Climate-Smart Cotton Production Technologies for Improved Yields

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Predominantly rainfed cultivation – prone to erratic rainfall

Area and yield of 153 districts in 10 States growing cotton in more than 5,000 ha for the TE 2020-21, (https://eands.dacnet.nic.in/)
Increasing vulnerability of cotton in the irrigated north zone

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<td>438</td>
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</table>
Climate Smart Agriculture (CSA)

Mitigation – reducing GHG emissions

Increasing income & productivity

CC Adaptation & Resilience
Scaling out Climate Smart Agriculture (CSA) : case study of a cotton growing district (Adilabad, Telangana state)

https://cgispace.cgiar.org/handle/10568/111203
Excess and deficit rainfall

Frequency of excess rainfall

Frequency of rainfall deficit
Technology targeting to agro-ecology: large scale demonstrations for increased productivity
Joint Initiative of Ministry of Agriculture & Farmers Welfare & Ministry of Textiles

Launch of Special Project on Cotton for Productivity enhancement in 8 states in 2023-24 in Public Private Partnership mode

- Project management by ICAR-CICR & CITI
- Seed Associations (FSII & NSAI)
- Textile industry associations (CITI & SIMA CDRA)
- ICAR-ATARI & Krishi Vigyan Kendra (KVK)
- State Dept of Agriculture
- 10422 farmers in 61 districts

- Farmers registered in mobile app
- Georeferenced demonstration sites
- Web portal for DBT through payment gateway in the form of eRupi voucher to farmers
### Targets and Implementation

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Scalable technology</th>
<th>Current (Kg lint/ha)</th>
<th>Target (kg lint/ha)</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Density Planting System (HDPS) in low productivity areas under rainfed cotton ecosystem with canopy management</td>
<td>350</td>
<td>750</td>
<td>3502</td>
</tr>
<tr>
<td>2</td>
<td>Closer spacing 90 x 30 cm in medium deep soils with canopy management</td>
<td>600</td>
<td>1000</td>
<td>3394</td>
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<tr>
<td>3</td>
<td>Production technology for ELS cotton in niche areas under irrigated/rainfed farming situations</td>
<td>500</td>
<td>750</td>
<td>2279</td>
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<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>9175</td>
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</tbody>
</table>

*machine planting in about <15% area*
# Rate of technology assistance for farmers - HDPS

<table>
<thead>
<tr>
<th>Input</th>
<th>Type</th>
<th>Rs Per acre</th>
<th>Rs Per ha*</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>Seed</td>
<td>Compact hybrids/variety</td>
<td>4800</td>
<td>12000</td>
<td>Max 6 packets/acre</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PGR</td>
<td>Mepiquat Chloride/ Manual</td>
<td>800</td>
<td>2000</td>
<td>1-3 sprays</td>
</tr>
<tr>
<td></td>
<td>canopy management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPM</td>
<td>Monitoring, need based</td>
<td>800</td>
<td>2000</td>
<td>Pheromone traps, Neem</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Total</td>
<td>6400</td>
<td>16000</td>
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</table>

*~192 dollars/ha
Educating the stakeholders

Youtube links of video tutorials

HDPS in Cotton (Hindi) - https://youtu.be/UFqpy9g8jiw
Closer Spacing 90x30cm Protocol: https://youtu.be/75FSmEaFssc
HDPS 90x15cm Protocol: https://youtu.be/eLwui3aB9E
Manual Canopy Management technique in closer planted cotton in medium soils  
(Dada Lad Technique)

<table>
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<tr>
<th>Operations</th>
<th>Details</th>
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<tbody>
<tr>
<td>Cultivar</td>
<td>Any hybrid</td>
</tr>
<tr>
<td>No. of seed packets</td>
<td>3-4 packets/acre</td>
</tr>
<tr>
<td>Spacing</td>
<td>90 cm x 30 cm</td>
</tr>
<tr>
<td>Monopodia cutting</td>
<td>After 40-45 DAS, monopodia pruned</td>
</tr>
<tr>
<td>De-topping</td>
<td>Once crop gains a height of 1 m, de-topping done at 90 cm height. Top 3-4 nodes to be removed</td>
</tr>
<tr>
<td>Feasibility</td>
<td>• Polymulch – drip irrigated conditions</td>
</tr>
<tr>
<td></td>
<td>• Rainfed conditions</td>
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<tr>
<td></td>
<td>• Harvest in 150 days, scope for 2nd crop</td>
</tr>
</tbody>
</table>

