Impact of Bt Cotton on Production and Utility in India

ISAAA SEAC WEBINAR SERIES ORGANIZED BY CROPLIFE ASIA THROUGH FEDERATION OF SEED INDUSTRY OF INDIA

CD Mayee
South Asia Biotech Centre
Cotton Pink Bollworm:
https://www.sabc.asia/outreach.html

India Africa Agriculture Engagement:

WWW.SABC.ASIA
Importance of Cotton

- India - four species of cotton
- Cotton - 9 to 12 million hectares
- India - inter-specific diploid hybrids & intra-specific tetraploid hybrids
- Average cotton holding <1.5 ha; 7-7.5 million smallholder cotton farmers
- Diverse cropping practices including hand dibbling to drip-based-precision-planting to technology-intensive-inter-cropping system
- A robust cotton value chain providing employment to roughly 50 million people

Source: Central Institute of Cotton Research (CICR)
www.cicr.res.in
Cotton Map of India

All India-2019-20

Area (lakh ha)=125.84

Production (lakh bales): 360 (3rd adv est as on 15-5-2020)

Productivity (kg lint/ha): 486 kg/ha
Growth in area, production and productivity of cotton in India
<table>
<thead>
<tr>
<th>States</th>
<th>2020-21</th>
<th>2019-20</th>
<th>Changes (+/-)</th>
<th>Changes in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punjab</td>
<td>5.010</td>
<td>4.020</td>
<td>0.990</td>
<td>24.63%</td>
</tr>
<tr>
<td>Haryana</td>
<td>7.370</td>
<td>7.010</td>
<td>0.360</td>
<td>5.14%</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>6.979</td>
<td>6.445</td>
<td>0.534</td>
<td>8.29%</td>
</tr>
<tr>
<td><strong>North Zone</strong></td>
<td><strong>19.359</strong></td>
<td><strong>17.475</strong></td>
<td><strong>1.884</strong></td>
<td><strong>10.78%</strong></td>
</tr>
<tr>
<td>Gujarat</td>
<td>22.792</td>
<td>26.668</td>
<td>-3.875</td>
<td>-14.53%</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>42.341</td>
<td>43.837</td>
<td>-1.496</td>
<td>-3.41%</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>6.440</td>
<td>6.090</td>
<td>0.350</td>
<td>5.75%</td>
</tr>
<tr>
<td><strong>Central Zone</strong></td>
<td><strong>71.573</strong></td>
<td><strong>76.595</strong></td>
<td><strong>-5.022</strong></td>
<td><strong>-6.56%</strong></td>
</tr>
<tr>
<td>Telangana</td>
<td>24.219</td>
<td>18.595</td>
<td>5.624</td>
<td>30.25%</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>5.760</td>
<td>6.330</td>
<td>-0.570</td>
<td>-9.00%</td>
</tr>
<tr>
<td>Karnataka</td>
<td>6.789</td>
<td>5.754</td>
<td>1.035</td>
<td>17.99%</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>0.347</td>
<td>0.501</td>
<td>-0.154</td>
<td>-30.74%</td>
</tr>
<tr>
<td><strong>South Zone</strong></td>
<td><strong>37.115</strong></td>
<td><strong>31.180</strong></td>
<td><strong>5.935</strong></td>
<td><strong>19.03%</strong></td>
</tr>
<tr>
<td>Orissa</td>
<td>1.712</td>
<td>1.696</td>
<td>0.016</td>
<td>0.94%</td>
</tr>
<tr>
<td>Others</td>
<td>0.222</td>
<td>0.271</td>
<td>-0.049</td>
<td>-18.08%</td>
</tr>
<tr>
<td><strong>All India</strong></td>
<td><strong>129.981</strong></td>
<td><strong>127.217</strong></td>
<td><strong>2.764</strong></td>
<td><strong>2.17%</strong></td>
</tr>
</tbody>
</table>
### Compound Annual Growth Rate (%) in area, production and productivity of cotton in India

