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EVALUATION OF BT COTTON UNDER INTEGRATED PEST MANAGEMENT

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ABSTRACT

Field experiments were conducted at Regional Agricultural Research Station, Lam, Guntur to study the performance of Bt cotton under IPM, conventional control (CC) and unprotected conditions (check) for two consecutive seasons. The incidence of aphids and whiteflies was low in IPM block compared to conventional control, while the incidence of leafhoppers was high under IPM. But the population of thrips was more or less similar. The larval incidence and fruiting bodies damage of American and pink bollworm were slightly high in IPM block. The activity of natural enemies under ecofriendly IPM was more compared to conventional control and check without pesticidal application. Though the yield was slightly less, the cost benefit ratio was high from IPM block (1:2.26) compared to conventional control (1:1.57) due to low cost of plant protection. Hence, 'Bt' cotton hybrids should be viewed as a foundation on which Integrated Pest Management (IPM) has to be built up to combat the pest problems for sustainable transgenic Bt cotton cultivation.

Key words: Bt cotton, IPM, C:B ratio

Cotton is one of the most important commercial crop of Andhra Pradesh and insect pest complex is one of the major constraint. Over dependence and indiscriminate use of insecticides led to control failures due to development of resistance in major pests and resurgence of minor pests besides deleterious effect on the biocontrol agents. IPM helps in preservation of natural biodiversity apart from reducing the cost of plant protection. The genetically modified transgenic Bt cotton was commercially available in India from 2002 and found favor with farmers due to its favourable role in IPM. However, conflicting reports are available on the incidence of insect pests on transgenic Bt cotton hybrids. (Cui and Xia, 2000; Barwale *et al*., 2002). If transgenic Bt cotton is to be a major component in IPM, it is important to evaluate the impact of IPM strategies on Bt cotton and to formulate a suitable IPM module. Hence, the present study is aimed to evaluate Bt cotton under different modules and the results presented herein.

MATERIALS AND METHODS

The experiment was conducted at Regional Agricultural Research station (RARS), Lam, Guntur during *kharif*, 2005-06 and 2006-07 under rainfed conditions in black cotton soils. Bunny Bt was sown during second fortnight of July at a spacing of 120 × 60 cm. The agronomic practices were taken up as per the recommendations except for plant protection measures. Three different modules adopted are as follows:

1. IPM block : Area -750 sq.m
2. Conventional control block (CC) : Area - 350 sq.m
3. Unprotected block (Check) : Area - 200 sq.m

IPM block had the following:

Seed treatment with imidacloprid @ 5g/kg seed; stem application with imidacloprid at 1:20 ratio; intercropping with green gram; growing jowar as border crop; growing marigold and castor as trap crops; erection of bird perches; installation of pheromone traps; spraying with 5% NSKE; and need based application of insecticides

Conventional control block (CC) had Insecticidal interventions taken up for every 7 to 10 days in Bt hybrid.

Unprotected block (Check) had Bt cotton kept under completely unprotected conditions without any pest management interventions.

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The incidence of sucking pests, bollworms, fruiting body damage and the occurrence of natural enemies were recorded at weekly intervals from 25 randomly selected plants. Sucking pests such as aphids, leafhoppers, thrips and whiteflies were recorded from three leaves, each one from top, middle and bottom canopies. For the bollworms damage to fruiting parts and natural enemies were recorded from whole plant. Cost of cultivation and yields were recorded and cost benefit ratio calculated. The incidence of different pests and damage were given as seasonal mean and cost of cultivation as mean for both the seasons.

