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EFFECT OF ABT NO. 7 COMPOUND ON PHYSIOLOGICAL, CHEMICAL CONSTITUENTS, YIELD AND YIELD COMPONENTS OF GIZA 83 COTTON VARIETY

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ABSTRACT: Two field experiments were carried out at the Experimental Farm of Mallawi, Agric. Res. Station, Minia Governorate during 2000 and 2001 seasons to study the physiological effects of ABT No. 7 compound (containing IAA and NAA) on the chemical composition and yield and yield components as well as fiber properties of cotton plants. ABT No. 7 was applied as soaking seeds (10, 20 and 30 ppm) and spraying at thinning stage or at squaring stage (10, 20 and 30 ppm) on cotton plants.

Soaking treatment with ABT No. 7 (30 ppm), spraying at thinning (20 ppm) and squaring at all concentrations had positive effect on chlorophyll leaf contents, while spraying at thinning and squaring stages (10, 20 and 30 ppm) resulted in relative decrease in carotenoides contents as compared to control. Spraying at squaring stage with ABT No. 7 at (10, 20 and 30 ppm) produced the highest level of reducing sugars, non-reducing sugars and total soluble sugars. In general, treatments seemed to increase phenolic compounds as well as auxin contents in cotton leaves. Soaking seeds or spraying plants led to insignificant increase in plant height or number of fruiting branches per plant. Significant increases in number of bolls per plant was observed. All treatments increased the plants to retain more bolls (boll setting %) and reduced shedding % of young bolls. No significant differences were observed in boll weight or seed index. Significant increases in seed cotton yield (kentar/feddan) were observed especially when plants sprayed at squaring stage> Different treatments did not exert significant effects on earliness % and lint% as well as fiber properties, i.e. micronaire reading or pressely index.

Key words: Cotton, ABT No. 7, IAA, NAA, Boll setting, boll shedding, chlorophylls, carbohydrates, phenols, auxins, cotton yield

INTRODUCTION

One of the important causes for reducing shedding of buds, flowers and young bolls is physiologically controlled by chemical substances that is of particular interest in this connection are the bioregulators.

In order to achieve higher seed cotton yield, it is necessary to improve the fruiting coefficient. Application of these substances in the correct concentration and at a specific time during plant development may improve the fruit set. Auxins are thought to play a part in abscission of leaves and

young bolls (Goodwin and Mercer, 1985). The levels of auxins in cotton plants can be controlled by supplying it from outside source by soaking or spraying a chemical substances containing IAA and NAA commercially known as ABT No.7.

The use of synthetic growth regulator chemicals to improve yield and quality of cotton has been researched by numerous investigators. Eid and Abdel-Al (1985) found that hormonal contents of bolls, especially auxin, have important role in boll abscission. They added that spraying 10 and 20 ppm NAA tended to increase reducing sugars and total phenols in leaves. Abdel-Al (1981) reported that spraying IAA at start of flowering increased the polyphenols content in bolls. Gamalat Wahdan (2000) reported that IAA application affected significantly most of the chemical constituents of cotton leaves i.e., chlorophyll a, total soluble sugars and phenolic compounds. El-Gabiery (2002) obtained similar approaches with spraying NAA twice on cotton plants.

Concerning yield and yield components, several investigators (Osman et al., 1985; Sawan et al., 1989; Gamalat Wahdan, 2000) reported that most of yield components of cotton plant were increased by application of IAA. Furthermore, Sawan et al. (1989), Sawan and Saker (1998) and El-Gabiery (2002) reported that application of NAA significantly affected the number of flowers per plant, boll setting percentage and number of total and open bolls per plant.

Gamalat Wahdan (2000) and El-Gabiery (2002) reported that foliar application of IAA or NAA generally had practically no effect on fiber properties.

The aim of this study was to evaluate the effect of the synthetic growth regulator (containing IAA and NAA) commercially known as ABT No. 7 as soaking or foliar application at various concentrations on Giza 83 cotton variety.

MATERIALS AND METHODS

The present work was designed to evaluate the effect of China growth regulators ABT No. 7 (containing Indole acetic acid and 2-Naphthalene acetic acid 1:1) on some chemical contents, boll shedding, yield and yield components of the Egyptian cotton cultivar Giza 83.

