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Incidence of Major Sucking Pests in Cotton as Influenced by Plant Spacing

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Abstract: The study was carried out at Regional Agricultural Research Station (RARS), Lam, Guntur during *kharif,* 2024**.** An experiment was conducted using *Bt* cotton hybrid Siri NCS-8899 BG-II in two spacing regimes: normal spacing (105 × 60 cm; 15,873 plants/ha) and closer spacing (90 × 30 cm; 37,037 plants/ha). The mean leafhopper population was significantly higher under closer spacing (with peak incidence observed during the 44th standard meteorological week (SMW) Aphid incidence ranged from 2.72 to 15.02/3 leaves (normal) and 2.92 to 17.2/3 leaves (closer), with no significant differences. Thrips population ranged from 0.45 to 11.32/3 leaves (normal) and 0.72 to 13.34/3 leaves (closer), with significantly higher populations under closer spacing during the early vegetative stage (38th – 42nd SMW). Whitefly incidence ranged from 0.90 to 2.96 (normal) and 0.98 to 3.01/3 leaves (closer) with no significant difference between the two spacing regimes.

Keywords: *Bt* cotton, Closer spacing, Standard metrological week, Sucking pests

Cotton (*Gossypium hirsutum* L.) is the major fiber and cash crop globally, cultivated in tropical as well as sub-tropical regions across more than seventy countries. Cotton plays a significant role in the agricultural and industrial economies globally. India ranks first in area and second in production on global basis. It is cultivated on 12.47 million ha with a production of 32.31 million bales and with the average productivity of 440.52 kg lint per ha (CICR 2024). Despite of the large area, the productivity in India is very low. In Andhra Pradesh, cotton is grown in an area of 0.43 million ha with a productivity of 461 kg lint per ha, with a total production of 1.16 million bales (AICRP 2024-25). Around 60% of fiber to Indian textiles is derived from cotton. However, cotton production is often hampered by various biotic stresses, among which insect pests pose a major threat. Among the insect pests, sucking pests such as leafhopper (*Amrasca biguttula* Ishida), whitefly (*Bemisia tabaci* Gennadius), aphids (*Aphis gossypii* Glover), and thrips (*Thrips tabaci* Lindeman) are of particular concern. To enhance the cotton productivity while minimizing input costs has been a key challenge for Indian agriculture, especially under resource-limited and rainfed conditions. One promising agronomic approach to improve yield potential is the adoption of closer spacing. Closer spacing in cotton refers to the reduction in plant-to-plant and row-to-row distances, thereby increasing the plant population per unit area. Under this system, short-duration, compact varieties are planted at a higher plant population per unit area.

The concept of closer spacing in cotton began gaining popularity in the early 2000s, but it was during the post-*Bt* cotton era (after the introduction of *Bt* hybrids around 2002-2004). Traditional cotton hybrids have a longer crop duration and indeterminate growth habit, often leading to excessive vegetative growth under wider spacing. In contrast, *Bt* cotton, with a shorter crop duration and more synchronized flowering, responded well to closer spacing due to better canopy structure and resource utilization. It aims to maximize the capture of solar radiation, reduce weed competition, and enhance the land-use efficiency (Venugopalan et al., 2011, Reddy et al., 2010) and Rathinavel and Dhivya (2013) reported an increased incidence of sucking pests under high-density planting, especially during early growth stages. This presents a significant trade-off between achieving higher yields and managing pest pressure effectively. Despite this, closer spacing has shown potential to increase yield under rainfed and resource-constrained ecosystems by increasing the number of productive bolls per unit area, even though individual plant performance may decline. Therefore, the present study was undertaken to assess the impact of plant spacing on the incidence and population dynamics of major sucking pests in *Bt* cotton under field conditions. The findings are expected to provide understanding into optimizing plant density to balance yield advantages with effective pest management in *Bt* cotton.

MATERIAL AND METHODS

The field experiment was laid out at Regional Agricultural Research Station, Lam, Guntur which is located in upland coastal area of the Krishna Agro Climatic Zone of Andhra Pradesh during *kharif,* 2024. Two bulk plots were maintained with 100 m^2 area each to study the incidence of sucking pests under normal (105 × 60 cm) and closer planting system (90 ×

30 cm) under unprotected conditions. The cotton hybrid Siri (NCS 927 BG 11) was sown manually by dibbling at normal (105 × 60 cm) and closer spacing (90 × 30 cm) during last week of July. Gap filling was done twice within seven to ten days interval after sowing to maintain uniform plant population. Observations on number of leafhoppers, thrips, aphids and whiteflies per three leaves one each from top, middle and bottom of plant was recorded. Thrips were observed and counted by using magnifying lens. About 20 plants were selected randomly in each bulk plot. Weekly observations were recorded from 30 days after sowing and data was subjected to square root transformation and subjected to two sample 't' test assuming unequal variances to compare the pest incidence between normal and closer spacing treatments.

