REFINING AND ADAPTING GLOBAL BEST PRACTICES FOR ENHANCING THE PRODUCTIVITY OF INDIAN COTTON

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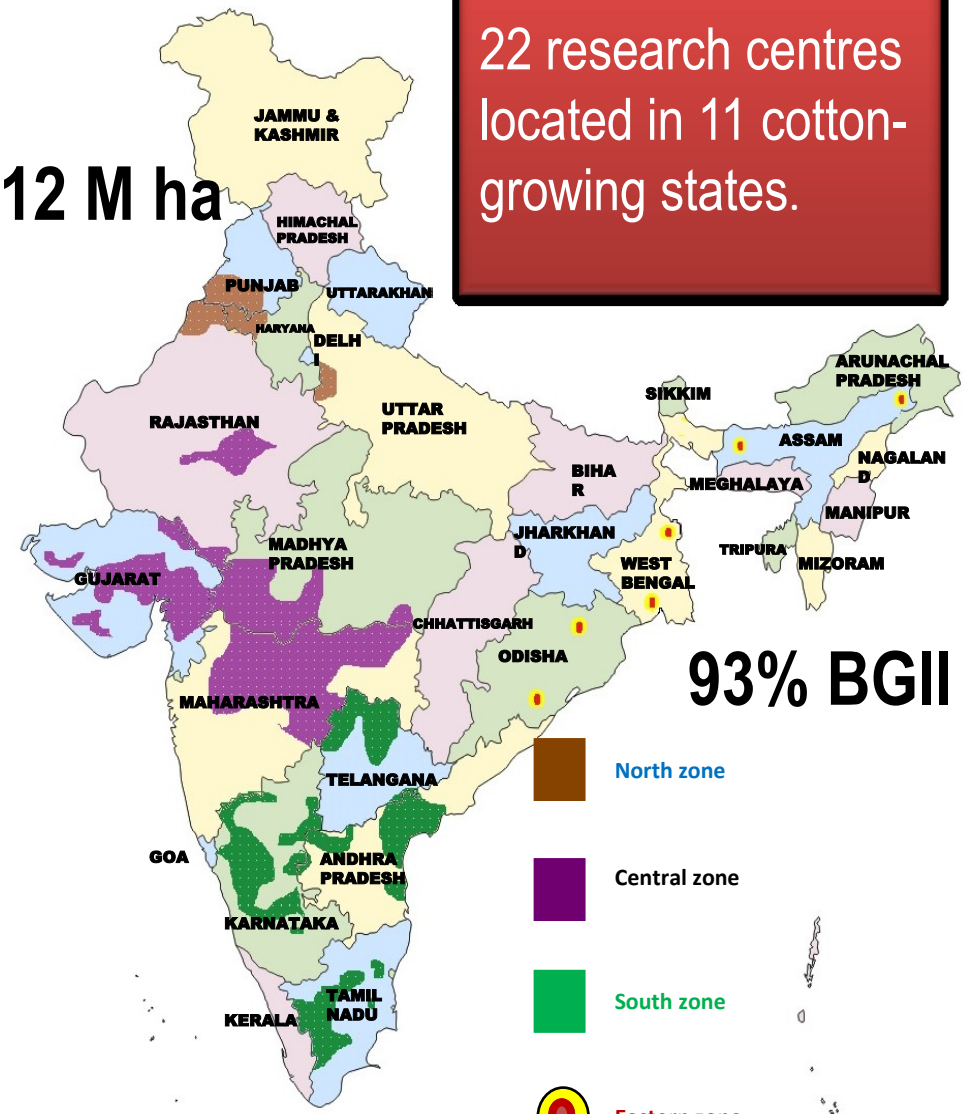
Diversity of Cotton Cultivation in India

CICR + network of 22 research centres located in 11 cotton-growing states.

