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Impact of canopy management on sucking insect pests in high density *Bt* cotton

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Abstract

An experiment entitled "Effect of Canopy Management on Sucking Pests in *Bt* Cotton under High-Density Planting System" was carried out during *Kharif*, 2024-25 at the Department of Entomology, College of Agriculture, Latur, to assess the influence of different canopy management practices on the incidence of major sucking pests in *Bt* cotton (RCH 929 BG-II). The experiment was laid out in a Randomized Block Design (RBD) with seven treatments and three replications, including pruning of monopodia, detopping, and foliar application of mepiquat chloride under HDPS and conventional spacing.

The major sucking pests observed were leafhopper (*Amrasca biguttula biguttula*), thrips (*Thrips tabaci*), aphid (*Aphis gossypii*), and whitefly (*Bemisia tabaci*), along with their predator lady bird beetle (*Coccinella septempunctata*). The population of sucking pests appeared from 30 days after sowing (DAS), increased gradually, and reached a peak between 60 to 90 DAS, followed by a decline at later stages.

Among the treatments, HDPS without canopy modification (T_1) recorded the highest mean populations of jassids (6.7/3 leaves), thrips (24.0/3 leaves), aphids (5.05/3 leaves), and whiteflies (8.15/3 leaves). In contrast, the lowest mean populations were recorded in HDPS + pruning of monopodia + mepiquat chloride (T_6) with 4.95, 20.45, 4.25, and 5.75 per 3 leaves, respectively. The conventional planting system (120 × 45 cm) also recorded comparatively lower pest incidence than unmodified HDPS.

The reduction in pest incidence under canopy-managed plots is attributed to improved aeration, light penetration, and a balanced microclimate that are less favourable for sucking pest multiplication. Overall, the study revealed that integrated canopy management involving pruning of monopodia and mepiquat chloride application effectively minimized sucking pest populations and enhanced the ecological balance in *Bt* cotton under high-density planting conditions.

Keywords: *Bt* cotton, High-density planting system (HDPS), canopy management, sucking pests mepiquat chloride, pruning, detopping

Introduction

Cotton (*Gossypium spp.*) is one of the most important commercial crops in India, providing livelihood to millions of farmers and serving as a vital raw material for the textile industry (Bhanderi *et al.*, 2024) [1]. Despite its economic importance, cotton productivity is often constrained by insect pest infestation. More than 160 insect species are known to attack cotton, among which the sucking pests-leafhopper (*Amrasca biguttula biguttula*), thrips (*Thrips tabaci*), aphid (*Aphis gossypii*), and whitefly (*Bemisia tabaci*) are the most destructive during the early and vegetative growth stages (Nikam, 2017; Sasikumar, 2021) [4, 5]. These pests suck plant sap, cause leaf curling and yellowing, and lead to stunted growth and significant yield loss, often ranging from 20-25% under field conditions.

Recently, the High-Density Planting System (HDPS) has been introduced to increase yield potential by accommodating more plants per unit area (Chavan *et al.*, 2019) [3]. Cotton yields on medium to shallow soils can be significantly boosted through the implementation of high-density planting systems (HDPS) (Pandagale *et al.*, 2020) [8]. However, the dense canopy formed under HDPS creates a favourable microclimate for sucking pests due to poor aeration and higher humidity (Sasikumar, 2021) [5]. Regulation of plant growth and canopy with application of any promising growth regulator may provide an opportunity to modify the plant geometry and density per unit area which affects the economic yield of the crop (Patel *et al.*, 2021) [10].

High-Density Planting System (HDPS) in cotton, while offering significant advantages in yield and resource efficiency, also presents a dynamic scenario for pest management. Hence, the present investigation entitled “Effect of Canopy Management on Sucking Insect Pests in *Bt* Cotton under High-Density Planting System” was undertaken during *Kharif*, 2024-25 at the Department of Entomology, College of Agriculture, Latur.

Materials and Methods

A field experiment entitled "Effect of Canopy Management on Sucking Insect Pests in *Bt* Cotton under High-Density Planting System" was conducted during the *Kharif* season of 2024-2025. The study was carried out at the research farm of the Department of Entomology, College of Agriculture, Latur, India. The experiment was laid out in a Randomized Block Design (RBD) with a total of seven treatments replicated three times. The gross plot size for each treatment replicate was 7.2 x 3.6 meters.

