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Performance of Integrated Pest Management Practices in Production of Bt Cotton in Karimnagar District of Andhra Pradesh - A Case Study

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ABSTRACT: Integrated Pest Management in cotton production was demonstrated under Front Line Demonstration (FLD) in two villages in Karimnagar district of Andhra Pradesh during 2008-09 to 2010-11. The results revealed that IPM practices were superior in controlling aphids, mealy bug and *Spodoptera* as the incidence of these pests was significantly lower in the production of cotton. The activity of beneficial insects also improved in IPM fields when compared with non IPM fields. Seed cotton yield obtained was 16.6% higher in IPM fields than non IPM fields. Higher net returns (₹ 54217/ha) and B:C ratio 2.69 registered in IPM fields compared to non IPM fields (₹ 40488/ha and 2.15, respectively).

Key words: FLD, Bt. cotton, IPM, sucking pests

Cotton is one of the most important commercial crops of India which provides livelihood to over 60 million people. According to the statistics of Cotton Corporation of India, the crop occupied an area of 11.61 million hectares producing 33.40 million bales of cotton. Among the cotton growing states, Andhra Pradesh occupied third position with a cultivated area of 2.14 million ha and production of 7.20 million bales. Cotton plant is highly vulnerable to insect pests attack causing loss of 87% in seed cotton yield (Taley *et al.* 1988). Cost of plant protection is one of the important components of cost of cultivation of cotton accounting for 20%. Cotton crop consumes huge quantities of insecticides for managing pest complex. Out of 7684 crores spent on use of chemical pesticides in agriculture, ₹1034 crores is spent only in case of cotton (Kranthi *et al.,* 2011). Among insect pests, aphids [*Aphis gossypii* (Glover)], jassids [*Amrasca biguttula* (Ishida)], whiteflies [*Bemisia tabaci* (Genn.)], thrips [*Thrips tabaci* (Linde.)] and boll worm complex *viz.,* American boll worm [*Helicoverpa armigera* (Hub.)], tobacco caterpillar [*Spodoptera litura* (Boisd.)] and pink bollworm [*Pectinophora gossypiella* (Saund.)] are considered to be the major insect/ pests in Andhra Pradesh. The transgenic Bt. cotton cultivars expressing Cry1Ac toxin were proved highly toxic to American boll worm, pink boll worm, and spotted boll worms (Perlak *et al.*1991).

The Participatory Rural Appraisal (PRA) survey report of the adopted villages in Karimnagar district of Andhra Pradesh revealed that cotton is one of the major crops occupying 2.35 lakh hectares. Farmers are using pest control chemicals indiscriminately and incurring an expenditure of ₹ 10000-12500 per hectare on insect pest control. The Integrated Pest Management (IPM) package formulated by the scientists consisted of cost effective, eco friendly novel approaches for stabilizing the cotton ecosystem and improving the socio-economic status of cotton growers. In this study, an attempt was made to demonstrate the IPM technology on large scale in the farmers' fields in Karimnagar district of Andhra Pradesh during 2008-09 to 2010-11 under Technology Mission on Cotton and Mini Mission-II.

Materials and Methods

Integrated Pest Management practices were demonstrated during 2008-2009 to 2010-11 in two villages i.e. Kothapally and Gopalpur in Elkaturthy mandal in Karimnagar district of Andhra Pradesh by Krishi Vigyan Kendra, Karimnagar. In each village, 50 hectares of contiguous area was covered with IPM technology under Front Line Demonstration (FLDs) involving 135 farmers. Similarly, another 50 hectares of cotton area in the village was selected as control in which farmers adopted their own pest control measures. The demonstrations were conducted under rainfed situation in medium black soils in which the status of nitrogen is low, phosphorus is medium and the potash is high. The annual average rainfall of the area is 800 mm. In both IPM and non-IPM fields, sowing was completed during 15-30 June. Cotton hybrids Mallika Bt. and Bunny Bt. were cultivated in both IPM and non-IPM fields. Critical inputs for IPM were provided to the farmers. Pest management practices implemented in IPM and non-IPM blocks are presented in Table 1. All the other practices were similar in both IPM and non IPM fields.

