EFFECT OF TOPPING AND PLANT DENSITIES ON GROWTH AND YIELD OF COTTON.

O. S. Hasab M. A. Al-Naqeeb
Researcher Prof.
Dept. of Field Crops – Coll. of Agric. – Univ. of Baghdad
ollasami85@gmail.com dr.m_alnakeb@yahoo.com

ABSTRACT

The objective of this study was to investigate the effect of topping and plant densities on growth and yield of cotton (*Gossypium hirsutum L.*) .A field experiment was conducted at the research station of Field Crop Department- College of Agricultural Engineering Sciences - University of Baghdad,during two summer seasons (2016 and 2017).This study included two factors using Ranndomiled Complele Block Design within split plot arrangement .The first factor, regulate growth through foliar with the growth retardants (pix) at the beginning of flower buds appearance , foliar at the beginning of The flower appearance and growing tips topping at the beginning of flower buds appearance and tip topping at the beginning of flower appearance and control (without topping). These treatments occupied the main plots .The second factor was the number of plants in hill (1,2 and 3 plant hill^{-1}),which occupied the sub plots. The results indicated significant differences among regulate growth traetment in most studied characters, P2 was exceeded by producing the highest number of branches and number of open bolls .This causes to increase plant yield , which reach 23.78 and 22.86 g plant^{-1} and seed cotton yield giving2124.8 and 1972.3 kg ha^{-1}, whereas treatment T_4 had the highest average in dry weight, lint length and lint fineness. The treatment 1 plant hill^{-1} was exceeded by producing the highest plant height, number of sympodia, leaf area, dry weight, boll weight and the number of open bolls which reflected on increasing plant yield by (32.63 and 34.58) g plant^{-1} and lint fineness by (4.66 and 4.72) micronear for both seasons respectively . The results indicated a significant interaction between regulate growth treatments and number of plants per hill in some studied characters. This indicate that the responce of cotton topping differed due to plant densities,with topping.

Key words: Number of symbodia, Leaf area , lint length , microneare.number of plant in hill.
***Part of Ph.D. Dissertation of the first author.**

تأثير قطع القمة النامية والكثافات النباتية على النمو وحاصل القطن .

علا سامي حسب موفق عبد الرزاق سهيل النقيب
باحث أستاذ
قسم المحاصيل الحقلية – كلية لزراعة – جامعة بغداد

المستخلص

تهدف الدراسة إلى الكشف عن تأثير إزالة القمة النامية والكثافات النباتية على النمو وحاصل القطن. نفذت تجربة حقلية في محطة التجارب التابعه لقسم المحاصيل الحقلية كلية علوم الهندسة الزراعية– جامعة بغداد – الجادرية خلال الموسمين الصيفيين للسنتين 2016 و2017. نفذت التجربة بأستعمال تصميم القطاعات الكاملة المعشاة بترتيب الألواح المنشقة بثلاثة مكرارات. تألفت الدراسة من عاملين هما العامل الاول معاملات تنظيم النموهي رش معيق النمو المبيكوات كلورايد(pix) عند مرحلة بدء ظهورالبراعم الزهرية ورش معيق النمو المبيكوات كلورايد (pix) عند مرحلة بداية ظهور الأزهار وأزالة القمة النامية عند مرحلة بدء ظهور البراعم الزهرية وأزالة القمة النامية عند مرحلة بداية ظهور الأزهار ومعاملة المقارنة (بدون معاملة) حيث أحتلت الالواح الرئيسية .العامل الثاني عدد النباتات في الجورة (1 و2 و3 نبات جورة$^{-1}$) وقد أحتلت الالواح الثانوية. أوضحت النتائج إلى وجود فروقات معنوية بين معاملات تنظيم النمو في معظم الصفات المدروسة، أذ تفوقت معاملة تنظيم النمو P2 وأنتجت أعلى متوسط لعدد الأفرع الثمرية وعدد الجوز المتفتح ونتيجة لذلك ازداد حاصل النبات (23.78 و22.86 غم نبات$^{-1}$) وحاصل القطن الزهر(2124.8 و1972.3 كغم هـ$^{-1}$)، بينما أعطت معاملة تنظيم النمو T4 أعلى متوسط للوزن الجاف. تفوقت معاملة 1 نبات جورة$^{-1}$ فأعطت أعلى متوسط لأرتفاع النبات وعدد الأفرع الثمرية والمساحة الورقية والوزن الجاف ووزن الجوزة وعدد الجوزالمتفتح فأنعكس على زيادة حاصل النبات (32.63 و34.58) غم نبات$^{-1}$ ونعومة التيلة (4.66 و4.72) مايكرونير في حين معاملة 2 نبات جورة$^{-1}$ سجلت أعلى متوسط لحاصل القطن الزهر (2625.0 و2261.8) كغم هـ$^{-1}$ أما معاملة 3 نبات جورة$^{-1}$ أعطت أعلى متوسط لنعومة التيلة (4.06 و 4.72) مايكرونير للموسمين بالتتابع. بينت النتائج إلى وجود تداخل معنوي بين معاملات تنظيم النمو وعددالنباتات في الجورة في بعض الصفات، هذا دليل على أختلاف إستجابة القطن للكثافة النباتية بأختلاف أزالة القمة النامية.

