

3. RESEARCH ACHIEVEMENTS

Theme1: Cotton Genetic Resources and Pre-breeding

1.1 Project name: Harnessing the potential of wild and unadapted germplasm for cotton improvement

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Importance of the study: Wild species of *Gossypium* are the reservoir of many useful genes governing different economic traits including lint yield, fibre quality and resistance to biotic and abiotic stress. In view of narrow genetic base of cultivated cotton, the available wild species, races of cultivated species and synthetic polyploids of *Gossypium* are conserved and utilized in introgression breeding to broaden the genetic base and to create newer genetic variations for various traits of interest.

Salient findings

Conservation of wild and unadapted germplasm: A total of 24 wild species, 15 races of cultivated species and more than 45 synthetic polyploids are conserved in the 'wild species garden' at ICAR-CICR, Nagpur. A new species *G. nelsonii* Fryx established through embryo culture was hardened and established in the green house (Fig 1.1.1) for its further utilization in inter-specific hybridization. The plants of *G.anomalum*, *G. triphyllum*, *G. capitis viridis*, *G. thuberi*, *G. armourianum*, *G. davidsonii*, *G. raimondii*, *G. trilobum*, *G. stocksii*, *G. somalense*, *G. longicalyx*, *G.nelsonii* Fryx, *G. barbasonum* established from seeds /cuttings collected from different sources were confirmed through morphological characterization.



Fig 1.1.1: *G. nelsonii* plant established in the greenhouse

Inter-specific hybridization: A total of 1165 new crosses were attempted using wild species namely *G. longicalyx*, *G. somalense*, *G.*

anomalum, *G. capitis virides*, *G. australe*, *G. thurberi*, *G. raimondii*, *G. barbasonum*, *G. triphyllum*, *G. klotzchianum*, and *G. mexicanum*.

Evaluation of advanced generations: Plant to row progenies (F₅ generation) of the crosses viz., *G. arboreum* x *G. longicalyx*; *G. arboreum* race indicum x *G. davidsonii*; *G. arboreum* x *G. thurberi* and AK 8401 x *G. davidsonii* were evaluated for yield, fibre quality and resistance to pests and diseases.

Confirmation of hybridity of interspecific crosses through SSR markers : The SSR markers polymorphic between parental lines of 26 inter-specific crosses were identified for confirmation of hybridity. These crosses involved following wild and cultivated species of cotton viz., *G. arboreum* (Race Indicum - A₁), *G. arboreum* (Race Burmanicum - A₂), *G. arboreum* (Race Bengalense - A₃), *G. arboreum* (Race Cernuum - A₄), *G. arboreum* (Race Sinense - A₅), *G. arboreum* (Race Soudanense - A₆), *G. anomolum* (B₁), *G. barbosanum* (B₃), *G. capitis virides* (B₄), *G. aridum* (D₄), *G. stocksii* (E₁), *G. longicalyx* (F₁), *G. hirsutum* cv. H777, *G. arboreum* cv. Jawahar Tapti, *G. hirsutum* cv. JK4, *G. hirsutum* cv. Anjali, *G. hirsutum* cv. MCU5, *G. hirsutum* NISC261, *G. hirsutum* Race Palmeri, *G.*

arboreum cv. Roja, PA 255 and *G. herbaceum* cv. Digvijay.

Evaluation of introgressed derivatives for resistance to pests and diseases: Evaluation revealed that the population of *H. armigera*, Whitefly and Aphids was below ETL. For natural enemies of the pests, the average number of lady bird beetle/plant ranged from 0.0-2.0 and average number of spider /plant were ranged from 1.0-3.0. During the crop season, periodical observations were recorded on the incidence of diseases. Grey mildew and *Corynespora* leaf spot were the major diseases whereas bacterial blight and root rot were negligible on introgressed derivatives. *G. arboreum* race Cernuum (19025) was free from grey mildew disease.

Colour cotton: Naturally brown colour cotton lint samples were analyzed for their colour parameters and fibre properties using standard procedures at ICAR-CIRCOT. Fibre properties of some promising derivatives are listed in Table 1.1.1:

Table 1.1.1: Fibre properties of coloured cotton samples (HVI mode)

S No	Sample No	UHML (mm)	Tenacity (g/tex)	Micronaire (µg/inch)	Elongation %	Uniformity Index
1	CICR-17405 LB	29.6	25.5	3.3	5.3	86
2	CICR-17441 LB	28.9	26.9	4.3	6.3	86
3	CICR-17492 LB	28.8	26.3	3.5	5.8	85
4	CICR-17406 LB	28.3	26.2	3.2	5.3	86
5	CICR-17417 LB	27.5	24.7	3.3	5.6	86
6	CICR-17493 LB	27.4	25.8	3.9	5.4	84
7	CICR-17452 LB	26.6	28.6	4.6	4.5	84
8	CICR-17493 LB	27.4	25.8	3.9	5.4	84
9	CICR-17521 LB Arb	25.9	21.8	4.1	6.5	82
10	CICR-17522 LB Arb	24.9	21.6	4.2	5.8	79

