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**Prasad R Shinde**

Department of Agricultural  
Entomology, Post Graduate  
Institute, Mahatma Phule Krishi  
Vidyapeeth, Rahuri,  
Maharashtra, India

**UB Hole**

Department of Agricultural  
Entomology, Post Graduate  
Institute, Mahatma Phule Krishi  
Vidyapeeth, Rahuri,  
Maharashtra, India

**SM Gangurde**

Department of Agricultural  
Entomology, Post Graduate  
Institute, Mahatma Phule Krishi  
Vidyapeeth, Rahuri,  
Maharashtra, India

## Seasonal incidence of pink bollworm, *Pectinophora gossypiella* (Saund.) in *Bt* and non *Bt* cotton

**Prasad R Shinde, UB Hole and SM Gangurde**

### Abstract

An investigation was undertaken with an objective to study the seasonal incidence of pink bollworm under field condition at the Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, (Maharashtra) for two years (2016-17 and 2017-18). The results indicated that the flower rosetting, green boll damage, pink bollworm larval population per 20 green bolls and locule damage in green bolls in non *Bt* cotton ranged from 1.07 to 28.01 per cent, 0.83 to 70.83 per cent, 0.17 to 22.00 larvae per 20 green bolls and 0.44 to 39.08 per cent respectively, while in *Bt* cotton, 1.77 to 15.73 per cent, 0.83 to 35.00 per cent, 0.17 to 10.50 larvae per 20 green bolls and 0.44 to 18.79 per cent respectively. The peak of flower rosetting, green boll damage, pink bollworm larval population per 20 green bolls and locule damage in green bolls was observed during 46<sup>th</sup>, 48<sup>th</sup>, 48<sup>th</sup> and 48<sup>th</sup> MW, respectively in non *Bt* cotton, while in *Bt* cotton, flower rosetting, pink bollworm larval population per 20 green bolls and locule damage in green bolls was observed during 47<sup>th</sup>, 46<sup>th</sup> and 47<sup>th</sup> MW, respectively. However, the peak green boll damage was observed in 46<sup>th</sup>, 47<sup>th</sup> and 48<sup>th</sup> MW.

**Keywords:** Pink bollworm, *Pectinophora gossypiella*, seasonal incidence, rosette flower, green boll damage, larval population, locule damage.

### Introduction

Cotton, white gold is an important fibre crop of global significance, cultivated in tropical and subtropical regions of more than seventy countries. India is the largest producer of cotton in the world accounting for about 25% of the world cotton production. Average per hectare yield of cotton reduced to 519 kgs per hectare in 2017-18 as against 542 kgs per hectare in 2016-17 in India (Anonymous, 2018) [2]. Though, there are several reasons attributed to this low yield, losses due to pests assume significant importance as cotton crop is a heaven for insects. The pink bollworm, *Pectinophora gossypiella* (Saunders), was described by W.W. Saunders in 1843 as *Depressaria gossypiella* from specimens found to damaging cotton in India. At present, the pink bollworm has been recorded in nearly all cotton-growing countries of the world and is a key pest in many of these areas. In recent years, severe damage to bolls by pink bollworm and yield-losses were observed in *Bt*-cotton in many regions of Gujarat and some parts of AP, Telangana and Maharashtra. (Kranthi, 2015) [9]. Maharashtra is also having more than 90% area under *Bt* cotton genotypes. Therefore, the present studies were designed to collect information on the incidence of pink bollworm on cotton.

### Materials and Methods

This experiment was carried out in black cotton soil at Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri during *kharif* 2016-17 and 2017-18. The *Bt* cotton hybrid, RCH-2 BG-II, along with a popular inter-specific non-*Bt* hybrid, DCH-32 were used under unprotected irrigated conditions. A bulk plot of 1000 m<sup>2</sup> was maintained each with *Bt* cotton and non *Bt* cotton hybrid to assess the pink bollworm incidence at field level. Each plot was divided into three subplots. The observations on flower rosetting, per cent green boll damage, number of PBW larvae per 20 green bolls and locule damage in green boll were recorded in both the *Bt* and non *Bt* cotton plots. 60 green cotton bolls collected for estimation of pink bollworm larval population and then total number of pink bollworm larvae per 20 bolls was worked out. Per cent rosette flowers, per cent green boll damage and per cent locule damage in green boll were worked out by using the following formulae (Nadaf, 2006) [13],