كلمات مفتاحية: عدد الأفرع الثمرية، المساحة الورقية ،طول التيلة،نعومة التيلة، عدد النباتات في الجورة.
***جزء من أطروحة دكتوراه للباحث الاول.**

***Received:25/3/2018, Accepted:9/8/2018**

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is considered one of the most important fibrous crops globolly and it comes as the most preceding industrial crop in Iraq.One of the methods used in developing this crop is topping ,by cutting growing apex from the main stem in order to reduce plant height and therefore this leads to increase the number of sympodia and increases number of bolls. Determination of adequate plants in each hill, also can be considered as one of the important way to reduce competition between plants to benefit from the necessary nutrients.The results of Gie and Bin (5) indicated that manual removing caused significant increases in the average of open boll number, plant yield and seed cotton yield, as removal to was exceeded and produced the highest average 40 boll and 53.87 g plant^{-1} and 5387.52 kg ha^{-1} in comparison with control treatment (without removing) which produced the lowest average in these characters. Shahar and Mirshekari (20) indicated that the treatment of growth tip removal from major stem after 30 days of flowering produced lowest plant height and leaf area, whereas the treatment without removing produced the tallest plants averages. A study was conducted by Farrukh *et.al.* (6) included three removal stages: (at height of 90 cm, 120 cm and 150 cm) in addition to control treatment (without removing), and found that there was a significant effect of removal treatments in plant height and leaf area, The results of Saleem *et.al.* (17) indicated increase in number of sympodia when growing apex were removed (at height of 60, 90 and 150 cm) in cotton plants in the average of branches number dry matter and number of open bolls, removal treatment recorded the highest average at height of 150 cm giving (44.68 branch plant^{-1} and 70.32 g plant^{-1} and 40.44 boll plant^{-1}) compared with control treatment (without removing) which produced lowest averages in these characters and giving (30.12 branch plant^{-1}, 34.76 g plant^{-1} and 20.13 boll plant^{-1}) . The results of Fromme *et.al* (7) shows that treatments of plant densities (84000 and 126000) plant ha^{-1} significantly affected plant height and number of open bolls . Khan *et.al*.(9)found a significant effect of plant densities (75000 , 90000 and 105000) plant ha^{-1} on the number of sympodia and open bolls.Kumar *et.al*. (10) studied the effect of plant densities (148148 , 98765, 74074 and 166666) plant ha^{-1} and found a significant effect seed cotton yield , plant densities 148148 plant ha^{-1} produced the highest average giving 2063 kg ha^{-1} compared with plant densities treatment 74074 plant ha^{-1} which produced lowest average in this character giving 1621 kg ha^{-1}, whereas the densities (98765 and 166666) plant ha^{-1} recorded an average of (1807 and 1798) kg ha^{-1}. Madavi *et.al.* (11) indicated that there were significant differences between plant densities (55555 , 111111 and 148148) plant ha^{-1} in dry weight and number of open bolls, while treatment 55555 had highest average in these characters. Manjua and Shashidhara (12) indicated significant differences plant densities (111111 , 148148 and 222222) plant ha^{-1} in the average of leaf area ,number of open bolls and plant yield.The results of Nagender *et.al.* (13) indicated significant effect of plant densities (18518, 55555 and 148148) plant.ha^{-1} in the average of boll weight and number of open bolls, whereas treatment 18518 plant ha^{-1}, the produced highest average in this character compared with 148148 plant ha^{-1} which had lowest average in this character.Sawan (18) found a significant differences in the average of open bolls number, plant yield and fineness lint when studied three plant densities (166000 , 222000 and 333000) plant ha^{-1} .Udikeri and Shashidhara (21) indicated significant effect of the plant densities (111111, 148148 and 222222) plant ha^{-1} to the number of sympodia number and leaf area, while treatment 111111 plant ha^{-1} had highest average in these characters. The aim of this experiment was to investigate the effect of topping .mepiquat chloride and plant density on growth and yield of cotton.

MATERIALS AND METHODS

A field experiment was conducted at the researches station of Field Crops, College of Agricultural Engineering Sciences - University of Baghdad-Al-Jaderyah during the summer season of 2016 and 2017. The field was prepared by plowing twice vertically,using mold board plow, and the soil was smoothed and settled then canals were ditched. Triflan herbicide was sprayed by (44%) in the average of 1.25Lha^{-1} after plowing to weeds and it was mixed with soil, using disc arrows (1).The area of sub plot was (3m × 2.25m) consisted of four row , the length of each rows was 3m, the distance between rows was 0.75m witin the rows 0.25m (2) Leaving a space of 1.5 m between the plots to avoid any effect on nearby plots. The seeds was cultivated at 8/4/2016 and 10/4/2017. The thinning was condacted after two weeks from emergence according to the experiment treatments. The phosphorus was added in the form of Triple super phosphate (20%P) after preparing the land for cultivation in an average of 100kg P_2O_5 ha^{-1} (14), while nitrogen was added in the form of urea (46% N) in an average of 200 kg N ha^{-1} in two splite , the first one was at thinning and the second after 30 days from the first one (3) ,The experiment conducted using RCBD within split – plot arrangement, with three replications. The study included the effect of two factors:

The first factor: regulate growth treatments which occupied the main plots and included:

Foliar (pix) at the beginning of flower squars appearance which was coded as (P_1) and foliar (pix) at the beginning of flowers appearance was coded as (P_2) and topping at the beginning of flower squars appearance coded as (T_1) and topping at the beginning of flowers appearance was coded (T_2) and the control treatment (without topping) coded as (C_0).

The second factor: number of plants 1, 2 and 3 plant hill^{-1} in the sub plots. The treatment of 2 plant hill^{-1} was considered the control treatment as recommended by previous studies (3 and 4), so the plant densities became 33353 , 106000 and 159000 plant.hill^{-1} respectively. Ten plants were chosen randomly from each plot and from the middle rows for harvesting in order to measure the following characters:

Plant height (cm^{-1}) , number of symbodia , leaf area (cm^2) ,dry weight (g plant^{-1}), number of open bolls boll plant^{-1},boll weight (g plant^{-1}) , plant yield (g plant^{-1}), seed cotton yield (kg ha^{-1}),lint length (mm) and lint fineness. For both seasons results were analysed using Genstat program according to the applied design and the means were compared using 5 % LSD (20).

