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Response of *Bt* cotton (*Gossypium hirsutum* L.) to spacing and detopping on growth parameters under north Gujarat conditions

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Abstract

A field experiment entitled “Response of *Bt* Cotton (*Gossypium hirsutum* L.) to Spacing and Detopping on Growth Parameters under North Gujarat Conditions” was conducted at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *kharif* 2024-25 and 2025-26. There were eighteen treatment combinations comprising three spacings (main plots) and six detopping treatments (sub-plots) evaluated in a split-plot design with four replications. The experimental soil was loamy sand, low in organic carbon and available nitrogen, and medium in available phosphorus and potassium. Pooled results revealed that spacing of 90 cm × 30 cm recorded significantly greater plant height at 80, 95 DAS and at harvest, which was remaining at par with 60 cm × 45 cm at 80 DAS and harvest. The widest spacing (120 cm × 45 cm) produced the highest dry matter accumulation at 60 and 90 DAS. Dense spacing (60 cm × 45 cm) resulted in significantly higher crop growth rate during 30-0, 60-30 and 90-60 DAS, which was remaining at par with 90 cm × 30 cm during 30-0 and 90-60 DAS. Relative growth rate was not significantly affected by spacing. Among detopping treatments, the control (no detopping and no monopodial branch removal) recorded the highest plant height at 95 DAS and harvest, while removal of monopodial branches combined with detopping at 80 DAS resulted in the lowest plant height. Plant height at 80 DAS, dry matter accumulation at 30, 60 and 90 DAS, crop growth rate and relative growth rate were not significantly influenced by detopping treatments.

Keywords: *Bt* cotton, detopping, spacing, growth parameters, CGR and RGR

Introduction

Cotton is an important cash crop belonging to the *Malvaceae* family. India has the unique distinction of cultivating all four cultivated *Gossypium* species, viz., *G. arboreum*, *G. herbaceum* (Asian cotton), *G. barbadense* (Egyptian cotton) and *G. hirsutum* (American upland cotton), besides hybrid cotton. The first two are diploid (2n=26), while the latter two are tetraploid (2n=52). Among these, *Gossypium hirsutum* L. is cultivated on more than 90 per cent of the cotton-growing area world-wide. Cotton, known as the “King of Fibres” and “White Gold”, is an important cash crop influencing the economic and social affairs of India and the world. During 2023-24, global cotton cultivation covered about 31.8 million hectares with production of nearly 113 million bales. India produced approximately 25.5 million bales, while China, Brazil and the United States produced 27.5, 14.6 and 12.1 million bales, respectively (Anonymous, 2026^b)^[2]. India exported about 2.8 million bales during the same season (Anonymous, 2026^c)^[3]. In India, cotton production during 2023-24 was 325.22 lakh bales from 126.88 lakh hectares, with a productivity of 436 kg/ha (Anonymous, 2026^a)^[1]. Genetically Modified (GM) cotton, popularly known as ‘*Bt* cotton’, has emerged as an effective alternative to conventional cotton by reducing bollworm damage and improving yield and income. Cotton production increased more than four-fold, from 86.24 lakh bales in 2002-03 to 359.02 lakh bales in 2013-14 (DCD, 2017)^[5]. To make cotton cultivation economically viable, low-cost production practices such as crop geometry, detopping and removal of monopodial branches play an important role. Maximum growth and yield can be achieved when plant population allows individual plants to express their inherent potential (Ghule *et al.*, 2013)^[8]. The terminal bud produces auxin, which suppresses the development of lateral or axillary buds. Hall *et al.* (1957)^[11] reported that removal of the terminal

bud can encourage lateral bud development. Thus, detopping at the appropriate vegetative stage may promote the growth and development of sympodial branches and fruiting bodies. Similarly, removal of monopodial branches can improve plant architecture, light interception and reduce mutual shading (Shwetha *et al.*, 2009)^[21]. Increased sympodial branches, squares and bolls are essential for maximizing seed cotton yield (Dhillon *et al.*, 2006)^[6].

