Main building

Agricultural Technology Information Centre

Krishi Vigyan Kendra

Bio-control Laboratory


# वार्षिक रिपोर्ट

# Annual Report

# 2001-2002

**Central Institute for Cotton Research**

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Nagpur – 440010 (Maharashtra), India


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## Correct Citation
CICR, Annual Report 2001-2002
Central Institute for Cotton Research , Nagpur, India
PP. 136

## Photography
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Printed at : Surya offset, Ramdashpeth, Nagpur


**Cover:**

*Front :* Detection and Monitoring of Bt toxin expression in Bt-cotton through the use of detection kits (Bt-Express, Cry 1Ac Bt-Quant, Bt-detect) developed by CICR.

*Back :* Illuminated buildings/Laboratory of CICR during the Silver Jubilee celebrations

# PREFACE

Cotton as a crop as well as a commodity plays an important role in the agrarian and industrial activities of the nation and has a unique place in the economy of our country. Inspite of the fact that cotton cultivation has a long historical back-ground in our country, the production and productivity are much lower as compared to many other countries . To over come the limitations that cause the low productivity and to improve the quality under varied conditions through basic and strategic research, Central Institute for Cotton Research was established in the year 1976 with headquarters at Nagpur and regional stations at Coimbatore and Sirsa. This institute has completed 25 years of its existence and celebrated the year 2001-02 as the silver jubilee year.

During the past 25 years this institute has made significant contributions in the field of genetic improvement, production and protection technologies which has contributed immensely in improving the cotton productivity and fibre quality across the three major cotton growing zones of the country. This Institute has evolved and released nine varieties of *G.hirsutum* and six hybrids having varied quality norms and some of the them have become extremely popular with farming community. In the field of production technology – packages for Organic Cotton Cultivation, Rainwater Harvesting and Recycling, Integrated Nutrient Management, Cropping systems and Tillage and Residue Management were developed and demonstrated. To mitigate the onslaught of pests in cotton, IPM technologies were evolved, fine-tuned and location specific modules were perfected and demonstrated. To combat the insecticidal resistance development in the major pests of cotton, CICR has made significant contributions not only in identifying the mechanisms of resistance buildup but also evolved means to manage the resistance through integrated resistance management systems. Effective diagnostic tools were developed to detect the resistance at the field level. This institute is considered as one of the leading centres for IRM studies in the world. Integrated Disease Management strategies were evolved in addition to the conduct of basic studies on major cotton diseases including the Leaf Curl Virus. In depth basic studies were conducted on varied abiotic stresses including drought, salinity, water-logging, $CO_2$ enrichment and some lines with tolerance to these stresses were identified. Considerable progress was made by this institute during the decade in the development of transgenic cotton with Bt gene. Excellent facilities for advanced studies in

molecular biology were created and few transgenic cultivars were developed in *G.hirsutum* and *G.arboreum* and are in advanced stages of testing. Through the implementation of Lab to land programme, Front Line demonstrations, IPM/ IRM demonstrations, Seed village and KVK the latest technologies were effectively disseminated to the farming community.

During this year the institute has developed three diagnostic kits namely, Cry 1 Ac Bt. Detect, Cry 1 Ac Bt. Express, Cry 1 Ac Bt. Quant for rapid detection of Bt toxin expression. CICR has been identified by the GEAC (DST) as the nodal agency to detect and monitor changes in baseline toxicity and development of resistance in bollworm to Bt. cotton.

As the nodal agency for the implementation of TMC MM-I programme, more than 28 projects were executed in many centres all over the country and the entire programme was effectively coordinated and monitored by the Institute. Considerable progress was recorded in respect of quality diploid cotton development, introgressive breeding and many other aspects. The institute scientists were involved in many projects under different modes of NATP. Under TMC and NATP Institute infrastructure has been upscaled considerably which is likely to provide an impetus and enhance the capabilities for the future research efforts at the institute.

Through the intensive efforts under way and likely to be initiated in the coming years at CICR and in the NARS it is hoped that our country will be able to withstand the pressures of globalisation and liberalisation with specific reference to cotton R&D scenario much more effectively which in turn will enable the realisation of the targets set for the next decade in respect of quality and productivity.

This has been made possible by the untiring efforts of my colleagues and also due to the support and guidance received from the ICAR headquarters.

I am presenting the Annual Report 2001-2002 with pride, which gives a glimpse of our activities.

**C D Mayee**
Director

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# Introduction

## Brief history with summary of past achievements

At the dawn of independence, the erstwhile 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. To further cotton research efforts in the country, an All India Coordinated Cotton Improvement Project (AICCIP) was initiated by the Council in the year 1967. The establishment of AICCIP with headquarters at Coimbatore gave new fillip and direction in terms of multidisciplinary and multi-centre approaches in all the three cotton zones of the country 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 major cotton growing area being 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 in the year 1976 by the ICAR. The erstwhile Regional Station of IARI at Coimbatore (Tamil Nadu) became a part of CICR simultaneously to cater to the needs of southern cotton zone. In the year 1985, the IARI Regional Station at Sirsa (Haryana) was transferred to CICR as a regional centre for the northern irrigated cotton zone.

## Summarized Past Achievements

The main mission of CICR is to improve the production, productivity and profitability of cotton cultivation in all the distinctly different agro-ecological cotton growing zones of the country 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 fundamental research pursuits in all the disciplines to further our understanding of the crop *vis-a-vis* the ambient biotic and abiotic environment.

The past achievements of the Institute are summarized below :

- The Institute has released nine varieties of *G.hirsutum* , four intra-*hirsutum* hybrids and two *hirsutum* x *barbadense* (inter-specific) hybrids. The details are given below.

***G.hirsutum***

- o MCU5-VT-Verticillium wilt tolerant- 60s counts
- o LRA 5166-Drought tolerant and adaptable to different agro-climatic conditions- 30s-40s counts
- o Supriya-Whitefly tolerant- 40s-50s counts
- o Kanchana-Whitefly tolerant- 40s counts
- o LRK 516 (Anjali)-Early maturing, compact and semidwarf, suited for closer spacing.
- o CNH 36- Dwarf early maturing- 40s counts
- o Arogya-Bacterial blight immune-12s counts
- o Surabhi-Verticillium tolerant, extra long staple, high yielding than MCU 5VT- 55s counts
- o Sumangala – Medium staple quality with a ginning outturn of 38 per cent
- o CNH 120 MB – High yielding, medium

staple, early maturing

**Intra-specific hybrid (intra-*hirsutum*)**

- o Savita - hybrid of MCU 5 quality- 60s counts
- o CICR HH1- Early maturing hybrid- 40s counts
- o TM 1312 (Surya)- Presence of genetic marker character- 50s-60s counts
- o Om-Shankar- Early maturing, high yielding hybrid- 30s-40s counts

**Interspecific hybrid (*G.hirsutum x G.barbadense*)**

- o HB 224- Extra long staple hybrid- 80s counts
- o Shruthi- Compact, short duration hybrid

- A rich repository of cotton germplasm with more than 9700 accessions of all the four cultivated species of cotton has been established. It contains *G.hirsutum* 5900, *G.barbadense* 750, *G.arboreum* 1750, *G.herbaceum* 450, 300 accessions including 24 wild species, 14 races, perennials, inter-specific hybrids, synthetic polyploids.
- Three germplasm lines of *G.arboreum*, G-135-49 of race *bengalense* and 30805 and 30838 of race *cernuum* were registered with NBPGR, New Delhi. These lines are immune to grey mildew disease (*Ramularia areola* Atk.) of cotton.
- The ideal crossing period was identified for hybrid seed production with respect to higher yield and superior seed quality under different agro climatic conditions.
- Agrobacterium mediated transformation was successful in LRK 516 with Cry 1A(b) gene. Two regeneration protocols from shoot tip and cotyledon for *G.hirsutum* and *G.arboreum* cotton cultivars were standardized.
- The regeneration protocols for multiple shoot induction from meristematic tissues were standardised in cotton.
- SDS PAGE analysis of protein and isozyme studies were done for characterization of hybrids and varieties and also as markers studies.
- DNA finger printing of germplasm and wild species provide valuable information on cotton traits.
- Comprehensive production technologies were developed to improve the resource use efficiency under different cotton based cropping systems viz., mono-cropping, organic cotton, cotton-wheat double cropping and inter-cropping with green gram, black gram, soybean, onion, chillies etc.,
- Integrated nutrient management techniques were standardized for sustainable cotton production in rainfed and irrigated vertisols using a combination of inorganic and organic sources, to minimize nutrient losses.
- Water management techniques including *in-situ* moisture conservation, water harvesting and recycling using micro irrigation techniques like drip and sprinklers were perfected.
- Minimum tillage plot were significantly better than conventional tillage plot in terms of lower weed density, higher dry matter, greater soil microbial biomass and micro fauna.
- A two row bullock drawn planter was developed for sowing cotton in vertisols at 60 x 60, 60 x 30 and 60 x 90 and 60 x 120 cm.
- Physiological shedding of fruiting parts had positive association with flower production and negative relationship with stomatal resistance under rainfed condition.
- Delay in planting dates enhanced physiological shedding of fruiting parts. Shedding of buds and bolls under cloudy conditions was considerably reduced by alternate application of 10 ppm NAA and 1% DAP.
- *Desi* cottons are found more tolerant to salinity.
- Elaborate IPM strategies have been evolved to reduce insecticides application and make cotton production more environmental friendly.
- Subject Matter Specialists of nine cotton growing states were imparted practical

training on IPM throughout cotton seasons.

- Entomopathogenic nematodes (EPNs) have been identified and found effective against *H.armigera.*
- New pesticide molecules including botanicals and insect pathogens (Bt and NPV) were tested for efficacy and bio-safety in the cotton ecosystem. IPM practices were developed and popularized and notable achievements have been the success of IPM in Tamil Nadu and Maharashtra.
- The utility of sex pheromone traps in pest monitoring was demonstrated. Role of bio-agents in cotton pest management was established. Mass production protocols for *Chrysoperla carnea.* (Predator), *Trichogramma chilonis* (egg parasitoid) and NPV of *Heliothis* (pathogen) against bollworms were developed and popularized.
- Resistance to insecticides in *H.armigera* was monitored throughout the country. The nature of resistance was worked out. IRM technology was developed and implemented in farmers field with their participation.
- Resistant sources against insect-pests and diseases were identified and inducted into resistance breeding programme.
- The seed dressing insecticide imidacloprid and its sprayable formulation were effective against early season sucking pests like aphid, thrips and jassids. RH 2485 and spinosad were effective in reducing the larval infestation and reducing the boll damage.
- The bio-agents – *Trichoderma harzianum, T.Viride* and *Pseudomonas fluorescens* (CHAO strain) have been found as effective as the fungicides in the management of grey mildew and Alternaria leaf spot diseases.
- Seed treatement with Carbendazim along with combined application of *T.harzianum, G.virens* and *T.viride* showed lowest root rot in cotton caused by *Rhizoctonia spp.*
- Three cultures viz., CNH 911, CNH 2713 and CNH 4736, resistant to bacterial blight, Myrothecium and Alternaria leaf spots and cotton leaf curl virus have been developed.
- Yield gap models showed that plant density gap in hybrid and soil dummy in variety were the major significant variables responsible for the yield gap while nutrient gaps is common to both.
- Micro and macro constraints, types and extent of risks in cotton cultivation were identified and quantified.
- Commodity diversion model results indicated that delay in cash payment and improper grading were the inducing factors for cotton diversion from the monopoly procurement than price difference and avoidance of credit recovery.
- Priority of the organisation set by various mechanism has emerged as the most important criteria followed by foreign collaborations, feedback from clients, current hot topics, contribution to scientific theory and publication probability in research problem selection among cotton scientists in India.
- Pattern of diffusion of selected cotton technologies was studied in market and infrastructure perspective. Adoption was higher in villages close to the propagator.
- The percentage of woman folk and their proportion of time spent in farm has increased over years because of unfavourable terms of trade towards agriculture.

## Basic and fundamental research

In addition to the applied research aspects considerable amount of work on the following basic aspects was carried out to further strengthen the applied approaches.

- Physiological and biochemical basis for abiotic and biotic stress tolerances.
- Dot-blot assay for rapid detection of insecticide resistance levels in pests.
- Isolation and characterisation of native Bt strains

- Identification of new sources of male sterility.
- Assessment of essential fatty acid profile of seed oil.
- Molecular basis of pathogenicity of cotton pathogens.
- High gossypol gland density on ovary and calyx surface showed comparatively low incidence of bollworms on loculi basis.

## Transfer of Technology

The technologies evolved are effectively demonstrated and disseminated through KVK, Front Line Demonstrations, Seed Village programme, IPM/IRM demonstrations etc. Many training programmes were organised at the institute for the Subject Matter Specialist, and other state level functionaries to upgrade their skills in respect of latest technological developments.

## Promising Technologies Generated

**Mass production of bio-control agents**

Technologies to mass multiply predator (*Chrysoperla*), parasitoid (*Trichogramma*) and insect pathogen (HNPV) have been standardized and transferred to entrepreneurs. These bio-agents are being supplied for use in farmers' fields. Formulation of *T.viride* which can be used as spray or seed treatment has been prepared. This is useful for the management of cotton diseases.

**'Bt-bucket' for small scale farmer's use**

A simple cost-effective method has been designed and developed to indigenously produce Bt-toxins at small-scale under residential conditions. The Bt-broth can be either sprayed directly on crops for the control of lepidopteron insect pests or harvested through filtration and preserved for further use. The cost of the basic unit would be about Rs 600 and the cost of producing Bt-toxins required for each application on one hectare would be about Rs 160. Farmers can produce the toxins cheaply without having to depend on traders and pesticide dealers.

**Bed Planter model fabricated**

A model of Bed Planter was fabricated at the Regional Station, Sirsa. The purpose of the machine is to prepare seed beds and also do the sowing at fixed spacing. In addition to that, consumption of water use can also be economized with this machine. The width of the bed formed by this machine comes to 75 cm and sowing of seed with row to row spacing at 67.5 cm as practiced under north zone conditions.