250 participating farmers, 750 acre demonstrations in progress, expected yield : 1000 to 1500 kg lint/ha)
Nitrogen Uptake Pattern and Water Use (%)

- Increasing rainfall variability
  - Deficit rainfall in Jul-Aug
  - Excess rainfall in Sep
  - Terminal moisture stress
District level average productivity in Maharashtra

- 4 million ha
- Rainfed cultivation
- 350 kg lint/ha
Between 2001-02 to 2009-10: positive (+0.69) correlation between Yield & fertilizer use
Between 2010-11 to 2018-19: negative (-0.37) correlation between Yield & fertilizer use
Sustainable practices to build SOM – a basket of options

Key is wider acceptance and adoption by small farmers
Earthing up after last intercultural operation improved soil moisture retention in rainfed shallow to medium soils.

In low rainfall areas, dead furrow (furrow with desi plough) opened at 2-3 m interval after sowing conserves more rainwater.
Best bet climate resilient practices – excess/deficit RF

Bed planting & mulching

Adoption Barriers
- Material cost
- Biodegradability
- Weed management on beds
- Access to Machinery - Bed planters
- Drip-fertigation system cost
Cotton Stalks after harvest
Compost heap preparation
Compost heaps covered

Matured cotton stalk compost
Microbial enrichment
Ready for field application
Alley cropping of perennial legumes with cotton

Alley cropping with Desmanthus produced 75 t fresh biomass, 24t dry biomass, 758 kg N in 42 months. The organic carbon improved from 0.53% to 0.86%
The pink bollworm re-emerged as a major limiting factor due to the field-evolved resistance against Bt cotton.

Severe outbreaks of the whitefly during 2015 and 2022 and spread of cotton leaf curl virus disease (CLCuD) in the north zone.

Increased infestation of thrips and occurrence tobacco streak virus in the central and south zone.

Emerging pests and diseases like tea mosquito bug, *Helopeltis theivora*, and boll rot in the south zone.
Employing remote sensing techniques using multi/hyperspectral imaging are successfully demonstrated for cotton aphid (Reisig and Godfrey, 2006), leafhopper (Prabhakar et al., 2011) and mealybug (Singh et al., 2016).

**Climate-Smart Pest Management strategies in cotton**

**Early detection of pests and diseases**

- Artificial-intelligence (AI) and machine learning techniques in early detection of cotton diseases.
- Automatic detection of cotton leaf diseases viz., bacterial blight, Alternaria, Cercospora, fusarium wilt (Sarangdhar, and Pawar, 2017) grey mildew and rust (Usha Kumari et al., (2019) were developed using a support vector machine (SVM) algorithm.

![Mean reflectance spectra of cotton plants infested by leafhopper at different levels of infestation (Prabhakar et al., 2011)](image)

![Original Image](image)

![Threshold Segmentation](image)

![SVM Segmentation](image)
Sensor based applications in cotton - AI Smart Trap for monitoring Cotton Pink Bollworm

- Field trap catch data images transferred to App
- >90% accuracy in detection of trap catch
- Enables Economic threshold level based spray decisions
Biorational approaches

- Eco-friendly strategies like use of sex pheromones for monitoring mass trapping and mating disruption

**Monitoring** of PBW in Sokkanur village, Tamil Nadu

**Mass trapping** of PBW - Field view in Umari Meghe village, Maharashtra

**Mating disruption** technology applications in Palem, Telangana
• A smart trap developed by the ICAR-CICR for the monitoring of pink boll worm in cotton (Rameash, 2021).
• Trap catch data along with corresponding weather parameters is delivered via mobile application.

ICAR-CICR is executing “e-Kapas network” for delivering cotton advisories through mobile.

• Voice message of 30 seconds duration is recorded in vernacular languages and pushed through the GSM network.
• 32 million voice messages were delivered to over 7 lakh cotton growers in the country.
The project is being implemented by ICAR-CICR in collaboration with 10 State Agricultural Universities.
Way forward

• Climate resilience in rainfed areas - a more immediate priority
• Convergence & synergy with ongoing programs/ public investments
• Public Private partnerships – research, extension, development
• Precision cultivation & mechanization of harvesting
• Next step - linking traceability & branding with sustainability
Thank you