RESULTS AND DISCUSSION

Plant height

Results in Tables 1 and 2 indicate significant differences among regulate growth treatments, number of plants hill^{-1} and their interaction for the average of plant height in both seasons 2016 and 2017. The plants at the control treatment (C_0) produced the highest in this character giving (124.9 and 132.62) cm compared with regulate growth treatments which didn't differ significantly in this character. This due to the role of (pix), which prevented cell division in meristem region and as a result leaded to reduce stem elongation, Other opinions indicated that plant growth obstruction is a result to the effect of growth obstructers in reducing oxygen level in plant which stimulates gibberellin through its effect on plant elongation. This is similar to the effect of topping in slowing main stem growth as buds of growth tip is responsible for plant elongation and its growth also increased competition with minor branches and therefore leads to decrease plant height.This at the same trend with the results found by Shahr and Mirshekari (14)and Farruk *et.al*. (6),They indicated that regulate growth treatment lead to reduced average of cotton plant height. The results of Table 1 and 2 shows significant differences between number of plants in hill for plant in both seasons. The treatment of one plant.hill^{-1} had highest level in this character giving119.43 and 124.93 cm whereas the treatment 3 plant hill^{-1} had lowest average in this character 107.17 and 113.12 cm for both seasons, while the treatment of leaving 2 plants hill^{-1} produced an average of 116.54 and 121.81 cm plants respectively which was less than the treatment1 plants hill^{-1} , but exceeded to the treatment 3 plants hill^{-1} .The lowest plant densities increased plant height, and this can be due to the decreased plants number in hill which led to decrease shading and increase a amount of light to vegetation especially lower leaves which increased the efficiency of photosynthesis and then increasing the biological activity of photosynthesis necessary to produce compounds necessary for cotton growth and development , also reduce the competition between plants to water and basic nutnerty . These results at the same trend with the results found by Fromme *et.al.* (7) and

Parlwar *et.al*.(16) ,Which indication that the decreased number of plants in the hill increased plant height. The results of Tables 1 and 2 indicate a significant interaction between regulate growth treatments and plants number in hill in the average of plant height for both seasons. This indicated that response of cotton plants to plant regulaters differed with number of plants hill^{-1}. The interaction of untreated plant C_0 (control) of low densities achieved lowest average giving 130.65 and 139.99 cm whereas treatment T_4 of high densities and T_3 with the same plant densities achieved the lowest average in this character giving 103.76 cm in 2016 and 107.99 cm in the second season.

Table 1. Plant height (cm) under effect regulate growth treatments and number of plant hill^{-1} in the season 2016

Regulate growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	130.65	126.19	117.87	124.90
P1 (Foliar pix at the beginning of flowers squares appearance)	116.25	114.36	105.38	111.99
P2 (Foliar pix at the beginning of flowers appearance)	119.15	116.45	108.22	114.61
T3 (Topping at the beginning of flowers squares appearance)	113.28	112.45	106.63	110.79
T4 (Topping at the beginning of flowers appearance)	117.82	113.27	103.76	111.73
LSD 0.05		6.46		6.29
Means	108.37	116.48	119.43	
LSD 0.05		1.14		

Table 2. Plant height (cm) under effect regulate growth tretments and number of plant hill^{-1} in the season 2017

Regulate growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	139.99	136.99	120.89	132.62
P1 (Foliar pix at the beginning of flowers squares appearance)	121.16	118	111.84	117
P2 (Foliar pix at the beginning of flowers appearance)	124.24	119.48	113.7	119.14
T3 (Topping at the beginning of flowers squares appearance)	118.65	116.75	107.99	114.46
T4 (Topping at the beginning of flowers appearance)	120.61	117.83	110.21	116.22
LSD 0.05		5.66		4.74
Means	124.93	121.81	112.93	
LSD 0.05		2.02		

Number of sympodia

The results in Tables 3 and 4 shows significant effects of regulate growth treatment, number of plants in hill and their interaction in the average of sympodia number for both seasons. the phenomenon of dominant tip which in turn causes transfer of formed oxygen in the lateral bud and then encourages the growth of minor buds which become strong when water is available and this leads to increase the number of sympodia in the plant. This result at the same trend with the results of Saleem *et.al*.(17),Who indicated that the treatments significantly affected the average of number sympodia number in cotton plants. The results in Tables 3 and 4 shows that the treatment 1 plant.hill^{-1} produced highest average in this character giving 13.85 and 14.94 branch plant^{-1} respectively, compared with , treatment 3 plant,hill^{-1} which produced the lowest average of 9.65 and 11.33 branch plant^{-1} for both seasons. This can be due lowest densities in which vegetative growth was perfect and therefore the competition between plant parts to necessary nutrients could be reduced and lead to increasing the number of sympodia. These results in a similar trend with the results of Khan *et.al.*(9) Udikeri and Shashihara(21).Results of Tables 3 and 4 reveal significant interaction between two ,variables.This indicate that cotton plants response to pix corrdated within number of plant hill^{-1} . treatment 1 plant hill^{-1} produced highest average in this character giving14.21 and 15.40 branch plant^{-1} while untreated plants C_0 (control) with treatment 3 plant.hill^{-1} produced the lowest average in this character giving8.25 and 9.87 branch.plant^{-1} for both seasons.

Table 3. Number of sympodia plant^{-1} under effect regulate growth tretments and number of plant hill^{-1} in the season 2016.

Regulate growth treatments	Number of plant hill^{-1} One	Two	Three	Means
Co (Control)	12.54	10.68	8.25	10.49
P1 (Foliar pix at the beginning of flowers squares appearance)	14	13.53	9.94	12.49
P2 (Foliar pix at the beginning of flowers appearance)	14.21	13.72	10	12.64
T3 (Topping at the beginning of flowers squares appearance)	14.17	13.4	9.91	12.49
T4 (Topping at the beginning of flowers appearance)	14.35	12.59	10.18	12.37
LSD 0.05		1.05		0.92
Means	13.85	12.78	9.65	
LSD 0.05		0.32		

Table4. Number of sympodia.plant^{-1}under effect regulate growth tretments and number of plant hill in the season 2017.

