

# 1. EXECUTIVE SUMMARY

## Crop Improvement

### Genetic Resources of *Gossypium*

- Fifty-nine variants of cotton including 42 perennials and 17 landraces belonging to *G. arboreum* and *G. barbadense* were collected from states of Arunachal Pradesh, Madhya Pradesh, Maharashtra and Karnataka, established in pot culture and conserved in the Gene bank for their further utilization in cotton improvement.
- 26 wild species, 15 races of cultivated species and more than 45 synthetic polyploids are maintained in the wild species garden. One new species (EC 669583) established in a pot during 2013-14 was found to be genetically distinct from other wild species based on genotyping data.
- One hundred and forty-two perennials and landraces of cotton were characterized for DUS traits. 96 lines, wild species, races of cultivated species, synthetic polyploids and introgressed derivatives were characterized using 52 polymorphic SSR markers.
- One *G. arboreum* genetic stock CNA 5 (INGR14005; pigmented and long linted (26.7 mm), tolerant to jassids, bollworm, bacterial blight and grey mildew), and two *G. hirsutum* genetic stocks viz., CNH CB-211 (INGR14058; Cluster boll bearing habit), CNH CB -212 (INGR14059; Compact and cluster boll bearing habit) have been registered with NBPGR, New Delhi.
- Seven *G. hirsutum* genetic stocks viz., CNH 1102, GMR 5, IRH 1-4-4, IC 1007, MCU 5 Lintless Mutant, AKH 98-81 Naked Seed Mutant, PI - 3-1-1, five *G. arboreum* genetic stocks viz., CNA 1052, CNA 1051, CNA 405, CNA 407, CNA 407 and one *G. babadense* genetic stock viz., Suvin restorer have been identified for registration.
- One hundred seventeen (117) exotic accessions (*G. hirsutum*-112 from USA and *Gossypium barbadense* -5 from Israel) were procured through NBPGR, New Delhi for enrichment of Indian Cotton Gene Pool.
- Sixteen long linted accessions with staple length (31.0 – 32.6 mm) and 28 accessions for high fibre strength (25.0 – 26.8 g/tex) were identified upon evaluation of two hundred and fifty two (252) exotic accessions of *G. hirsutum*.
- Upon evaluation of eight hundred and thirty six (836) accessions of *G. arboreum*, twenty long linted accessions having staple length ranging from 26 mm to 28.3 mm and 14 accessions having high fibre strength (22.8 – 26.0 g/tex) were identified.
- Accessions possessing high fibre strength, fibre length, ginning outturn, boll weight and seed cotton yield were identified after evaluating five hundred and fifty (550) *Gossypium herbaceum* germplasm accessions.
- Seeds of 618 accessions (*G. arboreum* -268 and *G.hirsutum*-350) were submitted for conservation in long term storage at NBPGR and medium term storage at CICR, Nagpur.
- Four thousand eight hundred and fifty (4850) germplasm accessions (*G. hirsutum*- 4000, *G. arboreum*-300 and *G. herbaceum*- 550) were grown for rejuvenation and seed multiplication
- Eight thousand three hundred and forty three (8343) germplasm accessions (*G. hirsutum*-8311, *G. barbadense*-1, *G. arboreum*-23 and *G. herbaceum*-8) were distributed to Breeders/ Scientists of State Agricultural Universities for their utilization in research programmes.
- Three thousand eight hundred and eight (3808) accessions of *Gossypium hirsutum* were evaluated at CICR-RS, Sirsa.





- Six single plant selections from germplasm lines *viz.*, IC291590, IC360026, IC356618, IC359978, IC 358085 evaluated during 2013-14 were found to exhibit zero branching habit.
- Among 12 accessions of *Gossypium barbadense* evaluated at CICR-RS, Coimbatore, ICB-194 recorded the highest yield of 130 g/plant followed by ICB-39 (125 g/plant). ICB-194 exhibits high ginning outturn (32%) and boll weight (3.6 g). Upon evaluation of seven dwarf germplasm accessions, ICB-124 is identified for higher seed cotton yield (154 g/plant) and boll weight (3.6 g), EC-16 was found to be earliest in maturity (165 days) compared to Suvin (183 days). Twelve hairy accessions were identified from base collection of *G. barbadense* germplasm and evaluated for yield and sucking pest tolerance.
- Twenty-six *G. hirsutum*, two *G. barbadense* and four *G. arboreum* varieties were established at "Varietal Garden" to conserve them in a perennial form and also assure the continuous supply of genetically pure seeds of cotton varieties for future cotton research. On the basis of genotyping using linked marker CIR 246, selected F<sub>1</sub> plants were backcrossed to the recurrent parent Suraj to develop backcross populations and generation was advanced by taking two crops per year at Nagpur and Coimbatore. Crossing and backcrossing were also attempted to develop cotton varieties resistant to cotton leaf curl virus and nematode resistance using marker assisted breeding.

