



Performance of Bt Cotton against Insect Pest Complex under Field Conditions

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ABSTRACT

Bt cotton hybrids were proved highly resistant against bollworms with very low larval incidence of both American and pink bollworms which resulted in less fruiting body damage compared to non Bt hybrid. However, the incidence of sucking pests was slightly elevated in Bt hybrid and simultaneously the population of predatory species was also high. The high seed cotton yield together with less investment on plant protection resulted in high cost benefit ratio from Bt hybrid compared to its non Bt hybrid under field conditions.

Key words : Bt cotton, Bollworms, C:B ratio, Sucking pests, Predators.

Cotton is the most vital crop of commerce in the tropical and sub tropical region and is popularly referred as White Gold. Andhra Pradesh occupies prime place in country's cotton scenario, contributing around 15 per cent production from an area of about 10 lakh hectares. Among the various problems that confront cotton cultivation, the major reason for the low productivity in cotton is insect pests attack. The average yield loss in cotton due to insect pests alone is estimated around 35 per cent and the major culprits will always be the bollworms. The farming community continues to believe that the only remedial measure to keep the pests under check is insecticides. Hence, over dependence and indiscriminate use of insecticides led to the control failures of the target pests due to development of resistance in many of the major pests and resurgence of minor pests besides causing hazards to the bio control agents and environmental pollution.

The rapid changes witnessed in the biotechnology resulted in the development of genetically modified crops which evolved as effective alternate tools for pest management. Transfer of crystal gene (Cry1Ac) derived from soil bacterium, *Bacillus thuringiensis* to the cotton plants offered greatest resistance to American bollworm, pink bollworm and spotted bollworms. Apart from the improvement in yield of cotton, Bt hybrids have also reduced the bollworm incidence and consequently the pesticide usage by at least 50-75 per cent (Kranthi, 2002). Though the Bt hybrids are resistant to bollworms, there are reports on high incidence of sucking pests in Bt hybrids and occurrence of natural enemies also varied in Bt hybrids. Hence, the incidence of different insect pests on Bt cotton was studied at RARS, Lam.

MATERIAL AND METHODS

The Bt hybrid (Bunny Bt) and its non Bt counterpart (Bunny hybrid) were sown in two blocks of 100 sq.m at RARS, Lam, Guntur during *khariif*, 2004-05 and 2005-06 which were kept completely under unprotected conditions. The incidence of sucking pests and bollworms was recorded from 25 randomly selected plants at weekly interval from each block. Sucking pests such as aphids, (nymphs), thrips and whiteflies (both nymphs and adults) were recorded from three leaves, each one from top, middle and bottom canopies of the plant, while the bollworms and natural enemies were recorded from whole plant. Another two blocks of 150 sq.m were maintained with Bt and its non Bt hybrids for evaluating the economics which received need based plant protection. Cost of cultivation and yield were recorded for both Bt and non Bt hybrid and cost benefit ratios were calculated. The mean data of two seasons i.e. 2004-05 and 2005-06 was given in the present study.

RESULTS AND DISCUSSION

The incidence of sucking pests such as aphids, and whiteflies was more on Bt hybrid compared to non Bt hybrid. The average number of aphids was 9.34/ 3 leaves in Bt hybrid as against 7.53/ 3 leaves in non Bt hybrid. The number of jassids was 8.65 and 7.27/ 3 leaves and whiteflies were 3.04 and 2.87/3 leaves in Bt and non Bt hybrids respectively under unprotected conditions (Fig.1). The data clearly indicating that the Bt hybrids are more prone to sucking pests which is in agreement with many of the earlier reports. The incidence of sucking pests was comparatively high in Bt cotton

Table 1. Economics of plant protection technologies in Bt and non Bt hybrid

S.No.	Particulars	Bt	Non Bt
1	No. of sprays	6	12
	Sucking pests	5	4
	Bollworms	1	8
2	Plant Protection cost (Rs ha ⁻¹)	4,460	14,530
3	Yield (q ha ⁻¹)	34.87	22.58
4	Gross Income (Rs ha ⁻¹)	64,509	41,773
5	Cost of Cultivation (Rs ha ⁻¹)	26,680	33,741
6	Net Income (Rs ha ⁻¹)	37,829	8,032
7	Cost Benefit Ratio	1:2.42	1:1.23

* Price of Kapas @ Rs.1850 q⁻¹

cultivars than their corresponding non Bt cotton cultivars (Radhika *et al.*, 2004; Abro *et al.*, 2004; Cui and Xia, 2000). However, the present results are contradicting with Reed *et al.* (2000) and Bambawale *et al.* (2004) who reported that the incidence of sucking pests was more or less similar in both Bt and non Bt hybrids.