**Cotton Planter**

A two row bullock drawn cotton planter for small farmers, especially for vertisols has been developed at CICR, Nagpur. The implement weighs 50 kgs and is pulled by a pair of bullocks. It can cover an area of one hectare in two hours. Cup feed type seed mechanism has been used for metering seeds. The row to row spacing is kept at 60 cm. while the seed to seed spacing within the row can be varied from 30 cm to 120 cm The seed rate was found to be 4.6 kg/ha for 60 x 60 cm and 3.0 kg/ha for 60 x 90 cm spacing.

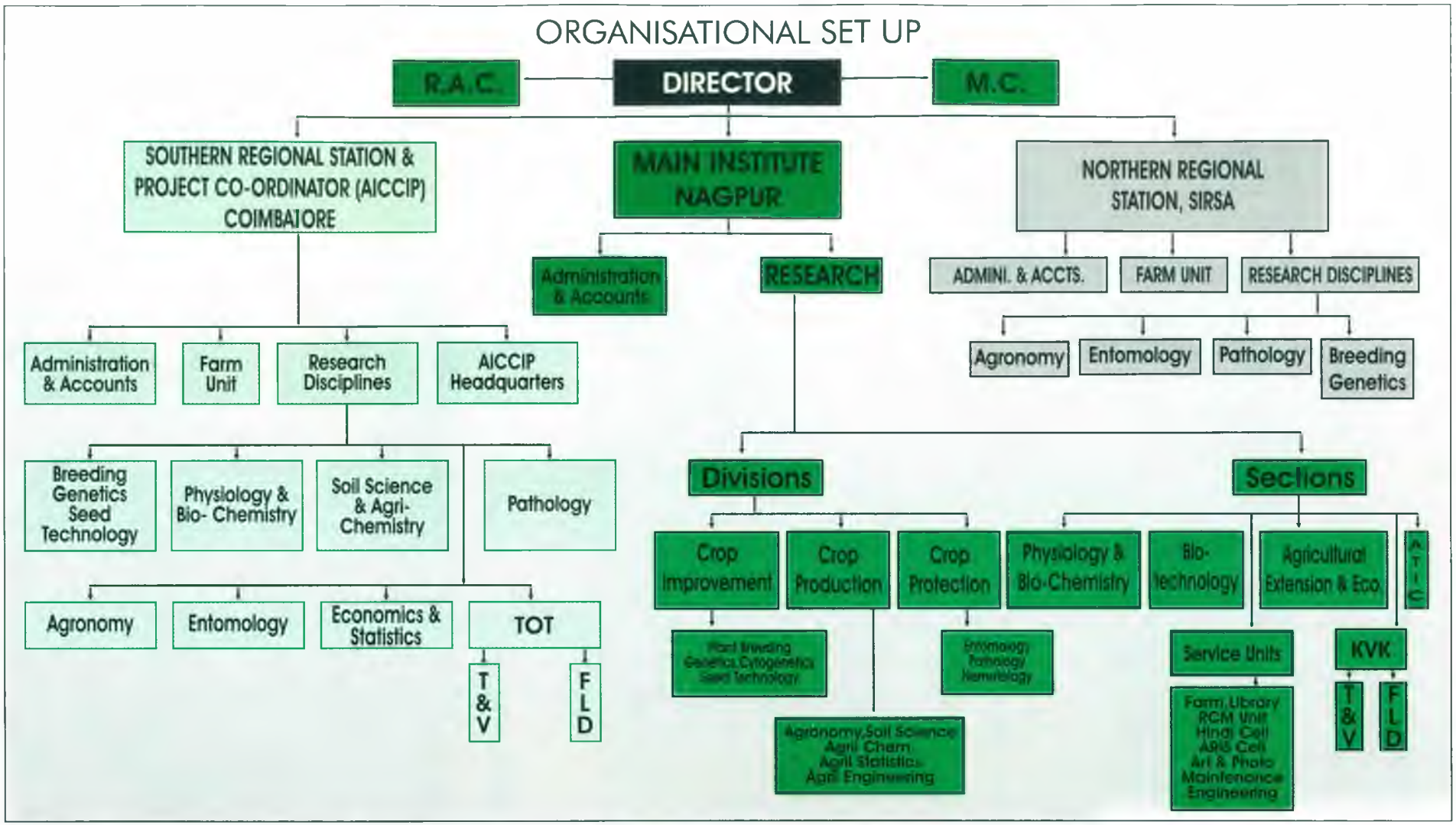
**Organic cotton technology**

Institute has developed a technology for organic cotton production using organic soil amendments and bio-control based pest management. This technology is now being successfully utilised by organic cotton growers in Amravati and Yeotmal districts of Maharashtra in about 1000 ha.

## 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.

# ORGANISATIONAL SET UP



## Financial Statement

The budget grant and actual expenditure at CICR, Nagpur and its Regional Stations, Coimbatore and Sirsa for the year 2001-2002 are furnished below:

| Budget Sanctioned and Expenditure | | (Rs. in Lakhs) |
|---|---|---|
| **Scheme** | **Sanctioned** | **Expenditure** |
| Non-Plan | 910.00 | 747.10 |
| Plan | 200.00 | 198.55 |
| **PLAN SCHEME** | | |
| NSP Crop | 003.50 | 000.70 |
| AICCIP | 350.72 | 350.72 |
| KVK Scheme | 018.55 | 021.41 |
| **AP CESS FUND** | | |
| CO, Scheme | - | 000.44 |
| IICBP | 007.70 | 001.49 |
| ENBCHABC | 001.51 | 007.09 |
| **R DEPOSIT SCHEME** | | |
| Front Line Demonstration | 001.26 | 002.98 |
| DBT Scheme | 005.24 | 005.00 |
| EPS EC (De Nocil) | - | 003.25 |
| IRM/IPM Project | - | 000.95 |
| NCIPM Scheme | - | 000.63 |
| NRI Scheme | 076.15 | 320.99 |
| TMC Scheme | 286.85 | 224.60 |
| NATP Schemes | 277.73 | 181.06 |

## Staff Position

| Name of the 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** | - | 1 | - | **1** |
| Scientific | 54 | 26 | 5 | **85** | 43 | 15 | 6 | **64** |
| Technical | 51 | 31 | 11 | **93** | 47 | 32 | 9 | **88** |
| Asstt Dir (OL) | 1 | - | - | **1** | 1 | - | - | **1** |
| Administrative | 31 | 14 | 8 | **53** | 30 | 13 | 8 | **51** |
| Supporting | 77 | 48 | 18 | **143** | 73 | 45 | 15 | **133** |
| **KRISHI VIGYAN KENDRA** | | | | | | | | |
| Training Organiser | 1 | | | **1** | 1 | | | **1** |
| Technical | 9 | | | **8** | 8 | | | **8** |
| Administrative | 2 | | | **2** | 2 | | | **2** |
| Supporting | 2 | | | **2** | 1 | | | **1** |

Transgenic *G. arboreum* variety RG 8 with Cry 1 A(c) Bt gene.

Induction of root nodules in cotton

Bullock drawn seed planter

Dr. Mangala Rai, DDG (CS), ICAR in discussion with the Director and scientists in the field.

# Research Achievements



## Crop Improvement

**Nagpur**

**P1-86/1-ICR-F30/0430:**
**Collection, Conservation, Evaluation, Documentation and Utilization of Genetic Resources** (V.V.Singh and Punit Mohan).

*G. hirsutum*

About 1045 USA germplasm lines, 310 exotics, 800 core collections and 350 working collections were grown and evaluated during the year. Observations recorded in the above material showed wide range of variability for most of the economic characters and reaction to major pests and diseases.

In all 446 accessions of *G. hirsutum* were deposited in long term cold storage conservation (-20 °C). Passport data of 4219 accessions were documented. Characterization of 1603 accessions was completed. Multilocation evaluation of two sets of 100 accessions each of *G. hirsutum* and *G. arboreum* was done under Br 01 trial of AICCIP at Nagpur (rainfed), Sirsa and Coimbatore (irrigated).

Six $F_1$ combinations were evaluated for yield and other ancillary characters. One hundred and fifteen cross combinations were made involving pests and disease resistant/ tolerant genotypes and cultivars.

*G. arboreum*

Fourty seven germplasm lines of *G. arboreum* and 25 of *G. herbaceum* were collected from coastal areas of Andhra Pradesh and Saurashtra region of Gujarat respectively.

Thirty seven accessions of *G. arboreum* and 15 accessions of *G. herbaceum* from working collections were evaluated for yield contributing characters and mean halo length. Two hundred accessions of *G. arboreum* were evaluated under Br 01 trial at Sirsa, Nagpur and Coimbatore for seed cotton yield, boll weight, ginning per cent and mean halo length.

Fifteen accessions of *G. arboreum* and ten accessions of *G. herbaceum* were used in crossing programme for development of diploid cotton genotypes with high yield, high fibre strength under diploid (*desi*) cotton improvement programme.

**P1-86/2-ICR-F50/0430 :**
**Conservation of wild species of *Gossypium* and introgressive hybridization for the improvement of cultivated cotton including application of tissue culture** (Vinita Gotmare, M.K.Meshram, S.Vennila, G.Balasubramani and K.B.Hebbar).

**Conservation of wild species of *Gossypium***

One *G.tomentosum* derivative from Surat has been added to the collection during the year.

**Screening of segregating population (*G. arboreum x G. australe*)$_2$**

The fertilized ovules at different stages were examined for gossypol density. Plant to plant differences were observed for density of gossypol gland and it varied from 33 to 59. Few seeds were obtained by backcrossing some of the segregants with *G. australe* and *G.bickii*. Selfing and intermating was done to recover lines with delayed morphogenesis of gossypol gland.

**Identification of CMS/GMS sources**

Three new $F_1$ crosses of last year involving the wild species *G.capitis viridis, G. gossypioides* and *G. stocksii* with *G. hirsutum* were found sterile. These were treated with colchicine (0.01 and 0.05%).

Colchicine treatment to some more $F_1$ hybrids involving wild species *G.anomalum G.australe, G.aridum and G.klotzschianum,* was repeated and results are awaited as the treated portion is yet to flower.

New crosses have also been obtained with, *G.australe, G.aridum, G. longicalyx* and *G.sturtianum.*

Selection of single plants in the derivatives of synthetic polyploids was made for yield and fibre characters.

Seed oil estimation was done in 22 wild and cultivated species and six perennial races of *G. arboreum*. Those possessing 20% or more than 20% oil are presented in Table-1.

**Table 1: Mean oil content of cultivated and wild species of *Gossypium* and races of *G. arboreum***

| Sr. No. | Wild Species | Mean Oil (%) |
|---|---|---|
| 1 | *G strutianum* | 21.39± 0.11 |
| 2 | *G.thurberi* | 21.35± 0.15 |
| 3 | *G.lobatum* | 22.89± 0.28 |
| 4 | *G.australe* | 20.00± 0.07 |
| 5 | *G.harknessi* | 22.16± 0.34 |

**P1-2000/1-ICR-F30/0430 :**

**Breeding for high yielding, long staple genotypes of *G. arboreum* cotton with high fibre strength** (Punit Mohan and P.Singh).

Culture CINA 316 was entered in National Trial and culture CINA 329 was retained in Br 24 (b) trial in south zone. The culture CINA 305 was promoted from NEVT to Br 24 (b) trial in south zone. Three new cultures based on yield, fibre strength and length were identified for further seed multiplication and evaluation.

One hundred and fourty two progenies of segregating population ($F_2$-$F_6$) were evaluated for yield contributing characters and mean halo length. Fifteen plant selections were made based on high yield, earliness, boll opening and medium and superior medium fibre length coupled with adequate strength.

Higher locule tenacity was observed in fully burst bolls of CINA 310, CINA 323 A and CINA 323 B (17 days) and CINA 329 (13 days) than AKH 4 and AKA 8401 (6 days).

**P1-88/1-ICR-F30/0430 :**

**Genetical and anatomical studies for drought tolerance in cotton (*G. hirsutum*)** (Suman Bala Singh and N.K.Perumal).

This year, 25 $F_2$, 18 $F_5$ and 23 advance cultures were evaluated under rainfed and irrigated conditions. Three crosses viz. P1 x SP 3892, P8 x Arogya and P7 x SP 3895 were found promising with seed cotton yield of 1322.25, 1307.95 and 1304.05 kg/ha respectively. Out of 18 $F_5$ crosses tested, P10 x EL 500 (862.95 kg/ha), P3 x EL 500 (786.25 kg/ha) and P8 x EL 500 (739.80 kg/ha) were the top yielding under rainfed condition. The cross P3 x A 72-62 recorded the lowest drought susceptibility index of 0.05 followed by P9 x A72-62 (0.48) and P10 x A 72-62 (0.68). Among the 28 advance cultures tested Txmaroon x P1 recorded the highest yield of 786.35 kg/ha followed by Texas 1050 x P3 (740.80 kg/ha) and M7 x P2 (734.00 kg/ha). The cross M7 x P2 also recorded low drought susceptibility index 0.29. Both Texas 1050 x P3 and M7 x P2 were the best combinations identified last year also.

Out of 32 single plant selections tested under replicated trial, SPS 29 recorded seed cotton yield of 1649.1 kg/ha with 131.72 and 305.99% increase over check PKV 081 and LRA 5166 respectively, followed by SPS 35 (1239.50 kg/ha). Two entries viz. SPS 43 and SPS 52 have consistently performed better and were among the top five for two years. Selections viz. SPS 41, 59, 55, 2, 7, 11, 14 & 42 were found promising in unreplicated trial.

Out of 11 crosses, one (40a) performed well over all the three checks and recorded 147.31, 31.29 and 12.75 per cent increase over LRA 5166, LRK 516 and PKV 081. Other promising crosses included 28a (4I-7I), 30a (46I-51I), 25a (52I-55I) and 12a (86I-90I) which performed better than LRA 5166.

**P1-2000/2-ICR-F30/0430 :**

**Breeding Cotton genotypes suitable for cultivation in shallow soils** (V.N.Waghmare, Punit Mohan, K.S.Bhaskar and N.K.Perumal).

