



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
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NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(4): 16-21
Received: 18-01-2026
Accepted: 23-02-2026

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Effect of detopping and growth regulators on Incidence of Sucking Pest of Bt cotton (*Gossypium hirsutum*)

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i4a.5317>

Abstract

Cotton production faces significant yield losses owing to biotic stresses, particularly insect pests. This study evaluated detopping (manual removal of apical buds and monopodial buds) as a cultural practice within Integrated Pest Management (IPM) for *Bt* cotton. The experiment was conducted during the *Kharif* 2024 season in Maharashtra, India, using a Randomized Block Design with eight treatments, including detopping alone (T₁), detopping combined with pest management (T₂), growth regulators (Mepiquat Chloride/Chlormequat Chloride) with/without pest management, and an untreated control (T₈). The results demonstrated that T₂ (Detopping + Pest Management) significantly suppressed major sucking pests (aphids, jassids, thrips, and whiteflies). This treatment also enhanced boll weight (6.51 g) and seed cotton yield (31.97 q/ha). Detopping alters plant architecture, improving light penetration and aeration, which disrupts pest habitats and boosts pesticide efficacy. This study concluded that integrating detopping with IPM offers an economically viable and ecologically sustainable strategy to enhance cotton productivity while minimizing pest-related losses.

Keywords: Detopping, integrated pest management, sucking pests, yield parameters, cultural practices, sustainable agriculture, *Bt* Cotton

Introduction

Cotton, popularly known as 'White Gold' or 'King of natural fibers,' is an important commercial crop. Cotton is a major fiber crop of global significance, cultivated in more than 70 countries worldwide. Cotton crops play an important role in the economic, political, and social affairs of the world. Cotton belongs to the family 'Malvaceae' and genus '*Gossypium*,' which includes more than 50 species. However, only four species are commercially cultivated *Gossypium hirsutum* (upland cotton), *G. barbadense* (Egyptian cotton), *G. arboreum* (Desi cotton), *G. herbaceum* (levant cotton). Among these, *Gossypium hirsutum* accounts for more than 90% of global production owing to its high yield potential and adaptability (Hu *et al.*, 2019) [14].

India ranked as the second-largest cotton producer in 2025, with an estimated production of approximately 25 million bales. India's cotton sector provides huge employment opportunities to approximately 50 million people involved in cultivation, trade, and processing (Pandey and Mathur, 2013) [9]. Cotton is widely cultivated across India, particularly in key states such as Gujarat, Maharashtra, Telangana, Rajasthan, and Karnataka. In Maharashtra, cotton was grown over an area of 41.82 lakh/ha with a production of 80.25 lakh bales of 170 kg, with an average productivity of 343 kg per ha during 2022-23 (COCPC, 2023).

A study by Agarwal *et al.* (1984) [2] found that Indian cotton crops are attacked by approximately 162 species of insect pests, leading to significant yield losses of up to 50-60%. These pests are divided into two main groups: sucking pests and bollworms. Sucking pests, including aphids (*Aphis gossypii*), jassids (*Amrasca biguttula*), thrips (*Thrips tabaci*), and whiteflies (*Bemisia tabaci*), are particularly damaging. They are present throughout the crop growth cycle and are responsible for both direct and indirect reductions in yield. In India, the bollworms commonly encountered in cotton cultivation are the spotted bollworm, *Earias vittella* (Fabricius), American bollworm, *Helicoverpa armigera* (Hubner), tobacco leaf-eating caterpillar, *Spodoptera litura* (Fabricius), and pink bollworm, *Pectinophora gossypiella* (Saunders). Among these pink bollworms, *P. gossypiella* is one of the most serious pests of

cotton worldwide, causing losses in both yield and quality of cotton.