Materials and Methods

A field experiment entitled “Response of *Bt* Cotton (*Gossypium hirsutum* L.) to Spacing and Detopping on Growth Parameters under North Gujarat Conditions” was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, on plot No. C-9 and A-7 during *kharif* 2024-25 and 2025-26, respectively. The experiment was conducted on *Bt* cotton variety GTHH-49 with 18 treatment combinations comprising three plant spacings as main plots: S₁: 60 cm × 45 cm, S₂: 90 cm × 30 cm and S₃: 120 cm × 45 cm, and six detopping treatments as sub-plots: D₁: control (no detopping and no monopodial branch removal), D₂: detopping at 80 DAS, D₃: detopping at 95 DAS, D₄: removal of monopodial branches, D₅: removal of monopodial branches + detopping at 80 DAS and D₆: removal of monopodial branches + detopping at 95 DAS. Treatments were replicated four times in a split-plot design. The soil was loamy sand, low in organic carbon and available nitrogen, and medium in available phosphorus and potassium. During 2024-25 and 2025-26, mean maximum temperature ranged from 24.6-40.6 and 24.5-38.8 °C, respectively, while mean minimum temperature ranged from 6.3-26.9 and 9.7-26.7 °C. Morning relative humidity ranged from 70-98 and 73-96 per cent, and evening relative humidity from 23-89 and 22-87 per cent, respectively. Mean bright sunshine hours ranged from 0.5-9.4 and 0.2-9.1 hours/day, while mean evaporation ranged from 2.0-11.2 and 1.2-7.6 mm during the respective years. A common application of 10 t FYM /ha was made before sowing. The crop received the recommended fertilizer dose of 320-00-120 kg N-P₂O₅-K₂O /ha. At sowing, one-fifth of nitrogen (64 kg/ha) as urea and the entire potassium (120 kg/ha) as muriate of potash were applied in furrows. The remaining nitrogen was top-dressed in four equal splits at 30, 60, 75 and 90 DAS through urea, depending on soil moisture. Detopping was performed at 80 and 95 DAS by pinching the apical bud, while monopodial branches were removed by pruning non-fruiting vegetative branches from the basal portion. For dry matter accumulation, five plants were uprooted from the sampling area of each plot at 30, 60 and 90 DAS. Plants were destructively sampled by cutting at the base, shade-dried for 24 hours, cut into pieces, placed in labelled brown paper bags and oven-dried at 65 °C for 72 hours. Oven-dried weight was recorded using an electronic balance and expressed as dry matter accumulation (g/plant). Crop growth rate (CGR) and relative growth rate (RGR) were calculated using the methods of Radford (1967)^[20] and Hunt (1990)^[13], respectively:

$$CGR = (W_2 - W_1) / (t_2 - t_1) \times 1/P$$

where CGR = crop growth rate (g/m²/day), W₁ and W₂ = dry weight of plant (g) at times t₁ and t₂, respectively, t₂ - t₁ = time interval between consecutive stages (days), and P = ground area (m²) per plant.

$$RGR = [\ln W_2 - \ln W_1] / (t_2 - t_1)$$

where RGR = mean relative growth rate (mg/g/day), W₁ and W₂ = dry weight of plant (g) at times t₁ and t₂, respectively, t₂ - t₁ = time interval between consecutive stages, and LN = natural logarithm.

Results and Discussion

1) Plant height (cm)