This year, 60 *G. hirsutum* and 70 *G. arboreum* cultures were evaluated for their performance in shallow soil. Five varieties viz. G.Cot 10, JBWR 25, AV 3699, Reba Pvt.9 and 98/L6 recorded better performance compared to check.

**Trial on Bt Cotton** (P.Singh and Punit Mohan).

A set of seven intra-*hirsutum* hybrids (3 Bt, 3 non-Bt and 1 check NHH 44) was evaluated. The hybrid MECH 12 was found to be the earliest maturing. The hybrid MECH 162 is medium maturing and MECH 184 is late in maturity. However, all Bt hybrids matured about 20 days earlier than their non Bt counterparts. The Bt hybrids recorded higher seed cotton yield than non Bt hybrids and check (NHH 44). The highest seed cotton yield was recorded by MECH 162 Bt followed by MECH 184 Bt and MECH 12 Bt.

**Coimbatore**

**P1-75/2-ICR-F-30/0430 :**

**Development of high yielding intra hirsutum hybrids** (K.N. Gururajan and S. Manickam).

Twenty one intra-*hirsutum* hybrids were evaluated along with the check hybrids viz., Surya, Savita and NHH 44. The hybrid 98 L 4 X T 4 recorded the highest yield of 926 kg/ha with 50% increase in seed cotton yield over the best check hybrid,Savita.

A perusal of three years data indicated that the hybrid 98 L4 X T4, with a mean seed cotton yield of 14.17 q/ha, recorded 25 per cent increased seed cotton yield over the best check hybrid Surya (11.3 q/ha). Quality wise, 98 L5 X T4 was the best (Table 2).

Forty five hybrids developed in a partial diallel fashion were tested for the second year. The results indicated that the cross BWR 5 X BWR 9 recorded the highest yield of 10.3 q/ha as against 5.4 q/ha recorded in Surya, the best check hybrid. The hybrid is characterized by high boll weight (4.6 g/boll) and high ginning outturn (37 %). Based on two years data, three hybrids viz, BWR5x6, BWR5x9 and BWR7x9 were selected for further evaluation .

Hybrid CCHH 10555 recorded a mean seed cotton yield of 1512 kg/ha as against 1343 kg/ha of zonal checks in the national trial. In the north zone trial centres, it recorded a mean

**Table 2. Performance of Superior hybrids (mean of 3 years).**

| Sr. No. | Hybrid | Mean Seed Cotton Yield (kg/ha) | % increase over Surya | 2.5% SL (mm) | Micronaire | Bundle Strength (g/tex) |
|---|---|---|---|---|---|---|
| 1 | 98 L4 X T4 | 1417 | 25 | 28.2 | 4.9 | 20.0 |
| 2 | 98 L4 X T5 | 1313 | 16 | 28.6 | 4.9 | 20.1 |
| 3 | 98 L4 X T6 | 1330 | 17 | 30.2 | 5.0 | 21.1 |
| 4 | 98 L5 X T4 | 1259 | 11 | 29.8 | 4.5 | 22.3 |
| 5 | Surya [C] | 1132 | - | 33.2 | 4.4 | 22.5 |
| 6 | NHH 44 [C] | 997 | - | 28.2 | 4.1 | 21.5 |

seed cotton yield of 13.3 q/ha as against 8.13 q/ha of the zonal check hybrid LHH 144. The increase in seed cotton yield was of the order of 63 per cent and has been promoted from preliminary hybrid trial to coordinated hybrid trial.

**P1-89/2-ICR-F30/0430:**

**Breeding new *G. hirsutum* varieties with new plant types – Development of medium staple varieties** (K.N. Gururajan and S. Manickam).

Of the 17 cultures resistant to Alternaria and grey mildew, GMR 7-314 recorded the highest seed cotton yield of 10.1 q/ha with 51% yield increase over the best check variety, Anjali (with 6.7 q/ha).

Of the 18 cultures tested in the second trial along with LRA 5166 and CNH 120 MB as the check, CCH 526612, was found to be the best with 11.8 q/ha as against 5.9 q/ha in LRA 5166.

In the third trial, of the 19 cultures evaluated, 329 x RRM 103-118-2 recorded the highest yield of 11.2 q/ha against 4.2 q/ha of LRA 5166.

In the AICCIP south zone trials, culture CCH 526612 with 16. 97 q/ha recorded the highest yield as compared to 12.3 q/ha of LRA 5166 (Zonal Check). Similarly in the central zone, culture CCH 4 recorded the highest yield of 16.89 q/ha as against 13.63 q/ha of LRA 5166 (Zonal Check).

**P1-89/3-ICR-F30/0430 :**

**Development of high yielding and high spinning extra long staple cotton** (S. Manickam and K.N. Gururajan).

In a trial conducted with 20 cultures, culture HLS 72 [T 13 x VRS] 22422-3 recorded the highest yield of 1436 kg/ha as compared to 569 kg/ha recorded in Surabhi, the best check variety. However, quality wise L [RCH x T13] LB 744 with a 2.5% SL of 32.2 mm, micronaire of 4.7 and bundle strength of 23.3 g/tex was the best.

In another trial of 11 cultures, HLS 92-1 was the best recording an yield of 451 kg/ha as compared to 165 kg/ha recorded in Surabhi (173% yield increase over Surabhi).

**P1-89/1-ICR-F30/0430 :**

**Development of extra long staple high spinning hybrids of interspecific origin with wider adaptability** (S. Manickam and K.N. Gururajan).

A replicated trial to evaluate interspecific hybrids developed by crossing 10 gms lines of *G. hirsutum* and six accessions of *G. barbadense* indicated that the hybrid G 4 x P 26 recorded the highest yield of 571 kg/ha with 12 % yield increase over the best check hybrid, TCHB 213.

Hybrid CCHB 1054 recorded a mean seed cotton yield of 11.5 q/ha as against 8.98 q/ha of DCH 32 [C] in the national breeding trial of interspecific hybrids in AICCIP. The increase in seed cotton yield was of the order of 28 per cent and has been promoted to coordinated hybrid trial in south zone.

**Ad hoc Project:**

**Maintenance and Evaluation of Cotton Germplasm** (S. Manickam).

When 200 lines each of *G. hirsutum* and *G. arboreum* were evaluated for yield and other traits, a wide range of variability was noticed in both for various morphological characters. These accessions were also studied for their reaction to grey mildew and alternaria leaf spot .

**P1-89/5-ICR-F30-0430:**

**Development and utilization of cytoplasmic and genetic male sterility for hybrid seed production and fertility restoration in cotton** (S. Manickam).

The gms based hybrid gms J.34 x Sn recorded the highest seed cotton yield of 22.1 q/ha as against 15.45 q/ha of Savita (c). The increase in yield was 43 per cent.

Ninety-one cms based hybrids were evaluated in three trials. Four hybrids recorded

more than 30 per cent increased yield over the check hybrid Savita.

Thirty five cytoplasmic-genic male sterile A lines developed in the station are being maintained by mating with B lines. The *G. aridum* source of cytoplasm has been successfully developed. They are being utilized to convert the promising parental lines viz., LRA 5166, Anjali, HLS 329, HLS 72, Jorhar, Pusa 39, IRH 1-4, 29F and SRT-1 into *G. aridum* cytoplasmic background.

The fertility restorer gene from Pima restorer (*G. barbadense*) and Deshaff 277 and Mex (*G. hirsutum*) have been transferred to the thirteen promising genotypes and are being maintained by selfing. Suvin restorer has been successfully developed under the *barbadense* background.

**P1-89/6-ICR-F30-0430:**

**Interspecific and inter-racial hybridization and gene transfer in Gossypium** (S. Manickam).

Seventy six cultures developed from interspecific and inter-racial hybrid derivatives were evaluated in two different trials. As many as six cultures recorded significantly higher seed cotton yield over LRA 5166. The culture IRH 1-9 recorded the highest seed cotton yield of 2044 kg/ha. The test cultures were also characterized by a high ginning out turn of over 37 per cent.

**Sirsa**

**P1-85/2-ICR-F30/0430:**

**Evaluation of parents in *G. hirsutum* for heterotic potential and useful heterosis for replacement of existing cultivars under North Indian conditions** (O. P. Tuteja).

**Demonstration trial**

The demonstration trial of 17 hybrids developed at the station and in the public sector was conducted. The hybrid CSHH-198 gave the highest seed cotton yield of 2505 Kg/ha.

Two hybrids CSHH 238 and CNHH 348 were tested in Br 05(a)-1Preliminary *hirsutum* National trial during 2001-02. The hybrids were ranked third and fourth.

**Local conventional hybrid trial 1**

The trial comprised 78 hybrids and two local check varieties RS 810 and H 1098. The highest seed cotton yield was recorded in CSHH 351(3103 Kg/ha). The 2.5% span length ranged from 23.1 to 26.9 mm and it was found to be maximum in CSHH 305 (26.9 mm).

**Local conventional hybrid trial 2**

The trial comprised 78 hybrids and two local check varieties i.e. RS 810 and H1098 The highest seed cotton yield was recorded in CSHH 436 (2905 Kg/ha). The highest ginning out turn of 36 per cent was recorded in cross combination CSHH 443. The 2.5% span length ranged from 23.1 to 27.7 mm and was found to be maximum in CSHH 396 followed by 27.6 mm in CSHH 434.

**Local conventional hybrid trial 3**

In this trial, 56 hybrids were tested against the local check variety H 1098, Om Shankar and LHH 144. The highest seed cotton yield of 3432 Kg/ha was recorded in CSHH 465. Maximum 2.5% span length of 26.6 mm was found to be in CSHH 499 followed by 25.8 mm in the local check LHH 144.

**Local conventional hybrid trial 4**

Thirty-five hybrids, were evaluated in comparison with RS 810, H 1098 and LH 1556. The highest seed cotton yield of 3234 Kg/ha was observed in CSHH 530. The 2.5% span length of 26.4 mm in CSHH 530 was found to be higher than the local checks.

**Local conventional hybrid trial 5**

The trial comprised 60 hybrids and two check hybrids Om Shankar and LHH 144. The highest seed cotton yield of 2411 Kg/ha was recorded in CSHH 596. 2.5% span length was found to be maximum in CSHH 592 and CSHH 594 (26.7 mm) followed by 26.6 mm in CSHH 541

### Local conventional hybrid trial 6

The trial comprised 60 hybrid and two checks hybrid Om Shankar and LHH 144. The highest seed cotton yield of 2469 Kg/ha was recorded in CSHH 606. The 2.5% span length was found maximum in CSHH 616 and CSHH 660 i.e 27.1 mm and 27.0 mm. The highest ginning out turn of 34 per cent was recorded in the hybrid CSHH 606.

**Development of male sterility based hybrids of *Gossypium hirsutum* for North India** (O. P. Tuteja, D.Monga and P.Jeyakumar).

### Local CMS based hybrid trial 1

None of the CMS based hybrids showed significantly higher seed cotton yield in comparison to check hybrids. The highest ginning out turn of 35 per cent was found in the CMS hybrids SPC17 X CIR15 and SPC11 X CIR15. The 2.5% span length was found to be highest in CMS hybrid SPC17 X CIR23 (28.5 mm) followed by 26.9 mm in hybrid SPC11 x 74

### Local CMS based hybrid trial 2

Ninety-five crosses were attempted between CMS lines and restorer lines. Only 29 hybrids could set seed and rest were found to be sterile. The 29 CMS based hybrids were evaluated in comparison with conventional hybrids LHH 144. Highest seed cotton yield of 1938 Kg/ha was found to be in SPC 9 x CIR 7. The highest ginning out turn of 36 per cent was found in the CMS hybrid SPC 11 XCIR 9. The 2.5% span length was found to be highest in only one CMS hybrid i.e. SPC 15 X CIR 12 (27.6 mm).

### Local GMS based hybrid trial 3

Sixteen GMS based hybrids were evaluated in comparison with conventional hybrids Om Shankar, varieties RS 810 and H1098. Highest seed cotton yield of 2812 Kg/ha was found to be in CISHHG 41. The highest ginning out turn of 33.5 per cent was found in the GMS hybrid CISHHG 54. The 2.5% span length was found to be highest in GMS hybrid CISHHG (28.4 mm) followed by CISHH 64 (27.1 mm).

**Identification and development of *G. arboreum* cotton for high yield, long staple with fiber strength for high speed spinning** (Surender Kumar and O.P.Tuteja).

### AVT 1

Under this trial all the entries except CISV 1 and CISV5 gave higher yield over the check RG 8. The entries CISV 8, CISV 4 and CISV 7 were found promising for 2.5% span length. The maximum GOT% was observed by CISV 1 and CISV 5 and the highest boll number (34.9) and boll weight (2.0) in CISV 4.

### AVT 2

Under this trial, all the entries except CISV 34 gave higher yield over the check RG 8. CISV 28 (20.7 mm) was found promising for 2.5% span length. The maximum GOT % was observed in CISV 34. The highest boll number (26.6) and boll weight (2.15 gm) was recorded in CISV 26 and CISV 28 respectively.

### AVT 3

Under this trial all the entries gave higher yield over the check RG 8. For 2.5 % span length the entry CISV 63 (20.7 mm) was found promising. The maximum GOT % was observed by CISV 34. The highest boll number (26.6) and boll weight (2.1 gm) was recorded by CISV 28 and CISV 56 respectively.

### Evaluation of Segregating generation

Eleven $F_2$ progenies were evaluated and from these seggregants, 18 single plants have been selected based on earliness, yield potential and superior fibre properties.

Nine $F_3$ progenies were evaluated and 28 single plants have been selected based on earliness, yield potential and superior fibre properties.

Six $F_4$ progenies were evaluated and, 15 single plants have been selected based on earliness, yield potential and superior fibre properties.

**New Crosses**

Four hybrids namely CISAA 3, CISAA 4, CISAA5. CISAA 6 and CISAA 7 were developed.

One culture and one hybrid are entered in AICCIP trials.

**Collection, conservation, evaluation and maintenance of genetic resources** (R. A. Meena. D.Monga. and P.Jeyakumar)

Under Br 01 trial 100 lines each of *G. hirsutum* and *G. arboreum* were evaluated for various characters. In addition to that 1060 germplasm lines of *G. hirsutum* and 540 lines of *G. arboreum* were maintained and also evaluated.

