A System Approach to Sustainable Insect Pest Management in Cotton

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ABSTRACT

A sustainable insect pest management strategy has been developed with special emphasis on Helicoverpa armigera (Hübner) the success of which evaluated through farmers' participatory programmes in two villages, Idigarai and Kalipatti, near Coimbatore. The main components of this strategy are (i) growing cowpea, Vigna sinensis on irrigation channels and bunds to increase predator-coccinellids (ii) imidacloprid seed treatment to reduce or avoid early season insecticide application against sucking pests for 40-50 days (iii) removal of terminals (topping) at 90-100 days of growth to encourage sympodial branching and reduce Helicoverpa oviposition on new growth (iv) insecticide application based on ETL (v) ensuring the correct dose of insecticide and uniform coverage (vi) rotation of various chemical groups and (vii) hand picking of bigger boll worms (4 to 6 instars) before spraying during peak infestation periods. Adoption of this strategy gave effective management of cotton pests including the resistant pest Helicoverpa armigera., resulting in reduced insecticide usage and plant protection cost by 54 and 39 % for the two villages, respectively.

Introduction

Chemical insecticide application came as a boon to farmers during the Green Revolution as a means of containing pests and increasing crop yields. However, this has grown into a serious problem as pests have developed immunity to some pesticides. Cotton is attacked by about 150 species of insects in India and estimates of losses to cotton due to insect pests are in the region of 10-15 per cent annually. Agarwal and Katiyar (1979) noted that bollworms alone cause losses to the tune of over $23.5 million every year. Recently, the loss due to one species of bollworm, *Helicoverpa armigera* (Hb) is estimated to be approximately $98 million in cotton in one season in Andhra Pradesh, one of the nine important cotton growing states in India (APAU, 1988). Inappropriate use of insecticides against this bollworm often leads to crop failures and pest resistance (Armes *et al.*, 1992, 1994; Surulivelu, 1996). The problem has assumed alarming proportions with heavy losses in production and frustration in the farming community. To overcome this problem and attain a system approach to sustainable management of cotton pests on a larger area, a "best-bet" IPM technique has been developed. Its success was evaluated through on-farm-farmer participatory trials in two villages, Idigarai and Kalipatti of the Palani district of Tamil Nadu, South India during the 1996-97 and 97-98 seasons.

Material and Methods

During 1996-97, six farms of 0.4 ha each were selected in Idigarai village and the best bet IPM techniques were demonstrated to 50% of the farms and the remainder served as farmer managed fields for comparison. In the following year, the village of Kalipatti, situated in the cotton belt and surrounded by several cotton growing villages, was selected for implementation of this strategy. This occurred on 20 farmers' fields of 0.8 ha each, representing groups of small, marginal and big farmers as well as covering the geographic spread of the village comprising a radius of 3 km. The main components of this technique were (i) growing cowpea, vigna sinensis, on irrigation channels and bunds to increase predatory coccinellids (ii) imidacloprid seed treatment to reduce or avoid early season insecticide application against sucking pests for 40-50 days (iii) removal of terminals (topping) at 90-100 days of growth to encourage sympodial branching and reduce *Helicoverpa* oviposition on new growth (iv) insecticide application based on economic threshold levels (ETL) (v) ensuring correct dose of insecticide and uniform coverage (vi) rotation of various chemical groups (for bollworm: endosulfan (relatively soft on beneficials) followed by organophosphate, a carbamate if necessary and one or more pyrethroid applications at the end of the season, only if required - pyrethroid efficay remains high against pink bollworm which is mainly a late season pest in Tamil Nadu). and (vii) hand picking of bigger boll worms (instars 4-6) before spraying during peak infestation periods. The fields of the project farmers were inspected at weekly intervals during the cropping season (August-February) with the farmers. Identification of various pests and natural enemies were taught to the farmers and the level of infestation

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of major pests assessed periodically. The results were discussed in group meeting of the farmers and spray decisions were taken by the farmers with the help of the project staff. Several group meetings were conducted. The farmers were advised on identification and assessment of pests and beneficials with audio visual aids and through farm visits. Insecticide application was taken up only when the pest reached the ETL the minimum spray interval had been observed and as a last resort.

