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Development of an Integrated Pest Management module for cotton in Andhra Pradesh

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ABSTRACT : In an attempt to develop an integrated pest management (IPM) strategy for cotton pests four modules comprising integrated pest control tactics, judicious use of pesticides, farmer's practice and untreated control were evaluated. The approach, consisting of limited use of pesticides coupled with biocontrol measures and other resistance management strategies, was found economically viable for sustaining cotton production in addition to conserving and augmenting natural enemies in the cotton ecosystem. IPM practice also resulted in a higher cost : benefit ratio (1 : 5.3 and 1 : 6.1) in comparison with the farmer's practice (1 : 2.5 and 1 : 1.6).

KEY WORDS: Cost : benefit ratio, integrated pest management module, intercrop, natural enemies

The concept of integrated pest management (IPM) not only emphasises the need for keeping the pest under check but also for the conservation of naturally occurring beneficial arthropods. Conserving naturally occurring beneficial arthropods, growing intercrops, inundative release of natural enemies including use of baculoviruses and *B.t.* formulations and application of botanicals in cotton pest management were highlighted by Sundaramurthy and Basu (1985), Rabindra and Jayaraj (1986) and Natarajan and Seshadri (1988). Using the above components a strategy for pest management was developed, demonstrated and compared with intensive chemical control strategy during 1993-95.

MATERIALS AND METHODS

The trials were conducted at Regional Agricultural Research Station, Lam Farm, Guntur, over two seasons (1993-94 and 1994-95). In the IPM treatment the main crop cotton (Var. MCU-5) and intercrop groundnut (Var. TPT 1) were seed dressed with Carbofuran 20 SD (@ 20g/kg seed) and mancozeb (@ 3g/kg seed) before sowing. During the two seasons, *Trichogramma chilonis* Ishii was released (1,00,000/ha) at 40-45 days after sowing (DAS) synchronising with the initial egg laying by *Helicoverpa armigera* (Hübner) followed by the release of *Chrysoperla carnea* (Stephens) (50,000/ha) at 60 DAS in the IPM plot. Between 80-150 DAS, attention was focussed on bollworm control (particularly *H. armigera*). On 110th day, endosulfan (1.5 l/ha) plus *Ha*NPV (500 LE/ha) along with adjuvants (Teepol and jaggery) was sprayed since the number of *H. armigera* larvae had reached ETL. On 125th day neem seed kernel extract (5%) was sprayed followed by chlorpyriphos (1.5 l/ha) plus sesame oil (5%) spray at 135 DAS since the boll damage crossed the ETL. In the farmer's practice treatment only insecticides were sprayed at weekly interval as was done by the local farmers. These two treatments formed the trial during 1993-94 while these two supported by two more i.e. application of pesticides based on economic threshold levels (judicious use) and untreated control (where no insecticides were used) constituted the additional treatments during 1994-95 cropping season. Each treatment covered an area of 1000 m^2.

Counting was done at fortnightly interval from 15 DAS on 50 randomly selected plants in each treatment. Sucking pests were counted from three leaves in a plant while bollworms and natural enemies were observed from the entire plant for recording the incidence. Populations of bollworms were monitored through pheromone traps and whitefly through yellow pan traps to decide on control measure adoption. One egg or larvae of *H. armigera*/ten plants and ten per cent square damage or five per cent boll damage was reckoned as ETL. After harvest, the yields of both

main and intercrops were recorded. The expenditure towards plant protection was taken into account to calculate the cost : benefit ratios.

RESULTS AND DISCUSSION

The incidence of aphids, jassids and thrips was high in the IPM treatment initially due to the avoidance of insecticidal sprays during the early stages of crop growth. This is inevitable to help conservation of the naturally occurring and augmented natural enemies. This is evidenced by the presence of 40 natural enemies per 50 plants and an egg and larval parasitization of 11.1 and 8.2 per cent, respectively (Table 1 and 2). The population of natural enemies which included coccinellids, syrphids, spiders and chrysopids have taken care of the sucking pests, gradually. However, because of some damage by the early season sucking pests in the absence of sprays to control them *vis-a-vis* protecting the natural enemies, a certain yield loss can be anticipated. This loss in cotton crop can be (to a certain extent) recovered from the intercrop. The density of natural enemies and parasitization in the chemical control treatments (a total of 28 sprays) was negligible. Eventhough high yields were recorded in chemical control plot during 1993-94, the cost of pesticides was very high (Rs.15570/ha) as against IPM treatment (Rs.5050/ha) resulting in a net profit of Rs.26,650 and Rs.38,430 in the IPM and chemical control treatments, respectively (Table 3). This suggests that even if yields were higher in chemical control plots the cost: benefit ratio was in favour of IPM plot (1 : 5.3) while it was only 1 : 2.5 in the intensive chemical treatment.

