BT Cotton Origin
and Biosafety in Haryana
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Origin and Biosafety
in Haryana

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This book is dedicated to my parents
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PREFACE

The Asia-Pacific Consortium of Agricultural Biotechnology (APCoAB), a program of the Asia-Pacific Association of Agricultural Research Institutions (APAARI), has been working to facilitate exchange of information and promote informed opinion across the region on issues of common interest related to agricultural biotechnology. In 2006, APCoAB published first status report on Bt Cotton in India when 40 Bt hybrids were being cultivated on an area of 1.26 million hectares. Besides tracing the development of Bt hybrids and their adoption by Indian farmers, the report highlighted issues that needed to be addressed to effectively harness the benefits that Bt technology promised. During the past three years, Indian cotton scenario has changed dramatically, largely due to the adoption of Bt cotton. The number of Bt hybrids released for commercial cultivation till date has crossed 600 with more than 35 seed companies and public sector institutions currently engaged in their development. In addition, the first true breeding variety has also been released by the Indian Council of Agricultural Research (ICAR), a public sector institution. This provides an opportunity to the farmers to save their own seed without losing the efficacy of Bt gene. The area under Bt cotton reached 7.6 million hectares in 2008-09 constituting nearly 81% of the total cotton area in India. As a result, the production also reached 4.9 million tonnes. All these are indicators of the extraordinary impact and acceptance of Bt technology in cotton by the Indian farmers. This is quite comparable to the success of dwarf varieties of wheat and rice during the Green Revolution period. Several studies have established considerable economic benefits of Bt cotton cultivation to the farmers of all strata. Another significant development relates to creation of enabling environment by the Government of India.
The Ministry of Environment and Department of Biotechnology simplified the regulatory procedures leading to expeditious commercial release, especially of events with well established biosafety record.

In view of all these new developments, it was felt appropriate to bring out an updated edition of our earlier status report on Bt cotton highlighting contemporary issues related to both technology development and its commercialization.

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Chapter 1

INTRODUCTION

India, China, U.S.A, Brazil, Egypt, Mexico, Turkey and Sudan are the major cotton growing countries in the world. The U.S.A, Russia, China, India and Pakistan produce approximately 75 per cent of total production of it. Cotton popularly known as “White Gold” is a major fiber crop of the world. India alone being the major cotton producing country occupies 23 per cent area and contributes about 10 per cent of the total produce of cotton. India’s cotton production for the year 2010-11 (October 2010-September 2011) was 31.2 million bales, covering 11.16 million hectare with average yield 475.23 kg/ha. India is one of the leading producers of cotton in the world. However, its average productivity is far less than other countries. In our country before the introduction of Bacillus thuringiensis (Bt) cotton, nearly 50 per cent of the pesticides approximate value of (Rs. 3000 crores) were sprayed on cotton for the control of bollworms, which accounts for major damage for the crop (Anonymous, 2014). Several farmers committed suicides due to crop failure as a result of pest attack in year 1987, 1997 and 2000 in the state like Andhra Pradesh and Maharashtra, respectively (Narayanmoorthy and Kalamkar, 2006). The Bt cotton assume a lot of importance in this situation. The variety can helps the farmers, as it resist American bollworm and raise productivity. In India, Bt cotton is cultivated on large scale in Central, Southern and Northern zone.

Cotton popularly known as a major fiber crop of the world and is used about 75 per cent of world’s population for textile purposes.
Its fiber is used universally as a textile raw material. In India, it is an important cash and commercial crop valued for its fiber and vegetable oil. It is a source for earning the valuable foreign exchange by providing employment to millions of people and hence plays a significant role in the national economy. The diverse products obtained from cotton include textile raw material, cotton seed is a major source of vegetable oil and cotton cake as a rich source of high quality protein for livestock feed. Cotton is harvested as ‘seed cotton’, which is then ‘ginned’ to separate the seed and lint. The long ‘lint’ fibers are further processed by spinning to produce yarn that is knitted or woven into fabrics. With the steep increase in adoption of Bt cotton between 2002 and 2011, the average yield of cotton in India, which used to have one of the lowest yields in the world, increased from 308 kg/ha in 2001-02 to 500kg/ha in 2011-12, before reaching the highest national cotton yield of 550 kg/ha in 2013-14 as compared to 766 kg/ha of the world, cotton production increased from 13.6 million bales in 2002-03 to 37 million bales in 2013-14. Hence, the country was transformed from a net importer of raw cotton until 2002-03 to net exporter of cotton (Anonymous, 2014).

