J. Cotton Res. Dev. **33** (2) 273-280 (July, 2019) **ISSN No. 0972-8619**

Estimation of yield losses due to sucking pests of *Bt* cotton under high density planting system

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ABSTRACT : Studies was carried out during *Kharif* 2015-2016 and 2016-2017 to yield losses due to sucking pests *viz.,* aphid, leafhopper, thrips and whitefly. The unprotected treatments recorded significantly higher aphid population over protected ones with 14.81, 5.61, 15.08, 12.41 and 3.66, 1.90, 3.83, 1.81 sucking pests per three leaves, respectively, with 75.29, 66.13, 74.63 and 85.41 per cent overall increase in population in the unprotected treatments over protected treatments ones. Significantly more yield (18.67 q/ha) was obtained under protected condition as compared to unprotected condition (12.47 q/ha) with avoidable loss of 33.02 % per cent by unprotected condition over protected condition ones.

Key word : Estimation of yield losses, high density planting system, sucking pests

Cotton is a major fiber crop of global significance, cultivated in more than seventy countries in the world. Cotton crop is playing an important role in economic, political and social affairs of the world. Cotton belongs to the family "*Malvaceae*" and genus "*Gossypium*". Cotton crop as commercial commodity, plays an important role in industrial activity of nation, in terms of both employment generation and foreign exchange, Hence it is popularly known as "White Gold" and "Friendly Fiber".

Cotton is being cultivated in 70 countries of the world with a total coverage of 33.14 m ha. China, India, USA and Pakistan are the major cotton producing countries in the world accounting for 70 per cent of the world's cotton area and production. India is the largest cotton growing country in the world with 35.29 per cent of world cotton area followed by China (15.23%). China and India are the major cotton consuming countries in the world (around 55%). USA and India constitute 27 and 19.5 per cent of the worlds cotton exports respectively. China is the major importer in the world with around 28 per cent of the total imports (11.00 million bales of 480 kg). Among the major cotton growing countries, Australia tops the productivity level of 2151 kg lint/ha followed by Turkey (1484 kg lint/ ha) and Brazil (1465 kg lint/ha). In production, India ranks second next to China. In India, cotton is cultivated in an area of 11.70 m ha with a production of 29.00 million bales of seed cotton during 2015-2016. Average productivity of cotton in India is 540 kg lint/ha, which is low when compared to world average of 766 kg lint/ha (Anonymous, 2015-2016). In Maharashtra, the present cotton growing situation is showing improvement after release of *Bt* cotton and is cultivated in an area of 38.27 lakh ha with total production 71.25 lakh bales with an average productivity of 342 kg/ha (Anonymous, 2015-2016). The area under

transgenic cotton is upto 99%.

Cotton crop is subjected to damage by 162 species of pests right from germination to the final picking (Dhaliwal and Arora, 1998). In Maharashtra about 25 pests are reported to cause damage to cotton crop at different growth stages (Thakare *et al.,* 1983). The important sucking pests are aphids *Aphis gossypi* (Glover), leafhopper *Amrasca biguttula bigutulla*, (Ishida), Whitefy *Bemisia tabaci*, (Gennadius), thrips *thrips tabaci*, mealybugs *Phenococcus solenopsis* (Tinsley). The bollworms include spotted bollworm *Earias vittella* (Fab.), American bollworm *Helicovera armigera* (Hubner) and pink bollworm *Pectinophora gossypiella (*Saund.*).* The losses in cotton due to sucking pests, bollworms and both together have been reported as 11.60, 44.50 and 52.10 per cent, respectively (Dhawan and Sindhu, 1986).

In order to get economic and effective management of sucking pests it is essential to know the actual amount of the loss caused by them. The investigation was, therefore, undertaken to quantify yield losses caused by sucking insect pests of cotton.

MATERIALS AND METHODS

The field experiment was carried out during *kharif* 2015 and 2016 at Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Transgenic cotton Balwan (NSC-8899) BG II sown and the crop were raised as per the package of practices recommended by the VNMKV, Parbhani. The observations were made on number of leafhoppers, aphids, whiteflies and thrips on five randomly selected plants from each plot *i.e.* protected and unprotected at weekly interval starting from 45 DAS from top, middle and bottom three leaves, throughout the crop season (*kharif* and *rabi*).

