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Response of two Egyptian cotton cultivars to indole–3–acetic acid application.

Reaktion von zwei ägyptischen Baumwollsorten aufIndole –3–Essigsäure Behandlung

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1. Introduction

Recent changes in the cotton crop production systems are very important to be sensitive to competition from the synthetic substitutes – the man–made fibres. For this, there is a particularly pressing need for new ways to be followed to cut costs and or to increase productivity. Plant growth regulators (like, indole–3– acetic acid »IAA«) may be a major avenue by which we can improve this needs.

MALKANI and ASANA (1958) found the one spray with IAA at 20 ppm increased the number of open bolls and seed cotton yield, but fiber quality was not affected. AVTAR and DARGAN (1963) reported that, spraying cotton plants with IAA at 20 and 40 ppm once or twice resulted in no significant response with regard to boll number and yield per plant, lint percentage, seed index, or lint index. BHARDWAJ and SHARMA (1971) noticed that, the seed cotton yield per boll increased with the application of 1 mg IAA. RAMDAS et al. (1972) found that the application of N + P + 10 ppm IAA increased the seed cotton yield by 43,2%. The findings of DHINDSA (1978) agreed with those of BIRNBAUM et al. (1974) and BHATT et al. (1972) that exogenous IAA was necessary for cotton fiber growth and elongation in isolated unfertilized ovules. In this respect, HSU et al. (1974) found that the fertilized cotton bolls contained more growth promoting substances than unfertilized ones and the main growth substance present was IAA. Also, the application of exogenous auxin to unfertilized bolls reduced shedding and stimulated the development of young bolls.

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ALY (1975) concluded that treating the Egyptian cotton with 15 ppm IAA at intervals increased the seed cotton yield per plant, yield per boll and seed index, but fiber properties were not affected. At the same time, LALL and SHASTRI (1975) reported that application of IAA to cotton plants at the flowering stage increased seed cotton yield due to the reduction in boll shedding.

This work was undertaken to determine the extent of the improvement in yield components and fiber properties of two Egyptian cotton cultivars (»Giza 66« and »Giza 70«) by using IAA substance during flowering stage.

2. Materials and Methods

Two Egyptian cotton cultivars (*Gossypium barbadenseL.*), »Giza 66« (medium staple) and »Giza 70« (long staple), were the subject of this study. The field work was carried out during the two successive seasons of 1980 and 1981 at the Experimental Station, Faculty of Agriculture, Cairo University. A complete randomized block design with four replications was used. Each plot area was 12 m^2 (3x4 meter), with five ridges. Seed was sown in March 20thin both seasons. Common agricultural practices used in cotton cultivation were carried out. Five concentrations of IAA (indole–3–acetic acid), namely, i.e. 5, 10, 20, 40 and 80 ppm., were sprayed twice on the two cultivars. Untreated plants of each cultivars were used as control. The first spray was at 90 days after sowing and the second one was 30 days later.

The plants were randomly taken from the entire rows of each plot to study the following yield components: number of open bolls per plant, boll weight (in gram), lint percentage, seed index (mean weight of 100 seed, in gram), lint index (weight of lint per 100 seed, in gram) and seed cotton yield per plant (in gram).

Earliness as percentage of first picking was determined by using the following formula:

$$\frac{\text{seed coton yield of the first picking}}{\text{total seed cotton yield}} \times 100$$

The first picking was taken on September 12th, and the second on October 11th in the two seasons.

Fiber properties tests were carried out at the laboratories of Cotton Technology Research Div., Cotton Research Institute, Agricultural Research Centre, under the standard atmospheric conditions of 65 ± 2 percent relative humidity and 70 ± 2°F.

The following fiber properties were determined: 2.5% span length (measured by digital fibrograph according to ASTM D–1447-63), micronaire value (determined by Micronaire instrument ASTM D–1448–59), and flat bundle strength (measured by Pressley instrument as Pressley index ASTM D–1445–60 T.).

