MM 3.1: IPM at village level to produce cost effective quality fiber

Principal Investigator: O. M. Bambawale, NCIPM, New Delhi

Targets and achievements

Targets	Achievements
Development of a model IPM Farm and technology dissemination in the Nucleus village would continue.	Each of the field centers (12) under the project has developed a nucleus IPM village in which a model IPM farm of 10-25 acres has been developed. Performance of IPM is being thoroughly monitored in terms of the pest and natural enemy status, damage levels and seed cotton yield and economics vis-à-vis the non IPM fields in the adjoining villages.
Polyclinic for IPM information and scouting would be established.	Polyclinics have been developed by some of the centers. Some centers are facing difficulty in getting appropriate space for the activity. Efforts are being made to make these operational in the 2005-06 season.
Developmental activity for PMIS and IPM documentary to continue. PMIS in vernacular language to be attempted. On-line pest monitoring and reporting system software would be made available to all cooperators for use as a decision making tool.	Developmental activity for Pest Management **I**nformation **S**ystem has continued at most of the centres. The PMIS developed at some of the centers as well as expert systems developed at CICR, Nagpur and ANGRAU, Hyderabad were deliberated upon for the group's education to come out with improvements and incorporations. OUAT, Bhawanipatna (Oriya and English languages) and PKV, Akola (two films) have completed Documentary films on cotton IPM. These were screened and course of action/approaches/ideas for developing films on different aspects of IPM at different centers were deliberated upon in the group meeting. On-line pest monitoring and reporting system has been initiated.
Survey updating of Nucleus and a cluster of villages.	Yearly surveys are being conducted at project villages to monitor the progress of the project.
Pheromone confirmation aspects to continue.	A large scale validation trial of Mating Disruption Technique against pink bollworm was organized in 150 acres in village Anantavarappadu in Guntur distt. using PB Rope L. A total of 3367 adult moths/10 traps were caught in control block compared to 359 moths from PB Rope L IPM block. Field trials were conducted at two locations with varying loadings of pheromones (1, 5 and 10 mg) and in different ratios of Z11:Z9, namely, 90:10 (low ratio), 93:7 (medium ratio) and 97:3(high ratio). Even at high loading, a distinct sex pheromone polymorphism was evident and confirmed the utility of the approach on a commercial scale. Indigenous synthesis of good amounts of 1.60 g of *Z*-(9)-Hexadecnal, 1.70 g of *Z*-(11)-Hexadecenal, 300 mg of *Z*-(11)-Octadecenal and 900 mg of *E,E*-10, 12-Hexadecadienal was made.
Quality parameters of cotton fibre in IPM and Non-IPM cotton would be evaluated.	Appropriate amounts of lint samples have been submitted by all the field centers to CIRCOT, Mumbai and the results of the same are awaited.

❖ **Village level IPM Approach**

This was the second year of the implementation of reoriented approach under the Tenth Plan towards more proactive ways of promotion of IPM.

Each of the field centers (12) under the project has developed a nucleus IPM village in which a model IPM farm of 10-25 acres has been developed. Further, the performance of IPM is being thoroughly monitored in terms of the pest and natural enemy status, damage levels and seed cotton yield and economics vis-à-vis the non IPM fields in the adjoining villages. Simultaneously, IPM dissemination efforts are being made in the cluster of villages around the nucleus IPM village through FFSs and field days and simultaneously educational tools such as PMIS and IPM films on various aspects of IPM are in various stages of development. The whole effort of IPM in these villages is being monitored through benchmark and further yearly surveys. The other complementary aspects of the project concern development of effective means of utilization of sex pheromones and monitoring fiber quality.

The pest scenario and damage due to sucking pests and bollworms during 2004-05 is summarized in the Tables 3.1.1-3 for all the 12 field centers. In the North Zone, thrips and whitefly were the major sucking pests at Sriganganagar, whereas all the sucking pests were of minor level in Sirsa and Udaipur. In the Central Zone, the sucking pests were of moderate level. Jassids were a cause of concern on Bt cotton at Akola and thrips were also of a moderate to serious nature at all the Central Zone centers except Khandwa. In the South Zone the main sucking pest was thrips at Guntur and Dharwad and jassids at Bhawanipatna.

