3. Introduction

3.1 Briefhistory

Nagpur

Indian Central Cotton Committee used to sponsor cotton research schemes on an adhoc basis till the work of the committee was taken over by the ICAR in 1966. All India Coordinated Cotton Improvement Project (AICCIP) initiated by the Council in the year 1967 with headquarters at Coimbatore gave new fillip and direction in terms of multi-disciplinary and multi-centre approaches with the active involvement of State Agricultural Universities. The project has contributed significantly in tackling location-specific problems in terms of varietal improvement and development of appropriate production and protection technologies. However, looking to the low level of productivity which is primarily due to the fact that the major cotton growing area is under rainfed conditions and the need for expanding the research efforts in the spheres of basic and fundamental research, the Central Institute for Cotton Research was established at Nagpur by the ICAR, in 1976. The two regional stations of IAR! at Sirsa (Haryana) and Coimbatore (Tamil Nadu) were transferred to CICR to cater to the needs of cotton farming in north and south India, respectively.

The main mission of CICR is to increase the production, productivity and profitability of cotton cultivation in different agro-ecological cotton growing zones through the development of relevant, feasible and economically viable and ecologically friendly production and protection technologies including the development of improved varieties and hybrids and promoting basic and strategic research.

3.2 Summarized Last Five Years (X Plan) Achievements

Genetic Resources

- 3518 collections have been added to the cotton gene-pool in G. *hirsutum.*
- 5520 accessions have been kept in Long term and Medium Term Storage.
- Five genotypes of G. *hirsutum* and two genotypes of G. *arboreum* with unique characters have been registered with NBPGR.
- Triploid hybrids have been developed between cultivated G. *hirsutum* and wild diploid G. *armourianum* and the hybridity was confirmed through RAPD analysis.

Release ofimproved varieties/hybrids

- CSHH 198 (Shresht) an *intra-hirsutum* hybrid high yielding medium staple, resistant to CLCuV was developed and released for cultivation in North zone in 2004.
- CISAA 2 *intra-arboreum* GMS based hybrid was released for North zone in 2004.
- CSHH 238 and CSHH 243 *intra-hirsutum* hybrids have been developed and identified for release in north zone in 2006.
- CINA 316 *(G. arboreum)* for superior fibre quality traits was identified for agronomical trial.
- Other G. *arboreum* cultures (CINA 333,CINA 334, CINA 343 and CINA 344) were identified for superior fibre quality traits as long staple.
- Several lines possessing resistance to grey mildew, alternaria leaf spot or bacterial leaf blight like CCH 4, GMR 5, CBR20, CBR 22 etc. were developed.

Development of Transgenic Cotton

- Three cotton genotypes viz. LRA 5166, Anjali and RG 8 containing three Bt genes viz. *cry* 1 Ac, *cry* 1 Aa3 and *cry* 1 F have been developed and tested in the RCGM trial during 2006-07 crop season.

Cytoplasmic and Genetic male sterility

- Under the Diversification and utilization of male sterility system, 82 genotypes were converted under CMS background, 66 genotypes were converted under GMS background. 12 GMS based hybrids were found to be promising in AICCIP trials.

Seed Technology

- Foliar spray of 1% $MgS0_4$ was found to improve seed quality.
- Under DUS testing project, about 107 cultivars have been characterized morphologically as per DUS testing guidelines.

Crop Modeling

- A crop model for cotton based on INFO CROP was developed to assess cotton area and production utilizing remote sensed data and GIS (weather and soil data).

Integrated Nutrient Management (INM)/package of practices

- INM module inclusive of temperature tolerant

PGPRs were tested under rainfed and irrigated conditions and were found to improve yields and reduced costs. Cotton-pigeonpea strip cropping recorded 15% improvement in yield with bio-fertilizers (Rbi, Azt, Asp., PSB) seed treatment.. Supplemental irrigations (two) at flowering stage, improved yield by 25-35%.

Integrated Crop Management (Southern Zone)

- Drip fertigation saved 50% water and 25% fertilizer compared to conventional practices.
- Paired row technique with drip and cowpea intercrop resulted in 50% saving of laterals cost for drip system in addition to additional income through cowpea and effective weed control..
- Pink pigmented facultative methylotroph (PPFM) isolated from cotton phyllosphere improved vigour index of cotton.
- Growing cotton under polymulch enhanced seed cotton yield by 2.3 fold besides 40% water saving and complete control of weeds.
- Maize, when grown as a rotation crop after cotton in the same polymulch sheet with zero tillage, gave 2.78 tonnes/ha of additional yield than conventional system.
- To reduce the cost of drip irrigation system, poly-tube laterals (600 gauge) were used, which was found to give maximum gross return (RsA 7951/ha), net return (Rs.17151/ha) and benefit cost ratio (1,56).
- Multitier intercropping of radish and amaranthus planted between cotton rows under normal planting method registered the higher gross return (99%), net return (252%), benefit cost ratio (81%) and seed cotton equivalent yield (99%) than sole cotton crop.
- Combined application of FYM @ 5 t/ha, cotton whole residues@2.5 t/ha and sunhemp seeded@ 15 kg/ha in inter-rows as GM (buried at 45 DAP) produced significantly higher seed cotton yield.