Regulate growth treatments	Number of plant hill^{-1} One	Two	Three	Means
Co (Control)	13.28	11.36	9.87	11.5
P1 (Foliar pix at the beginning of flowers squares appearance)	15.37	14.52	11.68	13.85
P2 (Foliar pix at the beginning of flowers appearance)	15.4	14.64	11.81	13.95
T3 (Topping at the beginning of flowers squares appearance)	15.32	14.43	11.65	13.8
T4 (Topping at the beginning of flowers appearance)	15.35	14.49	11.66	13.83
LSD 0.05		1.61		1.57
Means	14.94	13.88	14.94	
LSD 0.05		0.26		

Leaf area

Results in Tables 5 and 6 indicat significant effect of regulate growth treatment, number of plants in hill and their interaction in the average of leaf area in cotton plants for both seasons 2016 and 2017. The untreated plants C_0 (control)had highest leaf area (2144.4 and 2300.1 cm^2), compared with regulate growth treatments which didn't differed significantly, where regulate growth treatment t_3 had lowest average in this character giving 1902.6 and 2157.4 cm^2. This could be due to the process of removing growing apex which affected on growth inhibition and cell elongation in leaves and therefore decreased leaf area. These results are in sort of agreement with the results of Farrukh *et.al*.(6) and Yu *et.al*.(23)who found that regulate growth process had smaller leaf area. The results in Tables 5 and 6 shows increases in leaf area with the reduction in plants number in hill. Treatment 1 plant hill^{-1}produced the highest average in this character giving2196.8 and 2386.5 cm^2 and differed significantly from treatment 2 plant hill^{-1},while treatment 3 plant hill^{-1} had the lowest average in this character (180.9 and 1941.1 cm^2) for both seasons, respectively. This could be due to the effect of the different number of plants in hill, so reducing plants number in hill reduced the competition between plants to light, water and nutrients and this reflected on increasing the leaf area. These results at the same trend with the results of Manjula and Shashidhara (12) and Udikeri and Shashidhara (21) They indicated a significant effect of plant densities in the average of leaf area.The results of Tables 5 and 6 shows significant interaction between regulate growth treatments and plants number in hill for the average of leaf area for both seasons2016 and 2017.As untreated plants C_0(control) with the treatment of 1 plant hill^{-1} produced high average in leaf area giving2283.2 and 2464.6 cm^2 while the regulate growth treatment T_3 produced lowest average in this character (1739.8 and 1813.4 cm^2) for both seasons ,respectively.

Table5 . Leaf area cm^2 under effect regulate growth tretments and number of plant hill^{-1} in the season 2016

Regulate growth treatments	Number of plant hill^{-1} One	Two	Three	Means
Co (Control)	2283.2	2185.6	1964.4	2144.4
P1 (Foliar pix at the beginning of flowers squares appearance)	2127.8	1938.8	1727.4	1931.3
P2 (Foliar pix at the beginning of flowers appearance)	2194.4	2031.2	1826	2017.2
T3 (Topping at the beginning of flowers squares appearance)	2081.4	1886.7	1739.8	1902.6
T4 (Topping at the beginning of flowers appearance)	2162.4	1974.7	1790.5	1975.8
LSD 0.05		37.77		22.61
Means	2169.8	2003.4	1809.6	
LSD 0.05		17.84		

Table 6 . Leaf area cm^2 under effect regulate growth tretments and number of plant hill^{-1} in the season 2017

Dry weight

Regulation growth treatments	Number of plant hill^{-1} One	Two	Three	Means
Co (Control)	2464.6	2371.3	2064.4	2300.1
P1 (Foliar pix at the beginning of flowers squares appearance)	2351.4	2241	1881.7	2158
P2 (Foliar pix at the beginning of flowers appearance)	2387.6	2286.5	1936.4	2203.5
T3 (Topping at the beginning of flowers squares appearance)	2338.8	2260	1873.4	2157.4
T4 (Topping at the beginning of flowers appearance)	2390.2	2280.4	1949.7	2206.8
LSD 0.05		30.26		19.70
Means	2386.5	2287.8	1941.1	
LSD 0.05	13.76			

The results in Tables 7 and 8 shows significant effects of regulate growth treatment , number of plants in hill and interaction with significant effect on dry weight for both seasons. The regulate growth treatment T_4 had the highest average dry weight (99.75 and 109.77 g),which didn't differed significantly from other treatments but exceeded to untreated plants in C_0 (control) which recorded lowest average in this character (92.29 and 102.51 g),for both seasons, respectively. This could be due to the superiority of this treatment in the character of number of sympodia (Tables 3 and 4). This affected positively on increasing total dry weight plants^{-1}. This at the same trend with the results found by Virdia (22) and Saleem et.al.(17) whe indicated a significant increases in plant dry weight, which affected by, regulate growth treatments. The results in Tables 7 and 8 reveal asignificant differeances between the treatment of plants number in hill in the average of plant dry weight, as treatment 1 plant hill^{-1} exceeded in producing highest dry weight giving(106.48 and 117.08 g). compared with treatment of 3 plant hill^{-1},when produced lowest average in this character (88.31 and 90.06gm). for both seasons respectively. While treatment of leaving 2 plants hill^{-1} which considered control treatment produced an average of 96.24 and 109.85 which was lowest than the average of treatment 1 plant hill^{-1} but it exceeded on the treatment 3 plants hill^{-1} . The reason behind the increases in dry matter by the reduction of plants number in hill could be due exceed in the number of sympodia (Tables 3 and 4) and leaf area (Tables 5 and 6). These results at the same trend with the results of Madavi *et.al*. (11) and Parlwar. *et al*.(16). The reduction of plants number in hill led to increase in the average of dry matter, because cotton is a unlimited in growth and capable of forming new branches and as a result forms huge vegetation which can be reflected positively on dry matter yield.The results in Tables 7 and 8 shows no significant interaction between regulate growth treatment and number of plants in hill in the dry weight for both seasons 2016 and 2017.

