

RESEARCH ARTICLE :

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

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SUMMARY : Studies was carried out during *Kharif* 2015-16 and 2016-17 to investigate on estimation of yield losses due to sucking pests *viz.*, aphids, leafhoppers, thrips and whiteflies, 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 pest 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. The yield differed with protection irrespective of protected and unprotected condition observed that on an average 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.

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KEY WORDS :

Yield losses, Sucking pests, High density planting system, Bt cotton, Protected condition

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BACKGROUND AND OBJECTIVES

Cotton is a major fibre 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 Fibre".

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 2015-16. 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, 2015-16). 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 hectares with total production 71.25 lakh bales with an average productivity of 342 kg per hectare (Anonymous, 2015-16). 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 gossypii* (Glover), Jassids *Amrasca biguttula biguttula*, (Ishida), Whiteflies *Bemisia tabaci*, (Gennadius), Thrips *thrips tabaci*, Mealybugs *Phenococcus solenopsis* (Tinsley). The bollworms include spotted bollworm *Earias vitella* (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%, respectively (Dhawan and Sidhu, 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.

RESOURCES AND METHODS

The field experiment was carried out during *Kharif* 2015 and 2016 at Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S.). Transgenic cotton Balwan (NSC-8899) BG-II sown and the crop were raised as per the package of practices recommended by the VNMKV, Parbhani, (M.S.). 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 details :

- T₁ -Protected condition
 T₂ -Unprotected condition
- One spray of acephate 75% SP @ 20 g/10 lit. water at 30
 - One spray of imidacloprid 17.8% SL @ 4 ml/10 lit. water at 45 DAS
 - One spray of acetamiprid 20% WG @ 2.0 g/10 lit. water at 60 DAS
 - One spray of flonicamide 50% WG @ 2 g/10 lit. water at 75 DAS
 - One spray of fipronil 5 SC @ 30 ml/10 lit. water 90 DAS
 - One spray of diafenthiuron 50% WP @ 12 g/10 lit. 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

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

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 per 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 per 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 per 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

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 /three leaves			Leafhopper population /three leaves			Thrips population /three leaves			Whitefly population /three leaves		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
Protected condition (T ₁)	4.44 (2.22)#	2.89 (1.84)	3.66 (2.04)	1.80 (1.52)	1.99 (7.15)	1.90 (1.55)	3.93 (2.10)	3.72 (2.05)	3.83 (2.08)	1.84 (1.53)	1.78 (1.52)	1.81 (1.51)
Unprotected condition (T ₂)	19.83 (4.51)	9.79 (3.21)	14.81 (3.91)	4.07 (2.14)	7.15 (2.77)	5.61 (2.47)	17.86 (4.29)	12.29 (11.71)	15.08 (3.95)	10.7 (3.35)	14.12 (3.82)	12.41 (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