### Genetic Improvement for target traits

- Most promising lines for earliness (Sahana, G-Cot 16, CNHO-12,) compactness (Anjali, Arogya, Pratima), and jassid tolerance (CNH-2024, CNH-409-9, CNHO-7-34) were identified for their utilization to develop early maturing, compact cotton varieties having jassid tolerance.
  - A compact, densely hairy and pyramid shaped plant type has been identified in back cross derived culture (Sumangala x ACT SP 16-1)
- ACT SP 16-1 C-5-1 which showed cleistogamous flower character and cluster boll bearing.
  - The drought tolerant cultures DTS 155, DTS 62 and DTS 104 recorded more than 50 per cent increase over the check for seed cotton yield [recorded fibre strength <20 g/tex, fibre length >24 mm, micronaire of 3.5 µg/in and short fibre content of >10 per cent.
  - Based on lenticel formation, 23 accessions have been identified as water logging tolerant lines out of 150 accessions screened.
  - Field evaluation of thirty one advance genotypes from segregating population and Suvin multiple cross progenies was carried out. Eight high yielding extra long staple (ELS) genotypes of *G. barbadense* yielded more than 1000 kg/ha over the control Suvin (711 kg/ha) apart from having more than 37 mm 2.5% span length and 27-28 g/tex strength with > 3.5 micronaire and 30-31% GOT.
  - The *G. arboreum* cultures CISA-6-295, CISA-10, CISA-33-6, CISA-33-7, CISA-33-7, CISA-33-8, CISA-54-1 and CISA-44-1 were found promising for spinning having 2.5% span length >23.0 mm and micronaire between 5-6 and strength >19.0 g/tex.

### Heterosis Breeding

- Based on the evaluation of 10 GMS and 23 conventional *G. arboreum* hybrids, GAK-423 x G-135-49 (2944 kg/ha) in GMS hybrids and PA 255 x 30805 (3139 kg/ha) in conventional hybrids have been identified for high yield.
- Heterotic populations developed for superior medium staple (25-27 mm) category from parents selected on the basis of geographic diversity and promising lines were identified.

### Introgress Breeding

- F<sub>2</sub> mapping population of *G. herbaceum* x *G. longicalyx*, *G. arboreum* race *indicum* x *G. davidsonii*, *G. arboreum* x *G. thurberi* and AKA 8401 x *G. davidsonii* were transplanted in species garden for phenotyping.





- 164 introgressed lines developed from CICR, Nagpur were evaluated at CICR Sirsa, a hot spot area for leaf curl virus. Only seven introgressed lines viz., 11, 49, 51, 54, 145, 149, and 150 showed some tolerance against CLCuV with less than 30% PDI. However, most of the lines showed susceptible reaction against CLCuV.
- The interspecific hybrid of *G. herbaceum* and *G. anomalum* cross having high fibre strength (upto 36.7g/tex) has been conserved as a perennial in the wild species garden for further utilization. Out of the eleven fibre strength specific SSR primers, two of them (BNL 3644 and BNL 1317) were highly polymorphic for a set of 58 F<sub>2</sub> plants of *G. herbaceum* and *G. anomalum*.
- Sixteen (16) naturally coloured cotton introgressed genotypes (*G. hirsutum* and *G. arboreum*) were provided for mass scale seed cotton production in farmers field.

#### Varietal Development and Multi-location testing

- Two promising cultures CNH 25 (*G. hirsutum*) and CNA 449 (*G. arboreum*) were identified and sponsored in AICCIP for evaluation in 2014-15. *G. arboreum* cultures CNA 2019 and CNA 2043 were evaluated in station trial at CICR, Nagpur.
- *G. arboreum* culture, CISA-6-2 and GMS based *G. arboreum* hybrid CISA-27 was sponsored in AICCIP Br22a/b and Br25a/b national trials, respectively.
- CCA-2003 and CNA-2023 have been sponsored for the current season in Br 22 a/b.
- Cultures MM 03-39-4-2-3 (Br-02a) and MM03-40-4-3-1 (Br-02b) have been sponsored for multi-location testing in initial evaluation trial of AICRP on cotton during 2014-15 in irrigated and rainfed trials, respectively.
- Five cultures developed from random mating populations have been identified for promotion in AICCIP national trials.