Data obtained for all characters were statistically analized according to SNEDECOR (1961), and the Angular or Arcsin transformation for percentages was used. New least

significant difference (New L.S.D.) was utilized to measure the significance of differences between treatment means (WALLER and DUNCAN,1969).

3 Results and Discussion

3.1. Yield and yield components:

3.1.1 Number of open bolls per plant:

Data presented in Table 1 indicated that the treatments of 5 and 10 ppm IAA produced significant positive effects on the number of open bolls per plant, while rate of 80 ppm significantly reduced it as compared with the controls in both cultivars. The two levels 20 and 40 ppm had no effect, and this agreed with the findings of AVTAR and DARGAN (1963), using the same concentrations. On the contrary, MALKANI and ASANA (1958) reported that one spray of IAA at 20 ppm increased the number of open bolls of cotton plants. This could be explained as a result of the interference between IAA and different growth substances in plant tissues. For instance ethylene production can be stimulated by auxin and the ethylene is probably responsible for the present effects (BURG and BURG, 1966). On the other hand, the low levels of IAA possibly reduced boll shedding and stimulated the growth of young cotton bolls as stated by HSU et al. (1974) and LALL and SHASTRI (1975).

3.1.2 Boll weight:

The results obtained in Table 1 revealed that, plants treated with 10 and 20 ppm IAA showed significant increases in boll weight as compared with the control plants in both cultivars. The highest level (80 ppm) significantly lowered the boll weight in »Giza 70« only. The beneficial effect of IAA on seed cotton yield per boll was also found by BHARDWAJ and SHARMA (1971) and ALY (1975). This might be due to the stimulating effects of IAA on growth and fruiting which in turn reflect on boll weight. This explanation is in agreement with that of HSU et al. (1974).

3.1.3. Lint percentage:

It was noticed from Table 1 that, the treatment with 10 ppm IAA significantly increased lint percentage in the »Giza 66« cultivar. On the other hand, the 80 ppm significantly reduced the lint percentage in both cultivars as compared with the control. In this respect, AVTAR and DARGAN (1963) reported that 20 and 40 ppm IAA had no significant effect on lint percentage.

3.1.4 Seed index

Results recorded in Table 1 show that, all concentrations of IAA used, caused a significant increase in the weight of 100 seed in the two cultivars in comparison with the controls. These results were in agreement with the findings of ALY (1975), although they disagreed with those of AVTAR and DARGAN (1963). Since almost every dynamic part of plant growth and development seems to be affected by auxin

Tab. 1: Average values of yield components for the two cotton cultivars as affected by IAA concentrations in 1980 and 1981 season.