Bollworms were generally low (Table 3.1.2) in the country. *Helicoverpa armigera* was of moderate level at Nanded, Surat, Khandwa and Dharwad. Nanded and adjoining district of Parbhani and Jalna experienced epidemic situation during the first fortnight of September. *Earias* was at the higher side at Surat and Khandwa.

Pink bollworm (PBW) is emerging as the most serious bollworm in the Central and South Zones, particularly at Surat, Khandwa, Nanded, Nagpur, Guntur, Coimbatore and Dharwad (Table 3.1.4). At the 9 centres where Bt cotton was introduced as one of the components of IPM, the bollworms were at the minimum as well as damage to fruiting bodies was also very low in Bt cotton as compared to Conventional Cotton (CC) in IPM or non IPM modes. CC in non IPM mode recorded the highest levels of % damage to squares and green bolls (Table 3.1.3). *Spodoptera litura* was noted in

epidemic proportions on soybean in Khandwa and Nanded regions around last week of August and early September and a mild infestation level was seen on cotton at Nanded. In the entire North Zone, *Spodoptera* occurred in epidemic proportions, and for the first time so in Haryana State. Bt cotton also had very high number of larvae with extensive damage to foliage. However, since the pest appeared at the fag end of the season in end Sept.- early October, it did not translate into reduction in seed cotton yield. Bollgard I (Bt cotton) with *cryIAc* gene does not offer protection against *Spodoptera*. With Bt cotton hybrids getting commercial approval in the North Zone in 2005, and the expected rapid coverage of the area with Bt cotton in all the three Zones, it would be necessary for the project to introduce *Spodoptera* management options such as planting castor as a trap crop, use of sex pheromone traps, and use of SlNPV in the North Zone for the first time and strengthening these for the rest of the zones. Parawilt was observed in large scale in the Parbhani and Aurangabad area on Bt MECH 184 and the causes and remedies need to be worked out. Similarly foliar disease problems and sucking pest problems are on the increase in Bt cotton.

Natural enemies were generally high (Table 3.1.5) in IPM fields compared to non IPM fields in CC and their population also was high on Bt cotton compared to CC non IPM. In the Central and South Zones, overall, the ladybird beetle and chrysoperla levels were even higher on Bt cotton compared to CC IPM and at par with respect to spider population in the Central Zone. Bt cotton *per se* did not seem to adversely impact the natural enemy population.

PBW was effectively managed through Bt cotton and the percent damaged bolls and locules were the lowest in Bt cotton across all the zones compared to CC IPM and non IPM (Table 3.1.4). The number of PBW larvae was also very low in Bt cotton compared to CC. It is the past experience under the TMC IPM project that the silent pest PBW could not be properly managed through IPM in CC. Bt cotton is proving to be a boon for the management of PBW and is also leading to improved lint quality. However, PBW management would need close observation because some of the Bt hybrids have low levels of toxin expression during the later stages of crop growth and their might be chances of development of resistance.