RESULTS AND DISCUSSION

The seasonal mean data showed that the incidence of aphids was low under IPM (3.02/3 leaves) compared to conventional control (CC) (4.68/3 leaves) and check (6.39/3 leaves); and IPM practices played a major role in suppressing aphid population. The population of leafhoppers was 0.92/3 leaves under conventional control, while it was 1.70/3 leaves under IPM, which indicated that its incidence was reduced by the insecticidal interventions effectively than IPM practices (Fig.1). The thrips incidence was more or less similar under both IPM (5.55/3 leaves) and conventional control (5.03/3 leaves) with slightly higher population in unprotected block (6.26/3 leaves). But the incidence of whiteflies was high in conventional control block (3.43/3 leaves) compared to IPM (1.92/3 leaves) and check (1.95/3 leaves) (Fig.1), indicating resurgence due to frequent insecticidal sprayings. In general, the population of all the sucking pests was high in check compared to IPM and conventional control modules except whiteflies. The lower incidence of sucking pests under conventional control can be attributed to insecticidal interventions at frequent intervals, but resulted in resurgence of whiteflies. While adoption of IPM practices such as seed treatment, stem application, intercropping with greengram and spraying with 5% NSKE reduced the population of sucking pests under IPM without any insecticidal interventions. The efficacy of imidacloprid at 5, 7.5 and 10 g /kg seed as seed dresser is similar to earlier reports in controlling the leafhoppers, aphids, thrips and whiteflies upto 30-50 days after sowing (Gupta *et al*., 1998; Satpute *et al*., 2001; Kannan *et al*., 2004). Rama Rao *et al*. (1998) reported that stem application with imidacloprid (200 SL) at 1:20 dilution at 20, 40 and 60 DAS was highly effective in controlling aphids, leafhoppers and mealy bugs. Venkatesan *et al*. (1987) observed low incidence of leafhoppers when intercropped with greengram and blackgram, while Rao and Chari (1992) reported that the cotton crop bordered by sorghum showed significantly lower aleyrodid populations. Sohi *et al*. (2004) reported that the incidence of leafhoppers and whiteflies per leaf were low in IPM fields.

The egg load of *H.armigera* was high in check (0.34/plant) followed by conventional control (0.17/plant) and IPM (0.11/plant). The mean larval population was very low and never reached ETL in any of the module due to the toxic effect of Bt protein and it was further reduced both under IPM (0.03/plant) and conventional control (0.02/plant) compared to check (0.08/plant) (Fig.2). The higher population of natural enemies and spraying of NSKE 5% reduced the egg load under IPM, while it can be attributed to