Only in India, all the four spinnable fibre yielding species of Gossypium viz., Gossypium hirsutum, G. barbadense, G. arboreum and G. herbaceum are cultivated commercially. Bt cotton was planted for the 12th year in India at 11 million ha, 200,000 more than the 10.8 million ha planted in 2012. The 11 million ha Bt cotton is 95 per cent of the total 11.6 million ha of Indian cotton, an increase of 2% from the 93 per cent adoption rate in 2012. 7.3 million farmers farming on average 1.5 ha planted 200,000 ha more Bt cotton than 2012. The yield of cotton in India has gradually increased from 170 kg/ha (lint) in 1947-48 to 524 kg/ha (lint) in 2008-09. Commercialization of Bt cotton increased 220 fold in 2013 at 11 million ha from 50,000 ha in 2002. India was estimated to have enhanced farm income from Bt cotton by 95.14 thousand crores rupees in the 11-year period 2002 to 2012 and 14 thousand crores rupees in 2012 alone (Brookes and Barfoot, 2014). In India, 45 million small farmers have benefited from planting Bt cotton repeatedly year after year during the 12-year period 2002 to 2013. Commercialization of Bt cotton increased 220-fold in 2013.
at 11 million ha from 50,000 ha in 2002. Of the 11 million ha of Bt cotton hybrids, 35 per cent was under irrigation and 65 per cent rainfed. The Genetic Engineering Appraisal Committee (GEAC) of the Ministry of Environment and Forest (MOEF) approved 6 events of Bt cotton incorporating single and double genes in the 12-year period from 2002 to 2013. Out of the six approved events, four events were backcrossed with a large number of superior cotton genotypes and released for commercial plantings from 2002 to 2013. In 2013, a total of four events were approved for incorporation in a total of 213 hybrids in addition to the 884 Bt cotton hybrids approved for sale in 2011, for a total of 1,095 Bt cotton hybrids (excluding one variety and a hybrid of event BNLA-601).

The ICAR’s Central Institute of Cotton Research (CICR), vision 2030 document released in 2011 noted that the development of the first cotton hybrid was one of the most spectacular achievements that had greatly influenced the cotton industry in India (CICR, 2011). Savings in insecticides between 2004 and 2010 coincided with the large-scale adoption of Bt-cotton. The share pest decline in insecticide use was from 10.72 billion rupees in 2004 to 1.67 billion rupees in 2010 an 85 per cent decrease, equivalent to a saving of 9.04 billion rupees. The quantity of insecticides used to control bollworm reduced by 96 per cent from 5,748 metric tons of active ingredients in 2001 to 222 metric tons of active ingredients in 2011, when approximately 88 per cent (10.6 million ha) of the cotton area in 2011 was planted to Bt-cotton.

In Haryana cotton is grown during Kharif season. Cotton accounts for an area of 610 thousand ha in Haryana with total production of 24,000 thousand bales and yield of lint is 664.50 kg/ha (Anonymous 2014). Cotton is attacked by several insect pests reducing the crop yield to a greater extent. The insect pests that attack cotton crop may be classified into sap sucking insects (aphids, Jassids and white fly) or chewing insects (bollworms, leaf eating caterpillars etc.) of the total pesticides used in Indian Agriculture, about 45 per cent is sprayed on cotton crop alone. To reduce pesticide usage in cotton, several strategies like use of Genetic Resistance to insect pests, Integrated Pest Management
(IPM), Insecticide Resistance Management (IRM) etc. are advocated. In recent times, *Bt* cotton technology is found to be one of the best strategies to manage bollworms, the most important pest of cotton.

*Bt*-cotton was introduced in India in 2002 for commercial production in Southern states followed by that in Northern states (Haryana, Punjab and Rajasthan) in 2005. In India, biotechnology made its long-awaited entry into commercial agricultural in March, 2002 with the approval of three (MECH-12, MECH-162 and MECH-184) *Bt* cotton hybrids for commercial cultivation. The Genetic Engineering Approval committee (GEAC), Ministry of Environment and Forest, Government of India granted the approval, at its 32nd meeting held in New Delhi. The transgenic hybrids were developed by MAHYCO (Maharashtra Hybrid Seed Company Limited) in collaboration with Monsanto. Later five more events were undertaken namely: MON 15985, Event-1, GFM Event, Cry 1 Ac Event and Cry 1 Ac Event 9124.

Presently, 1340 *Bt* cotton hybrids have been released and recommended for cultivation in India (Bharud, 2014), which has created a confusing situation for the farmers for choosing the appropriate hybrid.

### BT Technology In India

**Who developed the technology?**

Six *Bt* cotton events have been approved thus far in India for commercial cultivation. There are four *Bt* Cotton events expressing Cry1Ac, one event with Cry1C, and one event with Cry2Ab2.

**The various technology developers are:**

a) Monsanto: MON531 (Cry1Ac) event Bollgard;
b) Monsanto: Mon15985 (Cry2Ab2) event in Bollgard-II
c) JK seeds, India: JK Event-1 (Cry1Ac);
d) Chinese Academy of Agricultural Sciences, China: GFM Cry1A (Cry1Ac), introduced by Nath seeds India;
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The Asia-Pacific Consortium of Agricultural Biotechnology (Apcoab), A Program of The Asia-Pacific Association of Agricultural Research Institutions (Apaari), Has Been Working To Facilitate Exchange of Information And Promote Informed Opinion Across The Region on Issues of Common Interest Related To Agricultural Biotechnology. In 2006, Apcoab Published First Status Report on Bt Cotton In India When 40 Bt Hybrids Were Being Cultivated on An Area of 1.26 Million Hectares. Besides Tracing The Development of Bt Hybrids And Their Adoption By Indian Farmers, The Report Highlighted Issues That Needed To Be Addressed To Effectively Harness The Benefits That Bt Technology Promised. During The Past Three Years, Indian Cotton Scenario Has Changed Dramatically, Largely Due To The Adoption of Bt Cotton. The Number of Bt Hybrids Released For Commercial Cultivation Till Date Has Crossed 600 With More Than 35 Seed Companies And Public Sector Institutions Currently Engaged In Their Development.