td>
<td>23.00</td>
<td>5.68</td>
<td>14.50</td>
<td>2.70</td>
<td>25.70</td>
<td>9.30</td>
<td>88.21</td>
<td>39.78</td>
<td>10.11</td>
<td>4.30</td>
<td>9.85</td>
<td></td>
</tr>
<tr>
<td>100 cm³/fed.</td>
<td>110</td>
<td>14.25</td>
<td>27.00</td>
<td>4.23</td>
<td>19.25</td>
<td>2.94</td>
<td>32.35</td>
<td>11.08</td>
<td>85.27</td>
<td>39.69</td>
<td>10.85</td>
<td>4.20</td>
<td>9.72</td>
<td></td>
</tr>
<tr>
<td>150 cm³/fed.</td>
<td>105</td>
<td>15.00</td>
<td>26.75</td>
<td>3.78</td>
<td>19.75</td>
<td>2.87</td>
<td>32.88</td>
<td>11.28</td>
<td>89.47</td>
<td>39.76</td>
<td>10.64</td>
<td>4.15</td>
<td>9.10</td>
<td></td>
</tr>
<tr>
<td>200 cm³/fed.</td>
<td>102</td>
<td>14.50</td>
<td>27.50</td>
<td>3.71</td>
<td>17.75</td>
<td>2.84</td>
<td>30.98</td>
<td>10.61</td>
<td>90.42</td>
<td>39.41</td>
<td>10.35</td>
<td>4.30</td>
<td>9.57</td>
<td></td>
</tr>
<tr>
<td>250 cm³/fed.</td>
<td>93</td>
<td>12.25</td>
<td>26.75</td>
<td>3.61</td>
<td>17.50</td>
<td>3.00</td>
<td>30.48</td>
<td>10.44</td>
<td>85.46</td>
<td>39.30</td>
<td>11.08</td>
<td>4.35</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>L.S.D. 0.05</td>
<td>8.65</td>
<td>1.64</td>
<td>2.87</td>
<td>0.41</td>
<td>1.32</td>
<td>N.S.</td>
<td>2.16</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Effect of mepiquat chloride on yield, yield components and lint quality in 1998 season.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant Height (cm)</th>
<th>Fruit branches per plant</th>
<th>Nodes per main stem</th>
<th>Internode length (cm)</th>
<th>Internode No. open</th>
<th>Boll weight per plant (gm)</th>
<th>Seed cotton per plant (gm)</th>
<th>Seed cotton per fed. (gm)</th>
<th>Earliness %</th>
<th>Lint %</th>
<th>Seed index</th>
<th>Mic index</th>
<th>Pressley index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>135</td>
<td>17.50</td>
<td>24.00</td>
<td>5.86</td>
<td>18.00</td>
<td>3.26</td>
<td>27.57</td>
<td>9.99</td>
<td>83.68</td>
<td>38.62</td>
<td>11.15</td>
<td>4.95</td>
<td>9.85</td>
</tr>
<tr>
<td>100 cm³/fed.</td>
<td>120</td>
<td>18.00</td>
<td>25.50</td>
<td>4.89</td>
<td>20.25</td>
<td>3.15</td>
<td>32.00</td>
<td>10.96</td>
<td>85.57</td>
<td>38.89</td>
<td>11.94</td>
<td>4.80</td>
<td>10.95</td>
</tr>
<tr>
<td>150 cm³/fed.</td>
<td>115</td>
<td>18.00</td>
<td>26.00</td>
<td>4.60</td>
<td>22.25</td>
<td>3.37</td>
<td>33.61</td>
<td>11.51</td>
<td>84.47</td>
<td>39.08</td>
<td>11.73</td>
<td>4.80</td>
<td>10.15</td>
</tr>
<tr>
<td>200 cm³/fed.</td>
<td>115</td>
<td>17.25</td>
<td>26.50</td>
<td>4.51</td>
<td>20.25</td>
<td>3.49</td>
<td>32.06</td>
<td>10.98</td>
<td>87.71</td>
<td>39.63</td>
<td>11.43</td>
<td>5.10</td>
<td>10.40</td>
</tr>
<tr>
<td>250 cm³/fed.</td>
<td>100</td>
<td>14.25</td>
<td>23.75</td>
<td>4.39</td>
<td>18.50</td>
<td>3.15</td>
<td>30.54</td>
<td>10.46</td>
<td>88.14</td>
<td>39.01</td>
<td>12.09</td>
<td>5.00</td>
<td>10.58</td>
</tr>
<tr>
<td>L.S.D. 0.05</td>
<td>11.60</td>
<td>2.20</td>
<td>3.85</td>
<td>0.41</td>
<td>1.67</td>
<td>0.22</td>
<td>2.22</td>
<td>0.78</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
</tr>
</tbody>
</table>
Number of open bolls per plant was significantly increased by mepiquat chloride spraying until the rate of 150 cm³/fed., then decreased by increasing the rate of mepiquat chloride. The number of open bolls/plant remained higher with applying any rate of mepiquat chloride than the check treatment, since mepiquat chloride used to minimize the vegetative growth, it allows to direct more metabolic energy towards the reproductive structure, (Fletcher et al., 1994). Similar results were obtained by Cathay and Meredith, (1988) and Kerby et al., (1989).

Boll weight; data in Table 1 and 2 revealed that foliar application of mepiquat chloride tended to produce the heaviest bolls in both seasons. These results obtained were in accordance with data obtained by Abdel-AI et al., (1986); Sawan and Saker, (1990) and Fatma, (1994).