### Correspondence

**Prasad R Shinde**

Department of Agricultural  
Entomology, Post Graduate  
Institute, Mahatma Phule Krishi  
Vidyapeeth, Rahuri,  
Maharashtra, India

$$\begin{aligned} \text{Per cent Rosette flowers} &= \frac{\text{Number of Rosette flowers}}{\text{Total number of flowers}} \times 100 \\ \text{Per cent green boll damage} &= \frac{\text{No. of damaged green bolls}}{\text{Total No. of green bolls observed}} \times 100 \\ \text{Per cent locule damage} &= \frac{\text{Damaged locules}}{\text{Total number of locules}} \times 100 \end{aligned}$$

All observations were taken at weekly intervals on randomly selected 15 plants by avoiding border rows and analyzed by "t" test after suitable transformation.

**Results and Discussion**

**Rosette flower**

The data presented in Table 1 shows that significantly lower percentage of rosette flowers was recorded in RCH-2 BG-II (6.64 per cent) compared to non-Bt DCH-32 (11.50 per cent)

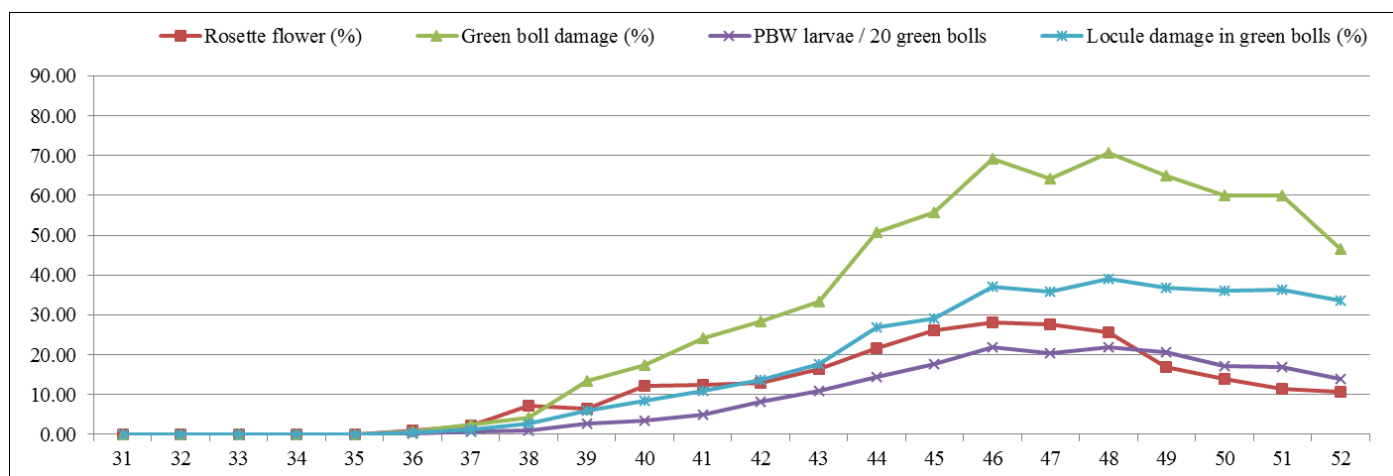
as revealed by the seasonal average. The incidence of pink bollworm started in the first week of September (36<sup>th</sup> MW) in non Bt cotton and in the third week of September (38<sup>th</sup> MW) in Bt cotton and there after increased gradually reaching to its peak in the second week of November (46<sup>th</sup> MW) in non Bt cotton, while, in the third week of November (47<sup>th</sup> MW) in Bt cotton as 28.01 and 15.73 per cent, respectively. Later on the incidence declined gradually in both Bt and non-Bt cotton during 2016-17 and 2017-18).

