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RESPONSE OF THE EGYPTIAN COTTON PLANT TO FOLIAR SPRAY WITH SOME MACRO-NUTRIENTS (NPK) AND THE GROWTH REGULATOR PACLOBUTRAZOL (PP_{333})
BY
2- EFFECTS ON REPRODUCTIVE GROWTH, ANATOMY OF FLOWER PEDICEL AND YIELD COMPONENTS
BY

El- Demerky, S.A.; Kheder, Z.M.; Wanas, A.L. and Ahmed, H.S.
Dept. of Agric. Botany, Fac. of Agric., Moshtohor, Zagazig Univ., Benha branch.

ABSTRACT

Under Field conditions during two seasons of study (1999 and 2000); with the onset of flowering stage of cotton plants under different applied treatments (NPK and growth regulator paclobutrazol as well as their combinations); several alterations in its economic characters were existed. Since, number, fresh and dry weights of fruiting branches either insignificantly or significantly increased with different applied treatments. Also, numbers of formed flowers and bolls/plant were significantly increased with all applied treatments; in contrast, reduction in the number of aborted flowers was existed.

In addition ,yield components as seed cotton yield, lint and seed yields per boll or per plant as well as the oil percentage in cotton seeds were positively affected with nearly all applied treatments. Here, of interest and of economic value was the highest lint percentage and its weight/boll or plant existed with PP_{333} at 5 ppm + K at 25 ppm treatment.

On the other hand, the essentiality of this study brought about from these increases in the thickness of both phloem and xylem tissues (conducting tissues) and number and wall thickness of xylem vessels (supporting factors) as well as the formation of new vascular bundles in the cortex (new cortical bundles) with some of the applied treatments (N at 250 ppm, K at 25 ppm, PP_{333} at 5 & 10 ppm and the three combination treatments). These bundles represent an additional pathway for photosynthates and different nutrients being translocated from sources (different plant parts) to sinks (bolls). That simply reflected upon each of boll retention and increasing boll weight and its final yield as well.

INTRODUCTION

In cotton plant sink competition for carbohydrates, root activity and thus, nutrient uptake by the roots decline with the onset of the reproductive stage. So, foliar sprays containing nutrients can compensate for this decline (Trubisch and

Schalling, 1970). Although not always but quite often, foliar application of NPK during flowering and at fruit development can be quite effective in increasing the yield. Hence, both the application of NPK alone and particularly in combination with a source-containing surfactant, steeply increased yield and nitrogen content of the plants (Neumann, 1982 and Marschner, 1995).

The subject of boll abscission has interested cotton producers and research workers for many years. Some regard the process of boll abscission or shedding as a physiological disorder which, if corrected, would greatly increase productivity of the crop. Others, however, regard boll abscission as a natural process by which the plant adjusts its fruit load to match the supply of organic and in organic nutrients.

In this respect, despite possible adverse effects of excessive N in promoting vegetative growth; yield of cotton is probably more often limited by a deficiency than by an excess of N. Hence, N deficiency can stimulate abscission. Also, few reports suggested that K should affect abscission in cotton. In addition, a deficiency of P delays and reduces fruiting of cotton (Addicot and Lyon, 1973).

On the other hand, most of the research on the biochemistry and anatomy of abscission has been conducted with explants (Marschner, 1995).

Also, plant hormones apparently interact to control abscission. Since, gibberellins have been reported to increase abscission (Morgan and Durham, 1975; Varma, 1976 a, b & c and Chanerjee, 1977). Here, it was thought advisable to study the effect of paclobutrazol; the newest regulator as antigibberellins. In addition, this substance was known to stimulate cytokinins creation and that could be either inhibit or promote abscission , depending upon time and site of application(Addicott, 1970). Therefore, the present study was planned to complete its first part (EL- Desouky *et al* 2001). It was prolonged to investigate the effect of NPK and paclobulrazol upon cotton yield and to correlate achieved yield with those anatomical alterations being created in different tissues of survived flowres (new set ones).

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture at Moshtohor, Zagazig University, Benha Branch during two successive seasons of 1999 and 2000.

Seeds of the egyptian cotton plant (*Gossypium barbodense* Mill) cultivar Giza 85 were secured from Institute of Cotton Research, Agriculture Research Center, Ministry of Agriculture, Giza.