The incidence of *H.armigera* larvae was almost nil in Bt hybrid while it was above ETL i.e. 1.05/plant in non Bt hybrid. The per cent square damage was also negligible (1.25 %) in Bt hybrid as against 46.38 per cent in non Bt hybrid (Fig.2). The incidence of pink bollworm and locule damage in green bolls due to pink bollworm was also very low in Bt hybrid. The mean number of larvae over two seasons was only 3.25/10 bolls in Bt hybrid as against 13.86/10 bolls in non Bt hybrid, while the per cent locule damage in green bolls was 17.20 and 50.87 in Bt hybrid and non Bt hybrid, respectively (Fig.3). The present data indicate that the Bt hybrids are highly resistant against bollworms which is concurrent with the earlier reports. Bt cottons were highly resistant to *H.armigera* and the larval populations were significantly lower than in non Bt cottons (Cui and Xia, 2000; Vennila *et al.*, 2004). The occurrence of pink bollworm larvae was also significantly low in Bt cottons compared to non Bt cottons (Bambawale *et al.*, 2004; Patil *et al.*, 2004) which was evident from the present study.

The Bt hybrids had no adverse effects on natural enemies or bio control agents as reported earlier, since the population of natural enemies was high in Bt hybrid compared to non Bt hybrid (Fig.4). The population of natural enemies such as wasps and ladybird beetles was higher in Bt cotton fields compared to conventionally sprayed non Bt cotton fields (Burankanonda, 1999). The population of predators was 24 - 25 per cent more in Bt cotton fields (Xia *et al.*, 1999). These reports support the

present data which showed that the occurrence of natural enemies was high in Bt hybrid (1.23 plant⁻¹) compared to non Bt hybrid (1.06 plant⁻¹). But the present results are contradicting with Cui and Xia (2000) who reported that there was no significant increase in the populations of predatory arthropods in Bt cotton fields compared to non Bt cotton fields.

The average seed cotton yield was high from Bt hybrid (34.87 q ha⁻¹) compared to non Bt hybrid (22.58 q ha⁻¹) which can be attributed to very low incidence of both American and pink bollworms in Bt hybrid (Fig.5). The results obtained in the present study are in harmony with Benedict *et al.* (1996) and Wu *et al.* (2003) who reported that the seed cotton yield from Bt cotton hybrids was significantly higher than non Bt hybrids.

The economic evaluation indicated that Bt hybrid received six sprays as against twelve sprays in non Bt hybrid. As many as five interventions are against sucking pests (2 stem applications + 3 foliar sprays) and only one spray for control of bollworms at a total cost of Rs.4,460 ha⁻¹. While, in non Bt hybrid, four sprays against sucking pests and eight rounds against bollworms and altogether 12 insecticide sprays were given with a total investment of Rs.14,530 ha⁻¹ (Table.1). The high seed cotton yield together with low cost of plant protection resulted in high cost benefit ratio from Bt hybrid (1:2.42) compared to non Bt hybrid (1:1.23) (Table.1). Yousouf *et al.* (2001) reported that Bt cotton cultivation resulted in increased yields, reduction in pesticide cost and gave a substantial increase in gross margins with high cost benefit ratio.

Conclusion

Transgenic Bt cotton with inbuilt resistance reduced the incidence of bollworms such as American bollworm and pink bollworm with minimum insecticidal interventions. While, the incidence of