The result of experiments on plant height at 80, 95 DAS and at harvest of *Bt* cotton is summarized in Table 1 and graphically depicted in Fig. 1. An examination of data revealed that *Bt* cotton planted at 90 cm × 30 cm (S₂) spacing recorded significantly higher plant height at 80 DAS (87.81, 92.91 and 90.36 cm), 95 DAS (110.60, 114.59 and 112.59 cm) and at harvest (120.58, 124.29 and 122.43 cm) during 2024-25, 2025-26 and in pooled data, respectively which was statically at par with spacing at 60 cm × 45 cm during both the years and in pooled analysis except pooled data of plant height at 95 DAS. The more number of plants per unit area produced more height per plant which may be due to the increased competition for sunlight and CO₂ and might be the closer spacing induced vertical growth due to congestion of plant per unit area. In contrast, significantly lowest plant height at 80 DAS (80.64, 85.27 and 82.96 cm), 95 DAS (98.88, 102.34 and 100.61 cm) and at harvest (106.11, 110.18 and 108.14 cm) were observed under wider spacing of 120 cm × 45 cm during both the years and in pooled results, respectively. Similar results were reported Khargharate *et al.* (2015)^[15], Yadav *et al.* (2021)^[22] and Hirpara *et al.* (2023)^[12]. For different detopping treatments, the plant height at 80 DAS of *Bt* cotton was not influence significantly due to detopping treatments. This is because detopping treatments were imposed at 80 DAS after taking of plant height measurement. Significantly higher plant height at 95 DAS (117.76, 119.55 and 118.66 cm) was registered under control treatment (D₁) and it was remained at par with treatment D₃ (detopping at 95 DAS), D₄ (removal of monopodial branches) and D₆ (removal of monopodial branches + detopping at 95 DAS) during both the years but for pooled analysis, it was at par with treatment D₃ only. Significantly higher plant height at harvest (130.05, 132.97 and 131.51 cm) was observed under control treatment (no detopping no removal of monopodial branches) during both the year and in pooled analysis, respectively and it was found statistically at par with treatment D₄ (removal of monopodial branches) during both the years but not for pooled mean data. Contrary to this removal of monopodial branches + detopping at 80 DAS (D₅) recorded significantly lower plant height at 95 DAS (88.43, 91.47 and 89.95 cm) and at harvest (98.88, 99.42 and 99.15 cm) during both the year and in pooled data, respectively. This was due to the elimination of the apical meristem, which curtailed auxin-mediated stem elongation and apical dominance. The removal of monopodial branches further reduced vegetative growth potential and altered assimilate distribution within the plant. Consequently, photosynthates were preferentially allocated towards reproductive sinks rather than continued stem growth, resulting in reduced plant height at 95 DAS and harvest. Detopping also restricted the production of new nodes and internodes beyond 80 DAS, thereby limiting vertical growth and producing shorter plants compared to untreated plants. The findings are also in agreement with Chaudhari *et al.* (2021)^[4], Kakade *et al.* (2023)^[14], Yashashri *et al.* (2024)^[23] and Mundare *et al.* (2025)^[16].

2) Dry matter accumulation (g/plant) at 30, 60 and 90 DAS

Table 2 indicated that different plant spacing showed significant effect on dry matter accumulation (g/plant) of *Bt* cotton at 60 and

90 DAS except at 30 DAS during both the years and in pooled results. It was increased with broader spacing. Spacing of 120 cm × 45 cm (S_3) recorded significantly the highest dry matter at 60 DAS (89.87, 96.94 and 93.41 g/plant) and 90 DAS (149.06, 164.57 and 156.81 g/plant) as compared to narrow spacing during both years and in pooled analysis, respectively, but dry matter accumulation at 60 DAS was at par with plant spacing 60 cm × 45 cm during the year 2025. On contrary, significantly the lower dry matter accumulation at 60 DAS (78.98, 83.27 and 81.13 g/plant) and 90 DAS (130.95, 139.78 and 135.36 g/plant) during both the years and in pooled analysis, respectively was observed under 90 cm × 30 cm (S_2). The increase in dry matter accumulation/plant at wider spacing might be mainly due to the larger ground area, maximum moisture and more interception of light by more number of leaves and leaf area resulting in more photosynthetic activity and more biomass accumulation through the process of plant metabolism. Similar observations of higher dry matter accumulation/plant at wider spacing compared to dense spacing was also reported by Nagender *et al.* (2017)^[17], Parihar *et al.* (2018)^[18], Patel *et al.* (2021)^[19] and Gouthami *et al.* (2023)^[10]. On the other side, dry matter accumulation at 30, 60 and 90 DAS didn't significantly influence due to various detopping treatments during both the years and in pooled analysis. This might be due to detopping treatments were imposed from 80 DAS which cause no significant changes in dry matter of *Bt* cotton.

3) Crop growth rate at 30-0, 60-30 and 90-60 DAS (g/m²/day)

Dry matter production per ground area *i.e.* CGR increased significantly with increase in age and crop growth period up to 60-90 DAS. It was increased with dense spacing. Scrutiny of crop growth rate data (Table 3) revealed that dense spacing (60 cm × 45 cm) recorded significantly higher crop growth rate of 4.05, 4.20 and 4.13 g/m²/day between 30-0 DAS during both the year and in pooled results, respectively which was remain statistically at par with 90 cm × 30 cm spacing (S_2). Between 60-30 DAS, crop growth rate also found significantly the highest under dense spacing of 60 cm × 45 cm during both the year and for pooled data, which was 6.22, 7.23 and 6.72 g/m²/day, respectively. This spacing found statistically at par with spacing S_2 (90 cm × 30 cm) during the year 2024-25 only. Crop growth rate between 90-60 DAS found significantly higher for spacing of 60 cm × 45 cm during the year 2024-25 and pooled analysis, which remain at par with 90 cm × 30 cm spacing. Whereas crop growth rate between 90-60 DAS during second year found significantly higher under