Cotton seeds well treated with Rizolex Rt 50 as fungicide and sown on the 15th of March during 1999 season and on the 18th of March during 2000 season at the rate of 10 seeds per hill. The experiment was arranged in a randomized complete block design with four replicates. The experiment unit was 3 x 3.5 meter, including five rows with a distance of 40 cm between hills.

At 37 days from sowing, hills were thinned to one seedling. Then, different agricultural practices including irrigation, weed and pest control were done according to the management system in the Faculty Farm.

Different applied treatments were as follow:

1- Spraying with nitrogen N (in the form of urea 46.5 % N w / was nitrogen source) at the levels of 50 and 250 ppm.
2- Spraying with phosphorus P (in the form of phosphoric acid 80% P a.i. w/v) at the levels of 25 and 50 ppm.
3- Spraying with potassium K (in the form of potassium citrate 48% K a.i. w/w) at the levels of 25 and 50 ppm.
4- Spraying with paclobutrazol (PP_{333} 0.23% a.i.) at the levels of 5 and 10 ppm.
5- Spraying with the combination of PP_{333} at 5 ppm + N at 50 ppm.
6- Spraying with the combination of PP_{333} at 5 ppm + P at 25 ppm.
7- Spraying with the combination of PP_{333} at 5 ppm + K at 25 ppm.
8- Spraying with only distilled water as control treatment.

Cotton plants were foliar sprayed with different assigned treatments five times at 60, 75, 90, 105 and 120 days after sowing, using hand operated compressed air sprayer at the rate of 10 liter/ plot with 1 ml/l of Tween 20 as a wetting and spreading agent.

Sampling and collecting data:

1- Fruiting branches:

Four plants were randomly taken from each plot at 75, 105 and 190 days after sowing to estimate the number of fruiting branches as well as their fresh and dry weights only at 105 days of plant age.

2- Flowering data:

a- Number of opened or aborted flowers; counting was started at the age of 100 days with 3 days intervals until 165 days.
b- Number of formed or opened bolls counting was started at the age of 120 days with 3 days intervals until 175 days after sowing.
c- Percentage of flower abortion, it was calculated using the following equation:

$$\% \text{ of flower abortion} = \frac{\text{No. of aborted flowers/plant}}{\text{Total No. of flowers/plant}}$$

d- percentage of boll opening, it was calculated using the following equation:

$$\% \text{ of boll opening} = \frac{\text{No. of opened bolls/plant}}{\text{Total No. of bolls/plant}}$$

3 –Anatomical study:

At 120 days after sowing in the second season, specimens (1 cm long) of the pedicel of the third survived flower (i.e. new set one) on the 4th apical fruiting branch on the main stem were taken from the basal part of flower pedicel, for the anatomical study.

Specimens were then killed and fixed for at least 48 h. in F.A.A. (10 ml formalin, 5ml glacial acetic acid and 85 ml ethyl alcohol 70%), washed in 50% ethyl alcohol, dehydrated in a series of ethyl alcohol (70, 90, 95 and absolute), infiltrated in xylene, then embedded in paraffin wax of a melting point 60-63 C°, (Sass, 1951). Specimens were sectioned at 20 µ ' using a rotary microtome, double stained with fast green and safranin, (Johanson, 1940) cleared in xylene and mounted in Canada balsam.

The prepared sections were microscopically examined, counts and measurements (u) were taken using a micrometer eye piece. Averages of readings from 4 slides/ treatment were calculated.

4-The final yield sample;

It was taken at 190 days after sowing (at the harvest date) to estimate seed cotton (g) / boll or plant, lint weight (g) / boll or plant, lint %, seed number and weight / boll or plant as well as the seed index.

5 –Determination of oil percentage in cotton seeds:-

The seeds were ground in a disentegrator. The ground seeds were extracted with *n-hexane* for 48 h. then filtered. This process was repeated 3 times using fresh solvent each time to extract most of the oils from the ground seeds. Then, the ground seeds were extracted by *Soxhlet* procedure according to the A.O.A.C. (1980)method.

III –Statistical analysis:

Data of reproductive growth and yield components were subjected to statistical analysis according to (Steel and Torrie, 1980), using L. S. D test.

RESULTS AND DISCUSSION

Reproductive growth:

With the onset of flowering stage of cotton plants of different applied treatments; some of reproductive characteristics were estimated.

