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INFLUENCE OF MECHANICAL TOPPING AND GROWTH REGULATORS ON GROWTH, YIELD AND FIBER PROPERTIES OF EGYPTIAN COTTON (*GOSSYPIUM BARBADENSE*)

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ABSTRACT: Two field experiments were carried out at Gemmeiza Agricultural Research Station, El-Gharbia Governorate during two seasons of 2006 and 2007. This investigation aimed to study the effect of foliar application of Maliec Hydrazide (MH) at 50, 100 and 200 ppm and Ethephon (Eth) at 10, 20 and 40 ppm and mechanical topping on growth, yield and fiber properties of Giza 89 cotton variety.

The obtained results showed that, in comparison with the control, MH and Eth tended to decrease plant height and leaves content of chlorophyll. Such reductions were increased as MH and Eth concentrations increased. On the other hand, all MH and Eth concentrations in general in creased leaves content of sugars, number of fruiting branches / plant, number of open bolls per plant, earliness %, seed index, seed cotton yield per fed. as well as oil and protein contents in seeds. While, mechanical topping decreased growth characters and yield components.

Fiber properties were not affected by either MH and Eth or mechanical topping in both seasons.

It could be concluded that foliage spraying of cotton plants with 50, 100 and 200 ppm of MH or 10 and 20 ppm of Eth at fruiting stage improved performance and yield of cotton plants, contrary, mechanical topping practice was not fruitful in this respect.

Key words: Cotton, Maliec Hydrazide, Ethephon, Growth, yield, chemical composition.

INTRODUCTION

Excessive vegetative growth is a frequent trouble observed in cotton fields that may cause high fruit shedding, late maturity and low cotton yields. Therefore, much efforts have been paid to control the plant vegetative growth and to reduce cotton yield losses with either mechanical topping or growth regulator treatments. Topping main stem apex, is an effective tool to avoid the further development of such trouble but it is a quite difficult practice to be applied at the commercial scale in case of wide cotton areas (Brown *et al*., 1999). This in turn presents to view the need for another reasonable alternative. Many plant growth inhibitors (Maliec hydrazide and Ethephon)

have been practically proved to achieve chemical termination of cotton plant growth.

Maliec hydrazide (MH) is well known as plant growth retardant and acts antimitotic agent inhibiting cell division but not cell enlargement (Kihiman, 1966 and Nooden, 1969). It has been shown that both MH concentrations (50 ppm and 100 ppm) increased number of fruiting branches per plant and number of bolls per plant than the other growth retardants and the control (El-Antably and Abu-El-Atta, 1992). Moreover, Brown *et al*. (2000) revealed that MH was one of the most successful chemicals at removing upper-canopy fruit.

Ethephon (2-chloroethyl-phosphoric acid) is an ethylene releasing compound that has been shown to inhibit shoot apex growth, stem elongation and plant growth in many crop species (Abeles *et al*., 1992 b). Ethephon used in cotton (Kassem, 2003) to inhibit apical dominance and encourage lateral growth (Abeles *et al*., 1992) by reducing the upward translocation and increase the downward translocation of assimilates (Grodzinski and Woodrow, 1989) and consequently cotton yield and its components were increased (Bondok *et al*., 1994; Wahdan and Ghourab, 1995; Wahdan and Wassel, 2000 and Kassem 2003).

The main purpose of this study was to investigate the efficiency of hand topping and the growth inhibitors as Maliec hydrazide and Ethephon in controlling vegetative growth of cotton plant and their reflection on quantity and quality of seed cotton yield.

MATERIALS AND METHODS

The work was carried out in 2006 and 2007 seasons in Gemmeiza Experimental Research Station at El-Gharbiya Governorate Egypt to evaluate the performance of cotton plant under mechanical topping and growth regulators application treatments.

Experimental unit area was 14 m^2 (4 x 3.5) and contained five ridges. Each ridge was 4.0 meters long, 65 cm wide with the hills 25 cm a part in one side of ridge. Hills were thinned after three weeks from planting to two seedlings. Egyptian cotton Giza 89 variety was used in this investigation and sown on March 27th and 31th for the 1st and 2nd seasons, respectively. Each experiment was planned in a complete randomized block design with 4 replicates. Growth regulators used in this investigation were Maliec hydrazide (MH) ($C_4H_4N_2O_2$ at 50, 100 and 200 ppm and Ethephon (Eth) (2-chloro ethyl phosphoric acid) at 10, 20 and 40 ppm. Therefore, the eight applied treatments were as follows:

1- Control (untreated)	**2- Mechanical topping**
3- MH 50 ppm.	**4-MH 100 ppm.**
5- MH 200 ppm.	**6- Eth 10 ppm.**
7- Eth 20 ppm.	**8- Eth 40 ppm.**

Both mechanical topping and chemical treatments were done after 105 days of planting i.e. 13 – 14 sympodia. After 2 weeks of topping application (120 day of planting) samples of the fourth upper leaves were taken to

estimate Chlorophyll a and b (Arnon, 1949), Carotenoids (Rolbelen, 1957), reducing sugars and total soluble sugars A.O.A.C. (1965).