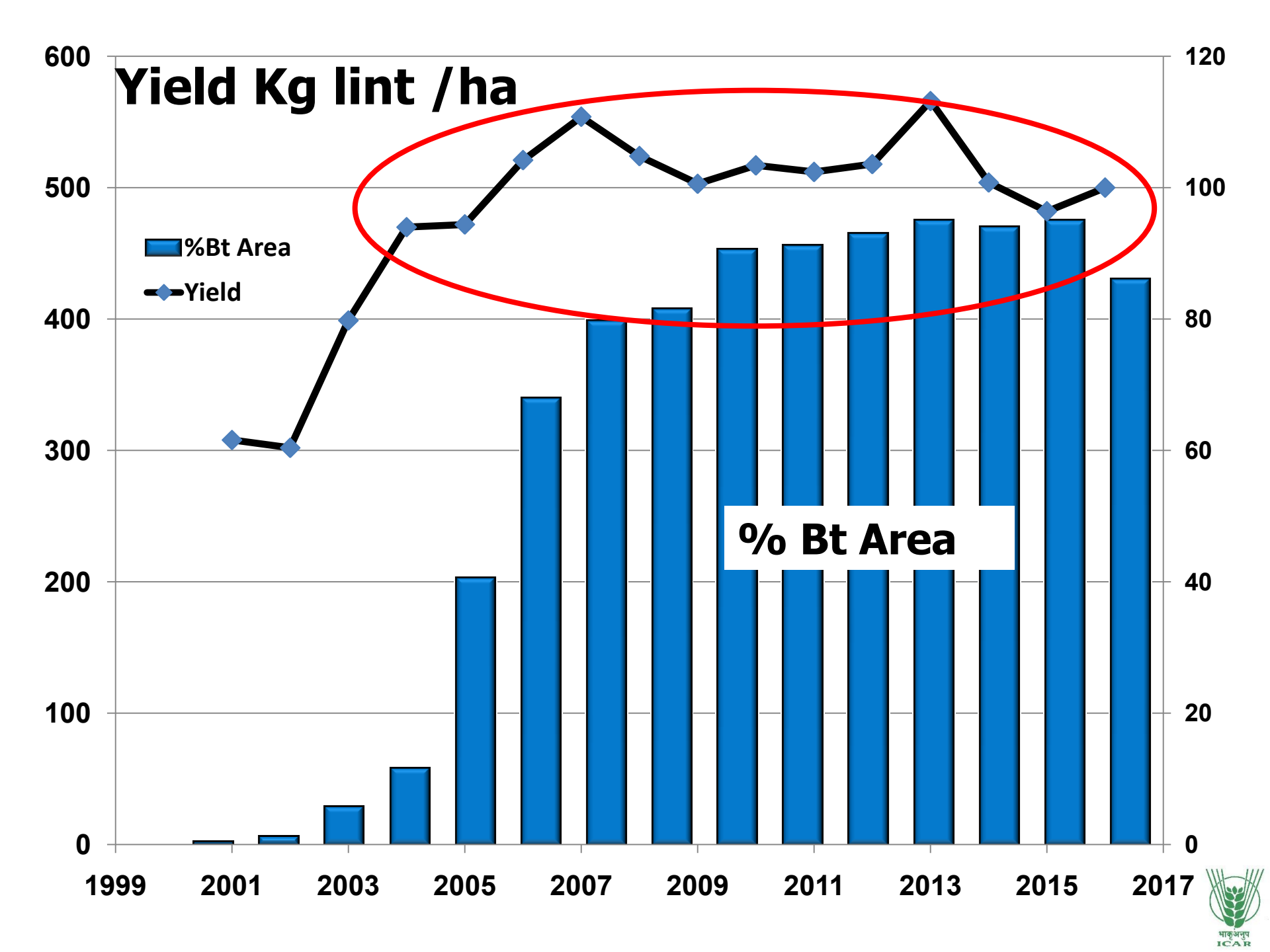
12 M ha



93% BGII

4 M farmers

- ✓ Climate
- ✓ Soil
- ✓ Cotton species grown
- ✓ Hybrids/varieties (duration and plant type)
- ✓ Cropping systems
- ✓ Water management
- ✓ Fertilizer rates
- ✓ Seed rate, spacing and plant population
- ✓ Production systems
- ✓ Pests and natural enemies
- ✓ Resources with farmers
- ✓ Social and cultural


