J. Agric. Sci. Mansoura Univ., 29(2): 527 - 534, 2004

THE PHYSIOLOGICAL RESPONSE OF COTTON PLANT TO FOLIAR APPLICATION WITH THE GROWTH REGULATOR AMCOTONE

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ABSTRACT

Two field experiments were carried out at Mallawi Agric. Res. Station, Minia Governorate, in 2002 and 2003 seasons to study the response of Giza 83 cotton cultivar to foliar application of the growth regulator Amcotone which contains 1-naphthyl acetic acid (NAA) and 1-naphthyl acetamide (NAAM). Besides the control treatments, Amcotone was used at the rates of 1.0, 1.2 and 1.4 g/l. applied once at the beginning of flowering stage (BF) or twice at BF and 15 days later.

Results of this study reveal that some treatments of Amcotone exhibited significant increases in leaves content of chlorophyll a, total chlorophyll, poly phenols, total phenols, number of open bolls/plant and seed cotton yield/fad. However, it exerted a significant reduction in leaves content of reducing sugars, total soluble sugars, number of aborted fruiting sites/plant and bud and boll shedding%. The application of Amcotone had no significant effect on plant growth characters, number of sympodia/plant, total fruiting sites/plant, number of unopen bolls/plant, boll weight, earliness%, lint% or seed index in both seasons.

The application of Amcotone at the rate of 1.2 g/l. either one or two times of application produced the highest seed cotton yield and gave the best results in general during the two studied seasons.

It could be concluded that spraying cotton plants with the growth regulator Amcotone exerted some biochemical and physiological effects which reduced bud and boll shedding and increased boll retention and yield production under the environmental conditions of the present study.

INTRODUCTION

Cotton plant is characterized by high shedding rate of fruiting organs owing to many internal and external factors. Two physiological theories have been put forth to explain fruit shedding : (a) as the plant ages, anti-auxin hormones increases presenting hormonal imbalance between auxin and plant growth retarding which signal the plant to retard or even inhibit boll formation, (b) as boll load increases, carbohydrate shortage can exist and the supply of carbohydrate to bolls could be reduced causing fruit shedding (Abdel-Al, 1998). Bud and boll shedding in cotton is considered a physiological disorder and reducing fruit shedding could increase cotton yield (Prakash and Perumal, 2001). Fruit shedding in cotton could be reduced by ensuring regular supply of photosynthates to the developing bolls, through enhancing leaf photosynthesis and/or leaf longevity during boll development stage (Wallschleger and Oosterhuis, 1990 and Prakash and Perumal, 2001).

Otherwise, the supply of assimilates during boll development stage is restricted by the decline in leaves photosynthetic rate as they ages correlating with decreasing free IAA level (Guinn and Brummett, 1993). Wallschleger and Oosterhuis (1990) reported that photosynthesis declined throughout the boll-filling period since leaf photosynthesis and carbon production peaked prior to maximum photosynthate demand by bolls presenting poor synchronization between carbon production and its utilization by developing bolls. They suggest that enhancing leaf photosynthesis and/or leaf longevity during boll filling stage could increase the cotton yield. In this respect, growth regulators auxins have been reported to stimulate photosynthesis and photosynthate transport to developing fruit (Arteca, 1996 and Ozga and Reinecke, 2003).

Auxins are important growth regulators involved in regulating many aspects of plant growth and development. They represent one of the important classes of signaling molecules transcribed in plants. Auxins action and perception is thought to involve auxin binding to specific receptor(s) and regulating gene expression and protein synthesis with consequent metabolic changes (Leyser, 2001). NAA is an auxinic hormone that is identified with promoting fruit setting. The response of cotton plant to the exogenous application of NAA has been studied by many researchers; Kapgate *et. al.* (1989) reported that NAA increased chlorophyll content and photosynthetic rate and reduced respiration rate in cotton leaves. El-Hamawi *et. al.* (1975) and Abdel-Al *et. al.* (1982) demonstrated that hormonal contents in bolls, especially auxins, have an important role in boll abscission. NAA application reduced the shedding of young bolls through increasing the total and poly phenol contents in bolls. Akhunov *et. al.* (2000) and Gokani and Thaker (2002) reported that NAA and IAA promote cotton fiber formation through acting as regulators of the main enzymes activities involved in fiber formation and development i.e. peroxidase, glucan synthetase, and cellulase. It has been shown that the application of NAA on cotton stimulated boll retention and reduced bud and boll shedding (Bhatt, 1991; Swamy, 1991; and Brar *et. al.* 2001), and increased number of open bolls/plant boll weight, seed index and seed cotton yield (Eid and Abdel-Al, 1985; Swamy, 1991; Sawan and Saker, 1998; and El-Gabiery, 2002).

