Innovative Front Line Demonstrations in Tribal Areas to Enhance Bt Cotton Income through Integrated Pest Management

Mounica .D[1], V. Govardhan Rao[2]

[1, 2]Krishi Vigyan Kendra, Dr. Y. S. R. Horticultural University, Pandirimamidi-533208, East Godavari District- Andhra Pradesh, India

Abstract: ***Cotton (Gossypium spp.) is a major cash crop, being the world's leading natural fibre for the manufacture of textiles and edible oil. Cotton crop suffers more from insect pest attack. Due to lack of awareness of tribal farmers, KVK scientists promoted the integrated pest management practices in tribal areas for the suppression of sucking pests. The integrated pest management strategy involving many components was demonstrated through innovative large scale contagious technology demonstration in 50 acres cotton (variety- Tulasi) crop area during the year 2014-2015 Kharif season in rain fed track of East Godavari District in Andhra Pradesh, India. The various production and protection parameters indicated that adoption of IPM strategies decrease the cost of production without affecting the yield. The IPM demonstration, insecticides sprays quantity reduction in Bt Cotton was 40 litres per acre respectively as compared to the local check. Adoption of IPM technology increased the net income over the local check in Bt cotton hybrids Rs. 18500/ac. In spite of increase in yield of cotton, technological gap, extension gap and technology index existed. The improved technology gave higher gross return, net return with higher benefit cost ratio as farmer's practices.***

Keywords: Cotton Hybrids, IPM, Sucking pests, cultural control, traps

1. General Introduction

Cotton (*Gossypium sp*) white gold is a major commercial crop grown in India. Over 1000 species of insects and mites have been recorded on cotton (Hargreaves, 1984). Among these, 162 species of insects have been reported to attack cotton at various growth stages and 15 are considered as key pests (Puri, 1998). There are some studies that find that Bt cotton does not significantly increase yield and income and bollworms continue to grow (Hayee 2005), These studies identify a variety of factors for the failure of Bt cotton such as limited knowledge on how to use the technology, prevalence of a black market for un-improved Bt cotton varieties, and climatic variations and other disasters. Negating these findings are studies by Sheikh et al. (2008), Nazli (2009, 2010) and Ali and Abdulai (2010), who indicate that the overall outcome of adopting Bt cotton is positive for all farm categories, but in varying degrees. While the literature on the impacts of Bt cotton on small farmers is mixed, other worries remain about the long term impacts of Bt cotton. Two public bads that can occur are the loss of biodiversity and genetic pollution (Park *et a*l. (2011). Biodiversity loss may occur as farmers start planting only Bt cotton on their farms. Study of Pray *et al*. (2002), report that a larger percent of non-Bt growing farmers (around 22 percent) identified various health problems related to pesticide use compared to farmers planting only Bt cotton (5-8 percent). Kousar and Qaim (2011) also argue that Bt cotton has led to a notable decline in acute pesticide poisoning cases among cotton growers in India.

The magnitude of pest problem forced cotton growers to depend heavily on insecticides, about 56 per cent of the insecticides produced was consumed by this crop alone. This has really caused ecological disaster and resistance of pests to pesticides. It awakened wide scale public concern about excess use of pesticides and led to the emergence of Integrated Pest Management (IPM) concept as an environmentally safe alternative to sole use of insecticides. Andhra Pradesh was one of the important cotton areas in India and covered an area and production of 23.7 lakh acres and 230 Kg/acre in 2006-2007 (Anonymous 2007). This production in the state decreased year by year owing to pest problem and more cost on protection measures. Though IPM developed long back, the technological knowledge and adoption rate was low in the minds of cotton farmers. The improved technology package was found beneficially attractive, yet adoption levels for several components were low, hence emphasizing the need for better dissemination innovative large scale 50 acres IPM front line demonstration was planned and implemented successively during the year 2014-2015 (Kharif season) to diffuse and influence the practices of IPM technology on yield, cost of plant protection, quantity of pesticides consumption and frequency of pesticides sprays.