Yield Kg lint /ha
%Bt Area
Yield
% Bt Area
600
500
400
300
200
100
0
120
100
80
60
40
20
0
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017

Why are the yields low in India?

- Too many hybrids, expansion of hybrid area to less suitable areas
- Low plant density – more branching, emphasis on more bolls/plant
- More bolls/plant - long duration, lowers GOT
- Long duration-moisture & nutrient stress at boll formation stage, Long vulnerable boll window – multiple pest and diseases
- High cost of cultivation and decline in factor productivity
- Climate change induced uncertainties in weather conditions

Best management practices for breaking yield barriers

1. Restrict hybrids to suitable areas. Redeploy early compact, *G. hirsutum* cotton varieties (with Bt) and long linted-desi cotton varieties in dryland area
2. High Density Planting System- compact early genotypes
3. Legume Based Cropping Systems
4. Residue Recycling, Soil Organic C Enrichment
5. Precise Water and Nutrient Delivery
6. Canopy Management- breeding and physiology
7. Convergence of IPM / IRM / INM / IWM etc.
8. ICT enabled TOT
9. Mechanization to reduce picking and sowing cost
10. Improved Ginning Outturn

Bt varieties released

Name	Developer	Recommendation
RS 2013	ICAR-CICR	Haryana & Punjab
PAU 1*	PAU, Ludhiana	Haryana, Rajasthan & Punjab
ICAR-CICR Bt-7 (CICR F1861 Bt)	ICAR-CICR	Haryana
ICAR-CICR Bt 9 (CICR SRI 1)	ICAR-CICR	Maharashtra &Madhya Pradesh
ICAR-CICR Bt 14 (CPT 2)	ICAR-CICR	Maharashtra
ICAR-CICR GJHV374 Bt	ICAR-CICR	Maharashtra & Odisha
ICAR-CICR PKV 081 Bt	ICAR-CICR	Maharashtra
ICAR-CICR Rajat Bt	ICAR-CICR	Maharashtra
ICAR-CICR Suraj Bt	ICAR-CICR	Maharashtra
Rahuri 1*	MPKV Rahuri	Maharashtra

* Ideal for HDPS

21 Bt varieties- tested at 19 locations in 3 cotton zones in 2016-17

Long linted *Desi* cotton in drylands

Drawbacks in *G. arboreum* cotton:
Low boll weight (2.5-3.0 g) , Low locule retention, Poor fibre & Instability across environments

