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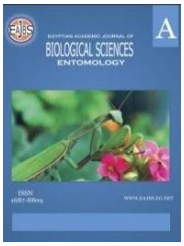

Effect of Manual Topping of Cotton Plants on Some Parameters Affecting Productivity of Cotton Yield

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ABSTRACT

The present work was carried out to study the effect of manual topping of cotton plants at different ages, on the infestation levels of bollworms (Pectinophora gossypiella (Saund.) and Earias insulana (Boisd.)) and produced cotton yield. All trials were conducted at a private farm, El Azizia village, Minia Al-Kamh district, Sharkia Governorate, Egypt during 2021 and 2022 seasons. Three main treatments of topping cotton plants were conducted, each main treatment including sub-treatments. Results revealed that all treatments of plants topping at different ages had achieved significant increase in the produced mature bolls per plant, highly significant decrease of bollworms infestation and significant increase of boll weight and total yield per plant as compared to the same parameters in un-topped plants. Results also demonstrated that the highest number of produced bolls per plant, reduction of bollworms infestation and increase of yield per plant were achieved in the topped plants three times at age between 120 and 140 days.

INTRODUCTION

Cotton is one of the most field cash crops in Egypt and many other countries all over the world, insect pests are the most serious and destructive of cotton plants, especially cotton bollworms: *Pectinophora gossypiella* (Saund.) and *Erias insulana* (Boisd.). In Egypt, the two insect pests are key pests of cotton. They attack the fruiting parts (flower buds i.e., squares, flowers, and green bolls), causing considerable losses in both quantity and quality of cotton yield (Abdallah, 2005; Rashwan *et al.* 2009; Radwan *et al.* 2019).

During the cotton growing season, the authorized programs of cotton pest management are mainly depend on the intensive use of chemical control which is the main tool for controlling cotton bollworms, However, the intensive use of insecticides in cotton field had led to tremendous environmental pollution and disturbance in natural balance and caused severe loss in natural enemies, populations.

In Egypt, the area planted with cotton had reached 311700 feddans in 2024. There is an increase of about 23% over the same periods of the previous year (Cotton Research Institute, 2024).

Timely topping of cotton is essential to prevent unproductive fruit branches, promote rational distribution of nutrients, and increase the boll formation rate and boll weights. Plant

topping breaks apical dominance, increases earliness, and promotes partitioning of assimilates to the reproductive organs. However, the apical dominance of cotton increases as the density increases, reducing the topping effect and seed cotton yields (Wang *et al*. 2023).

Manual topping in cotton greatly reduced bollworm infestations not only on topped plants but also on neighboring plants. Also, topping has other benefits, such as a reduction in insecticide applications which have drawn the attention of the most of cotton producers (Téréta, 2015).

MATERIALS AND METHODS

Field experiments were carried out during two successive seasons of 2021 and 2022 at a private farm, El Azizia village, Sharkia Governorate, Egypt. The study was conducted in order to investigate the effect of manual topping of cotton plants at different ages on bollworms (*Pectinophora gossypiella* (Saund.) and *Earias insulana* (Boisd.)) infestation, number of produced bolls/plant, weight of boll, and weight of yield/plant.

Cotton seeds were sown on 28th Mach and 1st April in 2021 and 2022 growing seasons, respectively. The experimental design was a completely randomized block design with three replicates for each treatment. The experimental unit area replicate was 24 m^2, involving five ridges each of 6 m long and 1.25 m wide. Seeds of cotton cv. Giza 94 were sown in hills (6 seeds per each) spaced 25 cm apart on both sides of the ridge. At 35 (DAS), plants were thinned to secure two plant per hill. In both seasons. All other cultural practices were followed throughout the two seasons as recommended for cotton production in the region of the experiment.

Three main treatments of topping cotton plants were conducted, each main treatment including sub-treatments:

First: Once topping at plant age 100 days after sowing (DAS); twice toppings at plant ages 100 and 110 DAS and topping plants three times at ages 100, 110 and 120 DAS.

Second: Once topping at plant age 110 DAS; twice toppings at plant ages 110 and 120 DAS and topping plants three times at ages 110, 120 and 130 DAS.