Treatment deatails

T1 -Protected condition

T1 -Unprotected condition

1. One spray of acephate (75% SP) @ 20 g/ 10 l water at 30
2. One spray of imidacloprid (17.8% SL) @ 4 ml/10 l water at 45 DAS
3. One spray of acetamiprid (20% WG) @ 2.0 g/10 l water at 60 DAS
4. One spray of flonicamide (50% WG) @ 2 g/10 l water at 75 DAS
5. One spray of fipronil (5 SC) @ 30 ml/10 lit. water 90 DAS
6. One spray of diafenthiuron (50% WP) @ 12 g/10 l water at 105 DAS

Loss assessment : Popular technique of crop loss assessment as suggested by Leclerg (1971) was followed in this experiment. A paired plot technique was used in which yields of protected and unprotected plots were compared. The plants in protected plot were spared against insect pests following spray of insecticides as shown above in treatment details. Plants from other plots allowed to damage by naturally occurring population of the same insects pests.

Total seed cotton yield obtained from different plots were recorded. Losses of seed cotton due to insect pests were worked out by using the formula given by (Pradhan, 1964)

$$\text{Avoidable loss in yield (\%)} = \frac{T - C}{T} \times 100$$

Where T = Yield from treated plot
C = Yield from control plot

RESULTS AND DISCUSSION

Incidence of sucking pest on *Bt* cotton under protected and unprotected conditions : The pooled data on aphid populations *kharif* 2015 and 2016 as influenced by protection irrespective of protected and unprotected condition are presented in Table 1 and Fig 1. The unprotected treatments recorded significantly higher aphid population over protected ones with 14.81 and 3.66 aphids/three leaves respectively with 75.29 per cent overall increase in population in the unprotected treatments over protected treatments ones.

The mean data on leafhopper populations as influenced by protection irrespective of protected and unprotected condition are presented in Table 1 and Fig 1. The unprotected treatments recorded significantly higher leafhopper population over protected ones with 5.61 and 1.90 leafhopper/three leaves respectively with 66.13 per cent overall increase in population in the unprotected treatments over protected treatments ones.

The mean data on thrips populations as influenced by protection irrespective of protected and unprotected condition are presented in Table 1 and Fig 1. The unprotected treatments recorded significantly higher thrips population over protected ones with 15.08 and 3.83 thrips/ three leaves respectively with 74.63 per cent overall reduction in population in the unprotected treatments over protected treatments ones.

The mean pooled data on leafhopper populations as influenced by protection irrespective of protected and unprotected condition are presented in Table 1 and Fig 1. The unprotected treatments recorded significantly higher leafhopper population over protected ones with 12.41 and 1.81 whitefly/ three leaves respectively with 85.41 per cent overall reduction in population in the unprotected treatments over protected treatments ones.

The results are in parallel with the findings of Ramalakshmi (2012) was reported that the mean incidence in unprotected plot recorded significantly higher whitefly population over protected ones. Renuka (2013) who reported decrease of sucking pest under protected conditions of Jaadoo and RCH 2 over unprotected plots.

Estimation of loss in cotton seed yields : The data pertaining to the seed cotton yield during *kharif* 2015 and 2016 and pooled as influenced by protected and unprotected conditions are presented in Table 2 and Fig. 2. Significant differences were observed between protection and unprotected condition.

During *kharif* 2015-2016, the yield differed with protection irrespective of protected and unprotected condition. The unprotected plot recorded (19.68 q/ha) significantly higher mean leafhopper population over protected ones (12.53 q/ha) with mean reduction 36.33% q/ha (Fig. 1) yield was observed in unprotected conditions to protected conditions.

During *kharif* 2016-2017 also with significant differences of yield between protections levels of protected and unprotected condition are presented. The unprotected plots

Table 1. Mean incidence of sucking pests on *Bt* cotton in protected and unprotected conditions under HDPS during *kharif* 2015 and 2016