Cultivar	IAA concentrations (ppm)	Number of bolls/plant			Boll weight (g)			Lint percentage (%) Actual		Lint percentage (%) Arcsin*			Seed index (g)			Lint index (g)		
		1980	1981	Aver.	1980	1981	Aver.	1980	1981	1980	1981	Aver.	1980	1981	Aver.	1980	1981	Aver.
Giza 66	Control	8.54	8.62	8.58	1.82	2.09	1.96	34.0	34.6	22.1	22.5	22.3	8.56	8.88	8.72	4.40	4.80	4.60
	5	9.83	11.11	10.47	1.90	2.10	2.00	35.0	36.8	22.8	24.0	23.4	9.19	9.37	9.28	4.95	5.44	5.20
	10	10.22	10.69	10.46	2.04	2.29	2.17	36.0	37.5	23.4	24.5	24.0	8.83	9.72	9.28	4.91	5.84	5.36
	20	8.83	9.17	9.04	2.03	2.23	2.13	34.8	35.3	22.6	22.9	22.8	9.09	9.54	9.32	4.84	5.20	5.02
	40	8.06	8.12	8.09	1.88	2.06	1.97	33.1	31.2	21.5	20.2	20.8	9.22	9.69	9.46	4.55	4.41	4.48
	80	7.19	7.40	7.30	1.83	2.02	1.93	32.9	30.7	21.4	19.9	20.6	8.71	9.78	9.25	4.00	4.04	4.02
Giza 70	Control	8.06	9.50	8.78	2.21	2.37	2.29	36.6	38.1	23.8	24.9	24.4	8.04	8.44	8.24	4.92	5.52	5.22
	5	10.05	9.98	10.02	2.32	2.40	2.36	37.9	39.1	24.7	25.6	25.2	9.28	9.01	9.15	5.40	5.90	5.65
	10	10.29	10.10	10.20	2.40	2.54	2.47	38.6	39.8	25.4	26.3	25.9	8.58	8.91	8.75	5.76	5.89	5.82
	20	9.18	9.29	9.24	2.40	2.50	2.45	36.7	38.6	24.9	25.4	24.6	8.77	9.34	9.06	5.09	5.88	5.49
	40	7.88	8.98	8.43	2.16	2.28	2.22	35.9	34.6	23.3	22.5	22.9	8.59	9.25	8.82	4.49	4.48	4.49
	80	7.49	7.95	7.72	2.06	2.18	2.12	35.6	33.6	23.2	21.8	22.5	9.09	9.26	9.18	4.74	4.38	4.56
New L.S.D.																		
	0.05	0.50	0.59	0.71	0.09	0.13	0.08			0.32	0.31	1.60	0.28	0.19	0.50	0.21	0.15	0.58
	0.01	0.69	0.81	0.97	0.12	0.18	0.11			0.44	0.42	2.24	0.39	0.26	0.69	0.29	0.20	0.82

* Arcsin = Angles corresponding to percentages.

(LEOPOLD and KRIEDEMANN, 1980), then exogenous auxin may stimulate the accumulation of the different substances which increase the seed weight.

3.1.5 Lint index:

It was obvious from Table 1 that, the rates of 5 and 10 ppm IAA significantly increased lint index in »Giza 66«, while in »Giza 70« cultivar, 10 ppm alone had this effect. These findings disagreed with those obtained by AVTAR and DARGAN (1963), as no significant response appeared. The higher concentration of 80 ppm produced significant decreases in lint index in both cultivars compared with the control plants, while 40 ppm lowered it in »Giza 70« only.

These results indicated the varietal differences in response to IAA. Plants responded positively to lower concentrations but not to the higher ones, where negative effects appeared.

3.1.6 Seed cotton yield per plant:

The data given in Table 2 indicated that, the low concentrations of IAA (5, 10 and 20 ppm) caused significant increases in seed cotton yield per plant in the two cultivars as compared with the controls, and 10 ppm was the most effective concentration. On the other hand, the high level of 80 ppm significantly reduced seed cotton yield per plant in both cultivars, while 40 ppm decreased it in »Giza 70« only. Similar results concerning the positive effect of IAA on seed cotton yield were obtained by MALKANI and ASANA (1958), RAMDAS et al. (1972), ALY (1975), and LALL and SHASTRI (1975). However, AVTAR and DARGAN (1963) reported that 20 and 40 ppm IAA had no significant effect on seed cotton yield per plant. These results could be explained as stated previously, since the same low levels of IAA increased the number of open bolls, boll weight, and lint index, while the high level caused reverse effects.

3.1.7 Earliness:

Data illustrated in Table 2 indicated that, the 10 ppm IAA treatment significantly enhanced the earliness as percentage of first picking, in both cultivars, while the other concentrations had no effect. The positive effect of IAA on yield earliness is probably due to the diverse effects of auxin on plant growth and differentiation. The auxin plays an important role in flower initiation and development, fruit–set, and fruit growth (HSU et al., 1974 and LEOPOLD and KRIEDEMANN, 1980).

3.2. Fiber properties:

The fiber traits under investigation included the 2,5% span length, flat bundle strength and micronaire value. The results pertaining to these characteristics are presented in Table 3.

