



## Seasonal Dynamics of Sucking Insect Pests on *Bt* Cotton as Influenced by Plant Density

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### ABSTRACT

A field experiment was carried out at Regional Agricultural Research Station, Lam, Guntur to study the influence of plant density on dynamics of sucking insect pests on *Bt* cotton hybrid *viz.*, Tulasi BG-II under unprotected conditions during *kharif* 2012. The population of sucking pests *viz.*, leafhoppers, aphids, thrips and whiteflies were significantly affected by plant density and increased with increase in plant density from 11111 plants ha<sup>-1</sup> (100 cm × 90 cm) to 66666 plants ha<sup>-1</sup> (100 cm × 15 cm). Among the sucking insect pests only leafhoppers and aphids crossed the ETL at various stages of crop growth period. The peak incidence of leafhoppers (16.10 leafhoppers per three leaves) and aphids (171.25 aphids per three leaves) was observed at 45 DAS and 118 DAS respectively at higher plant density of 66666 plants ha<sup>-1</sup>. The population of other sucking insect pests such as thrips and whiteflies were below ETL throughout the crop season. The population of natural enemies was found to have direct relation with sucking insect pest population.

**Key words :** ETL, Natural enemies, Plant density, Sucking insect pests.

Cotton is a predominant cash crop grown in India. It is grown over an area of 117.73 lakh ha with an annual production of 340 lakh bales and productivity of 489 kg lint ha<sup>-1</sup> during 2012-13 ([www.cotcorp.gov.in](http://www.cotcorp.gov.in)). Though India has highest acreage under cotton in the world, the low level of productivity caused by some serious constraints, particularly of plant protection measures and serious pest outbreaks, notably of American bollworm *Helicoverpa armigera* (Hubner) have been the major limiting factors in the past (Mohanty *et al.*, 2002). The pest scenario in cotton ecosystem has changed after the introduction of *Bt* cotton hybrids from 2002. The bollworm complex attained a non-pest status and sucking pests have become major pests on cotton. Most of the commercially available *Bt* cotton hybrids are inheritably susceptible to sucking pest complex and changed the dynamics of insect pests on cotton (Vennila, 2008). Due to earliness of *Bt* cotton and lack of incidence of bollworms, higher plant population of *Bt* cotton per unit area can be maintained with an aim to enhance the production and productivity. Plant density showed a significant effect on population of the sucking insects *viz.*, leafhoppers *Amrasca biguttula biguttula* (Ishida), aphids

*Aphis gossypii* (Glover), thrips *Thrips tabaci* (Lindman) and whiteflies *Bemisia tabaci* (Genn.). In view of existing situation and importance of cotton in Indian economy, it is a necessary to know the influence of plant density on dynamics of sucking insect pests in *Bt* cotton. With this background a field trial was conducted at RARS, Lam to evaluate the effect of plant density on dynamics of sucking pests of *Bt* cotton.

### MATERIAL AND METHODS

A field experiment was conducted during *kharif*, 2012 at RARS, Lam to study the influence of plant density on dynamics of sucking insect pests on *Bt* cotton, Tulasi BG-II under unprotected condition. The experiment was laid out in a randomized block design with six treatments replicated four times in a plot size of 6m × 5.4m (32.4m<sup>2</sup>) as detailed in Table 1.

The crop was sown on first week of August, 2012 and all the cultural practices except the plant density were followed as per the ANGRAU recommendation. Incidence of sucking insect pests *viz.*, leafhoppers, aphids, thrips, whiteflies and natural enemies such as spiders and ladybird beetles was recorded on five randomly

selected plants in each plot at weekly interval from 30 DAS ((Days After Sowing) in all the treatments. The population of both nymphs and adults of leafhoppers, aphids, thrips and whiteflies was recorded from three leaves *viz.*, one each from top, middle and bottom canopies of the plant. The natural enemy population was recorded on whole plant basis. The average of all the five observations was calculated and expressed as mean population. The data pertaining to the population of insect pests and natural enemies was subjected to square root transformation from respective treatments. Analysis of variance was done with the transformed data by using AGRISTAT statistical package.