Treatments	Aphids population / 3 leaves			Leafhopper population / 3 leaves			Thrips population / 3 leaves			Whitefly population / 3 leaves		
	2015	2016	**Pooled**	2015	2016	**Pooled**	2015	2016	**Pooled**	2015	2016	**Pooled**
Protected condition (T1)	4.44	2.89	**3.66**	1.80	1.99	**1.90**	3.93	3.72	**3.83**	1.84	1.78	**1.81**
	(2.22)#	(1.84)	**(2.04)**	(1.52)	(7.15)	**(1.55)**	(2.10)	(2.05)	**(2.08)**	(1.53)	(1.52)	**(1.51)**
Unprotected condition (T2)	19.83	9.79	**14.81**	4.07	7.15	**5.61**	17.86	12.29	**15.08**	10.7	14.12	**12.41**
	(4.51)	(3.21)	**(3.91)**	(2.14)	(2.77)	**(2.47)**	(4.29)	(11.71)	**(3.95)**	(3.35)	(3.82)	**(3.59)**
% Increase over unprotected plot	77.61	70.48	**75.29**	55.77	72.17	**66.13**	78.02	69.73	**74.63**	82.80	87.39	**85.41**
't'value	36.37*	17.03*	**40.10***	11.26*	16.09*	**24.42***	15.73*	11.71*	**18.63***	23.97*	37.08*	**40.17***

Table t value at 13 df =2.16 Average of 20 SMW # Figures in parentheses denote $\sqrt{n + 0.5}$ transformed

**Significant at 5 (%) level *Significant at 1 (%) level

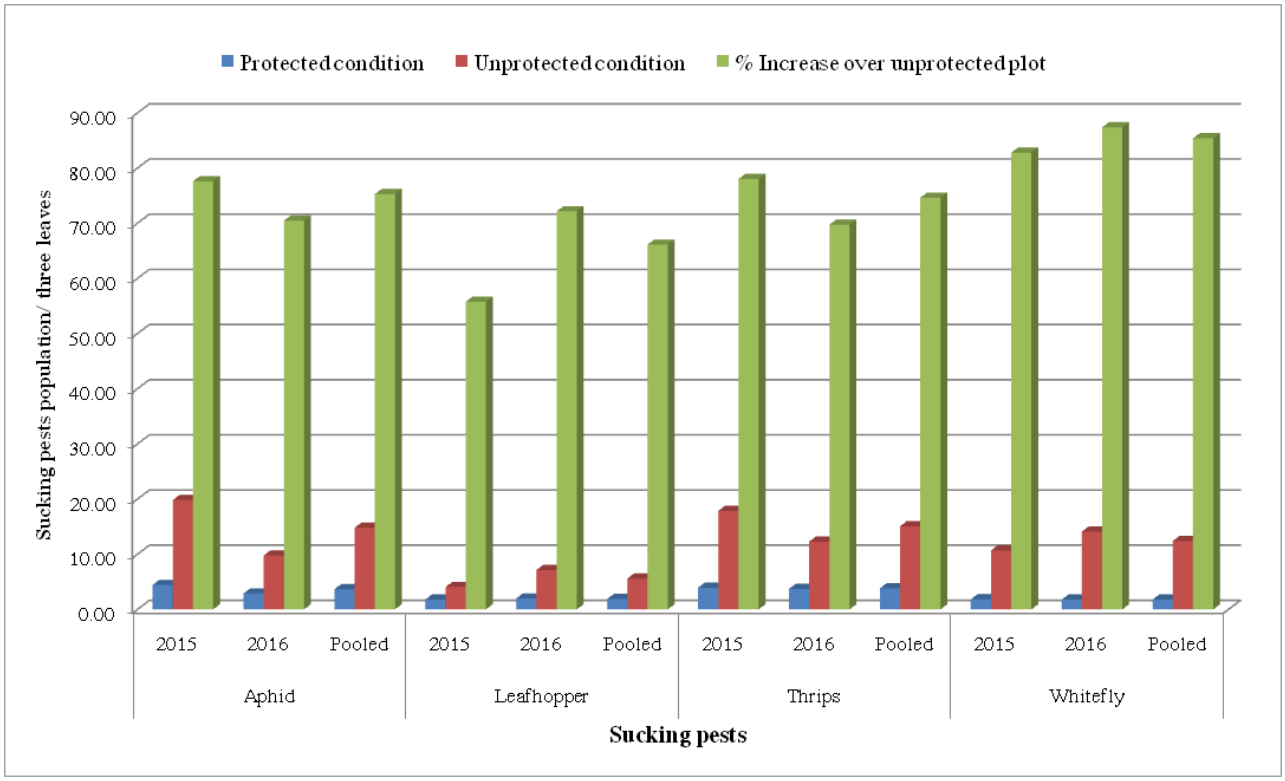
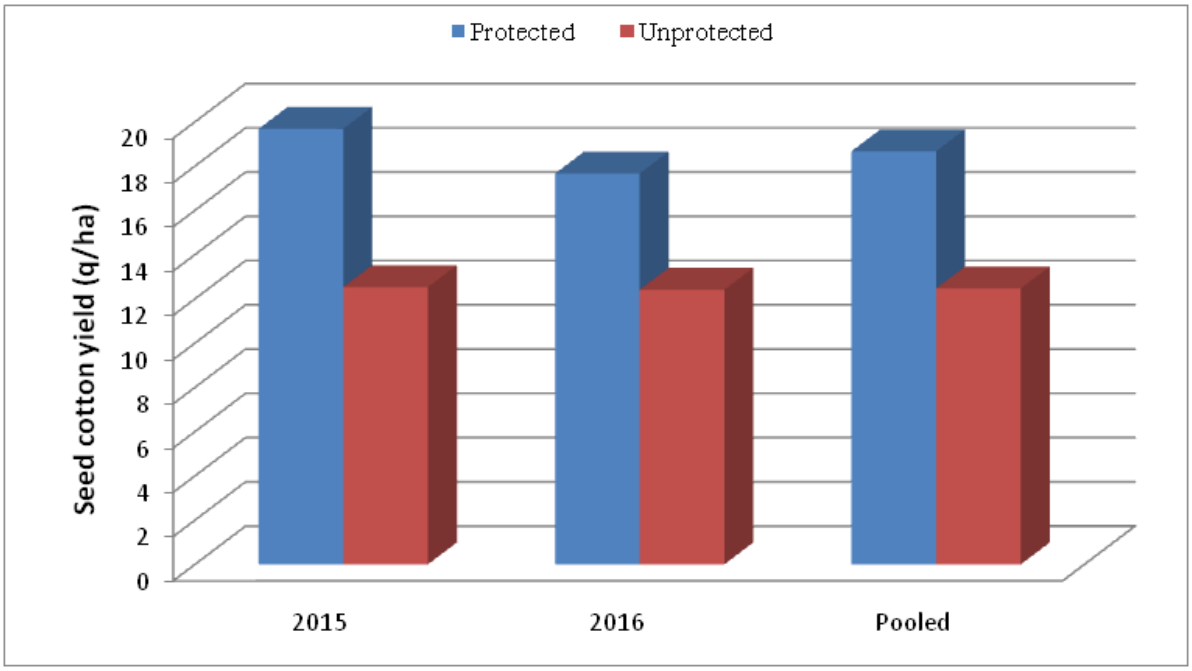


