ATTEMPTS TO CONTROL EXCESSIVE VEGETATIVE GROWTH OF COTTON

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Abstract

Two field experiments were carried out at Sakha Agricultural Research Station during 1997 and 1998 seasons, using the Egyptian cotton cultivar Giza 87 (G. barbadense L.) to study the effect of some cultural treatments in order to check excessive vegetative growth i.e. topping at 120 days age, spraying 8 kg/fed. super phosphate (15% P_2O_5) on mid-July and 15 days later, spraying Pix (mepiuat chloride) 500 ml/fed. (50 gm a.i/L) twice in the beginning of squaring and 15 days later and single spray of Pix at the beginning of squaring +topping at 120 days age, besides untreated control. The results indicated that the different treatments significantly affected all the studied characters compared to the control except number of fruiting sites whereas they reduced final plant height, main stem internodal length, monopodia, sympodia, aborted sites and unopen bolls/plant. In general the studied treatments increased boll retention, earliness percentage, number of open bolls, boll weight, lint percentage, seed index and seed cotton yield (Kintar/fed.). The main prominent effect was detected with single spray of Pix + toping followed by two sprayings of Pix specially for seed cotton yield and its components.

INTRODUCTION

Irrespective to variety, plant type, population density and sowing date, soils with high fertility and moisture availability will tend to produce abundant vegetation in cotton (Makram, *et al.*, 1994). Excessive vegetative growth in cotton occurs at the expense of reproductive growth. A greater portion of squrares and small bolls on the lower sympodia may shed, and this results in a late maturing and often low yielding capacity. A dense, luxuriant canopy provides a more favorable microclimate for boll rot fungi and may hinder effective application of insecticides (York, 1983). In the few later years, several methods for altering excessive vegetative growth such as topping and/or foliar spraying of either growth regulators or calcium super phosphate were applied in Egypt and other cotton growing countries. El-Gnayni *et al.*(1984) showed that cotton plants topped late (mid July or first August) produced high yield, seed index and lint percentage. Ghaly *et al.* (1988) and Wassel (1990) found that topping cotton plants at 105 days age gave the highest yield/fed., number of open and total bolls/plant

and boll weight. Abd El-Aal *et al.* (1993) reported that topping generally increased boll set, number of fruiting sites, seed cotton yield/fed, and yield components, while it dereased plant height, number of monopodia, days to both first open flower and boll, main stem internode, shedding and earliness percentages. Also, Abd El-Malek *et al.* (1997) stated that late topping at formation of 10 or 12 sympodia/plant decreased plant height, while increased numbern of open bolls per plant and seed cotton yield/fed. Other's used calcium super phoshate to obtain proper plant growth. Girgis *et al.* (1984) found that spraying cotton with calcium super phosphate at 3% concentration three times at the beginning of flowering with 15 days intervals increased nuumber of flowers, open bolls, boll setting, earliness percentage, boll weight and seed cotton yield/fed. Abou-Ahmed (1985) stated that spraying cotton with 4% superphosphate four sprays during vegetative and flowering stages, resulted in higher number of flowers, open bolls, boll weight, seed index and seed cotton yield/fed. Abd El-Malik (1988) reported that spraying cotton plants with 4% superphosphate four times, hastened first flower, first fruiting branch, increased number of opn bolls, earliness, seed cotton yield, seed index and lint percentage. Abo-Soliman et al. (1990) stated that spraying phosphoruus at flowering and one month later produced the lowest node location of the first sympodiuum, the highest earliness, boll set percentages and seed cotton yield. El-Sayed (1996) showed that three foliar sprayings of phosphorus at 75, 90 or 105 days from sowing enhanced flower appearance, boll set, number of open bolls, earliness with higher seed cotton yield.

Regarding growth regulators, Azab *et al.* (1993) found that Pix (mepiquat chloride) applicantion reduced plant height, number of nodes and sympodia while it increased seed index, earliness, boll weight, number of open bolls, lint% and seed cotton yield. Abd El-Aal (1997) reported that Pix treatment resulted in higher number of sympodia, open bolls, earliness, boll weight and seed cotton yield while depressed plant height and internode length.