The present results confirms the earlier findings of Venugopal Rao *et al.* (1993) who reported that increased usage of pesticides has led to proportionate increase in resistance levels in *H., armigera* besides eroding the natural beneficial fauna. The concepts of limited usage of insecticides coupled with augmenting natural enemies developed by Smith and Reynolds (1972), Litsinger and Moody (1976) and Natarajan and Seshadiri (1988) also corroborates the results of the present study.

Similar trend during the second season of experimentation also proved the utility of the IPM module (Table 4). However, the second season crop was severely affected due to excessive rains (more than 400 mm during October - November) resulting in heavy square and boll shedding thus masking the treatmental differences. Generally, low yields were obtained in all the treatments as against the 1993-94 season. Thus growing an intercrop and avoiding initial spray for controlling sucking pest complex to protect the naturally occurring and augmented natural enemies should form the basic component of IPM module in cotton as was also proposed by Jayaraj (1988), Sundaramurthy (1990) and Yadav (1990). This IPM module clearly showed its economic viability in cotton.

Table 1. Incidence of cotton pests and their natural enemies (1993-94)

Treatment	Sucking pest (no./50 plants)				*H. armigera* incidence (no./50 plants) and damage (%)				Parasitization (%)		Predators (no./50 plants)
	Jassids	Aphids	Thrips	Whitefly	Eggs	Larvae	Square	Boll	Eggs	Larvae	
Integrated Pest Management	45	750	90	75	63.5	46.0	10.5	4.1	11.1	8.2	40.0
Farmer's practice	14	30	45	182.5	45.0	5.0	1.6	1.4	1.1	-	1.3

Table 2. Incidence of cotton pests and their natural enemies (1994-95)

Treatment	Sucking pest (no./50 plants)				*H. armigera* incidence (no./50 Plants) and damage (%)				Parasitization (%)		Predators (no./50 plants)
	Jassids	Aphids	Thrips	Whitefly	Eggs	Larvae	Square	Boll	Eggs	Larvae	
Integrated Pest Managment	55.8^{b}	14.0^{d}	83.2^{c}	40.0^{a}	9.6^{a}	5.2^{b}	8.2^{c}	6.9^{b}	19.2	11.2	13.3^{c}
Farmer's practice	13.6^{a}	65.6^{b}	38.2^{a}	150.0^{b}	12.8^{a}	1.2^{a}	1.2^{a}	0.4^{a}	-	8.1	0.2^{a}
Judicious use of pesticides	71.8^{b}	41.4^{ab}	70.2^{bc}	90.0^{a}	12.4^{a}	2.8^{ab}	7.5^{c}	6.4^{b}	-	7.3	5.4^{b}
Untreated check	69.6^{b}	121.8^{c}	59.4^{b}	11.0^{a}	11.6^{a}	1.6^{a}	2.8^{b}	7.7^{b}	9.2	13.6	7.2^{b}

Figures followed by the same letters do not differ significantly (P=0.05) by DMRT

Table 3. Yield and economics of different treatments (1993-94)

Treatment	Cost of inputs (Rs./ha)	Yield (q/ha)	Gross returns (Rs.)		Net returns (Rs.)	Cost : benefit ratio
			Main	Intercrop		
Integrated pest management	5050	17.6	5.3	31,700	26,650	1 : 5.3
Farmer's practice	15570	36.0	-	54,000	38,430	1 : 2.5

Table 4. Yield and economics of different treatments (1994-95)

Treatment	Cost of inputs (Rs./ha)	Yield (q/ha)	Gross returns (Rs.)		Net returns (Rs.)	Cost : benefit ratio
			Main	Intercrop		
Integrated pest management	4320.00	13.2^{b}	4.2	30,600	26,280	1 : 6.1
Farmer's practice	11000.00	14.4^{b}	-	28,840	17,840	1 : 1.6
Judicious use of pesticides	8000.00	10.1^{a}	-	20,360	12,360	1 : 1.5
Untreated check	-	9.3^{a}	-	18,620	18,620	-

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