Seed cotton yield per feddan; data in Table 1 and 2 indicated that mepiquat chloride treatments caused an increase in this trait, which was pronounced specially at the rate of 150 cm³/fed. These results were expected since, mepiquat chloride application gave compact plants with higher number of open heavy and mature bolls, caused in many cases high yield from the first and second picking. Abdel-AI et al., (1986); Azab et al., (1988); Kerby et al., (1989); Weir and Constable, (1989); McCarty et al., (1990); Sawan and Saker, (1990); Livingston et al., (1992) and Munier et al., (1995), obtained similar results. These results confirm the theory that using growth retardants as mepiquat chloride should be used at the optimum dose and the time of application should be perfectly selected, (Eid et al., 1986 and Cothren et al., 1988).

Earliness percentage was slightly increased by the foliar application of mepiquat chloride and the differences between treatments means did not reach the level of significance in both seasons. The same trend was obtained by Hart et al., (1996).

Lint percentage and seed index were not significantly affected by any foliar treatment of mepiquat chloride. The same results were obtained by Eid et al., (1986); Malik et al., (1988); Saad, (1989); Wahdan, (1990) and Kassem, (1999).

B- Fiber quality: lint quality i.e., micronaire reading and Pressley index, were not significantly affected by mepiquat chloride application. These results are similar to those obtained by Abdel-AI et al., (1986); Sawan and Saker, (1990); Fatma, (1994); and Kassem, (1999).
C-Chemical constituents

Carbohydrate contents in leaves data in Table 3 show that mepiquat chloride application significantly affected carbohydrate contents. It could be concluded that mepiquat chloride play a role as activators or intermediates in the formation of chlorophyll contents in leaves and this coverts in an increase of carbohydrates. The highest values were obtained from using 100 cm$^3$/fed. Mepiquat chloride. These results are similar to those obtained by Wahdan, (1990).

Phenol compounds results in Table 3 reveal that application of mepiquat chloride exerted a significant increase in leaves phenol contents except the application of 150 cm$^3$/fed. Polyphenols compounds play an important role in decreasing IAA oxidation in fresh leaves (Abdel-Al et al., 1988). These results are in accordance with data obtained by Azab et al., (1988) and Lewis et al., (1992). Imamaliyev et al., (1975), reported that the application of plant growth retardants to cotton plants increased phenolic compound contents in leaves and inhibited vegetative growth.

Seed oil content data in Table 3 show that seed oil percentage was significantly affected by the application of mepiquat chloride. All mepiquat chloride treatments tended to increase oil content. Abdel-Al et al., (1986) and Azab et al., (1988) found that oil content in seed higher in mepiquat chloride treated plants.

Seed protein percentage data presented in Table 3 indicated that mepiquat chloride application had no significant effect on protein content in seed. Anyhow, there is a clear trend for higher increase in seed protein content in mepiquat chloride treated plants. Abdel-Al et al., (1986) and Azab et al., (1988) obtained the same trend.

It is clear from the previous results that using the plant growth retardant mepiquat chloride had many benefits on the productivity of cotton plant, as it stopped plant excessive elongation, hastened boll maturity at first picking, may prevent regrowth, increased the seed cotton yield to some extent by 15-20%, increased some of chemical constituents inside the plant that inhibited the excessive vegetative growth, and slightly improved earliness.
Table 3. Effect of mepiquat chloride on some chemical constituents in 1998 season.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Carbohydrate</th>
<th>Phenols</th>
<th>In leaves</th>
<th>In seed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R.S.</td>
<td>T.S.S.</td>
<td>P.Phenol</td>
<td>T.Phenol</td>
</tr>
<tr>
<td>Check</td>
<td>16.71</td>
<td>30.20</td>
<td>13.40</td>
<td>21.51</td>
</tr>
<tr>
<td>100 cm³/fed.</td>
<td>21.90</td>
<td>31.11</td>
<td>13.52</td>
<td>25.02</td>
</tr>
<tr>
<td>150 cm³/fed.</td>
<td>14.91</td>
<td>25.22</td>
<td>12.47</td>
<td>18.86</td>
</tr>
<tr>
<td>200 cm³/fed.</td>
<td>15.06</td>
<td>26.48</td>
<td>14.23</td>
<td>21.64</td>
</tr>
<tr>
<td>250 cm³/fed.</td>
<td>18.16</td>
<td>30.84</td>
<td>15.05</td>
<td>25.08</td>
</tr>
<tr>
<td>L.S.D. 5%</td>
<td>0.76</td>
<td>0.60</td>
<td>0.73</td>
<td>1.44</td>
</tr>
</tbody>
</table>

Note: R.S. = Reduced Sugar, T.S.S. = Total Soluble Solids, P.Phenol = Phenolic Content, T.Phenol = Total Phenolic Content.
REFERENCES


تأثير استعمال مبيدات الكلورايد على إنتاجية نيابات القطن

مصطفى حسن عراب، أسامة محمد واحمد
محمد شعبان أبو النور

- معهد بحوث القطن - مركز بحوث الزراعة - الجيزة.


يمكن تلخيص أهم النتائج المتحصل عليها فيما يلي:

1. أدى الرش بموبيكوات الكلورايد إلى نقص في طول النباتات وطول الساق.

2. إنجبت النباتات التي رشت موبيكوات الكلورايد إلى زيادة عدد الفواكه المثمرة على النبات.

3. وتم تسجيل وزن اللوزة بالجرام.

4. لم يؤثر الرش بموبيكوات الكلورايد على معدل الزيت، ونسبة النموذجية للشمع، وكذلك على صنف الشمع (البوموية والثانية).

5. أظهر الرش بموبيكوات الكلورايد زيادة ملحوظة في الكتلات الفيتيولية بالإدرار، ونسبة النموذجية للوزن بالجرام. بينما لم يؤثر الرش بموبيكوات الكلورايد ملحوظاً على النسبة المئوية للبروتين بالجرام.