- The proposal for notification of medium staple Central Cotton CCH 2623, for South Zone States under irrigated conditions has been submitted for consideration of Central Sub-Committee on Crop Standards, Notification and Release of Varieties.
- Seventeen promising cultures were sponsored in various National trials of AICCIP during the crop season of 2014-15. Of these, 6 entries were sponsored for National trials of *G. hirsutum* and 4 of *G. arboreum* trial. Seven entries were sponsored for high density planting system trial. CNH 7008 was promoted to Central zone trial Br 03(b) and CNH 1111 was promoted to South zone trial Br 06(b). Three entries (CSH 1110, CNA 1016 and CNH 28I) were retained for central and south zone trials. Fifteen and 6 entries of *hirsutum* and *arboreum* cottons were tested in Common Institute trial. One entry CCB-29 has been entered in AICCIP trial. The genotypes CCB- 44 was identified for high seed cotton yield with high length and other fibre properties.

#### DUS Characterization

- Two thousand seven hundred nineteen (2719) germplasm lines of *G. hirsutum* were field characterized as per DUS descriptors at CICR-RS, Coimbatore.
- 49 EDVs, 43 VCKs, 63 genotypes under first year testing and 30 under second year testing were subjected to DUS characterization.

#### Molecular Breeding

- RIL population (EL 958 x UPA 57-17) was developed using single seed descent method for genetic mapping. During 2014-15, 857 SSR markers were screened for parental polymorphism, 157 were found to be polymorphic. So far, 4417 SSR markers were screened for parental polymorphism in *G. hirsutum* and 702 informative SSR markers were identified. Genotyping of 188 RILs using 162 SSR markers and 172 RILs using 2979 SNP



markers (50K SNP chip) has been completed.

- Sixty SSR markers were identified as polymorphic among 48 public sector released cotton varieties of *G. hirsutum* as well as *G. barbadense*. Twelve markers were polymorphic among the 50 SSR screened in *desi* cotton varieties. These markers can effectively identify and distinguish cotton varieties.
- Sixty four polymorphic markers were identified after screening more than 450 genome wide SSR markers among the private sector cotton hybrids and popular cotton varieties. Higher genetic diversity was observed among cotton varieties (47%) as compared to private sector hybrids (32%). SSR markers effectively distinguished varieties (capturing both inter and intra species variation) and hybrids compared to DUS characters.

#### Development of Transgenics

- Generated *in-vitro* nano complex of VirD2-SS TDNA- VirE2 with cell penetrating peptide (Tat2) for transgene delivery into cotton.
- Transgene delivery using cell penetrating peptide (CPP) through pollen tube pathway was carried out using gossypol biosynthesis gene coding for delta Cadinene synthase.
- *In-planta* transformation using pollen tube pathway was carried out in cv Suraj using agrobacterium containing CICR multigene construct and around 300 seeds were harvested.
- CICR multigene construct was also subjected to transformation and regeneration through somatic embryogenesis.
- Molecular identification of isolated bacterial and fungal strain for glyphosate tolerant / utilization, was done through 16s rDNA and ITS region sequencing.
- Full length coding sequence for *Helicoverpa armigera* chitin synthase B sequence was isolated successfully and characterized for

functional motif.

- Members of COBRA gene family was identified as new players in the regulation of the orientation of cell expansion in the plant cell wall and in cotton known to play key role in fibre development.
- Gene expression analysis was carried out through qPCR using mapping population for high fibre strength.

#### Seed Production and Quality Improvement

- A total of 484.5 q seed including breeder, foundation, certified and truthfully labelled seeds was produced for different crops and about Rs 15-16 lakhs was generated through the sale of these seeds or its by-products.
- The seed cotton yield of 1 month old transplanted crop was found to be superior to 20 days old transplanted and direct sown crop. Bio priming with *Pseudomonas* (2 g/kg) and pulsed magnet treatment at 750 nT 5hr for 15 days have significantly increased the germinability and seedling vigour.
- Higher boll and seed setting was observed with hand pollination over NPK 2%, CICR consortium, Godrej double, DAP 2% and check. Much lower boll and seed setting percentage observed in sterile lines indicated negligible contribution of pollinators in cotton. Studies indicated significant influence of prevailing environment on boll formation percentage and seed setting efficiency.