Among the cultural practices, detopping, also known as terminal clipping or apical bud removal, has gained attention as a practical and eco-friendly tool for managing pest infestations in cotton crops. Cotton de-topping (topping or tipping) is a manual or mechanical operation that consists of cutting off the top of the plant, *i.e.* the terminal bud of the main stem, which reduces the height of the plant to prevent apical dominance and further vegetative growth. When cotton plants grow in fertile soil, they can become unmanageably tall. This makes it difficult to spray the plants effectively, leaving the top portions vulnerable to bollworms. These high, unsprayed areas do not produce much cotton but are a major breeding ground for pests. To combat this, it is advisable to trim back any plants that grow taller than 1.5 meters (approximately 5 feet). We can do this by hand, with pruning shears, or with secateurs, and it will help control the bollworm population. This technique enhances harvesting efficiency and contributes to higher fiber yield and improved fiber quality, including better staple length, strength, uniformity index, and micronaire value (Alam *et al.* 2024) ^[1]. Detopping also synchronizes boll development, shortens the pest-susceptible period, and improves spray coverage by reducing canopy density. Manual topping improved cotton yield across different plant densities and ecological conditions compared to non-topped plants. In contrast, chemical topping led to a yield reduction at low plant densities because of a more significant decrease in overall plant biomass (Dai *et al.* 2022) ^[4]. Therefore, it is necessary to study the effect of detopping on the incidence of sucking pests, pink bollworms, and natural enemies to understand its role in ecological pest regulation. Additionally, evaluating its influence on cotton yield will help to determine its agronomic benefits. Furthermore, the economic viability of detopping Bt cotton should be assessed. Therefore, the present investigation with the title Effect of Detopping on incidence of major insect pests of cotton (*Gossypium hirsutum*) was undertaken.

Methodology

Experimental Site

The experiment was conducted during the *Kharif* season of 2024 at the Research Farm of AICRP on Cotton, MPKV, Rahuri. The site was selected for its suitability for cotton cultivation and for its established pest observation facilities. The soil at the experimental site consisted of medium to deep black vertisols with clay to clay-loam texture.

Climatic Conditions

The study was conducted under semi-arid conditions in the Western Maharashtra Scarcity Zone. The monsoon commences in mid-June and continues until late September, with seasonal rainfall of approximately 810.8 mm. Temperatures ranged between 22 and 38 °C, and the maximum relative humidity reached 80%. The average wind speed was 11–12 km h⁻¹, and sunshine hours remained low because of the cloud cover. These conditions favored an increased incidence of sucking pests in cotton.

Cultivation Practices

After harvesting the preceding crop, the field was deep-plowed and harrowed twice to achieve a fine tilth. Sowing was undertaken on 6th June 2024 (23rd SMW) using the dibbling method with two seeds per hill at the recommended spacing. The first irrigation was applied immediately after sowing, and

subsequent irrigations were scheduled based on the crop growth stages and prevailing soil moisture.

Experimental Design

The experiment was laid out in a Randomized Block Design (RBD) with three replications and eight treatments. Treatments, including detopping of main and monopodial shoots at 75–80 DAS, were randomly assigned within each replication. Individual plots were uniformly sized and separated by buffer rows to avoid treatment interference.

Detopping Treatments

Manual detopping was carried out when the crop attained 75–80 DAS, approximately 105 cm plant height, or 20 sympodial nodes, whichever occurred first. The terminal growing points of the main shoot and monopodial branches were removed using a sharp secateur without injuring the adjoining foliage. Growth regulator treatments and combinations with pest management were also included in this study.

Pest Management Schedule

Integrated pest management consisted of sticky trap installation, botanical extracts, fungal bioagents, and economic threshold level (ETL)-based application of recommended insecticides for sucking pests and bollworms. The application dosages and timings were standardized to maintain uniformity across the relevant treatments.

Observation Recording

The populations of major sucking pests, aphids (*Aphis gossypii*), jassids (*Amrasca biguttula biguttula*), thrips (*Thrips tabaci*), and whiteflies (*Bemisia tabaci*), were recorded at 30, 45, 60, 75, 90, and 105 DAS. Counts were taken manually from the top, middle, and bottom leaves of five randomly tagged plants in each plot.

Yield Parameters

Seed cotton yield was recorded through manual picking at boll maturity. The picking weights from the net plot areas were summed to obtain the total yield per plot and converted to kg ha⁻¹. The total picking weight was obtained by summing all the harvests from each treatment plot.

Statistical Analysis

All data were subjected to Analysis of Variance (ANOVA) appropriate to RBD. Treatment means were compared using the Critical Difference (CD) at a 5% significance level. Percentage data and count-based observations were normalized using arcsine and square root transformations, respectively. The standard deviation was calculated as follows:

$$SD = \sqrt{\frac{\sum (X_i - \bar{X})^2}{n - 1}}$$

The critical Difference was computed using:

$$CD = SE_m \times t_{0.05, df}$$

where SE (m) denotes the Standard Error of Mean and the tabulated t-value at the 5% significance level.