The objective of this investigation was to examine and evaluate some treatments which may check excessive vegetative growth of cotton.

MATERIALS AND METHODS

Two field experiments were conducted at Sakha Agricultural Research Station during 1997 and 1989 seasons using Giza 87 cotton cultivar (G.barbadense L.). The experimental design was randomized complete blocks with four replications. Plot size was 18 m^2 (3.6 m width x 5 m long) including 6 rows 60 cm apart. Cotton seeds were

planted in the last week of March in both seasons on hills spaced 20 cm apart and seedlings were hand-thinned, leaving two plants/hill 40 days after sowing. In both seasons, imblalanced fertilization was practiced by adding 100 kg N/fed. in two equal doses before the second and third irrigations, and 15 kg/fed. P_2O_5 during land preparation without applying potassium due to high content of K in the soil (Table 1).

Table 1. Mechanical and chemical analysis at 30 cm depth of the soil of the experimental site.

Characters		1997	1998
Soil structure		Clay	Clay
pH (1:25)		8.10	8.30
Organic matter	%	2.10	1.90
Total S.S	%	0.55	0.65
Bicarbonate	%	1.80	2.00
Chloride	%	7.30	8.20
Sulfuric	%	5.00	6.50
Ca	%	1.60	1.90
Mg	%	1.40	1.70
Na	%	4.35	4.65
Available N	(ppm)	12.80	9.80
Available P	(ppm)	9.20	8.10
Available K	(ppm)	680.0	650.0

All other cultural practices were applied as recommended in cotton production despite irrigation intervals ranged from 12-15 days. Samples of ten plants (5 guarded hills) were randomly chosen from each plot at the end of season to evaluate the effect of the following treatments on vegetative growth and some other traits:

1- Control (untreated plants). 2- Topping at 120 days from sowing (removing apical bud of main stem and monopodia). 3- Super phosphate (15.0% P_2O_5) spraying of the rate of 8 kg/fed. (60 gm H_2PO_3/L) in mid July and 15 days later. 4-Two Pix [mepiquat chloride] sprays at the contcentration of 500 ml/fed. (50gm a.i/L) at the beginning of square formation and 15 days later. 5-Single spray of Pix 500 ml/fed. (50gm a.i./L) at the beginning of square formation followed by topping after 120 days from sowing.

Characters studied:

A. Growth habits:

Final plant height (cm), number of main stem internodes, main stem internodal length and number of monopodia.

B. Fruiting habits:

Number of sympodia, aborted sites, fruiting sites and boll retention.

C. Earliness parameters:

Days to both first open flower and boll and earliness percentage:

$$\frac{\text{First picking} \times 100}{1^{st} + 2^{nd} \text{ picking}}$$

D. Seed cotton yield and its components:

Number of open and unopen bolls, boll weight (gm), lint percentage and seed index (g/100 seeds).

Picking was practiced twice for all plants of the four inner rows of each plot and then transformed into corresponding values in kintar per feddan. Statistical analysis was done according to Little and Hills (1978). Mean values were tabulated and compared at the 5% level of significance as outlined by Duncan's Multiple Range Test (1955).

RESULTS AND DISCUSSIONS

A. Growth habits:

Data presented in Table 2 clear the effect of some cultural treatments on some growth habits in 1997 and 1998 seasons. Compared with untreated control plants, treatments had a highly significant effect on this group of traits, whereas it depressed plant height, main stem internodal length and nuumber of monopodia/plant in both seasons. Number of main stem internodes tended to increase in favour of Pix spraying twice followed by single spray of Pix+topping and phosphorus spraying twice in similar magnitudes with untreated control, while topped plants gained the lowest values. It is apparent that spraying Pix either single or twice at square initiation accelerated node formation with shorter internode, and consequently shorter plants. Spraying phosphor-

Table 2. Means of some growth habits as affected by some growth control treatments, 1997 and 1998 seasons.