(1) Number of fruiting branches:

Table (1) indicates that, at 75 days of plant age the number of fruiting branches was significantly increased only with paclobutrazol (PP_{333}) at 10 ppm and paclobutrazol at 5 ppm + potassium (K) at 25 ppm. Yet, its insignificant increase existed with nitrogen (N) at 250 ppm, K at 25 ppm, phosphorus (P) at 25 ppm, PP_{333} at 5 ppm + N at 50 ppm and the rest of treatments (N, K or P at 50 ppm and PP_{333} at 5 ppm) did not show any effect upon this number.

While, at 105 days after sowing increases of this number were the dominant effect of different applied treatments. Increases reached the 5% level of significance with N, K and PP_{333} at the two applied concentrations and P at 50 ppm as well as the combinations of PP_{333} at 5 ppm + N at 50 ppm or + K at 25 ppm. Yet, insignificant increase existed with the rest of treatments (P at 25 ppm

and the combination of PP_{333} at 5 ppm + P at 25 ppm). Also, it could be noticed that PP_{333} at 5 ppm + K at 25 ppm gave the highest values in this respect at this stage of growth (105 days after sowing).

On the other hand, at 190 days of plant age the number of fruiting branches nearly behaved as the same as at 105 days of plant age. Since, insignificant increase of this number existed with N at 50 ppm, K at 50 ppm and PP_{333} at 5 ppm; yet, its significant increase existed with the rest of treatments.

(2) Fresh and dry weights of fruiting branches:

As shown in Table (1) both fresh and dry weights of the fruiting branches were increased with most of the applied treatments at 105 days of plant age. Increases were reached the 5% level of significance with N, K and P at the two applied concentrations and the combination of PP_{333} at 5 ppm + K at 25 ppm. Yet, its insignificant increase existed with the rest of treatments. Exception was only that insignificant reduction of both weights with PP_{333} at 5 ppm. Also, it could be noticed that both N concentrations as well as K at 25 ppm and P at 50 ppm showed the highest values in both weights.

Table (1): Effect of some macro-nutrients (NPK) and paclobutrazol (PP_{333}) on some reproductive growth characters of cotton (*Gossypium barbadense* Mill. cv.Giza 85) plants at different stages of growth.*

Characters / Treatments ppm		No. of fruiting branches/plant			Fresh weight g/plant	Dry weight g/plant
		Days after sowing				
		75	105	190	105	105
Control	0.0	3.00	10.50	11.25	47.07	12.59
Nitrogen	50	3.00	13.25	12.00	52.03	14.90
	250	3.25	14.00	14.25	56.08	16.16
Potassium	25	3.50	13.75	15.50	52.55	15.25
	50	3.00	14.00	13.50	51.58	14.81
Phosphorus	25	3.50	10.75	12.50	49.78	13.98
	50	3.00	13.50	15.25	52.95	15.33
Paclobutrazol	5	3.00	13.75	12.75	37.88	9.95
	10	3.75	14.00	15.50	47.50	13.87
PP_{333}	5 + N 50	3.25	14.50	14.25	48.48	13.43
PP_{333}	5 + K 50	3.75	14.75	15.00	49.75	14.74
PP_{333}	5 + P 50	3.25	12.25	14.00	48.16	12.82
L.S.D.	0.05	0.6078	2.53	2.1750	2.294	1.3148

* Data represent the mean values of two seasons.

In this respect El-Shahawy and Abdel-Malik (1999) reported that the highest N rate increased number and dry weight of fruiting parts. Besides,

Abd El-Dayem and El-Deeb (2000), stated that PP_{333} increased number and dry weight of fruiting branches.

II- Flowers setting and abortion:

(1) Number of flowers /plant:

Data in Table (2) clearly indicate that all applied treatments increased the total number of formed flowers /plant during the flowering stage of cotton plant. Increases reached the 5% level of significance with different applied treatments. The only exception was that its insignificant increase with N at 50 ppm and PP_{333} at 5 ppm. Here, combination of PP_{333} at 5 ppm + K or P at 25 ppm gave the highest increases of this number. Yet, PP_{333} at 5 ppm was less effective in this respect.