S_2 (90 cm × 30 cm) spacing, which was remain at par with spacing of 60 cm × 45 cm. Significantly the lowest crop growth rate (2.14, 2.12 and 2.13 g/m²/day between 30-0 DAS, 3.41, 3.86 and 3.64 g/m²/day between 60-30 DAS and 3.65, 4.17 and 3.91 g/m²/day between 90-60 DAS) were recorded with wider spacing of 120 cm × 45 cm during both the years and in pooled results, respectively. Crop growth rate (CGR) are derived with biomass over time unit, hence these parameters improved with the corresponding increase in dry matter accumulation per ground area with narrow plant spacing. These results are in conformity with the results reported by Parihar *et al.* (2018)^[18], Ghetiya *et al.* (2021)^[7] and Gohil *et al.* (2024)^[9]. Crop growth rate (g/m²/day) between 30-0, 60-30 and 90-60 DAS didn't significantly influence by various detopping treatments during both the years and in pooled analysis.

4) Relative growth rate at 30-0, 60-30 and 90-60 DAS (mg/g/day)

Different spacing exhibited their non-significant effect on relative growth rate (mg/g/day) between 30-0, 60-30 and 90-60 DAS during both the years as well as in pooled analysis (Table 4). Relative growth rate was numerically increased with wider spacing. Numerically higher relative growth rate (117.80, 33.22 and 17.42 mg/g/day) between 30-0, 60-30 and 90-60 DAS respectively, was registered under wider spacing 120 cm × 45 cm than other spacing for pooled results. Detopping treatments statistically not differed with each other for the relative growth rate (mg/g/day) at 30-0, 60-30 and 90-60 DAS during the year 2024-25, 2025-26 and for pooled data.

5) Interaction effect

Interaction effect of spacing and detopping treatment were found significant with respect to plant height at 95 DAS and at harvest of *Bt* cotton during second year of 2025-26 and it is presented in Table 5 and Table 6. Results indicated that treatment combinations of 90 cm × 30 cm spacing along with control (no detopping and no removal of monopodial branches) registered significantly higher plant height at 95 DAS (124.80 cm) and at harvest (138.59 cm) during the year 2025-26.

The interactions between spacing and detopping was failed to exert significant influence on dry matter accumulation (g/plant) at 30, 60 and 90 DAS, CGR (g/m²/day) and RGR (mg/g/day) between 30-0, 60-30 and 90-60 DAS during both the years and in pooled analysis.

Table 1: Effect of spacing and detopping on periodical plant height of *Bt* cotton

Treatments	80 DAS (cm)			95 DAS (cm)			At harvest (cm)		
	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled
Main plot treatments: Spacing (S)									
S ₁ : 60 cm × 45 cm	86.09	91.41	88.75	105.52	110.15	107.84	117.68	118.38	118.03
S ₂ : 90 cm × 30 cm	87.81	92.91	90.36	110.60	114.59	112.59	120.58	124.29	122.43
S ₃ : 120 cm × 45 cm	80.64	85.27	82.96	98.88	102.34	100.61	106.11	110.18	108.14
S.E.m.±	1.47	1.67	1.11	2.22	1.95	1.48	2.40	1.72	1.48
C.D. (P = 0.05)	5.09	5.79	3.43	7.69	6.74	4.55	8.31	5.96	4.55
C.V.%	8.49	9.12	8.84	10.37	8.75	9.57	10.24	7.17	8.81
Sub-plot treatments: Detopping (D)									
D ₁ : Control (no detopping and no removal of monopodial branches)	87.90	91.93	89.91	117.76	119.55	118.66	130.05	132.97	131.51
D ₂ : Detopping at 80 DAS	85.61	88.40	87.01	90.20	96.96	93.58	105.57	109.86	107.72
D ₃ : Detopping at 95 DAS	83.53	89.28	86.41	112.04	117.60	114.82	117.31	120.52	118.91
D ₄ : Removal of monopodial branches	84.13	90.24	87.18	110.67	115.40	113.03	123.81	126.92	125.37
D ₅ : Removal of monopodial branches + Detopping at 80 DAS	84.64	89.04	86.84	88.43	91.47	89.95	98.88	99.42	99.15
D ₆ : Removal of monopodial branches + Detopping at 95 DAS	83.26	90.29	86.78	110.89	113.17	112.03	113.12	116.01	114.56
S.E.m.±	1.80	1.49	1.17	2.74	2.25	1.77	2.80	2.14	1.76
C.D. (P = 0.05)	NS	NS	NS	7.79	6.41	4.98	7.98	6.09	4.95