Third: Once topping at plant age 120 DAS; twice toppings at plant ages 120 and 130 DAS and topping plants three times at ages 120, 130 and 140 DAS.

Each experimental area (replicate) was divided into two equal parts (A and B). The first part (A) consisted of three ridges in which the sampling of green bolls and inspection process was carried out at 7 days interval from the first day of July during the two season, aiming to follow up the development of bollworms infestation in the treated and untreated plants.The second part (B) consisted of two ridges in order to estimate the number of produced bolls per plant, mean weight of boll and weight of cotton yield per plant in all tested treatments, compared to the untreated plants.

When the majority of matured bolls well opened, 100 cotton plant were chosen randomly from each treatment (50 plants/replicate) to estimate number of produced bolls per plant, mean weight of boll and total yield per plant. Equal samples were taken and processed from untreated cotton plants (control).

RESULTS AND DISCUSSION

1. Effect of Topping Plants on Produced Bolls/Plant, Bollworms Infestation, Mean Weight of Bolls/Plant and Mean Yield/Plant During The 2021 Season:

Data presented in Table (1), show the obtained results from the topped cotton plants three times at 10 days interval from the beginning of plant age 100,110 and 120 days after

sowing. Carefully examination of the data show that the highest number of produced bolls/ plant was obtained of the topped plants three time at ages (120, 130 and 140 days) after sowing with mean number (49.43 bolls/plant) followed by (42.85 bolls/ plant) in the topped plant at (110, 120 and 130 days) after sowing and (33.41 bolls/ plant) in topped plants at (100, 110 and 120 days) after sowing as compared to only (27.02 bolls/ plant) from the un-topped plants (control).

Table 1: Effect of topping cotton plants at different ages (100,110 and 120 days) on bollworms infestation, weight of bolls and weight of plant yield, during 2021 season, Sharkia Governorate.

Treatment		Mean no. of bolls/ plant ±s.e.	Mean no. of infested bolls/ plant ±s.e.	Boll worms Infestation% ±s.e.	Mean weight of boll (g) ±s.e.	Mean yield / Plant (g) ±s.e.
Topping at different Plant ages	100 days	30.32±0.18 i	2.18±0.06 d	7.17±0.19 cd	2.61±0.07 d	79.14±0.22 i
	110days	34.10±0.27 h	2.36±0.16 d	6.90±0.48 cd	2.69±0.02 cd	91.73±0.03 h
	120days	35.80±0.04 g	2.38±0.06 d	6.64±0.17 d	2.76±0.12 c	98.81±0.05 g
	Mean	**33.41**	**2.31**	**6.90**	**2.69**	**89.89**
	110 days	40.20±0.1 f	3.06±0.07 c	7.62±0.17c	2.78±0.01 c	111.76±0.03 f
	120 days	43.16±0.45 e	3.24±0.02 c	7.51±0.12 c	2.84±0.02 bc	122.57±0.09 e
	130 days	45.20±0.42 d	3.14±0.12 c	6.95±0.31cd	2.93±0.02 b	132.44±0.02 d
	Mean	**42.85**	**3.15**	**7.36**	**2.85**	**122.26**
	120 days	47.02±0.19 c	4.56±0.19 b	9.70±0.37 b	2.95±0.02 ab	138.71±0.08 c
	130 days	49.06±0.29 b	4.52±0.1b	9.22±0.14 b	3.00±0.02 ab	147.18±0.33 b
	140 days	52.20±0.1 a	4.74±0.12 b	9.08±0.21 b	3.07±0.05 a	160.25±0.23 a
	Mean	**49.43**	**4.61**	**9.33**	**3.01**	**148.71**
Control		27.02±0.08 j	7.96±0.06 a	29.49±0.27 a	2.00±0.06 e	54.04±0.28 j
F value		1197.46	318.02	684.93	39.10	7356.74
L.S.D.		0.71	0.28	0.82	0.14	0.45
P. value		0.05	0.05	0.05	0.05	0.05

Statistical analysis of the data yielded highly significant effect of plant topping on the total number of produced bolls/plant, so, the data appeared that plant age of 120 days is the most appropriate age for topping cotton plants, this age permit cotton plant to produce more fruiting branches and produce more bolls, while topping plants at early age district plant potential to produce sufficient bolls.

