Front Line Demonstration on IPM Practices for the Management of Pink Boll Worm (*Pectinophora gossypiella*) in *Bt* Cotton of Mancherial District, Telangana State

Abstract

A front line demonstration (FLD) on Integrated Pest Management (IPM) practices for the management of pink boll worm, *Pectinophora gossipiella* (Saunders) has been conducted in different villages in various mandals of Mancherial district in Telangana state during *Kharif* (June – December) season of 2018–19, 2019–20 and 2020–21 respectively to create awareness about the IPM practices among the farming community. The adoption of IPM practices like installation of pheromone traps AT 45 DAS, removal & destruction of rosette flowers, spraying of Azadiractin 1500ppm and need-based application of selective insecticides etc.were carried out. The results revealed that the lowest percent rosette flowers (6.63, 6.52 and 2.84) and green boll damage (5.71, 8.91 and 13.39) was recorded in IPM demonstrated plots over farmers practice (percent rosette flowers (11.69, 8.51 & 13.39), green boll damage (8.57, 10.46 and 21.84) with increased yields of 7.83, 9.98 and 9.85 during corresponding *Kharif* (June – December), 2018–19, 2019–20 and 2020–21. Further, the demonstration plots registered with higher cotton yield of 2079, 1785 and 1817 kg ha^{-1} as compared to 1928, 1623 and 1654 kg ha^{-1} under farmers practice. The Cost-Benefit ratio of 1.89, 1.90 and 1.80 respectively in the technology demonstrated plots whereas in farmers practice the recorded Cost - Benefit ratio of 1.55, 1.64 and 1.45 during corresponding *Kharif* (June – December), 2018–19, 2019–20 and 2020–21. Hence, need to popularize the IPM practices through FLD among the farming community to alleviate the gap between the improved technology and farmer's practice.

Key words: Cotton, Pink Boll Worm, Integrated Pest Management, Percent yield increase

1. Introduction

Cotton (*Gossypium spp.)* is an important and oldest commercial fiber crop of India as well as in the state of Telangana. Popularly known as white gold, playing a key role in socio economic affairs of the nation. In India the crop is cultivated in an area of 13.4 mha with a production of 36.5 mbales with a productivity of 460.0 kg ha^{-1}. The area of cotton in Telangana state is 21.2 lakh hectares whereas production is 54.0 lakh bales with a productivity of 432.0 kg ha^{-1} (Anonymous, 2020). In India, annually Rs. 3,39,660 million worth of yield loss (Dhaliwal et al., 2010). In India, since its introduction, the cultivation of *Bt* cotton has increased greater than before (Henneberry TJ

and Naranjo, 1998) and is instigated by 166 recorded insect pest species on cotton (Puri et al., 1999). Among them Pink bollworm, *Pectinophora gossypiella* (Saunders) is one of the key destructive insect pests of cotton (Balakkrishnan N et al., 2010) with an extensive range across India (Naik VC et al., 2018) leading to significant loss to the crop (Deore et al., 2010) by damaging squares, flowers and bolls (Ghosh, 2001, Amin and Gergis, 2006, Roopsingh et al., 2021). It has become economically the most destructive pest of cotton and during 2017–18, it's infestation ranged from 8–92% with corresponding yield losses of 10–30% in major cotton producing states like Maharashtra, Telangana, Andhra Pradesh, Karnataka and Madhya Pradesh (Anonymous, 2020). In Telangana the reduction in yield ranges from 35–90% (Naik et al., 2021). Large-scale cultivation of *Bt* cotton can impose a continuous and intense selection pressure on bollworms leading to the development of resistance to toxins (Hardee et al., 2001). Recently, in India, the development of resistance in Pink bollworm to Cry 1 Ac and Cry 2 Ab toxins has been reported (Chinnababu Naik et al., 2018). During the recent past, Pink Boll Worm is appearing early stage of the crop (45–60 DAS) on BG-II hybrids in Central and South India (Sivarama Krishna et al., 2020). Unless extension initiatives to manage PBW were implemented on war footing, the situation might have further lead to yield losses and had a surging effect on textile industry and Indian economy. The adoption of Integrated Pest Management helps the farming community in reducing the usage of chemical pesticides there by reducing cost of cultivation as well as increasing yields (Ajanta et al., 2019). Timely implementation of the IPM interventions by educating the farmers helps to reduce the cost of production (Raghava and Punnarao, 2013).To overcome these lapses KVKs acts as a Knowledge and Resource Centre at district level to demonstrate the technologies (Sharma et al., 2017) and the output of the research is disseminated to farmers through conduction of frontline demonstrations about the developed technologies (Singh et al., 2007). For this IPM technologies need to be practiced in cluster approach to manage the pest (Shankar et al., 2022). Hence, the following integrated pest management module under front line demonstrations has been validated in the field conditions for effective dissemination of new technologies in the different villages of various mandals in Mancherial district during *Kharif* (June – December),2018–19, 2019–20 and 2020–21to reduce the incidence of pink bollworm & cost on plant protection practicesand to study the yield and economic impact of the technology.