Result and Discussion

Effect of different treatments on Incidence of Sucking Pests

Data were collected on the population dynamics of major

sucking pests on cotton under different treatments. Observations on the incidence of sucking pests were recorded at 15-day intervals starting from 30 DAS, commencing on August 23, 2024, and continuing until October 22, 2024.

The interval-wise data on pest incidence are presented in the respective tables, whereas the incidence trends of sucking pests across different detopping treatments are illustrated through figures.

Effect of different treatments on Incidence of Sucking Pests Aphid

The data represented in Table 1 indicate that the mean aphid population differed significantly among the various treatments. The highest mean aphid incidence was recorded in the non-detopped plants (untreated control – T₈), which harbored 28.75 aphids per three leaves per plant.

Among the managed treatments, the minimum aphid population was observed in T₂ (Detopping + Pest Management) with a mean of 6.03 aphids per three leaves, which was significantly superior and recorded the highest reduction over the control (79.04%). This treatment was followed by T₄ (Mepiquat Chloride 5% + Pest Management), which recorded 8.06 aphids per three leaves and achieved a 71.98% reduction compared to the control. These two treatments were at par with each other, but they were both significantly better than the other treatments. The other treatments, T₁, T₆, and T₇, recorded intermediate levels of aphid infestation and were significantly superior to T₃, T₅, and T₈. The overall trend clearly indicated that detopping treatments were more effective in reducing aphid incidence than non-detopped treatments and the untreated control.

The pronounced suppression of aphid populations in the detopped *Bt*-cotton treatments in this study is in agreement with studies showing that canopy detopping can directly constrain aphid performance. Under greenhouse conditions, Llandres *et al.* (2023) [7] demonstrated that cotton topping significantly reduced aphid performance not only on topped plants but also on neighboring, non-topped plants, implicating plant-mediated or microclimatic effects that echo the field trends observed here. In addition, our results for the mepiquat chloride-based treatment are in agreement with Zhang *et al.* (2022) [15], who found that DPC (Mepiquat Chloride) enhances cotton's physiological resistance to aphids via elevated protective enzyme activities and related metabolic adjustments, offering a plausible biochemical basis for the reduced aphid loads we observed.

Jassid

The observations presented in Table 2 indicate a marked variation in jassid infestation across the treatments. The untreated control (T₈) recorded the maximum mean jassid population (2.88 per three leaves), which was significantly higher than that of all other treatments. Treatment T₅ exhibited 2.57 jassids per three leaves, which was notably lower than that in the control but comparatively higher than that in the remaining treatments.

The lowest jassid population was recorded in T₂ (Detopping + Pest Management) with a mean of 0.48 jassids per three leaves, achieving the highest reduction over the control (83.33%). This was closely followed by T₄ (Mepiquat Chloride 5% + Pest Management) with 0.81 jassids per three leaves and a 71.76% reduction over the control. Although these two treatments showed less significant differences from each other, they were both markedly superior to the other treatments tested. Other treatments, such as T₆, and T₇ showed moderate jassid incidence and performed better than T₁, T₃, and T₅. The marked reduction

in the jassid population following detopping combined with pest management (T₂) reflects a field-scale manifestation of earlier controlled and physiological insights into pest suppression. Notably, Subhashini *et al.* (2025) [11] reported that leaf hairiness confers resistance to jassids (*Amrasca devastans*), as the dense trichomes on the abaxial leaf surface deter feeding and oviposition, suggesting an inherent plant structural defense mechanism that parallels the architectural disruption caused by detopping.

Furthermore, Memon *et al.* (2011) [8] investigated mechanical leaf removal and pruning of cotton, demonstrating that such interventions can significantly reduce the populations of sucking pests, including jassids, thrips, and whiteflies. The reduction was most pronounced when higher percentages of leaf/fruitlet bodies were removed, highlighting how the alteration of plant canopy structure can effectively suppress pest establishment.