Solutions

Cernuum cotton-MDLABB1

Bolls -5.5-6.0 g ,Good retention, Surgical use

Phule Dhanwantary

Bolls - 3.2-3.5 g, Good retention, Surgical use

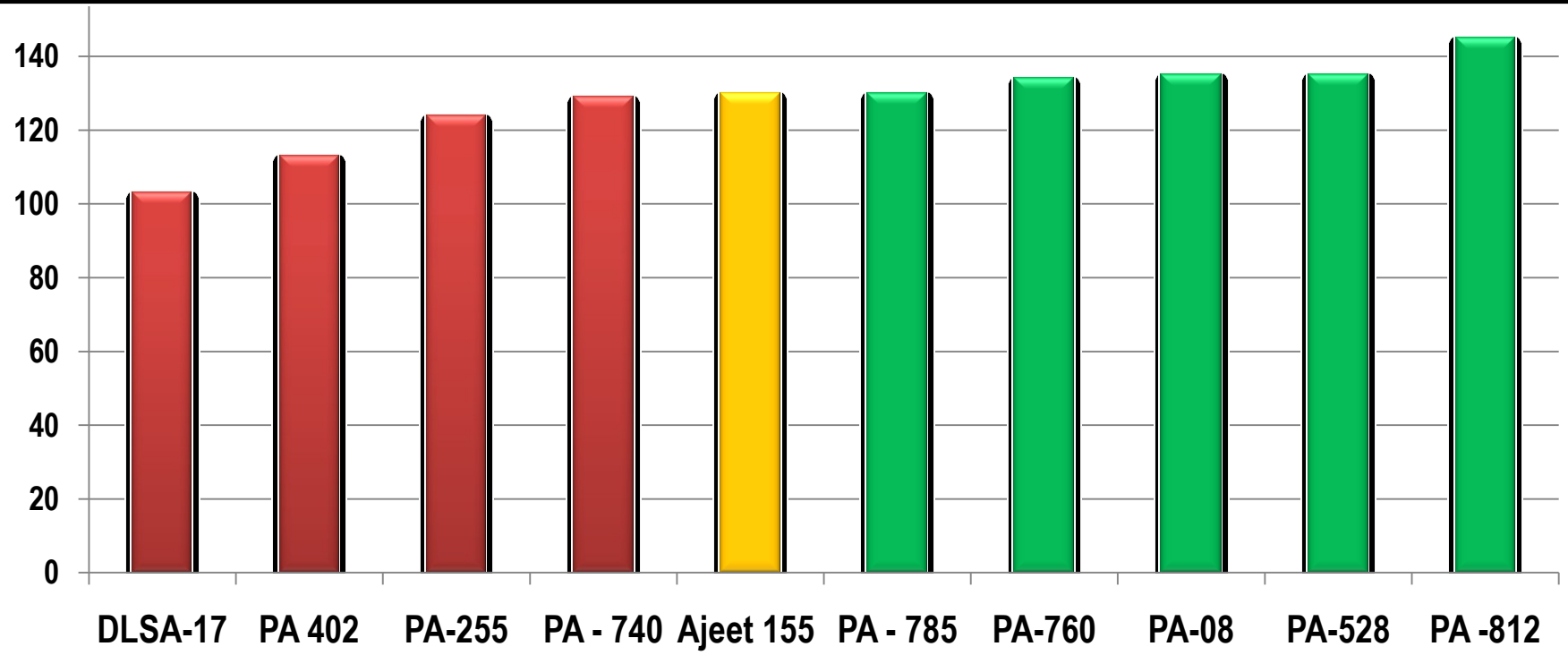
PA 255 (Thurab)

Early, high yield, good fibre quality, spinnable

Yield (165DAS) and fibre quality of long linted *Desi* cotton

Genotype	Lint yield in kg/ha (SE)	UHML (mm)	MIC ug/in	Strength (g/tex) - 3.2 mm gauge
PA-255	1177 (±31)	27.4	4.6	28.8
PA-08	1082 (±41)	28.3	4.7	28.7
PA-528	1240 (±61)	29.0	4.8	30.9
PA-760	1176 (±36)	29.9	4.4	29.1
PA 402	1089 (±8)	27.4	4.7	28.4
TKA-9102/3	977 (±48)	29.7	4.5	30.2
DLSA-17	1138 (±13)	29.5	4.6	29.6
PA - 740	1312 (±54)	28.3	4.7	31.1
PA -812	1222 (±71)	32.3	4.4	30.7
PA - 785	1248 (±35)	29.8	4.4	30.6
Ajeet 155 BG II	928 (±17)	29.1	4.0	28.4

Spinning consistency index of long linted *G. arboreum*



Spinning Consistency Index = -414.67 + 2.9×strength - 9.32×micronaire + 49.17×UHML + 4.74×UI + 0.65×Rd + .36×(+b)