(2) Number and percentages of aborted flowers /plant:

Data in Table (2) obviously indicate that significant reduction in the number of aborted flowers was dominant results of all applied treatments. This reduction reached its highest value with PP_{333} at 5 ppm + K at 25 ppm followed by K or P at 25 ppm. Thereby, these numbers when calculated as percentages dominantly gave significant reduction with all applied treatments. Hence, these results are of economic importance, since the cotton yield is a reflection for flower abortion and the following boll setting.

Table (2): Effect of some macro-nutrients (NPK) and paclobutrazol (PP_{333}) on some reproductive growth characters of cotton (*Gossypium barbadense* Mill. cv. Giza 85) plants at different stages of growth.*

Characters / Treatments ppm		No. of flowers /plant	No. of aborted flowers /plant	% of flower abortion	Total No. of bolls /plant	No. of opened bolls /plant	% of opening
Control	0.0	44.25	15.25	34.46	29.50	22.75	77.12
Nitrogen	50	46.25	13.00	28.11	33.25	25.75	77.44
	250	48.00	12.50	26.04	35.50	29.00	81.69
Potassium	25	47.75	12.25	25.65	35.50	27.50	77.46
	50	47.00	12.75	27.13	34.25	26.50	77.37
Phosphorus	25	47.25	13.00	27.51	34.25	26.75	78.10
	50	48.00	12.25	25.25	35.75	29.00	81.12
Paclobutrazol	5	44.75	13.50	30.17	31.25	24.25	77.60
	10	47.50	12.50	26.32	35.00	27.25	77.85
PP_{333}	5 + N 50	47.50	13.00	27.36	34.50	27.00	78.26
PP_{333}	5 + K 25	49.25	12.00	24.37	37.25	30.25	81.20
PP_{333}	5 + P 25	49.00	12.50	25.51	36.50	28.50	78.08
L.S.D.	0.05	2.5401	1.7082	1.3181	3.0656	2.239	3.545

* Data represent the mean values of two seasons.

(3) Number of opened and total bolls /plant:

Table (2) clearly indicates that both number of opened bolls and that of total ones /plant significantly increased with the applied treatments. Exception was only insignificant increase in both numbers with the treatment of PP_{333} at 5 ppm.

(4) Percentages of opening bolls:

Data in Table (2) also indicate that N at 250 ppm, P at 50 ppm and PP_{333} at 5 ppm + K at 25 ppm significantly increased the percentage of opening bolls, yet, its insignificant increase existed with the rest of treatments.

In this respect, other studies have been also reported nearly similar results [Palmo and Davis (1984), Oosterhuis *et al.*, (1990) Yasseen (1993), Miley and Oosterhuis (1994), Moore (1998), Vyakarnahal *et al.*, (1998) and Abd El-Dayem and El-Deeb (2000)] using either N, P, K or growth retardants.

Anatomical features of the pedicel of survived flowers (i.e. those formed new small bolls)

Anatomical features in the pedicel of the survived flowers (formed small bolls) at 120 days of plant age are indicated in Table (3) and Fig. (1)

With regard to the diameter of whole section it could be noticed that its significant increase existed with all applied treatments. Also, the highest increase of this diameter was that existed with PP_{333} at 5 ppm + P at 25 ppm. Meanwhile, N at 25 ppm showed the lowest increase in this parameter.

Regarding the epidermis thickness; its significant increase was the dominant result of different applied treatments. Exception only was its insignificant increase that existed with PP_{333} at 10 ppm and N at 50 ppm. On the other hand, cortex thickness nearly behaved as the same as in case of epidermis thickness. Yet, its insignificant increase was only existed with N at 50 ppm.

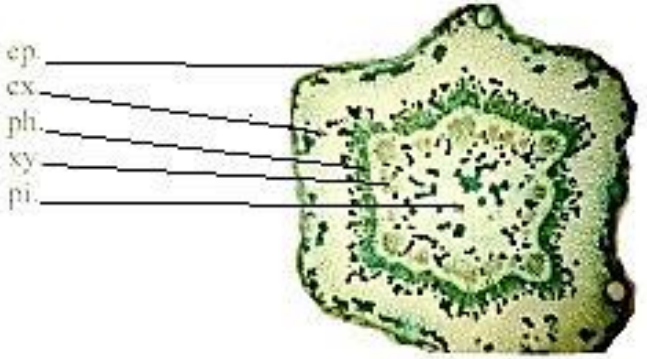
Concerning, the phloem tissue, its thickness significantly increased with the assigned treatments. The highest increase existed with PP_{333} at 10 ppm followed by K at 25 ppm, N at 250 ppm and PP_{333} at 5 ppm.