#### Crop Production

##### Phenotyping for drought tolerance

- Eighty seven cotton germplasm accessions were identified as drought tolerant out of 350 germplasm lines screened during rain free hot dry summer days (April-May)
- Among the 87 accessions, Nagpur-9, SGNR-27, F-1226 and DTS-108-09 performed well under drought stress conditions.

##### Amelioration of Leaf Reddening in Cotton,



## CICR, Nagpur

- Based on visual screening, monochrotophos (3 ml/litre), kinetin 20 ppm and CICR nutrient consortia treated plants showed delayed onset of reddening. As the days progressed, monochrotophos (3 ml/litre) sprayed plants remained healthy with relatively higher percentage of green foliage followed by CICR nutrient consortia treated plants.
- Chlorophyll stability index was higher in red leaves of RCH 2Bt (70.5%) than green leaves of RCH 2Bt (64.5) providing evidence for protective role of anthocyanins.
- Seed cotton yield was higher in monochrotophos treated plants (924 kg/ha) followed by CICR consortia treated plants (769 kg/ha) as against control (523 kg/ha).

## Weed management

- Among the different concentrations of glyphosate, 5 ml/l and 7.5 ml/l were effective in controlling both the dicot (broad leaved) and monocot (grassy) weeds.
- With enhancers, combination of even a very low concentration of glyphosate (1ml/l) and 100 mM ammonium sulphate was effective in controlling weeds. The activity of glyphosate was also increased by other enhancers such as 100 mM  $\text{KH}_2\text{PO}_4$ , 2% urea and 5% neem oil, however, at a slower rate than ammonium sulphate.
- Among the 48 different combinations of glyphosate, Quizalofop ethyl 5% EC, Propanil 10% EC and Pyriproxyfen Sodium tried at low concentrations, combination of Glyphosate 2.5 ml/l and 2.5 ml/l of Quizalofop ethyl 5% EC was found effective in killing both broad leaved and grassy weeds.
- Sorghum and sunhemp were found to be the most effective cover crops for controlling weeds.
- Newspaper as a mulch was found to provide

total weed control and was as good as the polythene mulch treatment.

## Cotton Mechanization

- Modifications of grid concave, gathering reel and combs were carried out to optimize the CICR Precision Cotton harvester.
- The cotton harvester and modified components were evaluated in RCH-2 at 60 x 60 cm spacing and Suraj at 80 x 10 cm HDPS system.
- 80% harvested seed cotton came off relatively cleaner (25% trash) from the threshing unit and into the pre-cleaner while 20% trashy cotton (40% trash) got discharged from the opening below the grid concave unit.
- Pre-cleaner could clean 20% of overall trash found at the gathering unit.

## HDPS

- New genotypes like DSC 99, G. cot 16, H 1098i were found suitable for planting under HDPS at 45 x 10 cm or 60 x 10 cm under rainfed conditions on black soils.
- On the sandy loam soils of north India, CSH-3158, CSH-3132, CSH-3178, RS-2525 and Bhiani 251 were identified as having high yield potential under HDPS.
- Among super okra leaf cultures evaluated at Coimbatore, Surabhi x  $M_5Z_2$  4-2 Bk was identified as high yielding (3492 kg/ha) compared to Suraj (3137kg/ha)
- Surgical cotton varieties with high yield for the black cotton soils were CNA-375, CNA-418, Phule Dhanwantari & MDLABB.
- Inclined plate planter was found to be efficient and cost effective for planting cotton seeds under HDPS.
- Moisture conservation measures such as planting in ridges and furrows or use of bio-mulch resulted in an additional yield of 300 kg seed cotton per hectare over control.