## RESULTS AND DISCUSSION

### Influence of plant density on leafhopper population:

The mean leafhopper population was increased from 4.15 to 6.13 leafhoppers per three leaves as plant density increased from 11111 plants ha<sup>-1</sup> to 66666 plants ha<sup>-1</sup>(Table 1). The peak incidence of leafhopper was observed at 45 DAS. The leafhopper population crossed ETL (Economic Threshold Level) in all the treatments at 38, 45 and 52 DAS. The leafhopper population was recorded higher than ETL in the plots where the plant density was more than or equal to 22222 plants ha<sup>-1</sup> and 33333 plants ha<sup>-1</sup> at 60 and 68 DAS respectively (Fig. 1).

The increased leafhopper population at higher plant densities was due to the congenial microclimate prevailing during September and October months of South-West monsoon period and this was in agreement with the results of Shwetha *et al.* (2009) who reported that higher leafhopper population of leafhoppers were recorded at closer plant spacing of 90 cm × 30 cm (4.73 leaf<sup>-1</sup> plant<sup>-1</sup>) when compared to 90 cm × 60 cm spacing (3.93 leaf<sup>-1</sup> plant<sup>-1</sup>). Similarly, Mohite and Uthamasamy (1997) observed maximum leafhopper population (4.19 per leaf) at closer plant spacing (120 cm × 45 cm) and minimum leafhopper population (2.13 per leaf) at wider plant spacing (120 cm × 60 cm) in cotton.

### Influence of plant density on aphid population:

The mean aphid population was ranged from 14.45 to 28.55 aphids per three leaves and it was increased as plant density increases from 11111

plants ha<sup>-1</sup> to 66666 plants ha<sup>-1</sup> (Table 1). The aphid population was below ETL up to 100 DAS and crossed ETL from 110 DAS to 125 DAS in different plant densities and showed clear cut positive relation between number of aphids and plant density (Fig. 2) and this period was coincided with December and January months. The prevailing cool and dry weather conditions during the months of December and January and congenial along with congenial microclimate under higher plant densities. Were found extremely favourable for the rapid multiplication of aphids. This was in agreement with the findings of Shwetha *et al.* (2009) who reported that more aphids were recorded with a spacing of 90 cm × 30 cm (7.75 leaf<sup>-1</sup> plant<sup>-1</sup>) when compared to 90 cm × 60 cm spacing in cotton (4.95 leaf<sup>-1</sup> plant<sup>-1</sup>). Kalaichelvi (2008) found that the infestation of aphids was more at closer spacing of 90 cm × 45 cm (5.06 aphids per three leaves) than wider spacing of 90 cm × 60 cm (4.30 aphids per three leaves) and 120 cm × 60 cm (3.84 aphids per three leaves) in RCH-2 *Bt* cotton.

The aphid population in all the treatments never reached ETL upto 118 DAS and thereafter, there was a sudden decline in the population was due to the attack of entomopathogenic fungus *Neozygites fresenii* Batko. This was in agreement with findings of Steinkraus and Lorenz (1997) who reported when more than 15% of the cotton aphids in a field become infected with *N. fresenii*, a decline in the cotton aphid population usually occurs within seven days. Aphid populations were commonly reduced from peak densities to low numbers within five to ten days after the initial infection of *N. fresenii* (Steinkraus *et al.* 1995).