Regarding the effect of topping cotton plants at different age after sowing on bollworms infestation, data in Table (1), revealed that infestation percent of bollworms greatly reduced in all treatments of topped plants at any age as compared to the un-topped plants. The highest percent of bollworms infestation was recorded in un-topped plants (29.49%) as compared to 6.90%, 7.36% and 9.33% in the topped plants at the beginning age of 100, 110 and 120 days after sowing respectively.

Statistical analysis of the data yielded highly significant differences between bollworms infestation in all treatments of plant topping as compared to bollworms infestation in un-topped plants. These results confirm the efficiency of topping cotton plants for reducing infestation of bollworms in cotton fields. The increasing of bollworms infestation in the un-topped plants is due to the continuous of vegetative growth late in the season and forming a young suitable boll for bollworms infestation.

Data also summarized in Table (1), demonstrated that mean weight of boll and total yield/plant were increased in all treatments of topped cotton plants in all tested plant ages as compared to un-topped plants (control). The highest mean weight of bolls and total yield/ plant were recorded in the topped plants as compared to the un-topped plants. The mean weight of bolls and mean yield/plant were 2.69g. and 89.89g. in the topped plants three times at ages of 100,110and 120 days after sowing; 2.85g. and 122.26g. in the topped plants three times at age of 110,120 and 130 days after sowing and 3.01g. and 148.71 g. in the topped plants three times at age of 120, 130 and 140 days after sowing respectively as compared to 27.02 bolls/ plant and 54.04 g. total yield/plant in un-topped plants (control).

Statistical analysis of the data yielded highly significant differences between mean weight of boll and total yield/plant in all treatments of topped plants as compared to mean weight/boll and total yield/plant in un-topped plants (control).

These results may confirm that topping cotton plants help in redistribution of nutrient elements and directed it to the fruiting branches and accelerate maturation of bolls which make bolls resist and unattracted to bollworm infestation.

2. Effect of Topping Plants on Produced Bolls/Plant, Bollworms Infestation, Mean Weight of Bolls/Plant and Mean Yield/Plant During The 2021 Season:

Data summarized in **Table (2)** show the mean number of produced bolls/plant and infestation percentage of bollworms induced by topping cotton plants at different ages after sowing during 2022 season. Carefully examination of the data obtained were so similar to that obtained in the first season 2021. The mean number of bolls/plant and bollworms infestation percentage were 36.09 and 8.51%, respectively in the topped plants three times at plant age of 100, 110 and 120 days after sowing; 46.85 bolls/plant and 9.15% of bollworms infestation in the topped plant at age of 110, 120 and 130 days after sowing, while the highest number of produced bolls/plant was (53.95 bolls) with 11.06% of bollworms infestation in the topped plants at ages of 120, 130 and 140 days after sowing as compared to 30.0 bolls/ plant in the un-topped plants.

Regarding bollworms infestation percentage it is clear that infestation percentage in all treatments of topped plants usually less than bollworms infestation in the untopped plants, these results reflect the high effect of topping processes in reducing bollworms infestation as compared to the infestation percentage in the un-topped plants (33.75%). These results may be explain by the effect of topping plants on prevent the formation of new young bolls late in the season which act as suitable site for bollworms egg laying, in addition to early maturation of bolls in the topped cotton plants.

Data also presented in Table (2), show the mean weight of boll and mean yield/plant in different treatments of topped cotton plants at different ages as compared to the same criteria in un-topped plants (control). Data revealed that mean weight of boll weakly increased with the delay of topping process without significant differences between topped plants of different treatments. The mean weight of boll were 3.05, 3.28 and 3.44g. in the topped plants three times at 10 days interval from the beginning of 100, 110 and 120 days after sowing, as compared to mean weight of boll in un-topped plants (2.33g.). The only significant differences was recorded between weight of boll in the topped plant after 140 days of sowing and the un-topped plants. On the opposite side the mean yield/plant has greatly affected by plant topping at different age after sowing. The mean weight of yield/plant increased gradually by increasing of plant age after sowing. The recorded yield weight/plant were 110.50, 153.59and 185.53g. in the topped plants three times at 10 days interval from the beginning of plant age 100, 110 and 120 days after sowing as compared to 69.9 g. yield/plant in un-topped plants (control).