Interaction			
S × D	NS	NS	NS
Y × S	-	-	NS
Y × D	-	-	NS
Y × S × D	-	-	NS
C.V.%	7.35	5.74	6.55

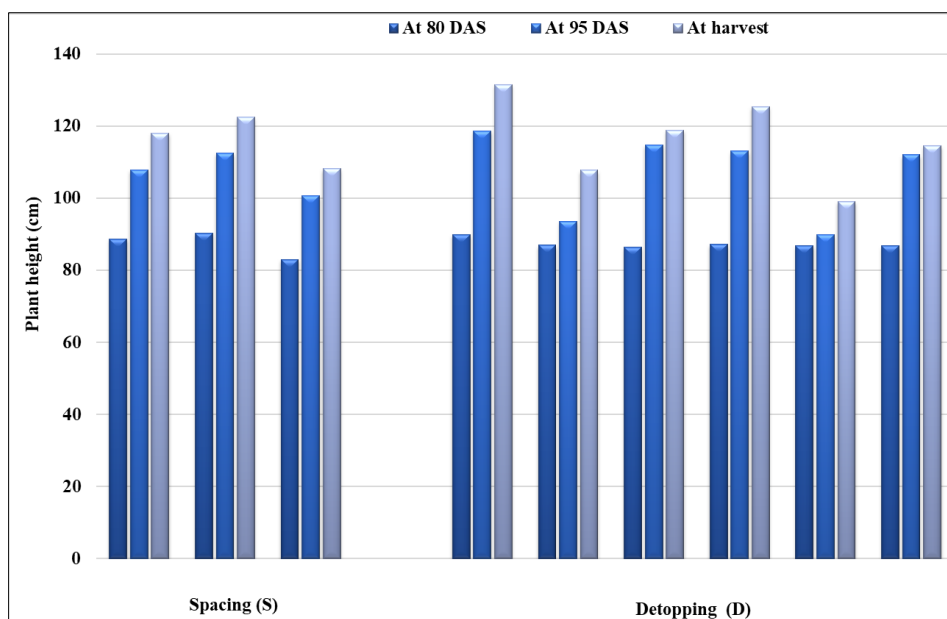


Fig 1: Effect of spacing and detopping on periodical plant height of *Bt* cotton (pooled)

Table 2: Effect of spacing and detopping on periodical dry matter accumulation of *Bt* cotton

Treatments	30 DAS (g/plant)			60 DAS (g/plant)			90 DAS (g/plant)		
	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled
Main plot treatments: Spacing (S)									
S ₁ : 60 cm × 45 cm	32.84	33.99	33.42	83.21	92.55	87.88	136.26	148.10	142.18
S ₂ : 90 cm × 30 cm	30.16	32.87	31.51	78.98	83.27	81.13	130.95	139.78	135.36
S ₃ : 120 cm × 45 cm	34.63	34.40	34.51	89.87	96.94	93.41	149.06	164.57	156.81
S.E.m.±	1.12	1.12	0.79	1.64	1.91	1.26	1.50	2.72	1.55
C.D. (P = 0.05)	NS	NS	NS	5.66	6.62	3.88	5.19	9.40	4.78
C.V.%	16.79	16.20	16.49	9.54	10.31	9.97	5.30	8.82	7.43
Sub-plot treatments: Detopping (D)									
D ₁ : Control (no detopping and no removal of monopodial branches)	31.34	33.19	32.26	82.22	89.16	85.69	137.91	149.28	143.59
D ₂ : Detopping at 80 DAS	32.55	33.70	33.13	85.49	92.98	89.24	139.41	153.07	146.24
D ₃ : Detopping at 95 DAS	32.08	33.54	32.81	83.71	90.68	87.20	139.64	149.42	144.53
D ₄ : Removal of monopodial branches	32.01	33.56	32.79	83.30	90.32	86.81	138.35	150.49	144.42
D ₅ : Removal of monopodial branches + Detopping at 80 DAS	34.53	34.62	34.57	85.54	91.76	88.65	139.14	151.35	145.24
D ₆ : Removal of monopodial branches + Detopping at 95 DAS	32.76	33.91	33.34	83.87	90.64	87.26	138.10	151.29	144.69
S.E.m.±	0.91	0.95	0.66	2.20	2.58	1.70	1.21	1.80	1.09
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction									
S × D	NS			NS			NS		
Y × S	-			-			NS		
Y × D	-			-			NS		
Y × S × D	-			-			NS		
C.V.%	9.68			9.78			9.74		