The incidence of sucking pests and *S. litura* along with predator status was recorded from 20 IPM fields in each block. Ten plants were randomly selected from each field and the data was recorded at 10 days interval. The incidence of leaf hopper and thrips was recorded from 3 leaves per plant taking each leaf from the top, middle and bottom portions. At the same time aphid and mealy bug infested plants were taken in to account and the *S. litura* larvae infested per plant was recorded. The 10 days interval data were pooled and the seasonal mean data were compared with the t-Test.

Table 1 : Pest management components in IPM and non-IPM blocks

IPM block	Non-IPM block
• Seed treatment with imidacloprid 70 WS (Goucho) @ 5 gm/kg or thiomethaxam 70 WS (Crusier) 4 gm/kg of seed to delay the first spray against sucking pests up to 20 days, in order to help build up of natural enemy population. • Stem application of monocrotophos (1:4 dilutions) at 20, 40 and 60 days after sowing (DAS) as a prophylactic measure against sucking pest complex. • No spray up to 60 DAS for early sucking pests. • Border crop of maize to enhance buildup of natural enemies. • Use of recommended dose of fertilizer i.e.48:24:24 NPK/ha • Monitoring of *Spodoptera litura* through pheromone traps. • Growing of castor as a trap crop for collection and destruction of *Spodoptera litura* egg masses.	Six to eight sprays of imidacloprid, thiomethoxam, monocrotophos, ecitamiprid and acephate

Results and Discussion

Performance of IPM methods on sucking pests

Aphids: The data recorded at 10 days intervals revealed that the incidence of aphids in IPM fields was significantly low when compared with non-IPM fields without much fluctuation throughout the season (Table 2). In non-IPM fields, the incidence recorded was high with 3 peaks at 30, 90 and 120 days after sowing (Figure 1). In the IPM fields, the percentage of aphids infested plants was 6.0, while it was 11.6 in non-IPM fields. Wang *et al., (*1994) and Rama Rao *et al. (*1998) also reported that stem application of insecticide was the most effective method against aphids in cotton. Seed treatment with imidacloprid was also effective in reducing sucking pests [(Karabhantanal *et al.* (2007); Kohle *et al.* (2009)].

Table 2 : Seasonal mean incidence of pests and natural enemies in IPM and non IPM fields during 2008-2009

Pest/Natural enemies	IPM fields	Non IPM fields	t-Test
Aphids infested plants %	6.0	11.6	Sig
Leaf hoppers/3 leaves	1.41	1.68	NS
Thrips/3 leaves	7.27	4.83	Sig
Mealybug infested plants %	3.2	4.3	Sig
Spodoptera larvae/plant	0.3	0.7	Sig
Coccinellids/Plant	2.05	0.6	Sig
Crysopa/Plant	0.12	0.05	Sig
Spiders/Plant	0.95	0.45	Sig

Leaf hoppers: Among the sucking pests, leaf hopper was the major pest with considerable activity throughout the season. The incidence of leaf hoppers in IPM fields was low during early stages of crop (20-70 DAS) in a range of 0.45 to 0.9/3 leaves. In the later stages, leaf hopper incidence was more in IPM fields. In non-IPM fields, two peaks were recorded at 60 DAS (2.5/3 leaves) and 110 DAS (2.8/3 leaves) while only one peak at 100 DAS was observed in IPM fields. However there was no significant difference in mean seasonal incidence between IPM and non IPM fields. Mahapatra and Patnaik (2006) as well as Rishi Kumar *et al.* (2011) reported less incidence of sucking pests in IPM fields.