## Crop Protection

### Pest dynamics

- Seasonal pest population dynamics under protected and pesticide free conditions at Nagpur indicated highest population of thrips, aphids and whitefly during (first fortnight of September). Jassids were above ETL during first week of September to third week of October.
- Seasonal peaks of sap feeders viz., jassids, thrips and whitefly across central zone locations from 2005-06 to 2013-14 (AICCIP data) varied from location to location. Jassids and thrips peaks were recorded between 34-44 standard week and whitefly between 34-54 standard week.
- In North India, whitefly peaks were recorded at 37 standard week and the corresponding populations were recorded as 50.1, 38.9, 33.0 whiteflies/3 leaves on genotypes RCH-134 BGII, HS-6 and Ganganagar Ageti, respectively.
- Pheromone trap catches of American bollworm, Tobacco caterpillar, Pink bollworm and Spotted bollworm were highest during second fortnight of November, between last week of October to first week of November, 10-16 November and 3-9 November, respectively at Nagpur.
- Five mealybug species viz., *Phenacoccus solenopsis*, *Nipaecoccus viridis*, *Maconellicoccus hirsutus*, *Ferrisia virgata* and *Paracoccus marginatus* belonging to Pseudococcidae family of order Hemiptera were recorded in Maharashtra and Madhya Pradesh.

### Novel technologies

- CICR Whitefly Adult Suction Trap was designed. The trap is power operated, shoulder mounted, adjustable and sucks whitefly adults available on the underside of the cotton leaves with least harm to the natural enemies flora and cotton crop.

- YST (yellow sticky trap) is an effective scouting mechanism. YST when stuck to the trouser on the outer thigh of the person operating the intercultural machine, trapped maximum number of whitefly when the crop was 45-60 days old.

### Biological control

- Fifteen species of spiders belonging to 6 families were recorded in cotton agro-ecosystem. Three species were of orb weavers from family Araneidae, a species of lynx spider from family Oxyopidae, 5 species of crab spider from family Thomisidae, 4 species of jumping spiders from family Salticidae, 2 species of cob web spiders of family Theridiidae. Family Araneidae contributed one third spider population (34.6%) followed by Oxyopidae (27%) and Thomisidae (24.5%).
- Eight natural enemies of mealybugs viz., parasitoids- *Aenasius bambawalei*, *Metaphycus* sp., *Anagyrus kamali*, *Acerophagous papayae*, *Pseudoleptomastix mexicana* hyperparasitoids- *Promuscidea unifasciatiiventris* and *Prochiloneurus albifuniculus* and predator *Cacoxenus perspicax* were recorded.
- Nineteen insecticidal formulations from 10 groups of insecticides were evaluated for their relative toxicity against cotton mealybug *Phenacoccus solenopsis* Tinsley and its fortuous parasitoid *Aenasius bambawalei* Hayat. Spinosad, Chlorpyrifos and Quinalphos were found to be extremely toxic to *A. bambawalei*, the application of which may be avoided for the control of *P. solenopsis*. Moderately toxic insecticide Thiodicarb was found effective against *P. solenopsis* and relatively less toxic to parasitoid.
- Mortality of pink bollworm from Bharuch district of Gujarat due to the parasitoid *Apanteles* sp., ranged from 21.2 to 60.9%

### Host Plant resistance

- Mealybug induced biochemical changes in cotton indicated increase in total protein,



phenol and total sugar by 50.9 %, 171% and 11.1%, respectively, over control.

- Increased ethylene emission from cotton plants stressed due to jassid infestation was observed with increasing infestation grades under both protected and pesticide free conditions during vegetative and fruiting stage.
- Plants suffering from sudden wilt emitted higher ethylene (2.27 ppm) as compared to healthy plants (1.02 ppm).

### Resistance Monitoring

- Resistance development of pink bollworm collected from BG, BG-II and non Bt cotton fields was monitored in 34 districts of India. Incidence of pink bollworm was not observed on Bt cotton in North and South India, but was recorded only in Gujarat. The larval intensity on Bt cotton was more in Amreli and Vadodara as compared to other locations.
- $LC_{50}$  of *Cry1Ac* was lowest against pink bollworm populations of Jalna (0.034  $\mu\text{g}$  /ml of diet) and Mansa (0.049  $\mu\text{g}$  /ml of diet). The highest  $LC_{50}$  of *Cry1Ac* was recorded on pink bollworm populations of Khandwa (0.204  $\mu\text{g}$  *cry1Ac* /ml of diet), Amreli (0.101  $\mu\text{g}$  *cry1Ac* /ml of diet) and Akola (0.11  $\mu\text{g}$  *cry1Ac*/ml of diet).
- Pink bollworm populations of Faridkot (0.05  $\mu\text{g}$  *cry2Ab*/ml of diet) followed by Ahmednagar (0.06  $\mu\text{g}$ /ml of diet), Mansa (0.07  $\mu\text{g}$ /ml of diet) and Sirsa (0.074  $\mu\text{g}$  *cry2Ab*/ml of diet) were most susceptible to *Cry2Ab* while populations from Khandwa (0.67  $\mu\text{g}$  *cry2Ab* /ml of diet) were most resistant.
- Forty four per cent survival was recorded with 10 ppm *Cry2Ab* in  $F_1$  population of pink bollworm derived from Bollgard-II in Bharuch. Population of pink bollworm collected on NBt from Surat, Anand, Amreli and Junagadh showed poor mortality with 10 ppm *Cry2Ab* as compared to the susceptible strain.