A field experiment was carried out at the experimental Farm of Mallawi Agricultural Research station, Minia Governorate, during the two successive seasons of 2000 and 2001.

The treatments of ABT No. 7 were as follows:

Treatments	ABT No. 7 concentration (ppm)
Control	0 zero
Soaking for 24 hr before sowing	10, 20, 30
Spraying at thinning stage	10, 20, 30
Spraying at squaring stage	10, 20, 30

Cotton seeds were planted on April 4th and 5th in 2000 and 2001 respectively. After 36 days, thinning was carried out leaving 2 plants per hill. All plants received an adequate amounts of nitrogenous, phosphatic and potassium fertilizers as recommended for cotton variety. All agricultural practices were carried out as usual.

The experimental design was randomized complete blocks in four replications; each consisted of 5 rows, 4 meters long, 60 cm apart and hill spacing.

For chemical analysis, a random sample of the top fourth node leaves were taken 15 days after thinning for soaking treatments and 15 days after spraying treatments to determine some chemical constituents, i.e. chlorophyll (Arnon, 1949); carotenoides (Rolbelen, 1957); total soluble sugars (Cerning, 1975); reducing sugars (A.O.A.C., 1965); polyphenols (A.O.A.C., 1965); and total phenols (Simons and Ross, 1971). Indole compound, i.e. auxins was determined using the method described by Flisson (1969).

To estimate growth and yield components, ten plants were chosen randomly from each plot and the following characters were recorded at harvest, except number of flowers per plant were recorded daily till the end of flowering season:

1. Number of flowers per plant
2. Number of total bolls per plant
3. Boll setting percentage: calculated from the following equation according to Richmand and Radwan (1962):
   Boll setting % = [(No. of total bolls/plant)/(No. of total flowers/plant)] x 100
4. Boll shedding percentage: calculated from the following equation:
   Boll shedding % = 100 – boll setting %
5. Morphological characters:
   a. Plant height (cm)
   b. Number of fruiting branches per plant
6. Yield and yield components
   a. Number of open bolls per plant.
   b. Boll weight (in gram)
   c. Seed index (in gram)
   d. Lint percentage
   e. Earliness percentage
   f. Seed cotton yield/feddan in kentars
7. Fiber quality:

Fiber fineness (micronaire value) and fiber strength (pressley index) were measured at the Laboratories of Cotton Research Institute, under the standard conditions of test (62+2% relative humidity and 70+2 F temperature) according to A.S.T.M. (1975).

All the obtained data were statistically analyzed according to Snedecor and Cochran (1971) using L.S.D. at 5% level.

RESULTS AND DISCUSSION

I. Chemical constituents of cotton leaves:

Data presented in Table (1) show clearly that early treatments using ABT No. 7 affected significantly most of the chemical constituents and auxins in cotton leaves, either when applied as soaking seeds before planting or spraying at thinning or at squaring stage.

a. Chlorophyll and carotenoide content in cotton leaves:

Data presented in Table (1) reveal that the effect of ABT No. 7 compound depends mainly on its concentration applied as well as the stage in which the plant is treated with such compound. Results indicate that soaking treatment (30 ppm) and spraying at thinning (20 ppm) had a positive effect on total chlorophyll contents of cotton leaves. ABT applications at squaring stage had a clear positive effect on chlorophyll (a) and (b) and total chlorophyll at three concentrations (10, 20 and 30 ppm) under study comparing with the control, this may be due to the great stimulation in formation of phytol which is an essential compound for chlorophyll formation. These results are in agreement with those obtained by El-Halawany (1985). On the other hand, ABT application had a negative effects on carotenoids at all treatments in both seasons. This reduction may be due to the reduction in essential metabolites needed for carotenoids biosynthesis. These results are in good accordance with those obtained by El-Gabiery (2002).

b. Carbohydrate contents:

