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Management Strategy for Pink Bollworm (*Pectinophora gossypiella*) in *Bt* Cotton by Community Basis

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The real-time management of the pink bollworm in the integrated way warrant concerted steps in cotton cultivation. Integrated Pest Management is a pest management system hat in the content of the associated environment and the pest population dynamics of the pest species. Frontline demonstrations were conducted wherein the critical inputs like pheromone traps, lures, and new molecules of insecticides were provided to 30 farmers during three consecutive years from the Krishi Vigyan Kendra, Raichur. Community based IPM for pink bollworm has given good results with

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better yield. The adopted farmers who actively participated in the training programmes organized by ICAR-KVK, Raichur started adopting the use of pheromone traps for pest monitoring, were able to identify the damage symptoms and learned the concept of economic threshold level (ETL) in deciding the timing of insecticide spray. Integrated management of pink bollworm performed good along with reduction in cost of cultivation. Apart from the monetary benefits, the additional advantages in terms of safety to environment and natural enemies were also noticed in the demonstrated fields.

Keywords: Management; community basis; pink bollworm; ETL.

1. INTRODUCTION

"Cotton is a commercial crop grown in 11 states in about 12-13 mha area in India. The crop suffers due to biotic and abiotic factors. Cotton ecosystem provides home to about 1326 species of insects from sowing to maturity in different cotton growing areas of the world" [1]. "However, due to the reduced use of insecticides for bollworms and the change of pest management regimes in Bt cotton fields, these secondary pest populations have increased and gradually evolved into key pests during the season in the USA, India, China, Australia, and other countries" [2,3,4,5, 6,7,8,9].

"Among the biotic factors, for the last 6-7 years, the cotton crop has been severely affected due to incidence of pests like pink bollworm in all cotton growing zones and caused significant yield losses. In recent years, pink bollworm, *Pectinophora gossypiella* (Saunders) has emerged as a serious problem causing severe damage to cotton in several parts of our country. Pink bollworm causes significant economic yield loss to the crop. Moreover, the larvae of pink bollworm usually lie within the cotton bolls making them unreachable to insecticidal sprays due to which, its management has become a difficult task" [10-12]. Moreover, "the use of insecticides has resulted in the problem of resistance, resurgence of pests and unwanted pesticide residues in the environment. Farmers mainly rely on chemical pesticides to control pest incidence that adversely affects naturally occurring predators and parasitoids in the crop ecosystems as well as results in resistance in the insect. The real-time management of the pink bollworm in the integrated way warrant concerted steps in cotton cultivation. Integrated Pest Management is a pest management system hat in the content of the associated environment and the pest population dynamics of the pest species" [13,14,15].

2. MATERIALS AND METHODS

2.1 Intervention of the ICAR-Krishi Vigyan Kendra, Raichur to address the problem

After conducting the preliminary PRAs (Participatory Rural Appraisal) in the different taluks of Raichur, ICAR-Krishi Vigyan Kendra started imparting early season training programmes to farmers on plant protection technologies, awareness campaigns to farmers through lectures, field demonstrations, group meetings and exhibitions and capacity building programmes to extension officers and input dealers. Also they were being trained on pest monitoring with pheromone traps, use of bio-control agents and safe handling of insecticides. "Regular monitoring of fields was done for sucking pests, natural enemies and boll damage at weekly intervals. KVK also involved in the field visits for Scouting and monitoring at early stage of crop, frontline demonstrations on integrated management of pink bollworm were taken up, Critical inputs were given and the farmers are advised to follow the plant protection measures, sensitization workshop to ginning mill owners, input dealers and state extension officers. Similarly, farmers' mela and outreach programmes on pink bollworm and emerging pests & diseases of cotton. During these programmes, experts from KVK and Research wings have interacted with the farmers and advised them about the integrated management of pink bollworm and sucking pests, boll rot disease complex, management of foliar diseases, installation of pheromone traps for pest monitoring and mass trapping etc" [10,12].