Table7 . Dry wight (g plant^{-1}) under effect regulate growth tretments and number of plant hill^{-1} in the season 2016

Regulate growth treatments	Number of plant hill^{-1} One	Two	Three	Means
Co (Control)	100.18	91.42	85.26	92.29
P1 (Foliar pix at the beginning of flowers squares appearance)	106.95	95.85	87.72	96.84
P2 (Foliar pix at the beginning of flowers appearance)	110.41	98	89.48	99.29
T3 (Topping at the beginning of flowers squares appearance)	105.38	96.61	88.72	96.9
T4 (Topping at the beginning of flowers appearance)	109.5	99.36	90.39	99.75
LSD 0.05		N.S		3.34
Means	106.48	96.24	88.31	
LSD 0.05		1.36		

Table8 . Dry wight (g plant^{-1}) under effect regulate growth tretments and number of plant hill^{-1} in the season 2017

Regulate growth treatments	Number of plant hill^{-1} One	Two	Three	Means
Co (Control)	110.37	104.52	92.64	102.51
P1 (Foliar pix at the beginning of flowers squares appearance)	118.78	109.87	95.65	108.1
P2 (Foliar pix at the beginning of flowers appearance)	120.6	111.22	95.98	109.26
T3 (Topping at the beginning of flowers squares appearance)	116.28	110.75	94.87	107.3
T4 (Topping at the beginning of flowers appearance)	119.41	112.91	96.16	109.49
LSD 0.05		N.S		2.23
Means	117.08	109.85	95.06	
LSD 0.05		1.57		

Number of open bolls

The results in Tables 9 and 10 shows significant differences between regulate growth treatments , number of plants in hill and their interaction in the average of open bolls number in plants for both seasons 2016 and 2017. The treatments didn't differed significantly from each other for the bolls number average but , they differed significantly from untreated plants C_0 (control), which produced lowest average in this character (6.22 and 6.31 boll plant^{-1}) for both seasons respectively. This increases could be due to the role of growth regulators in breaking apex domination and stimulating buds to produce branches and then increasing the total bolls number which reflected positively on increasing the number of open bolls . These results at the same trend with the results of Saleem *et.al*.(17) who indicated that growth regulaters significantly increased the average of open bolls number in cotton plants. From the results of Tables 9 and 10 significant differences between treatments in the average of open bolls number of plant numbers in hill One plant hill^{-1} average in the number of bolls (10.09 and 10.23) boll plant^{-1}compared with treatment 3 plant boll^{-1} which had lowest average in open bolls number of 4.69 and 4.73, respectively for both seasons, while the treatment 2 plants boll^{-1} which considered control treatment had an average of 7.86 and 7.99 boll plant^{-1}. These differences can be due to the decrease number of plants hill^{-1} which produced highest chance for the plant to increase number of sympodia (Tables 7 and 8) and then forming a highest number of bolls which positively produc large number of open bolls. These results at the same trend with the results of other researchers (7,9,12,15) .The results at Tables 9 and 10 indicat significant interaction between regulate growth treatments and plants number hill^{-1} for both seasons, respectively .This, indicated that response of cotton plants differed due to plant regulaters and plant densities.

Table9 . Number of open bolls plant^{-1} under effect regulate growth tretments and number of plant ill^{-1} in the season 2016

Regulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	8.1	6.4	4.18	6.22
P1 (Foliar pix at the beginning of flowers squares appearance)	10.5	8.16	4.79	7.81
P2 (Foliar pix at the beginning of flowers appearance)	10.7	8.42	4.86	7.99
T3 (Topping at the beginning of flowers squares appearance)	10.56	8.12	4.81	7.83
T4 (Topping at the beginning of flowers appearance)	10.6	8.23	4.85	7.89
LSD 0.05		1.13		1.00
Means	10.09	7.86	4.69	
LSD 0.05		0.36		

Table10. Number of open boll plant^{-1} under effect regulate growth tretments and number of plant hill^{-1} in the season 2017.

Regulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	8.58	6.36	4	6.31
P1 (Foliar pix at the beginning of flowers squares appearance)	10.57	8.29	4.91	7.92
P2 (Foliar pix at the beginning of flowers appearance)	10.8	8.5	5	8.1
T3 (Topping at the beginning of flowers squares appearance)	10.53	8.35	4.86	7.91
T4 (Topping at the beginning of flowers appearance)	10.69	8.46	4.89	8.01
LSD 0.05		0.78		0.69
Means	10.23	7.99	4.73	
LSD 0.05		0.25		

Boll weight(gm)

The results in Tables 11 and 12 indicate no significant differences of regulate growth treatments on the average of boll weight for both seasons 2016 and 2017. These results at the same trend with Saleem et. al. (17). Results in Tables 11 and 12 shows a significant differences between treatments of plants hill^{-1} in the average boll weigh. The treatment 1 plant boll^{-1} recorded highest average in this character (3.24 and 3.41 g), and didn't differed significantly from the treatment 2 plant hill^{-1} in season 2016 only, compared with the treatment 3 plant hill^{-1} which had lowest average in this character giving2.37 and 2.15 g. for both seasons 2016 and 2017. Those variances can be due to increased number of plants in hill^{-1}.This at the same trend with the results of Nagender et.al. (15). Results of Tables 11 and 12 we indicated no significant interaction between regulate growth treatment and number of plants in boll , which means that the effect of regulate growth treatments had no relation to the effect of treatments of plants number in boll.