### Novel Genes

- The combination of CICR-fusion protein (CICR truncated *Cry1Ac* and CICR *Cry2Ab*) with chitinase not only resulted in higher mortality and growth regulation but also caused mortality 48 h earlier than fusion alone. Combination of genes of CICR fusion protein and CICR chitinase is different and effective against *H. armigera*.
- Molecular characterization of four root knot nematode *Meloidogyne incognita* populations using rDNA sequences, the large subunit, small subunit and the internal transcribed spacer regions (ITS) was carried out. Sequence analysis confirmed the identity of *Meloidogyne incognita* species from Nagpur, Wardha, Yavatmal, Chandrapur populations.

### Endophytes and endosymbiots

- Based on 16S rRNA amplification and sequencing results, jassids from across India were found to harbor the bacterial endosymbiont, *Delftia acidovorans*.
- Forty seven fungal cultures and seventeen bacterial cultures were isolated as endophytes from cotton. Based on their virulence against *Pectinophora gossypiella*, *Spodoptera litura*, *Aphis gossypii*, and *Paracoccus marginatus*, nine bacterial and twelve fungal endophytes were selected for further studies.

### Non-compliance of refugia guidelines

- From the commercial seed packets procured from market, non Bt seeds provided as refuge were tested for the presence of Bt. Out of 91 samples tested, 21 packets from 13 companies, carried Bt seeds in refuge packet in addition to non Bt seeds.

### Pest and disease management

- Combination of cow urine and calcium nitrate showed significantly lowest CLCuD incidence followed by neem oil, cow urine+whey protein, cow urine alone, all five interventions in combination and kresoxim methyl+ whey protein.



- Maximum per cent reduction in whitefly population was observed with insecticide Diafenthiuron (59.6%) and Triazophos 40EC (49.2%) followed by Flonicamid 50%WG (48.8%) and Neemazal-T/S, 1%EC (44.8%).

### Yield modelling

- $\beta$  version of the ICAR-CICR yield prediction model has been developed using yield responsive factor. The CICR calculator helps determine the cotton crop yield by selecting a set of input parameters. Parameters such as rainfall, temperature, depth of soil, sowing time, solar radiation, sucking pest, bollworm and water logging are the main input factors used by the software.

### Dissemination of pest management strategies

- Cotton pest management strategies were disseminated through ICT tools as one of the stakeholders in Crop Pest Surveillance and Advisory Project (CROPSAP) 2014-15 in 28 districts of Maharashtra and through online pest monitoring and advisory services in Sirsa and Fatehabad districts of Haryana.
- NFSM-IRM-HDPS programme was implemented in 11 states covering 5925 ha with involvement of 5568 farmers. The HDPS module was demonstrated on 1096 ha in 131 villages of the 11 cotton growing states with the involvement of 1750 farmers.

### Varieties identified for release during 2014-15

#### CSH 3129

*G. hirsutum* culture CSH-3129 has been identified for release in irrigated north zone. It has recorded an overall mean seed cotton yield of 2293 kg/ha against 1935 kg/ha and 2068 kg/ha of zonal and local checks respectively. The increase in seed cotton yield of this culture over the Zonal check was 18.5 per cent. The culture has 29.5 mm span fibre length and fibre strength of 23.55 g/tex. CSH-3129 is spinnable at 40s count. The culture is tolerant to cotton leaf curl virus disease.



#### CCH 2623

The medium staple *G. hirsutum* culture CCH 2623 has been identified for release in southern states under irrigated conditions. The culture recorded a mean seed cotton yield of 1798 kg/ha as against 1589 recorded in the Zonal check variety of Surabhi with 17.0 per cent yield increase. The fibre quality of the culture is characterized by 27.2 mm of 2.5% span length, 4.5 micronaire and 21.3 g/tex of bundle strength.

