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Innovative frontline demonstrations in tribal areas to enhance Bt cotton yield and income through integrated pest management

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ABSTRACT

Cotton is a major cash crop being the world's leading natural fibre for the manufacture of textiles and edible oil. Cotton crop suffers from various types of insect pests. Due to lack of awareness amongst tribal farmers, Krishi Vigyan Kendra (YSR Horticultural University), Pandirimamidi, East Godavari, Andhra Pradesh promoted the integrated pest management (IPM) practices in tribal areas for the suppression of sucking pests of cotton. The IPM strategy involving many components was demonstrated through innovative large scale technology demonstration in 50 acres cotton (variety-Tulasi) crop area during 2014-2015 Kharif season in rainfed track of East Godavari district in Andhra Pradesh. The various production and protection parameters indicated that adoption of IPM strategy decreased the cost of production without affecting the yield. In the IPM demonstration quantity reduction of insecticidal sprays in Bt cotton was 40 litres per acre as compared to the local check. Adoption of IPM technology increased the net income over the local check in Bt cotton hybrids by Rs 18500/acre. 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 and higher benefit:cost ratio over farmers' practices.

Keywords: Cotton hybrids; IPM; sucking pests; cultural control; traps

INTRODUCTION

Cotton is a major commercial crop grown in India. Over 1000 species of insects and mites have been recorded on cotton (Hargreaves 1948). 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 reported 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, climatic variations and other disasters. Biodiversity loss may occur as farmers start planting only Bt cotton on

their farms. Pray et al (2002) reported that a larger percentage of non-Bt growing farmers (around 22%) identified various health problems related to pesticide use compared to farmers planting only Bt cotton (5-8%).

Andhra Pradesh is one of the important cotton areas in India and covers an area and production of 8.21 lakh ha and production of 27 lakh bales of 170 kg/ha respectively (Anon 2016). This production in the state decreased year by year owing to pest problem and more cost on protection measures. Though integrated pest management (IPM) developed long back the technological knowledge and adoption rate was low in the minds of cotton farmers.

METERIAL and METHODS

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 rainfed tracks of East Godavari district of Andhra Pradesh state during Kharif season. An area of 50 acres in the year of 2014-2015 at fifty different locations of the district involving 50 farmers irrespective of their farm size and cotton crop area was used for demonstrations. The selection of Taluks, villages and farmers was made purposively looking at the criteria of continuity of cotton crop in that area, pest population and lack of IPM package of practices.

The demonstrations were laid involving improved Bt cotton hybrid (Tulasi) and inputs muriate of potash (25 kg), castor plants (500), marigold plants (1000), imidacloprid (500 ml), acetamiprid (250 g), yellow sticky traps (16/acre) and neem oil (1 l) per farmer.

Before conducting demonstrations the actual existing field problems of cotton growing farmers and technological gaps in cotton production were identified through surveys, group discussions, secondary data and Gram Sabhas. During the implementation of these resource inventory techniques farmers were facilitated to express the constraints in the production of cotton crop over the years. The components of IPM demonstration in Bt cotton were summer ploughing, sowing of insecticide treated seeds, sowing of border 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 chemical pesticides, excluding the release of trichogramma egg card and helicoverpa nuclear polyhedrosis virus (HNPV). With all these farmers' practices data were collected on yield gaps between potential and demonstration yield, extension gap, technology index, quantity of insecticides used and reduction in plant protection measures. 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

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

RESULTS and DISCUSSION

Table 1. Productivity, yield gap and technology index of IPM demonstration on Bt cotton hybrid Tulasi

Parameter	Value
Average yield (q/acre) under potential plot	10
Average yield (q/acre) under demonstration	9
Average yield (q/acre) under local check	6
Increase in yield (%)	66.6
Technology gap (q/acre)	1
Extension gap (q/acre)	6.83
Technology index (%)	10

The data presented in the Table 1 reveal 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 over the local check. These results indicate that the IPM technology had an impact on Bt hybrids yields. The technology gap in the yield of Bt was 1 q/ac. The probable reason for this gap may be due to the soil type. Generally it was seen in the demonstration fields that 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 show 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 upgradation 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 the 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 farmers' 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 was 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 chemicals in Bt cotton was Rupees 10500 and Rupees 8000 per acre respectively. These data show that the adoption of IPM technology increased the net income over the local check in Bt cotton (Rs18500 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 of sprays hence it can be concluded that physical control reduced chemical load and also the data on number of sprays (Table 5) showed reduction in number hence it shows that IPM technology reduced usage of plant protection chemicals in cotton production system.

The economic, environmental and social benefits derived from adoption of IPM tool have very positive implications for the farmers, their surrounding communities and the future of agriculture (Purcell and Perlak 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).

Table 2. Economics of IPM demonstration

Parameter	Value
Increased yield (extension gap over local check) (q/acre)	0.83
Average price of cotton (Rs/q)	3500
Additional income due to increased yield (Rs/acre)	10500
Amount saved in plant protection chemicals over local check (Rs)	8000
Net income gained (Rs/acre)	18500

Table 3. Cost of plant protection in cotton IPM demonstration

Parameter	Value
Cost of plant protection under demonstration (Rs/acre)	4000
Cost of plant protection under local check (Rs/acre)	10824
Reduction in cost of plant protection (%)	63.04
Economic extension gap (saving on plant protection)	-8000

Table 4. Impact of yellow sticky traps on the level of sucking pests' incidence

Month	Week	Effect of yellow sticky traps on the mortality of insects/trap		
		whiteflies	Thrips	Aphids
July	1st	61	24	47
	3rd	53	21	45
August	1st	57	20	45
	3rd	59	19	44
September	1st	51	17	41
	3rd	47	15	41
October	1st	31	12	35
	3rd	35	9	28
November	1st	27	11	25
	3rd	21	7	20
December	1st	11	9	18
	3rd	9	11	27

Table 5. Effect on number of sprays applied in cotton IPM demonstration

Particulars	Value
# sprays under demonstration	12
# sprays under local check	20
Reduction in sprays (%)	40
Extension gap (reduction in # plant protection chemicals sprayed/acre	-8

CONCLUSION

The vast majority of farmers using Bt cotton globally were small landholders. Tribal farmers around the world benefit from IPM technology through increased productivity, convenience and time saving. In cotton production system IPM technology was found imperative for common pest problems. It increased the net income. There is need to adopt multipronged strategy that involves enhancing income of cotton tribal farmers through effective management of insect pests with the adoption of IPM technology. Hence the technology may be popularized to mitigate the extension gap.

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