Table11.Boll weight (g plant^{-1}) under effect regulate growth tretments and number of plant hill^{-1} in the season 2016

Rregulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	3.49	3.28	2.52	3.09
P1 (Foliar pix at the beginning of flowers squares appearance)	3.22	3.15	2.34	2.90
P2 (Foliar pix at the beginning of flowers appearance)	3.16	3.34	2.35	2.95
T3 (Topping at the beginning of flowers squares appearance)	3.17	3.12	2.32	2.87
T4 (Topping at the beginning of flowers appearance)	3.18	3.13	2.33	2.88
LSD 0.05		N.S		N.S
Means	3.24	3.20	2.37	
LSD 0.05		0.40		

Table 12 .Boll weight (g plant^{-1}) under effect regulate growth tretments and number of plant hill^{-1} in the season 2017

Regulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	3.88	3.07	2.20	3.05
P1 (Foliar pix at the beginning of flowers squares appearance)	3.34	2.64	2.13	2.70
P2 (Foliar pix at the beginning of flowers appearance)	3.30	2.60	2.12	2.67
T3 (Topping at the beginning of flowers squares appearance)	3.28	2.58	2.14	2.67
T4 (Topping at the beginning of flowers appearance)	3.23	2.56	2.16	2.56
LSD 0.05		N.S		N.S
Means	3.41	2.69	2.15	
LSD 0.05		0.52		

Plant yield

The results in Tables 13 and 14 shows significant effects of regulate growth treatments, number of plants in hill and their interaction on plant yield for both seasons 2016 and 2017. The plants at the treatment P_2 produced highest yield (23.78 and 22.86 g plant^{-1}) compared with untreated plants C_0 (control) which had lowest average in this character (19.92 and 20.64g plant^{-1}) and didn't significantly differed from other treatments for both seasons. This differences could be due to the effect of growth regulaters (Pix) in increasing yield components significantly which included number of open bolls (Tables 9 and 10) and boll weight (Tables 11 and 12).This results at the same trend with the results of Gin and Ben (5).There were significant differences between the treatments of plant yield, as treatment 1 plant hill^{-1} recorded highest average in this character (32.63 and 34.58 g plant^{-1}) which differed significantly from control treatment (2 plant hill^{-1}) which produced an average of 24.75 and 21.38 g plant^{-1}, while the treatment 3 plant hill^{-1}, produced lowest average in this character (11.11 and 10.16 g plant^{-1}), for both seasons, respectively. This can be due to the increase in yield components in the exceeded treatment. This results at the same trend with the results of other resarchers (8,12,18).who indicated that reduction in plant number hill^{-1} can cause increases in plant yield. Results of Tables 13 and 14,shows significant interaction between regulate growth treatments and number of plants hill^{-1} in the average of plant yield for both seasons . This reveald that the response of cotton yield was differed due to the plant regulaters and number of plant hill^{-1}.

Table 13 . Plant yield (g plant^{-1}) under effect regulate growth tretments and number of plant hill^{-1} in the season 2016

Regulate growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	28.26	20.99	10.53	19.92
P1 (Foliar pix at the beginning of flowers squares appearance)	33.81	25.70	11.20	23.57
P2 (Foliar pix at the beginning of flowers appearance)	33.93	26.00	11.42	23.78
T3 (Topping at the beginning of flowers squares appearance)	33.47	25.36	11.15	23.32
T4 (Topping at the beginning of flowers appearance)	33.70	25.72	11.29	23.57
LSD 0.05		0.86		0.55
Means	32.63	24.75	11.11	
LSD 0.05		0.39		

Table14 . Plant yield (g plant^{-1}) under effect regulate growth tretments and number of plant hill^{-1} in the season 2017

Regulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	33.62	19.52	8.80	20.64
P1 (Foliar pix at the beginning of flowers squares appearance)	35.30	21.88	10.45	22.54
P2 (Foliar pix at the beginning of flowers appearance)	35.64	22.34	10.60	22.86
T3 (Topping at the beginning of flowers squares appearance)	34.53	21.54	10.40	22.15
T4 (Topping at the beginning of flowers appearance)	33.85	21.65	10.56	22.02
LSD 0.05		1.50		1.45
Means	34.58	21.38	10.16	
LSD 0.05		0.31		

Seed cotton yield

Results of Tables 15 and 16 shows significant differences among regulate growth treatment , plants number hill^{-1} and their interaction in the average of seed cotton yield for both seasons. The plant at the treatment P_2 produced highest seed cotton yield (2124.8 and 1972.3 kg ha^{-1}), which didn't significantly differed from other treared treatment.Untreated plants C_0 (control)had the lowest average of seed cotton yield (1799.2 and 1744.2 kg ha^{-1}) for both seasons, respectively. Growth regulaters helped to increase yield and caused increase in the number of sympodia (Tables 3 and 4) , numbers of open bolls (Tables 9 and 10) and boll weight (Tables 11 and 12) there results are at a similar trend with Bin and Gie (5) . Results in the tables 15 and 16 shows significant effects between the treatments of plants number in hill in the average of seed cotton yield for both seasons, as treatment 2 plant hill^{-1} produced highest average in this character giving 2625.0 and 2261.8 kg ha^{-1} compared to treatment 1 plants hill^{-1} which had lowest average in this character (1729.6 and 1837.5 kg ha^{-1}) for both seasons. This increase can be due to increase in yield components for the same treatment. Kumar *et.al.* (10)found significant increases in the average of seed cotton yield. Results of Tables 15 and 16 indicat significant interaction between regulate growth treatment in number of plants in hill^{-1} the average of seed cotton yield. The regulate growth treatment P_2 of 2 plants hill^{-1}achieved highest average of 2760.2 and 2342.6 ka ha^{-1} while the untreated plants C_0 (control) witin high densities was produced lowest average in this character of 1674.8 and 1399.2 kg ha^{-1} for both seasons.