Besides, thickness of xylem tissue and number of xylem vessel rows in the vascular cylinder were significantly increased with all applied treatments. Meanwhile, number of vessels /row was increased with all applied treatments, to reach its maximum values with K at 25 ppm and the combination of PP_{333} at 5ppm + K at 25 ppm.

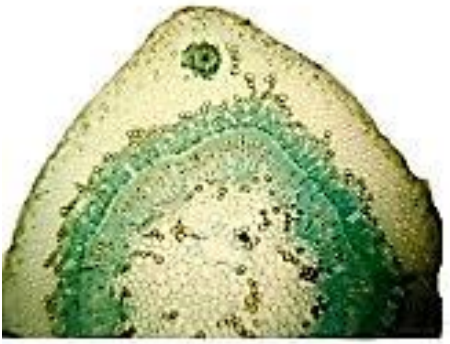
As regards the wall thickness of xylem vessel it was significantly increased with most applied treatments. Exception was only its insignificant increase existed with K at 50 ppm, PP_{333} at 5 ppm and PP_{333} at 5 ppm + N at 50 ppm.

Table (3): Mean counts and measurements of certain anatomical features in transverse sections through the pedicel of third flower survived on the 4th apical fruiting branch on the main stem cotton (*Gossypium barbadense* Mill. cv. Giza 85) plants.*

Characters / Treatments ppm		Diameter of whole section	Thickness of epidermis	Thickness of cortex	Thickness of phloem zone	Thickness of xylem zone	No. of xylem rows in the vascular cylinder	X' No. of xylem vessels in the row	Diameter of widest xylem vessel	Wall thickness of widest vessel	Diameter of pith
Control	00	2204.41	14.78	282.93	101.07	122.40	55.33	6.00	25.40	5.93	1122.93
Nitrogen	50	2559.57	15.63	291.70	121.30	142.16	75.00	7.00	24.83	5.84	1240.47
	250	2818.43	17.63	315.90	131.90	158.86	64.33	7.00	24.63	4.34	1439.53
Potassium	25	2792.53	17.33	306.80	126.10	164.20	49.00	8.67	24.80	4.20	1338.47
	50	2648.67	16.40	322.50	125.30	151.16	60.00	6.67	26.37	3.70	1191.95
Phosphorus	25	2823.33	16.17	349.50	123.00	156.15	71.00	7.00	28.96	4.23	1290.13
	50	2867.33	16.40	387.50	125.26	160.03	79.00	7.00	24.93	4.33	1302.69
Paclobutrazol	5	2747.23	17.43	331.90	131.57	147.46	68.33	8.67	28.96	3.63	1347.94
	10	2881.27	15.67	327.87	140.90	167.03	44.00	7.00	26.10	4.23	1465.63
PP_{100} 5+N	50	2658.43	18.33	343.70	132.50	148.27	72.33	6.67	26.36	3.83	1281.23
PP_{100} 5+K	25	2877.33	17.23	372.96	121.27	160.83	81.33	8.00	27.96	3.90	1289.93
PP_{100} 5+P	25	2985.86	16.43	408.53	117.57	155.10	71.33	7.67	26.26	3.96	1454.20
L.S.D.	0.05	169.56	1.4401	22.059	9.405	9.6984	4.791	1.5383	0.854	0.1758	113.88



a



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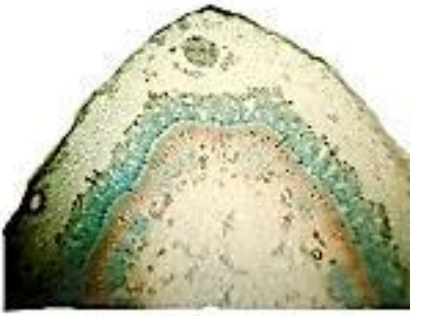

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Fig. (3): Transverse section through the pedicel of third flower survived on the 4th fruiting branch on the main stem of cotton. (x 50).
a)- Untreated plants.
b)- N at 250 ppm.
c)- K at 25 ppm.
d)-P at 50 ppm.
e)-PP_{333} at 10 ppm.
f)- PP_{333} at 5 ppm + N 50 ppm.
g)-PP_{333} at 5 ppm + K 25 ppm.
h)-PP_{333} at 5 ppm + P 25 ppm.