Thrips

The thrip populations exhibited significant differences among the various treatments, as shown in Table 3. Treatment T₂ (Detopping + Pest Management) recorded the lowest mean thrips count (4.21 per three leaves), which corresponded to the highest reduction in the untreated control (73.17%). This clearly indicates the effectiveness of integrating detopping with pest management practices in suppressing thrips incidence. Treatment T₄ (Mepiquat Chloride 5% + Pest Management) was the next most effective, with a mean thrips population of 5.15 and a reduction of 67.12% over the control. Both these treatments were found to be statistically at par, signifying that canopy modification through de-topping and growth regulation using Mepiquat Chloride, in combination with pest management, play an equally crucial role in minimizing thrips infestation. Moderate thrips suppression was noted under treatments involving either growth regulator alone or de-topping alone, while the untreated control (T₈) registered the highest thrips population, reflecting the vulnerability of unmanaged plants to thrips attack. The superior performance of de-topping-integrated treatments could be attributed to improved spray penetration and alterations in the microclimatic conditions within the canopy, which are less favorable for thrips multiplication.

The present findings are in agreement with those of Shwetha *et al.* (2019) [10], who reported that detopping and removal of monopodia significantly modified plant canopy structure, leading to improved light penetration and reduced pest incidence, including thrips (9.00 individuals per leaf), in *Bt* cotton.

Whitefly

The results presented in Table 4 show a marked variation in whitefly incidence across the different treatments. The untreated control (T₈) recorded the highest infestation with 1.65 whiteflies per three leaves, which was significantly higher than that of all other treatments. In contrast, T₂ (Detopping + Pest Management) exhibited the lowest population, averaging 0.36 whitefly per three leaves, which translated to an 77.98% reduction compared to the control. This treatment was the most effective in suppressing whitefly numbers. A comparable performance was noted in T₄ (Mepiquat Chloride 5% + Pest Management), which recorded 0.69 whitefly per three leaves, achieving a 58.08% reduction. Both treatments were statistically comparable but were distinctly better than the remaining options. The other treatments recorded moderate infestations, which fell between these extremes. Overall, the data indicate that canopy modification through detopping and the application of growth

retardant (Mepiquat Chloride) substantially minimized whitefly incidence when integrated with pest management measures, highlighting their role in creating an unfavorable microclimate for pest proliferation. The significant reduction in the whitefly population under detopping and Mepiquat Chloride treatments can be attributed to modifications in plant canopy architecture, which likely improved aeration and light penetration, creating less favorable conditions for pest multiplication.

In greenhouse studies, Flint *et al.* (1996) [5] observed that Mepiquat Chloride (Pix™) induced significant morphological changes in shorter plants with thicker leaves, which corresponded to a reduction in silverleaf whitefly populations, although this effect was not always replicated under field conditions.

Effect of different treatments on the Yield and Yield Parameters of Cotton

Effect on Cotton boll weight

The data on boll weight presented in Table 5 show significant differences among the treatments. The highest boll weight (6.51 g) was obtained in T₂ (De-topping + Pest Management), which was significantly superior to all other treatments. This was followed by T₄ (Mepiquat Chloride 5% + Pest Management) with 6.29 g and T₆ (Chlormequat Chloride + Pest Management) with 6.01 g. Among the individual treatments without pest management, T₁ (de-topping alone) also recorded a comparatively higher boll weight (5.98 g) than T₃ (5.82 g), T₅ (5.38 g), and T₈ (control, 5.10 g). T₇ (Pest Management alone) yielded 5.96 g, which was on par with T₁. The results clearly demonstrated that the integration of detopping with pest management (T₂) was the most effective in enhancing boll weight. This improvement can be attributed to the removal of apical dominance, which restricted vegetative growth and promoted better assimilate partitioning toward reproductive structures. Moreover, pest management reduced boll damage, allowing for proper development and filling of the bolls, thus increasing the boll weight.

Although Mepiquat Chloride (T₃ and T₄) and Chlormequat Chloride (T₅ and T₆) also improved boll weight compared to the control, their effect remained inferior to detopping. This indicates that physical canopy modification through detopping, when combined with pest management, is more effective in enhancing boll weight than chemical growth regulators.

These results align with the findings of Iqbal *et al.* (2024) [6], who reported that detopping at 75 DAS combined with wider plant spacing significantly increased boll weight owing to reduced competition and better resource allocation. Similarly, Wang *et al.* (2023) [13] observed that early topping promoted higher boll weight by enhancing reproductive sink strength and reducing vegetative biomass, thereby improving reproductive allocation.