## Seed Technology

**Nagpur**

**Improvement of seed yield and its quality in hybrids and varieties** (R.K.Deshmukh, V. Santhy, M.R.K.Rao and Phundan Singh).

Boll setting percentage in *desi* cotton : Boll setting percentage in conventional lines was 14.0% while it was 20% in GMS based *arboreum*.

**Effect of foliar application of hormone and nutrient on seed yield and quality**

Foliar application of potassium nitrate significantly improved the seed cotton yield over NAA 10 ppm application. Other treatments did not differ among themselves significantly.

**Impact of boll damage on seed quality**

In variety Anjali, total seed number per boll was 26.0, 20.6, 19.8, 16.8 and 13.8 while good seed number was 20.0, 16.6, 14.6, 10.9 and 2.2 respectively when seed cotton from fully open undamaged boll, from one, two, three and four damaged locule was collected.

**Impact of delinting on seed quality**

Four varieties namely AKA 7, AKH 081, Anjali and DHY 286 were used for this study. Treatments imposed were acid delinting (T1), gas delinting (T2) and fuzzy seed (T3). Seed of the same lot were used for the study. This year quality of all the four varieties obtained was excellent and due to this till six months of storage there is not much / prominent variation in the germination percentage, shoot and root length as well as vigour.

**Coimbatore**

**P1-97/1-ICR-F-25/0430.**

**Studies on Viability, Vigour and Longevity of Cotton Seeds** (K. Rathinavel, P. Chidambaram and K. Natarajan).

**Effect of combination of seed treatments on viability and vigour**

The seed quality assessment revealed that there is a progressive decline in the untreated seeds than the treated ones. Among the treatments, Imidacloprid and Neem leaf powder or the combination of Imidacloprid and Iodine formulation with carbendazim proved good in controlling the seed deterioration in LRA5166. In Surabhi, the deterioration of viability was reduced significantly due to treatment of seeds with carbendazim alone or in combination with iodine formulation. Treating seeds with combination of iodine formulation and neem leaf powder was also found beneficial in minimizing the viability and vigour loss.

**Effect of storability of cotton seeds under different relative humidity regimes**

Decline in viability and vigour was observed in all the varieties tested, irrespective of storage atmosphere. The reduction in germination was maximum and rapid at higher relative humidity levels (80% and 60%) than at lower levels (40 and 0 per cent). Electrical conductivity of the seed leachate was found increased with the increase of storage period and higher relative humidity.

**Sirsa**

**Studies on seed technological aspects of hybrid and varietal seed production under north zone** ( R. A. Meena, D.Monga and O.P.Tuteja).

## I . Hybrid Seed Production

### (A) Optimum sowing time and plant-to-plant spacing and suitable crossing period for higher yield and superior seed quality

The parents of hybrids Om Shankar and LHH 144 were sown on two dates i.e. 12th May and 27th May and at two different spacing i.e. 67.5 X 90 cm and 67.5 X 120 cm.

A slight increase in flower number per plant was also observed in wider spacing. The effect of date of sowing on flower production was not observed initially but during last phase the number of flowers per plant was slightly higher in late sown crop. The seed setting percentage was observed higher (above 80 %) up to 30th Sept. After that it gradually declined. In hybrid LHH 144 the seed setting percentage was slightly higher in wider spacing. The effect of date of sowing on seed setting behaviour was not observed. During this year the highest cross boll setting percentage was 33.65 in hybrid Om Shankar and 42.37 in hybrid LHH 144. The cross boll setting percentage was noticed higher during initial stage. After 15th of September it gradually declined and was noticed below 10 per cent after 1st Oct. The cross boll setting percentage was higher in early sown crop in both the hybrids. The effect of plant to plant spacing on cross boll setting was not noticed in hybrid Om Shankar, while in hybrid LHH 144 it was higher in wider spacing. The germination and vigour index were also higher in seed received from crossing period up to 30th Sept.

### (B) Effective pollination from one male flower

Ten female flowers were pollinated with one male flower. At initial stage up to 7th flower in hybrid LHH 144 and up to 9th in hybrid Om Shankar could set seed but the seed number declined if more than three female flowers were pollinated at this stage. The boll setting after September 17 declined gradually and during late phase (September, 27) only up to 3 pollinated flower in hybrid LHH 144 and 5 in hybrid Om Shankar could set seed and with same male flower the seed number per boll declined if two female flower pollinated with one male flower in both the hybrids.

### (C) Seed storage studies

To assess the storage potential of hybrid and varieties under North Zone, the seeds were packed in cloth bags and stored under room condition in the month of February 99. No significant reduction in germination and vigour were noticed up to nine months of storage. However, gradual decline in per cent germination and vigour index was observed afterwards. Up to 15th month, all the cultivars maintained germination above certification standard except the variety LRA 5166. At 18th month of storage the germination (%) in other hybrids and varieties two were noticed below or near certification standard.

## II. Varieties seed production

### (A) Seed quality at different intervals

The seeds of different pickings were obtained separately and data on various seed quality parameters were recorded. In all the varieties the seed setting percentage, seed index, germination percentage and vigour index were highest in second picking followed by first picking and least in third picking.

### (B) Standardization of delinting process

Three cultivars each of *G. hirsutum* and *G. arboreum* were delinted using different quantity of commercial sulphuric acid. By using 140 ml acid for *G. hirsutum* varieties and 125 ml for *G. arboreum* varieties, the delinting of one kg seed completed in 3-3.5 minutes. Use of less quantity of acid required more time for delinting. While washing, more than 50 % seed in *G. hirsutum* and 30% in *G. arboreum* were found to be inferior.

# National Agricultural Technology Project

## MM1: Development of Hybrid Crops – Cotton.

**Nagpur** (C.D.Mayee, Suman Bala Singh, P.Singh, Vineta Gotmare, S.Vennila, N.K.Taneja and M.K.Meshram).

Thirty-six CMS, 13 GMS and seven R-lines are being maintained in addition to 40 CMS, 10 GMS and 28 R-lines received through NATP common trial. This year, 18 CMS lines, 5 GMS and 12 R lines were evaluated under common trial. GSCMS 15, GSCMS 34 and PKV Rajat were found to be the best B lines under both sprayed and unsprayed conditions. AKH 39 R and GSR 6 were the best R lines and B 57-1684 was the best GMS line for seed cotton yield.

Sixty-three GMS and 200 CMS hybrids were tested in five different trials. Some of the promising hybrids identified were NGMSH 15-02, 14-02, 24-02, 23-02, 63-02 and 52-02. Among the 35 CMS hybrids tested in replicated trial, two hybrids viz. NCMSH 90-02 and 83-02 performed on par with the check NHH 44. Out of 165 hybrids tested for fertility restoration, 75 were completely fertile, 45 partially sterile and 45 completely sterile. Nineteen hybrids alongwith NHH 44 and CAHH 8 were tested under sprayed and unsprayed conditions in NATP common trial. The hybrid HHH 286 recorded the highest GOT of 37.95%, boll weight of 4.29 g and mean halo length of 22.7 mm.

Five GMS hybrids viz. NGMSH 104, NGMSH 70, NGMSH 30, NGMSH 59 and NGMSH 159 exhibited desirable fibre qualities and were among the top ten yielding hybrids.

Seeds of 50 GMS and 75 CMS crosses were produced for institute trial. Three kg delinted seed for CNHHG 2003 and 4 kg of seed cotton for CINHH 109 was produced for AICCIP trial.

Seven GMS lines of diploid cotton (*G. arboreum*) were evaluated and highest seed cotton yield was recorded for GAK 20A followed by SGMS 4 and GAK 09.

Twenty $F_1$ hybrids were evaluated under station trial and four crosses viz. GAK 4234 x CINA 310, GAK 4234 x CINA 318, GAK 4234 x CINA 305 and GAK 4234 x CINA 326 were found promising. Eight GMS hybrids were evaluated in national trial. AAH 7 was the best followed by AKDH 32 and RAJDH 12. However, none performed better than the check variety AKA 5 (16.01 q/ha).

For diversification of MS source, $F_1$ crosses utilizing *G. capitis viridis*, *G. gossypioides* and *G. stocksii* with *G. hirsutum* were raised and found to be sterile. These were treated with colchicine. Colchicine treatment to F 's of crosses *G. anomalum*, *G. australe*, *G. aridum* and *G. klotschianum* was repeated. Crossed seeds of some new crosses involving *G. aridum*, *G. longicalyx*, *G. australe* and *G. sturtianum* obtained.

All the lines/hybrids tested under national and station trials were screened for diseases and pests reaction. None of the GMS and CMS was found resistant to all the diseases. NGMSH 33 showed immune reaction to grey mildew while, NCMSH 96, 101, 106, NGMSH 15 and 39 were found immune to bacterial blight. Four B lines viz. RCMS B2, DMSB 4, LH 900 B and RCMS B-1, two R lines AKH 26 R and GSR 6 and one GMS line LRA 5166 were found moderately resistant to Alternaria blight. Eight B lines viz. DMSB 5, AK 1234 B, RCMS B-2, C 119 B, PKV Rajat, C 1412 B, DMSB 6 and LCMS 6 ; Seven R lines viz. AKH 545, Mex 685-3, GSR 22, AKH 39, DS 146-3, LR 29 and AKH 26 R and two lines i.e. LRA 5166 and MCU 4 were found immune to grey mildew.

None of GMS and CMS hybrids was found

to be tolerant to bollworms. Two B lines i.e. L 1412 B and LCMS 3 and one GMS line i.e. SGMS 4 were found moderately tolerant to bollworm. All the B-lines, A lines and R lines viz. LR 29, NH 258, AKH 26 R, AKH 545, AKH 39 and GSR 6 and all the hybrids except LMSH 115 and 102 were found tolerant to jassids under common trial.

**Coimbatore** - (S. Manickam)

**a. Evaluation of *Desi* hybrids**

Seven *desi* hybrids were evaluated in a replicated trial along with a hybrid check (AKDH 7) and a varietal check (G 27) in a common trial. None of the hybrids was significantly superior to the check hybrid.

**b. Evaluation of gms based interspecific (*G. hirsutum* x *G. barbadense*) hybrids**

Seven interspecific hybrids including DCH-32, DHB-105 and DHB-290 as checks were evaluated in a common trial. All the plants in the entries G 5 x P 27 and G 5 x P 28 were found to be sterile. None of the test hybrids were found to be superior over the check hybrids. The highest seed cotton yield was recorded in DHB-105 (1808 kg/ha).

**c. Evaluation of Intra *hirsutum* cms based hybrids**

In a common trial, 21 intra-*hirsutum* hybrids including NHH 44 and Savita (conventional hybrid check) and PKV Hy-4 (ms based hybrid check) were evaluated in a replicated trial. The highest yield was recorded in the check hybrid NHH 44 with 2180 kg/ha but none of the test hybrids were found superior to the check hybrids.

**d. Evaluation of A, B and R lines**

A common trial was conducted to evaluate ten restorer lines and 16 A and B lines. The highest seed cotton yield was recorded in DMSA-5B (with 1222 kg/ha).

**e. Evaluation of diploid gms lines**

Ten diploid gms lines were evaluated in an un-replicated common trial to study the stability and suitability of gms lines developed in various cooperating centers. The highest seed cotton yield was noted in gms GAK 20-A with 1613 kg/ha. Wide range of variability was noticed for all the characters studied.

**MM 3 : Sustainable management of plant biodiversity - cotton** (V.V.Singh).

Three explorations were conducted in Jharkhand, Coastal Andhra Pradesh and Saurashtra region of Gujarat and 130 samples of *G. hirsutum*, *G. barbadense*, *G. arboreum* and *G. herbaceum* were collected. Some of the samples had specific features like smooth staple *arboreum* and *herbaceum* and salinity tolerant types in *desi* cotton. The 91 collections made last year from Meghalaya, Melghat and Karnataka were evaluated in which wide range of variability was recorded especially for ginning outturn (34-49%) and mean halo length (18.3-26.6 mm).

**PSR 27: Evaluation and identification of suitable pest tolerant compact cottons amenable to mechanical harvesting** (S.K.Banerjee and V.V.Singh).

New genotypes were evaluated in three spacings i.e. 90x30 cm, 90x20 cm and 90x10 cm. Based on the performance of last year, five elite genotypes viz. LH 1948, HISAR 3, CNH 123, CNH 152 and GSH 2 were tested in larger plots and closer spacing of 90x05 cm. The results indicated that 90x10 spacing was the best for dwarf and compact genotypes which recorded highest seed cotton yield as compared to other spacings. In all, 38 genotypes were evaluated. The best genotypes identified were CNH 155, GSH 7, GSH 3, ACCLD 163, GSH 8. The yield of these genotypes ranged from 15 to 19 q/ha against 12 q/ha of the check. Results indicated that there are suitable genotypes which may be amenable to machine picking in all the three zones.

**RCPS 8 : Characterization and identification of productive and high quality cotton species/genotypes including *G. herbaceum* suitable for different rainfed agro-ecological situation through farmers participatory programmes**

(Vinita Gotmare).

The best three genotypes selected last year were tested at six different centres for confirmation of the performance. In deep soil and high rainfall condition, AK 8401 recorded the highest yield of 297 kg/ha against 250 kg/ha of check (AKH 4). Under deep soil and low rainfall condition, the highest yield of 367 kg/ha was recorded by Arvinda against 287 kg/ha of check (H10). In medium soil and high rainfall condition, hybrid G.Cot 8 recorded the highest yield of 542 kg/ha against 385 kg/ha of check (LRA 5166). Under medium soil and low rainfall condition hybrid NHH 44 recorded highest yield of 1148 against 637 kg/ha of check (LRA 5166). In shallow soil with high rainfall again NHH 44 recorded the highest yield of 1100 kg/ha against 802 kg/ha of check (H10). In shallow soil and low rainfall condition the variety AK 8401 recorded the highest yield of 385 kg/ha against 178 kg/ha of check (AKH 4).