Results tabulated in Table (1) show the stimulative and significant effects of ABT No. 7 application on the metabolism of carbohydrate contents, i.e. reducing sugars, total soluble sugars and non-reducing sugars. However, soaking treatments gave insignificant effects. Spraying ABT at thinning and squaring stage gave increase carbohydrate components (R.S., T.S.S> and Non R.S.). These increases may be due to either the stimulation of carbohydrate formation by photosynthesis as a result of ABT No. 7 application (containing IAA and NAA) or the induce of the hydrolytic enzymes to breakdown polysaccharides to soluble carbohydrates. Similar results were reported by Eid and Abdel-Al (1985) using NAA at start of flowering and Gamalat Wahdan (2000) using IAA at the start of flowering also.

c. Phenols content:

Concerning the effect of ABT No. 7 treatment, on phenols, results in Table (1) show that all treatments increased that total phenols and polyphenols contents in cotton leaves, as compared with the control in the two seasons. In general, ABT No. 7 application seemed to increase poly and

Table (1): Effect of ABT. No. 7 treatments on some chemical constituents in cotton leaves in 2000 and 2001 seasons.

BAT. No. 7 treatments	ppm	Chlorophylls			Caroten-oides	Carbohydrates			Phenols			Auxins
		a	b	Total		R.S.	Non. R.S.	T.S.S.	Mono-	Poly-		Total
2000 growing season												
Control	0	4.06	1.37	5.43	0.93	9.00	4.68	13.68	5.71	8.30	14.01	2.60
Soaking seeds	10	3.09	1.68	4.77	0.89	9.00	4.66	13.66	5.78	8.30	14.08	2.63
	20	3.43	1.80	5.23	0.90	9.01	4.68	13.69	5.17	8.78	14.95	2.98
	30	4.71	1.68	6.39	0.93	9.02	4.66	13.68	5.41	8.68	14.09	3.28
Spraying at thinning	10	3.54	1.75	5.29	0.85	9.50	4.30	13.80	4.88	9.20	14.08	3.69
	20	4.24	1.39	5.63	0.85	9.01	4.58	13.69	5.47	10.88	16.35	3.67
	30	3.81	1.40	5.21	0.75	9.80	4.72	14.52	5.88	8.80	14.68	3.13
Spraying at squaring	10	4.12	1.77	5.89	0.78	9.14	5.50	14.64	5.00	9.30	14.30	3.00
	20	4.07	1.41	5.48	0.65	9.09	5.35	14.44	5.20	9.80	15.00	3.18
	30	4.46	1.67	6.13	0.74	9.39	6.25	15.64	5.15	10.01	15.16	4.02
LSD at 0.05		0.21	0.67	0.09	0.06	0.01	0.05	0.03	0.06	0.02	0.31	0.03
2001 growing season												
Control	0	4.16	1.40	5.56	0.94	9.50	4.51	14.01	3.53	8.48	12.01	2.90
Soaking seeds	10	3.79	1.78	5.57	0.90	9.50	4.50	14.00	3.82	9.21	13.03	2.91
	20	3.73	1.80	5.53	0.89	9.51	4.50	14.01	4.11	9.19	13.30	3.00
	30	4.24	1.62	5.86	0.99	9.52	4.48	14.00	4.02	9.18	13.20	2.93
Spraying at thinning	10	4.20	1.30	5.50	0.86	9.98	4.12	14.10	3.50	10.30	13.80	3.00
	20	4.16	1.50	5.66	0.92	9.60	5.38	14.98	4.71	9.18	13.89	3.08
	30	3.80	1.70	5.50	0.80	9.90	5.12	15.02	4.76	9.25	14.01	3.02
Spraying at squaring	10	4.24	1.49	5.73	0.90	9.90	5.54	15.44	3.40	10.00	13.40	3.81
	20	4.21	1.47	5.68	0.70	9.80	6.10	15.90	3.75	9.80	13.55	3.64
	30	4.43	1.67	6.10	0.70	9.60	5.40	15.00	3.86	10.20	14.06	4.02
LSD at 0.05		0.07	0.08	0.95	0.03	0.25	0.03	0.05	0.05	0.06	0.32	0.22

R.S. = reducing sugars, T.S.S. = total soluble sugars, Non. R.S. = non-reducing sugars.