Where: Rd is the reflectance degree, and (+b) is the yellowness of fibre

High density production system (HDPS)-cotton

HDPS – semi-compact varieties - planted at population ranging from 111000 to 222000 plants/ha at 45 to 90 cm spacing between rows and 10 cm between plants

Semi compact genotypes for HDPS-different locations

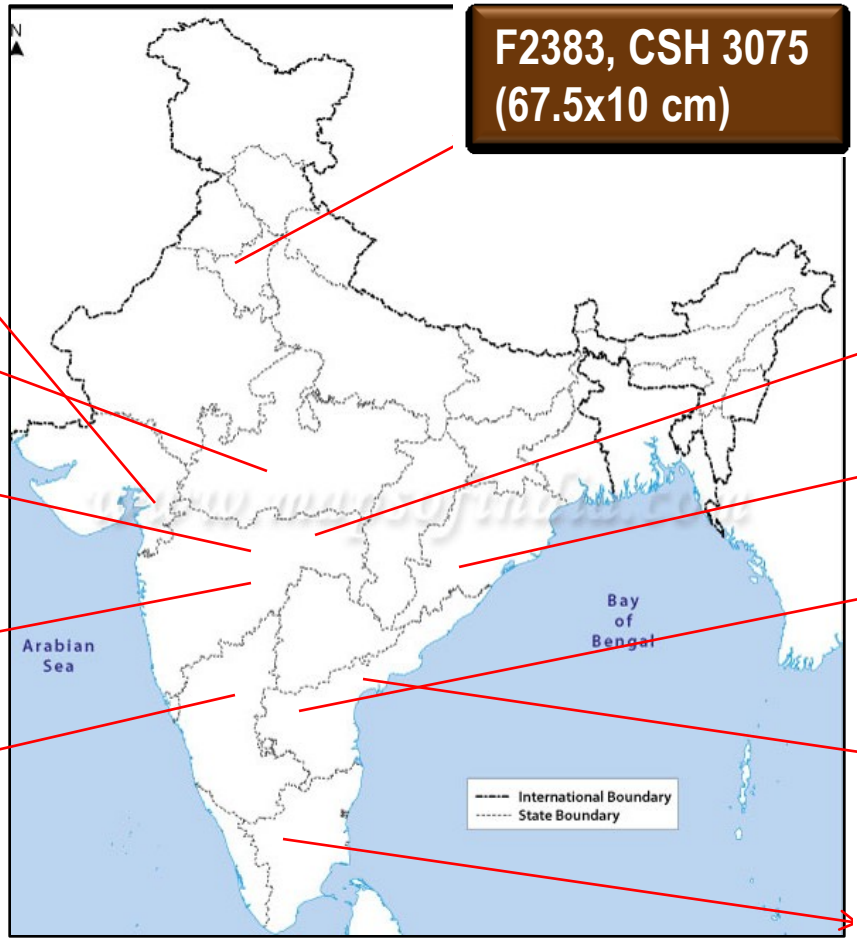
G Cot 16, GISV 272 (60x10 cm)

JK 4 (60x10 cm)

PKV 081, AKH 1317 (45x10 cm)

NH 615, Suraj (60x10 cm)

DSC 99, ARBC 64 (60x10 cm)



F2383, CSH 3075 (67.5x10 cm)

PKV 081 Suraj, NH615 (45/60 x10 cm)

BS 279, BS 30 (60x10 cm)

SCS 1206, NDLH 1938 (45x10 cm)

ADB 39, ADB 538 (60x10 cm)

Anjali, Subiksha, Suraj (60x10 cm)

All the genotypes recommended are tolerant to sucking pests

CSH 3075-first variety bred and released for HDPS

HDPS Demonstrations in farmers field

Year	Details
2012-13	160 demonstrations in Vidarbha
2013-14	2400 demonstrations in all cotton growing states except Gujarat
2014-15	1800 demonstrations in all cotton growing states –IRM-HDPS
2015-16	1525 demonstrations in all cotton growing states –IRM-HDPS under NFSM (including 100 demos of Phule Dhanwantary with YUVA Rural Association)
2016-17	700 demos in all cotton growing states