**RCPS 7 : Promotion of productive high quality *Gossypium arboreum* cotton to meet the needs of marginal cultivators of rainfed ecosystem *vis-a-vis* textile industry**

(V.N.Waghmare).

Six genotypes with three checks (AKA 8401, LRK 516 and PKV 081) were evaluated under rainfed eco-system. The five best genotypes included MDC 2463 (745.63 kg/ha), PA 255 (737.98 kg/ha), PA 464 (731.86 kg/ha), Jawahar Tapti (707.69 kg/ha) and DLSA 17 (696.02 kg/ha). The yields of checks were 577.97 (AKA 8401), 198.49 (LRK 516) and 272.85 (PKV 081). The genotype PA 464 recorded high GOT (40.06%).

Twelve genotypes derived from introgressed population of *G. hirsutum* into *G. arboreum* including one check LRK 516 were subjected to preliminary testing. Out of these, the genotypes PAIG 8/1, DLSA 17, PAIG 28, DLSA 24 and PAIG 24 were found superior to the check variety LRK 516 with yield range of 469.49 to 608.17 kg/ha.

In a large scale on-farm trial of promising quality *G. arboreum* genotypes under rainfed conditions, PA 255 recorded higher yield (kg/ha) than both the checks.

# Technology Mission on Cotton

## Crop Improvement

**MMA-1: Identification and development of promising genotypes from introgressed materials**

**Nagpur** - (Vinita Gotmare).

Eighty interspecific derivatives received from Akola (2), Dharwad (12), Gujarat (6), Nagpur (2), Nanded (50) and TNAU (8) were evaluated for yield and resistance to various insect pests. Seven were found to be resistant / tolerant to bollworm and jassids. The highest yield was recorded by IS 376/6-2 line no. 27 (42.06 q/ha) followed by DSFH-1 (34.64 q/ha) and TCH 165 (23.33 q/ha). Crosses of all the entries received from different centres were effected with wild and cultivated species / genotypes as well as with sterile interspecific derivatives.

**Coimbatore -** (S. Manickam).

A trial was conducted with 43 interspecific cross derivatives obtained from various cooperating centers to evaluate their performance for seed cotton yield and other characters. The results indicated a wide variability for all the characters studies in these derivatives which may be used in further breeding programmes (Table 3).

**Table 3 : Variability for yield and other characters in interspecific cross derivatives evaluated in common trial**

| | Seed Cotton Yield (Kg/ha) | Boll Weight (g) | Lint Index (g) | Seed Index (g) | Ginning (%) | 2.5% SL (mm) | UR % | Mic. Value | BS (g/tex) | EP |
|---|---|---|---|---|---|---|---|---|---|---|
| **Mean** | 379 | 3.5 | 3.3 | 11.1 | 22.9 | 21.7 | 47.4 | 3.6 | 16.9 | 6.0 |
| **Maximum** | 1271 | 4.7 | 5.1 | 14.8 | 31.1 | 27.2 | 52.0 | 4.4 | 19.1 | 6.8 |
| **Minimum** | 106 | 1.8 | 2.3 | 6.1 | 17.1 | 18.4 | 44.0 | 2.6 | 15.1 | 5.0 |

Several interspecific cross derivatives were evaluated for their yield and other agronomic characters in un-replicated trial. The seed cotton yield ranged from 3.1 – 74.4 g/ plant. The maximum yield of 74.4 g/plant was recorded in the derivative Cms *aridum* II-6 6-A1.

**Sirsa -** (Surender Kumar and O.P.Tuteja).

Three trials were conducted under this project. Two trials of interogressed material under normal and flooded condition were sown on 2.6.2001 and 5-6-2001 respectively. The material of third trial sown on 13.7.2001 did not germinate due to continuous rains.

Trial No 1: **Introgressed material under normal condition**

Nineteen entries were tested in three replications against the three check viz. H1098, RS 810 and PIL 8. None of the entry gave significantly high seed cotton yield over the checks. For 2.5% span length the entries RH1-6 (28.7), RH1-1(28.5) and RA x 16 (28.1) were found promising against the check PIL8 (26.4). The maximum GOT of (39.5%) was recorded by RA x 16. Most of the entries were found susceptible to CLCuV, however, RA x 16 was tolerant. The highest boll number (25.8) and boll weight (3.4 gm) were observed in RH1-9 and RA x 16 respectively.

Trial No 2: **Introgressed material under water logging conditions**

Thirty entries were tested in one replication. The five top yielding entries are RS-810 x PIL 43 (214 kg/ha), LHH-144 (189.4 kg/ha), LH 1556 (189.3 kg/ha) SH 2379 x PIL 8 (181.0) and 25M x PIL 8 (156.4). The maximum G.O.T. % and maximum 2.5 % span length was recorded by CISV 33 (33.0) and Jhorar x Bobdel (28.6) respectively. The highest boll number (13.6) and boll weight (4.3 gm) was recorded by LH 1556 and CSH 52 respectively.

### MMA-2 : Identification and development of diploid cotton with high yield and fibre quality suitable for high speed spinning

**Nagpur** - (Phundan Singh and Punit Mohan).

Three advanced cultures of *G. arboreum* developed at CICR, Nagpur (CINA 323 B, CINA 329 and CINA 316) were entered in MMA 2 project for multilocation testing in three cotton growing zones. In all 19 cultures were tested.

Seed Cotton Yield : The strain CINA 323-B ranked first followed by LD 733, PA 496, PA 514 and CINA 316 over locations.

Ginning outturn : PA 514 recorded highest ginning outturn (38.8%) followed by PA 496 (35.6%), CINA 323 B (35.1%), LD 733 (35.1%) and CINA 316 (34.1%).

Fibre properties : PA 496 (26.51 mm) and CINA 316 (25.5 mm) were found comparable to *hirsutum* checks (25.5 mm) in 2.5% span length. The 2.5% span length of CINA 323 B (25.5 mm) and PA 514 (24.4 mm) was also good.

Fibre strength : All the high yielding strains recorded average fibre strength ranging from 18.67 (LD 733) to 19.55 g/tex (CINA 316).

Uniformity ratio : Amongst the top five ranking strains, the strain CINA 316 (50.56) and CINA 323 B (50.47) exhibited better uniformity ratio.

Elongation ratio : The elongation ratio ranged from 4.42 (CINA 329) to 5.96 (CINA 316) amongst the strains under testing.

Short fibre content percentage : Amongst the top five ranking strains, PA 496 (10.12%) and CINA 316 (11.75%) recorded less short fibre content than LD 733 (15.87%) and CINA 323 B (11.78%). In general, it was observed that the strains PA 496 and PA 304 from Parbhani and CINA 316 from CICR Nagpur had better spinning potential and are suitable for high speed spinning coupled with higher yield potential.

**Coimbatore** - (K.N. Gururajan).

Sixteen entries received from various centres were tested along with three *G. arboreum* checks (K 9, K 10 and K 11) and one *G. hirsutum* check (LRA 5166) in a replicated trial. None of the entries recorded significantly higher yield than the best check i.e. K11. However, three entries viz., CINA 316, CINA 323, DLSA 9 and K 11 (C) recorded significantly higher yield than the *G. hirsutum* check. CINA 316 recorded the highest yield of 1791 kg/ha, followed by CINA 323 with 1706 kg/ha as against 1552 kg/ha of K 11 and 1031 kg/ha of LRA 5166. Among the entries, TKA 9410 recorded the highest ginning out turn of 38.9 per cent.

In second trial, 100 germplasm lines were evaluated in a replicated trial. As many as 17 entries recorded a mean fibre length of 25 mm and above. All the three check varieties recorded less than 25 mm fibre length. Accession No. 83843 recorded the highest yield of 12.2 q/ha and recorded as much as 45 per cent increased yield over the best check K 11. Accession No.30847 recorded the highest ginning outturn of 36.7 per cent coupled with good length of over 25 mm. Cultures 6481, 6536 and 79 BH 111 recorded a high fibre strength of 26.5 to 26.8 g/tex.

Nine $F_1$ crosses received from PAU, Ludhiana were sown for advancing the generation. Two fresh crosses are also being attempted to grow the $F_1$ generations during the next season in North Zone.

**Sirsa** - (Surender Kumar and O.P.Tuteja).

One trial was conducted and $F_1$ crosses were attempted among selected genotypes. Eighteen entries were tested including check RG 8 in three replications. One entry namely HD-400 gave significantly higher seed cotton yield over check. For 2.5 % span length the entries PA 255 (28.1 mm), PA 304 (27.8 mm), DLSA-8 (27.2 mm), PA 405 (27.1 mm), PA 496 (27.1 mm) and CINA 329 (27.1 mm) were found promising against the check (19.7 mm). The maximum GOT was recorded by CISA-2(33.5 %) with the highest boll number (17.6) and boll weight (2.6 gm) in RG 8 and HD 400 respectively

### MMA3: Characterization of plant ideotype suitable for different agro-climatic zones.

**Nagpur** - (V.V.Singh).

Six trials, three each in irrigated and rainfed conditions comprising robust, dwarf, compact and semi-compact genotypes received from all the centres were evaluated under different spacings to assess their yield potential adjusting plant population according to the plant ideotype. The results indicated that the dwarf and compact genotypes can give either equal or better yield than the robust types. The best yielding genotypes were – GJHV 370, LH 1948, PH 348, NH 545 and H 1252 (irrigated) and LH 1948, NH 545, Khd. 122, CNH 155 and KH 111 (rainfed). The seed cotton yield among the best five genotypes ranged from 33-47 q/ha in irrigated and 20-24 q/ha in rainfed conditions.

**Coimbatore** - (S. Manickam).

A replicated trial was conducted with three groups of genotypes viz. 1. Robust plant types – National (IAI) with six entries, 2. Robust plant types – Regional (IBI) with eight entries and 3. Compact plant types (ICI) with 19 entries. The results indicated that among

the six entries of national robust plant types, SVPR 2 recorded the highest yield of 1259 Kg/ha followed by GJHV 370 (1045 Kg/ha). Similarly, among the eight entries of regional robust entries, IRH 1-9 was the best for yield (1198 Kg/ha). Of the 19 entries included in the compact plant type, RACH 11 recorded the highest yield with 1495 kg/ha.

Comparison of all the three groups of genotypes indicated that the compact genotype RACH 11 was the best for kapas yield (1495 kg/ha) followed by another compact genotype 70 E with 1433 kg/ha of seed cotton yield. The yield component and plant type traits of the most productive genotypes in compact and robust plant types were also studied. The results indicated that there are differences in contribution of the characters towards the yield between compact and robust plant types as noticed in the case of plant height. In robust types, tall plants yielded more while it was *vice-versa* in compact types.

**Sirsa -** (Surender Kumar and O.P.Tuteja).

Four trials were conducted under this project viz. two national and two station. The details of the trials are:

Trial No.1: **Robust plant ideotypes for different agro climatic zones**

Eighteen entries were tested in three replications against the check H1098. None of the entries gave significantly higher seed cotton yield over the check. For span length the entries LH-1956, LRA5166, LH1954, LH-1950, CISV 2 and Pusa 954 were found promising (29.0 mm). The maximum GOT % (37) was recorded by H 1098 and LRA 5166. The highest boll number (26.8) and boll weight gm (3.5) was recorded by RS 2013 and RS 2186 respectively.

Trial No.2: **Compact plant ideotypes for different agroclimatic zones**

Seven entries were tested in three replications against the local check RS 810. None of the entries gave significantly higher seed cotton yield over the check. The maximum 2.5 % span length (27.5) was recorded by LH 1972. The maximum GOT % (32) was recorded by four entries namely RS 810,Pusa 3216, LH 1948 and KDCAKD.

Trial No. 3: **Local robust cotton plant ideotypes**

Twenty eight entries were tested in three replications against the check LH 1556. None of the entry gave significantly higher seed cotton yield over the check. The maximum GOT % (39) was recorded by C 1830. The highest boll number (18.2) and boll weight (3.3 gm) was recorded by C 1830 and CISV 26, LH 1556 respectively. The highest span length was recorded by CNH 36.

Trial No. 4: **Local compact cotton plant ideotypes.**

Twenty eight entries were tested in three replications against the check RS 810. None gave significantly higher seed cotton yield over the check. The maximum GOT % (37.5) was recorded by CISV 2. The highest boll number (23.5) and boll weight (3.6 gm) was recorded by CISV 13 and CISV 23 respectively. The highest span length (27.7 mm) was recorded by CISV 23.

**MMA 4: Improvement of medium long and extra long staple fibre suitable for high-speed spinning.**

**Nagpur** (V.N.Waghmare).

This year, 58 *G. hirsutum* and 70 *G. arboreum* genotypes were evaluated for yield, GOT and other fibre properties. The genotypes with high yield and high ginning outturn included PKV 081, Rajat, MCU 10, Arogya Coker 310, T x ORS 80 and M 18. Some genotypes were found to possess more than 40% GOT (G.Cot 100, CNH 36, Rajat, Arogya and LRK 516).

**Coimbatore -** (K.N. Gururajan).

**Screening for suitable sources of high fibre strength in available gene pool**

Forty one single plants were evaluated mainly

for their quality parameters. The selected plants studied recorded fibre strength ranging from 20.9 to 30.1 g/tex. All the plants tested belonged to long staple category. Genotypes (M5 x Z2) 1211-1-4, (M5 x Z2) 411-1284 and HLS 72 (M5xZ2) 7351-22-4-2 showed all round improvement in fibre qualities.

**Screening for suitable source for high ginning outturn in available gene pool and breeding material.**

Out of 100 germplasm lines evaluated, as many as 15 lines with ginning out turn of 36 and above were selected. Buri 0394, G 21-17-903 and Glandless High GP Fuzzy recorded more than 40 per cent ginning out turn.

Forty interracial derivatives were evaluated for ginning out turn and fibre properties. Culture D2 x RK –B1 with a mean seed cotton yield of 1956 kg/ha and a high ginning out turn of 41.2 per cent was the best.