total phenol compounds in leaves and this may be due to the increase in biosynthesis of such compounds from other related compounds such as carbohydrate and amino acids. In this connection, Schwenter and Morgan (1966) found that certain monophenols enhanced abscission in cotton, and they found that there is a role of phenols in abscission process. Phenolic compounds were found to affected the activity of IAA oxidase, where polyphenols inhibit the action of IAA oxidase while monophenols enhance its activity (Zenk and Muller, 1963). Abdel-Al (1982) found that NAA application was connected with an increase in the total phenols and poly-phenols contents in young bolls. Recently, Gamalat Wahdan (2000) reported that IAA application at start of flowering stimulated significantly the biosynthesis of phenol compounds.

d. Auxin contents:

Results as shown in Table (1) indicate that there were significant changes in auxin contents in cotton leaves due to soaking seeds or spraying cotton plants with ABT No. 7 compound at different concentrations. There was a positive correlation between ABT No. 7 application and auxins contents, as ABT concentration increased auxins contents increased. It is worth to note that auxins play an important role in setting of young bolls, and this effect may be due to the enhancement of hormonal biosynthesis in bolls during the critical phase of abscission and these actions strongly attributed to yield components in positive effects. In this concern, Gamalat Wahdan (2000) reported that the increase in units of promotion (level) of auxins) was connected with the increase of IAA concentration used, where application of 100 ppm IAA produced more units of promotion.

II. Growth, yield and yield components:

Plant height

Results in Table (2) indicate that soaking seeds of cotton or spraying cotton plants with ABT No. 7 compound at thinning or at squaring led to insignificant increases in plant height as compared with control plants, in both seasons. However, spraying such compound (30 ppm) at squaring stage produced the tallest plants (94.6 and 110.0 cm). It is worth to note that auxin increases cell wall plasticity and water uptake and these effects are probably major factors in stimulation of cell elongation by auxin (El-Gabiery 2002). .

Number of fruiting branches per plant:

The results presented in Table (2) reveal that the application of ABT No. 7 compound as soaking or spraying did not exert significant effects on number of fruiting branches per plant, in both seasons. Spraying this compound (30 ppm) at thinning stage produced the highest number (15.8 and 16.5) of such character. This may attributed to the fact that auxins also enhances the synthesis of RNA and protein, maintains differential permeability of

Table (2): Effect of ABT. No. 7 treatments on growth, yield and yield components of cotton plants in 2000 and 2001 seasons.