Growth habits	Seasons	Sig.	Control	Topping at 120 days from sowing	Phosphorus spraying in mid-July and 15 days later	Pix spraying (50 gm a.i./L) at the beginning of squaring and 15 days later	Single spraying of Pix at squaring+toppingat 120 days from sowing
Final plant height (cm)/plant	1997	**	145.67 a	110.20 d	129.10 b	114.63 c	107.67 d
	1998	**	147.77a	111.17 d	123.67 d	119.27 c	108.50 d
Number of main stem internodes/plant	1997	**	24.08 b	18.37 c	25.47 b	27.53 a	24.20 b
	1998	**	23.46 b	17.93 c	23.63 b	24.90 a	22.94 b
Main stem internodal length (cm)/ plant	1997	**	6.05 a	6.00 a	5.09 b	4.44c	4.45 c
	1998	**	6.30 a	6.20 a	5.23 b	4.80c	4.73 c
Number of monopodia/plant	1997	**	1.97 a	0.93 b	0.67 b	0.40 b	0.53 b
	1998	**	1.83 a	0.63 b	0.60 b	0.53 b	0.60 b

Means designated by the same letters are not significantly different at 0.05 level according to Duncan's M.R.T.

** Indicate P<0.01

Tabel 3. Means of some fruiting habits as affected by some plant growth control treatments, 1997 and 1998 seasons.

Fruiting habits	Seasons	Sig.	Control	Topping at 120 days from sowing	Phosphorus spraying in mid-July and 15 days later	Pix spraying (50 gm a.i./L) at the beginning of squaring and 15 days later	Single spraying of Pix at squaring+toppingat 120 days from sowing
Number of sympodia/plant	1997	**	20.87 a	15.43 c	18.93 b	20.70 a	15.47 c
	1998	**	17.07 a	14.08 c	15.93 b	17.9 7 a	14.10 c
Number of aborted sites/plant	1997	**	10.43 a	8.50 b	9..03 b	6.27 c	6.10 c
	1998	**	13.00 a	9.93 b	10.00 b	7.80 c	7.47 c
Number of fruiting sites/plant	1997	N.S	28.67	29.33	28.67	28.97	29.17
	1998	N.S	34.13	34.75	34.20	35.03	34.43
Boll retention/plant	1997	**	18.10 d	20.80 b	19.62 c	22.37 a	23.07 a
	1998	**	21.13 c	24.80 b	24.17 b	26.97 a	26.37 a

Means designated by the same letters are not significantly different at 0.05 level according to Duncan's M.R.T.
** and N.S.indicate P<0.01 and not significant, respectively.

Table 4. Means of some earliness parameters as affected by some plant growth control treatments, 1997 and 1998 seasons.

Earliness parameters	Seasons	Sig.	Control	Topping at 120 days from sowing	Phosphorus spraying in mid-July and 15 days later	Pix spraying (50 gm a.i./L) at the beginning of squaring and 15 days later	Single spraying of Pix at squaring+topping at 120 days from sowing
Days to first flower/plant	1997	**	111.67 a	110.77 a	110.73 a	104.00 b	103.37 b
	1998	**	105.33 a	104.37 a	104.37 a	99.50 b	99.13 b
Days to first open boll/plant	1997	**	162.67 a	159.90 a	161.00 a	152.17 b	151.57 b
	1998	**	156.60 a	153.60 a	154.54 a	148.30 b	147.40 b
Earliness pecentage	1997	**	54.51 c	62.79 b	61.80 b	70.88 a	69.90 a
	1998	**	64.83 c	71.65 b	72.18 b	74.85 a	74.58 a

Means designted by the same letters are not significantly different at 0.05 level according to Duncan's M.R.T.
** and N.S.indicate P<0.01 and not significant, respectively.

Table 5. Means of seed cotton yield and its components as affected by some plant growth control treatments, 1997 and 1998 seasons.