**Table 1:** Seasonal incidence of pink bollworm in non-Bt and Bt cotton (pooled w.e.f. 2016-17 to 2017-18)

Date	MW	Rosette flowers (%) Pooled*		% Green boll damage Pooled#		PBW larval population / 20 green bolls Pooled*		Locule damage in green bolls# (%)	
		DCH-32 Non Bt	RCH -2 Bt	DCH-32 Non Bt	RCH -2 Bt	DCH-32 Non Bt	RCH -2 Bt	DCH-32 Non Bt	RCH -2 Bt
30 Jul - 05 Aug	31	--	--	--	--	--	--	--	--
06 Aug - 12 Aug	32	--	--	--	--	--	--	--	--
13 Aug - 19 Aug	33	--	--	--	--	--	--	--	--
20 Aug - 26 Aug	34	--	--	--	--	--	--	--	--
27 Aug - 02 Sep	35	--	--	--	--	--	--	--	--
03 Sep - 09 Sep	36	1.07 (1.25)	0.00 (0.71)	0.83 (5.24)	0.00 (0.00)	0.17 (0.82)	0.00 (0.71)	0.44 (3.81)	0.00 (0.00)
10 Sep - 16 Sep	37	2.11 (1.61)	0.00 (0.71)	2.50 (9.10)	0.00 (0.00)	0.67 (1.08)	0.00 (0.71)	1.33 (6.61)	0.00 (0.00)
17 Sep - 23 Sep	38	7.25 (2.78)	1.77 (1.51)	4.17 (11.78)	0.00 (0.00)	1.00 (1.22)	0.00 (0.71)	2.81 (9.65)	0.00 (0.00)
24 Sep - 30 Sep	39	6.49 (2.64)	2.83 (1.82)	13.33 (21.42)	0.83 (5.24)	2.67 (1.78)	0.17 ((0.82)	6.03 (14.22)	0.44 (3.81)
01 Oct - 07 Oct	40	12.29 (3.58)	3.44 (1.98)	17.50 (24.73)	3.33 (10.53)	3.50 (2.00)	0.67 (1.08)	8.33 (16.77)	1.77 (7.64)
08 Oct - 14 Oct	41	12.51 (3.61)	6.95 (2.73)	24.17 (29.45)	5.00 (12.92)	4.83 (2.31)	1.00 (1.22)	10.86 (19.24)	2.21 (8.55)
15 Oct - 21 Oct	42	12.95 (3.67)	8.45 (2.99)	28.33 (32.16)	7.50 (15.89)	8.17 (2.94)	1.50 (1.41)	13.61 (21.65)	3.68 (11.06)
22 Oct - 28 Oct	43	16.36 (4.11)	11.29 (3.43)	33.33 (35.26)	16.67 (24.09)	11.00 (3.39)	3.33 (1.96)	17.74 (24.91)	6.88 (15.20)
29 Oct - 04 Nov	44	21.70 (4.71)	12.95 (3.67)	50.83 (45.48)	25.83 (30.55)	14.33 (3.85)	5.67 (2.48)	26.98 (31.29)	11.74 (20.04)
05 Nov - 11 Nov	45	26.21 (5.17)	15.07 (3.95)	55.83 (48.35)	28.33 (32.16)	17.67 (4.26)	8.00 (2.92)	29.22 (32.72)	13.72 (21.74)
12 Nov - 18 Nov	46	28.01 (5.34)	15.71 (4.03)	69.17 (56.27)	35.00 (36.27)	21.83 (4.73)	10.50 (3.32)	36.97 (37.45)	18.66 (25.59)
19 Nov - 25 Nov	47	27.51 (5.29)	15.73 (4.03)	64.17 (53.23)	35.00 (36.27)	20.50 (4.58)	9.83 (3.21)	35.93 (36.83)	18.79 (25.69)
26 Nov - 02 Dec	48	25.74 (5.12)	13.73 (3.77)	70.83 (57.31)	35.00 (36.27)	22.00 (4.74)	10.33 (3.29)	39.08 (38.69)	18.64 (25.58)
03 Dec - 09 Dec	49	16.88 (4.17)	10.68 (3.34)	65.00 (53.73)	30.00 (33.21)	20.67 (4.60)	9.50 (3.16)	36.71 (37.29)	18.04 (25.13)
10 Dec - 16 Dec	50	13.84 (3.79)	9.67 (3.19)	60.00 (50.77)	25.00 (30.00)	17.17 (4.20)	7.33 (2.80)	36.13 (36.95)	15.17 (22.92)
17 Dec - 23 Dec	51	11.31 (3.44)	9.29 (3.13)	60.00 (50.77)	23.33 (28.88)	17.00 (4.18)	6.67 (2.68)	36.45 (37.17)	14.26 (22.19)
24 Dec - 31 Dec	52	10.79 (3.36)	8.57 (3.01)	46.67 (43.09)	22.50 (28.32)	13.83 (3.79)	5.83 (2.52)	33.56 (35.40)	14.72 (22.56)
Seasonal Mean		11.50 (3.05)	6.64 (2.34)	30.30 (28.55)	13.33 (16.39)	8.95 (2.64)	3.65 (1.75)	16.92 (20.03)	7.12 (11.71)
T Value		2.33		2.92		2.74		2.82	
Table Value		2.03		2.04		2.04		2.03	