Results and Discussion

Idigarai village

There was a substantial reduction in insecticide usage in IPM fields compared to that of farmer managed fields (Table-1). *Helicoverpa armigera* larval reduction was 38 per cent and fruiting point damage was reduced 51 per cent in IPM fields. Bollworm damage (*H. armigera*, *Pectinophora gossypiella* Saund.) was reduced by 44 per cent compared to the control area. This led to an increase in seed cotton yield by 28 per cent. In addition, insecticide use was reduced by 54 percent and plant protection cost per unit area 36 per cent in IPM fields compared to the control area. Furthermore, the cost benefit ratio was better for the IPM farmers (1:3.4) than the control farmers (1:1.8).

Kalipati village

The project farmers in this village applied insecticides an average of 5.5 times compared to 9 times by non project farmers of the same village. Furthermore, the project farmers used less insecticides (3,317 g a.i./ha) and spent less money ($98.30/ha) than non project farmers who more insecticides (7,183 g a.i/ha) and spent more money on plant protection ($169/ha). The fruiting point damage during the cropping season was less by 34 percent and the boll damage at harvest 30 per cent while the seed cotton yield was increased by 31 per cent and resulted in higher benefit cost ratio (1:2.9 versus 1:1.7) to the project farmers compared to non-project farmers (Table 2).

The 26 project farmers of the two villages were trained and participated in selection and use of the management tactics. Following this strategy, *Helicoverpa* bollworm and other cotton pests were effectively managed with substantial reduction in insecticide usage and plant protection cost. This farmer participatory programme gave effective management of cotton pests including resistant *H. armigera* and created awareness of proper use of pesticides and management of pests effectively with reduced environmental contamination. This can be seen in the substantial reduction in spraying in non project farms in the project village in 1998. This strategy is spreading to the neighbouring villages. Unemployed village youths are effectively utilized for pest scouting, leading to appropriate spray decisions.

In this study, plant topping was found to be effective in reducing *Helicoverpa* oviposition on new growth. Gang *et al.* (1997) also noted that terminal nipping in cotton helped to reduce bollworm infestation. They also demonstrated the efficacy of hand picking larvae before spraying. In this study imidacloprid seed treatment was effective against sucking pests up to 50 days. This conforms with the results of Attique and Ghaffer (1996). The success of this strategy in the two villages participating in this study confirms the views of (Matthews, 1997) who emphasized the importance of farmer participation on an area wide basis for successful implementation of IPM. Matthews (1996) also noted the importance of scouting on cotton for successful IPM.

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Table 1. IPM for cotton through farmer participation Idigarai, 1996-97.

	H.armigera Larvae/25 plants	FPD%	Boll damage %	Insecticide used g ai/ha	Plant protection cost Rs./ha	S/C yield (Kg/ha)	Cost: Benefit ratio
IPM Farms	5.9 (-38%)	8.4 (-51%)	13.0 (-44%)	1643 (-54%)	2367 (-36%)	2,258 (+28%)	1:3.40 (+89%)
FM Farms	9.5	17.0	23.4	3565	3679	1,769	1:1.80

FPD-Fruiting points damage; FM farms-Farmer managed farms
Kalipatti village

Table 2. IPM for cotton through farmer participation 1997-98.

Location	FPD%[1]	Boll damage %	Insecticide used g ai/ha	Plant protection cost Rs./ha	S/C yield Kg/ha	Cost: Benefit ratio	Spray No.
Project Farms Kalipatti	8.6 (-34%)	10.3 (-30%)	3317 (-54%)	4177 (-42%)	2125 (+31%)	1:2.90	5.5
Non-Project Farms Kalipatti	13.0	14.6	7183	7181	1625	1:1.66	9.0
Control village Ramapattanampudur	Profit earned farms		9050 (+173%)	9750 (+133%)	1420 (-33%)	1:1.15	12.8
	Loss incurred farms		10390 (+213%)	9709 (+132%)	1110 (-48%)	1:0.89	13.4

[1]FPD-Fruiting points damage