Table 2: Effect of topping cotton plants at different ages (100,110 and 120 days) on bollworms infestation, weight of bolls and weight of plant yield, during 2022 season, Sharkia Governorate.

Treatment		Mean no. of bolls/ plant ±s.e.	Mean no. of infested bolls/ plant ±s.e.	Boll worms Infestation% ±s.e.	Mean weight of boll (g) ±s.e.	Mean yield / plant (g) ±s.e.
Topping at different Plant ages	100 days	32.24±0.33 h	2.88±0.33 d	8.93±0.40 cd	2.76±0.33 c	88.98±0.55 i
	110 days	37.52±0.07 g	3.22±0.33 cd	8.59±0.33 cd	3.16±0.34 bc	118.56±0.12 h
	120days	38.50±0.14 g	3.08±0.42 cd	8.00±0.21 d	3.22±0.42 bc	123.97±0.23 g
	Mean	**36.09**	**3.06**	**8.51**	**3.05**	**110.50**
	110 days	44.00±0.03 f	4.12±0.34 c	9.36±0.24 c	3.23±0.31 bc	142.12±0.25 f
	120 days	46.94±0.06 e	4.34±0.25 c	9.25±0.13 c	3.30±0.32 b	154.90±0.04 e
	130 days	49.62±0.12d	4.38±0.12 c	8.84±0.07cd	3.30±0.07 b	163.75±0.01 d
	Mean	**46.85**	**4.28**	**9.15**	**3.28**	**153.59**
	120 days	51.80±0.03 c	5.90±0.02 b	11.39±0.01 b	3.37±0.1 ab	174.57±0.32 c
	130 days	54.04±0.05 b	5.94±0.03 b	10.99±0.2 b	3.41±0.05 ab	184.28±0.42 b
	140 days	56.02±0.12 a	6.06±0.01 b	10.81±0.31b	3.53±0.04 a	197.75±0.17 a
	Mean	**53.95**	**5.97**	**11.06**	**3.44**	**185.53**
Control		30.00±0.23 i	10.12±0.21 a	33.75±0.17 a	2.33±0.31 d	69.9±0.35 j
F value		299.84	19.13	295.55	20.30	7356.74
L.S.D.		1.65	1.25	1.02	0.20	1.42
P. value		0.05	0.05	0.05	0.05	0.05

Statistical analysis of the data yielded highly significant differences between mean yield/plant in all treatments of topped plants and un-topped plants (control).

Results obtained are in agreement with those obtained by Vayssières and Mimeur (1926) who stated that cotton topping improve cotton production and reduce the incidence of pests; Bennett *et al*. (1965) mentioned that removal of apical points can reduce pest infestation. Many authors stated that topping cotton plants significantly reduced incidence of bollworms species (Nasr and Azab (1970); Bishop *et al.* (1977) and Naguib *et al*. (1978)), while Kittock and Fry (1977) stated that topping does not always contribute to the reduction of pest incidence. Hao (1985) in China reported that a reduction incidence of pests associated with the removal of the terminal leaves, he also found that topping cotton plants caused lower infestation of *Heliothis armigera*.

The finding in the present study are coincide with finding of Sundaramurthy (2002) in India, found lower infestation of bollworm *H. armigera* in topped cotton plants. Shewetha *et al.* (2009) in india, found that topped cotton plants showed significantly lower population of piercing sucking insects, jassids and thrips compared with non- topped plants. Also, Renou *et al.* (2011); Cabi (2011) and Ren *et al.* (2013) reported that cotton topping reduced bollworm infestation without negatively affecting cotton yields, they indicated that cotton topping has become a key step in cotton cultivation and management which can harmonize nutrient distribution and inhibit cotton apical dominance. Dai and dong (2014) in China stated that cotton topping is widely applied to increase cotton yield and boll weight in addition to improve quality of cotton. Zhu *et al.* (2020) in China mentioned that use of chemical topping agent significantly regulated the vegetative growth of cotton and increased the number of bolls by increasing the number of fruit branches.