Yield and yield components	Seasons	Sig.	Control	Topping at 120 days from sowing	Phosphorus spraying in mid-July and 15 days later	Pix spraying (50 gm a.i./L) at the beginning of squaring and 15 days later	Single spraying of Pix at squaring+topping at 120 days from sowing
Number of open bolls/plant	1997	**	13.57 d	16.73 c	16.83 c	20.33 b	21.33 a
	1998	**	18.20 d	21.00 c	22.00 c	23.20 b	25.10 a
Number of unopen bolls/plant	1997	**	3.70 a	2.47 b	2.33 bc	1.70 c	1.00 d
	1998	**	3.00 a	1.80 b	2.20 b	1.77 b	0.98 c
Boll weight (gm)	1997	**	1.55 c	1.96 b	2.01ab	2.05 a	2.06 a
	1998	**	1.13 c	1.30 b	1.33 b	1.42 a	1.44 a
Lint percentage	1997	**	30.16 c	3.049 ab	30.31 bc	30.59 a	30.65 a
	1998	*	28.49 c	29.14 bc	29.39 ab	29.91a	29.92 a
Seed index (g/100 seeds)	1997	*	9.73 c	9.81bc	9.88 b	10.02 a	10.10 a
	1998	**	9.17 d	9.77 c	10.03b	10.24 a	10.38 a
Seed cotton yield (kintar/fed.)	1997	**	5.82 c	8.41 b	8.05 b	9.53 a	10.45 a
	1998	**	4.72 c	7.04 b	7.04 b	8.38 a	8.84 a

Means designted by the same letters are not significantly different at 0.05 level according to Duncan's M.R.T.
** and * indicate P<0.01 and 0.05, respectively.

us twice resulted in somewhat shorter plants due to internode length reduction without a prononunced change in its number. All treatments resulted in similar induction with respect to number of monopodia/plant. Such findings were obtained by Azab *et al.* (1992 and 1993); Abd El-Aal *et al.* (1993), Abd El-Aal (1997) and Abd El-Malik *et al.* (1997).

B. Fruiting habits:

Table 3 shows the effect of some plant growth alteration treatments on some fruiting habits in 1997 and 1998 seasons. It is apparent that topped and/or Pix sprayed or phosphorus sprayed plants significantly differed than untreated ones except for number of fruiting sites/plant in both seasons. The above treatments reduced number of sympodia and aborted sites/plant, while increased boll retention. However, Pix spraying twice produced the highest sympodia as well as untreated control plants. Maximum values of boll retention were produced from spraying Pix either twice or single + topping followed by topping and spraying phosphorus twice in descending order. Similar results were obtained by Girgis *et al.* (1984), Abo-Soliman *et al.* (1990), Abd El-Aal (1993), El-Sayed (196) and Abd El-Aal (1997). On the other hand Azab *et al.* (1992 and 1993) reported that Pix application reduced number of sympodia/plant.

C. Earliness parameters:

Data presented in Table 4 show the effect of some treatments for controlling plant growth on some earliness parameters in 1997 and 1998 seasons. Although, evaluation of phosphorus spraying and topping effects indicted no influence on days to both first open flower and boll compared with untreated control, spraying cotton plants with Pix or Pix + topping caused marked early maturation based on both previous traits besides higher magnitudes of earliness percentage in the two seasons. These results were in agreement with those obtained by Girgis et al. (1984), Abd E-Malik (1988), Abd-Soliman *et al.* (1990). Azab *et al.* (1992 and 1993) and Abd El-Aal *et al.* (1993).

D. Seed cotton yield and its components:

Table 5 shows the effect of some plant growth control treatments on seed cotton yield (Kintar/fed.) and its components in 1997 and 1998 seasons. Generally, treated plants significantly surpassed control ones for all criteria in this group, but the reverse trend was noticed for number of unopen bolls/plant in both seasons. The highest numbers of open bolls, boll weight, lint percentage, seed index and seed cotton yield

were associated with single spray of Pix + topping followed by spraying Pix twice, phosphorus twice and topping at 120 days age, respectively.