1.2 Project name: Collection, conservation, evaluation, documentation and maintenance of germplasm of cultivated species of Gossypium

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Rameash, Dr. A. Manivannan, Dr. P. Valarmathi, Dr. Rishi Kumar, Dr. Debashis Paul, Dr. S. K. Sain, Dr. Anjali Kak (ICAR-NBPGR, New Delhi)

Importance of the study: The ICAR-CICR has been entrusted with the responsibility to plan, conduct, promote, coordinate the collection, characterization, evaluation, conservation, exchange, documentation and sustainable management of diverse germplasm of cotton and its storage (ex-situ at 5°C temp and 35% RH) with a view to ensure its maintenance and making them

available to researchers for cotton improvement programmes.

Salient findings

Status of cotton germplasm: ICAR-CICR, Nagpur maintains one of the largest cotton germplasm collections of the world with more than 12,335 accessions covering all the cultivated species, wild species, interspecific derivatives, perennials and landraces of *Gossypium* (Table 1.2.1). The *G. barbadense* germplasm lines (536) are being maintained at ICAR-CICR Regional Station, Coimbatore.

Table 1.2.1: Status of germplasm collections at ICAR-CICR, Nagpur

Species	Base Collection
<i>G. hirsutum</i>	8851
<i>G. barbadense</i>	536
<i>G. arboreum</i>	2053
<i>G. herbaceum</i>	565
Wild Species	24
Interspecific Derivatives	40
Perennials and land races	254
Races and derivatives of cultivated species	12
Total Collection	12335

Enrichment and evaluation of cotton genetic stocks: A total of 139 accessions [89 *G. barbadense*, 28 GMS Lines, 2 CMS Lines, 14 Maintainer Lines (B Lines) and 06 Restorer Lines] were deposited in Medium Term Storage (MTS). The harvested seed of imported exotic cotton germplasm shall be further multiplied in the field during coming *kharif* season, whereas *G. barbadense* lines are rejuvenated at ICAR-CICR Regional Station, Coimbatore.

Multiplication and characterization of germplasm: Sixty nine (69) germplasm of *desi* cotton collected from different states of North Eastern Hill Region (NEH Region) were characterized and evaluated. Forty Eight (48) germplasm consisting of *G. hirsutum*, *G. arboreum* and wild species were distributed to

breeders/ scientists of CICR, State Agricultural Universities and Private Seed Companies for utilization in their cotton improvement programme. Exotic cotton germplasm was evaluated in glass house for post entry quarantine pest, *Xanthomonas campestris* var. *malvacearum* (Fig.1.2.2).

Characterization of the primitive cultivars of cotton from Sundarbans of West Bengal

ICAR-CICR in collaboration with ICAR-NBPGR, New Delhi explored Sundarban region of West Bengal and collected 39 primitive cultivars and tree cotton of *G. hirsutum* and *G. barbadense*. These lines were characterized using 11 polymorphic SSR markers and were grouped into 7 clusters (Fig 1.2.1) using DARwin statistical package.