Fig. 1 Mean incidence of sucking pests on *Bt* cotton in protected and unprotected conditions under HDPS

recorded significantly higher mean yield over protected ones with 17.66 q/ha, respectively. The yield was recorded in protected conditions and it differed significantly over unprotected conditions (12.41 q/ha). The mean reduction 29.72 per cent q/ha (Fig. 2) yield was recorded in unprotected treatments over protected treatments.

The pooled data on sucking pest populations *kharif* 2015-2016 and 2016-2017 as influenced by protection irrespective of protected and unprotected condition are presented in Table 2 and Fig.1. The unprotected treatments recorded significantly higher yield over protected ones with 18.67 and 12.47q/ha, respectively with 33.02 per cent (Fig. 2) overall increase yield in the unprotected treatments over protected treatments ones.

Though the incidence of sucking pests *viz.*, aphid, leafhopper, thrips and whitefly were observed and significant differences were recorded among protection levels protected and unprotected condition of *Bt* cotton during *kharif* 2015-2016 and 2016-2017. These results are inconformity with the findings of Dhawan *et al.,* (1988) and Satpute *et al.* (1990) who reported that sucking pests have become quite serious from seedling stage and their heavy infestation at times reduces the crop yield to a great extent, loss due to sucking pests was estimated at 21.20 and 22.86 per cent, respectively. Bhosle *et al.,* (2009) recorded a yield loss of 21.2 per cent in *Bt* cotton due to sucking pest incidence. Bhute (2010) reported that significantly more yield (17.74 q/ha) was obtained under protected condition as compared to unprotected condition (12.56 q/ha). Avoidable loss of 29.20 per cent