Table 3.1.2. Population of Bollworms

S. No.	Location of Centre	Av. Population/ plant								
		H. armigera						*Earias* sp. (larvae)		
		Eggs			Larvae					
		Bt IPM	CC IPM	CC NIPM	Bt IPM	CC IPM	CC NIPM	Bt IPM	CC IPM	CC NIPM
North										
1	Sirsa	NR	0	0	0.00	0.03	0.03	0.00	0.02	0.00
2	SGNagar	NR	0.33	0.56	0.11	0.27	0.59	0.22	0.69	0.33
3	Udaipur*	-	1.33	2.53	-	0.35	0.51	-	0.25	0.30
	Mean		**0.83**	**1.55**	**0.04**	**0.22**	**0.38**	**0.07**	**0.32**	**0.21**
Central										
4	Surat	0.47	0.57	0.75	0.11	0.35	0.49	0.34	0.49	0.78
5	Khandwa	0.11	0.68	2.41	0.09	0.41	2.08	0.13	0.73	1.73
6	Nanded	0.65	0.37	0.71	0.02	0.39	0.59	0.01	0.13	0.21
7	Akola	0.25	0.44	0.23	0.21	0.16	0.12	0.00	0.00	0.00
8	Nagpur	0.18	0.17	0.23	0.26	0.12	0.28	0.02	0.03	0.04
	Mean	**0.33**	**0.45**	**0.87**	**0.14**	**0.29**	**0.71**	**0.10**	**0.28**	**0.55**
South										
9	Bhawanipatna*	-	0.27	0.52	-	0.34	0.51	-	0.33	0.54
10	Guntur	0.25	0.33	0.39	0.07	0.07	0.14	0.00	0.00	0.00
11	Coimbatore**	-	0.07	0.10	-	0.07	0.10	-	0.00	0.00
12	Dharwad	0.00	0.00	0.00	0.42	0.53	0.61	0.37	0.00	0.00
	Mean	**0.25**	**0.22**	**0.34**	**0.25**	**0.25**	**0.34**	**0.19**	**0.08**	**0.14**

Table 3.1.3. Damage of fruiting bodies

S. No.	Centre	Av. Percent damaged / plant by bollworms					
		Sqares			Green bolls		
		Bt IPM	CC IPM	CC NIPM	Bt IPM	CC IPM	CC NIPM
North							
1	Sirsa	0.02	1.22	1.60	0.06	0.56	1.04
2	SGNagar	2.03	8.14	12.45	1.81	4.89	6.83
3	Udaipur*	-	11.07	20.44	-	8.29	14.24
	Mean	**1.03**	**6.81**	**11.50**	**0.94**	**4.58**	**7.37**
Central							
4	Surat	4.29	8.96	14.64	1.31	3.46	5.18
5	Khandwa	3.57	4.51	8.16	1.61	5.62	9.94
6	Nanded	0.64	6.94	14.43	0.60	5.80	11.44
7	Akola	0.25	3.02	1.33	1.04	0.96	1.56
8	Nagpur	7.55	3.52	6.55	NR	5.07	7.62
	Mean	**3.26**	**5.39**	**9.02**	**1.14**	**4.18**	**7.15**
South							
9	Bhawanipatna*	-	8.08	11.17	-	7.58	10.43
10	Guntur	0.91	2.84	3.03	0.28	0.88	1.45
11	Coimbatore**	-	1.35	4.24	-	-	-
12	Dharwad	4.51	4.17	6.39	-	8.22	12.39
	Mean	**0.91**	**4.11**	**6.21**	**0.28**	**5.56**	**8.09**

* Bt Trial was not conducted, ** Observation not recorded separately, CC = Conventional cotton

Table 3.1.5. Population of Beneficial Insects in IPM and Non IPM Blocks

S. No.	Centre	Av. Population/three leaves								
		Coccinellids(Grub & adult)			Chrysoperla (Egg & larvae)			Spider (Adult)		
		Bt IPM	CC IPM	CC NIPM	Bt IPM	CC IPM	CC NIPM	Bt IPM	CC IPM	CC NIPM
North										
1	Sirsa	0.00	0.00	0.00	0.08	0.03	0.01	0.13	0.05	0.03
2	SGNagar	0.26	1.83	1.50	0.19	7.07	3.83	0.49	4.05	2.05
3	Udaipur*	-	1.44	0.92	-	1.70	1.00	-	0.47	0.33
	Mean	**0.63**	**1.09**	**0.81**	**0.14**	**2.93**	**1.61**	**0.31**	**1.52**	**0.80**
Central										
4	Surat	15.50	0.58	0.15	12.34	0.97	0.19	0.51	0.07	0.01
5	Khandwa	5.63	4.90	3.55	3.78	4.16	3.80	0.00	0.00	0.00
6	Nanded	1.88	3.59	0.51	0.32	0.65	0.08	0.32	0.67	0.14
7	Akola	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Nagpur	0.06	1.04	0.71	0.30	0.11	0.17	0.02	0.39	0.37
	Mean	**4.61**	**2.02**	**0.98**	**3.35**	**1.18**	**0.85**	**0.21**	**0.23**	**0.10**
South										
9	Bhawanipatna*	-	0.69	0.33	-	0.78	0.37	-	0.81	0.49
10	Guntur	0.07	0.08	0.11	0.00	0.08	0.00	0.13	0.08	0.15
11	Coimbatore**	-	0.22	-	-	-	-	-	-	-
12	Dharwad	1.64	1.21	0.64	0.83	0.20	0.16	-	-	-
	Mean	**0.86**	**0.73**	**0.36**	**0.42**	**0.35**	**0.18**	**0.13**	**0.45**	**0.32**