2. Materials andMethods

The present study was carried out in the different villages of various mandals in Mancherial district during *Kharif* (June – December), 2018–19, 2019–20 and 2020–21 by the Krishi Vigyan Kendra, Bellampalli, Mancherial, PJTSAU. In this study, 25 farmers were selected for the demonstration of the technology in the three consecutive years. The improved technology were

imposed, consisting deep summer ploughings, erection of pheromone traps at 45 DAS @ 4acre for monitoring of the pest or 8 per acre for mass trapping and control of the pest, need based spraying of Azadiractin 1500 ppm @ 5ml $lt^{-1}$with Surf/Sandovit @ 1ml or g lt^{-1} of water as a prophylatic measure at 40–45 DAS of the crop, if the pest reaches ETL (trap catches 8/day/trap for 3 consecutive days or 10% rosette flowers or 10% damaged green bolls) then spray with Thiodicarb 75 WP @ 1.5g lt^{-1} or Profenophos 50 EC @ 2ml per litre and termination of the crop before 200 days or by end of the December etc. Whereas the farmers practice includes indiscriminate spraying of different insecticides like Acephate 75SP @ 300 – 400gacre^{-1}),Ampligo 150ZC (80–100 mlacre^{-1}), Chlorantraniliprole 18.5SC (60–80mlacre^{-1}) and Synthetic pyrethroids, Lambdacyhalothrin 5EC (250 mlacre^{-1}) during the cropping period from vegetative stage to end of the crop growth period. The regular field visits were taken up for recording the data on the following observations such as per cent rosetteflowers, per cent green bolldamage, adult mothcatches/trap/week (Monthly Average), cottonyield, yield attributes and cost benefitratio etc. These studies also provide information about the favourable periods for pest build-up that help in the management of the pest. The weather parameters viz., Maximum and Minimum Temperatures (^{o}C) and Rainfall (mm) were recorded on monthly basis from August to December during 2018–19, 2019–20 and 2020–21 respectively.Observations on the incidence of pink bollworm in green bolls were made during the field visits at regular intervals. For this purpose, selected 30 cotton green bolls randomly with optimal size were collected to cut open the bolls for the careful examination of pink bollworm damage.

3. Results and Discussion

The observations were recorded on intensity of pink boll worm (*Pectinophora gossypiella*) consequently in three years during *Kharif*(June – December), 2018–19, 2019–20 and 2020–21.

Rosette flowers and Green Boll Damage:

The statistics presented in the Table 1 showed that the percent rosette flowers found to 6.63%, 6.52% and 2.84% in the demonstration of IPM module as compared to11.69%, 8.51% and 8.20% in farmers practice during *Kharif* (June – December), 2018–19, 2019–20 and 2020–21 respectively. Whereas the percent pink bollworm infestation in green boll found to 5.7%1, 8.91% and 13.39% in IPM module as compared to 8.57%, 10.46% and 21.84% in farmers practice. In all the three years, the demonstration plots showed significant differences in the percentage damage in rosette flowers and green bolls against farmers practice.