\*Figures in parentheses are square root transformed values

# Figures in parentheses are arc sin transformed values



**Fig 1:** Seasonal incidence of pink bollworm in non Bt cotton (Pooled)

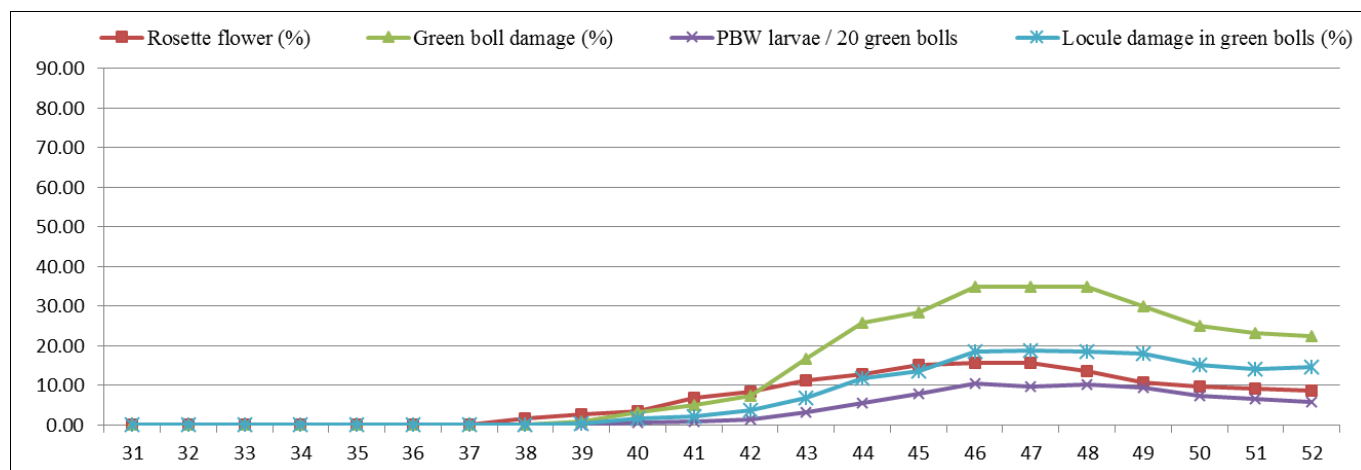


Fig 2: Seasonal incidence of pink bollworm in Bt cotton (Pooled)

These results are in the line with the findings of Nadaf and Goud (2006) [11] who reported that irrespective of Bt and non-Bt cotton, the rosette flowers were observed from September onwards, which peaked during the 45<sup>th</sup> week of November. Later, there was a gradual decrease in the number of rosette flowers, while, Verma *et al.* (2017) [19] observed that the pink bollworm, *P. gossypiella* infestation on flowers found higher in 2<sup>nd</sup> week of September with intensity of 7 larvae/ 30 flowers. Benedict *et al.* (1996) [4] reported significantly lower flower bud injury in Bt cotton as compared to non-Bt cotton lines. Taneja (1980) [18], Sharma (1981) [15] and Singh and Sidhu (1982) [16] reported as high as 22.00 per cent rosette flowers recorded on early maturing *hirsutum* varieties.