Reduction in cost of production of cotton by increased productivity and efficient use of resources

- With the use of Bio-fertilizers as seed treatment and Foliar sprays of urea 2% in shallow and medium soils, *desi,* American and hybrid cottons recorded higher yields by 10-15% with higher B:C ratios.
- Deep ploughing once in two years before cotton sowing was found effective in increasing the yield of irrigated cotton by 6-7 q ha'! over control..
- The incorporation of cotton stalk and wheat residue in the soil enhanced seed cotton yield by about 5 q ha'! and wheat yield by 10-15 q ha'! over control respectivel y.

Development of machineries suited to small scale cotton production for increased resource use efficiency

- Bullock drawn planter developed can do planting @ 0.2 to 0.5 ha/hr compared to the requirement of 12-20 females for six hours. It has been commercialized.
- Different Nozzles were evaluated for uniform droplet size generation and reduction in pesticide losses due to drift..
- A tractor drawn cotton stalk puller prototype has been developed.

Assessment, refinement and reintroduction of selected cotton technologies

- Three technologies viz. integrated pest management in cotton, introduction of CICR Planter, Insecticide application and *in-situ* moisture conservation in cotton were assessed and found suitable. Under rainfed situations shallow soils were found suitable for cultivation of varieties and deeper soils (>60 cm deep) were found suitable for hybrid cotton cultivation.

Integrated Pest Management (IPM)

- IPM module/packages were developed for insect pest and disease management.. 50 on farm trials conducted to validate the IPM components. IPM polyclinics were established at village level and the package along with Bt cotton were implemented.
- Additionally entomopathogenic nematode bacterial symbionts were recorded as a new management option for management of sucking pests. A new culture media incorporating animal fat has been developed which gives higher production of EPN population having infectivity against cotton bollworm larva for large scale field application.

Management of Stem Weevil *(Pempherulus affinis* Faust)

- Several management strategies have been evolved to control the stem weevil incidence including:

- Application ofNeemcake (150 kg/ha) + Carbofuran (1.0 kg a.i/ha) at 15-20 days after sowing (DAS). Stem drenching with Neem seed extract 5% from 45 DAS,4 times at weekly interval or drenching with Chlorpyriphos 0.1 %,4 times at weekly interval from 45DAS.

Chemical control of pests and diseases

- Several broad spectrum fungicides belonging to the Triazole group viz., Propiconazole, Cyproconazole, Hexaconazole and Benzothiadiazole have been found effective in the contol of both grey mildew and alternaria leaf spot diseases.
- Spraying of carbendazim 50WP at 35,50,65,80 and 95 DAS reduced the grey mildew incidence to the extent of 19.44 per cent and increased the seed cotton yield to 33.5 per cent when compared to the check (50.00% and 1313 kg/ha).

Biological control

- Spraying of 0.2 per cent *Trichoderma harzianum* or *Pseudomonas jluorescens* at 10 day intervals reduced the grey mildew incidence (13 to 14%).

Biochemical mechanism of resistance to bollworms of cotton

- Squares of Bollworm tolerant genotypes possessed lesser protein, sugars and higher levels of secondary metabolites like condensed tannin, gossypol and phenolics as compared to susceptible cultivars.

Developmental biochemistry of cotton pest/disease interaction

- Seed dressing insecticides imidacloprid and chlothianidine helped in better metabolic status of cotton seedlings due to enhanced peroxidase, acid and alkaline phosphatase activities.
- Variation seen in Polyphenol oxidase, Superoxide dismutase and Catalase enzymes during interaction of cotton genotypes with isolates of grey mildew is useful in diagnostic tool development.
- G. *herbaceum* genotypes (RAHS 14 & G.Cot 21) and *desi* hybrids (G.Cot DH 7 & G.Cot DH 9) have been identified with yielding ability of 15-20 q/ha and better adaptability to adverse situations in coastal areas of the country.

Pest and disease warning system

- Forewarning models for *H. armigera* and *P gossypiella* were developed.