Abb: ep. = epidermis, cx. = cortex, ph. = phloem tissue, xy. = xylem tissue and pi. = pith.

Moreover, pith diameter was significantly increased with different applied treatments Exception it's insignificant increase existed only with K at 50 ppm

In general, to our knowledge there are no studies have been carried out on the effect of such applied treatments upon the anatomical features of flower pedicels of cotton plant. But, to interpret the obtained results, the most important are those increases existed in the conductive tissues. Since, both phloem and xylem tissues being directly correlated with survival of cotton flowers or small bolls and improving translocation processes of both inorganic nutrients and photosynthates as well. Besides, number of xylem vessels as well as wall thickness of xylem vessels are considered main factors for increasing the attachment of flowers and bolls to their carrying stems; in other wards, increasing flower and boll retention.

New findings of the present study:

The effect of N, P, K and PP_{333} in the assigned concentrations as well as some of their combinations are indicated in Table (4) and Fig. (3).

The anatomical features of the present study showed that some assigned treatments (N at 250ppm, K at 25 ppm, PP_{333} at 5&10 ppm and the three combination treatments), led to formation of new vascular bundles in the cortex tissue (i.e. cortical bundles). Meanwhile, other treatments (N, K or P at 50 ppm) included the control did not show any effect in this respect. Here, it could also be noticed that the treatment of K at 25 ppm and also the combination of PP_{333} at 5 ppm + P at 25ppm gave the highest diameter of the cortical bundles when compared with the other treatments. Meanwhile, the treatment of N at 250 ppm and PP_{333} at 5 ppm + N at 50 ppm ranked the second in this respect.

Here, of interest is to note that this new formed bundles represent an additional pathway of photosynthates and different transminable nutrients from different plant parts (i.e. sources) to bolls (i.e. sinks). That could be simply reflected upon each of boll retention and the number of abscised bolls as well as increasing boll weight and its final yield. That could be drive us to suggest such treatments to be practically applied.

VI- Effects on yield components:

1- Seed cotton yield:

As shown in Table (5) seed cotton yield either per boll or per plant was significantly increased with all applied treatments. Exception, was only that insignificant increase of seed cotton /boll existed with N at 50 ppm. Also, it could be noticed that PP333 at 5ppm + K 25 ppm, P at 50 ppm, N at 250 ppm and K at 25 ppm were more pronounced in this respect. Since, they gave values of 106.18 & 3.53; 98.89 & 3.41; 98.02 & 3.38 and 95.43 & 3.77 for seed cotton weight per plant and per boll weight, respectively.

Table (4): Mean counts and measurements of certain anatomical features in transverse sections through the pedicel of third flower survived on the4th apical fruiting branch on the main stem (for the new formed lateral cortical bundles) of cotton *(Gossypium barbadense* Mill cv. Giza 85) plants as affected by NPK and paclobutrazol.

Characters / Treatments	ppm	Thickness of fiber layers	Thickness of phloem Zone	Thickness of xylem zone	Diameter of cortical bundles	No. of cortical bundles
Control	00	00.00	00.00	00.00	00.00	00.00
Nitrogen	50	00.00	00.00	00.00	00.00	00.00
	250	15.86	29.43	36.36	140.40	1.33
Potassium	25	12.73	50.36	58.23	185.40	1.67
	50	00.00	00.00	00.00	00.00	00.00
Phosphorus	25	00.00	00.00	00.00	00.00	00.00
	50	00.00	00.00	00.00	00.00	00.00
Paclobutrazl	5	11.33	16.13	32.60	72.52	2.00
	10	06.33	18.40	35.40	94.86	2.67
PP_{333} 5+N	50	27.16	19.26	49.70	144.54	2.67
PP_{333} 5+ K	25	24.33	25.73	35.92	136.04	2.33
PP_{333} 5+ P	25	19.46	38.56	48.13	164.17	1.33
L.S.D	0.05	3.1075	1.1962	1.3879	74.915	0.8323

(2) Lint characters:

Data in Table (5) clearly show that except that insignificant increase of lint weight /boll existed with N at 50 ppm, the rest of treatments significantly increased led to significant increase which reflected in the lint yield per plant. Since, also it was significantly increased with the all applied treatments. Hence, lint percentage, nearly behaved as the same as lint weight. Here, the combination of PP_{333} 5 ppm + K 25 ppm exhibited the highest values of the above mentioned aspects (i.e lint weight per boll or plant and the lint percentage).