The crop used was *Bt* cotton (*Bt* hybrid RCH 929 BG-II, commercialized as Rasi Swift). Two distinct planting systems were utilized: the High-Density Planting System (HDPS) with a spacing of 90 cm between rows and 30 cm between plants, and a Conventional planting system with 120 cm between rows and 45 cm between plants. The remaining agronomic and cultural practices were maintained uniformly across all plots according to university recommendations.

The incidence of key sucking insect pests was recorded at four growth intervals: 30, 60, 90, and 120 days after sowing (DAS). The target pest species included were jassid or leafhopper (*Amrasca biguttula biguttula*), thrips (*Thrips tabaci*), aphid (*Aphis gossypii*) and whitefly (*Bemisia tabaci*). To monitor the pest population, five plants were randomly selected from the net plot area of each treatment replicate, ensuring that border plants were excluded from the sample. On each of the five selected plants, the population of each pest species was counted from three leaves, representing the three distinct canopy layers: one leaf from the top, one from the middle, and one from the bottom. The mean number of insects per three leaves per plant was computed for subsequent statistical analysis.

Results and Discussion

The seasonal incidence of major sucking pests-leafhopper (*Amrasca biguttula biguttula*), thrips (*Thrips tabaci*), aphid (*Aphis gossypii*), and whitefly (*Bemisia tabaci*)-was significantly influenced by different canopy management practices in *Bt* cotton during *Kharif,* 2024-25. Integrated canopy management treatments consistently reduced pest populations compared to HDPS without modification, indicating the importance of canopy regulation in pest management.

Jassid (*Amrasca biguttula biguttula*): The population of leafhoppers increased from 30 DAS to 90 DAS and then declined at 120 DAS. The highest mean population (6.7/3 leaves) was recorded in HDPS without canopy management (T_1), followed by HDPS + detopping (T_4) (6.25/3 leaves). The lowest mean population (4.95/3 leaves) was observed in HDPS + pruning of monopodia + mepiquat chloride (T_6). (Table 1).

The denser canopy under HDPS without modification created a humid microclimate, favouring jassid multiplication. In contrast, pruning and mepiquat chloride restricted vegetative growth and improved air circulation, which reduced pest buildup. These results agree with Venugopalan *et al.* (2014) [6] and Prasad *et al.* (2019) [7], who reported that canopy openness decreases humidity and pest proliferation under HDPS cotton.

Thrips (*Thrips tabaci*): Thrips population followed a trend similar to jassids (Table 2). The infestation started at 30 DAS, peaked at 90 DAS, and declined thereafter. The highest mean thrips population (24.0/3 leaves) was observed in HDPS (T_1), while the lowest (20.45/3 leaves) occurred in HDPS + pruning of monopodia + mepiquat chloride (T_6).

The increased thrips incidence in unmodified HDPS plots could be attributed to the dense plant stand, poor aeration, and high humidity. The reduction in thrips population under pruning and growth regulator treatments indicates the effectiveness of canopy regulation in maintaining a balanced microclimate. Similar findings were reported by Pandagale *et al.* (2020) [8] and Murtza *et al.* (2022) [9], who observed that mepiquat chloride reduces excessive vegetative growth, improving pest control efficiency.

Aphid (*Aphis gossypii*): Aphid incidence was confined to early crop stages (30-60 DAS) and declined thereafter (Table 3). The maximum mean population (5.05/3 leaves) was observed in HDPS (T_1), followed by HDPS + detopping (T_4) (4.9/3 leaves). The minimum population (4.25/3 leaves) was recorded in HDPS + pruning of monopodia + mepiquat chloride (T_6).

The dense canopy under narrow spacing provided suitable microhabitats for aphid multiplication due to reduced light and higher relative humidity. Application of mepiquat chloride minimized excessive vegetative growth, thereby decreasing pest shelter and improving canopy aeration. These results align with Patel *et al.* (2021) [10], who reported similar reductions in aphid incidence under canopy-managed conditions.