Table 3: Effect of spacing and detopping on periodical crop growth rate of *Bt* cotton

Treatments	30-0 DAS (g/m ² /day)			60-30 DAS (g/m ² /day)			90-60 DAS (g/m ² /day)		
	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled
Main plot treatments: Spacing (S)									
S ₁ : 60 cm × 45 cm	4.05	4.20	4.13	6.22	7.23	6.72	6.55	6.86	6.70
S ₂ : 90 cm × 30 cm	3.72	4.06	3.89	6.03	6.22	6.13	6.42	6.98	6.69
S ₃ : 120 cm × 45 cm	2.14	2.12	2.13	3.41	3.86	3.64	3.65	4.17	3.91
S.E.m.±	0.14	0.14	0.10	0.24	0.23	0.17	0.20	0.23	0.15
C.D. (P = 0.05)	0.47	0.47	0.30	0.83	0.80	0.51	0.71	0.81	0.48
C.V.%	20.11	19.41	19.75	22.64	19.56	21.03	18.04	19.02	18.59

Sub-plot treatments: Detopping (D)									
D1: Control (no detopping and no removal of monopodial branches)	3.19	3.41	3.30	5.16	5.63	5.39	5.62	6.09	5.85
D2: Detopping at 80 DAS	3.31	3.46	3.38	5.32	5.95	5.64	5.50	6.07	5.79
D3: Detopping at 95 DAS	3.27	3.45	3.36	5.30	5.80	5.55	5.60	5.80	5.70
D4: Removal of monopodial branches	3.25	3.44	3.35	5.24	5.74	5.49	5.56	6.01	5.79
D5: Removal of monopodial branches + Detopping at 80 DAS	3.46	3.50	3.48	5.15	5.82	5.48	5.47	5.97	5.72
D6: Removal of monopodial branches + Detopping at 95 DAS	3.36	3.50	3.43	5.14	5.68	5.41	5.48	6.08	5.78
S.Em.±	0.07	0.08	0.05	0.24	0.26	0.18	0.25	0.33	0.21
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction									
S × D	NS			NS			NS		
Y × S	-			-			NS		
Y × D	-			-			NS		
Y × S × D	-			-			NS		
C.V.%	7.72			7.76			7.74		

Table 4: Effect of spacing and detopping on periodical relative growth rate of *Bt* cotton

Treatments	30-0 DAS (mg/g/day)			60-30 DAS (mg/g/day)			90-60 DAS (mg/g/day)		
	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled
Main plot treatments: Spacing (S)									
S ₁ : 60 cm × 45 cm	116.24	117.40	116.82	31.08	33.47	32.28	16.48	15.68	16.08
S ₂ : 90 cm × 30 cm	113.37	116.26	114.81	32.13	31.01	31.57	16.98	17.38	17.18
S ₃ : 120 cm × 45 cm	117.91	117.69	117.80	31.88	34.56	33.22	17.01	17.82	17.42
S.Em.±	1.25	1.17	0.86	1.60	1.49	1.09	0.62	0.55	0.41
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V.%	5.29	4.90	5.10	24.67	22.15	23.40	17.95	16.09	17.02
Sub-plot treatments: Detopping (D)									
D1: Control (no detopping and no removal of monopodial branches)	114.69	116.63	115.66	32.16	32.91	32.54	17.29	17.25	17.27
D2: Detopping at 80 DAS	115.91	117.14	116.52	32.26	33.85	33.05	16.34	16.62	16.48
D3: Detopping at 95 DAS	115.46	117.01	116.24	31.99	33.08	32.53	17.13	16.65	16.89
D4: Removal of monopodial branches	115.31	116.91	116.11	31.99	33.04	32.52	16.98	17.07	17.02
D5: Removal of monopodial branches + Detopping at 80 DAS	117.51	117.68	117.60	30.65	32.64	31.65	16.29	16.89	16.59
D6: Removal of monopodial branches + Detopping at 95 DAS	116.14	117.32	116.73	31.13	32.56	31.85	16.93	17.30	17.11
S.Em.±	0.83	0.87	0.60	1.19	1.14	0.85	0.93	1.11	0.72
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction									
S × D	NS			NS			NS		
Y × S	-			-			NS		
Y × D	-			-			NS		
Y × S × D	-			-			NS		
C.V.%	2.48			2.57			2.53		