Losses in yield of *Bt* cotton under HDPS due to infestation by sucking pests

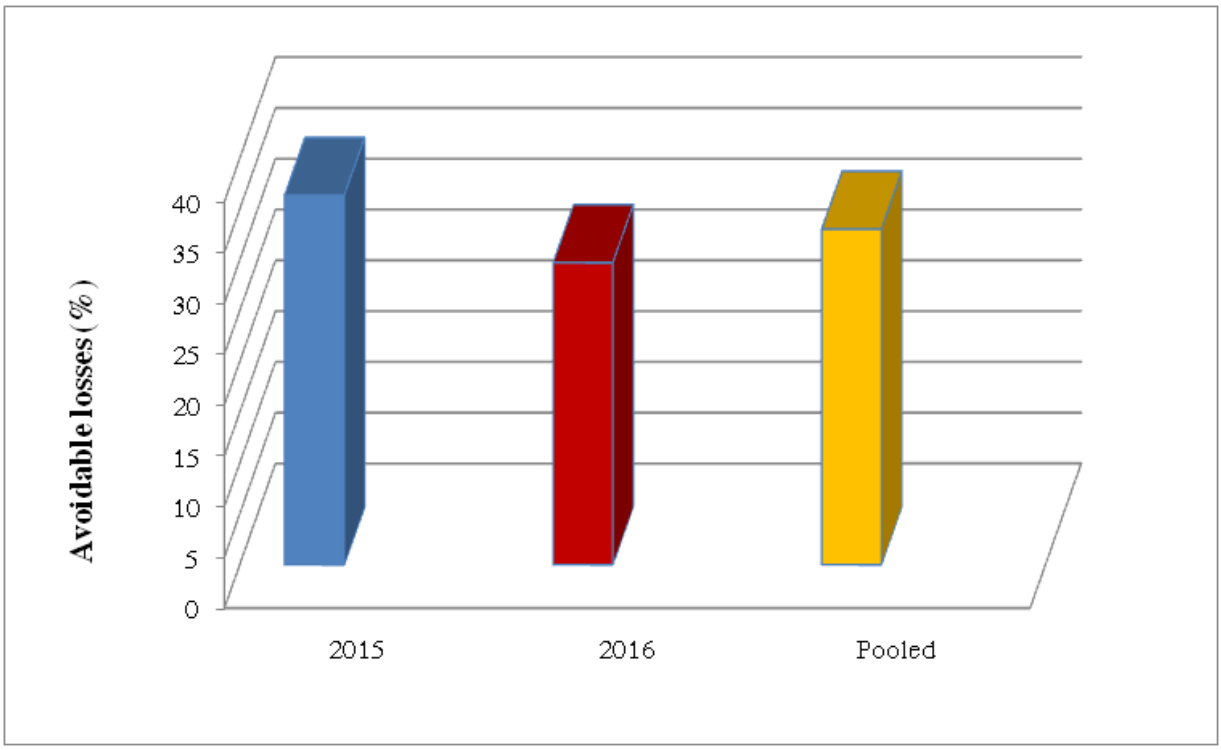


Fig. 2. Estimation of avoidable losses due to sucking pests on *Bt* cotton in protected and unprotected conditions under HDPS

Table 2. Losses in yield of *Bt* cotton under HDPS due to infestation by sucking pests

Sr. No	Treatments	Seed cotton yield (q/ha)			Avoidable losses (%)		
		2015	2016	**Pooled**	2015	2016	**Pooled**
1	Protected	19.68	17.66	**18.67**	36.33	29.72	**33.02**
2	Unprotected	12.53	12.41	**12.47**			
	't' value	12.92*	8.40*	**12.08***			

Table t value at 13 df =2.16; Average of 3 picking; **Significant at 5 % level; *Significant at 1 % level

was observed if crop is protected from major pests. Ramalakshmi (2012) reported that seed cotton yield indicated significant differences between protected and unprotected treatments with a yield of 15.03 and 12.62 q/ha respectively and mean loss of 16.29 % in the seed cotton yield was recorded under unprotected conditions as compared to protected due to sucking pests. Renuka (2013) reported that the significant differences between protected and unprotected treatments in seed cotton yield and *Bt* cotton hybrids recorded highest yield loss (48.89%) due to sucking pests.

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Received for publication : April 29, 2017
Accepted for publication : December 16, 2017