### Influence of plant density on thrips population:

The plant density had effect on incidence of thrips. The mean thrips population was increased from 1.78 to 2.62 thrips per three leaves as plant density increased from 11111 plants ha<sup>-1</sup> to 66666 plants ha<sup>-1</sup>(Table 1). This corroborates with the findings of Shwetha *et al.* (2009) who reported that higher thrips were recorded at 90 cm × 30 cm (12.00 leaf<sup>-1</sup> plant<sup>-1</sup>) when compared to 90 cm × 60 cm spacing (8.00 leaf<sup>-1</sup> plant<sup>-1</sup>). Arif *et al.* (2006) observed the higher population of thrips (10 thrips per leaf) was noted when inter plant spacing was 12.5 cm compared to that of 38 cm (8.45 thrips per leaf).

Table 1. Influence of plant density on dynamics of sucking insect pests and natural enemies.

S.No	Treatments	Mean population/plant*					
		Sucking pests			Natural enemies		
		Leafhopper	Aphids	Thrips	Whiteflies	Spiders	Coccinellid beetles
1	T166666 Plants ha <sup>-1</sup> (100 cm × 15 cm)	6.13 (2.66) <sup>c</sup>	28.55 (5.42) <sup>d</sup>	2.62 (1.90) <sup>d</sup>	1.78 (1.66) <sup>d</sup>	0.36 (1.16) <sup>e</sup>	0.43 (1.18) <sup>d</sup>
2	T233333 Plants ha <sup>-1</sup> (100 cm × 30 cm)	5.62 (2.57) <sup>c</sup>	23.96 (4.99) <sup>cd</sup>	2.46 (1.84) <sup>cd</sup>	1.41 (1.55) <sup>c</sup>	0.31 (1.14) <sup>d</sup>	0.35 (1.15) <sup>c</sup>
3	T322222 Plants ha <sup>-1</sup> (100 cm × 45 cm)	5.17 (2.47) <sup>bc</sup>	21.32 (4.72) <sup>bc</sup>	2.20 (1.78) <sup>bc</sup>	1.18 (1.47) <sup>bc</sup>	0.27 (1.12) <sup>c</sup>	0.28 (1.12) <sup>bc</sup>
4	T416666 Plants ha <sup>-1</sup> (100 cm × 60 cm)	4.67 (2.37) <sup>ab</sup>	19.20 (4.48) <sup>b</sup>	2.09 (1.75) <sup>b</sup>	1.01 (1.41) <sup>ab</sup>	0.22 (1.10) <sup>b</sup>	0.24 (1.10) <sup>ab</sup>
5	T511111 Plants ha <sup>-1</sup> (100 cm × 90 cm)	4.15 (2.26) <sup>a</sup>	14.45 (3.92) <sup>a</sup>	1.78 (1.66) <sup>a</sup>	0.81 (1.34) <sup>a</sup>	0.16 (1.07) <sup>a</sup>	0.17 (1.08) <sup>a</sup>
6	T613889 Plants ha <sup>-1</sup> (120 cm × 60 cm)	4.45 (2.33) <sup>ab</sup>	17.03 (4.24) <sup>ab</sup>	1.93 (1.71) <sup>ab</sup>	0.90 (1.38) <sup>a</sup>	0.20 (1.10) <sup>b</sup>	0.21 (1.09) <sup>a</sup>
	SEm	0.06	0.10	0.04	0.02	0.01	0.01
	CD (P=0.05)	0.19	0.28	0.13	0.07	0.04	0.03