This study was conducted to investigate the response of cotton plant to foliar application of Amcotone compound.

MATERIALES AND METHODS

Two field experiments were conducted at Mallawi Agric. Res. Station, Minia Governorate, in 2002 and 2003 seasons, to study the physiological response of Giza 83 cotton cultivar to the foliar application with a synthetic growth regulator compound commercially known as Amcotone which contains 1-naphthyl acetic acid (NAA) and 1-naphthyl acetamide (NAAM). The used rates of Amcotone were 1.0, 1.2 and 1.4 gm/litre applied one time at the beginning of flowering stage (BF) or two times at BF and 15 days later. The two experiments were laid out in a randomized block design with four replicates. The experimental unit was 13 m^2 in area, including 5 ridges; 4 m long and 65 cm apart. Sowing date was during the last week of March in both seasons. All cultural practices were done as recommended for cotton production. For estimating the effects of Amcotone treatments the following measurement were determined :

1- Chemical constituents of leaves, a random sample of leaves on the top fourth node was collected after 15 days of the application of Amoctone in 2003 season only to determine leaves contents of chlorophyll (Arnon, 1949), reducing sugars (A.O.A.C., 1965), total soluble sugars (Cerning, 1975), polyphenols (A.O.A.C., 1965) and total phenols (Simons and Ross, 1971).
2- Growth parameters : final plant height (cm), number of main stem nodes and internode length (cm).
3- Fruiting characters : number of sympodia/plant, number of aborted fruiting sites/plant, total fruiting sites/plant, and fruit (buds and bolls) shedding% (aborted fruiting sites divided by total fruiting sites multiplied by 100).
4- Yield and yield components : number of open boll/plant, unopen bolls/plant, boll weight (gm), earliness%, seed cotton yield/fad., lint% and seed index (gm).

All the obtained data were statistically analyzed according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1- Chemical constituents of leaves :

Results shown in Table (1) reveal that, in comparison with the control, Amcotone application exhibited significant effects on leaves content of chlorophyll a and total chlorophyll but it had no significant effects on chlorophyll b. Leaves content of chlorophyll a was significantly affected by all used Amcotone treatments except with one spray of 1.0 g/l., and two sprays of 1.2 g/l. At the same time, total chlorophyll level was significantly increased by various Amcotone treatments except with one spray of 1.0 g/l. The highest rate of Amcotone (1.4 g/l.) when applied once or twice gave the highest content of chlorophyll in leaves. Exogenously applied NAA have been reported to stimulate photosynthetic rate and chlorophyll content in cotton leaves (Kapgate *et. al.* 1989). Similar results were obtained by El-Gabiery (2002) who reported that foliar application of NAA increased chlorophyll level in cotton leaves.

Table (1) : Effect of foliar application of the growth regulator Amcotone (containing NAA + NAAM) on some chemical constituents of cotton leaves (mg/g dry weight) in 2003 season.

Amcotone treatment	Chlorophylls			Carbohydrates		Phenols	
	Chl. a	Chl. b	Total chl.	Reducing sugars	Total soluble sugars	Poly phenols	Total phenols
Control	5.050	2.822	7.872	5.190	7.830	5.060	8.340
1.0 g/l at BF	5.170	2.960	8.130	5.627	7.733	6.080	9.160
1.2 g/l at BF	5.355	3.085	8.350	5.102	7.082	7.140	10.923
1.4 g/l at BF	5.380	3.080	8.460	3.730	5.065	6.275	10.185
1.0 g/l at BF + 15 days later	5.307	3.110	8.417	5.197	6.520	6.280	9.553
1.2 g/l at BF + 15 days later	5.240	3.077	8.317	3.630	4.190	6.318	10.547
1.4 g/l at BF + 15 days later	5.440	3.112	8.552	3.620	4.322	7.163	11.828
L.S.D 0.05	0.225	N.S.	0.396	0.587	0.740	1.116	1.053

BF; the beginning of flowering stage.

