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Adoption and Application of Btcotton in India

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Abstract
Cotton is one of the principal commercial crops of the country. More than seventy countries in the world cultivate cotton. Cotton production is crucial as the whole spectrum of textile sector depends on it. Further, the export performance of textile sector is also depends on the quality of cotton produced. To put it straight cotton plays an important role in terms of generating direct and indirect employment as well as earning foreign exchange. Over the years, the production of cotton in India has been reduced due to the pest attack. The main pest is cotton bollworm. To control the pest incidence, the farmers have applied more than recommended levels of pesticides. This has escalated the cost of cultivation and many farmers fell in to the debt trap. This has led to suicides of cotton farmers in the states like Andhra Pradesh, Maharashtra, Karnataka and Orissa. In this context, it is advocated that Integrated Pest Management (IPM) is the best tool for minimizing the risk and problems in cotton cultivation. Further, inventions of cotton varieties that resist pest attach. One such technological breakthrough has been Bt cotton. The innovation in bio- technology in the form of Bt cotton controls the bollworms which has now occupied the centre stage.

Keywords: Cotton, Bt Cotton, Farmers

Introduction
In the year 2002, the first year of approval, three *Bt*-cotton hybrids, Mech 12, Mech 162 and Mech 184, were commercially planted on about 29,415 ha (72,685 acres) in six states - Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Gujarat and Tamil Nadu. In 2014, the adoption of Bt cotton in India increased by 600,000 hectares to a record 11.6 million hectares, equivalent to a high adoption rate of 95% of 12.25 million hectares total cotton area. In 2014, India planted the largest ever area of cotton – 105,000 ha more than the previous record cotton area of 12.1 million ha in 2011. Thus, in 2014, India achieved a near–optimal adoption rate of 95% at the national level, and this was distributed evenly among the ten cotton growing States. The number of Bt cotton farmers increased to 7.7 million in 2013-2014 from 7.3 million in 2012- 2013.

Statement of the Problem
Objectives
1. To understand the adoption of Bt cotton in India
2. To study State-wise cultivation of Bt cotton in India
3. To understand the pesticide consumption in Bt cotton

Methodology of Study
Nature of Research Design
The study was based on both descriptive and analytical in nature and analysing was done with basic statistical tools like Annual Growth Rate and Trend Analysis was used with the following formula.

- Annual Growth Rate $\frac{present\ value - past\ value}{past\ value} * 100$
- Trend Analysis $Y_t = a+bx$

Period of Study
The study covered a period from 2002- 2014.

Sources of Data
The study was solely based on secondary data such as the data from ISAAA, Cotton Corporation of India and others.

Adoption and Farmers Participation in Bt Cotton

The adoption of Bt cotton was increased from 50,000 hectares of Bt cotton in 2002, (when Bt cotton was first commercialized) to 11.6 million hectares in 2014 and the percentage of area under Bt cotton also increased from 1 per cent to 95 per cent in the same years. In the initial period only 0.05 million farmers cultivated Bt cotton and it has increased to 7.7 million in 2014. A cumulative 54 million small-holder cotton farmers planted Bt cotton in the thirteen-year period. From the trend analysis it was found that in 2019-20, the adoption of Bt cotton in India expected to increase to 20.39 million hectares.

Table 1: Adoption of Bt Cotton in India

Year	Adoption of Bt cotton (Mha)	Total cotton area (Mha)	% Bt cotton area	Bt cotton farmers (Million) `
2002-03	0.05	7.7	1	0.05
2003-04	0.1	7.6	1	0.08
2004-05	0.5	8.9	6	0.3
2005-06	1.3	8.9	15	1.0
2006-07	3.8	9.2	42	2.3
2007-08	6.2	9.4	66	3.8
2008-09	7.6	9.4	81	5.0
2009-10	8.4	10.3	81	5.6
2010-11	9.4	11.0	85	6.2
2011-12	10.6	12.2	88	7.0
2012-13	10.8	11.6	93	7.2
2013-14	11.6	12.25	95	**7.7**

Source: Choudhary & Kadambini, 2014

Trend Analysis

Year	Adoption of Bt cotton (Mha)	x	x2	xy	Yt=a+bx
2003-04	0.1	-5	25	-0.5	0.02
2004-05	0.5	-4	16	-2	1.3
2005-06	1.3	-3	9	-3.9	2.57
2006-07	3.8	-2	4	-7.6	3.84
2007-08	6.2	-1	1	-6.2	5.11
2008-09	7.6	0	0	0	0
2009-10	8.4	1	1	8.4	7.66
2010-11	9.4	2	4	18.8	8.94
2011-12	10.6	3	9	31.8	10.2
2012-13	10.8	4	16	43.2	11.48
2013-14	11.6	5	25	58	12.75
	70.3		110	140	