* Bt Trial was not conducted, ** Observation not recorded separately, CC = Conventional cotton

The chemical pesticide application in the IPM and non IPM blocks, Yield and economics of cotton production (Table 3.1.6) showed the expected trend of better performance of IPM vs non IPM with respect to the reduction in quantity and the number of pesticide sprays, seed cotton yield and C:B ratio in all the three zones. Bt cotton did not perform well in comparison to CC in the North where it was tested at two locations. The reason for the poor performance appears to be the low seed rate with provision of only one seed per hill. There could be other possible reasons as well. Under the severe summer coinciding with sowing time in the North, at least two seeds per hill would ensure a better crop stand. However, this may lead to higher production cost. A record average yield of 50.37 q/ha was noted at Surat in Gujrat (RCH-2 Bt = 51.26 q/ha; MECH 162 Bt = 49.48 q/ha) compared to 34.36 q/ha in CC IPM. Overall in the Central and South Zones the Bt IPM yields were around 7 q/ha higher compared to CC IPM and nearly 10 q/ha higher compared to CC non IPM. However, C:B ratio in Bt cotton was at par in South and slightly higher in Central Zone as compared to CC IPM. This could be, in part, due to higher cost of Bt seed.

The promotional activities of IPM have been continued at each of the field centers through the establishment of Model IPM farm and technology dissemination in the adjoining cluster of villages. Surveys have been conducted as per the proforma and the compilation work would be taken up at NCIPM.

- **Development and Promotion of Pest Monitoring Information System (PMIS)**

Developmental activity for PMIS has continued at most of the centres. The PMIS developed at some of the centers as well as expert systems developed at CICR, Nagpur and ANGRAU, Hyderabad were presented in the group meeting and deliberated upon for the group's education and to come out with improvements and incorporations in the PMIS to be developed by other centers.

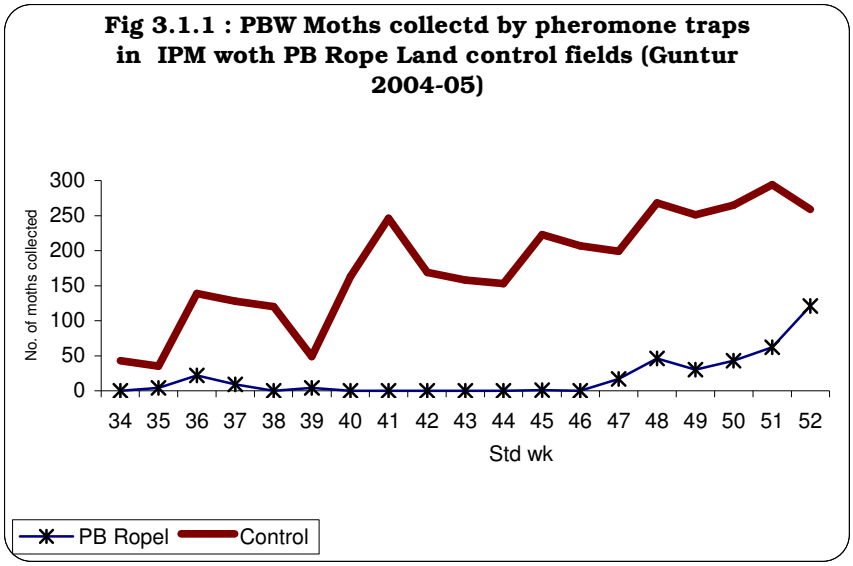
Documentary films on cotton IPM have been completed by OUAT, Bhawanipatna (Oriya and English languages) and PKV, Akola (two films). NCIPM has also completed a film on the success story of cotton IPM –Ashta Project. These would be screened and course of action/approaches/ideas for developing films on different aspects of IPM at different centers would be deliberated upon in the group meeting. Video camera and a motorcycle have been approved in the project for all the field centres and this would immensely facilitate production of high utility video-educational materials.