Figures in parentheses are x+1 values

\*Pooled mean of 14 observations

Numbers with same superscript are not statistically different

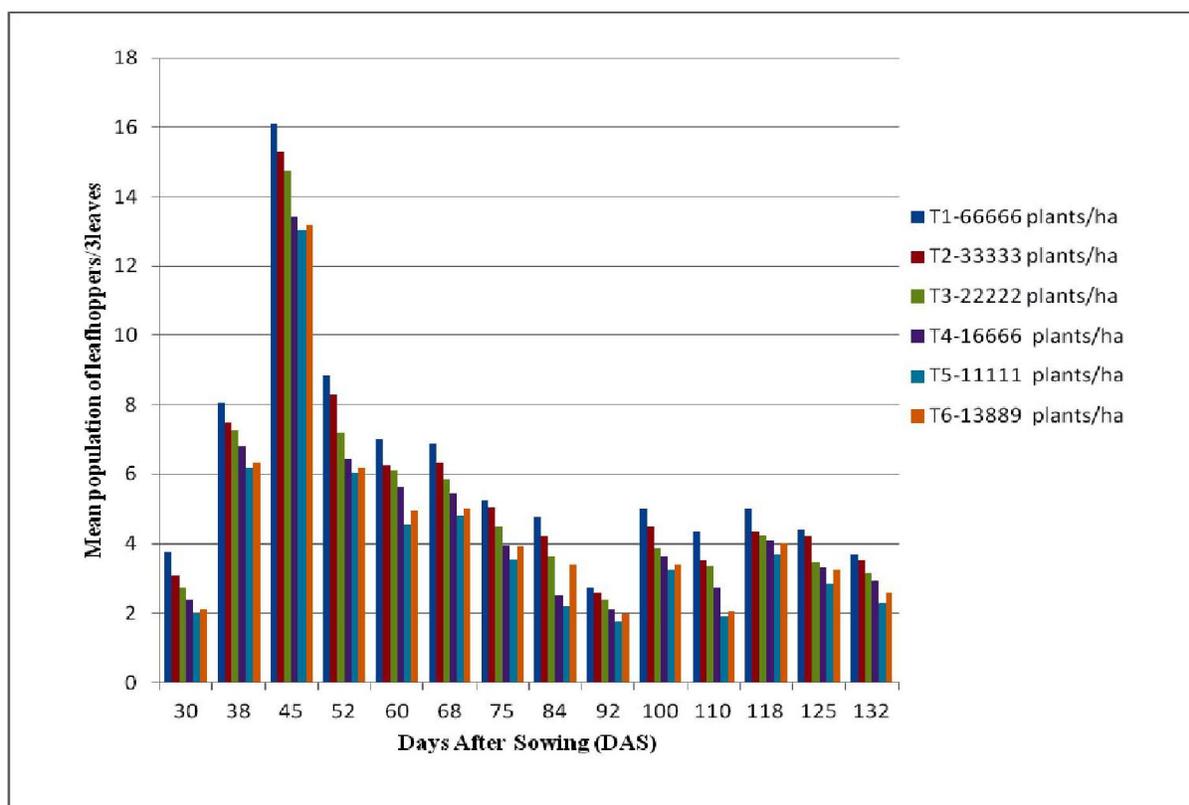


Fig 1. Incidence of leafhoppers on Tulasi BG-II cotton as influenced by plant density.