In relation to the effect of Amcotone treatments on leaves content of carbohydrate, it is obvious from Table (1) that reducing sugars content was significantly decreased by one or two sprays of Amcotone with 1.4 g/l and by two sprays of 1.2 g/l. Similarly, total soluble sugars level was significantly reduced by various Amcotone treatments except the lowest rate (1.0 g/l.) when applied once at the beginning of flowering stage (BF) only. In general, the reduction in leaves content of carbohydrate was increased with increasing Amcotone rate and times of application. Two sprays of Amcotone with 1.2 or 1.4 g/l. caused the highest reduction in carbohydrate level. Such carbohydrate reduction could be a result of the auxin roles in enhancing carbohydrate transport and mobilization and/or inducing incorporation of carbohydrate into the synthesis of other compounds such as phenols, amino acids and other related compounds. Auxins participate in regulating assimilates mobilization via controlling the concentration gradient of photoassimelates between source and sink tissues. Auxins may stimulate phloem transport, modify the strength of sink by stimulating its growth, increase the ability for sucrose unloading from the phloem, or act on metabolism of sucrose (Arteca, 1996 and Ozga and Reinecke, 2003).

With regard to leaves content of phenols, results presented in Table (1) indicate that Amcotone application increased leaves content of poly phenols and total phenols as compared with the control. The treatment of 1.0 g/l. at BF only did not exert significant increase in phenolic compounds level, while the other Amcotone treatments significantly increased leaves content of poly and total phenols as compared with the control. Phenols level was highest with two sprays of the highest rate of Amcotone (1.4 g/l.). El- Hamawi *et. al.* (1975) reported that NAA increased the total and poly phenol contents in bolls. Such results are in agreement with those of Abdel-Al *et. al.* (1982); and Eid and Abdel-Al (1985) who obtained significant increases in cotton leaves content of phenols with NAA application.

2- Plant growth parameters :

Results shown in Table (2) reveal that different treatments of Amcotone had no significant effects on plant growth parameters; plant height, number of main stem nodes and internode length in both seasons. Similar results were obtained by Brar *et. al.* (2001), and Eid and Abdel-Al (1985).

3- Fruiting characters :

It is obvious from Table (2) that the application of Amcotone did not significantly affect number of sympodia /plant and total fruiting sites /plant in both seasons but, it did significantly affected number of aborted fruiting sites/plant and bud and boll shedding % in both seasons. Results reveal that, in comparison with the control, all used Amcotone treatments except one spray of 1.0 g/l. caused a significant reduction in the number of aborted fruiting sites/plant in both seasons, consistent with such results, all Amcotone treatments reduced bud and boll shedding % compared with the control but the significance level was not always reached. The lowest values of bud and boll shedding % were produced by two sprays of 1.4 g/l. and one or two sprays of 1.2 g/l., the treatments that reduced shedding % in both seasons.

Table (2) : Effect of foliar application of the growth regulator of Amcotone (containing NAA + NAAM) on some vegetative and fruiting characters of cotton plant in 2002 and 2003 seasons.

Amcotone treatments	Plant height (cm)		No. Of main stem nodes		Internode length (cm)		No. Of sympodia, plant		Aborted fruiting sites/plant		Total fruiting sites/plant		Buds and bolls shedding %	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Control	105.2	109.8	25.1	25.5	4.20	4.20	15.2	16.7	15.13	17.00	33.78	34.63	44.79	49.09
1.0 g/l at BF	104.0	108.6	24.9	24.9	4.18	4.37	15.2	16.4	14.20	16.20	32.78	33.80	43.32	47.93
1.2 g/l at BF	105.9	108.4	25.0	25.7	4.23	4.21	15.4	17.1	13.10	15.05	34.75	35.38	37.70	42.54
1.4 g/l at BF	103.8	110.2	24.6	25.1	4.23	4.39	15.3	16.7	13.43	15.63	33.15	34.91	40.51	44.77
1.0 g/l at BF + 15 days later	103.8	109.5	24.9	25.3	4.17	4.33	15.6	16.9	12.83	15.70	34.02	35.20	37.71	44.60
1.2 g/l at BF + 15 days later	104.8	107.8	25.0	25.2	4.20	4.28	15.1	16.9	12.98	15.63	33.70	35.60	38.52	43.90
1.4 g/l at BF + 15 days later	104.0	108.7	24.9	25.0	4.18	4.36	15.3	16.7	12.78	15.03	34.21	34.84	37.36	43.21
L.S.D 0.05	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	1.54	1.14	N.S.	N.S.	4.55	5.11

BF; the beginning of flowering stage.

