HYBRID COTTON REVOLUTION IN INDIA

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Attur, Salem
Tamil Nadu, India
37.5% of world Cotton Area is in India

26% of World Cotton is Produced in India.

Wider Planting Window: April - Aug

60 + Million People are involved in Cotton

Textile Industry Contributes 4% of Nation’s GDP

There are 11 Cotton Growing States in India & cultivated in ~12.5 million Ha

Large Geographical Spread: 10°N to 30°N and 68°E to 86°E

Produce widest range of Cotton

Capable of Spinning 10s to 120s Count

Only Country cultivating all four cotton Species
15 Agroclimatic regions in India; Cotton is cultivated in 7 Agroclimatic regions

Cotton growing regions receives 40 to 80 cm average annual rainfall

On an average 60 to 70 rainy days in cotton growing regions

Cotton cultivated in wet season under rainfed and also with irrigation support.

We have 8 different soil types and cotton is cultivated in 5 soils types

Maximum Temperature varies from 35°C to 45°C & Minimum temperature is 12°C to 20°C during the Cotton growing season
Agroclimatic Zones and Soil types of India

**Agro-Climatic Regions in India**

1. North-Western Mountain Region
2. The North-Eastern Hill Region
3. The Satluj-Yamuna Plain Region
4. The Upper-Ganga Plain Region
5. The Middle-Ganga Plain Region
6. The Lower-Ganga Plain Region
7. The South-Eastern Plateau Region
8. The Aravalli-Mahwa Upland
9. The Maharashtra Plateau Region
10. The Deccan Interior Region
11. The Eastern Coastal Region
12. The Western Coastal Region
13. The Gujarat Region
14. The Western Rajasthan Region
15. Andaman & Nicobar Island Region

**Legend:**
- Forest soils
- Arid soils
- Black soils
- Laterite soils
- Alluvial soils
- Red and yellow soils
### Cotton Growing Regions of India

<table>
<thead>
<tr>
<th>Particulars</th>
<th>North Zone</th>
<th>Central Zone</th>
<th>South Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil type</td>
<td>Alluvial</td>
<td>Black cotton, medium and Light Soil</td>
<td>Black and Red soil</td>
</tr>
<tr>
<td>Soil topography</td>
<td>Plain</td>
<td>Undulating</td>
<td>Undulating</td>
</tr>
<tr>
<td>Irrigation</td>
<td>98%</td>
<td>20%</td>
<td>32%</td>
</tr>
<tr>
<td>Sowing time</td>
<td>April last week to May last week</td>
<td>June first week to July first week</td>
<td>June to August</td>
</tr>
<tr>
<td>Yield level</td>
<td>High</td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>

**North**
- Punjab
- Haryana
- Rajasthan

**Central**
- Gujarat
- Madhya Pradesh
- Maharashtra

**South**
- Telangana
- Andhra Pradesh
- Tamil Nadu
- Karnataka
- Odisha
1904
The varietal improvement work in cotton started

1911
Indian Central Cotton Committee was constituted

1967
All India Coordinated Cotton Improvement Project (AICCIP)

1970
The first cotton hybrid H4 was released for commercial cultivation

2002
Bt cotton was introduced into Indian agriculture

1997
From late nineties there is a decline in Cotton acreage due Bollworm menace

1990
This decade Public & Private sector started commercial sale of Cotton Hybrids

1970-1990
Public Sector Hybrids under Cotton Cultivation
Challenges in Indian cotton cultivation

- Around 72% of cotton area comes under low to medium productivity, in which 65 percent area is rainfed, mainly in the Central and Southern zones.

- Most of the rainfed area has soil with low water holding capacity, poor fertility, shallow and with less accessibility to water resource for irrigation.

- Cotton crop is highly prone to pests like Pink bollworm, American bollworm, Whiteflies, Jassids, Thrips and Mirid bugs.

- CLCuV is the major disease in North zone. Verticillium wilt, Grey mildew, TSVD, ALB & BLB are gaining its importance in recent years in central and south zone.

- Predominant cotton growing farmers are having marginal land holdings.
What make India to adopt Hybrid Cotton in large scale?