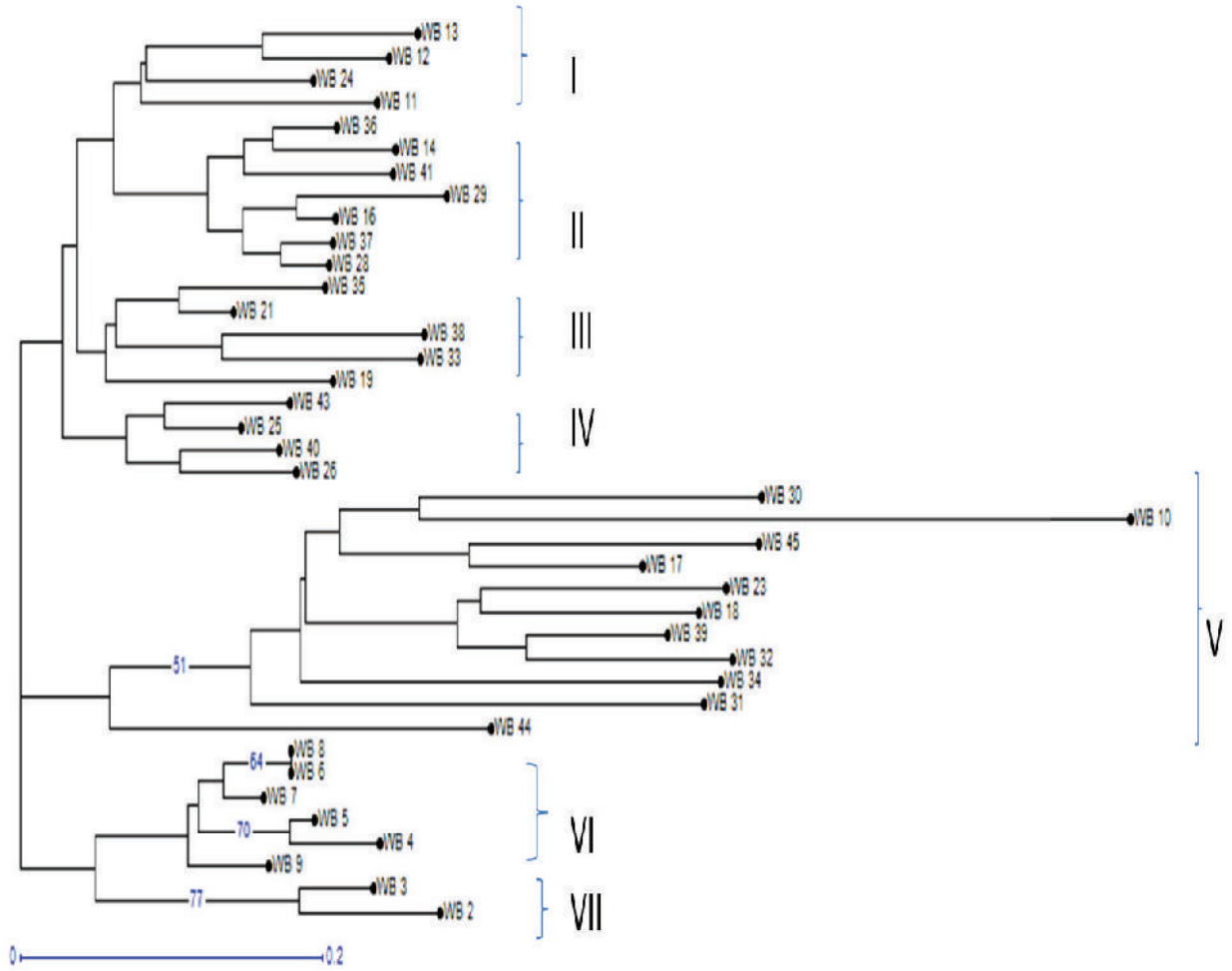


Fig.1.2.1: Molecular characterization of *G. hirsutum* and *G. barbadense* accessions of Sundarban region of West Bengal

Registration of genetic Stocks and Evaluation of cultures under ICAR-AICRP trials: One *G. barbadense* line CCB-12 was identified for the registration with ICAR-NBPGR, New Delhi for its cleistogamous nature of flower as unique trait. A field trial was conducted at ICAR-CICR, Nagpur, MPKV, Rahuri and CICR Regional Station, Sirsa for expression of a cleistogamous nature of *G. barbadense* mutant No.CCB-12. It has been proposed for germplasm registration with ICAR-NBPGR, New Delhi.

Evaluation of hairy lines of *Gossypium barbadense*: Among the single plant progenies of ten (H1 to H10) promising cross combination, ICB-124 × Suvin and ICB- 264 × Suvin exhibited high seed cotton yield, which are moderately resistant to jassids.

Evaluation of new exotic collection of *G. barbadense*: A total of 207 exotic collection of *G. barbadense* (Fig.1.2.3) is being evaluated in this crop season.



Fig.1.2.2: Exotic cotton germplasm evaluated in glass house for post entry quarantine pest, *Xanthomonas campestris* var. *malvoacearum*



EC-1

EC-5

Fig.1.2.3: Evaluation of new *G. barbadense* germplasm entries.

1.3 Project name: Development of cotton leaf curl virus resistant genotypes using *G. arboreum* / *G. herbaceum* through introgression

Name of PI & Co-PIs: Dr. S. K. Verma (PI); Co-PI's: Dr. V. N. Waghmare, Dr. S. M. Palve, Mr. Rakesh Kumar

Importance of the study: Cotton leaf curl virus (CLCV) is one of the most important diseases in North India affecting cotton productivity. The cultivated *G. arboreum* is considered immune to CLCV and therefore, it was targeted for introgressing genes for CLCV resistance to *G. hirsutum* to eventually develop high yielding, CLCV resistant and whitefly tolerant *G. hirsutum* genotypes.

Salient findings

One inter-specific hybrid (*G. hirsutum* × *G. arboreum*) plant was established at ICAR-CICR, Nagpur (Fig.1.3.1) through embryo rescue technique. Colchicine treatment (0.5% & 1.0%) of *G. arboreum* was attempted. Crosses attempted between CSH3075, CSH3129 and F2228 with colchicine treated *armourianum*.

plants. More than 3000 crosses were attempted using CSH3129 (tetraploid) as female parent and diploid *G. arboreum* genotypes CISA310, CISA614 & LD327 as male parent. Less than 1% seed setting was observed. While, using CSH3075 as female parent and CISA614 as male parent, more than 200 crosses were attempted. *G. hirsutum* lines *viz.*, CSH3129, CSH3075 were crossed with BC1F1 plants of F1861 × *G.*



Fig.1.3.1: Interspecific hybrid (*G. hirsutum* × *G. arboreum*)