2. Materials and Methodology

Large scale integrated pest management demonstrations were conducted with medium staple cotton hybrids in a contagious area of 50 acres during the year 2014-15 in rain fed tracks of East Godavari District of Andhra Pradesh state during Kharif season. The 50 acres in the year of 2014-2015 in fifty different locations of the district involving 50 farmers irrespective of their farm size and cotton crop area. The selection of taluk, village and farmers were made purposively looking the criteria of continuity of cotton crop in that area, cotton crop pest population and lack of IPM package of practices.

Materials Distributed:
1. MOP- 25kgs/farmer
2. Castor plants- 500 & Marigold plants – 1000/farmer
3. Imidacloprid – 500ml/farmer

4. Acetamiprid – 250g/farmer
5. Yellow sticky traps – 16pc/acre/farmer
6. Neem oil – 1 lt/farmer

Before conducting of demonstrations the actual existing field problems of cotton growing farmers and technological gaps in cotton production were identified with care through extension methods like survey, group discussion, secondary data and gram Sabha. During the conduct of these resource inventory techniques farmers were facilitated to express the constraints in the production of cotton crop over the years. Due care was taken to listen and consider the field experiences of progressive cotton growers, medium to big land holders and categories of tribal farmers and gender. The components of IPM demonstration in Bt cotton were summer ploughing, sowing of insecticides treated seeds, sowing of boarder crop (Castor) and trap crop (Marigold), stem smearing with Imidacloprid at 35 days of crop, monitoring of pest load through pheromone traps, need based application of neem and need based sprays of chemical pesticides, excluding the release of trichogramma egg card and HNPV. With all these farmer's practices collected the data on yield gaps between potential yield and demonstration yield, extension gap, technology index, quantity of insecticides used and reduction of plant protection were the parameters observed to analyze the impact of IPM in enhancing the productivity in turn net income from cotton cultivation. The insect pest population level and stage of crop was considered to impose the IPM components. Traditional calendar based pest management practices were considered as local check for comparative study. Technological gap, extension gap and the technological index were calculated using the following standard formula (Samui, *et al*. 2000).

Technology gap = Potential yield – Demonstration yield;
Extension gap = Demonstration yield – Farmers / Local check yield;

Technology index = [(Potential yield – Demonstration yield) / Potential yield] x 100.

3. Results and Discussion

The data presented in the table 1 revealed that the yield difference between potential, demonstration and local check attributed for the fact that the cotton was grown in the rain fed situations during Kharif season. The study revealed that there was much difference in the yield of Bt hybrids both in the demonstration and local check. The per cent increase in the yield of Bt was 66.6. These results indicate that the IPM technology had an impact on Bt hybrids yields. The technology gap in the yield of Bt was 1q/ac. The probable reason for this gap may be due to the soil type. Generally as seen in the demonstration field's Bt cotton hybrid was cultivated in medium to deep red soils. The extension gap was 6.83 q/ha in Bt cotton hybrids. The data shows that there was much extension gap in the yield levels; however some more efforts are yet to be intervened to convince the advantages and effectiveness of IPM technologies. The knowledge up gradation on eco friendly farmer friendly and cost effective technologies, time of proper use of IPM inputs and accessibility of IPM inputs at times of need may definitely create positive impact on the enhanced yields of Bt cotton hybrids and also influence in the reduction of cotton pest load. The IPM technologies demonstrated eventually lead the farmers to discontinue the old practices with adoption of demonstrated practices. The technology index showed the feasibility of the evolved technology at farmer's fields. The lower the value of technology index the more shall be the feasibility of the technology. The technology index of Bt hybrid was 10 per cent. Considering these data it seems that the technology is 10 per cent feasible. However, in view of the ecological safety and net economic benefits (Table 2) the technology is much feasible as IPM technology includes ecologically safer pest management practices.