(3) Seeds characters:

With regard to the number of seeds per boll; the only N at 50 ppm and P at 25 ppm insignificantly increased this number, yet, its insignificant increase obtained with the rest of treatments. On the other hand, weight of seeds/boll nearly behaved as the same as their number (Table 5).

As for either seed number or weight, their significant were the dominant result of all applied treatments. Here, also it is obvious that PP_{333} 5 ppm + K 25 ppm showed the highest increases of these two parameters.

In addition, the above mentioned results were prolonged to affect the calculated seed index. Since, its increase was dominantly existed and reached the 5% level of significance with N at 250 ppm, K at the two applied concentrations, P at 50 ppm, PP_{333} at 10 ppm and the three applied combination treatments.

Table (5): Effect of NPK and growth regulator paclobutrazol on yield components of cotton (*Gossypium barbadense* Mill. cv. Giza 85) plants.*

Characters / Treatments	ppm	Seed cotton g/boll	Seed cotton yield g/plant	Lint weight g/boll	Lint yield g/plant	Lint %	Seed No./boll	Seed weight g/boll	Seed No./plant	Seed yield g/plant	Seed index	Oil % in seeds
Control	00	2.72	61.88	1.09	24.80	35.97	17.20	1.63	391.50	37.17	9.50	17.27
Nitrogen	50	2.86	73.65	1.19	30.46	36.28	17.40	1.67	448.00	43.01	9.60	22.13
	250	3.38	98.02	1.36	39.44	37.16	18.70	2.02	542.30	58.57	10.80	22.00
Potassium	25	3.77	95.43	1.44	39.60	38.09	18.50	2.03	508.75	55.76	10.96	23.47
	50	3.32	87.98	1.38	36.57	38.35	18.20	1.94	485.00	51.41	10.60	18.40
Phosphorus	25	3.09	82.66	1.32	35.31	38.48	18.10	1.77	484.20	47.45	9.80	19.60
	50	3.41	98.89	1.41	40.89	37.07	19.40	2.00	562.60	57.95	10.30	22.13
Paclobutrazl	5	3.18	77.12	1.34	30.07	38.07	18.60	1.84	451.00	44.65	9.90	17.67
	10	3.33	90.74	1.43	38.97	38.86	18.80	1.90	512.30	51.74	10.10	24.00
PP_{333}+N	50	3.29	88.83	1.36	36.72	37.88	18.40	1.93	496.80	52.16	10.05	20.27
PP_{333}+ K	25	3.51	105.18	1.53	46.28	39.74	19.00	1.98	574.75	59.77	10.40	20.67
PP_{333}+ P	25	3.31	94.34	1.39	39.62	38.29	18.60	1.92	530.10	45.60	10.30	21.93
L S D	0.05	0.331	9.541	0.239	4.918	0.865	1.037	0.291	37.902	5.056	0.499	-----

* Data represent the mean values of two seasons.

In this respect, other studies reponed nearly similar results on yield components of cotton plant using either N, P, K, or growth retardants. Of these are Oosterhuis *et al.*, (1990), Yasseen (1993), Sawan *et al.*, (1997 a&b) , Sawan *et al.*, (1999), Mekki (1999) and Abd El-Dayem and El-Deeb (2000).

(4) Oil percentages:-

As shown in Table (5) all applied treatments increased the oil percentage in cotton seeds at the harvest time. This increase reached its maximum with PP_{333} at 10 ppm (24.00%) followed by K at 25 ppm (23.74%) and P at 50 ppm (22.13%), yet the treatment of PP_{333} at 5ppm gave the lowest increase of oil percentage comparing with the control. These results were in harmony with those obtained by Abd El-Dayem and El-Deeb (2000) using PP_{333} on cotton plants.

In general, nutrient deficiencies may cause a decrease in growth with a concomitant reduction in the number of squares produced, they may cause an increase in abscission of fruiting forms, or they may cause both (Guinn, 1977).