- Our country is having diverse cotton growing environment and adaptation of hybrids are better than varieties due to
  - Broader genetic base
  - Early vigour and establishment of hybrids even under rainfed conditions resulting better productivity than varieties.

- Hybrids are responsive to better crop management practices (Eg. Fertilizer response)

- It is possible to Combine multiple traits like
  - Biotic & abiotic stress tolerant
  - Higher yield with better fibre quality.
• The first cotton hybrid H4 (Sankar-4) was released for commercial cultivation in 1970 from Cotton Research Station, Surat by Dr. C.T. Patel.

• After this, the area under hybrid cultivation started increasing due to its high yielding potential and wider adaptability.

<table>
<thead>
<tr>
<th>Year</th>
<th>Area under Hybrids</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>3%</td>
</tr>
<tr>
<td>1980</td>
<td>11%</td>
</tr>
<tr>
<td>1985</td>
<td>26%</td>
</tr>
<tr>
<td>1990</td>
<td>36%</td>
</tr>
<tr>
<td>1997</td>
<td>40%</td>
</tr>
</tbody>
</table>

• Till early 1990’s, the hybrids were confined to central and south zones of India.

• Gradually North Zone farmers were also started hybrid cotton cultivation with Wheat - Cotton cropping pattern.

• Public sector hybrids like H4, NHH 44, Savitha, H6, Suguna, JKHY1, PKV HY2, H8 were widely grown by farmers before 1990.

• After 1990, the private seed industries also started providing cotton hybrids for commercial sale.

• Private sector hybrids like MECH 2, RCH 2, Bunny, Brahma and Mallika were mostly cultivated.

• After 1990, the area under desi cotton and Barbadense were drastically reduced and HXH hybrids occupied majority of cotton area.

• From 1997 onwards the cotton area starts declining due to bollworm menace.
In 2002, first Cotton hybrids with Bt. technology (Bollguard I) were approved in central and south zone. Subsequently in 2006, hybrids were released with Bollguard II Technology.

Hybrids with Bt. Technology performed with fullest potential by reducing the yield loss due to bollworm complex.

Private sector released more number of hybrids with Bt. Technology and farmers were highly benefited and reached 12 M Ha under cotton cultivation with 98% Hybrid crop coverage.
## Commercial Release of Different Bt. Cotton Events in India, 2002 to 2014

<table>
<thead>
<tr>
<th>S. No.</th>
<th>GENE(S)</th>
<th>EVENT</th>
<th>DEVELOPER</th>
<th>STATUS</th>
<th>YEAR OF APPROVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>cry1Ac</td>
<td>MON-531</td>
<td>Mahyco/Monsanto</td>
<td>Commercialized</td>
<td>2002</td>
</tr>
<tr>
<td>2</td>
<td>cry1Ac and cry2Ab2</td>
<td>MON-15985</td>
<td>Mahyco/Monsanto</td>
<td>Commercialized</td>
<td>2006</td>
</tr>
<tr>
<td>3</td>
<td>cry1Ac</td>
<td>EVENT-1</td>
<td>Jk Agri-Genetics</td>
<td>Commercialized</td>
<td>2006</td>
</tr>
<tr>
<td>4</td>
<td>Fusion genes cry1Ab and cry1Ac</td>
<td>GFM Event</td>
<td>Nath Seeds</td>
<td>Commercialized</td>
<td>2006</td>
</tr>
<tr>
<td>5</td>
<td>Synthetic cry1Ac</td>
<td>MLS-9124</td>
<td>Metahelix Life Sciences</td>
<td>Commercialized</td>
<td>2009</td>
</tr>
</tbody>
</table>

Source: ISAAA, 2014
Superior Fiber Quality Hybrids
Inter-Specific Hybrids – *G. hirsutum* X *G. barbadense*

- Inter-specific hybrid between *G. hirsutum* X *G. barbadense* has better fiber quality than *G. hirsutum* and better yield over *G. barbadense*.

- World’s first inter-specific hybrid (*G. hirsutum* X *G. barbadense*) was Varalaxmi, developed in 1972 by Dr. B.H. Katarki of University of Agricultural Sciences, Dharwad. They also developed DCH 32 which could spin at 80’S counts.