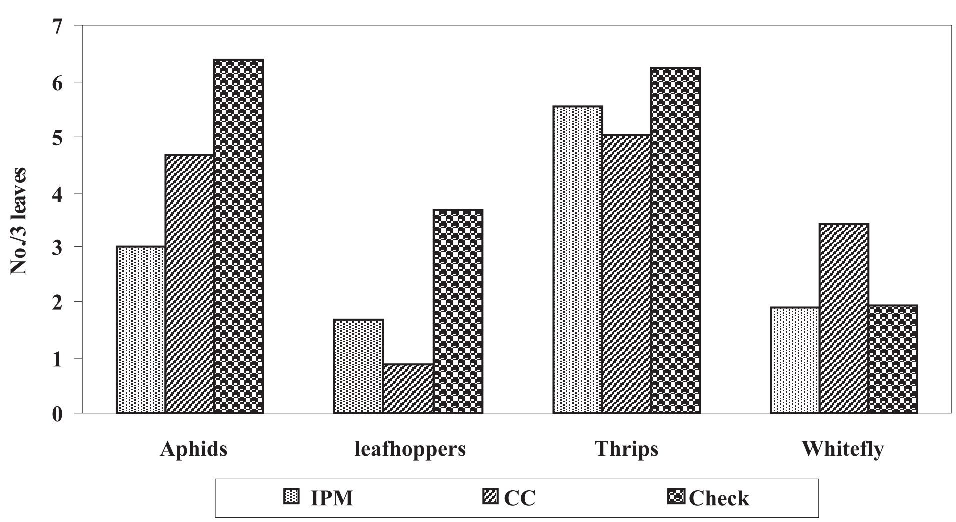

Fig. 1. Seasonal mean incidence of sucking pests in Bt hybrid

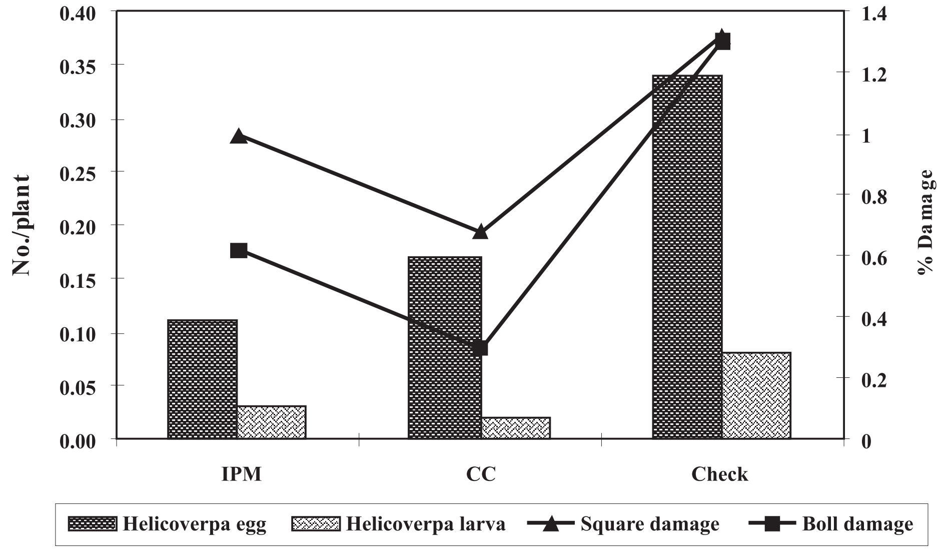

Fig. 2. Seasonal mean larval incidence of and fruiting body damage of *H.armigera*

insecticidal sprays under conventional control. Ramteke *et al*. (2002) reported that NSKE (5%) and neem oil (300 ppm) were more economical in suppressing the population of *H.armigera*. Sohi *et al*. (2004) reported that the larval incidence of *H.armigera* per plant, *E.vitella* and *P. gossypiella* in intact green fruiting bodies were low in IPM fields.

The present studies indicated that the mean per cent square and boll damages were high in IPM block compared to conventional control which can be attributed to insecticidal interventions (Fig.2). In contrast, Kulkarni *et al*. (2004) reported that the mean boll damage was 12.16 % in Bt cotton with IPM against 14.58 % in Bt cotton with insecticide spraying. Bambawale *et al*. (2004) reported significant reduction in boll damage by the bollworms in Bt cotton with IPM which was 11.5 % as against 29.4 % in conventional control.

The larval incidence of pink bollworm through destructive sampling showed that the mean number of larvae and per cent locule damage in green bolls due to pink bollworm were comparatively low under conventional control than IPM and check module. The number of pink bollworm larvae/10 bolls were 0.30, 0.20 and 0.20 under IPM, conventional control and check, respectively (Fig.3). Earlier, Sohi *et al*., (2004) reported that the larval incidence of *P.gossypiella* in intact green fruiting bodies were low in IPM fields compared to that of non IPM fields.

The occurrence of natural enemies was high under IPM (0.37/plant) followed by check (0.25/plant) while it was very low under conventional control (0.14/plant) (Fig.4). The population of natural enemies were conserved under IPM due to intercrop, application of safer chemicals like NSKE, avoidance of early season sprays through seed treatment and stem application. The increase natural enemies due to seed treatment (Kannan *et al*., 2004), due to intercropping with greengram or blackgram (Venkatesan *et al*., 1987) had been well documented. Kulkarni *et al*. (2004) reported that natural enemies population was significantly higher i.e. 9.93/ plant in Bt cotton IPM when compared to 7.87/ plant in Bt cotton with insecticidal sprayings. The population of coccinellids and chrysopids increased by 45.5 and 38.7%, respectively in Bt cotton IPM plots over control (Cui and Xia, 1998).

The seed cotton yield was slightly high from conventional control (36 q/ha) compared to IPM (34 q/ha) and it was low in check (21 q/ha). But, the cost benefit ratio was high from IPM block (1:2.26) compared to conventional control (1:1.85) and check (1:1.80) (Table 1). Though the yield was high, the net profit and cost benefit ratio were low from conventional control module due to higher plant protection cost than in IPM and check. The number of interventions were only six with low cost techniques like stem application and spraying of NSKE led to low plant protection cost of Rs. 2608/ha under IPM as against 12 insecticidal interventions with Rs.8688 /ha under conventional control module, which resulted in low net profit though the yield was high in conventional control. The present results reveal the fact that the use of insecticides indiscriminately lead to the reduction in net profits with