It was also indicated that cotton plants sprayed twice with Pix had similar boll weight, lint percentage, seed index and cotton yield as those treated with single spray of Pix + topping. Such results were obtained as previouusly mentioned in the introduction.

The previous results could be summarized as follows:

1- Topping normally stops the orientation and development of lateral organs and vertical growth except the upper two or three sympodia which tend to be longer. That is for the absence of the endogenous hormones i.e., auxins, gibberellins and cytokins (Streek and Helgiopk, 1984 and Fry, 1985).

2- Topping had insigificant effect on days to first flower and that might be due to that topping was practiced after the initiation of the first sympodium.

3- Removal the terminal bud of the cotton plant causes rapid translocation and accumulation of the metabolites transversally to the nearby lateral buds that forms early maturing bolls and more boll set (Kittock and Fry, 1977).

4- Pix reduces plant growth through shorter plants and that may be due to its retardant action on internode length. This reduction due to Pix application could be explained on the basis that Pix partially inhibits one of the enzymes that is involved in Gibberellic acid biosynthesis which is an important plant hormone for cell elongation (Ramachandra *et al*., 1996).

5- Pix sprayed plants gained more open canopy which allows better lightness and aeration and consequently favourable micro-climate for boll formation and maturation.

6- Phosphorus is an important element in plant metabolism processes such as translocation and accumulation of metabolites into reproductive organs and consequently more and early bolls. Phosphate fertilizers may alter the nitrogen balance of the plant.

REFERENCES

1. Abd El-Aal, S.A.I. 1997. Response of Giza 86 cotton cultivar to sowing date and Pix (mepiquate chloride) application. J. Agric. Sci. Mansoura Univ., 22 (12): 4187-4195.

2. Abd El-Aal, S.A., R.R. Abd El-Malik and S.M. El-Ghael. 1993. Response of Giza 81 cotton cultivar to nitrogen levels and terminal bud removal (topping) Com. In Sci. and Dev. Res. No. 639.

3. Abdel-Malak, K.K.I., M.M. El-Razaz and F.M.Ghaly. 1997. Effect of phosphorus levels and topping dates on yield of transplanted cotton cultivar Giza 83. Egypt. J. Agric. Res. 75 (2)483-493.

4. Abd El-Mlik, R.R. 1988. Studies on earliness of Egyptian cotton. Ph.D. Thesis, Fac. of Agric., Kafr El-Sheikh, Tanta, Univ.

5. Abo-Soliman, M.S.M., M.A. Abou El-Soud and M.H. Hegazy. 1990. Preliminary studies on the methods and forms of phosphorus fertilizers application on cotton under saline soil conditions. J.Agric. Res. Tanta Univ., 16 (1):150-156

6. Abou-Ahmed, E.I. 1985. Effect of some cultural treatments on growth and shedding in cotton. M.Sc. Thesis, Fac. of Agric., Kafr El-Sheikh, Tanta Univ.

7. Azab, A.S.M., Sh. H.M. El-Halawany and M.S. Ismail. 1992. Response of some Egyptian cotton cultivars to Pix application. Zagazig. J.Agric. Res. 19 (4): 1673-1681.

8. Azab, A.S.M., Sh.H.M. El-Halawany and Fatima, M.M. Ahmed. 1993. Effect of mepiquate chloride under high nitrogen rates on productivity of cotton plant. Assiut. J. of Agric. Sci.24 (1): 283-295.

9. Duncan, B.D. 1955. Multiple Range and Multiple F.Test.Biometrics. 11:1-42.

10. El-Ganayni, A.E., M.H.Fouad and I.A. El-Kirsh. 1984. Effect of topping cotton plants on yield and other characteristics. Agric. Res. Rev. 62 (6): 157-163.

11. El-Sayed, E.A. 1996. Studies on cotton requirements of some nutrients, Ph.D. Thesis, Fac. of Agric. Minufiya Univ.

12. Fry, K.E. 1985 Earliness factors in tree pima cotton genotypes. Crop Sci 25:1020-1023.

13. Makram, E.A., M.I.El-Shahawy, S.F. El-Gahel and R.R. Abdel-Malik 1994.Effect of hill spacing, soil fertilization and its interaction on growth, yield and earliness in Egyptian cotton cultivars. 1-Giza 70. J. Agric. Sci. Mansoura Univ. 19 (1): 1-13.