<table>
<thead>
<tr>
<th>Period</th>
<th>Area</th>
<th>Production</th>
<th>Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950 to 1960</td>
<td>1.91**</td>
<td>4.22**</td>
<td>2.30*</td>
</tr>
<tr>
<td>1961 to 1970</td>
<td>-0.58</td>
<td>-0.27</td>
<td>-0.30</td>
</tr>
<tr>
<td>1971 to 1980</td>
<td>0.50</td>
<td>1.10</td>
<td>1.50</td>
</tr>
<tr>
<td>1981 to 1990</td>
<td>-0.97</td>
<td>3.32*</td>
<td>4.31***</td>
</tr>
<tr>
<td>1991 to 2000</td>
<td>2.21**</td>
<td>4.63**</td>
<td>2.31*</td>
</tr>
<tr>
<td>2001 to 2010</td>
<td>3.43***</td>
<td>9.63***</td>
<td>5.97***</td>
</tr>
<tr>
<td>2010 to 2019</td>
<td>1.28**</td>
<td>0.36</td>
<td>-0.96**</td>
</tr>
</tbody>
</table>

* *, ** and *** significant at 10%, 5% and 1% respectively
Phases of Yield Acceleration in Indian Cotton

Source: Analyzed by South Asia Biotechnology Centre, 2020
Why Biotech Cotton?

- Bollworm developed resistance to pyrethroids
- Cotton became highly susceptible to Lepidopteran pests
- *Frequent occurrence of the outbreak of Helicoverpa armigera* resulting in crop losses up to 80%
- Cotton consumed 46% of total insecticides valued at US$504 million in 2001
- Farmers suffered losses - annual yield as low as 300 kg/ha, and often <154 kg/ha in rain-fed areas
- Indiscriminate usages of chemical insecticides
- Increasing import of raw cotton to meet textile need

Source: ISCI 2013; Kranthi, 2012; Manjunath 2011; Mayee, 2019; SABC 2020
Adoption of Biotech Cotton, 2002-2019

Source: Analyzed by South Asia Biotechnology Centre, 2020
Cotton Transformation: Export and Import of Cotton in India, 2002 to 2020

Source: Analyzed by South Asia Biotechnology Centre, 2020
India's cotton exports

<table>
<thead>
<tr>
<th>Year</th>
<th>Exports (lakh bales)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015-16</td>
<td>69</td>
</tr>
<tr>
<td>2016-17</td>
<td>58</td>
</tr>
<tr>
<td>2017-18</td>
<td>69</td>
</tr>
<tr>
<td>2018-19</td>
<td>42</td>
</tr>
<tr>
<td>2019-20*</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: CAI

Indian Cotton cheapest in the world

<table>
<thead>
<tr>
<th>Country</th>
<th>Quoted cotton price in cents (per pound)</th>
<th>Quoted cotton price converted into ₹* (Per candy of 356 kg)</th>
<th>Difference from ICE rate of 65.4 cents (As on Sep 23, 2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>83.4</td>
<td>48,084.57</td>
<td>18.0</td>
</tr>
<tr>
<td>US</td>
<td>75.4</td>
<td>44,335.20</td>
<td>10.0</td>
</tr>
<tr>
<td>West Africa</td>
<td>73.4</td>
<td>43,159.20</td>
<td>8.0</td>
</tr>
<tr>
<td>Brazil</td>
<td>70.4</td>
<td>38,808.00</td>
<td>5.0</td>
</tr>
<tr>
<td>India</td>
<td>66.0</td>
<td>36,456.00</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Source: Trade data *Exchange rate: $=73.54
Changes in Staple length of Indian Cotton

1947
- Medium: 67%
- Short: 33%

1991
- Medium: 39%
- Long: 19%
- Superior Medium: 28%
- Extra Long: 7%
- Short: 7%

2007
- Medium: 22%
- Superior Medium: 11%
- Long: 63%
- Extra Long: 2%
- Short: 1%
Insecticide use (Kg/ha) on Cotton

% Bt Cotton

Insecticide Kg/ha

0.9 1.3 1.1 0.7 0.6 0.6 92 92 94 96

0.7 3.8 0.6 0.5 0.7 0.7 0.6 0.6 1.0

Environmental impacts.