Table 15 . Seed cotton yield (kg kh^{-1}) under effect regulate growth tretments and number of plant hill^{-1} in the season 2016

Regulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	1497.8	2224.9	1674.8	1799.2
P1 (Foliar pix at the beginning of flowers squares appearance)	1791.9	2724.6	1782.2	2099.6
P2 (Foliar pix at the beginning of flowers appearance)	1798.3	2760.2	1815.9	2124.8
T3 (Topping at the beginning of flowers squares appearance)	1773.8	2688.2	1774.3	2078.8
T4 (Topping at the beginning of flowers appearance)	1786.4	2727.2	1796.8	2103.4
LSD 0.05		44.39		33.75
Means	1729.6	2625.0	1768.8	
LSD 0.05		18.03		

Table16. Seed cotton yield (kg kh^{-1}) under effect regulate growth tretments and number of plant hill^{-1} in the season 2017

Regulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	1764.4	2069.1	1399.2	1744.2
P1 (Foliar pix at the beginning of flowers squares appearance)	1870.9	2319.3	1661.5	1950.6
P2 (Foliar pix at the beginning of flowers appearance)	1888.9	2342.6	1685.4	1972.3
T3 (Topping at the beginning of flowers squares appearance)	1830.0	2283.2	1653.6	1922.3
T4 (Topping at the beginning of flowers appearance)	1833.3	2294.9	1679.0	1935.7
LSD 0.05		74.79		44.37
Means	1837.5	2261.8	1615.8	
LSD 0.05		35.45		

Lint length (mm)

Results in Tables 17 and 18 shows no significant effect on regulate growth treatment ,plants number in hill and their interaction in the average of lint length for both seasons .These response at the same trend with the results of Saleem *et.al*.(17) who indicated no significant differences of regulate growth treatments on lint length . Hiwale *et.al*.(8) indicated also no significant effect of the treatments of number of plants in hill. The results of this experiment explained that the response of cotton lint length to the growth regulaters and plant densition was paralled

Table17. Lint length (mm) under effect regulate growth tretments and number of plant in hill in the season 2016

Regulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	27.58	27.40	26.73	27.24
P1 (Foliar pix at the beginning of flowers squares appearance)	27.88	27.42	26.72	27.34
P2 (Foliar pix at the beginning of flowers appearance)	27.95	27.38	26.73	27.35
T3 (Topping at the beginning of flowers squares appearance)	27.90	27.36	26.71	27.32
T4 (Topping at the beginning of flowers appearance)	27.87	27.41	26.74	27.34
LSD 0.05		N.S		N.S
Means	27.84	27.39	26.73	
LSD 0.05		N.S		

Table18 .Lint length (mm) under effect regulate growth tretments and number of plant hill^{-1} in the season 2017

Regulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	28.00	27.28	26.67	27.32
P1 (Foliar pix at the beginning of flowers squares appearance)	27.98	27.30	26.64	27.31
P2 (Foliar pix at the beginning of flowers appearance)	27.96	27.29	26.65	27.30
T3 (Topping at the beginning of flowers squares appearance)	27.95	27.31	26.67	27.31
T4 (Topping at the beginning of flowers appearance)	27.33	27.29	26.66	27.09
LSD 0.05		N.S		N.S
Means	27.84	27.29	26.66	
LSD 0.05		N.S		

Lint fineness

Results of Tables 19 and 20 shows significant effect between regulate growth treatment in the average of lint fineness in plants in both seasons . These results at the same trend with the results of Saeem *et. al*.(17). The results in Tables 19 and 20 shows also significant differences between the treatment of plants number hill^{-1} in the average of lint fineness. The treatment 1 plant hill^{-1} produced the better lint fineness of 3.68 and 3.54 micronear compared with the treatment 3 plant hill^{-1}, which produced lowest lint fineness (4.66 and 4.72 micronear). While the treatment 2 plants hill^{-1} had an average of 4.02 and 4.09 which was lowest than treatment 3 plants hill^{-1} but exceeded to the treatment of 1 plants hill^{-1}.This confirmed the results of other researchers (13,18).who indicated significant differences between densities in the average of this character . The results of Tables 19 and 20 confirmed that there was no significant differences between regulate growth treatments and number of plants hill^{-1} in the lint fineness for both seasons, respectively.

Table19 . Lint fineness (micronear) under effect regulate growth tretments and number of plant in hill in the season 2016

Regulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	3.62	4.00	4.56	4.06
P1 (Foliar pix at the beginning of flowers squares appearance)	3.60	4.05	4.51	4.05
P2 (Foliar pix at the beginning of flowers appearance)	3.64	4.00	4.53	4.05
T3 (Topping at the beginning of flowers squares appearance)	3.60	4.06	4.55	4.07
T4 (Topping at the beginning of flowers appearance)	3.96	4.03	5.18	4.39
LSD 0.05		N.S		N.S
Means	3.68	4.02	4.66	
LSD 0.05		0.27		

Table 20 . Lint fineness (micronear) under effect regulate growth tretments and number of plant hill^{-1} in the season 2017

Rregulation growth treatments	Number of plant hill^{-1}			Means
	One	Two	Three	
Co (Control)	3.57	4.10	4.72	4.13
P1 (Foliar pix at the beginning of flowers squares appearance)	3.52	4.11	4.70	4.11
P2 (Foliar pix at the beginning of flowers appearance)	3.55	4.09	4.74	4.12
T3 (Topping at the beginning of flowers squares appearance)	3.54	4.06	4.72	4.10
T4 (Topping at the beginning of flowers appearance)	3.52	4.10	4.73	4.11
LSD 0.05		N.S		N.S
Means	3.54	4.09	4.72	
LSD 0.05		0.19		

REFERENCES

1. Al-Joburi, B. A. K. 2003. Weed Science. Ministry of Higher Education and Scientific Research. Univ. of Baghdad. pp. 509.