Growth characters: final plant height and number of fruiting branches per plant.

Yield and its components: number of open bolls / plant, boll weight, seed index, lint %, earliness % and seed cotton yield / feddan.

Oil % and protein % in seeds were determined according to the methods of A.O.A.C. (1975).

Fiber properties: micronair value and pressely index at the laboratories of Cotton Research Institute according to A.S.T.M. (1975).

The data of the two experiments were subjected to statistical analysis according to Snedecor and Cochran (1981) and the treatment means were compared using L.S.D. at 0.05 level of probability.

RESULTS AND DISCUSSION

A- Effect of mechanical topping, Maliec hydrazide and Ethephon on leaves chemical composition:

1. *On Photosynthetic pigments*:

Results presented in Table (1) reveal that leaves content of chlorophyll a, b, total chlorophylls and carotenoids were significantly influenced by MH and Eth concentrations. Values of such pigments tended to increase as concentration of MH was increased. More or less, the highest values were obtained with MH at 200 ppm treatment.

Relative to the untreated (control) treatment, Ethephon concentrations generally decreased pigment values. Such inhibitory effects was concentration dependent. However, the highest reductions chlorophyll a, b, total chlorophyll and carotenoids were obtained by 40 ppm only. The inhibitory effect of MH and Eth application on photosynthetic pigments of cotton leaves may be a reflection of decreasing juvenility hormones in cotton leaves as plant age progressed. Ethephon has been shown to act as aging and senescence inducing hormone and the yellowing of leaves and fruits is a frequently observed effect of Eth. The promoting effect of Eth on chlorophyll degradation may contribute that Eth has an activating effect on chlorophyllase, the enzyme which its main function is chlorophyll degradation (Drazkiewicz, 1994). Also many workers obtained a reduction in chlorophyll with high Eth concentration (Bondok *et al*., 1994 and Wahdan & Wassel, 2000).

Table 1

2. O*n carbohydrate fractions*:

Data presented in Table (1) show that in comparison with the control, all MH and Eth concentrations exhibit significant increase in leaves content of reducing sugars, non-reducing sugars and total soluble sugars. Increasing carbohydrate level in cotton leaves treated with Eth appears to be a secondary result of decreasing the translocation of carbohydrate from the source leaf toward the stem apex (Abeles *et al*., 1992 a). Several reports showed that ethephon increased cotton leaves content of sugars (Abdel-Al *et al*. 1987, Bondok *et al*. 1994, Wahdan & Wassel 2000 and Kassem 2003).

3. *Oil and protein percentages*:

Data in Table (1) indicate that all MH and Eth concentrations led to significant increase in seed oil and protein percentages. The increase in cotton seeds oil and protein percentages might be due to the promoting effect of these nutrient on the various chemical constituents of the seeds including the oil and protein quantity.

B. Effect of mechanical topping, Maliec hydrazide and Ethephon on plant height and No. of fruiting branches per cotton plant:

Results in Table (2) show that MH and Eth concentration as well as mechanical topping treatments were significantly affected plant height and number of fruiting branches per cotton plant in both seasons.

Table (2): Effect of hand topping and foliage spraying of Maliec Hydrazide (MH) and Ethephon (ETH) on plant height and number of fruiting branches per cotton plant at harvest during 2006 and 2007 seasons.

Treatments	Plant height (cm)		No. of fruiting branches per plant	
	2006	2007	2006	2007
Control	153.13	156.50	17.63	16.50
Mechanical Topping	133.98	138.50	13.68	14.30
MH 50 ppm	142.52	150.25	18.35	16.50
MH 100 ppm	144.48	153.25	18.83	17.40
MH 200 ppm	145.40	155.00	19.51	19.80
Eth 10 ppm	149.48	152.50	18.50	17.80
Eth 20 ppm	146.90	150.50	19.00	18.30
Eth 40 ppm	146.08	144.50	18.06	16.50
L.S.D. at 5 % level	2.46	2.61	0.47	1.14

1. *Cotton Plant height (cm)*:

MH and Eth as well as mechanical topping treatments reduced significantly the height of cotton plant at harvest than the control. However, the height of cotton plant was gradually increased as MH concentrations increased, but decreased as Eth concentrations increased. These results were the same trend in both seasons. In this respect, Abeles *et al*. (1992 a) reported that Ethephon inhibits stem elongation and reduced plant height in many crop species and thus it is used to increase the hardiness to trans planted seedlings and the resistance to lodging in cereal crops.