Declarations:

Ethical Approval: All experiments in this research were approved by the Ethics Committee of the Faculty of Agriculture, Ain Shams University, Cairo, Egypt (Approval code: ASU-SCI/ENTO/2025/2/8).

Authors Contributions: All authors contributed equally, and have read and agreed to the published version of the manuscript.
Conflicts Interests: The authors declare no conflict of interest.
Availability of Data and Materials: All datasets analysed and described during the present study are available from the corresponding author upon reasonable request.
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ARABIC SUMMARY

تاثير تطويش نباتات القطن يدوياً على بعض المعايير المؤثرة على إنتاجية القطن

أحمد عادل رضوان[1] ، محمد سالم عبد الواحد[1] ، عزة كمال عبد الرحمن إمام[1] ، يوسف عز الدين يوسف عبد الله[1]، مصطفى جمال الدين شاهين[2]

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2- قسم محاصيل الحقل – كلية الزراعة – جامعة عين شمس – القاهرة – ج. م. ع.

نظراً للأهمية الاقتصادية لزراعات القطن في مصر وقبوله في الأسواق العالمية ودخول القطن في الكثير من الصناعات بما يخلق الكثير من فرص العمل، ويتسق البحث مع توجهات الدولة في تطوير زراعات القطن لزيادة الانتاجية وتعظيم القيمة المضافة، وقد اشتمل البحث على تقييم عملية تطويش نباتات القطن يدويا في أعمار مختلفة وأثرها على زيادة الإنتاجية.

فقد تم إختبار ثلاث معاملات رئيسية لتطويش النباتات بالإضافة إلى المقارنة (بدون تطويش) خلال موسمين متتاليين2022،2021 وقد أثمرت التجارب عن النتائج التالية:

التأثير الإيجابي المعنوي لعملية تطويش النباتات في جميع الأعمار على زيادة عدد اللوز المتكون على النبات مقارنة بعدد اللوز المتكون على النبات في نباتات المقارنة خلال عامي الدراسة 2022،2021. وتوضح النتائج زيادة عدد اللوز على النبات وذلك بتأخير عمليه التطويش حتى عمر ما بين ١٢٠ - 140 يوم بعد الزراعة مقارنة بعدد اللوز المتكون على النباتات التي طوشت في عمر ما بين120-100، 130-110يوم بعد الزراعة ، كما أدت عمليه التطويش إلى خفض نسبة الإصابة بكل من ديدان الوز وذبابة القطن البيضاء بدرجة عاليه المعنوية ، كما أدت إلى زيادة عالية المعنوية في متوسط وزن اللوزة خاصة تلك التي طوشت فيها النباتات في عمر يتراوح بين 140-120 يوم ، كما أكدت النتائج أهمية عمليه التطويش فى زيادة المحصول الناتج بدرجة عاليه المعنوية فقد أدى تطويش النباتات ثلاث مرات متتالية بفاصل 10 أيام اعتبارا من العمر 100، 110، 120 يوم إلى زيادة معنوية في محصول النبات مقارنة بالمحصول في نباتات المقارنة .

وترجع هذه الزيادة من المحصول إلى التأثير الإيجابي على زيادة عدد اللوز للنبات ، خفض نسبة الإصابة بديدان اللوز وزيادة وزن اللوزة بسبب منع النموات الخضرية المتأخرة التي تستنزف طاقة النبات وتؤدى إلى تكوين نموات غير ثمرية أو تكوين لوز صغير لا يتفتح ويكون عرضة للإصابة الشديدة بديدان اللوز.

وهذا يؤكد أهمية هذه الممارسات الزراعية فى زيادة إنتاجية القطن وتقليل الاعتماد على المبيدات الحشرية في مكافحة آفات القطن حفاظاً على سلامة البيئة وصحة الإنسان.