The results showed that IAA treatments had no significant effect on all fiber properties in both cultivars. These results agreed with the findings of MALKANI and ASANA (1958) and ALY (1975). The only exception was the 20 ppm concentration which significantly increased the fiber length in »Giza 70« only as compared with the control. These results agreed with those found by BHATT et al. (1972). The positive effect of IAA on fiber length can be explained in the light of the results found by BIRNBAUM et al. (1974) and DHINDSA (1978), who reported that exogenous IAA is necessary for cotton fiber growth and elongation.

Generally, it could be concluded that the low concentrations of IAA (5, 10, and 20 ppm) improved the quantity, and to a certain extent the quality, of seed cotton yield, while the higher concentrations (40 and 80 ppm) negatively affected the yield of cotton plants.

Tab. 2: Average values of seed cotton yield per plant and yield earliness for the two cultivars as affected by IAA concentrations in 1980 and 1981 seasons.

Cultivar	IAA concentations (ppm)	Seed cotton yield (g/plant)			Yield earliness (%)				
					Actual		Arcsin		
		1980	1981	Aver.	1980	1981	1980	1981	Aver.
Giza 66	Control	15.5	18.0	16.8	51.5	56.7	34.4	38.4	36.7
	5	18.7	23.3	21.0	55.6	58.6	37.5	39.9	38.7
	10	20.8	24.4	22.6	57.7	68.3	39.2	44.0	41.6
	20	17.9	20.4	19.2	54.4	57.9	36.6	41.0	38.8
	40	15.1	16.7	15.9	53.6	58.7	36.0	39.9	38.0
	80	13.2	14.9	14.1	52.6	57.0	35.3	38.6	37.0
Giza 70	Control	17.8	21.4	19.6	56.3	68.4	38.1	48.0	43.1
	5	23.3	24.0	23.7	62.3	72.9	42.2	52.0	47.1
	10	24.7	25.4	25.1	65.6	73.2	45.5	52.4	49.0
	20	19.7	22.8	21.3	61.2	72.1	42.9	51.3	47.1
	40	16.0	19.8	17.9	60.3	69.8	41.2	48.3	44.8
	80	15.4	17.3	16.4	58.1	69.0	39.5	48.5	44.0
New L.S.D.									
	0.05	0.50	0.40	1.60			0.26	0.35	4.17
	0.01	0.68	0.55	2.19			0.35	0.48	5.68

Tab. 3: Average values of fiber properties for the two cultivars as affected by IAA concentrations in 1980 and 1981 seasons.

Cultivar	IAA concentrations (ppm)	2.5% span length (inch)			Micronaire value			Flat bundle strength		
		1980	1981	Aver.	1980	1981	Aver.	1980	1981	Aver.
Giza 66	Control	1.043	1.062	1.053	4.88	4.93	4.91	8.92	8.87	8.90
	5	1.045	1.068	1.057	4.78	4.73	4.76	8.78	9.80	9.29
	10	1.048	1.053	1.051	4.75	4.83	4.79	8.65	9.00	8.83
	20	1.045	1.078	1.062	4.73	4.73	4.73	8.83	8.68	8.76
	40	1.040	1.046	1.043	4.75	5.02	4.89	8.83	9.80	8.32
	80	1.085	1.072	1.079	4.80	4.85	4.83	9.48	8.88	9.18
Giza 70	Control	1.286	1.360	1.323	3.92	4.18	4.05	11.45	11.71	11.58
	5	1.310	1.395	1.353	3.95	4.10	4.03	11.95	11.88	11.92
	10	1.310	1.360	1.335	3.98	4.05	4.02	11.43	11.43	11.56
	20	1.335	1.410	1.373	4.00	4.15	4.08	11.80	12.02	11.91
	40	1.288	1.375	1.332	4.10	4.00	4.05	11.80	11.55	11.68
	80	1.285	1.360	1.323	4.00	4.20	4.10	10.98	11.53	11.26
New L.S.D.										
	0.05	0.017	0.017	0.050	0.30	0.12	0.38	0.61	0.20	0.86
	0.01	0.023	0.023	0.070	0.41	0.16	0.53	0.84	0.27	1.18

