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Forty years of Cotton Crop Protection in India

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Cotton is a major commercial crop, affected by pests like insects, weeds and pathogens that limit its production in the country. This article, in brief, traces the history of cotton crop protection in India, with respect to insect pest control, post 1970. Dividing the entire period of 40 years into 4 decades, it dwells on the evolution of cotton crop protection, from the use of hazardous insecticides to the adoption of Bt technology. It also revisits two landmark pest management programmes, carried out on farmers' fields in the country during the period. The Integrated Pest Management programme of Astha village and the Insecticide Resistance Management programme disseminated across 12 states set a change in the tenets of cotton crop protection. Development of landmark varieties and hybrids, that changed the course of cotton as a commercial crop was an output of conventional breeding for host plant resistance. Conventional breeding of pest resistant varieties, of utmost importance, is not a part of this article.

GUEST COLUMN

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The pre- pyrethroid period (before 1980)

The insect pest complex on cotton before 1980 comprised mainly of the pink bollworm, *Pectinophora gossypiella*, spotted bollworm, *Earias sps* and *Spodoptera litura*. The American bollworm *Helicoverpa armigera* was mentioned in text books but was 'not a regular or a serious pest' of cotton in India (Nair, 1981). Standard text books published in the 70s do not describe *H. armigera* on cotton in more than 5 sentences. Sucking pests especially like the leaf hopper were reported. Popular recommendations for sucking pest control included the use of carbofuran granules, dimethoate and metasystox, with systemic and contact action. Bollworms and other lepidopteran insects were controlled with methyl parathion dust, quinalphos and chlorpyriphos, monocrotophos, carbaryl etc, insecticides with contact and stomach action. Insecticides were recommended at high usage rates, at kilograms per hectare. These insecticides were then unknown or ignored, for their toxicity to natural

Larvae of Pink Bollworm Pectinophora gossypiella

Spotted Bollworm (Earias sps) damaging young cotton boll

enemies by their mode of action, the dose at which they were used and their application methods. Importantly, insect pests were tackled independent of the ecosystem, during this decade. Resistance was first detected in the leaf worm, *Spodoptera litura* to several conventional insecticides in the late 70s (Ramakrishnan et al., 1984). That was when synthetic pyrethroids were introduced into India in 1980 to control *Spodoptera litura*.

During this period, important research pertaining to cotton pests was carried out at agricultural Universities like the Punjab Agricultural University, Tamil Nadu Agricultural University, the Indian Agricultural Research Institute, amongst others. Research across crops involved field trials, testing of chemicals, development and evaluation of simple cultural and mechanical control measures. Research was mostly individual centric and fragmented and papers published during this period are difficult to access as most of the findings were restricted to local journals and theses. Interdisciplinary research in the area of cotton crop protection was limited.

Tobacco caterpillar (Spodoptera litura) feeding on cotton leaves

The decade of pyrethroid use and misuse (1980-1990)

From 1980 to 1985, synthetic pyrethroids, highly effective on a wide range of insect pests at low dose application per unit area were excessively used. Pyrethroids began to lose their efficacy from 1986-87 when insecticide resistance developed in the American bollworm and resistance was recognised as a dominant factor that contributed to poor or inadequate pest control. Farmers in Andhra Pradesh reported acute insect pest problems on cotton in 1987.

As we look back, it was the excessive and indiscriminate use of insecticides belonging to the group of synthetic pyrethroids that led to the outbreaks of *H. armigera* and whiteflies in the next 2-3 years. Insect pest species replacement was also noted where Earias, leaf hopper and pink bollworm went into the background. The American bollworm *Helicoverpa armigera* was found to survive and cause extensive damage to cotton crop despite repeated applications of insecticides, upto 30 times. The pest later caused heavy economic losses to other crops such as chickpea and pigeon pea as well and was found to withstand sustained insecticide pressure. High levels of resistance to synthetic pyrethroids were subsequently confirmed in *H. armigera* by Dhingra et al. (1988) and McCaffery et al. (1989) as a major cause for control failures. Cotton yield worth US $100 million was lost to this insect pest in Andhra Pradesh alone, which led to a severe crisis in the state. Stories on the voracious feeding habit of *H. armigera* were reported. The insecticide resistant larvae were larger in size as compared to those collected on cotton now, very active, with a stinging bite and ate through polythene bags that were used for their collection. Their larval forms were colourful, the colour usually being influenced by the host plant on which

Cotton square being damaged by American bollworm (Helicoverpa armigera)

Adults of whitefly (Bemisia tabaci) on cotton leaves

the larvae were collected from. *H. armigera* was then recorded as a national pest. It was also the period when foreign researchers evinced interest in cotton pest management in India. The absence of data generated in the lab on the baseline susceptibility monitoring of synthetic pyrethroids on cotton insect pests was also felt. Several Masters and Doctoral theses pertaining to cotton pest problems, particularly due to pyrethroid misuse are available with the agricultural universities. The experience in this decade paved the way for integrated pest management not only in cotton but also in other field crops. It was the decade when more than 50% of insecticide use was on cotton in the country. Cotton pest management research extended its boundaries and the importance of disciplines such as agronomy and plant breeding in minimising insect pest problems in cotton was being realised.

(The views expressed in this column are of the author and not that of Cotton Association of India)