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THE EFFECT OF MEPIQUAT 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., mepiquat chloride (0,100, 150, 200, and 250 cm^3 /fed.), sprayed once at the start of flowering. The results revealed, that the application of mepiquat chloride reduced plant height and length of inter-nodes, 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 mepiquat chloride exerted a significant increase in phenol 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 off or on just 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).

Mepiquat chloride, is 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 gibbrellic acid (GA), (Wahdan, 1990 and Mahmoud *et al.*, 1994). The application of mepiquat chloride results in a shorter and a more compact plants because of shorter main stem, length of intertnode 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 Abdel-Al *et al.*, 1986, Azab *et al.*, 1988; Sawan and

Saker, 1990; Fatma, 1994 and Fletcher *et al.*, 1994, found that mepiquat 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 staed that earliness, lint percentage and seed index were not affected by mepiquat chloride application. Azab *et al.*, 1988; Sawan and Saker, 1990; Fatma, 1994 and Kassem, 1999, reported that mepiquat chloride application had no effect on micronaire reading and Pressley index. Abdel-Al *et al.*, 1986 and Azab *et al.*, 1988, found that mepiquat chloride application had no clear effect on oil and protein contents. Mepiquat chloride application to cotton plants increased seed cotton yield per feddan (Abdel-Al *et al.*, 1986; Azab *et al.*, 1988; Kerby *et al.*, 1989; 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 mepiquat chloride (1,1dimethyl-piperidinium -chloride commercial name is (ROQUAT) ^{TM} the active ingredient is 250 g/L) zero, 100,150, 200, 250,cm^3 / 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 12m^3 .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 mepiquat 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 significat 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 nuumber 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.

Treatments	Plant Height cm	Fruit-branches per plant	Nodes/ main stem	Internode length cm	No. open bolls/ plant	Boll weight gm	Seed cotton per plant gm	Seed cotton per fed. K/fed.	Earl-iness %	Lint %	Seed index gm	Mic	Pressley index
Check	125	13.75	23.00	5.68	14.50	2.70	25.70	9.30	88.21	39.78	10.11	4.30	9.85
100 cm^3/fed.	110	14.25	27.00	4.23	19.25	2.94	32.35	11.08	85.27	39.69	10.85	4.20	9.72
150 cm^3/fed.	105	15.00	28.75	3.78	19.75	2.87	32.88	11.26	89.47	39.76	10.64	4.15	9.10
200 cm^3/fed.	102	14.50	27.50	3.71	17.75	2.84	30.98	10.61	90.42	39.41	10.35	4.30	9.57
250 cm^3/fed.	93	12.25	26.75	3.61	17.50	3.00	30.48	10.44	85.46	39.30	11.08	4.35	10.00
L.S.D. 0.05	8.65	1.64	2.87	0.41	1.32	N.S.	2.16	0.76	N.S.	N.S.	N.S.	N.S	N.S.

Table 2. Effect of mepiquat chloride on yield, yield components and lint quality in 1998 season.

Treatments	Plant Height cm	Fruit-branches per plant	Nodes/ main stem	Internode length cm	No. open bolls/ plant	Boll weight gm	Seed cotton per plant gm	Seed cotton per fed. K/fed.	Earl-iness %	Lint %	Seed index gm	Mic	Pressley index
Check	135	17.50	24.00	5.86	18.00	3.26	27.57	9.99	83.68	38.62	11.15	4.95	9.85
100 cm^3/fed.	120	18.00	25.50	4.89	20.25	3.15	32.00	10.96	85.57	38.89	11.94	4.80	10.95
150 cm^3/fed.	115	19.00	26.00	4.60	22.25	3.37	33.61	11.51	84.47	39.08	11.73	4.80	10.15
200 cm^3/fed.	115	17.25	26.50	4.51	20.25	3.49	32.06	10.98	87.71	39.63	11.43	5.10	10.40
250 cm^3/fed.	100	14.25	23.75	4.39	18.50	3.15	30.54	10.46	88.14	39.01	12.09	5.00	10.58
L.S.D. 0.05	11.60	2.20	3.85	0.41	1.67	0.22.	2.22	0.78	N.S.	N.S.	N.S.	N.S	N.S.

Number of open bolls per plant was significantly increased by mepiquat chloride spraying until the rate of 150 cm^3/ 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 minimze the vegetative growth, it allows to direct more metabolic energy towards the reproductive structure, (Flotcher *et al.,* 1994). Similar results were obtained by Cathey 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-Al *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 prononunced specially at the rate of 150 cm^3/ 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 hgih yield from the first and second picking. Abdel-Al *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 affeced by any foliar treatment of mepiquat chloride. The same results were obtained by Eid *et al.,* (1986); Malik *et al.,* (1988); Saeed, (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-Al *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 signifcantly 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 hgihest 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 contens 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.,* 1998). These results are in accordance with data obtained by Azab *et al.,* (1988) and Lewis *et al.,* (1992). Imamaliev *et al.,* (1975), reported that the application of plant growth retardants to cotton plants increased phenolic compound contents is 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 treatmens 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.

Treatments	In leaves				In seed	
	Carbohydrate		Phenols			
	R.S.	T.S.S.	P.Phenol	T.Phenol	Oil	Protein
	mg/g		mg/g		%	%
Check	16.71	30.20	13.40	21.51	18.20	18.59
100 cm^3/fed.	21.90	31.11	13.52	25.02	21.67	20.88
150 cm^3/fed.	14.91	25.22	12.47	18.86	19.22	18.90
200 cm^3/fed.	15.06	26.48	14.23	21.64	19.62	18.89
250 cm^3/fed.	18.16	30.84	15.05	25.08	20.63	19.21
L.S.D. 5%	094	0.78	0.60	0.73	1.44	N.S.

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تأثير إستخدام ميبكوات الكلوريد على إنتاجية نباتات القطن

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أجريت تجربتان حقليتان بمحطة التجارب الزراعية بسدس - محافظة بنى سويف خلال موسمى ١٩٩٧ ، ١٩٩٨ لدراسة أثر الرش بميبكوات الكلوريد بتركيزات صفر ، ١٠٠ ، ١٥٠ ، ٢٠٠ ، ٢٥٠سم ٣ / فدان على إنتاجية صنف القطن جيزة ٨٠ .

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى :

١. أدى الرش بميبكوات الكلورايد إلى نقص فى طول النبات ، وطول السلاميات .

٢. إتجهت النباتات التى رشت بميبكوات الكلوريد إلى زيادة عدد اللوز المتفتح على النبات ، ومتوسط وزن اللوزة بالجرام.

٣. أدى الرش بميبكوات الكلورايد إلى زيادة معنوية فى محصول القطن الزهر بالقنطار فدان.

٤. لم يؤثر الرش بميبكوات الكلورايد على معامل البذرة ، والنسبة المئوية للشعر ، وكذلك على صفات الشعر (النعومة والمتانة).

٥. أظهر الرش بميبكوات الكلورايد زيادة معنوية فى المكونات الفينولية بالاوراق ، والنسبة المئوية للزيت بالبذور . بينما لم يؤثر إضافة ميبكوات الكلورايد معنوياً على النسبة المئوية للبروتين بالبذور .