RESULTS AND DISCUSSION

The leafhopper population was observed throughout the season and the first appearance of leafhoppers was observed from 35th SMW (end of August) in both the spacings. The incidence was moderate to high up to 49th SMW (December first week), thereafter declined and reached to a minimum number of 0.95 no.s /3 leaves at 1st SMW in normal spacing and 1.05 to 15.02 /3 leaves in closer spacing. The incidence of leafhopper population ranged from 0.95 to 11.48 /3 leaves in normal spacing and from 1.05 to 15.02 per three leaves in closer spacing. Peak population was observed with 11.48 / 3 leaves during 39th standard week (October 14th- 20th) under normal spacing and 15.02/ 3 leaves during 46th SMW (October 28th – November 3rd) under closer spacing. The overall population was slightly low under normal spacing when compared to closer spacing. The seasonal mean population of leafhoppers was 2.50 /3 leaves in normal spacing as against 2.79 /3 leaves in closer spacing. The computed t-statistics for differences between the above two mean values was statistically different indicating that the leafhopper population was significantly higher in closed spacing than the normal spacing. Mahalakshmi and Prasad (2018) also observed that the leafhopper population was significantly higher in high-density planting system (HDPS) (closer spacing) compared to recommended spacing in cotton. The increased canopy density in HDPS likely provides a more favorable microclimate for leafhopper multiplication. Pandagale et al. (2020) also observed that the leafhopper population was higher in narrow row spacing (45 × 10 cm) compared to wider row spacing (75 × 10 cm), attributing it to greater plant density (Table 1).

Aphid population in normal spacing conditions ranged from 2.72 to 15.02 per three leaves, while under closer spacing, the population varied from 4.01 to 17.2 no. per three leaves throughout the crop growth period. During 44th to 47th SMW, the aphid incidence was at peak level and there was significant difference between both the spacings with higher aphid incidence recorded in closer spacing than normal spacing**.** However, aphid population never crossed ETL (30 aphids per three leaves) in normal and closer spacing. Kalaichelvi (2008) also documented maximum aphid incidence between 43rd and 48th SMW in *Bt* cotton fields. Although higher aphid counts were observed under HDPS, the values remained below ETL and the differences were not statistically significant.

Thrips population ranged from 0.45 to 11.32 no.s /3 leaves during the crop growth period in normal spacing, whereas in closer spacing it was 0.72 to 14.50 /3 leaves. The population of thrips was high from September (38th SMW) to the end of October (42th SMW). In both normal and closer spacings, thrips population never crossed ETL throughout the season. Although slightly higher thrips populations were observed under closer spacing than normal spacing, the difference was statistically non-significant. The present findings are in conformity with those of Rajasekhar et al. (2018) where thrips population was initially higher in HDPS during the early vegetative phase, particularly up to 90 days after sowing and the difference in population between closer and normal spacing was not statistically significant in later stages. Rajesh and Dhakad (2016) also observed that closer spacing favored slightly higher thrips populations, especially in the early vegetative phase, but the population remained below ETL throughout the season.

The incidence of whitefly population ranged from 0.28 to 2.96 no.s per three leaves in normal spacing and 0.38 to 3.01 no.s in closer spacing during crop growth period. No significant difference was found between both the spacings throughout the cropping period (30 to 150 DAS). Rajasekhar et al. (2018) also reported that whitefly populations were not significantly affected by plant spacing. The variations in population were more strongly linked to prevailing weather conditions and inter-pest competition, especially when other sucking pests like leafhoppers and thrips were more dominant. Mahalakshmi and Prasad (2018), also observed that whitefly incidence remained statistically non-significant between HDPS and recommended spacing in *Bt* cotton.'

CONCLUSION

Closer spacing (90×30 cm) led to slightly higher populations of sucking pests, particularly during the vegetative phase, due to denser canopy and modified microclimate. However, pest levels largely remained below ETL throughout the crop growth period, except for occasional peaks. Significant impact of spacing was observed only for

Table 1. Effect of spacing on major sucking pest complex in cotton during *kharif,* 2024