Table (3) : Effect of foliar application of the growth regulator of Amcotone (containing NAA + NAAM) on cotton yield and yield components in 2002 and 2003 seasons.

Amcotone treatments	No. Of open bolls/plant		No. Of unopen bolls/plant		Boll weight (gm)		Earliness %		Seed cotton yield kentor/fad.		Lint %		Seed index (gm)	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Control	15.03	13.25	3.63	4.38	2.51	2.42	68.2	63.4	11.96	11.57	40.53	38.77	11.1	11.0
1.0 g/l at BF	15.38	14.15	3.20	3.45	2.59	2.45	70.3	62.0	12.13	11.81	40.30	39.08	11.4	10.9
1.2 g/l at BF	17.18	15.58	4.50	4.75	2.59	2.52	69.9	63.0	13.01	12.41	40.64	38.67	11.1	11.2
1.4 g/l at BF	15.35	14.15	4.38	5.13	2.58	2.46	66.6	63.3	12.50	12.14	40.59	39.04	11.2	11.1
1.0 g/l at BF + 15 days later	16.45	14.50	4.75	5.00	2.60	2.35	68.3	63.2	12.79	12.14	40.56	39.32	11.3	11.5
1.2 g/l at BF + 15 days later	16.33	14.68	4.40	4.90	2.57	2.41	69.6	62.9	12.74	12.19	40.73	38.54	11.1	11.3
1.4 g/l at BF + 15 days later	16.80	14.83	4.73	4.98	2.57	2.40	66.7	63.3	12.91	12.48	40.61	38.37	11.2	11.1
L.S.D 0.05	1.33	1.29	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.68	0.57	N.S.	N.S.	N.S.	N.S.

BF; the beginning of flowering stage.

Such reduction in bud and boll shedding associated with Amcotone application could be due to its effect in increasing phenols level. El-Hamawi *et. al.* (1975) and Abdel-Al *et. al.* (1982) reported that the reduction in young boll shedding, due to NAA application, was connected with an increase in the total and poly phenols content in young bolls. Poly phenols play an indirect role in inhibiting the action of IAA oxidase. Hormonal content of bolls, especially auxin, have an important role in the abscission of young bolls. Results of many previous studies indicate that NAA is identified as a fruit setting promoter and the exogenous application of NAA reduced bud and young boll shedding in cotton (Bhatt, 1991; Swamy, 1991; and El-Gabiery, 2002).

4- Yield and Yield component :

Results presented in Table (3) reveal that the application of Amcotone significantly increased number of open bolls/plant and seed cotton yield/fad. as compared with the control in both seasons. However, number of unopen bolls/plant, boll weight, earliness %, lint% and seed index were not significantly affected by the application of Amcotone in the two studied seasons. In general, all used treatments of Amcotone exhibit an increase in number of open bolls/plant and seed cotton yield/fad. in both seasons. However, the consistent significant increases in both traits were obtained by one or two sprays of 1.2 g/l. and two sprays of 1.4 g/l. Such results indicate that cotton plants treated with Amcotone produced more open bolls and higher seed cotton yield than the untreated ones. This could be attributed to reducing shedding of fruiting organs concomitant with increasing the supply of photoassimelates to the developing bolls during boll-filling stage. Exogenously applied auxins have been reported to stimulate photosynthetic rate through increasing chlorophyll content and promoting stomatal opening (Kapgate *et. al.*, 1989; and Arteca, 1996). Auxins also, induce assimilate mobilization to the developing fruit and promote sucrose incorporation into cellulose in cotton fiber (Basra *et. al.*, 1992; and Ozga and Reinecke, 2003). Additionally, auxins promote fiber formation and growth (Akhunov *et. al.*, 2000; and Gokani and Thaker, 2002).