Basic studies on insecticide and Bt resistance

- Basic studies on insecticide and Bt resistance have lead to the development of rapid diagnostic kits to detect *cry 1* Ac and they have been commercialized. The genetics of *cry1Ac* in *H. armigera* was elucidated through crosses. Two isozymes identified played a key role in resistance to carbamates and organophosphates. Rapid detection kits and ELISA methods were developed to detect fake insecticides and Bt formulations. A simple resistance detection bioassay method was developed using Bt cotton seed. BtAdapt stochastic model was developed.
- A stochastic model Bt-Adapt-II to predict resistance development pyramid toxins (dual gene) Bt cotton was developed.
- Eleven kits to detect resistance to pyrethroids, endosulfan and methomyl were developed which include 4 SCAR markers, 3 ELISA kits, 2 dot-blot and 2 immunochromatographic dip-sticks. The immunochromatographic kits were distributed to entomologists of State Agricultural Universities for field validation.
- Resistant strains selected with crylAc exhibited a broad spectrum resistance, to a variable degree, to almost all the Cry 1 toxins tested but showed an unchanged susceptibility pattern to *cry2Ab*. A near-isogenic *cry* lAc-line exhibited some amount of cross resistance to *cry2Ab*. Joint toxic action studies indicated that none of the Cryl toxin combinations displayed any significant synergism.

Development of diagnostic tools for differentiation of biotypes/races of *Ramularia areola* and *Fusarium oxysporum* f.sp. *vasinfectum*

- Standardized the media and methods for isolation of grey mildew pathogen *R. areola* for its maximum growth.
- Standardised the protocol for the DNA isolation.
- Seventeen cultures of *Fusarium oxysporum* f.sp. *vasinfectum* were isolated from different cotton growing areas.
- The pathogen *R. areola* was successfully cultured with the method of inoculation of healthy leaftissue.

Development of detection kits

- Bt detection kits: Three kits namely: Bt-Zygosity, Bt-Express-II and Bt-Elisa II were developed and commercialized. This led to recognition of the

Institute and a 'Bt Referral Lab' was opened by Government ofIndia.

- Kits to detect quality of spurious insecticides formulations: Eight kits, which include ELISA as well as dip-stick to test the quality and residue of pyrethroids and endosulfan were developed.

Assessment, refinement and reintroduction of selected cotton technologies

- IRM programme was implemented in 1,70,816 ha involving 46,431 farmers in 565 villages of 26 districts in 11 states during 2005-06. The project aims to establish sustainable cotton pest management systems in India that lead to the overall reduction of insecticide resistance and enhance the pest control efficacy of the recommended molecules.

3.3

MANDATE

- **To conduct basic and strategic research on cotton to improve yield, fibre quality and by-products.**
- **To create new genetic variability for location-specific adoption in cotton-based cropping systems.**
- **To assist in the transfer of modern cotton production technology to various user agencies.**
- **To extend consultancy and link with international agencies to accomplish the above mandate.**

3.4 Financial Statement

The budget grant and actual expenditure for the year 2006-07 are furnished below:

Budget Sanctioned and Expenditure

Scheme	Sanctioned	Expenditure
1. Plan	135.00	135.00
2. Non-Plan	995.00	988.98
PLAN SCHEME		
3. NSP Crop	001.57	000.06
4. AICCIP	483.00	483.00
5. KVK Scheme	040.40	39.35
6. TMCMMI	400.00	400.00
7. MSP	141.60	116.37
APCESSFUND		
8. Bt. Resistance	17.99	17.78
R DEPOSIT SCHEME		
9. DBT Scheme (DST)	4.56	4.56
10. DST Scheme (Race-18)	3.99	3.99
11. EPS & C (De Nocil)	3.98	1,31
12. FLD in Cotton	61.00	59.76
13. DBT Bt Cellules	7.20	0.21
14. FLD KVK	2.19	0.64
15. DDS Scheme Ngp	-	7.56
16. DDS Cbe	-	16,44
17. Maintenance of Breeder Seed	59.95	56.73
18. DBT (QTLS)	-	3.32
19. TMC MM II	326.28	325.91
20. Bt. Resistance Monitoring (Mahyco) I	8.80	1,41
21. Bt. Resistance Monitoring (Mahyco) II	11,03	1,84
22. Bt. Tech	53.78	15.74
23. Transgenic Crops	46.85	46.85

3.5 Staff Position (As on 31 March 2007)

Name of Post	Sanctioned cadre Strength				Post Filled Up			
	NGP	CBE	Sirsa	Total	NGP	CBE	Sirsa	Total
Director (RMP)	1	-	-	1	1	-	-	1
P.c. & Head	-	1	-	1	-	-	-	-
Scientific	54	26	5	**85**	37	19	6	**61**
Technical	50	23	8	**81**	46	22	8	**76**
Administrative	33	10	6	**49**	28	8	5	**41**
Supporting	65	34	12	**111**	62	34	12	**108**
KRISm VIGYAN KENDRA								
Training Organiser	1	-	-	1	1	-	-	1
Technical	8	-	-	8	8	-	-	8
Administrative	2	-	-	2	2	-	-	2
Supporting	2	-	-	2	1	-	-	1

NGP Nagpur; CBE - Coimbatore

ORGANOGRAM OF CICR