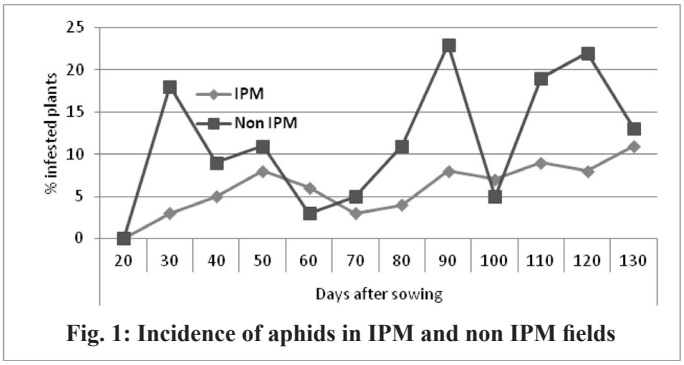

Fig. 1: Incidence of aphids in IPM and non IPM fields

Thrips: The data recorded on incidence of thrips in IPM fields revealed that the incidence was low during early stages of cotton crop (20-40 DAS), attained peak at 50 DAS (13.2/3 leaves), and after that gradually reduced (Figure 2). In non IPM fields, the incidence attained peak little early at 30 DAS (11.5/3 leaves), and after that reduced drastically. The seasonal mean incidence of thrips in IPM fields was significantly higher with 7.27/3 leaves compared to non-IPM i.e. 4.83/3 leaves (Table 2). Though the incidence was higher in most of the period, but it remained below the economic threshold level of 10 thrips per leaf.

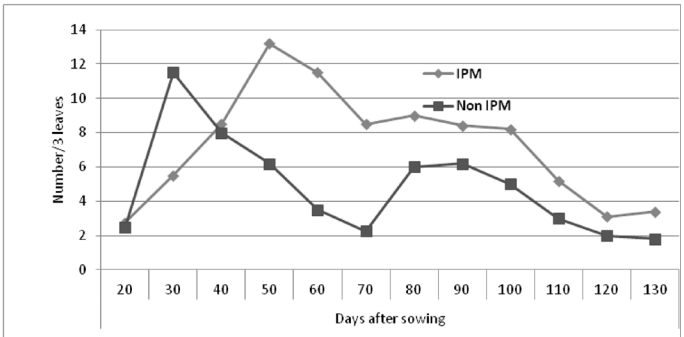

Fig. 2: Incidence of thrips in IPM and non IPM fields

Mealy bug: Mealy bug infestation started from 30 DAS and was steadily increased to reach its peak at 130 DAS in both IPM and non IPM fields (Figure 3). The seasonal mean incidence of mealy bug was significantly low in IPM fields (3.2%) when compared to non IPM fields (4.3%) (Table 2). Similar results were found by Rishi Kumar *et al.* (2011).

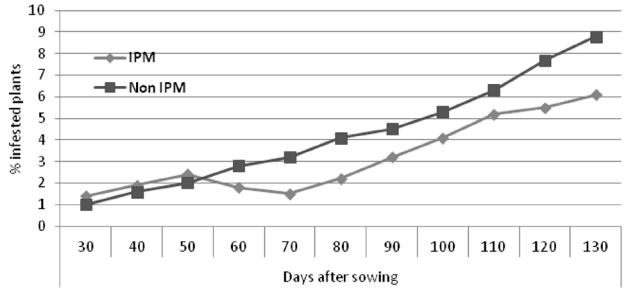

Fig. 3: Incidence of mealybug in IPM and non IPM fields

Spodoptera: The *Spodoptera* incidence started during flowering stage. IPM fields recorded lower incidence compared to non IPM fields (Figure 4). Seasonal mean incidence of *Spodoptera* was significantly lower (0.3 larvae/plant) in IPM fields compared to non IPM fields (0.7 larvae/plant) (Table 3).