It could be thought that the positive effects for Amcotone application on boll retention and yield production were through enhancing metabolate supply to bolls during boll development stage. Boll shedding could be decreased through ensuring regular supply of metabolites to the developing bolls (Prakash and Perumal, 2001). Wallschleger and Oosterhuis, (1990) demonstrated that cotton yield could increased by enhancing photosynthetic activity of leaves and/or leaf longevity during the reproductive development. Several investigators reported that the application of NAA significantly increased number of open bolls/plant and seed cotton yield/fad. (Eid and Abdel-Al, 1985; Swamy, 1991; Sawan and Saker, 1998; Brar *et. al.*, 2001; Katkar *et. al.*, 2002; and El-Gabiery, 2002).

It could be concluded from this study results that treating cotton plants with the growth regulator Amcotone at 1.2 g/l. as one or two sprays at the beginning of flowering only or + 15 days later could enhance leaf photosynthetic rate during boll-filling stage and promote the supply of photosynthates to the developing bolls, thereby it could reduce fruit shedding and increase boll retention and cotton yield production.

REFERENCES

]Abdel-Al, M. H. (1998). Effect of foliar methanol application on Egyptian cotton plants. Egypt. J. Agric. Res., 76 (3): 1183-1196.

Abdel-Al, R. S.; M. S. Fadl; and M. H. Abdel-Al (1982). Physiological studies on the effect of some growth regulators on Egyptian cotton. 2-Effect of naphthaline acetic acid (NAA) El-Azhar Agric. Res. Bull No. 37, El-Azhar Univ., Cairo.

Akhunov, A. A.; Z. Golubenko; E. Ch. Mustakimova; N. A. Abdurashidova; Ibragimov, F. A. and Beresnera, Yu. V., (2000). Role of phytohormones in cotton fiber formation. Chemistry of Natural Compounds, 36 (5): 521-524.

A.O.A.C., (1965). Official Methods of Analysis of Official Agricultural Chemists. Washington. D. C., USA.

Arnon, D. I. (1949) copper enzymes in isolated chloroplasts plant physiol, 24: 1-15.

Arteca, R. N. (1996). Plant growth substances; principles and applications. Chapman and Hall, New York, London.

Basra, A. S.; R.S. Sarlach; H. Nayyar and C. P. Malik (1992) Hormonal effects on partitioning of C^{14}-sucrose in cotton fibers. Acta Physiologiae Plantarum, 14 (3): 137-142.

Bhatt, J. G. (1991). Auxin-gradient and abscission of bolls in cotton. J. Indian Society for Cotton Improvement, 16 (1): 36-38.

Brar, Z. S.; Jagiit Singh, Mathauda, S. S.; Harmeet Singh; J. Singh (2001). Fruit retention and yield of cotton as influenced by growth regulators and nutrients. J. Res. Punjab Agric. Univ., 38 (1-2): 6-9.

Cerning, B. J. (1975). A note on sugar determination by the enthrone method. Cereal Chem., 52: 857.

Eid, Etidal T., and M. H. Abdel-Al (1985). Effect of naphthaline acetic acid on growth, yield, yield components and chemical constituents of cotton plant and seeds of three Egyptian cotton varieties (G. barbadense L.). Annals Agric. Sci., Ain Shams Univ., 30 (2): 1031-1046.

El-Gabiery, A. (2002). Effect of some growth regulators on growth, boll shedding, yield components in Egyptian cotton. MSc. Thesis Al-Azhar Univ. Egypt.

El-Hamawi, H.; M. A. El-Ghandour; M. H. Abdel-Al; and M. S. Tewfic, (1975). Shedding of young cotton bolls as affected by its phenolic content. Egyptian J. Physioloical Science, 2 (1): 155-163.

Gokani, S. J. and V. S. Thaker (2002). Physiological and biochemical changes associated with cotton fiber development. 1X-Role of IAA and PAA. Field Crops Research, 77 (2-3): 127-136.

Gomez, K. A. and A. A. Gomez (1984). Statistical procedures for agricultural research. 2nd Ed., An International Rice Research Institute Book. John Willy and Sons, New York, U.S.A.