**Identification and development of genotypes with combination of long and extra long staple, high fibre strength and high ginning out turn.**

Seventeen advanced extra long staple *G. hirsutum* cultures were evaluated along with three checks in a replicated trial. Five cultures recorded significantly higher yield than the best check Surabhi. The ginning per cent varied from 32 to 40 per cent and as many as seven cultures recorded a ginning out turn of 37 per cent and above. 2.5 per cent span length varied from 28.1 to 35.1 mm , micronaire from 3.8 to 5.2, bundle strength from 19.1 to 23.3 g/tex and elongation per cent from 4.0 to 6.5. Cultures L(RCH x T13)LB 74-4 and L (RCH x T13) LB 222-5 showed all round improvement in yield and quality.

**Development of new breeding materials for further selection**

Fourteen $F_2$ segregating progenies were evaluated for various quality parameters. The ginning outturn varied from 29 to 36 per cent, 2.5% span length from 28.3 to 31.6 mm, bundle strength from 20.8 to 27.3 g/tex. Similarly, the materials showed variation for elongation percentage and short fibre content. Single plants (M5Z2 x M9ROK) 2-3, (M5 Z2 x M9ROK) 4-3 and (M5 Z2 x M9ROK) 18-3 recorded all round improvement in fibre qualities.

**Sirsa -** (O.P.Tuteja and Surender Kumar).

**Screening for suitable sources for high fibre strength in available gene pool and breeding material.**

**Trial 1 :** The trial consists of 16 entries and two checks varieties RS 810 and H 1098. Only two entries 101 (1326 Kg/ha) and 106 (1280 Kg/ha) showed higher seed cotton yield as compared to checks.

Three entries *viz.,* 101, 112 and 958 showed higher GOT of 32.7%, 33.0 and 32.3% respectively over check. The entry no. 923 recorded the highest 2.5 % span length of 28.1 mm. The micronaire value ranged from 3.9 to 5.0. The maximum fibre strength of 21.5 g/tex was recorded by the entry 923.

**Trial 2.** The trial consists of 46 CISV entries and two checks. Significantly higher seed cotton yield in the trial found to be in entry CISV 16 P3 ( 1149 Kg/ha) followed by CISV 29 P2 (1132 Kg/ha) and CISV 16 P10 (1046 kg/ha), were the local checks. Maximum GOT was shown by the CISV 4 P5 (42%). Maximum 2.5% span length was recorded in CISV 1556 P3 (27.8 mm)

**Trial 3.** Thirty five entries for long fibre received from CICR Nagpur were evaluated against local check RS 810. Only one entry CAT-133 gave higher seed cotton yield i.e. (1303 Kg/ha) over check. Maximum boll weight of 3.8 g was recorded in CAT 456 and 3.6 g in CAT 133. The entries CAT 217 and CAT 658 recorded the highest ginning out turn of more than 36.0%. The 2.5 % span length was found to be maximum in CAT-6 (27.4 mm) CAT 456 entry showed the micronaire value of 4.0. Similarly none of

entries could show the fibre strength more than 21.3 g/tex.

**Trial 4.** Thirty five entries for high fibre strength received from CICR, Nagpur were tested against check H 1098. CAT 1058 was found to give seed cotton yield of 1063 Kg/ha on par with check H 1098 (1132 Kg/ha). None of entries could record the ginning outturn comparable to check H 1098 (32.0%). The 2.5% span length was maximum in CAT-52 i.e. only one entry CAT 1633 gave the highest strength of 22.0 g/tex as well as micronaire value of 4.0.

**Trial 5.** Eighty nine $F_5$ progenies were evaluated in this trial against two checks H 1098 and RS 810. Highest seed cotton yield was found in the entries CISH 28 i.e. 2237 Kg/ha followed by 2146 Kg/ha, 2100 Kg/ha and 2055 Kg/ha yield given by entries CISH 31, CISH 32, and CISH 35 respectively. Maximum GOT was found to be 37% in two entries i.e. CISH 40 and CISH 64, in comparison to 34.0 % of GOT found in two local checks. Maximum 2.5% span length of 28.0 mm was observed in entries CISH 61 followed by 27.5 mm in CISH 56, whereas local check H1098 gave only 25.0 mm and RS-810, 23.0 mm. Only four progenies viz. CISH 3, CISH 36, CISH 37 and CISH 40 recorded more than 22.0 g/tex bundle strength.

### MMA 5: Quantitative and Qualitative Improvement of Cottonseed Oil.

**Nagpur** (D.K.Agarwal and Mukta Chakrabarty).

A set of twenty nine advanced cultures were evaluated for seed oil content and fibre traits, Culture 3 HS (24.9) recorded highest oil % followed by 2 HS (24.4). 10 HS performed the best for seed cotton yield (15.33 q/ha). For fibre technological properties viz., culture 2A II recorded highest value for 2.5 % staple length (27.4 mm) while 30 AI recorded maximum bundle strength (22.0 ). A total of 118 single plant selection progenies of *G. hirsutum* in various filial generations ($F_1$-$F_5$) were evaluated for seed oil content, seed cotton yield and mean halo length. Lines 17SC, 25 K, 14 K, 34 K and 22 K recorded seed oil % to the tune of more than 25%. Lines 14 K and 32 K, apart from oil content, registered good values for fibre length (>26.0 mm 2.5 % SL) and strength (> 22.5 3.2 mm g/tex) also. Apart from these 381 lines received from Sirsa and 19 lines from PAU, Faridkot were also evaluated for seed oil content. A number of lines among Sirsa material recorded >27%.

Deploying population improvement technique in developing suitable selection platform for lines with high seed oil content, a total of 70 new crosses were effected through intermating among selected genotypes in advanced generations having good seed oil content. Among the crosses attempted in the previous year 57 new single plant selection from $F_2$ generation were made. Single plant progenies 43 M, 3 M and 45 M performed better on the basis of seed cotton yield/ plant (approx. 100 g / plant), while 21 M and 58 M recorded high values for mean halo length (>28.0 mm).

**Coimbatore -** (N. Gopalakrishnan and K.N. Gururajan).

Twenty genotypes from the participating centre and eighty advanced germplasm lines available at Coimbatore were evaluated for seed oil content. F 776 and SA-21 received from Faridkot and HOC 2 and HOC 5 PAU possessed seed oil content of 23% SOCB 52, SOCB 62 and SOCC 17 possessed higher seed oil content of 25%. Supriya, Khandwa, MCU 5 and NME 70 possessed high oil content ranging between 22-25%. In general, the *G.barbadense* germplasm lines available had lower oil percentage. GA 28 and GA 39 had higher oil content of 22% among *G.arboreum* lines, while G.Cot.13 had higher oil content of 18%.

**Sirsa -** (O.P.Tuteja and Surender Kumar).

Trial 1. **Estimation of oil content in differ-**

**ent germplasm lines for identification of sources of high oil content and quality.**

The trial consists of 106 entries of germplasm lines maintained at the station. Maximum oil content was recorded in germplasm line CISV 45 (26.5%) KH 2 (26.4%) followed by CISV 46 (26.3%). CSHH 238 (26.2%) against the local check RS 810 (26.0%). Out of 106 entries tested, 28 entries showed more than 25% oil content.

Trial 2 **Performance of naked seed entries for seed cotton yield and component traits.**

The trial consist of 16 entries of naked seed. The maximum seed cotton yield of 1701 Kg/ha was recorded in V3-73/355-p2 followed by 1509 Kg/ha in V3-73/355-p6 and 1281 Kg/ha in F4.102-p1. Maximum number of bolls/plant was recorded in SH-2329-p8 (34.0) followed by V3-73/ 355-p1 (33.7) and V3-73/355-p6 (30.7). Maximum boll weight was recorded to be 3.1 g in V3-73/355-P6 followed by 3.0 g in V3-73/355-p2 and 2.9 g in SH-2379-P14. GOT was found to be maximum in SH-2329-P39 (37.0%) followed by V3-73/355P2 (35.0%) and V3-73/355-P3 (33.0%). 2.5 % span length was recorded to be maximum (28.3 mm) in SH-2329-P6 followed by 27.7 mm in two entries i.e SH-2329-P2 and SH-2379-P8.

Trial 3. **Evaluation of different cultivars of *G. hirsutum* for seed cotton yield and oil content.**

This trial consists of 11 CISV entries and five checks. None of the entry was found to be superior for seed cotton yield than the 5 local checks. Yield of only one entry CISV 44 was at par with local check RS 810 (1543 Kg/ha). Maximum no. of boll/plant was recorded in CISV 44 (23.1) followed by 20.2 bolls/plant in CISV 33 which is higher than the local checks. Maximum weight of boll was found in CISV 44 (3.3) followed by CISV 24 (3.2), which is higher as compare of the local checks. Maximum GOT was found to be 35.5% in CISV 30 and CISV 44. Oil content was Maximum in CISV 47 (26.1%) followed by CISV 29 (25.9%), whereas it was (26.0%) in RS 810.

Trial 4. **Evaluation of different hybrids of *G. hirsutum* for seed cotton yield and oil content.**

Thirty one crosses obtained during 2000-01 were evaluated for seed cotton yield and oil content. Maximum yield of 2329 Kg/ha was recorded in SPC-7x CIR-9 followed by 2197 Kg/ha in SPC-37x CIR-72. Maximum oil content was recorded 25.6% in SPC-11 x CIR-15 followed by 25.5% in SPC-22 x CIR-72.

Trial 5. **Estimation of oil content in miscellaneous entries (crosses & single plant selection).**

The trial consists of 87 entries of miscellaneous lines and crosses being isolated from the various segregating material. It was interesting to find out that the crosses involving LRA 5166 as female parent has shown the oil content more than 27.0%. These crosses are LRA 5166 x 39, LRA 5166 x 10, LRA 5166 x 8, LRA 5166 x 35 and LRA 5166 x 34 against the local check RS 810 (26.1%). The $F_2$ of these crosses will be grown next year to isolate the desirable segregants.

**Coimbatore**

**MMA 6: Overcoming incompatibility barriers in interspecific crosses of cotton**

(S. Manickam and A. H. Prakash).

Crosses were effected between two cultivated species of cotton viz., *Gossypium hirsutum* and *G. herbaceum* as female parents with four wild species viz., *G. armourianum*, *G. anomalum*, *G. aridum* and *G. triphyllum* as male parents during the summer season of 2001. Out of 3009 flower buds crossed using the above parents, 37 bolls were set with a boll setting efficiency of 1.23%. Attempts were also made to cross *G. hirsutum* with the above wild species during the *kharif*, 2001-02. In this season, out of 1490 floral buds

crossed, 82 bolls were formed with a setting efficiency of 5.5%.

Pistils were collected from the plants, cultivated species pollinated with pollen grains of wild species at 24 hrs after pollination to study the pollen-pistil interactions. They were fixed in fixative (3:1, Ethyl alcohol: Glacial Acetic Acid, V/V) for over night and then transferred to 70% ethyl alcohol and stored in refrigerator at 4°C for further studies.

The pistils were collected from wide crosses effected during the summer, 2001 for the *in vitro* embryo culture. The embryos were extracted aseptically from the flower buds at 3 DAP from the crosses viz., DB 3-12 x *G. armourianum,* LRA 5166 x *G. anomalum*, Jayadhar x *G. anomalum*, G. COT 13 x *G. armourianum*, LRA 5166 x *G. aridum* and G. COT 13 x *G. aridum* and cultured in MS medium with various combinations of IAA, GA and Kinetin. Efforts were also taken to culture immature embryos from the crosses effected between LRA 5166 as female parent and *G. triphyllum* and *G. aridum* as the pollen parents during the kharif, 2001-02.

## Seed Technology

### MMB 1: Maintenance of genetic purity of released varieties and parents

**Nagpur -** (R.K.Deshmukh, V. Santhy and P.Singh).

Comparative performance of superior bulk, model bulk, ordinary bulk, selected tall plants from breeder seed and normal plants from breeder seed was studied. Highest per plant yield was obtained from selected tall plants from breeder seed and lowest yield was obtained from the plants raised from ordinary bulk.

**Coimbatore -** (K. Rathinavel)

The results of field experiment conducted during winter 2001 with seeds from single plants of varieties LRA 5166 and Sumangala, designated to superior bulk (A), model bulk (B) and ordinary bulk (C) raised along with breeder seed revealed significant differences due to bulks in both the varieties.

The plants raised from superior bulk of both the varieties came to flowering earlier than the ordinary bulk and on par with the breeder seeds. In case of LRA 5166, the model bulk performed equally with superior bulk and breeder seed. The number of days to 50% flowering, completion of flowering and first boll bursting were also exhibited the similar trend. The number of sympodia recorded was maximum especially in superior bulk of Sumangala (15.6) when compared with ordinary bulk (13.7). Superior bulk of LRA 5166 and model bulk of Sumangala showed the better performance for morphometric character such as plant height.

The number of bolls plant$^{-1}$, bolls weight and yield ha$^{-1}$ exhibited significant variation among the bulks. The number of bolls plant$^{-1}$ recorded was maximum in superior bulk of LRA 5166 and breeder seeds of Sumangala. In case of Sumangala the superior bulk and model bulk were on par with the breeder seed. The 10 bolls weight recorded was maximum in model bulk in both the varieties, whereas the maximum yield ha$^{-1}$ was recorded in model bulk of Sumangala followed by breeder seed of LRA 5166. But the ordinary bulk exhibited the lowest values when compared with the other bulks. The seed weight, lint weight, seed index, seed number and ginning percentage exhibited significant variations among the bulks. Better performance of the fibre quality parameters like span length and bundle strength were registered in superior bulk followed by model bulk and breeder seed when compared with ordinary bulk. Similar trend of results were also recorded in case of seed quality parameters like germination, root length, shoot length, dry matter production and seedling vigour index.

**Sirsa -** (R.A.Meena).

Based on morphological characters, last year

130 progenies of female parents and 54 progenies of male parents were selected. These progenies were grown during this year and evaluated based on their identified distinguishable characters and 20 true to the type superior progenies were identified in the field. Crosses among these 20 progenies were made to get $F_1$ seed. In the field these 20 progenies were also evaluated for minor differences in flower characters, seed characters and fibre properties. Finally five true to the type progenies of each parent were selected. The crosses of these progenies only will be evaluated for trueness of hybrid in next year to identify true combination.