Additional demonstrations - State governments

Yield improvement 15-20% over existing farmers practice
Cost reduction 22-25 %
Earliness 2 weeks
Higher benefits where entire POP was adopted.
Famers are now convinced but want Bt varieties

Increase in planting density - Bt hybrids

Confederation of Indian Textile Industries and Bayer Crop Science (BCS) –in Southern Rajasthan. Hybrid Surpass yielded highest at 80x15 cm followed by 80x30 cm

Nuziveedu- Erect hybrids (Bhakti, Bhadra, Malini), PGR (Mepiquat chloride, mepiquat pentaborate), defoliant thidiazuron, Thidiazuron+ Diuron), Boll openers (Ethepon, paraquat). Spacing -90-120 cm x 30 cm

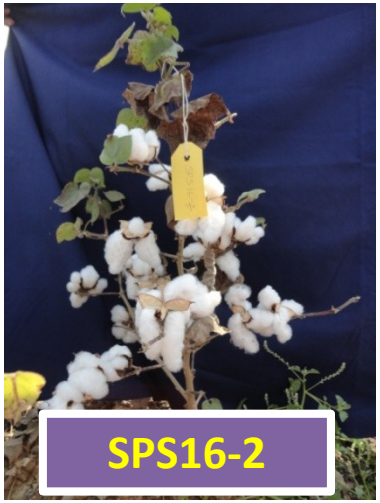
Mahyco-Monsanto and Ankur seeds-Yield increase by HDPS was 13% in Gujarat, 44% in Maharashtra, 48% in Andhra Pradesh

Promising early maturing cotton developed at CICR

Many promising progenies are under stabilization and selection, both in Bt (Mon531) and non-Bt versions.

- ✓ Earliness (120 -130 days)
- ✓ Jassid tolerance (grade I)
- ✓ Compact plant architecture (100cm tall & width around 40cm)
- ✓ Boll weight (3.5-5 gm)
- ✓ Per plant yield (80-100gm)
- ✓ Fibre length (26-31mm; HVI)
- ✓ Fibre strength (28-32g/tex; HVI)
- ✓ Can be machine picked