Fig.1: Mean incidence of sucking pests in Bt and non Bt hybrids

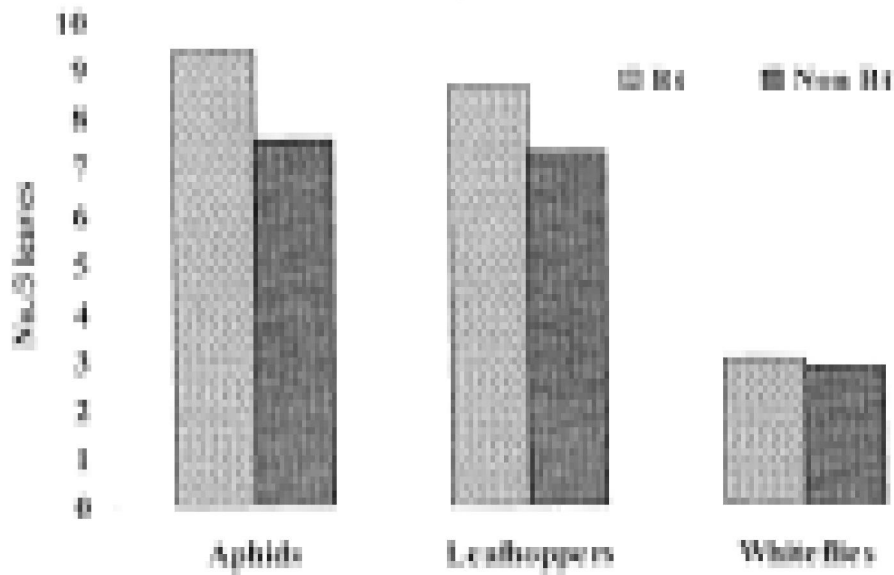
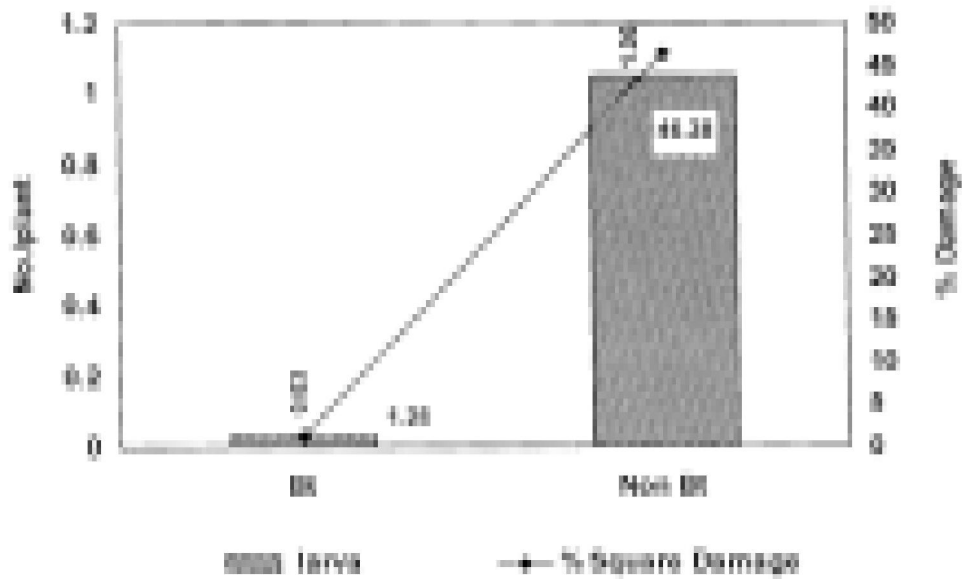