2. N*umber of fruiting branches per cotton plant*:

Data presented in Table (2) show that mechanical topping secured a significant reduction on number of fruiting branches per plant. On the contrary, both MH and Eth growth regulators application stimulated lateral buds and increased significantly number of fruiting branches per plant than the control. Such effect was concentration dependent. MH at 50, 100 and 200 ppm increased number of fruiting branches per plant than the control by 4.1, 6.8 and 10.7 % in the first season and by 0.0, 5.4 and 20.0 % in the second season, respectively. Analogous values with Eth at 10, 20 and 40 ppm were 4.9, 7.8 and 2.4 % in the 1st season and 7.9, 10.9 and 0.0 % in the second one. In this respect El-Antably and Abu-El-Atta (1992) pointed out that MH at 50 and 100 ppm increased number of fruiting branches per plant whereas, Brown *et al*. (2000) considered that MH was one of the most successful chemicals at removing upper canopy fruit. Results of Eth are in the same context of those obtained by Abeles *et al*. (1992 a) who indicated that both Ethephon and ethylene inhibit apical dominance and encourage lateral growth by reducing the capacity of polar auxin transport probably through inhibiting the synthesis of auxin porters or suppressing protein synthesis in general. Thus, Ethephon is commercially used to release bud, rhizome and tuber dormancy in many plants (Abeles *et al*. 1992 b). Similar results were obtained by Bondok *et al*. (1994) and Kassem (2003).

C. Effect of mechanical topping, Maliechydrazide and Ethephon on cotton yield and yield components:

Data given in Tables (3 and 4) for the two seasons show that MH concentrations of 50, 100 and 200 ppm increased to different extents number of open bolls / plant, earliness %, boll weight, lint %, seed index and seed cotton yield / fed. This retard effect was found to be due to the blocking of gibberellin biosynthesis and hence reduced the growth of the treated plants. However, such effect was found to be removed after a short time, during which the plants were able to synthesis new amount of gibberellin enough for inducing cell enlargement and cell division for all biological processes (El-Antably, 1975).

Table 3

Table 4

Ethephon effects results in both seasons, showed that number of open bolls / plant, earliness %, boll weight, lint %, seed index and seed cotton yield / fed. values were significantly increased by spraying Ethephon at 10 or 20 ppm, while it was increased only numerically by spraying 40 ppm Eth in comparison with the control.

It could be detected that Eth increased plant productivity as a result of the sum of its morphological, biochemical physiological effects on plants as previous discussed. Induction of flowering may be a form of ethylene induced aging (Abeles *et al*., 1992 a).

D. Effect of mechanical topping, Maliechydrazide and Ethephon on cotton fiber quality:

Data shown in Tables (3 and 4) reveal that mechanical topping and foliage spraying of either Maliechydrazide or Ethephon concentration treatments had no measurable effect on fiber fineness (micronaire reading) and fiber strength (Pressely index). These results are similar to those of Wahdan & Wassel (2000) and Kassem (2003).

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تأثير التطويش ومنظمات النمو على النمو والمحصول وصفات التيلة للقطن المصرى

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الملخص العربى

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بالجميزة – محافظة الغربية خلال موسمى ٢٠٠٦ – ٢٠٠٧ ، لدراسة تأثير الرش بالماليك هيدرازيد بتركيزات (٥٠ ، ١٠٠ ، ٢٠٠ جزء فى المليون) والرش بالأثيفون بتركيزات (١٠ ، ٢٠ ، ٤٠ جزء فى المليون) والتطويش اليدوى صنف القطن "جيزة ٨٩"

أظهرت نتائج الدراسة أن الرش بالتركيزات المنخفضة بالمليك هيدرازيد والأثيفون أدى إلى انخفاض طول النبات ومحتوى الأوراق من الكلورفيل ، وقد أظهرت مختلف تركيزات الماليك هيدرازيد والأثيفون زيادة محتوى الأوراق من السكريات المختزلة والسكريات الذائبة الكلية وعدد الأفرع الثمرية وعدد اللوز المتفتح على النبات وكذلك التبكير % والنسبة المئوية للشعر وتصافى الحليج ومحصول القطن الزهر للفدان. بينما أدى التطويش اليدوى إلى انخفاض قيم جميع قراءات المحصول كما لم تتأثر صفات التيلة (النعومة والمتانة للشعر) معنوياً بالرش بالماليك هيدرازيد و بالأثيفون خلال موسمى الزراعة.