More Crop per Area per Time per Input



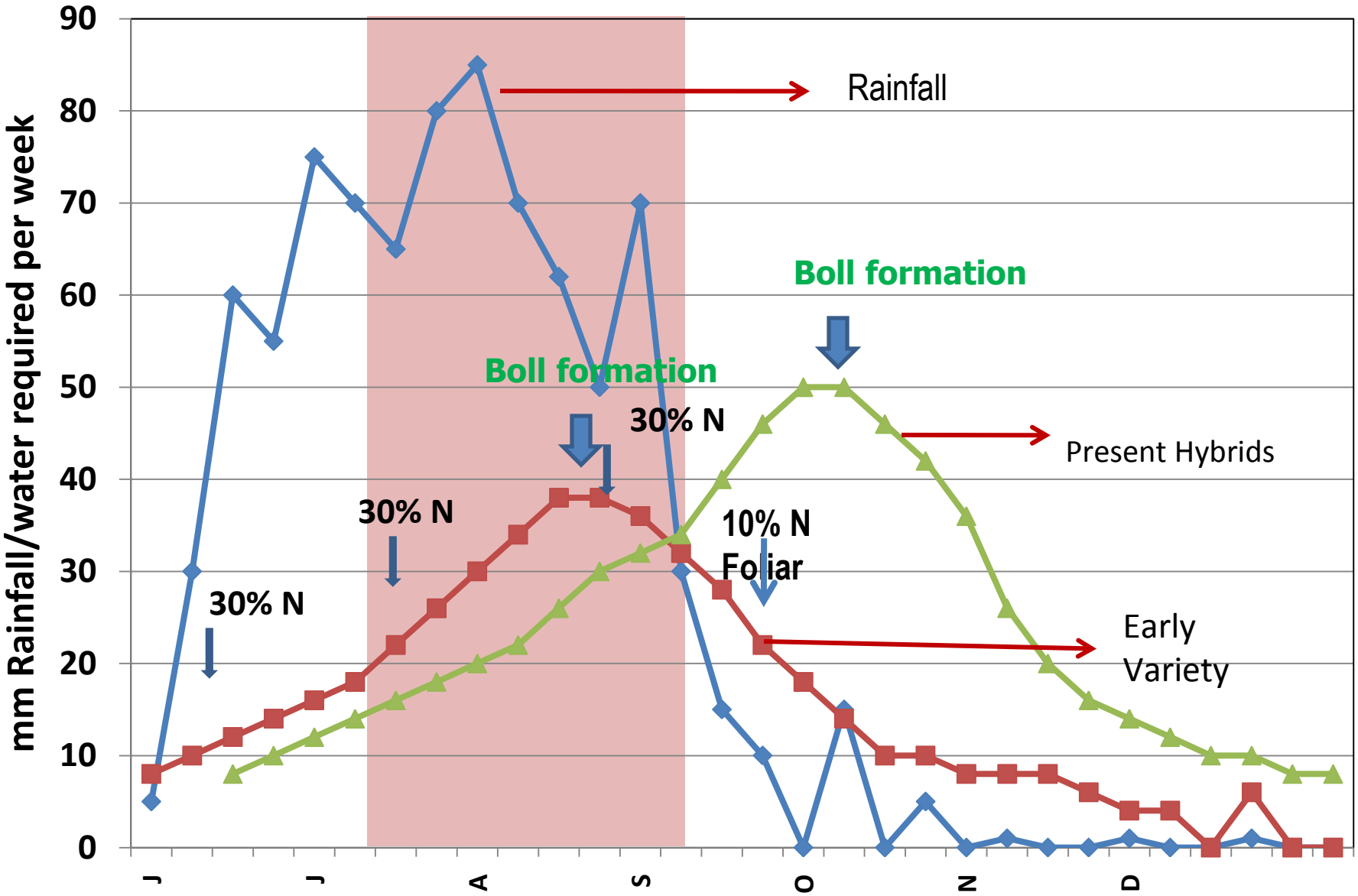
Higher yields per area per time ***(compact plant type, mechanized picking and early maturity)***
Lesser cost of production ***(Bt and sucking pest tolerance, escape pink boll worm damage)***

Cotton based intercropping systems – N economy

Zone	Intercrops
Central	Cowpea, soybean, green gram, black gram, pigeon pea, groundnut, clusterbean
South	Groundnut, soybean, green gram, Desmanthes

FLDs to popularize them

Central India –Water and N synchrony



Cover crop and mulch – weed management and water conservation

- Broadcast sun hemp in between cotton rows (15 days after cotton emergence). Turn down after 30-35 days
- Brown mulch effective in controlling weeds and also conserve soil moisture
- Polythene and news- paper mulch

Water management-rainfed and irrigated

- Et based water application
- Micro-irrigation – central and south India with a poly mulch
- In north India – furrow irrigated raised bed technique
- Alternate furrow irrigation
- In-situ water -conservation – BBF, Ridge/furrow

Fruit retention and Canopy management

Plant Growth Regulators for fruit retention

- NAA@40 ppm to reduce bud/boll shedding due to cloudy weather
- NAA at 50-55 days for improved early square and boll retention

Canopy Management

- De-topping and side shoot removal-compact and early
- Mepiquat chloride (2 sprays @ 25 g ai.ha)
- Ethrel application (5.6 m molar) at 45 DAS – shed early squares, alter mopho-frame, robust growth, short fruiting window & uniform boll bursting
- Combining de-topping with maleic hydrazide spray