Table 5: Effect of interaction S × D on plant height (cm) at 95 DAS of *Bt* cotton during the year 2025-26

Spacing (S)	Detopping (D)					
	D ₁ Control	D ₂ De-topping at 80 DAS	D ₃ De-topping at 95 DAS	D ₄ Removal of mono-podial branches	D ₅ Removal of mono-podial branches + Detopping at 80 DAS	D ₆ Removal of mono-podial branches + Detopping at 95 DAS
S ₁ : 60 cm × 45 cm	118.01	102.50	116.04	114.42	99.60	110.34
S ₂ : 90 cm × 30 cm	124.80	103.13	121.80	117.77	100.18	119.85
S ₃ : 120 cm × 45 cm	115.83	85.26	114.96	114.01	74.63	109.33
S.Em.±	3.90					
C.D. (P= 0.05)	11.10					
C.V.%	7.15					

Table 6: Effect of interaction S × D on plant height (cm) at harvest of *Bt* cotton during the year 2025-26

Spacing (S)	Detopping (D)					
	D ₁ Control	D ₂ De-topping at 80 DAS	D ₃ De-topping at 95 DAS	D ₄ Removal of mono-podial branches	D ₅ Removal of mono-podial branches + Detopping at 80 DAS	D ₆ Removal of mono-podial branches + Detopping at 95 DAS
S ₁ : 60 cm × 45 cm	130.51	112.12	119.39	126.20	107.73	114.33
S ₂ : 90 cm × 30 cm	138.59	112.33	127.0	136.80	109.26	120.69
S ₃ : 120 cm × 45 cm	129.79	105.13	114.10	117.76	81.28	113.00
S.Em.±	3.70					
C.D. (P= 0.05)	10.54					
C.V.%	6.30					

Conclusion

The pooled results of the two-year field experiment indicated that plant spacing significantly influenced the growth of Bt cotton, whereas the effect of detopping was comparatively limited. Among the spacing treatments, 90 cm × 30 cm produced significantly greater plant height at 80, 95 DAS and harvest, while 120 cm × 45 cm recorded the highest dry matter accumulation at 60 and 90 DAS. In contrast, 60 cm × 45 cm resulted in the highest crop growth rate during 30-0, 60-60 and 90-60 DAS. Relative growth rate was not significantly affected by spacing. Among detopping treatments, the control (no detopping and no removal of monopodial branches) maintained the highest plant height at 95 DAS and harvest, whereas removal of monopodial branches + detopping at 80 DAS resulted in the shortest plants. However, detopping treatments did not significantly affect plant height at 80 DAS, dry matter accumulation, CGR and RGR.