2.2 Input Provided by ICAR-KVK, Raichur Including Advisories/Services

Frontline demonstrations were conducted wherein the critical inputs like pheromone traps, lures, and new molecules of insecticides were

Fig. 1. Installation of pheromone traps at Jakkaldinni, FLD plot (2021-22)

Fig. 2. Awareness programme on pink bollworm

Fig. 3. Observations and discussion with FLD Farmer at Jakkaldinni

Fig. 4. Group discussion at Mandalgera FLD plot (2020-21)

Fig. 5. Demonstration of installation of pheromone traps at Mandalgera FLD plots

Fig. 6. Field day at Mandalgera

Fig. 7. Installation of pheromone traps FLD plot (2019-20)

Fig. 8. Field day

Fig. 9. Field visit

provided to 30 farmers during three consecutive years from the Krishi Vigyan Kendra, Raichur. Before providing the critical inputs, the farmers' were made aware of the IPM technology through trainings and awareness programmes. The IPM of pink bollworm technology taught to the farmers' included proper sowing time, sanitation measures to management of pink bollworm in *Bt* cotton, importance of Non-*Bt* in resistance management through refugia, installation of pheromone traps for monitoring and mass trapping of PBW @ 12/ac, use of ovicides and judicious and timely use of insecticides. Around five awareness trainings and regular advisories in the form of text messages, whatsapp messages, TV and radio programmes were also provided by KVK, Raichur.

3. RESULTS

Raichur is primarily a cotton growing area, 80 per cent of the farmers take up cotton as a *Kharif* crop. All the taluks of Raichur grow cotton of which Devadurga taluk tops in the targeted cotton cultivation with 56,698 hectares followed by Raichur with 51,870 hectares, Manvi 21,248 hectares and Maski with 7,271 hectares. Among all these cotton growing areas, the major problem in the past 5-6 years has been pink bollworm. In this regard, the demonstrations on the integrated management of pink bollworm in *Bt* cotton technology were taken during 2019 to 2021, three years consecutively. This technology was widespread in all the cotton growing areas as a result of continuous awareness programmes and trainings and demonstrations conducted in various taluks of the Raichur district.

Table 1. Impact of Integrated management of pink bollworm in cotton

Farmer	Yield (quintals)		% increase of yield over check
	Demo	Check	
1	42.12	35.05	16.79
2	43.00	33.55	21.98
3	41.25	37.00	10.30
4	44.00	36.52	17.00
5	39.85	35.45	11.04
6	38.95	34.12	12.40
7	41.25	33.95	17.70
8	40.95	34.15	16.61
9	43.00	38.27	11.00
10	40.58	31.25	22.99
11	42.25	35.48	16.02
12	41.22	33.71	18.22
13	40.95	34.55	15.63
14	42.20	34.15	19.08
15	44.00	36.15	17.84
16	41.35	37.25	9.92
17	40.85	32.15	21.30
18	41.20	33.95	17.60
19	42.75	34.48	19.35
20	43.11	35.12	18.53
21	43.25	33.15	23.35
22	39.00	35.10	10.00
23	38.75	33.85	12.65
24	38.12	32.25	15.40
25	40.05	34.15	14.73
26	41.15	35.15	14.58
27	40.35	33.98	15.79
28	42.00	33.47	20.31
29	38.91	33.55	13.78
30	38.75	34.55	10.84
Avg	**41.17**	**34.52**	**16.16**