IRM-Insecticide Resistance Management

IRM strategies- varietal selection, good agronomy, window based insecticide selection (insecticide chemistry, resistance level by target pest, safety to natural enemies, WHO classification and IRAC classification)

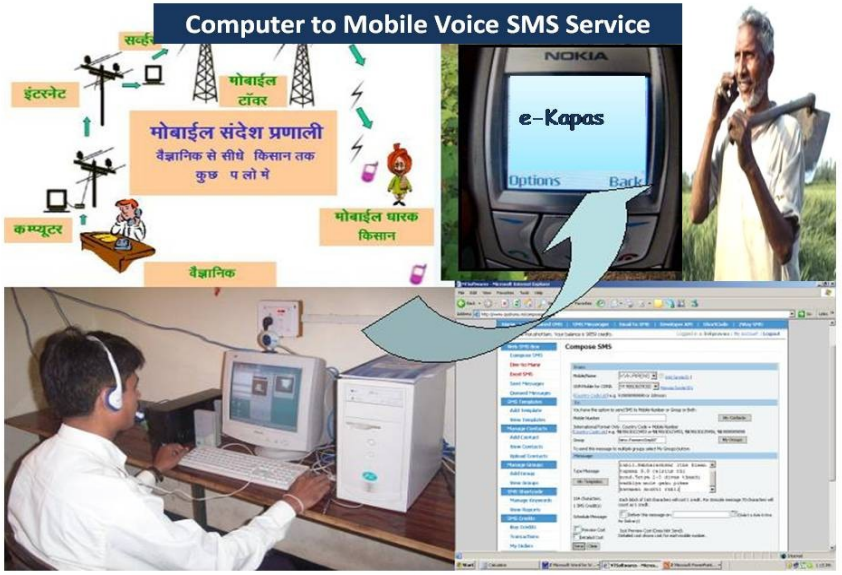
Radical change in farmers' perceptions on pesticide use, a drastic reduction in the pesticide use and a concomitant decrease in insecticide resistance in cotton pests.

Since 2002 IRM strategies were disseminated to **3,38,519** farmers in **720444 hectares** in **33 districts** from **12 different states of India**. Resulted in 14 % yield increase, 45.5% reduction in insecticide use. **Additional benefit of Rs 40.29 crores**.

e-Kapas: Voice-mail service: ICAR-CICR + SAUs

0.37 million farmers registered

1.40 crores voice messages/ alerts on BMPs sent in nine regional languages



Web Based weekly advisories

Mobile Apps

ICAR-CICR-CIRCOT-Mahindra Cotton Harvester

Finger Type

Brush Type Header

Harvester	Tractor mounted
Picking Capacity	4 hectares/day
Picking efficiency	Upto 98%
Approx Cost	Rs. 7 lakhs
Suitability	For all line spacings and direction
Up keep	Easy to operate, maintain and repair
Picking Cost	Rs.4.1/kg (with cleaning)
Trash content (Finger type)	Average 17% Seed cotton basis
Trash content (Brush type) Under refinement	Average 13% Seed cotton basis

Summary: BMPs for Doubling Farm Income of cotton farmers

- **Short duration varieties: long-lint Desi (*Gossypium arboreum*) and Bt-varieties** to reduce production costs
- **High density planting systems & early sowing** - to reduce production costs
- **Sub-soiling to break hard-pans-** to increase water storage and cotton yield
- **Precision planting, north-south oriented row direction** - to increase yield
- **Plastic mulching, drip irrigation under plastic mulch & water management-** plants-to increase yield
- **Conservation tillage, cover crops, crop residue recycling / mulching-** to reduce production costs and increase yield
- **Canopy management for better square and boll retention** with PGRs to increase yield
- **Precision chemical input management-** to reduce production costs and increase yield
- **Place technologies -agro-ecological perspective**

Thank you

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