**MMB 3 : Pre and post harvest management techniques for improvement of seed quality.**

**Nagpur** - (R.K.Deshmukh and V. Santhy).

Soaking the seed in potassium hydrogen phosphate (100 ppm) improved the first count emergence as well as final germination percentage.

Detopping at 90 DAS gave the highest yield. Further, the detropping at 120 DAS also improved the seed cotton yield. Spraying of defoliant reduced the yield significantly.

**Coimbatore** - (K. Rathinavel).

**Effect of growth hormones and chemicals on field emergence, phenology and morphometric characters.**

Soaking of seeds in succinic acid @. 0.2% for 6 hours recorded significantly higher field emergence of 98%, days to 50% flowering, the number of days taken for completion of flowering and also for the days taken for first boll bursting. The observations on the morphometric characters such as plant height, number of sympodia, number of bolls per plant revealed significant variation due to the seed soaking treatment, foliar application of growth hormones and the interaction of both.

**Effect of crop management practices on seed quality**

The number of bolls plant$^{-1}$, boll weight and yield ha$^{-1}$ were maximum in plants when topping was done at 120 days and spraying of ethrel @ 450 g a.i. at 160 days after sowing. A maximum seed cotton yield of 1131.2 kg ha$^{-1}$ was recorded in the above treatment when compared with other treatments. Seed quality parameters like root length, shoot length and vigour index differed significantly due to topping and spraying of defoliant. The maximum root length was recorded in topping at the age of 90 days, while, the shoot length and vigour index were recorded the highest values in topping at the age of 120 days followed by 90 days.

**Effect of micronutrient spray on seed quality**

Foliar application of borax @ 0.5% had taken minimum number of days for completion of flowering and boll bursting followed by spraying of $CuSO_4$ @ 0.5% against the control. The number of sympodia recorded was highest (18.2) in borax sprayed plants than the control (14.0). The boll weight (3.70 g) and seed cotton yield ha$^{-1}$ (981.75) were maximum in borax @ 0.5% spraying when compared to control. The number of bolls plant$^{-1}$ were maximum (26.8) in $CuSO_4$ @ 0.5% spraying followed by borax @ 0.5% spraying (26.2). The highest values for quality characters like seed index, lint index and seed number boll$^{-1}$ were registered in plants sprayed with borax @ 0.5%. Seed quality characters such as germination, root length, dry matter production and vigour index values were maximum in $CuSO_4$ @ 0.5% spraying followed by borax @ 0.5% , while the shoot length recorded was on par (13.9 cm) in both the treatments.

**Sirsa** - (R.A.Meena).

**Effect of Foliar application of chemicals**

Two popular north zone varieties i.e. H 1098 and RS 810 were selected for this study. The chemicals were sprayed on the crop at 60 and

75 days after sowing. Higher number of bolls per plant, boll weight, seed cotton yield, G.O.T. and seed quality parameters were noticed when these chemicals were applied as compared to control.

**Identification of suitable crossing period for getting higher yield to reduce the cost of seed production**

The study was conducted on hybrid Om Shankar and LHH 144. On 20-selected female plants of each hybrid, crosses were made from beginning to completion of flowering. The most suitable crossing period was noticed from 15th August to 15th September. The crossed boll setting percentage was noticed above 50 per cent during this period in both the hybrids. The seed obtained from crossed bolls of this period also showed higher seed index, germination percentage and vigour index. The crossed boll setting percentage declined gradually after this period. In case the crosses were made after 5th October the crossed boll remained unopened due to low temperature during its maturity.

**Effect of crop management practices on seed quality**

Topping was done at 90 and 120 days after sowing in variety HS 6. It was observed that topping at 90 DAS provided more yield, bolls, No. of seeds/boll.

**On farm trial**

The performance of $F_1$ seed and $F_2$ seeds of hybrid LHH 144 was compared at farmers' field in village Mirpur. The yield obtained was 7.6 quintal per acre in case of $F_1$ and 4.8 quintals per acre in case of $F_2$.

**Popularization of seed production by training the farmers in the adopted village**

One week training for hybrid seed production was organized at the station from September 9 to September 16. Under this programme about 50 farmers obtained the training. After receiving training from this station, farmers started crossing programme in their own fields. For this purpose parental seed of hybrid Om Shankar and LHH 144 were also given to farmers.

**Post harvest management techniques**

Evaluation of physical, physiological and genetic quality of seed samples collected from different sources: 500 g. of seed of market grade popular variety H 1098 was collected from market and evaluated for germination percentage, physical purity, genetic purity and seed health parameters in three replications. The germination percentage (60%) in the market-graded seed was much lower than certified seed (78%). The mixture of other plants was also observed up to 13% in market graded seed crop.

The different types of seeds of variety of H 1098 were evaluated for seed index germination percentage and vigour index. The delinted graded seed and delinted processed seed were found superior than other category of seeds in respect of germination percentage and vigour index.

The seeds of popular varieties of various centres were obtained. These seeds were packed in cloth and polythene bags and stored under ambient conditions. The data on germination and vigour index are being recorded at three month intervals.

# Biotechnology

**P1-91/1-ICR-F30/0430:**

**Development of tissue culture protocols for use in breeding and genetic transformation** (S.B. Nandeshwar and A.B. Dongre).

**Performance of R-II plants derived by tissue culture techniques**

Plants regenerated by the multiple shoot induction technique were grown in field as R-I generation by adopting normal pest control measures and fertilizer doses. Ten plants each of six regenerated varieties were studied for various morphological characters. Single plant selections were made based on earliness and other yield attributing characters. In all, 108 plants of Coker 312, 219 plants of LRK 516, 103 plants LRA 5166, 23 plants of Stoneville, 3 plants of Khandwa 2 and 36 plants of Indore 2 were grown in field.

**Regeneration of diploid cotton *G. arboreum***

**a) Callus induction and somatic embryogenesis**

Regeneration of cvs RG 8, AKH 4, AKA 5, AKA 8401 was investigated. Hypocotyl explants were evaluated against various growth regulator combination and media for callus induction was perfected. The MS medium supplemented with IAA and kin (2+1 mg/l) was found to be the best for callus induction. Amongst all four combination somatic embryogenesis was observed in IAA 1.5+kin 1.0 mg/l. For somatic embryogenesis, callus was sub-cultured in medium with high nitrogen source. The calli showed globular somatic embryos all over its surface.

Hypocotyl explants cultured in medium containing IAA 1.5 mg/l + kin 1.0 mg/l showed 41.66% callusing while it was very less in medium containing equal proportion of IAA + Kin in medium with high nitrogen source. The calli showed globular somatic embryos all over its surface.

b) **Regeneration by multiple shoots**

Delinted seeds of cvs RG 8, AKH 4, AKA 5 and AKA 8401 were surface sterilized with liquid detergent followed by transfer in 1.0% solution of Bavistin for 20 min and mercuric chloride (0.1%) for 7 min. The seeds after washing 3-4 times, were cultured in half-strength Murashige and Skoog medium with 12-15 seeds in each flask. The seeds were grown initially in dark for 4 days and later transferred to 16:8 hrs photoperiods. Shoot tip explants were excised from various age group of seedling and used in regeneration studies.

**Explant:** The shoot tip explant consisted of apical meristem covered with primordial leaves to supply indigenous harmones and coty node attached to the one fourth portion of hypocotyls. Explants were cultured on MS medium supplemented with myo-inositol (100 mg/l) thiamine (10 mg/l), glucose (30 g/l). The pH of the medium was kept at 6.0 before autoclaving. In all, 1060 shoot tips were cultured in the medium containing BAP (2 mg/l). All the cultures were incubated at 50±2 $^0$c under 16:8 hrs. of photoperiod.

**Observations:** Seven days old shoot tip explant of cv RG 8 recorded highest percentage of multiple shoot induction (81.1%). This was followed by cv AKA 8401 where frequency of multiple shoots was 80%. In AKA 5 and AKH 4, the frequency was above 50%. In AKA 8401 the 12 days old seedling re-

sponded to multiple shoots in 78.4% of the explant followed by 57.3% in 16 days old explant. The genotypic differences with regard to induction of multiple shoots was not much. The cultivars RG 8 and AKA 8401 recorded more or less similar response. This showed that effect of variable seedling age on shoot induction was more. Nearly 30 days are required to induce a mass of shoots bud and after 2-3 passages in reduced hormone combination, the mass is differentiated into well-defined shoots. The shoots were rooted in medium with lower glucose concentration. The rooted plants were hardened and established in the soil.

### Evaluation of cotton germplasm through molecular techniques

(A.B. Dongre, J. Amudha, S.B. Nandeshwar, G. Balasubramani and V. V. Singh).

Genomic DNA was isolated from sixteen wild species and 100 germplasm lines. The DNA was used as template for RAPD analysis using random primers to obtain DNA fingerprints and phylogenetic mapping was done using the computer software.

### Gene tagging for Leaf curl virus resistance

RAPD analysis was carried out with cotton leaf curl virus (CLCuV) resistant (CNH 123, CNH 1012) and susceptible (CNH 1020, CNH 120) accessions. These lines were characterized using 80 decamer primers by amplification in a PCR. The primer OPC 02 produced polymorphic fragment in the resistant lines CNH 123, CNH 1012 and it is designated as OPC 02 (1700 bp).

Ten resistant and susceptible $F_2$ DNA were pooled for bulk segregant analysis and amplified with the same primer OPC 02, which also produced the 1700 bp fragment and confirmed it repeatedly. This fragment has been converted into SCAR marker and the primer pair designed was 5' GTGAGGCGTCAGAGGGAT –3'(forward) and 5' -GTTGCCGTGCACTAGGCT – 3' (reverse). The $F_2$ segregating RAPD loci were mapped using mapmaker program into ten groups.

## National Agricultural Technology Project

**MM 4 : Development of Bt transgenic cotton (*G. hirsutum* L.)** (A.B. Dongre, S.B. Nandeshwar, G. Balasubramani and K.R. Kranthi).

### Agrobacterium – mediated gene transfer in Indian cultivars of *G. hirsutum*

Genotype independent transformation and regeneration of Indian Cotton (*G. hirsutum* L.) cultivars were carried out with Bt cry I A (c) gene by *Agrobacterium* mediation. Apical meristem of elite Indian cultivars viz., Anjali (LRK 516), LRA 5166, PKV 081, MCU 5 and H 777, were co-cultivated with *Agrobacterium tumefaciens* EAH 105 carrying synthetic Bt cry I A(c) + npt – II genes. Putative transformants were regenerated by direct shoot organogenesis in the selection medium containing 100 ug/ml kanamycin. Putative transformants were obtained after 3-4 weeks of culture. Around 42 putative transformants of different cultivars are under selection medium. However, the transformation frequency was found to be 0.3%.

### CGP-I: Induction of para-nodule in cotton with nitrogen fixing bacterium *Azorhizobium caulinodans*

(G. Balasubramani and J. Amudha).

*Rhizobium* and *Azorhizobium* strains from their hosts were isolated. Fast and slow growing 12 cultures were selected on Congo red medium and all were characterized using standard tests like reaction on Bromothymol blue, gas production, growth on lactose agar medium and growth in Hofer's alkaline medium. All the cultures were used for nodule induction in cotton. *In vitro* root induction studies were carried out using shoot tip of cotton (*G. hirsutum*) cv LRA 5166 and LRK 516 with different growth hormones viz. IAA, IBA, $GA_3$, NAA and 2, 4-D. Among these growth hormones used, IBA 0.4 mg/l induced more roots (average 20 roots/plant). The fresh roots

were treated with log phase cultures of rhizobia. Among 12 cultures tested, fast growing *Rhizobium fredii* (isolated from *G. max*) induced nodules after 10-15 days of inoculation. Around 50 nodular structures were observed all over the root system. Rhizobia were located in the nodular structure and it was re-isolated on the Congo red medium.

## RCPS-10: Development of Bt transgenic diploid cotton against bollworm

(S B. Nandeshwar).

### Transformation of shoot tips

Transformation was carried out with the meristematic cells of shoot tips by *Agrobacterium*. Shoot tips measuring 0.5 mm long from *in-vitro* germinated seedlings were pre-cultured for two days in MS medium containing 0.1 mg/l kinetin. The actively growing shoot apices from these shoots were excised and inoculated with *Agrobacterium* strain EHA containing Cry I A(b) and Cry I A(c) genes. The inoculation period ranged from 3, 23, 48 and 72 hrs. After different hours of inoculation, the shoot tip explants were removed blot dried and co-cultivated for one week. Later, the explants were subjected to selection medium containg Kanamycin (50 mg/l), Carbanicillin (500 mg/l) and Cephotoxine (250 mg/l). The surviving explants were grown in regeneration medium.

### Transformation with Cry IA (b)

Two types of gene constructs were used i.e. Cry IA(b) and Cry I A(c). Four prominent cultivars currently under cultivation in North and Central India were exploited for this purpose. The cry I A(b) gene was used in 1264 shoot tips of RG 8, 2316 shoot tips of AKA 8401 and 55 shoot tips of AKH 4. While 766 explants were co-cultivated with Cry I A(c) gene in RG 8 and 601 shoot tips in AKA 8401.

### Transformation with Cry I A(c) gene

In RG 8, 766 shoot tip explants were inoculated with Cry I A(c) gene for 24, 48 and 72 hrs respectively. After co-cultivation for one week, all the explants were subjected to selection medium. The selection medium consisted of MS basal formulation, Kanamycin (50 mg/l), carbanicillin (500 mg/l) and cephotoxine (250 mg/l). The number of explants growing on kanamycin medium were 40 and 33 which were isolated from 24 hrs and 48 hrs of inoculations. In case of AKA 8401, 28 shoots were isolated.

**Gene integration:** Some of the samples of putative transformed shoots were collected and tested for ELISA positive at CICR, Nagpur. Few sample showed positive response to gene integration.

### Micrografting

Delinted seeds of LRA 5166 were germinated in plastic pots containing soilrite. Shoot tips of the germinated seedling was cut transversely just above the cotynode. This stock of seedling without shoot tips was used for micrografting.