The additional income due to increased yield and saving on plant protection chemical in Bt cotton was Rupees 10500/- and Rupees 8000/- per acre respectively. (Table 2). These data showed that the adoption of IPM technology increased the net income over the local check in Bt cotton (Rs.18500 per acre) hybrids. The data showed that the per cent reduction in cost of plant protection was 63.04 (Table 3). The data on impact of yellow sticky traps on the level of sucking pests incidence (Table 4) in Bt showed reduction in number, hence it can be concluded that physical control reduces chemical load and also the data on number of sprays (Table 5) in Bt showed reduction in number, hence it can be concluded that IPM technology reduces usage of plant protection chemicals on cotton production system.

4. Conclusion

Tribal farmers around the world both large and smallholders benefit from this technology through increased productivity, convenience and time savings. The vast majority of farmers using Bt cotton globally are smallholder farmers. The economic, environmental, and social benefits derived from adoption of this important tool have very positive implications for the farmers, their surrounding communities and the future of agriculture (Purcell, J.P.,& Perlak, F.J., 2004). It was concluded that if the profitability status of Bt cotton cultivation in the area could be enhanced, the sustainability status of Bt cotton could be increased (Nithy et al. 2009). In cotton production system, IPM technology was found as imperative for common pest problems. The adoption of IPM technology increased the net income. There is need to adopt multipronged strategy that involves enhancing income of cotton tribal farmers through effective management of insect pest with the adoption of IPM technology. Hence, the technology may be popularized to mitigate the extension gap.

References

[1] Anonymous, ―Mini Mission II Annual report 2005-06, Directorate of Cotton Development, Ministry of Agriculture, Government of India, Mumbai, pp, 7 – 9, 2007.
[2] Ali, A. Abdulai, ―The adoption of genetically modified cotton and poverty reduction in Pakistan‖. *Journal of Agricultural Economics*, 61:175-192, 2010.

[3] H. Hargreaves, ―List of recorded cotton insects of the world. Common Wealth Institute of Entomology‖, London, pp 50, 1984.
[4] A .Hayee, ―Cultivation of Bt cotton-Pakistan's experience‖. Actionaid-Pakistan Islamabad. www.actionaid.org/Pakistan 2005.
[5] S . Kousar, M. Qaim, ―Impact of Bt cotton on pesticide poisoning in smallholder agriculture: A panel data analysis. *Ecological Economics*, vol. 11, pp. 2105–2113, 2011.
[6] H. Nazli, ―Adoption of unapproved varieties of Bt cotton in Pakistan: Impact on production and trade. The Brown Bag Seminar, IFPRI, 2009.
[7] H. Nazli, ―Impact of Bt cotton adoption on farmers' wellbeing in Pakistan‖. PhD Dissertation, Faculty of Graduate Studies, University of Guelph, Canada, 2010.
[8] V. Nithya, S. Arunkumar, and B. Saikumar, ―Sustainability of Bt Cotton in Karnataka – An Economic Analysis, International Conference on Applied Economics – ICOAE, 2009 pp. 799-804, 2009.
[9] J. Park, I. McFarlane, R. Phipps and G. Ceddia, ―The role of transgenic crops in sustainable development. *Plant Biotechnology Journal*, vol. 9 pp. 2-21, 2011.
[10] E Pray, J Huang, R. Hu, S. Rozelle, ―Five years of Bt cotton in China—the benefits continue. *Plant Journal*, vol. 31 pp. 423–430, 2002.
[11] P. Purcell, J. Perlak, ―Global Impact of Insect-Resistant (Bt) Cotton, AgBio Forum, 7(1 and 2), 5 2004.
[12] N. Puri, ―Non pesticidal Management of Helicoverpa armigera (Hubner) on cotton and pigeon pea, Workshop on non pesticidal management of cotton and pigeon pea, pp 79 April 10-11, 1998.
[13] K. Samui, S. Maitra, D. Roy, K.Mondal, and D. Saha, ―Evaluation on front line demonstration of groundnut (Arachis hypogeal L.), *Journal of the Indian Society of Coastal Agriculture Research*, vol. 18 (2), pp. 180-183, 2000.
[14] D. Sheikh,A. Mahmood, A. Hussain, A. Bashir and R. Saeed, ―Bt-Cotton Situation in Punjab . Technology Transfer Institute. Faisalabad, 2008.