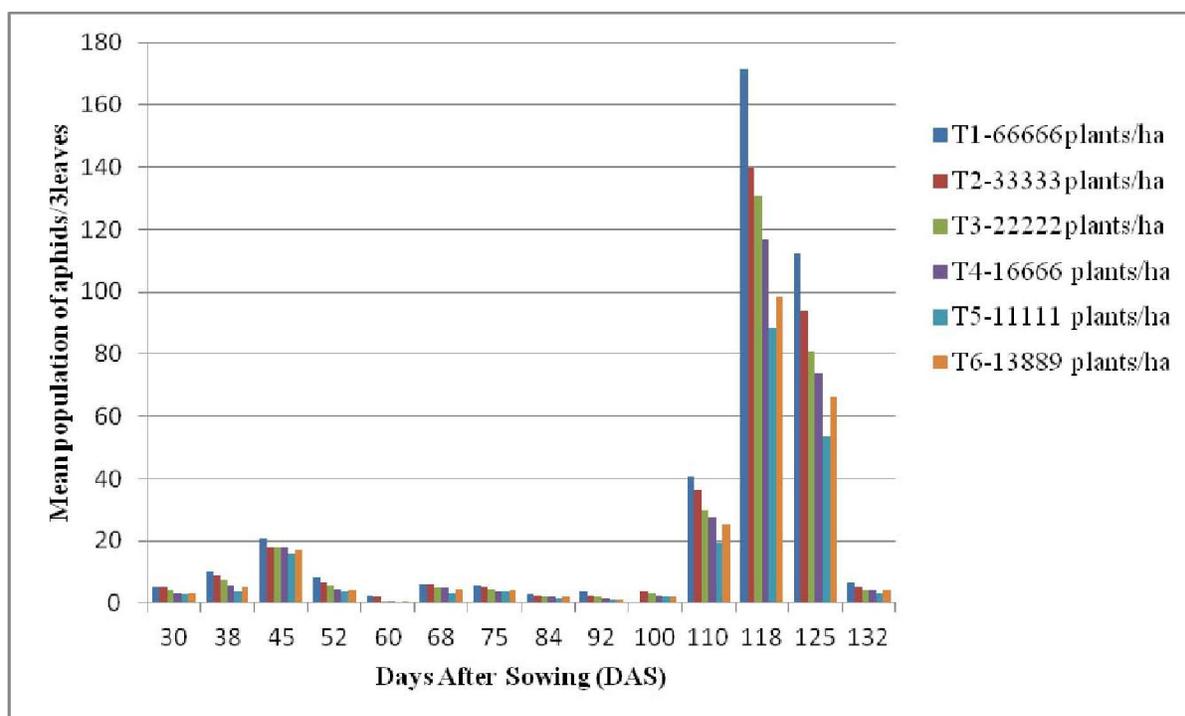


Fig. 2 . Incidence of aphids on Tulasi BG-II cotton as influenced by plant density.

#### **Influence of plant density on whitefly population:**

The mean whitefly population was found increased from 0.81 to 1.77 whiteflies per three leaves as plant density was increased from 11111 plants ha<sup>-1</sup> to 66666 plants ha<sup>-1</sup>(Table 1). Which was in agreement with findings of Arif *et al.* (2006) who reported that higher population of whiteflies (5.23 whiteflies per leaf) was noted at less plant to plant spacing of 12.5 cm as opposed to 38 cm (2.82 whiteflies per leaf). Mohite and Uthamasamy (1997) also observed that maximum whitefly population (5.95 per leaf) was recorded at closer plant spacing (120 cm × 45 cm) and minimum leafhopper population (0.06 per leaf) was noted at wider plant spacing (120 cm × 60 cm) in cotton.

The high incidence of sucking insect pests at higher plant densities may be due to the humid micro climate in the plant canopy, which encourages the build of pest population. In addition, easy availability of food sources and more number of sites for oviposition also favoured for faster growth and multiplication of the insect pest studies. Coaker (1990) in a review pointed out that the basic and central factors determining insect abundance and

survival are directly dependent on the dispersion of their food sources.

#### **Influence of plant density on natural enemy population:**

The natural enemies like spiders and coccinellid beetles were observed on the plants at various stages of crop growth period. The mean populations of spiders and coccinellid beetles were increased from 0.16 to 0.36 spiders per plant and 0.17 to 0.43 coccinellid beetles per plant respectively as plant density increased from 11111 plants ha<sup>-1</sup> to 66666 plants ha<sup>-1</sup>(Table 1). Since abundance of natural enemies is density dependent on their prey population. The enhanced activity of spiders and coccinellid beetles documented in this study at higher plant densities more than or equal to 22222 plant ha<sup>-1</sup> can be attributed to the availability of more prey at higher densities. This was in agreement with findings of Kalaichelvi (2008) who observed that closer spacing of 90 cm × 30 cm recorded more number of spiders (3 spiders and 4 coccinellid beetles per 50 plants) than wider spacing of 120 cm × 60 cm (1 spider and 2 coccinellid beetles per 50 plants).

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