$a = \sum Y/N = 70.3/11 = 6.39$

$b = \sum xY/\sum x^2 = 140/110 = 1.272727$

$Yt = a+bx = 6.39 + 1.272727x$

Year	X	Yt=a+bx
2014-15	6	14.02
2015-16	7	15.3
2016-17	8	16.57
2017-18	9	17.84
2018-19	10	19.11
2019-20	11	20.39

State-wise Cultivation of Bt Cotton in India

In the year 2002, the first year of approval, three *Bt*-cotton hybrids, Mech 12, Mech 162 and Mech 184, were commercially planted on about 29,415 ha (72,685 acres) in six states - Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Gujarat and Tamil Nadu. After that, it spread to all the other states.

Over the years, the area under Bt cotton cultivation has been on the increase (Table 2). In 2002, the area under cultivation was 50,000 hectares, and it has been reported that 9.4 million hectares were under Bt in 2010. The major states growing Bt cotton in 2014, listed in order of hectarage, were Maharashtra (3.9 million hectares) followed by Gujarat (2.5 million hectares), Andhra Pradesh and Telangana (2.3 million hectares, Northern Zone (1.4 million hectares), Madhya Pradesh (560 thousand hectares), and the balance of 835 thousand hectares in Karnataka, Tamil Nadu and other cotton growing States. It has been noted that in Madhya Pradesh, Tamil Nadu and others, the area under Bt cotton was decreased in 2014.

Table 2: State-wise Adoption of Bt Cotton in India from 2002-2014 (000'ha)

State	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Maharashtra	25	30	200	607	1840	2800	3130	3396	3710	3960	3995	3860	3950
Andhra Pradesh	8	10	75	280	830	1090	1320	1049	1650	1820	1935	2011	1175
Gujarat	10	36	122	150	470	908	1360	1682	1780	1930	2015	2130	2525
Madhya Pradesh	2	13	80	146	310	500	620	621	610	640	605	620	560
Northern Region	-	-	-	60	215	682	840	1243	1162	1340	1390	1365	1425
Karnataka	3	4	18	30	85	145	240	273	370	570	520	580	610
Tamil Nadu	2	7	5	27	45	70	90	109	110	220	220	194	110
Other	-	-	-	-	5	5	5	8	8	120	120	146	115
Total	50	100	500	1300	3800	6200	7605	8381	9400	10600	10800	10995	11570

Source: Choudhary & Kadambini, 2014 and Various Issues

Pesticide Consumption and Bt Cotton in India

Traditionally, cotton consumed more insecticides than any other crop in India. Bt cotton has made a substantial contribution to stop the cost of production by drastically reducing applications of insecticide sprays to control key cotton pests such as American bollworm, pink bollworm, spotted bollworm. Over the years, the market share for cotton insecticides as a percentage of total insecticides declined steeply from 46 per cent in 2001 to 26 per cent in 2006 and to 20 per cent in 2011.

Year	Total insecticides to control bollworms (Metric tons)	AGR
2002-03	4470	-
2003-04	6599	47.63
2004-05	6454	-2.20
2005-06	2923	-54.71
2006-07	1874	-35.89
2007-08	1201	-35.91
2008-09	652	-45.71
2009-10	500	-23.31
2010-11	249	-50.20
2011-12	222	-10.84

Source: Choudhary & Kadambini, 2014

The quantity of insecticides used to control bollworm reduced by 96 per cent from 5748 metric tons of active ingredients in 2001 to as low as 222 metric tons in 2011. Thus, insecticide use for the control of bollworm dropped significantly at the same time 95 per cent (see table1) of total cotton area in 2014 was benefiting from controlling bollworm with Bt cotton.

Conclusion

From the study, it was found that since 2002, the adoption of Bt cotton in India and other states has been increasing. In cotton, the major problem was cotton bollworm, in order to control the pest; the farmers were spraying more amounts of pesticides. Prior to introduction of Bt cotton in the economy, a steep decline in percentages of pesticides applied in cotton particularly on cotton bollworm and now it was effectively controlled by the Bt cotton

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