Table 1: Percent of rosette flower, green boll damage, green boll locule damage, open boll damage, open boll loculedamage during *Kharif*(June – December), 2018–19, 2019–20 and

2020–21						
Particulars	**Percent Rosette Flowers (%)**			**Percent Green Boll Damage (%)**		
	2018–19	**2019–20**	**2020–21**	**2018–19**	**2019–20**	**2020–21**
IPM Module	6.63	6.52	2.84	5.71	8.91	13.39
Farmer Practice	11.69	8.51	8.20	8.57	10.46	21.84

3.1. Adult Trap Catches:

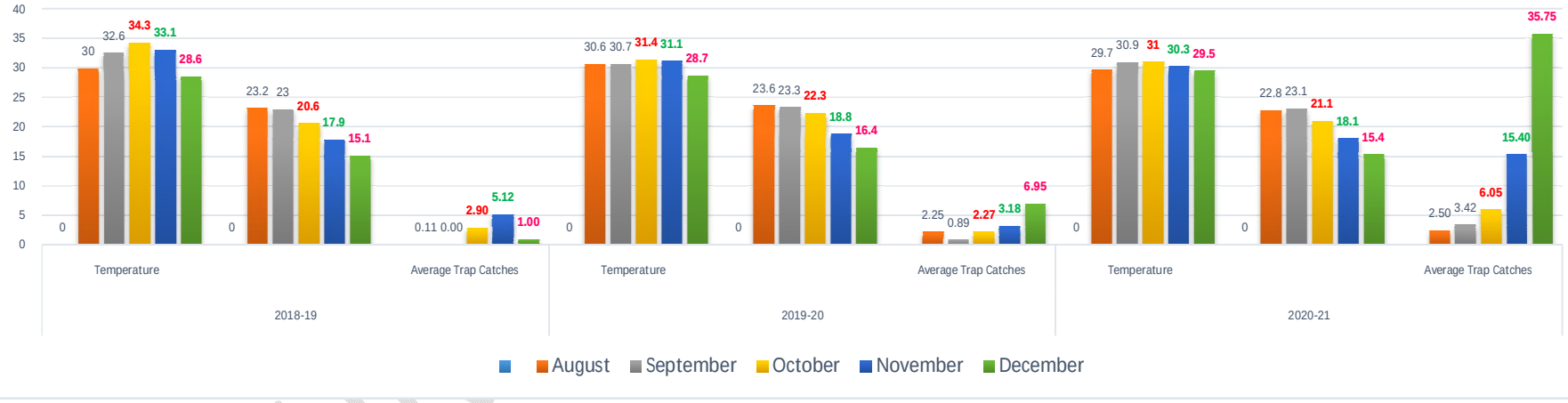
Studies on adult moth catches of pink bollworm in pheromone traps installed in the demonstrations indicated that the early catches of adults noticed during October, 2018–19, 2019–20 and 2020–21 with a peak adult emergence in the months of November and December of last two years.

Table 2: Seasonal incidence of pink boll worm, *Pectinophora gossypiella* in cotton in relation to meteorological condition during *Kharif* (June – December), 2018-19, 2019–20 and 2020-21

Month	2018–19								2019–20								2020–21							
	RF (mm)	Temperature (^{0}C)		Demonstration			Farmer's Practice		RF(mm)	Temperature (^{0}C)		Demonstration			Farmer's Practice		RF (mm)	Temperature (^{0}C)		Demonstration			Farmer's Practice	
		Max	Min	Avg. Trap Catches	% Flower Damage	% Boll Damage	% Flower Damage	% Boll Damage		Max	Min	Avg. Trap Catches	% Flower Damage	% Boll Damage	% Flower Damage	% Boll Damage		Max	Min	Avg. Trap Catches	% Flower Damage	% Boll Damage	% Flower Damage	% Boll Damage
August	531.5	30.0	23.2	0.11	8.88	0.00	10.37	0.00	469.2	30.6	23.6	2.25	7.50	12.50	10.58	10.67	323.1	29.7	22.8	2.50	0.00	0.00	8.00	0.00
September	107.5	32.6	23.0	0.00	4.87	4.31	8.78	5.35	284.3	30.7	23.3	0.89	7.66	8.65	6.13	6.63	130.0	30.9	23.1	3.42	6.00	6.46	12.77	14.46
October	7.4	34.3	20.6	2.90	13.44	9.21	13.01	9.12	123.0	31.4	22.3	2.27	9.16	5.13	9.76	12.08	87.1	31.0	21.1	6.05	4.63	12.84	8.42	22.11
Novemb	0.0	3	1	5.12	4.71	7.78	8.68	11.38	8.1	31.1	18.8	3.18	7.04	8.99	5.98	7.40	12.	30.3	18.1	15.40	2.40	20.0	6.40	32.8