Appendix

Table 1: Productivity, Yield Gap and Technology Index of IPM Demonstration

Type of cotton: Bt cotton hybrid (Variety-Tulasi)

Average Yield (qt/ac) under Potential	10qt/acre
Average Yield (qt/ac) under Demonstration	9qt/acre
Average Yield (qt/ac) under Local Check	6qt/acre
Per Cent Increase in Yield	66.6%
Technology Gap	1qt/acre
Extension Gap	6.83 qt/acre
Technology Index	10%

Table 2: Economics of IPM Demonstration

Increased Yield (Extn Gap Over Local Check) (qtl/ac)	0.83
Average Price of Cotton (Rs./qtl)	3500
Additional Income Due to Increased Yield (Rs./ac)	10500
Amount saved in plant protection chemical over local check	8000
Net Income Gained (Rs./ac)	18500

Table 3: Cost of Plant Protection in Cotton IPM Demonstration

Cost of plant protection under Demonstration (Rs./ac)	4000
Cost of plant protection under Local Check (Rs./ac)	10824
Per Cent reduction in cost of Plant Protection	63.04
Economic Extension Gap	-8000

Negative digits of economic extension gap can be read as saving on plant protection chemicals

Table 4: Impact of Yellow sticky traps on the level of sucking pests incidence

S.No.	*Name of the month*		*Effect of yellow sticky traps on the mortality of insects/ 1 trap*		
		Period	Whiteflies	Thrips	Aphids
1	July	1^{st}	61	24	47
		3^{rd}	53	21	45
2	August	1^{st}	57	20	45
		3^{rd}	59	19	44
3	September	1^{st}	51	17	41
		3^{rd}	47	15	41
4	October	1^{st}	31	12	35
		3^{rd}	35	9	28
5	November	1^{st}	27	11	25
		3^{rd}	21	7	20
6	December	1^{st}	11	9	18
		3^{rd}	19	11	27

Table 5: Number of Sprays to Cotton IPM Demonstration

Number of sprays under Demonstration	12
Number of sprays under Local check	20
Per Cent reduction in sprays	40
Extension Gap	-8

Negative digits of extension gap can be read as reduction in number of plant protection chemical sprayed in one acre area.

Author Profile

Mounica. D is research Associate (Entomology), Krishi Vigyan Kendra, Pandirimamidi, East Godavari District-533208, Andhra Pradesh, India, Completed Agricultural B. Sc., from Agricultural College, Bapatla, Aacharya N.G. Ranga agricultural University in the year 2012. Agricultural M.Sc., from Tamil Nadu Agricultural University, Coimbatore in the year 2014. Research work in master's programme was on Non-chemical management strategies against pulse bruchids. During my service as research Associate, I have implemented on farm testing's, front line demonstrations and organized trainings and extension activities. To be published the three research articles in Journal Of Insect Science, International Journal of Agricultural Environment and Biotechnology and The Andhra Agricultural Journal. Published three popular articles in Sedya phalam, Agriclinic.

V. Govardhan Rao is Subject Matter Specialist (Plant Pathology), C/O Krishi Vigyan Kendra, Pandirimamidi. Awarded B.Sc., M.Sc., degrees from Acharya N.G. Ranga Agricultural University, Andhra Pradesh. He has served in the cadre of assistant professor at Krishi Vigyan Kendra as Subject Matter Specialist (Plant Pathology) to cater the actual problems and difficulties faced by farmers in East Godavari district of Andhra Pradesh state for four years. During his service he has implemented on farm testing's, front line demonstrations and organized trainings and extension activities.