SMW	Leafhoppers/3 leaves/plant *			Aphids/3 leaves/plant *			Thrips/3 leaves/plant *			Whiteflies/3 leaves/plant *		
	Normal spacing (105X60)	Closer spacing (90X30)	t-test	Normal spacing (105X60)	Closer spacing (90X30)	t-test	Normal spacing (105X60)	Closer spacing (90X30)	t-test	Normal spacing (105X60)	Closer spacing (90X30)	t-test
35	3.48 (1.86)	3.75 (1.93)	NS	2.72 (1.64)	2.92 (1.70)	NS	1.38 (1.17)	1.98 (1.40)	NS	1.52 (1.23)	1.95 (1.39)	NS
36	5.13 (2.26)	5.52 (2.34)	NS	6.30 (2.51)	6.51 (2.55)	NS	1.92 (1.38)	2.26 (1.50)	NS	1.44 (1.20)	1.98 (1.40)	NS
37	7.13 (2.67)	7.85 (2.80)	NS	6.80 (2.60)	6.93 (2.63)	NS	11.32 (3.36)	13.34 (3.65)	S	0.35 (0.59)	0.38 (0.61)	NS
38	8.98 (2.99)	9.02 (3.00)	NS	7.50 (2.73)	7.62 (2.76)	NS	10.95 (3.30)	14.50 (3.80)	S	0.28 (0.52)	0.49 (0.70)	NS
39	11.48 (3.38)	11.98 (3.46)	NS	8.25 (2.87)	8.54 (2.92)	NS	10.05 (3.17)	13.01 (3.60)	S	0.41 (0.64)	0.56 (0.74)	NS
40	10.60 (3.25)	10.75 (3.27)	NS	7.09 (2.66)	7.42 (2.72)	NS	7.86 (2.80)	8.12 (2.84)	NS	2.08 (1.44)	2.72 (1.64)	NS
41	11.02 (3.31)	11.31 (3.36)	NS	8.15 (2.85)	8.92 (2.98)	NS	3.8 (1.94)	3.95 (1.98)	NS	1.52 (1.23)	1.72 (1.31)	NS
42	10.62 (3.25)	11.06 (3.32)	NS	8.35 (2.88)	9.21 (3.03)	NS	4.81 (2.19)	4.92 (2.21)	NS	2.96 (1.72)	2.04 (1.42)	NS
43	9.38 (3.06)	13.72 (3.73)	S	9.40 (3.06)	12.23 (3.49)	S	2.45 (1.56)	2.50 (1.58)	NS	1.60 (1.26)	1.76 (1.32)	NS
44	8.25 (2.87)	14.68 (3.83)	S	13.21 (3.61)	15.26 (3.90)	S	2.30 (1.51)	2.47 (1.57)	NS	2.84 (1.68)	2.04 (1.42)	NS
45	6.13 (2.47)	13.95 (3.73)	S	13.05 (3.61)	16.84 (4.10)	S	1.92 (1.38)	2.12 (1.45)	NS	1.24 (1.11)	1.92 (1.38)	NS
46	5.82 (2.41)	12.92 (3.59)	S	15.02 (3.87)	17.20 (4.14)	S	1.84 (1.35)	2.01 (1.41)	NS	2.94 (1.71)	3.01 (1.73)	NS
47	7.62 (2.76)	9.81 (3.13)	S	14.98 (3.87)	15.98 (3.99)	S	1.22 (1.10)	1.95 (1.39)	NS	2.38 (1.54)	2.92 (1.70)	NS
48	5.98 (2.44)	6.15 (2.47)	NS	13.10 (3.61)	14.59 (3.81)	NS	1.38 (1.17)	1.40 (1.18)	NS	2.04 (1.42)	2.32 (1.52)	NS
49	4.96 (2.22)	5.13 (2.26)	NS	10.24 (3.20)	10.92 (3.30)	NS	0.49 (0.70)	0.55 (0.74)	NS	2.56 (1.60)	2.92 (1.70)	NS
50	4.16 (2.03)	4.92 (2.21)	NS	7.75 (2.78)	8.20 (2.86)	NS	0.40 (0.63)	0.47 (0.68)	NS	0.88 (0.93)	1.20 (1.09)	NS
51	3.35 (1.83)	3.85 (1.96)	NS	7.02 (2.64)	7.64 (2.76)	NS	1.2 (1.09)	1.49 (1.22)	NS	0.92 (0.95)	0.98 (0.98)	NS
52	2.05 (1.43)	2.84 (1.68)	NS	4.68 (2.16)	5.12 (2.26)	NS	0.81 (0.90)	0.95 (0.97)	NS	2.91 (1.70)	2.96 (1.72)	NS
1	0.95 (0.97)	1.05 (1.02)	NS	3.62 (1.34)	4.01 (2.00)	NS	0.45 (0.60)	0.72 (0.84)	NS	2.4 (1.54)	2.71 (1.64)	NS

*Figures in parentheses are square root transformed values. NS: Non-significant; S - Significant

leafhoppers, which were more abundant in closer spacing likely due to a denser canopy and favorable microclimatic conditions.

AUTHORS CONTRIBUTION

K. Pavan Sathish conducted the field investigations, collected the data, and performed the data analysis. N. V. V. Durga Prasad and B. Ratna Kumari designed the study and coordinated the research work. S. Prathibha Sree critically reviewed, edited, and finalized the manuscript. L. Rajesh Chowdary contributed to the preparation of the initial manuscript draft. All authors read and approved the final version.

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