- Inter-specific hybrids showed very significant hybrid vigour and these hybrids are having better lint quality and able to spin at 80’S and 100’S counts.

- After Bt. Cotton release, hybrids like RCHB 708 BGII, MRC 7918, JK Chammundi, Bio Puli are leading HxB hybrids from private sector and it can be spinned at 80’S and 100’S counts.
High Fiber quality Intra-Specific Hybrids  
G. hirsutum X G. hirsutum

• Intra hirsutum hybrids of public sector like Savitha and Surya had better fiber quality and its spinning count is 60’S

• Intra hirsutum hybrids of private sector like RCH 20, RCH 35, Bunny, Mallika and Brama also have better fiber quality and it could be spinned at 60’S count
37.4% of the total area i.e. 4.1 Million ha Contributing to only 22.3% of total production i.e. 7.1 Million bales

62 districts spread across 9 states are under low productivity of average 252 Kgs/ha

Source of data is https://eands.dacnet.nic.in/ (Season 2017-18)
<table>
<thead>
<tr>
<th>S.NO</th>
<th>Year</th>
<th>Area In million hectares</th>
<th>Production In million bales (1 bale = 170 kgs)</th>
<th>Yield (kgs) per hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1947-48</td>
<td>4.42</td>
<td>3.33</td>
<td>132.00</td>
</tr>
<tr>
<td>2</td>
<td>1950-51</td>
<td>5.88</td>
<td>3.43</td>
<td>99.00</td>
</tr>
<tr>
<td>3</td>
<td>1960-61</td>
<td>7.61</td>
<td>6.01</td>
<td>134.00</td>
</tr>
<tr>
<td>4</td>
<td>1970-71</td>
<td>7.60</td>
<td>5.66</td>
<td>127.00</td>
</tr>
<tr>
<td>5</td>
<td>1980-81</td>
<td>7.82</td>
<td>7.80</td>
<td>169.00</td>
</tr>
<tr>
<td>6</td>
<td>1990-91</td>
<td>7.43</td>
<td>11.70</td>
<td>267.00</td>
</tr>
<tr>
<td>7</td>
<td>1996-97</td>
<td>8.86</td>
<td>17.87</td>
<td>343.00</td>
</tr>
<tr>
<td>8</td>
<td>1997-98</td>
<td>8.72</td>
<td>14.80</td>
<td>288.00</td>
</tr>
<tr>
<td>9</td>
<td>1998-99</td>
<td>9.28</td>
<td>16.50</td>
<td>313.00</td>
</tr>
<tr>
<td>10</td>
<td>1999-2000</td>
<td>8.73</td>
<td>15.60</td>
<td>304.00</td>
</tr>
<tr>
<td>11</td>
<td>2000-01</td>
<td>8.57</td>
<td>14.00</td>
<td>278.00</td>
</tr>
<tr>
<td>12</td>
<td>2001-02</td>
<td>8.73</td>
<td>15.80</td>
<td>308.00</td>
</tr>
<tr>
<td>13</td>
<td>2002-03</td>
<td>7.66</td>
<td>13.60</td>
<td><strong>302.00</strong></td>
</tr>
<tr>
<td>14</td>
<td>2003-04</td>
<td>7.63</td>
<td>17.90</td>
<td>399.00</td>
</tr>
<tr>
<td>15</td>
<td>2004-05</td>
<td>8.78</td>
<td>24.30</td>
<td>470.00</td>
</tr>
<tr>
<td>16</td>
<td>2005-06</td>
<td>8.67</td>
<td>24.10</td>
<td>472.00</td>
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<tr>
<td>17</td>
<td>2006-07</td>
<td>9.14</td>
<td>28.00</td>
<td>521.00</td>
</tr>
<tr>
<td>18</td>
<td>2007-08</td>
<td>9.41</td>
<td>30.70</td>
<td>554.00</td>
</tr>
<tr>
<td>19</td>
<td>2008-09</td>
<td>9.40</td>
<td>29.00</td>
<td>524.00</td>
</tr>
<tr>
<td>20</td>
<td>2009-10</td>
<td>10.31</td>
<td>30.50</td>
<td>503.00</td>
</tr>
<tr>
<td>21</td>
<td>2010-11</td>
<td>11.25</td>
<td>33.90</td>
<td>513.00</td>
</tr>
<tr>
<td>22</td>
<td>2011-12</td>
<td>12.17</td>
<td>36.70</td>
<td>512.00</td>
</tr>
<tr>
<td>23</td>
<td>2012-13</td>
<td>11.97</td>
<td>37.00</td>
<td>525.00</td>
</tr>
<tr>
<td>24</td>
<td>2013-14</td>
<td>11.96</td>
<td>39.80</td>
<td><strong>565.00</strong></td>
</tr>
<tr>
<td>25</td>
<td>2014-15</td>
<td>12.84</td>
<td>38.60</td>
<td>511.00</td>
</tr>
<tr>
<td>26</td>
<td>2015-16</td>
<td>12.29</td>
<td>33.20</td>
<td>458.00</td>
</tr>
<tr>
<td>27</td>
<td>2016-17</td>
<td>10.86</td>
<td>34.50</td>
<td>542.00</td>
</tr>
<tr>
<td>28</td>
<td>2017-18</td>
<td>12.58</td>
<td>37.00</td>
<td>500.00</td>
</tr>
<tr>
<td>29</td>
<td>2018-19</td>
<td>12.61</td>
<td>33.30</td>
<td>449.00</td>
</tr>
<tr>
<td>30</td>
<td>2019-20*</td>
<td>13.37</td>
<td>36.50</td>
<td><strong>464.00</strong></td>
</tr>
<tr>
<td>31</td>
<td>2020-21*</td>
<td>12.95</td>
<td>37.10</td>
<td><strong>487.00</strong></td>
</tr>
</tbody>
</table>