4. Summary

The present investigation was carried out during 1980 and 1981 seasons at the Exp. St., Fac. of Agric., Cairo Univ., Giza, Egypt, to study the influence of IAA on two Egyptian cotton cultivars (»Giza 66 and Giza 70«). IAA was applied twice as foliar sprays in five concentrations, i.e. 5, 10, 20, 40 and 80 ppm. The first application was 90 days after sowing and the second was 30 days later.

The results showed that: the lower two rates of IAA (5 and 10 ppm) produced significant increases in the number of open bolls per plant, and the seed cotton yield per plant in the two cultivars. The 10 ppm concentration significantly increased the boll weight, lint index and yield earliness in both cultivars and the lint percentage in »Giza 66«. Boll weight, seed cotton yield per plant in the two cultivars, and fiber length in »Giza 70« were also positively affected by the 20 ppm concentration. The 5 ppm concentration increased the lint index significantly in »Giza 66«. Seed index in both cultivars was significantly increased due to IAA application. The higher rate (80 ppm) produced a significant decrease in the number of open bolls per plant, lint percentage, lint index and seed cotton yield per plant in both cultivars, and boll weight in »Giza 70«. Also, 40 ppm significantly reduced lint index and seed cotton yield per plant in »Giza 70«.

Practically, the lower two rates of IAA, 5 and 10 ppm, can be recommended for improving yield components and fiber properties of the two used Egyptian cultivars.

Zusammenfassung

Die beschriebenen Untersuchungen wurden 1980 und 1981 auf dem Versuchsfeld der Landwirtschaftlichen Fakultät, Kairo Univ., Giza, Ägypten, durchgeführt, zur Erfassung des Einflusses von IES auf zwei ägyptische Baumwollsorten (»Giza 66« und »Giza 70«). IES wurde zweimal gespritzt und kombiniert in fünf Konzentrationen (5, 10, 20, 40 und 80 ppm). Die erste Behandlung wurde 90 Tage nach Aussaat durchgeführt, während die zweite 30 Tage später durchgeführt wurde.

Die Ergebnisse zeigen, daß die beiden niedrigen Konzentrationen (5 und 10 ppm) die offenen Samenkapselzahl pro Pflanze und auch Samenertrag pro Pflanze der beiden geprüften Sorten erhöhten. Die Konzentration von 10 ppm erhöhte das Samenkapselgewicht, den Faserindex und führte zu einer früheren Reife bei den beiden Sorten, sowie Erhöhung des Fasergehaltes bei »Giza 66«.

Die Behandlung mit 20 ppm beeinflußte positiv das Samenkapselgewicht, den Samenertrag pro Pflanze bei beiden Sorten sowie die Faserlänge bei »Giza 70«.
Die Behandlung mit 5 ppm erhöht den Faserindex in »Giza 66«. Der Samenindex bei beiden Sorten wurde gesichert erhöht als ein Einfluß durch die IES–Behandlung. Die höchste Konzentration (80 ppm) erniedrigt die Anzahl der offenen Samenkapseln pro Pflanze, Fasergehalt, Faserindex und Samenertrag pro Pflanze bei beiden Sorten

sowie das Samenkapselgewicht bei »Giza 70«. Die Benutzung von 40 ppm IES erniedrigte Faserindex und Samenertrag pro Pflanze bei »Giza 70«.
Zur Verbesserung der Ertragskomponenten und der Fasereigenschaften bei den beiden untersuchten Sorten »Giza 66« und »Giza 70« kann für die Praxis die Anwendung der beiden niedrigsten Konzentrationen (5 und 10 ppm) empfohlen werden.

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