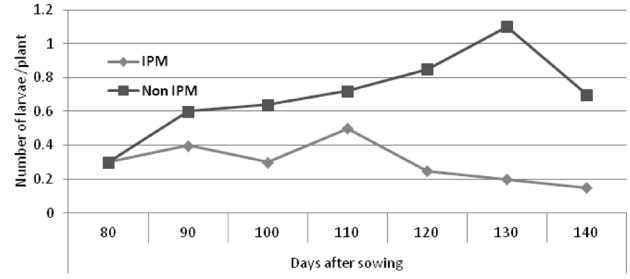

Fig. 3: Incidence of *spodoptera* in IPM and non IPM fields

Table 3 : Seed cotton yield (kg/ha) in IPM and non-IPM fields

Year	IPM	Non-IPM	% increase
2008-09	2383	1960	21.58
2009-10	2356	1716	37.29
2010-11	2900	2500	16.00
Average	2546	2058	23.71

Occurrence of natural enemies

Activity of coccinellids, chrysopids and spiders was noticed during the early growth stage of the cotton crop i.e. up to 90 days, thereafter gradually decreased. The mean seasonal activity of coccinellids (2.05/plant), chrysopids (0.12/plant) and spiders (0.95/plant) was significantly higher in IPM fields compared to non IPM fields (0.6, 0.05 and 0.45/plant, respectively) (Table 2). Seasonal mean data on the occurrence of natural enemies like coccinelids, chrysopids and spiders was higher in IPM fields because of avoidance of insecticide spraying and eco friendly interventions like stem application of insecticides, maize as border crop and destruction of *Spodoptera* egg masses by hand collection, whereas in non IPM fields the natural enemy population was lower due to heavy usage of insecticides reflecting to higher cost of cultivation (Table 4). The results of the study corroborated with the findings of Puri *et al.,* 1997; Sharma *et al.,* 2001; Laveker *et al*., 2001 who reported abundance of natural enemies by practicing IPM methods . However, the findings of Mahapatra and Patnaik (2006) revealed that the seed treatment with imidacloprid suppressed the sucking pests.

Table 4 : Economics of cotton crop under IPM and non-IPM practices (Average of 3 years)

Particulars	IPM	Non-IPM
Total cost of cultivation (₹/ha)	32116	35278
Gross returns (₹/ha)	86333	75766
Net returns (₹/ha)	54217	40488
B:C ratio	2.69	2.15

Yield and income

The average yield obtained in IPM fields was significantly higher (2546 kg/ha) than non IPM fields (2058 kg/ha) with an increase of 23.71% (Table 3). Economics of cotton crop revealed that the total cost of cultivation incurred per hectare was higher (₹ 35278) in non-IPM fields compared to 1PM fields (₹ 32116) (Table 4). This was due to the heavy usage of insecticides in case of the former than the latter. However, the situation was opposite in case of per ha net returns accrued. Obviously, per ha net returns accrued registered higher (₹ 54217) in IPM fields compared to non-IPM fields (₹ 40488) which was due to the higher yield obtained in the former than the latter. Higher benefit-cost ratio (BCR) registered in IPM fields (2.69) of cotton than that of non-IPM fields (2.15) indicating that on every rupee investment made on IPM fields gave a dividend of ₹ 2.69 while ₹ 2.15 in case of non-IPM fields. The above results showed that the adoption of IPM technology in cotton cultivation is more profitable than that of non-IPM technology. The results are in conformity with the findings of Patil *et al*. (1992), Bhosle *et al.* (2004) and Giri and Kapse (2007) that the IPM module resulted in higher seed cotton yield with higher benefit-cost ratio.

Conclusions

The results of the front line demonstrations with IPM practices clearly indicated that the incidence of aphids, mealybug, *Spodoptera* were significantly lower in IPM fields. Though the incidence of thrips was higher in IPM fields there registered higher yield, net returns and B:C ratio. Hence, there is immense need of policy measures and support mechanism for up-scaling the IPM practices in cotton cultivation.

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