### Green Boll Damage

Significantly minimum mean green boll damage (13.33 per cent) was recorded in Bt cotton as compared to 30.30 per cent in non-Bt cotton. The pink bollworm infestation in green boll started from first week of September i.e. 36 MW (0.83 per cent) in non-Bt cotton, while in Bt cotton it was started from fourth week of September i.e. 39 MW (0.83 per cent). However, irrespective of non-Bt and Bt cotton, peak green boll damage was recorded during first week of December (48<sup>th</sup> MW) which was 70.83 and 35.00 per cent in non-Bt and Bt cotton, respectively (Table 1).

The present findings of per cent damage on green bolls due to *P. gossypiella* corroborate with the results of Anonymous (2017b) [1], who reported that the green boll damage was ranged from 5.04 to 84.07 with peak infestation during the end of the season (49<sup>th</sup> MW) in Rahuri. Verma *et al.* (2017) [19] and Solangi *et al.* (2016) [17] reported that *P. gossypiella* infestation started late in Bt cotton than non-Bt cotton with peak in the second week of September, while Laxman *et al.* (2014) [10] recorded maximum green boll damage in October.

### Larval population of pink bollworm in green bolls

The larval infestation on green bolls in non-Bt cotton varied from 0.17 to 22.00 larvae per 20 green bolls, with a seasonal mean of 8.95 larvae per 20 green bolls while, in Bt cotton, it varied from 0.17 to 10.50 larvae per 20 green bolls (seasonal mean of 3.65 larvae/20 green bolls). In non-Bt cotton, incidence started from first week of September (36<sup>th</sup> MW) (0.17 larvae/20 green bolls) and it was minimum up to 38<sup>th</sup> MW and later, the larval population increased gradually with a peak of 22.00 larvae per 20 bolls during 48<sup>th</sup> MW. However, in Bt cotton, incidence of pink bollworm started from 39<sup>th</sup> MW (0.17 larvae/20 green bolls) and there was gradual

increase in the larval population from 43<sup>rd</sup> MW and reached to peak of 10.50 larvae per 20 bolls during 46<sup>th</sup> MW (Table 1).

The present findings on larval population of *P. gossypiella* in green bolls corroborate with the results of Anonymous (2017b) [1], who reported that the larval population were ranged from 3.60 to 24.00 larvae/ 5 plants with peak infestation during the end of the season (49<sup>th</sup> MW) in Rahuri. Nadaf and Goud (2006) [11], Bambawale *et al.* (2004) [3] reported that significantly lower number of pink bollworm larvae was registered in Bt and non-Bt cotton. Similar results were obtained by Henneberry and Jech (2000), Nadaf and Goud (2007b) and Rawal *et al.* (2017) [6, 12, 14].

### Locule damage in green bolls

Per cent locule damage in green bolls ranged from 0.44 to 39.08 and 0.44 to 18.79 in non-Bt and Bt cotton, respectively. During peak boll developmental period (up to November), maximum of 17.74 per cent locule damage in green bolls were noticed in non-Bt cotton, while, in Bt cotton it was 6.88 per cent. During early period of crop growth, very less locule damage in green bolls was observed in both non-Bt and Bt cotton. Whereas, at first week of December (48<sup>th</sup> MW) highest locule damage in green bolls (39.08 per cent) registered in non-Bt cotton, while in Bt cotton, highest 18.79 per cent locule damage in green bolls was registered at last week of November (47<sup>th</sup> MW). However, significant difference in the mean locule damage in green bolls in non-Bt cotton (16.92 per cent) and Bt cotton (7.12 per cent) was observed (Table 1).

The present findings on locule damage in green bolls due to *P. gossypiella* corroborate with the results of Anonymous (2017b) [1], who reported that the locule damage in green bolls were ranged from 3.15 to 49.25 per cent with peak locule damage during the end of the season (49<sup>th</sup> MW) in Rahuri. Verma *et al.* (2017) [19] observed that the locule damage in green bolls due to pink bollworm, *P. gossypiella* was found higher in 2<sup>nd</sup> week of September with intensity of 18.05 per cent. Locule damage due to pink bollworm was 9.14 to 10.54 per cent in Bt cotton hybrids, while it was 17.61 to 19.66 per cent in non Bt cotton hybrids (Bhosle *et al.*, 2004) [5]. Similar results were obtained by Hugar *et al.* (2006) [7] and Jeushale *et al.* (2007) [8].

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