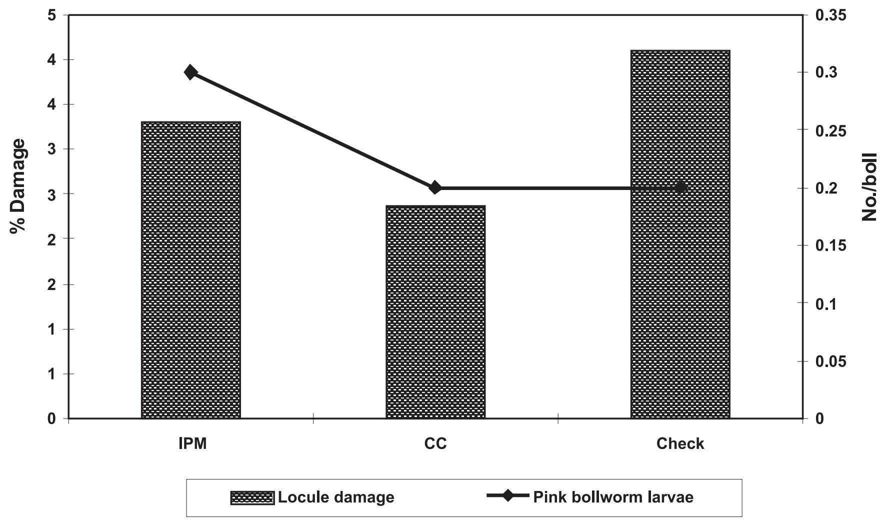

Fig.3. Seaonal mean incidence of pink bollworm larvae and locule damage in green bolls

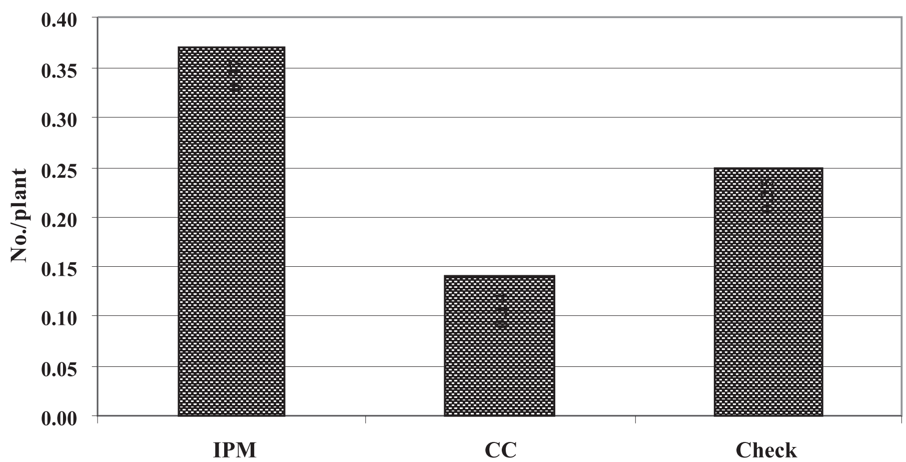

Fig. 4. Mean incidence of natural enemies under different control modules

Table 1. Economics of different modules on Bt cotton (2005-06 & 2006-07)

S.No.	Particulars	Bt cotton hybrid IPM	Coventional control	Untreated check
1	Plant protection cost (Rs/ha) -Interventions	2608	8688	0
	-Stem application of insecticides	3	-	-
	-Botanicals (NSKE)	1	-	-
	-Insecticides	2	12	-
	-Total no. of interventions	6	12	0
2	Yield (q/ha)	34	36	21
3	Gross income (Rs./ha)	61200	64800	37800
4	Cost of cultivation (Rs./ha)	27040	34999	20969
5	Net profit (Rs./ha)	34160	29801	16831
6	Cost benefit ratio	1:2.26	1:1.85	1:1.80

Cost of seed cotton: Rs. 1800/q

low cost benefit ratio and adverse effect on natural enemies. The present findings are in conformity with Sohi *et al*. (2004) who reported 53.3% reduction in insecticide use in IPM fields with 12.2 insecticide sprays as against 18.7 sprays in non IPM fields. Kumar (2006) reported that growing of Bt cotton reduced the cost of bollworm control upto 60 % with corresponding saving from plant protection cost and increase in seed cotton yield. Rao *et al*. (1995) reported that the seed cotton yield from IPM plots was high which resulted in a higher cost benefit ratio (1:5.3) in comparison with conventional farming practice (1:2.5). Hence, transgenic Bt cotton with inbuilt resistance to certain bollworms under IPM umbrella can combat pest problems for sustainable cotton cultivation.

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