Community based IPM for pink bollworm has given good results with better yield. The adopted farmers who actively participated in the training programmes organized by ICAR-KVK, Raichur started adopting the use of pheromone traps for pest monitoring, were able to identify the damage symptoms and learned the concept of economic threshold level (ETL) in deciding the timing of insecticide spray. They used to get an average annual income of Rs.1,70,200 from *Bt* cotton and they faced problems like pest and diseases, non-availability of labour, water scarcity, increase in critical input price etc. With KVK interventions like supply of critical inputs like Pheromone traps, proper insecticides, bio-agents and technical inputs like better cultivation practices, drought management techniques etc. They are now getting an average annual income of Rs. 2, 25,000/-. Overall, there was a reduction in pink bollworm incidence (12.39 %), cost of cultivation, increase in the net returns and benefit cost ratio (5.48 in demo over 3.51 in check) and increase in yield (16.95 %) in the IPM adopted farmers' fields. In addition, they also got trained on the use of bio-control agents and release of egg parasitoid in cotton, safe handling of pesticides and timely crop termination to prevent pest carryover of pink bollworm in cotton. They could also reduce the number of insecticides in their cotton crop as against 7-8 sprays by the non-IPM farmers.

4. DISCUSSION

The acceptance of the technology is the key factor in adoption. In order to accept and adopt, the technology should be cheap, efficient and easy to apply in the field. All these apply well to the mass trapping technology and thus were adopted by the farmers. Sowing based on community approach escaped/lessened the PBW infestation, shredding of cotton stalks and

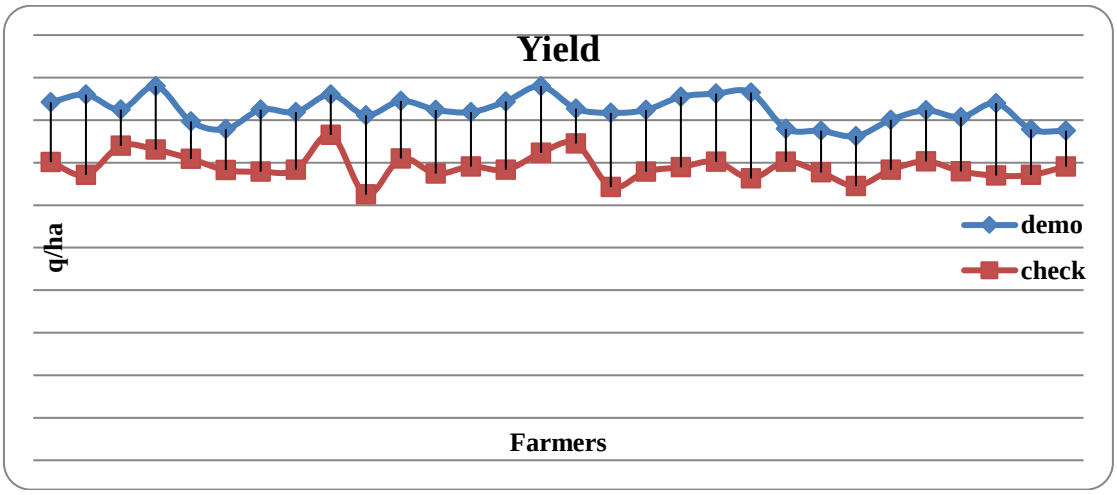

Fig. 10. Yield in IPM (demo) and non-IPM fields (check)

incorporating in the fields destroyed the pupa as well as provided nutrients to the next crop, the non-*Bt* seeds mixed along with *Bt* seeds aided in resistance management. At 30 days after sowing, the installation of pheromone traps which continued up to harvest period minimised mating and egg laying, meanwhile, the ovicides killed the eggs of the pink bollworm and the need-based insecticide use reduced the cost of cultivation. In the IPM plots, the farmers obtained an additional yield of around 1.5 quintals per acre which increased their income. It also has cut the cost of insecticides which was used for other expenses of the farmers family, has shown a better effect on their socio-economic conditions.

5. CONCLUSION

The integrated management of pink bollworm in farmers field has given a positive effect on the yield of the crop by reducing the PBW incidence and also the farmers are happy as there is a reduction in overall cost of cultivation. The adoption of the technology has facilitated the farmers in reaping the additional yield of nearly 1-1.5 quintal per acre. Integrated management of pink bollworm performed good along with reduction in cost of cultivation.Apart from the monetary benefits, the additional advantages in terms of safety to environment and natural enemies were also noticed in the demonstrated fields.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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