- Bt cotton in general delivered significant environmental benefits by reducing the insecticide usage by 50% and doubling the level of ladybirds, lacewings and spiders.
- Bt-cotton contributed to high Sap-sucking pest in cotton and overall usage of insecticides for sucking pests increased.
Socio Economic Benefits 2002-2018

• Macro level Impact: Tripling cotton production
• Micro level Impact: Bt cotton replaced the Chemical-based crop protection method
• Insecticides sprays reduced by half, NO spray required to control bollworm complex
• A very high level of repeat adoption for 19 consecutive years

Brookes and Barfoot provisionally estimated that India enhanced farm income from Bt cotton by US$24.3 billion in the 13-year period 2002 to 2018

Source: Brookes and Barfoot, 2019; ISCI, 2013; Naik, 2001; Qaim 2009; Gandhi & Namboodri, 2006; ICAR, 2005
Cotton: A Multipurpose Crop

Seed Cotton

Lint (fibre) (33%)

Cottonseeds (67%)

Lint (Industrial uses)

Hull (Feed)

Kernel

Oil (Food)

Meal (Feed)

Cottonseed byproducts:
Linters: Short fibres still clinging to the seed after ginning
Hulls: A tough protective covering of the kernel
Oil: Extracted from kernel and used for human consumption
Meal: Residue after extraction of oil

Source: Analysed by South Asia Biotechnology Centre, 2020
Value-addition to Cotton Plant By-produce

By-produce of Cotton

- **Cotton Seed**
  - 125 lakh tonnes per annum

- **Cotton Plant Stalks**
  - 30 million tonnes per annum

By-products of Cotton seed

- **Cotton Linters**
  - 5 lakh tonnes/annum

- **Cotton seed Hulls**
  - 34 lakh tonnes/annum

- **Cotton Seed oil**
  - 15 lakh tonnes/annum

- **Meal**
  - 4.4 million tonnes/annum
Value addition to Cotton Stalk

- Particle Boards
- Pulps & papers
- Corrugated boxes
- Briquettes as fuel
- Bio-enriched compost
- Growing Mushrooms
Advantages

- Additional income to farmers
- Rural Employment
- Avenues for Rural Industry
- New Raw Materials for industry
- Conservation of Natural Resources
Cottonseed Oil Production, 2002-2019

Source: CAB, 2020; Analysed by South Asia Biotechnology Centre (SABC), 2020
India consumed ~20 million tons of Bt cottonseeds oil from 2002-03 to 2019-20

- India produced and consumed staggering 20.78 million tons of Bt cottonseed oil from 2002-03 to 2019-20
- Cottonseed oil is trans-fat free, contains no cholesterol and can play a role in reducing saturated fat intake
- ~1.5 million tons of cottonseed oil is produced annually, making cottonseed oil the number one vegetable oil produced from secondary sources
- Cottonseed cultivar contains nearly 17-18% edible oil, & almost 12% of extracted with current methods of extraction
- 5-6% cottonseed oil is left in cottonseed cake
- Processors are improving the efficiency of extraction of oil through solvent extraction for hard seeds and expeller extraction for soft seeds to increase oil recovery

Source: COOIT, 2020; AICOSCA, 2020; Analyzed by South Asia Biotechnology Centre, 2020
Cottonseed de-oiled cake constitutes the largest share in terms of total availability of meal, followed by soy cake, rapeseed and rice bran in India

- Cotton de-oiled cake or meal contributes one third of the total meal consumed, and is the preferred feed for cattle and buffaloes in the country
- Cottonseed is also a major source of protein, as its by-product oil cake contains a high quality protein (23%) – a necessary ingredient for animal feed
- AICOSCA estimates that the availability de-oiled cake significantly boost the manufacturing prospects of compound cattle feed, fish feed and poultry feed

Source: COOIT, 2020; AICOSCA, 2020; Analyzed by South Asia Biotechnology Centre, 2020
FUTURE HOPE: Genomics and Biotechnology

- Cultivars suitable for HDPS
- Cultivars suitable for mechanical picking
- Salt and drought resistant varieties /hybrids
- Gene mining for quality fiber specially strength
- Indian cotton can make edge through this
HT Tolerant BGII Cotton

Trials completed and technical approval granted BUT technology withheld
FIRs against 12 Maharashtra farmers for illegally sowing Bt Cotton