**SOURCE:** COTTON CORPORATION OF INDIA
STATISTICS OF INDIAN COTTON

VARIETY ERA

HYBRID ERA

Hybrid + Transgenic Era

Area in lakh hectares
Production in lakh bales of 1.70 kgs
Yield (kgs) per hectare

SOURCE: DATA COLLECTED FROM AICCIP PROJECT COORDINATORS REPORT

YEAR

* PROVISIONAL DATA
STATISTICS OF INDIAN COTTON

<table>
<thead>
<tr>
<th>VARIETY ERA</th>
<th>HYBRID ERA</th>
<th>Hybrid +TRANSGENIC ERA</th>
</tr>
</thead>
</table>

Area In Million hectares
Production In Million bales of 170 kgs
Yield (kgs) per hectare

SOURCE: DATA COLLECTED FROM AICCIP PROJECT COORDINATORS REPORT

* PROVISIONAL DATA
Cotton Hybrid Seed Production

- Hybrid seeds were produced in both conventional & genetic male sterility techniques.

12 M ha

1. Needs 23 MT Seed
2. 4.98 Cr Packets (450g/Pkt)

5 States from Central and Southern India with 8 Major Seed Production centers

120 K Farmers Involved

Seed Production area of 58K Hectares with 500kg/ha productivity

3 M People are having employment opportunity of ~150-million-man hours

Post Harvest employment to 100 K People

Breeding Excellence
The livelihood of 60 million people depend on cotton cultivation, processing, trade and textiles.

3379 million USD from Export of cotton

COTTON VALUE CHAIN IN INDIA

Textile Industry contribution

- 4% of Gross domestic product
- 14% of the Total Industrial product
- 20% of Total work force
- 12% of World textile production
- 20.24% of Total Indian export

Provide raw material

- 1500 Mills
- 4 million handlooms
- 7 million power looms

Breeding Excellence
India has reached a plateau in Cotton productivity.

New variability needs to be created using wild relatives and land races.

Hybrids with better tolerance to biotic and abiotic stress to be evolved.

To develop hybrids with more yield in lesser number of days.

Focusing more on higher production/per unit area in hybrids with better agronomic practices.

Improving fiber parameters such as Extra Long Staple and strong fiber strength in hybrids.

Mechanization of labour-intensive cultivation practices like harvesting saves time and labour shortage issues.
Thank You all !