2. AL-Khaldy, R . A. A. .2004. Effect of Weed Control and Plant Spacing on Yield & Yield Components of Cotton (*Gossypium hirsutum* L.) . M. SC. Thesis, Coll.. of Agric., Univ. of Baghdad. pp:65

3. Al-Satori, H. K. S. 2012. Response of Cotton (*Gossypium hirsutum L*.) to Different Levels of Nitrogen Fertilizer, Irrigation Depth and Plant densities. Ph.D Dissertation, Dept. of Field Crop Sci., .Coll of Agric., Univ.of Al-Anbar pp.131.

4. Asker ., F.Y .2015 . Effect of plant spacing on flowering and fruiting of cotton cultieurs. Dept. of Field Crop.Coll of Agric.,Univ. of Baghdad.pp.85

5. Bin.,H. and W.Jie.2006. Experimental study on 3mdzk -12 type cotton topping machine under group control and single row profiling. National Agric Sci . (80):595 – 598

6. Farrukh., A .R, A. Ahmed. and M. Anjum. 2016.Topping chem-controlling phosphorus fertilization coupling long fiber cotton .Annu. Rev. Plant physiol.Plant Mol. Biol. 88(43):501-531

7. Fromme.,D.D.,L.L. Falconer.,R. D. Park.,R. G. Lemon.,C.J.Fernandez. and W. J. Grichar .2014.Effects of two planting patterns and plant densities on the productivity and profitability of cotton .American J .of Experimental. Agri .4 (2):130 -141

8. Hiwale., S.D. ,V. K. Kargakharate, S. S. Patil. and A.D. Nichal. 2018. Effect of hirsutum cotton to high plant densities and fertilizer doses on yield and nutrient uptake under rainfed condition .Inter .J .Curr .Microbiol .App. Sci.6 (2):2653-2658

9. Khan., A.,U. Najeeb, L.Wang, D.K. Y. Tan. And G.Yang .2017 .Planting densities and sowing date strongly influence growth and lint yield of cotton crops. Field Crops Res . 56(22):129-135

10. Kumar .,P. ,A .S.Karle ,D. N. Gokhale ,A .K. Keteku . and A. S. Jadhav . 2017. Effect of high densities planting system (HDPS) and varieties on growth and yield of cotton .National Acadmy of Agic sci.33(4):2429-2430

11. Madavi., B,P. L.Rani, G. Sreenivas. and K.Surekha. 2017.Impact of high densities planting and weed management practices on growth parameters and phenology of Bt cotton . Int. J. Curr .Microbiol .App.Sci.6(9):2360-2372

12. Manjula., U.and G.B. Shashidhara. 2017. Influence of different planting geometry and fertilizer levels on yield and economics of compact cotton genotypes. Inter. J .of Agric Sci.9 (33) :4482-4485

13. Mao.L. ,L.Zhang. ,J.B .Evers. ,W.V. D. Werf., S.Liu., S. Zhang., B.Wang. and Li. Zhaohu .2015. Yield components and quality of intercopped cotton in response to mepiquat chloride and plant densities. Field Crops Res. 10 (179) :63 – 71

14. Mohammed. ,H .A. 2012. Effect of Phosphate Fertilization and Foliar of Zinc on Growth and Yield of Cotton .*(Gossypium hirsutum L.)* M.Sc. Thesis .Dept .of Field Crop. Coll of Agric., Unvi . Of Baghdad . pp.82

15. Nagender., T. D. R. Reddy, P .L .Rani. G. Sreenivas, K.Surekha, A.Gupta. and P. D. Srcekanth .2017. Response nitrogen fertilization and plant densities on bt and non-btcotton *(Gossypium hirsutum L.)* hybrids. Int.J. Curr. Microbiol. App. Sci .6(9) :3199-3207

16. Parlawar. ,N .D, D. J. Jiotode, V. S. Khawle, K. J .Kubde .and P. D. Puri . 2017 . Effect of planting gyometry and varieties on morphophy siological parameters and yield of cotton .J.Soil and Crops .27(2) : 152-158

17. Saleem., M.F., A .M. Anjum., S .Ahmad, R. Raza. and M. A. Shakoor. 2016. Effect of topping under differen nitrogen levels on earliness and yield of cotton .Pak . J. Agric .40 (29):110 – 118

18. Sawan., Z.M . 2017 . Plant densities , plant growth retardant .Its direct and residual effect on cotton yield and fiber properties .Int.J. Environ .Sci .Nat .Res. 5 (3):1-12

19. Shahr., H., A .M. and B.Mirshekari. 2015 .Effect of hormonal growth regulator foliarand topping on some agronomic traits in the newly released cotton (*Gossypium hirsutum L*.) cultivars. Int. J .Adv . Lif. Sci. ,90 (8) :115-120

20. Steel, R. G. D,. and J. H. Torrie. 1980. Principles of Statistics. McGraw-Hill Book Co. Inc. New York. USA. pp: 485.
21. Udikeri., M. and G. B. Shashidhara. 2017. Performance of compact cotton genotypes under high densities planting system at different fertilizer levels. J. Farm. Sci. 30 (4): 460-466
22. Virdia., H.M. 2011. Effect of topping on growth and yield of hybrid cotton *(Gossypium Hirsutum).*Adv. Res. J. Crop Improv., 2 (1): 21-23
23. Yu .,Y .Z ,Z.W. Feng., X. S .Zhen, S.L.Long, L.F. Bin. And D.H. Yi. 2015. Effects of foliarchemical topping agents on canopy structure and canopy photosynthetic production in cotton .Sci Agric Sinica. (49) :1672 – 1684.