14. Ghaly, F.M., H.A.Abd El-Aal and A.M. El-Shinnawy. 1988. Effect of topping dates and nitrogen levels on yield and yield components of Giza 75 cotton cultivar Annals of Agric. Sci., Moshtohor, 26 (3): 1484-1492.

15. Girgis, E.A., M.H. Fouad, M.S. Ismail and A.E.El-Ganayni. 1984. Influence of application methods of phosphorus fertilizer on Giza 45 growth, yield and earliness. Agric. Res.Review, 62 (6):183-130.

16. Kittock, D.L. and K.E. Fry. 1977. Effect of topping pima cotton on lint yield and boll retention. Agron. J.69:65-67.

17. Little, T.M. and F.T Hills. 1978. Agricultural exerimentation design and analysis. John Wiley and Sons, New York U.S.A., 87-100.

18. Ramachandra, RA., K.R. Reddy and H.F.Hodges. 1996. Mepiquat chloride (Pix)-induced changes in photoynthesis and growth of cotton. Plant Growth Regulation, 20 (3):179-183 (En, 20 ref.)Department of Plant and Soil Scinces, Mississippi State Univ. Ms 39762, USA.

19. Street, H.E.and Helgiopik. 1984. The physiology of flowering plants. 3rd ed. Edward Arnold (Pub.) Ltd. London G.B.

20. Wassel, O.M.M. 1990. Effect of topping, defoliants and plant density on yield and fiber properties of cotton. Ph.D. Thesis, Fac. Agric. Al-Azhar Univ. Egypt. 157pp.

21. York, A.C. 1983. Cotton cultivar response to Mepiquate chloride. Agron. J. 75: 663-667.

محاولات للحد من النمو الخضرى فى القطن

محمد إبراهيم محمد الشهاوى

معهد بحوث القطن - مركز البحوث الزراعية

أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بسخا موسمى ١٩٩٧ ، ١٩٩٨ باستخدام صنف القطن المصرى جيزة ٨٧ لدراسة تأثير بعض المعاملات بغرض الحد من ظاهرة الهياج الخضرى وهى : التطويش عند عمر ١٢٠ يوم - الرش مرتين بالسوبر فوسفات (١٥٪ فو ٢أ٥) بمعدل (٨ كجم/ ف) فى منتصف يوليو وبعد ١٥ يوم من الرشة الاولى -الرش بالبيكس (كلوريد مبيكويت) بمعدل ٥٠٠ مل /ف (٥٠ جم مادة فعالة /لتر) مرتين فى بداية الوسواس وبعد ١٥ يوم من الرشة الاولى - الرش بالبيكس مرة واحدة عند بداية الوسواس +تطويش عند عمر ١٢٠ يوم بجانب المقارنة (بدون معاملة). وقد أوضحت النتائج ما يلى : أظهرت معاملات الحد من زيادة النمو الخضرى تأثيرا معنويا على كل الصفات تحت الدراسة ما عدا عدد المواقع الثمريةبالنسبة للمقارنة حيث أنقصت ارتفاع النبات النهائى وطول سلاميات الساق الرئيسية وعدد الأفرع الخضرية والثمرية والمواقع الخالية وعدد اللوز وعدد اللوز غير المتفتح بينما أدت بصفة عامة لزيادة عدد اللوز العاقد والنسبة المئوية للتبكير وعدد اللوز المتفتح ووزن اللوزة وتصافى الحليج ومعامل البذرة ومحصول القطن الزهر (قنطار /ف). وظهر أوضح تاثير من معاملة الرش بالبيكس مرة واحدة + التطويش , يليه تنازليا الرش مرتين بالبيكس وبصفة خاصة بالنسبة لمحصول القطن الزهر ومكوناته.