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References

- Anonymous. National cotton scenario. Cotton Corporation of India; 2026a. Available from: <https://cotcorp.org.in>
- Anonymous. Crop outlook reports of Andhra Pradesh-Cotton. Acharya N.G. Ranga Agricultural University; 2026b. https://angrau.ac.in/downloads/AMIC/OutlookReports/2023_24/Cotton%20outlook%20-June%20to%20May%202023-24.pdf
- Anonymous. Cotton industry and export. India Brand Equity Foundation; 2026c. <https://www.ibef.org/exports/cotton-industry-india.aspx>
- Chaudhari JH, Chauhan SA, Chaudhary MM. Effect of topping and nitrogen levels on growth, yield attributes and yield of Bt cotton under drip irrigation conditions. The Pharma Innovation Journal. 2021;10(10):1898-1902.
- Directorate of Cotton Development. Status paper of Indian cotton. Nagpur: Directorate of Cotton Development, Government of India; 2017.
- Dhillon GS, Chhabra KL, Punia SS. Effect of crop geometry and integrated nutrient management on fibre quality and nutrient uptake by cotton crop. Journal of Cotton Research and Development. 2006;28:221-223.
- Ghetiya KP, Chovatia PK, Dholaria TL, Jadav DA. Influence of different levels of spacing and growth regulation treatments on biochemical and quality parameters of Bt cotton. The Pharma Innovation Journal. 2021;10(8):388-392.
- Ghule PL, Palve DK, Jadhav JD, Dahiphale VV. Plant geometry and nutrient levels effect on productivity of Bt cotton. International Journal of Agriculture Sciences. 2013;9(2):486-494.
- Gohil B, Patel DM, Chaudhary MM. Effect of different agro-techniques on yield of Bt cotton. Indian Journal of Agronomy. 2024;69(2):184-189.
- Gouthami R, Nagabhushanam U, Ramanjaneyulu AV, Kamalakkar J. Influence of plant geometry and cultivars on growth, yield attributes and yield of HDPS cotton under rainfed shallow soils. International Journal of Environment and Climate Change. 2023;13(10):245-250.
- Hall WC, Truchelut GB, Leinweber CL, Herrero FA. Ethylene production by the cotton plant and its effects under experimental and field conditions. Physiology of Plant. 1957;10:306-317.
- Hirpara DS, Jotangiya KS, Vora VD, Vekaria PD, Kaneria SC, Sakariya GV. Effects of nitrogen levels and high-density planting of Bt cotton under rainfed condition in Saurashtra Region. International Journal of Agriculture Sciences. 2023;15(8):12543-12545.
- Hunt R. Basic growth analysis; plant growth analysis for beginners levels. Indian Journal of Agronomy. 1990;61(1):101-104.
- Kakade SU, Vaishnavi D, Gawate AN, Rakhonde OS, Potdukhe NR. Effect of fertigation levels and canopy management practices on growth, yield and economics of Bt cotton (*Gossypium hirsutum* L.). The Pharma Innovation Journal. 2023;12(6):4569-4575.
- Khargkharate VK, Ghanbahadur M, Pathrikar VB, Gaikwad JM, Shaikh SA. Production potential of hirsutum cotton (AKH-081) as affected by plant density and nutrient management under rainfed condition of Vidarbha region. International Journal of Current Microbiology and Applied Sciences. 2015;5(6):1189-1194.
- Mundare SS, Kakade SU, Rakhonde OS, Telase AR, Kayande NV. Effect of different plant geometry and canopy management practices on dry matter distribution and NPK uptake of Bt cotton under drip irrigation. International Journal of Advanced Biochemistry Research. 2025;9(12):1570-1574.
- Nagender T, Raji Reddy D, Leela Rani P, Sreenivas G, Surekha K, Gupta A, et al. Productivity of Bt and non-Bt cotton (*Gossypium hirsutum* L.) cultivars as influenced by plant geometry and fertilizer levels. International Journal of Current Microbiology and Applied Sciences. 2017;6(9):3208-3217.
- Parihar LB, Rathod TH, Paslawar AN, Kahate NS. Effect of high-density planting system (HDPS) and genotypes on growth parameters and yield contributing traits in upland cotton. International Journal of Current Microbiology and Applied Sciences. 2018;7(12):2291-2297.
- Patel BR, Chaudhari PP, Chaudhary MM, Patel KN. Effect of mepiquat chloride on growth parameters and yield of Bt cotton (*Gossypium hirsutum* L.) under high-density planting system. Indian Journal of Agronomy. 2021;66(1):67-73.
- Radford PJ. Growth analysis formulae. Their use and abuse. Crop Science. 1967;7(3):171-175.
- Shwetha NS, Halepyati AS, Pujari BT. Effect of detopping, removal of monopodial and plant spacings on nutrient uptake, quality parameters and economics of Bt cotton (*Gossypium hirsutum* L.). Karnataka Journal of Agricultural Sciences. 2009;22(4):892-893.
- Yadav S, Singh H, Kaur M. Effect of plant spacings and fertilizer levels on growth and productivity of desi cotton (*Gossypium arboreum* L.). The Pharma Innovation Journal. 2021;10(11):1975-1980.
- Yashashri LR, Amarsheetiwar SB, Baviskar SB, Gondane BG, Khandare KG, Shahare PY. Effect of different canopy management and mulching practices on growth and yield parameters of Bt cotton under drip fertigation. International Journal of Advanced Biochemistry Research. 2024;8(10):305-309.