كما تشير نتائج هذه الدراسة أن رش نباتات القطن بالماليك هيدرازيد بتركيزات ٥٠ ، ١٠٠ ، ٢٠٠ جزء فى المليون ، وأيضاً الرش بالأثيفون بتركيزات ١٠ ، ٢٠ جزء فى المليون تؤدى إلى رفع كفاءة الحمل الثمرى للنبات وبالتالى زيادة محصول النبات ، بينما لم يكن للتطويش اليدوى تأثير مفيد فى ذلك الشأن.

Table (1): Effect of hand topping and foliage spraying of Maliec Hydrazide (MH) and Ethephon (Eth) on photosynthetic pigments and carbohydrate fractions of cotton leaves (mg / gm. D.W.), oil and protein percentages in seeds (in 2006 season).

Treatments	Photosynthetic pigments (mg/gm D.W.)				Carbohydrate fraction (mg/gm D.W.)			Seeds	
	Chl a	Chl b	Total Chlorophyll	Carotenoids	Reducing sugars	Non reducing sugars	Total soluble sugars	Oil %	Protein %
Control (untreated)	4.99	3.45	8.44	0.80	11.81	5.70	17.51	18.60	21.20
Mechanical Topping	4.48	2.91	7.39	0.85	13.15	5.30	18.45	18.90	21.50
MH 50 PPm	4.35	3.03	7.38	0.82	13.73	5.00	18.73	20.00	22.12
MH 100 PPm	4.37	3.29	7.66	0.89	14.15	5.50	19.65	20.12	22.62
MH 200 PPm	6.02	4.17	10.19	0.95	14.97	5.80	20.77	18.20	22.30
Eth 10 PPm	4.70	2.72	7.42	0.93	12.29	5.44	17.73	18.50	22.65
Eth 20 PPm	4.75	3.60	8.25	0.85	12.75	5.60	18.35	18.80	23.00
Eth 40 PPm	4.11	2.44	6.55	0.63	12.07	5.30	17.37	18.00	21.20
L.S.D. at 5 % level	0.15	0.28	0.40	0.04	0.80	0.20	0.70	0.35	0.90

Table (3): Effect of hand topping and foliage spraying of Maliec Hydrazide (MH) and Ethephon (Eth) on cotton yield, yield components and fiber quality in 2006 season.

Treatments	No. of open bolls /plant	Earliness %	Boll weight (gm)	Lint %	Seed index	Seed cotton yield (k.*/fed)	Micronaire reading	Pressely index
Control (untreated)	18.66	48.55	2.81	36.24	11.20	8.10	4.80	10.47
Mechanical Topping	17.63	55.33	2.84	37.33	11.40	8.96	4.33	9.93
MH 50 ppm	19.31	53.69	2.78	35.84	11.29	8.57	4.43	9.40
MH 100 ppm	19.94	56.02	2.79	35.91	11.35	8.86	4.47	9.57
MH 200 ppm	21.50	57.48	2.92	36.63	11.65	9.91	4.50	9.80
Eth 10 ppm	19.69	54.50	2.81	35.98	11.30	8.84	4.50	9.43
Eth 20 ppm	20.56	57.62	2.87	36.77	11.45	9.00	4.70	9.47
Eth 40 PPm	19.56	57.20	2.75	35.96	11.30	8.75	4.30	9.07
L.S.D. at 5 % level	1.12	7.02	0.14	1.33	0.40	0.32	N.S.	N.S.

* k = kentar = 157.5 kg

Table (4): Effect of hand topping and foliage spraying of Maliec Hydrazide (MH) and Ethephon (Eth) on cotton yield, yield components and fiber quality in 2007 season.

Treatments	No. of open bolls /plant	Earliness %	Boll weight (gm)	Lint %	Seed index	Seed cotton yield (k.*/fed)	Micronaire reading	Pressely index
Control (untreated)	17.70	50.47	2.67	36.28	11.07	9.01	4.82	9.10
Mechanical Topping	17.30	56.95	2.66	37.27	11.19	9.32	5.00	9.80
MH 50 ppm	18.00	55.25	2.60	36.77	11.20	9.56	4.80	9.20
MH 100 ppm	18.90	56.98	2.65	37.24	11.29	9.90	4.90	9.53
MH 200 ppm	21.40	57.33	2.71	37.59	11.69	10.43	4.90	9.70
Eth 10 ppm	19.00	54.94	2.54	37.33	11.37	9.96	5.00	9.40
Eth 20 ppm	20.30	56.72	2.68	37.78	11.44	10.20	5.00	9.50
Eth 40 ppm	18.50	54.23	2.49	36.22	10.98	9.34	4.80	9.00
L.S.D. at 5 % level	1.02	4.35	N.S.	1.18	0.30	1.05	N.S.	N.S.

* k = kentar = 157.5 kg