Pheromone utilization work was taken up for the first time with respect to PBW mating disruption technique and work on exploring utilization in IPM of sex pheromone polymorphism in *H. armigera* continued.

A large scale validation trial of Mating Disruption Technique against pink bollworm was organized in 150 acres in the project village Anantavarappadu in Guntur distt. of Andhra Pradesh using PB Rope L of M/s New Chemi Industries Ltd., Mumbai. A check of 150 acres in a far off place was kept for comparison where only conventional pheromone traps of PBW were placed.

The data on daily trap catches of pink bollworm (Fig. 3.1.1) indicated wider variations in the trap catches between the PB Rope L IPM trial and control block. A total number of 3367 adult moths/10 traps were caught during September to January in control block while about 10 times less number of 359 adults were recorded from PB Rope L IPM block. Thus pheromone monitoring indicated the efficacy of PB ROPEL in reducing pink bollworm adult population probably by disrupting the mating.

Fig 3.1.1 : PBW Moths collectd by pheromone traps in IPM woth PB Rope Land control fields (Guntur 2004-05)



The PB Rope L use in IPM block though indicated some reduction in boll and locule damage and larval population compared to control block (Tables 3.1.7 & 8), the differences were not highly perceptible as in the case of pheromone trap catch mainly because of pest control operations on different scale. The technique needs to be critically evaluated in 2005 season in AP and the other nucleus IPM villages of the Central and South Zone States where PBW is a major problem.

Table 3.1.7. Kapas damage due to pink bollworm in IPM fields treated with PB Rope L and control (only PBW traps), Guntur

Piocking Of Kapas	IPM				Control			
	Total Kapas (gm)	Damaged Kapas (gm)	% Damaged Kapas	No. of Larvae/ Kg kapas	Total Kapas (gm)	Damaged Kapas (gm)	% Damaged Kapas	No. of Larvae/ Kg kapas
1st	2035	35	1.72	0	500	24	4.8	10
2nd	950	25	2.63	0	950	35	3.68	0
3rd	1050	28	2.66	1.9	750	10	1.33	2.66

Table 3.1.8. Boll damage due to pink bollworm in IPM fileds treated with PB Rope L and control, Guntur

Experimental field	Total bolls observed	% Boll damaged	Total locules observed	% locule damaged	Larvae / 100 bolls
P B Ropel	354	11.02	1444	6.02	13.29
Control	538	19.75	2611	11.72	23.4

Determination of pheromone blend profile of *H. armigera* was carried out at Coimbatore, Akola and Sriganganagar centers where it was not previously attempted. The evaluation indicated sex pheromone polymorphism at these centers as well. The utilization of sex pheromone polymorphism phenomenon in *H. armigera* was attempted at Guntur, Dharwad, Nanded, Akola, Nagpur, Surat and Sriganganagar with combination blends in one block and the standard blend in the other block. The data (Table 3.1.9, Fig. 3.1.2) established the value of using multiple blends over the conventional blend (97:3) as the trap catches were almost double in the bouquet of blends.