ABT. No. 7 treatments	ppm	Plant height cm	No. of fruiting branches per plant	No. of flowers per plant	No. of open bolls per plant	Boll setting %	Boll shedding %	Boll weight (gm)	Seed cotton yield K/fed*	Earliness %	Lint %	Seed index (gm)	Fiber properties	
													Micronaire reading	Pressley index
2000 growing season														
Control	0	90.5	14.7	18.89	12.7	67.23	32.77	2.95	9.06	73.80	40.56	11.34	4.2	9.7
Soaking seeds	10	92.8	14.9	17.05	12.7	74.48	25.52	2.97	9.09	69.80	40.49	11.31	4.4	9.3
	20	93.1	14.5	17.43	12.8	73.35	26.65	3.00	9.21	72.60	40.49	11.14	4.3	9.7
	30	94.1	15.4	18.91	13.6	71.91	28.09	3.07	9.12	70.20	40.34	11.43	4.4	9.5
Spraying at thinning	10	93.9	15.0	17.33	13.0	75.00	25.00	2.99	9.17	74.40	40.86	11.09	4.4	9.4
	20	94.1	15.4	18.17	13.8	75.94	24.06	3.03	9.32	74.00	39.98	11.17	4.5	9.8
	30	94.3	15.8	17.78	13.4	75.36	24.64	3.08	9.22	70.50	40.55	11.21	4.3	9.3
Spraying at squaring	10	91.8	14.6	18.04	13.8	75.77	24.23	3.00	9.31	72.10	40.18	11.46	4.5	9.7
	20	94.2	15.1	18.68	14.3	76.55	23.45	3.00	9.41	72.60	40.59	11.13	4.5	9.8
	30	94.6	15.3	19.48	15.2	78.02	21.08	3.04	10.09	70.20	40.57	11.31	4.3	9.9
LSD at 0.05		N.S	N.S	N.S	0.58	1.34	1.34	N.S	0.61	N.S	N.S	N.S	N.S	N.S
2001 growing season														
Control	0	105.0	16.1	19.31	13.4	69.39	30.61	2.80	9.64	70.40	40.02	10.68	4.3	9.6
Soaking seeds	10	106.6	16.5	18.39	14.0	76.12	23.88	2.84	9.67	72.00	40.03	10.34	4.5	9.2
	20	107.1	16.2	18.68	14.3	76.55	23.45	2.88	9.70	69.30	40.29	10.23	4.4	9.6
	30	107.7	16.4	19.44	14.1	75.53	24.47	2.81	9.67	70.80	40.19	10.54	4.5	9.4
Spraying at thinning	10	107.7	16.0	19.29	15.0	77.76	22.24	2.89	9.89	71.60	39.66	10.39	4.5	9.3
	20	109.0	15.6	19.00	14.6	76.84	23.16	2.84	9.85	71.00	40.39	10.25	4.4	9.7
	30	109.2	16.5	18.45	14.3	75.64	24.36	2.96	9.54	69.80	40.18	10.81	4.6	9.2
Spraying at squaring	10	106.7	15.8	19.11	15.0	78.49	21.51	2.89	10.19	68.40	39.94	10.37	4.5	9.8
	20	107.1	15.4	19.64	15.3	77.90	22.10	2.85	10.66	68.40	39.83	10.09	4.6	9.7
	30	110.0	16.1	20.25	15.7	77.53	22.47	2.85	10.67	68.80	39.33	10.55	4.4	9.6
LSD at 0.05		N.S	N.S	N.S	0.69	3.23	3.23	N.S	0.65	N.S	N.S	N.S	N.S	N.S

* K = Kentar

membranes and increase assimilates mobilization (Goodwin and Mercer, 1985).

Number of flowers and open bolls per plant:

The results presented in Table (2) reveal that the application of ABT No. 7 compound as soaking or spraying at thinning or squaring stage, had no significant effect on number of flowers, while number of open bolls as affected by ABT No. 7 was significantly affected in both seasons. Spraying ABT at squaring stage had a clear positive effect on No. of open bolls at all concentrations.

The same results were obtained by Subbiah and Maria Kulandai (1972) who found that NAA decreased abscission of squares and bolls and also Wahdan (2000) attained similar results when sprayed cotton plants during flowering period with IAA.

Boll setting and boll shedding percentages:

Results show that all treatments of ABT No. 7 compound increased the plants to retain more bolls (increasing boll setting percentage), by decreasing the shedding percentage of young developing bolls. El-Hamawi et al. (1975), Abdel-Al et al. (1982) found that the reduction in shedding of young boll was connected with an increase in total phenols and polyphenol content in young boll. However, data presented in Table (1) supports such results where treated plant leaves contained more phenol compounds, thus the reduction of bolls shedding may be due to the indirect effect of polyphenols in inhibiting the action of IAA oxidase (Wiese and DeVay, 1970).

Boll weight and seed index:

The obtained data show that during the two seasons, no significant differences were observed in boll weight or seed index due to the application of ABT No. 7 compound. The heaviest bolls were produced from plants sprayed at thinning (30 ppm). However, all treatments increased boll weight.

Seed cotton yield:

Concerning the effect of ABT No. 7 compound or seed cotton yield (kentar/feddan), the observed data reveal that such treatments in general, seemed to increase significantly seed cotton yield especially when sprayed at squaring stage at rates of 10, 20 and 30 ppm, in both seasons. The increase in yield may be mainly due to the increase in one or more of the flowering characters, i.e. number of flowers per plant, number of open bolls per plant, setting percentage and boll weight produced from treated plants. The present results are in line with those obtained by Osman et al. (1985), Sawan et al. (1989) and Gamalat Wahdan (2000) using IAA; and Sawan and Saker (1998) and El-Gabiery (2002) using NAA.