* and ** indicate significance of values at P=0.01 and 0.05, respectively

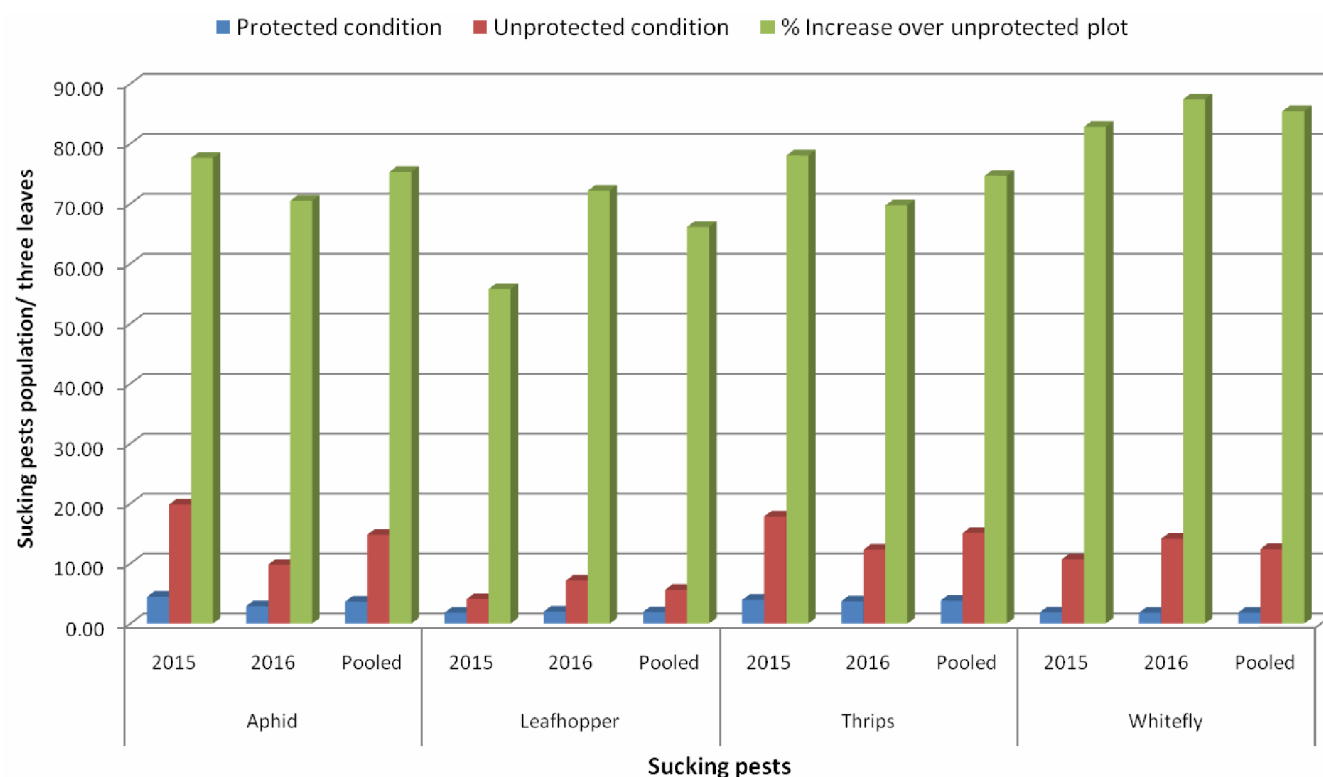


Fig. 1 : Mean incidence of sucking pests on Bt cotton in protected and unprotected conditions under HDPS

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			
2.	Unprotected	12.53	12.41	12.47	36.33	29.72	33.02
	't' value	12.92*	8.40*	12.08*			

Table t value at 13 df =2.16

Average of 3 picking

* and ** indicate significance of values at P=0.01 and 0.05, respectively

1. The unprotected treatments recorded significantly higher leafhopper population over protected ones with 12.41 and 1.81 whitefly per 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 sucking pest population per three leaves. With per cent overall increase in population in the unprotected plot over protected ones. Renuka (2013) who reported that per cent decrease of

sucking pest under protected conditions of Jaadoo and RCH-2 over unprotected plots was recorded, respectively.

Estimation of loss in cotton seed yields :

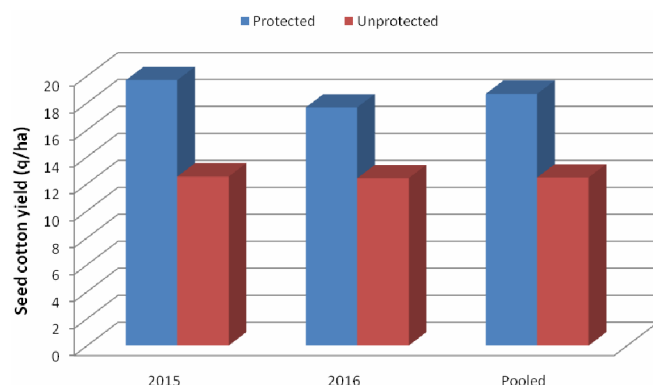
The data pertaining to the seed cotton yield during *Kharif* 2015, *Kharif* 2016 and pooled as influenced by protected and unprotected conditions are presented in Table 2 and Fig. 2. Significant differences were observed between protection and unprotected condition.

During *Kharif* 2015-16, 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* 2016-17 also with significant differences of yield between protections levels of protected and unprotected condition are presented. The unprotected plots 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% q/ha (Fig. 2) yield was recorded in unprotected treatments over protected treatments.

The pooled data on sucking pest populations *Kharif* 2015-16 and 2016-17 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., aphids, leafhopper, thrips and whiteflies were observed and significant differences were recorded among protection levels protected and unprotected condition of Bt cotton during *Kharif* 2015-16 and 2016-17. These results are



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

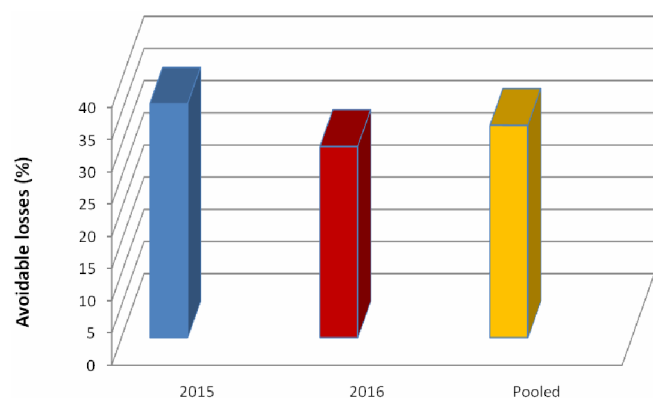


Fig. 2 : Estimation of avoidable losses due to sucking pests on Bt cotton in protected and unprotected conditions under HDPS

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%, respectively. Bhosle *et al.* (2009) recorded a yield loss of 21.2% 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 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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