er		3.1	7.9														0					0		0
December	28.9	28.6	15.1	1.00	1.25	7.25	17.62	17.01	1.1	28.7	16.4	6.95	1.25	9.28	10.12	15.55	8.8	29.5	15.4	35.75	1.20	27.67	5.4	39.85
Average	**135.1**	**31.7**	**20.0**	**1.826**	**6.63**	**5.71**	**11.69**	**8.57**	**177.2**	**30.5**	**20.9**	**3.108**	**6.52**	**8.91**	**8.51**	**10.47**	**112.2**	**30.3**	**20.1**	12.62	**2.84**	**13.39**	**8.19**	**21.84**

Graph 1. Graphical Representation of Average Month wise Trapcatches in relation with temperature in *Kharif* (June – December), 2018 - 2020



3.2. Yield impact:

The information regarding the impact of technology demonstrated in terms of escalation in yield have been presented in table 3. The data showned that the yield of cotton improved by 7.83% 9.98%and 9.85% in the demonstration of IPM module as compared to farmer's practice. In all the three years, the demonstration plots showed significant differences in the yields against farmers practice.

3.3. Economic impact:

The total cost of cultivation incurred, gross and net returns and B:C ratio were to assessed to study the economic impact of technology of IPM module and farmer practice. The data (table 3) revealed that the yield of IPM module demonstrated field was 2079, 1785 and 1817 kg ha^{-1}whereas in the farmer practice, the yield was 1928, 1623 and 1654 $kgha^{-1}$ during *Kharif*(June – December), 2018–19 and 2019-20 respectively. The economic analysis results revealed that the cotton crop recorded higher returns from demonstration as 103950, 92713 and 89917 Rs ha^{-1}as compared to 96400,85208 and 81873 Rs ha^{-1} in farmers practice during *Kharif* (June – December), 2018–19, 2019–20 and 2020–21 respectively. The B:C Ratio in IPM module was high 1.89, 1.90and 1.80 when compared to farmer practice 1.55, 1.64 and 1.45 during *Kharif* (June – December), 2018–19, 2019–20 and 2020–21 respectively. IPM module showned positive results with respect to yield and economics of cotton. It was marked from the results that B:C Ratio of cotton crop in IPM module was higher as compared to farmer practice in both the years. Because of non-adoption of IPM module for pink bollworm management in cotton crop resulted in lower B:C Ratio in farmer practice. Thus, promising B:C Ratio and higher net returns in IPM module showed the economic sustainability of the demonstrated technology and influenced the farmers on the utility of technology provided at actual farming situation. Similar results were also reported by Shankar et al., 2022, Undhad et al., 2018, Surulivelu, 2007 and Verma, 2017.

Table 3: Economic analysis of on-farm trial on cotton during *Kharif*(June – December), 2018–19, 2019–20 and 2020-21

Particulars	Yield ($Kgha^{-1}$)			Per cent increase in yield over check			Cost of cultivation Rs. ha^{-1})			Gross returns (Rs. ha^{-1})			B:C Ratio		
	2018–	2019–	2020–	2018–	2019–	2020–	2018–	2019–	2020–	2018–	2019–	2020–	2018–	2019–	2020–

	19	20	21	19	20	21	19	20	21	19	20	21	19	20	21
IPM module	2079	1785	1817	7.83	9.98	9.85	54795	48723	50153	103950	92713	89917	1.89	1.90	1.80
Farmer practice	1928	1623	1654	-	-	-	61940	52048	56486	96400	85208	81873	1.55	1.64	1.45

4. Conclusion

In IPM module, documented higher cotton yield with gross returns 103950, 92713 and 89917 Rs ha^{-1}which was about 7.83%,9.98% and 9.85%higher than the non IPM module with 96400, 85208 and 81873 Rs ha^{-1} during *kharif*, 2018–19 2019–20 and 2020-21 respectively. The IPM based practices were found effective in comparison to farmer practice. From the above study, it can be concluded that by adopting IPM based pink boll worm management strategies in *Bt* cotton can be efficiently managed instead of practicing chemical control measures. Similar results on yield improvement and reduced cost of cultivation on cotton through FLD has also been reported by Patel et al., 2013 and Dhaka et al., 2010.

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