Whitefly (*Bemisia tabaci*): Whiteflies were not recorded during the early crop stage (30 DAS) but appeared from 60 DAS onwards, peaking at 120 DAS. The highest mean population (8.15/3 leaves) was noted in HDPS (T_1), while the lowest (5.75/3 leaves) occurred in HDPS + pruning of monopodia + mepiquat chloride (T_6) (Table 4).

The compact canopy and humid microclimate under HDPS encouraged whitefly development, whereas canopy-modified treatments provided less favourable conditions. The combination of pruning and mepiquat chloride produced a balanced canopy, improving airflow and sunlight penetration, which helped suppress whitefly incidence. Similar results were reported by Khetre *et al.* (2018) [11] and Rossi *et al.* (2004) [12].

Among all treatments, HDPS without canopy management (T_1) recorded the maximum mean population of all sucking pests, whereas HDPS + pruning of monopodia + mepiquat chloride (T_6) consistently recorded the lowest pest population throughout the crop period. Conventional spacing (T_7) also maintained moderate pest levels but was less effective than the integrated canopy management treatments under HDPS.

The overall reduction in pest populations under canopy-managed treatments may be attributed to improved aeration, light interception, and reduced humidity, leading to an unfavourable environment for pest multiplication. These results emphasize the importance of integrating mechanical (pruning/detopping) and chemical (growth regulator) canopy management approaches for sustainable pest suppression in HDPS *Bt* cotton.

Table 1: Effect of canopy management on jassid population in *Bt* cotton under high density planting system (HDPS) during *kharif* 2024

Tr. No.	Treatments	No. of Jassids/3 Leaves				
		30 DAS	60 DAS	90 DAS	120 DAS	Mean
T_1	HDPS [90×30]	1.6 (1.26) *	8.6 (2.93)	9.2 (3.03)	7.4 (2.72)	6.7
T_2	HDPS + Mepiquat Chloride	1.6 (1.26)	6.8 (2.60)	8.0 (2.82)	5.4 (2.32)	5.45
T_3	HDPS + Pruning of Monopodia	1.8 (1.34)	7.0 (2.64)	8.2 (2.86)	5.6 (2.36)	5.65
T_4	HDPS + Detopping	1.4 (1.18)	8.4 (2.89)	9.0 (3.00)	6.2 (2.49)	6.25
T_5	HDPS + Pruning of Monopodia + Detopping	1.8 (1.34)	7.2 (2.68)	8.6 (2.93)	5.4 (2.32)	5.75
T_6	HDPS + Pruning of Monopodia + Mepiquat Chloride	1.6 (1.26)	6.4 (2.52)	7.2 (2.68)	4.6 (2.14)	4.95
T_7	Conventional practice [120 ×45 cm]	1.2 (1.09)	7.2 (2.68)	7.4 (2.72)	5.0 (2.23)	5.2
	SE(m) ±	0.10	0.39	0.32	0.19	
	CD at 5%	0.31	1.22	1.00	0.61	
	CV (%)	11.02	9.17	6.79	5.99	

* Figures in parentheses are square root transformed values.

Table 2: Effect of canopy management on thrips population in *Bt* cotton under high density planting system (HDPS) during *kharif* 2024

Tr. No.	Treatments	No. of Thrips/3 Leaves				
		30 DAS	60 DAS	90 DAS	120 DAS	Mean
T_1	HDPS [90×30]	2.8 (1.67) *	32.8 (5.72)	42.6 (6.52)	17.8 (4.21)	24
T_2	HDPS + Mepiquat Chloride	2.6 (1.61)	28.6 (5.34)	39.2 (6.26)	14.4 (3.79)	21.2
T_3	HDPS + Pruning of Monopodia	2.4 (1.54)	29.4 (5.42)	39.6 (6.29)	14.8 (3.84)	21.55
T_4	HDPS + Detopping	2.8 (1.67)	32.6 (5.70)	39.8 (6.30)	14.6 (3.82)	22.45
T_5	HDPS + Pruning of Monopodia + Detopping	2.6 (1.61)	27.2 (5.21)	39.4 (6.27)	14.2 (3.76)	20.85
T_6	HDPS + Pruning of Monopodia + Mepiquat Chloride	2.8 (1.67)	27.0 (5.19)	38.2 (6.18)	13.8 (3.71)	20.45
T_7	Conventional practice [120 ×45 cm]	1.6 (1.26)	26.2 (5.11	36.6 (6.04)	10.4 (3.22)	18.7
	SE(m) ±	0.123	0.664	0.867	0.437	
	CD at 5%	0.38	2.06	2.70	1.36	
	CV (%)	8.40	3.95	3.81	5.30	

* Figures in parentheses are square root transformed values.