Effect on seed cotton yield

The present study showed that the seed cotton yield (Table 6) was markedly influenced by the imposed treatments. Among all, T₂ (Detopping + Pest Management) recorded the highest yield (31.97 q/ha), followed by T₄ (Mepiquat Chloride 5% + Pest Management) with 30.88 q/ha. In comparison, T₈ (Control) produced the lowest yield (22.52 q/ha), whereas T₆ (Chlormequat Chloride + Pest Management) yielded 30.36 q/ha. The superior performance of T₂ can be attributed to the effective restriction of vegetative growth, better assimilate partitioning to reproductive structures, and improved canopy architecture favoring light penetration and boll development. Although T₄ also enhanced yield through growth regulation, it could not match the efficiency of the physical canopy modification achieved by detopping. These results clearly indicate that detopping integrated with pest management (T₂) is a more effective strategy for maximizing seed cotton yield than chemical regulation or pest management alone.

Similar results were reported by Vekaria *et al.* (2020) [12], who found that detopping combined with Ethrel spray produced the maximum yield (2859 kg/ha) under rainfed conditions.

Table 1: Effect of different treatments on incidence of aphids on *Bt* cotton

Tr. No.	Treatments	No. of aphids/3 leaves/plant							% ROC
		30 DAS**	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	Mean	
T ₁	De-topping	8.90 (3.07)*	3.66 (2.04)	43.24 (6.61)	40.60 (6.41)	17.44 (4.24)	25.83 (5.13)	23.28 (4.88)	19.03
T ₂	De-topping + Pest Management	7.25 (2.78)	1.33 (1.35)	11.23 (3.42)	5.70 (2.49)	3.88 (2.09)	6.77 (2.70)	6.03 (2.55)	79.04
T ₃	Mepiquat Chloride 5% (10 ml/10 lit.)	8.50 (3.00)	2.39 (1.70)	38.07 (6.21)	42.30 (6.54)	16.92 (4.17)	28.47 (5.38)	22.78 (4.82)	20.78
T ₄	Mepiquat Chloride 5% + Pest Management	7.10 (2.76)	1.46 (1.40)	13.77 (3.78)	8.30 (2.97)	6.12 (2.57)	11.58 (3.48)	8.06 (2.92)	71.98
T ₅	Chlormequat Chloride 2 ml/ 10 lit	7.86 (2.89)	2.63 (1.77)	37.80 (6.19)	42.00 (6.52)	16.80 (4.16)	29.96 (5.52)	22.84 (4.83)	20.25
T ₆	Chlormequat Chloride + Pest Management	6.92 (2.72)	1.52 (1.42)	12.82 (3.65)	9.35 (3.14)	6.05 (2.56)	12.43 (3.60)	8.18 (2.95)	71.54
T ₇	Pest Management	7.40 (2.81)	1.44 (1.39)	13.74 (3.77)	9.86 (3.22)	6.44 (2.63)	12.83 (3.65)	8.62 (3.02)	70.02
T ₈	Untreated Control	8.40 (2.98)	3.80 (2.07)	42.60 (6.57)	53.40 (7.34)	28.90 (5.42)	35.40 (5.99)	28.75 (5.41)	0.00
SE(m) ±		0.09	0.05	0.19	0.18	0.13	0.21	0.07	
CD at 5%		NS	0.17	0.59	0.56	0.41	0.65	0.21	
CV (%)		5.69	6.19	6.72	6.63	6.62	8.44	5.97	