The move came after several farmers under the banner of Shetkari Sangathana organised multiple sowing of HT BT as a mark of protest against what they said was illegal denial of technology to farmers

Topics
Bt Cotton  |  Maharashtra  |  Environment Protection Act

Sanjeeb Mukherjee  |  New Delhi
Last Updated at June 26, 2019 01:14 IST
Despite ban, HTBT cotton widely cultivated in Maharashtra

By: Nanda Kasabe | June 18, 2019 12:53 AM

On Monday, activists in Wardha district of Maharashtra held a press conference inviting farmers to participate in the plantation of HTBT cotton on June 20 at Hinghne Ghat village on the field of Madhusudan Harne, who is also an activist of the Shetkari Sanghatana.
Illegal cotton seeds sales surge in Maharashtra, other states

Sayantan Bera

Soaring sales of herbicide tolerant, genetically modified cotton seeds put farmers across states at risk
NEW DELHI: With reports of illegal cultivation of unapproved variety of transgenic cotton, HTBt cotton, coming in from Maharashtra, Telangana and Gujarat, the government on Tuesday told the Lok Sabha that as many as 67 cases were being probed by police since 2017 in these states. Highest 40 such cases were registered against suspects in Telangana, followed by 20 FIRs in Maharashtra and seven in Gujarat.

“In addition to punitive actions, the state governments have alerted quality control inspectors and district authorities to be vigilant to the illegal production and sale of HT (herbicide-tolerant) cotton seeds,” said agriculture minister Narendra Singh Tomar in his written response to a Parliament question.
Need For Cotton Machine Picking Technology

- Cotton Picking is Highly Labour Intensive and expensive
- Scarcity of Labour is making it increasingly difficult for farmers to rely on manual picking of cotton
- With the advent of Cotton high density planting system there will be an increased need for mechanization of cotton picking
Experience with High Density Planting

**Early sowing**
The crop escapes bollworms & moisture stress
Overcomes Flooding

Coragen & Fame control bollworms effectively

**Less weed infestation** – less cost of weeding
**Less crop foliage** - less nutrients needed
**Early & single picking** – less labour needed

**Less labour cost** on sowing, weeding and picking

**Low production cost** Rs 15,000/ha
## HDPS with Bt Hybrids

PPP Model

Aurangabad, Jalna, Beed, Jalgaon, Dhule, Yeotmal & Wardha

20,031 Farmers
11,100 Acres
331 Villages

<table>
<thead>
<tr>
<th></th>
<th>Plants/acre</th>
<th>Yield Q/ac</th>
<th>Production Cost</th>
<th>Gross Income</th>
<th>Net Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>16250</td>
<td>12.5</td>
<td>28,750</td>
<td>48,750</td>
<td>20,000</td>
</tr>
<tr>
<td>HDPS</td>
<td>24,200-43,500</td>
<td>16.87</td>
<td>41,575</td>
<td>65,812</td>
<td>24,237</td>
</tr>
</tbody>
</table>

21% increase in income
Acreage Shifts

King Cotton's comeback

The fibre crop, along with maize, seems the most attractive planting option for farmers this kharif

The Indian Express
Thu, 30 June 2011
epaper.indianexpress.com/ce/22048858

HARISHDAS MODARAN
MIRJIAPUR, MP: Last year, неделю tur (pigeon pea) and maize (green gram) on four acres in this small town in the eastern part of the district.

The government declared a minimum support price (MSP) of Rs 3,500 per quintal for tur, and Rs 3,900 per quintal for maize last season. The tur price jumped to Rs 4,500 per quintal, and the maize price rose to Rs 6,000 per quintal. The farmers made good profits.

This year, the tur price is expected to be higher than last year, and the maize price is expected to be around Rs 6,500 per quintal. The farmers are planning to grow tur and maize on all four acres.

The tur crop is expected to fetch a good price, and the maize crop is expected to be profitable. The farmers are also planning to grow tur and maize on the remaining two acres.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

Farmers are planning to sell the tur and maize crops at the prevailing market prices. The tur crop is expected to fetch a good price, and the maize crop is expected to be profitable.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.

The tur crop is expected to be harvested in the next two months, and the maize crop is expected to be harvested in the next three months.
# Cotton Is Cool