Table 3.1.9 : Comparative trap catch efficacy (@ 5 traps/ ha) by use of multiple blends and commercial blend of *H. armigera* (BARC, Mumbai)

Sr. No.	Blend combination	Male catch/ trap
A. Guntur, Andhra Pradesh		
1.	Multiple: 3, 3, 5, 5, 10 %	3.96*
2.	Multiple: 3, 3, 7, 7, 15 %	2.72
B. Dharwad, Karnataka		
1.	Multiple (3, 3, 5, 5 & 10 % and 3, 3, 7, 7 & 15 %)	57.14 *
2.	3% (Commercial)	23.74
C. Nanded, Maharastra		
	Multiple (3, 3, 7, 7 & 10 %)	1.69*
	3% (Commercial)	0.74

*** Significant at 5 % P**

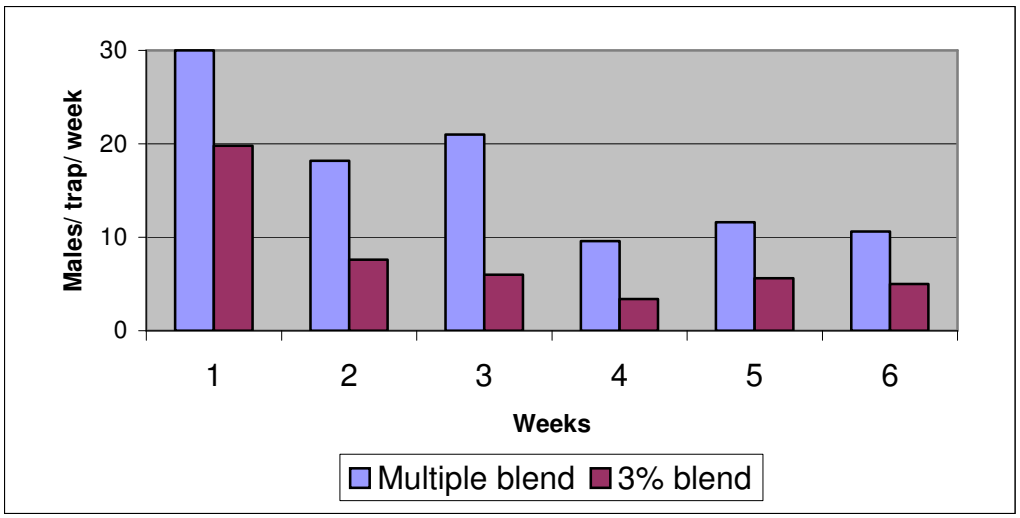


Fig . 3.1.2 : Performance of Multiple Blends over Conventional Blend

A common observation in scientific gatherings with respect to the question of sex pheromone polymorphism in *H. armigera* and its utilization in IPM is that of quantity of the pheromone used. It is contented if a proper quantity of pheromone is dispensed in the lure, probably it would level off the attraction of male moths to other blend combinations. A lot of interest was generated about the polymorphism issue in a workshop on "Enabling Small and Medium Entrepreneurs to promote pheromone-based pest control technologies in South Asia" held at Bangalore in 2004. Field trials were conducted in 2005 chickpea season at IARI, New Delhi and Sirsa with varying loadings of pheromones (1, 5 and 10 mg) and in different ratios of Z11:Z9, namely, 90:10 (low ratio), 93:7 (medium ratio) and 97:3(high ratio), (supplied by Morgo Biocontrols Pvt. Ltd., Bangalore). Preliminary interpretation of the results indicated that high loading generally resulted in more trap catches. However, even at high loading, a distinct sex pheromone polymorphism was evident. Detailed statistical interpretation of the results has not yet been done.

ILRI, Ranchi produced 1.60 g of Z-(9)-Hexadecnal , 1.70 g of Z-(11)-Hexadecenal, 300 mg of Z-(11)-Octadecenal and 900 mg of *E,E*-10, 12-Hexadecadienal and some samples of the product were also provided to two private entrepreneurs for field testing. Proper formulation of the indigenously prepared pheromones will have to be taken up for establishing field utility of the various products