*Figures in parentheses are square root ($\sqrt{x \pm 0.5}$) transformed values

**DAS = Days After Sowing

Table 2: Effect of different treatments on incidence of jassids on *Bt* cotton

Tr. No.	Treatments	No. of jassids/ 3 leaves/plant							% ROC
		30 DAS**	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	Mean	
T ₁	De-topping	1.90 (1.55)*	1.20 (1.30)	1.32 (1.35)	3.33 (1.96)	0.30 (0.89)	4.00 (2.12)	2.29 (1.67)	20.43
T ₂	De-topping + Pest Management	1.00 (1.22)	0.25 (0.87)	0.33 (0.91)	0.50 (1.00)	0.50 (1.00)	0.50 (1.00)	0.48 (0.99)	83.33
T ₃	Mepiquat Chloride 5% (10 ml/10 lit.)	1.80 (1.52)	1.18 (1.30)	1.35 (1.36)	4.00 (2.12)	2.40 (1.70)	4.40 (2.21)	2.52 (1.74)	12.44
T ₄	Mepiquat Chloride 5% + Pest Management	1.10 (1.26)	0.34 (0.92)	0.33 (0.91)	1.27 (1.33)	0.74 (1.11)	1.10 (1.26)	0.81 (1.15)	71.76
T ₅	Chlormequat Chloride 2 ml/ 10 lit	1.97 (1.57)	1.20 (1.30)	1.33 (1.35)	4.15 (2.16)	2.45 (1.72)	4.33 (2.20)	2.57 (1.75)	10.71
T ₆	Chlormequat Chloride + Pest Management	1.10 (1.26)	0.35 (0.92)	0.40 (0.95)	1.30 (1.34)	0.80 (1.14)	1.12 (1.27)	0.85 (1.16)	70.66
T ₇	Pest Management	1.12 (1.27)	0.40 (0.95)	0.53 (1.01)	1.45 (1.40)	1.05 (1.24)	1.41 (1.38)	0.99 (1.22)	65.51
T ₈	Untreated Control	1.82 (1.52)	1.25 (1.32)	1.40 (1.38)	4.50 (2.24)	2.68 (1.78)	5.60 (2.47)	2.88 (1.84)	0.00
SE(m) ±		0.08	0.07	0.05	0.08	0.08	0.12	0.05	
CD at 5%		0.26	0.21	0.17	0.24	0.24	0.37	0.16	
CV (%)		10.86	10.94	8.42	8.01	9.76	12.29	6.27	

*Figures in parentheses are square root ($\sqrt{x \pm 0.5}$) transformed values, **DAS = Days After Sowing

Table 3: Effect of different treatments on incidence of thrips on *Bt* cotton

Tr. No.	Treatments	No. of thrips/ 3 leaves/plant							% ROC
		30 DAS**	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	Mean	
T ₁	De-topping	2.45 (1.72)*	1.32 (1.35)	41.92 (6.51)	26.94 (5.24)	2.15 (1.63)	2.22 (1.65)	12.83 (3.65)	18.10
T ₂	De-topping + Pest Management	0.96 (1.21)	0.62 (1.06)	15.04 (3.94)	7.37 (2.81)	0.96 (1.21)	0.28 (0.88)	4.21 (2.17)	73.17
T ₃	Mepiquat Chloride 5% (10 ml/10 lit.)	2.40 (1.70)	1.60 (1.45)	37.30 (6.15)	36.81 (6.11)	2.40 (1.70)	2.48 (1.73)	13.83 (3.79)	11.73
T ₄	Mepiquat Chloride 5% + Pest Management	0.93 (1.20)	0.59 (1.04)	16.00 (4.06)	10.59 (3.33)	1.63 (1.46)	1.17 (1.29)	5.15 (2.38)	67.12
T ₅	Chlormequat Chloride 2 ml/ 10 lit	2.30 (1.67)	1.75 (1.50)	38.92 (6.28)	37.18 (6.14)	2.30 (1.67)	2.55 (1.75)	14.17 (3.83)	9.59
T ₆	Chlormequat Chloride + Pest Management	0.86 (1.17)	0.40 (0.95)	17.20 (4.21)	11.19 (3.42)	1.76 (1.50)	1.62 (1.46)	5.51 (2.45)	64.87
T ₇	Pest Management	0.73 (1.11)	0.43 (0.96)	20.16 (4.55)	11.51 (3.47)	1.73 (1.49)	1.32 (1.35)	5.98 (2.55)	61.84
T ₈	Untreated Control	2.35 (1.69)	1.82 (1.52)	42.28 (6.54)	42.20 (6.53)	2.60 (1.76)	2.75 (1.80)	15.67 (4.02)	0.00
SE(m) ±		0.07	0.07	0.23	0.19	0.08	0.10	0.09	
CD at 5%		0.21	0.21	0.70	0.58	0.26	0.30	0.28	
CV (%)		8.38	9.89	7.55	7.16	9.39	11.78	5.04	

*Figures in parentheses are square root ($\sqrt{x \pm 0.5}$) transformed values, **DAS = Days After Sowing