Also, the evidence suggests a three- way interaction between assimilates and plant hormones. First, certain hormones can mobilize assimilates and cause them to move to a boll in competition with other sinks. Second, assimilates are required for the continued growth of embryos and production of hormones. Third, the production of ethylene and ABA, hormones that promote abscission, is apparently increased by a deficiency of assimilates (Vaughan and Bate, 1977).

Finally, this investigation strongly admit the possibility of applying such treatments especially N at 50 ppm, K at 25 ppm, P at 50 ppm and PP_{333} at 10 ppm as well as PP_{333} at 5 ppm + K or P at 25 ppm as foliar spray treatments. Since, these treatments have economic importance regarding reduction of flowers and boll shedding accompanied by increasing the number of fruiting branches, boll and lint weights, in turn, increasing the seed cotton yield as well as oil yield in cotton seeds.

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استجابة نبات القطن المصري للرش الورقي بالنيتروجين والفسفور والبوتاسيوم وكذلك منظم النمو الباكلوبيوترازول
٢- التأثير على النمو الثمري وتشريح عنق الزهرة والمحصول ومكوناته

سعيد علي الدسوقي ، زكريا محمد خضر، أحمد لطفي ونس و حامد سيد أحمد
قسم النبات الزراعي- كلية الزراعة بمشتهر - جامعة الزقازيق/ فرع بنها

أجريت هذه الدراسة تحت الظروف الحقلية خلال موسمي ١٩٩٩ ، ٢٠٠٠ وقد أظهرت الدراسة أنه مع حلول مرحلة الأزهار في نباتات القطن أدت مختلف المعاملات المستخدمة (النيتروجين والبوتاسيوم والفوسفور ومنظم النمو باكلوبيوترازول وكذلك بعض معاملات التفاعل بين التركيز المنخفض من الباكلوبيوترازول والتركيز المنخفض من كل من النيتروجين والبوتاسيوم والفوسفور إلى حدوث تغيرات جديدة في كثير من الصفات الاقتصادية لنباتات القطن.

حيث وجد أن كل من العدد والوزن الطازج والجاف للأفرع الثمرية قد زاد إما بدرجة معنوية أو غير معنوية مع مختلف المعاملات المستخدمة. كذلك زاد عدد الأزهار والوز المتكونة/نبات بدرجة معنوية مع كل المعاملات المستخدمة وعلى النقيض من ذلك حدث نقص معنوي في عدد الأزهار المتساقطة مع تلك المعاملات.

بالإضافة إلى ذلك فإن مكونات المحصول معبرا عنها بمحصول القطن الزهر/نبات ، محصول التيلة ومحصول البذور/لوزه أو نبات وكذلك محصول الزيت بالبذور قد زاد معنوياً مع كل المعاملات تقريبا. وكان من الملفت للنظر وذو أهمية اقتصادية هي الزيادة الكبيرة في نسبة التيلة وكذلك وزن التيلة/لوزة أو نبات والتي ظهرت مع معاملة التفاعل باكلوبيوترازول بتركيز ٥ جزء في المليون + البوتاسيوم بتركيز ٢٥ جزء في المليون.

ومن ناحية أخرى تظهر أهمية هذه الدراسة من تلك الزيادة التي حدثت في سمك نسيجي اللحاء والخشب (الأنسجة الداعمة) وعدد وسمك جدار لوحية الخشب (عوامل تدعيمية) بالإضافة إلى تكوين حزم وعائية جديدة في النسيج القشرة وذلك مع بعض المعاملات المستخدمة (النيتروجين بتركيز ٢٥٠ جزء في المليون والبوتاسيوم بتركيز ٢٥ جزء في المليون والفوسفور بتركيز ٥٠ جزء في المليون والباكلوبيوترازول بتركيز ٥ ، ١٠ جزء في المليون ومعاملات التفاعل الثلاثة. وهذه الحزم الوعائية تمثل مسار إضافي لنواتج التمثيل والمغذيات المختلفة التي تنتقل من المصدر (أجزاء النبات المختلفة) إلى المخازن (اللوز). وهذا قد انعكس على كل من استمرار بقاء اللوز على النبات وزيادة وزن اللوزه. وأيضا المحصول النهائي.