Earliness percentage and lint percentage:

Data obtained show that different treatments or concentrations of ABT No. 7 compound did not exert significant effects on earliness and lint percentages during two seasons as compared with control plants. Negi and Singh (1956) applied NAA at 5, 10 and 20 ppm and reported an increase in the number of bolls and yield in the first picking. Gamalat Wahdan (2000) reported that IAA application at start of flowering did not affect significantly lint percentage, but the reverse was true for earliness.

Fiber properties:

During two seasons, results show that no significant differences were recorded in fiber properties i.e., micronaire reading or pressely index due to the application of ABT No. 7 compound. Sawan (1986) attained similar results using IAA. El-Gabiery (2002) reported also that NAA application did not affect significantly fiber properties.

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تأثير مركب ABT رقم ٧ على الصفات الفسيولوجية والكيميائية والمحصول ومكوناته لصنف القطن جيزة ٨٣

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لملخص العربى

نفـذت تجربـتان حقليتان فى المزرعة البحثية لمحطة البحوث الزراعية بملوى- محافظة المنيا خلال موسمى ٢٠٠٠، ٢٠٠١ وذلك لدراسة التأثيرات الفسيولوجية لمركب ABT رقم ٧ الـذى يحـتوى علـى (أنـدول أسـتيك أسيد – نافثالين استيك اسيد) على التركيب الكيماوى والمحصول ومكوناته وكذلك على خصائص الألياف لنبات القطن. اضيف مركب ABT إما بنقع الـبذور بتركـيزات ١٠، ٢٠، ٣٠ جـزء فـى الملـيون أو بالرش فى مرحلة الخف ومرحلة الوسواس بنفس التركيزات السابقة.

ويمكن تلخيص النتائج المتحصل عليها فى الآتى:

أدى نقع البذور فى محلول ABT عند تركيز ٣٠ جزء فى المليون كذلك الرش بتركيز ٢٠ جزء فى المليون عند بداية الخف وكذلك التركيزات الثلاثة تحت التجريب فى مرحلة الوسواس إلى زيادة فى محتوى الأوراق من الكلوروفيل، بينما كان الرش بتركيزات ١٠ ، ٢٠، ٣٠ جزء فـى الملـيون فـى مـرحلة الوسـواس والخـف له تأثير عكسى على مكونات الأوراق من الكاروتينـيدات وذلك بالمقارنة بالكنترول. وقد نتج عن الرش بمركب ABT رقم ٧ فى مرحلة الوسـواس بالتركـيزات الـثلاثة (١٠ ، ٢٠ و ٣٠ جزء فى المليون) إلى الحصول على أعلى المستويات من السكريات المختزلة والسكريات الذائبة الكلية والسكريات غير المختزلة.

وعمومـاً فإن معاملات المركب ABT رقم ٧ أدت إلى زيادة المركبات الفينولية كذلك إلى زيـادة محـتوى الأوراق من الأوكسينات. كما أدت المعاملة بنقع البذور أو الرش بمادة ABT رقم ٧ إلى زيادة غير معنوية فى طول النبات وعدد الأفرع الثمرية على النبات. فى حين كانت هـناك زيـادة معـنوية فى كل من عدد اللوز العاقد على النبات. وأظهرت النتائج أيضاً أن كل المعـاملات أدت إلـى زيـادة قدرة النباتات فى عقد أكبر عدد من اللوز (النسبة المئوية للعقد)

وأنقصت فى نفس الوقت النسبة المئوية لتساقط الأجزاء الثمرية. ولم تلاحظ أى اختلافات معنوية فى وزن اللوزة بالجرام أو معامل البذرة. بينما كانت هناك زيادة معنوية فى محصول القطن الزهر(قنطار/فدان) خاصة عند رش النباتات فى مرحلة الوسواس بمركب ABT رقم ٧ بينما لم تظهر المعاملات المختلفة اى تاثيرات معنوية على النسبة المئوية للتبكير والنسبة المئوية للشعر وكذلك صفتى التيلة (قراءة الميكرونير ومعامل برسيلى).