Table 3: Effect of canopy management on aphid population in *Bt* cotton under high density planting system (HDPS) during *kharif* 2024

Tr. No.	Treatments	No. of Aphids/3 Leaves				
		30 DAS	60 DAS	90 DAS	120 DAS	Mean
T_1	HDPS [90×30]	8.8 (2.96) *	11.4 (3.37)	0 (0.00)	0 (0.00)	5.05
T_2	HDPS + Mepiquat Chloride	8.2 (2.86)	9.2 (3.03)	0 (0.00)	0 (0.000	4.35
T_3	HDPS + Pruning of Monopodia	8.4 (2.89)	10.6 (3.25)	0 (0.00)	0 (0.00)	4.9
T_4	HDPS + Detopping	8.4 (2.89)	11.2 (3.34)	0 (0.00)	0 (0.00)	4.9
T_5	HDPS + Pruning of Monopodia + Detopping	8.6 (2.93)	9.8 (3.13)	0 (0.00)	0 (0.00)	4.6
T_6	HDPS + Pruning of Monopodia + Mepiquat Chloride	8.4 (2.89)	8.6 (2.93)	0 (0.00)	0 (0.00)	4.25
T_7	Conventional practice [120 ×45 cm]	5.8 (2.40)	8.2 (2.86)	0 (0.00)	0 (0.00)	3.5
	SE(m) ±	0.34	0.44			
	CD at 5%	1.08	1.37			
	CV (%)	7.44	7.73			

* Figures in parentheses are square root transformed values.

Table 4: Effect of canopy management on whitefly population in *Bt* cotton under high density planting system (HDPS) during *kharif* 2024

Tr. No	Treatments	No. of whiteflies/3 Leaves				
		30 DAS	60 DAS	90 DAS	120 DAS	Mean
T_1	HDPS [90×30]	0 (0.00) *	4.6 (2.14)	12.8 (3.57)	15.2 (3.88)	8.15
T_2	HDPS + Mepiquat Chloride	0 (0.00)	3.0 (1.73)	10.4 (3.22)	13.4 (3.66)	6.7
T_3	HDPS + Pruning of Monopodia	0 (0.00)	4.0 (2.00)	11.2 (3.34)	14.0 (3.74)	7.3
T_4	HDPS + Detopping	0 (0.00)	4.8 (2.19)	10.6 (3.25)	13.6 (3.68)	7.25
T_5	HDPS + Pruning of Monopodia + Detopping	0 (0.00)	3.8 (1.94)	8.4 (3.89)	12.4 (3.52)	6.15
T_6	HDPS + Pruning of Monopodia + Mepiquat Chloride	0 (0.00)	3.4 (1.84)	7.8 (2.79)	11.8 (3.43)	5.75
T_7	Conventional practice [120 ×45 cm]	0 (0.00)	2.6 (1.61)	7.2 (2.68)	10.6 (3.25)	5.1
	SE(m) ±		0.23	0.40	0.37	
	CD at 5%		1.72	1.26	1.17	
	CV (%)		10.79	7.17	5.03	

* Figures in parentheses are square root transformed values.

Concussion

The study demonstrated that canopy management practices significantly influenced the seasonal incidence of major sucking pests in Bt cotton under HDPS. Among treatments, HDPS without canopy modification recorded the highest pest populations, while HDPS with pruning of monopodia and mepiquat chloride application (T_6) consistently showed the lowest incidence of jassids, thrips, aphids, and whiteflies. Improved aeration, reduced humidity, and better light penetration under managed canopies created an unfavorable environment for pest buildup. These findings highlight that integrating mechanical (pruning/detopping) and chemical (mepiquat chloride) canopy management strategies effectively regulates plant growth and minimizes pest incidence in HDPS Bt cotton systems.

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