Table 4: Effect of different treatments on incidence of whitefly on *Bt* cotton

Tr. No.	Treatments	No. of whitefly/ 3 leaves/plant							% ROC
		30 DAS**	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	Mean	
T ₁	De-topping	0.00 (0.71)*	0.00 (0.71)	1.33 (1.35)	2.33 (1.68)	2.33 (1.68)	1.52 (1.42)	1.25 (1.32)	24.18
T ₂	De-topping + Pest Management	0.00 (0.71)	0.00 (0.71)	0.67 (1.08)	0.80 (1.14)	0.40 (0.95)	0.31 (0.90)	0.36 (0.93)	77.98
T ₃	Mepiquat Chloride 5% (10 ml/10 lit.)	0.00 (0.71)	0.00 (0.71)	1.23 (1.32)	2.40 (1.70)	1.50 (1.41)	1.25 (1.32)	1.06 (1.25)	35.56
T ₄	Mepiquat Chloride 5% + Pest Management	0.00 (0.71)	0.00 (0.71)	0.87 (1.17)	1.65 (1.47)	0.80 (1.14)	0.83 (1.15)	0.69 (1.09)	58.08
T ₅	Chlormequat Chloride 2 ml/ 10 lit	0.00 (0.71)	0.00 (0.71)	1.33 (1.35)	2.30 (1.67)	1.60 (1.45)	1.36 (1.36)	1.10 (1.26)	33.43
T ₆	Chlormequat Chloride + Pest Management	0.00 (0.71)	0.00 (0.71)	1.00 (1.22)	1.80 (1.52)	0.90 (1.18)	0.87 (1.17)	0.76 (1.12)	53.89
T ₇	Pest Management	0.00 (0.71)	0.00 (0.71)	1.33 (1.35)	1.83 (1.53)	0.94 (1.20)	0.95 (1.20)	0.84 (1.16)	48.99
T ₈	Untreated Control	0.00 (0.71)	0.00 (0.71)	1.67 (1.47)	3.44 (1.98)	2.92 (1.85)	1.87 (1.54)	1.65 (1.47)	0.00
SE(m) ±		NS	NS	0.07	0.12	0.07	0.08	0.04	
CD at 5%		NS	NS	0.22	0.36	0.21	0.25	0.14	
CV (%)		NS	NS	9.82	13.05	8.95	11.23	6.42	

*Figures in parentheses are square root ($\sqrt{x \pm 0.5}$) transformed values, **Days After Sowing

Table 5: Effect of different treatments on Cotton boll weight

Tr. No.	Treatments	Boll wt (g)
T ₁	De-topping	5.98
T ₂	De-topping + Pest Management	6.51
T ₃	Mepiquat Chloride 5% (10 ml/10 lit.)	5.82
T ₄	Mepiquat Chloride 5% + Pest Management	6.29
T ₅	Chlormequat Chloride 2 ml/ 10 lit	5.38
T ₆	Chlormequat Chloride + Pest Management	6.01
T ₇	Pest Management	5.96
T ₈	Untreated Control	5.10
SE(m) ±		0.04
C.D. at 5%		0.13
C.V. (%)		2.72

Table 6: Effect of different treatments on Seed cotton yield

Tr. No.	Treatments	Yield q/ ha
T ₁	De-topping	24.05
T ₂	De-topping + Pest Management	31.97
T ₃	Mepiquat Chloride 5% (10 ml/10 lit.)	24.25
T ₄	Mepiquat Chloride 5% + Pest Management	30.88
T ₅	Chlormequat Chloride 2 ml/ 10 lit	24.11
T ₆	Chlormequat Chloride + Pest Management	30.36
T ₇	Pest Management	28.57
T ₈	Untreated Control	22.52
SE(m) ±		0.19
CD at 5%		0.57
CV(%)		6.09

Conclusion

The present field investigation demonstrated that detopping, when practiced at the recommended physiological stage, effectively influenced the growth dynamics of cotton crops and altered canopy conditions that are otherwise conducive to the proliferation of major sucking pests. By removing apical dominance and restricting excessive vegetative growth, detopping reduces the availability of tender foliage and sheltered micro-niches, which typically support the colonization and population buildup of aphids, jassids, thrips, and whiteflies. This architectural adjustment subsequently helped suppress pest incidence compared to the untreated control, indicating that mechanical manipulation of the plant canopy can serve as a viable cultural practice within cotton pest management programs.

Overall, the results of this study underscore that detopping alone exerts a measurable effect on pest suppression, but its full potential is achieved when it is employed as a component of integrated pest management. The combined approach provides an agronomically feasible, economically viable, and ecologically compatible strategy for managing key sucking pests and bollworms in cotton crops. The findings are particularly relevant for farmers in semi-arid production zones, where pest incidence and input costs remain critical constraints. The present work contributes to a broader understanding of canopy manipulation strategies and their role in supporting sustainable pest management frameworks, offering practical insights for the future refinement of IPM modules under changing climatic and production scenarios

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