Guinn, G. and D. L. Brummett (1993). Leaf age, decline in photosynthesis, and changes in abscissic acid, indole 3-acetic acid and cytokinin in cotton leaves. Field Crops Research, 32 (3-4): 269-275.

Kapgate, H. G.; N. N. Potkile; Zode N. G. and A. M. Dhopte (1989). Persistence of physiological responses of upland cotton to growth regulators. Annals Plant Physiol., 3 (2): 188-195.

Leyser, O. (2001). Auxin signaling: the beginning, the middle and the end. Curr. Opin. Plant Biol., 4: 382-386.

Ozga, J. A. and D. M. Reinecke (2003). Hormonal interactions in fruit development. J. Plant Growth Regul., 22: 73-81.

Prakash, A. H. and N. K. Perumal (2001). Retention and shedding patterns of fruiting parts in four cotton genotypes (G. hirsutum L.) under rainfed condition. Indian J. Plant Physio., 6 (2): 182-186.

Sawan, Z. M. and R. A. Saker (1998). Effect of 1-naphthaline acetic acid concentration and the number of application on the yield components, yield and fiber properties of the Egyptian cotton (G. barbadense L.). J. Agron. and Crop Sci., 181: 89-90.

Simons, T. J. and A. F. Ross (1971). Change in Q metabolism associated with enclosed systemic resistance to tobacco. Phytopathology., 61: 1261-1265.

Swamy, N. R. (1991). Assessment of boll shedding and its control under rainfed conditions. Annals Plant Physiol., 5 (2): 266-269.

Wallschleger, S. D. and D. M. Oosterhuis (1990). Photosynthetic carbon production and use by developing cotton leaves and bolls. Crop Sci., 30: 1259-1264.

الاستجابة الفسيولوجية لنبات القطن للمعاملة بمنظم النمو أمكوتون

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أجرى هذا البحث بمحطة البحوث الزراعية بملوى – محافظة المنيا – خلال موسمى الزراعة ٢٠٠٢، ٢٠٠٣ بهدف دراسة تأثير المعاملة بمنظم النمو أمكوتون (نفثالين أستيك أسيد + نفثالين أسيتاميد) على النمو والتركيب الكيماوى والمحصول ومكوناته لصنف القطن جيزة ٨٣ .

اشتملت معاملات الدراسة على رش الأمكوتون بمعدل ١,٠، ١,٢، ١,٤ جم/لتر مرة واحدة فى مرحلة بداية التزهير أو مرتين الأولى فى بداية التزهير والثانية بعدها بأسبوعين بالإضافة إلى معاملة المقارنة (بدون رش) . ويمكن تلخيص نتائج هذه الدراسة فيما يلى :

أظهرت بعض معاملات الأمكوتون زيادة معنوية فى محتوى الأوراق من الكلوروفيل والفينولات وعدد اللوز المتفتح/نبات ومحصول القطن الزهر/فدان . بينما أدت هذه المعاملات إلى نقص معنوى فى محتوى الأوراق من الكربوهيدرات وعدد المواقع الثمرية الساقطة والنسبة المئوية لتساقط البراعم واللوز مقارنة بمعاملة الكونترول .

لم يكن للمعاملة بالأمكوتون تأثير معنوى على صفات النمو، عدد الأفرع الثمرية، إجمالى المواقع الثمرية للنبات، عدد اللوز غير المتفتح/نبات، وزن اللوزة، % للتبكير، % للشعر أو معامل البذرة خلال موسمى الدراسة .

تشير النتائج إلى أن المعاملة بالأمكوتون بمعدل ١,٢ جم/لتر سواء مرة واحدة أو مرتين قد أعطى أعلى عدد من اللوز المتفتح للنبات وأعلى محصول للقطن الزهر/فدان وكذلك أعطى أفضل النتائج بشكل عام خلال موسمى الدراسة .

يمكن أن نستخلص من هذه الدراسة أن معاملة نباتات القطن بمنظم النمو أمكوتون قد أظهر بعض التأثيرات البيوكيميائية والفسيولوجية التى أدت إلى نقص تساقط البراعم واللوز وزيادة قدرة النبات على الاحتفاظ باللوز وبالتالى زيادة محصول القطن الزهر تحت الظروف البيئية لهذه الدراسة.