Fig.2: Mean incidence of *Harmigera* larva and damage



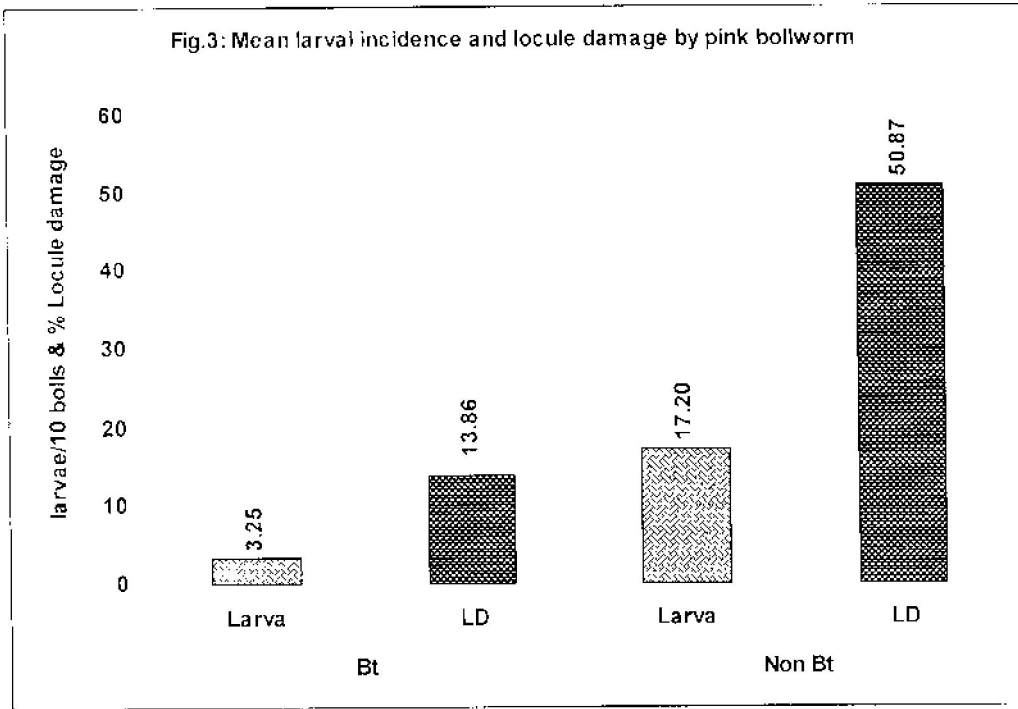


Fig.4: Mean occurrence of natural enemies

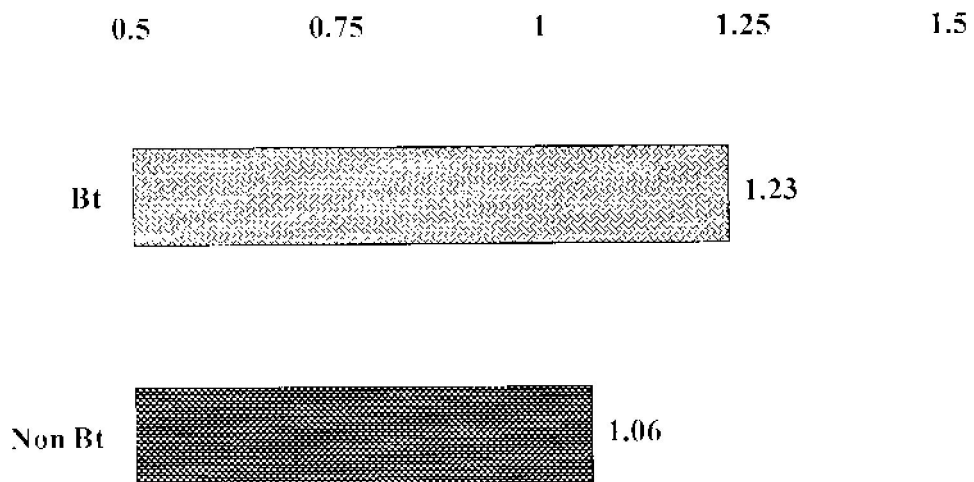
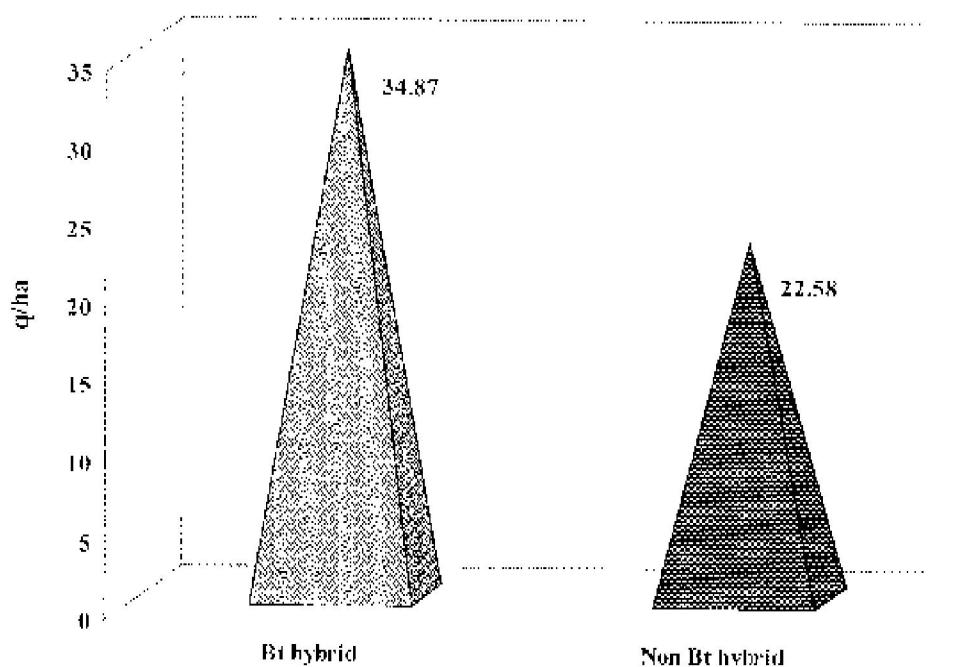


Fig.5: Mean seed cotton yield



sucking pests was more which necessitated additional insecticidal interventions than in non Bt hybrid. Bt cotton hybrids had no adverse effects on bio control agents or natural enemies. Growing of Bt cotton resulted in 50 % saving in pesticide usage and 69.30 % saving from cost of plant protection with 35.24 % increase in kapas yield.

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