For micrografting, vertical cut about half an inch deep between the two cotyledonary leaves was made with the help of sterile blade. Shoot tips of transgenic cotton seedling germinated aseptically in glass jar were isolated. These shoot tips were again given thin and oblique cut from both the sides of the base of shoot tip so as to assume 'V' shaped structures. Such shoot tips were later grafted in the vertical slit made in the seedling of LRA 5166. The micro grafted portion of seedling was tied closely round with the help of cellophane tape. The whole micrografted seedling was covered with the polythene bag for one week. Out of 50 micrografted seedling of LRA 5166, only two were successful and established. The leaf samples will be tested for the presence of Cry protein .

# Technology Mission on Cotton

**MMB 2: Molecular characterization of released varieties, parental lines of hybrids, germplasm and wild species of *Gossypium*** (A.B. Dongre).

Fresh leaves of 12 wild species of *Gossypium* viz. *G. thurberii, G. lobatum, G. mexicanum, G. barbosanum, G. africanum, G. harknessii, G. aridum, G. davidsonii, G. sinense, G. somalense. G. stocksii, G. sturtianum* were collected in cold condition and their DNA was isolated. RAPD reaction were carried out.

Out of 20 primers used, almost all primers generated polymorphic markers. Among those, only twelve generated reproducible DNA fragments ranging in size of 200-2050 base pairs. The number of markers produced by each primer in this study varies from 3 to 15. Out of one hundred and thirty three amplified bands, 118 (88.7%) were found to be polymorphic. Presence of the unique bands for each species is the specialty of most of the primers. Almost all bands amplified by primer no. 19 were polymorphic. Most of the primers gave more polymorphic bands than monomorphic except primer no. 12, which gave 5 monomorphic primers. This shows the high level of genetic diversity and low similarity among the wild species of the *Gossypium*.

**MMA 6: Overcoming incompatibility barriers in inter-specific hybridisation in cotton** (S.B. Nandeshwar).

Under this project the following crosses were effected between *G. arboreum x G. hirsutum* and *G. hirsutum* x *G. arboreum*. Crosses were also affected between diploid cultivated and wild species.

***G. arboreum* x *G. hirsutum* crosses**

Genotypes of *arboreum* i.e. AKA 8401, AKH 4, AKA 5 and RG 8 were crossed with G cot 10, MCU 5 and AKH 081.

Highest boll setting amongst all the crosses was recorded in cross AKH 4 x MCU 5 followed by AKA 5 x G cot 10. The number of seeds/boll was recorded highest in AKA 5 x MCU 5 followed by AKH 4 x AKH 081 and AKA 5 x AKH 081 respectively. Lowest boll setting was obtained in AKA 8401 x MCU 5 followed by cross AKA 8401 x AKH 081 and number of seeds per boll was recorded lowest in crosses AKA 8401 x G cot 10 and AKA 8401 x AKH 081 respectively.

***G. hirsutum* x *G. arboreum* crosses**

*G. hirsutum* cultivars G cot 10, MCU 5 and AKH 081 were crossed with AKA 8401 and RG 8. Of nearly 800 crosses made, boll setting percentage was observed lower in most of the crosses. Highest setting per boll was recorded in cross MCU 5 x AKA 8401 followed by MCU 5 x RG 8. The lowest number of seed set was obtained in cross AKH 081 x AKA 8401. Crosses involving RG 8 as male parent has set the seeds in all the crosses.

Highest boll setting among *arboreum* x *hirsutum* crosses was in AKH 4 x MCU 5, followed by AKA 5 x G. cot 10. No. of seeds per boll was highest in AKA 5 x MCU 5 followed by AKH 4 x AKH 081 and AKA 5 x AKH 081. Lowest boll setting was in AKA 8401 x MCU 5 followed by AKA 8401 x AKH 081. No. of seeds/boll was lowest in cross AKA 8401 x G. cot 10 and AKA 8401 x AKH 081.

In almost all the crosses, boll setting percentage was lower. Highest seed setting per boll was recorded in cross MCU 5 x AKA 8401 followed by MCU 5 x RG 8. The lowest number of seed set was observed in cross AKH 081 x AKA 8401. Crosses involving RG 8 as male parent has set the seeds in all the crosses.

**In-ovule-embryo culture (AKH 4 x MCU 5)**

The cross-pollinated ovaries of the above cross were collected at 5-6 DAP, 8-10 DAP and 12-15 DAP. The ovules were removed after surface sterilization and cultured in MS medium with different hormone combination. Ovules 12-15 DAP of the above cross cultured in embryo development medium regenerated in to plant .

# Crop Production

## Nagpur

**Studies on use of harvested rain water for recycling at critical stages of rainfed cotton for augmenting its production in vertisols** (K.S.Bhaskar).

Seed cotton yield was positively correlated with number of irrigation at various crop growth stages, seed cotton yield increased in all the soils accordingly. It was highest (14.31, 17.10 and 23.45 q ha $^{-1}$) with four irrigations, and least (9.46, 13.98 and 15.38 q ha $^{-1}$) under control in shallow medium deep and dap soil respectively.

Yield increased with depth of soil under uniform level of management. It was 9.46 q ha $^{-1}$ in shallow, 13.98 q ha $^{-1}$ in medium deep and 15.38 q ha $^{-1}$ under very deep soil even under control conditions. This showed that soil depth plays an important role in maximization of seed cotton yield under rainfed as well as irrigated situation.

Yield contributing characters such as seed cotton yield per plant (g), number of bolls per plant and boll weight per plant were also showing increasing trend in the same fashion as that of seed cotton yield and significantly supporting the yield accordingly in all the soils.

It may be inferred from the data that through selection of suitable soil and life saving irrigation at critical stages, the yield of cotton can be increased by 3 to 8 q ha$^{-1}$.

In addition to this, additional data on rainfall characteristics, runoff water storage and recycling along with yield contributing characters has also been recorded.

**Studies on water use efficiency in rainfed cotton through drip irrigation in vertisol** (K.S.Bhaskar, Jagvir Singh, A.R.Raju and G. Majumdar).

It is very clear from the data that with increasing number of plants per hill, the yield of cotton was increases. It was highest (18.73 q ha $^{-1}$) under P3(3 plants per hill) closely followed (18.45 q ha $^{-1}$) by P2 ( 2 plants per hill) and the lowest (17.63 q ha $^{-1}$) under P1. The yield difference between P3 and P2 was not significant due to narrow increase of seed cotton yield by about 28 kg ha$^{-1}$ only. Further, result showed that there was a yield plateau upto P2 and after that there was decline in yield trend, which was significantly supported by yield contributing characters, such as yield per plant, number of bolls per plant and boll weight.

**Studies on long term effect of nutrient management practices on the productivity, nutrient balance and sustainability of cotton based cropping systems** (Jagvir Singh, and Blaise).

Field experiment was conducted for 17$^{th}$ consecutive year to evaluate the effect of long term application of nutrients on the productivity and sustainability of cotton in cotton based cropping systems viz. C1: *G. hirsutum* (monocropping), C2: *G. arboreum* (monocropping) and C3: *G. hirsutum* cotton-jowar (rotation). Over the cropping systems, different nutrient combinations of NPK with or without FYM or FYM alone were studied. Experiment was laid out in split plot design with three replications. Due to severe incidence of bollworms in cotton of both the species, treatment effects were not comparable and yields were very low ranging from 3.0 to 7.1 q/ha *hirsutum* monocropping from 3.0 to 11.1 q/ha *hirsutum* rotation and from 6.6 to 16.0 q/ha *arboreum*. However, *arboreum* cotton gave significantly higher yield over *hirsutum* cotton mono and rotation cropping. Seed cotton yield was the least in control and in the plots where no P was applied. Lowest seed cotton was recorded in treatment T8 (N90) may be due to high incidence of bollworms even lower to control. In general, yields of both genotypes were significantly lower than the mineral fertilized plots where combined application of organic

and inorganic fertilizers was given. The mean seed cotton yield data indicate the increase in yield with NPK + FYM over NPK was 20-38 %. Agronomic efficiency of fertilizer N ($AE_N$) of *G. arboreum* was more than *G. hirsutum* for the mean seed cotton yields of 16 years (Table 4) (1985 –86 to 2000-01). This indicates that the *arboreum* cotton had better root system, better moisture and nutrient absorption from lower soil layers. *Arboreum* cotton out yielded *hirsutum* cotton in all the years and had higher nitrogen use efficiency of 10.1 kg seed cotton per kg N. Cotton-jowar rotation had a higher agronomic efficiency than monocropped cotton at lower doses of NPK. Weekly data on number of squares and flowers per plant and shedding of squares recorded from 15/10/01 to 6/11/2001 indicate that treatment $N_0 P_{13} K_{25}$ + 5 t FYM and $N_{30} P_{13} K_{25}$ + 5 t FYM had better effect on increasing number of squares and flowers whereas no difference in shedding of squares was observed within treatments. In different cropping system, *arboreum* monocropping had higher total N uptake as compared to *hirsutum* (in both system) may be due to its higher biomass. Similar trend was observed in case of total P uptake.

**Table 4 : Effect of fertilisers and cropping systems on seed cotton yield (mean of 16 years) and agronomic efficiency of applied N ($AE_N$)**

| Treatments | Seed cotton yield (kg/ha) | | | $AE_N$ (kg seed cotton/kg fertilizer-N) | | |
|---|---|---|---|---|---|---|
| | *G. hirsutum* | *G.arboreum* | *G.hirsutum Jowar* | *G. hirsutum* | *G.arboreum* | *G.hirsutum Jowar* |
| Control | 445 | 510 | 504 | - | - | - |
| N60 | 653 | 769 | 794 | 3.47 | 4.32 | 4.83 |
| N90 | 567 | 930 | 713 | 1.36 | 4.67 | 2.32 |
| N60 P13 | 880 | 1096 | 967 | 7.25 | 9.77 | 7.72 |
| N60 K25 | 638 | 893 | 762 | 3.22 | 6.38 | 4.30 |
| N60 P13 K25 | 953 | 1114 | 996 | 8.47 | 10.07 | 8.20 |
| N90 P19 | 1038 | 1267 | 1125 | 6.59 | 8.41 | 6.90 |
| N90 K37 | 731 | 988 | 702 | 3.18 | 5.31 | 2.20 |
| N90 P19 K37 | 1091 | 1276 | 1137 | 7.18 | 8.51 | 7.03 |
| Mean | 777 | 983 | 856 | 5.09 | 7.18 | 5.44 |

## Adhoc Trial

**Agronomic evaluation of hybrid CINHH 109, grown on medium deep soil** (Jagvir Singh and Suman Bala Singh).

Cotton hybrid CINHH 109 was sown late i.e. on 16th July, 2001 with three fertilizer levels, F1 - 60:30:30 (75 % RDF), F2 - 90 : 45 :45 (100 % RDF) and F3 - 90 : 60 : 60 (125 % RDF) + 30 kg N through 5 t FYM / ha on medium deep soil. Inspite of higher seed cotton yield of 14.56 q/ha obtained at higher dose of NPK (125 % RDF). Treatment differences with respect to yield attributing characters were not found significant. An increase in boll weight from 3.4 to 3.9 gm, number of bolls/plant from 20 to 26, seed cotton yield from 10.1 to 14.6 q/ha and nitrogen content in leaf from 1.8 to 2.5 % was observed due to higher dose of NPK (125 % RDF).

**Agronomic evaluation of Bt cotton** (M R K Rao, Jagvir Singh and Blaise).

Three Bt cotton hybrids viz 184, 162 and 12 of Mahyco Monsanto alongwith their non Bt counterparts and NHH 44 (local check) were evaluated under three fertility levels (125% of RDF, RDF and 75% of RDF). In general, fertility levels had little impact on yield realization, while 162 BT and 184 BT out yielded their respective non-Bt and local check. 184 Bt gave the maximum yield. The total dry matter production was relatively less in Bt hybrids as compared non-Bt counterparts and

local check. Pronounced earliness was evident in Bt hybrids as compared to others tested.

### Tillage and crop residue effects on soil, nutrient and cotton crop behaviour

(Blaise, C.D.Ravindran and N.Gokte – Narkhedkar).

Field experiment was conducted for the sixth consecutive year on the fixed layout with tillage treatments assigned to main plots and with (cotton leaf + stalks 1 : 1 ratio) and without residue as sub plots.

Results indicated no differences between the tillage and residue treatments. Yield in the reduced till-1 RT-1 and RT-2 plots ranged from 9.38 – 9.46 q/ha, while the yield in the conventional till plots was 9.55 q/ha. The early cessation of rain resulted in greater loss of fruiting structures at peak boll formation.

Since the studies were conducted on the fixed site, nutrient stratification was studied. A vertical stratification of nutrients especially P (Fig.1) and $NH_4$+ was noticed. (Fig.2). Among the tillage treatments, CT had lower nutrient content (available P and ammonium N) in the inter-row (IR) than RT-1 and RT-2. The trend was just reverse for between row (BR) samples. $NaHCO_3$ extractable P was higher in IR soil samples of the RT plots (Fig.1), with the maximum values noticed in RT2 where no intercultural operations were performed. These differences were conspicuous only in the surface layer (0-7.5 cm). Similar trend was noticed for the exchangeable $NH_4 \pm N$ (Fig.2). The nutrients were concentrated especially in the surface layer (0 – 7.5 cm) and decreased with depth (7.5 – 15 and 15-30 cm). Soil samples of 15-30 cm depth, in general, had the lowest nutrient content.

Fig. 1. NaHCO3 extractable -P stratification as affected by tillage methods

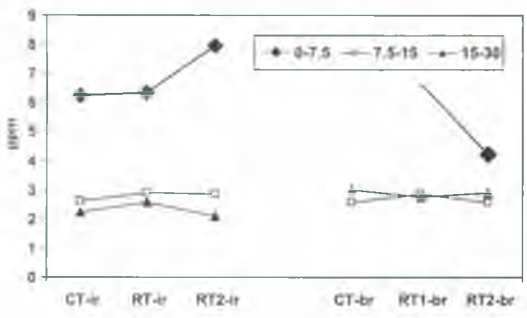
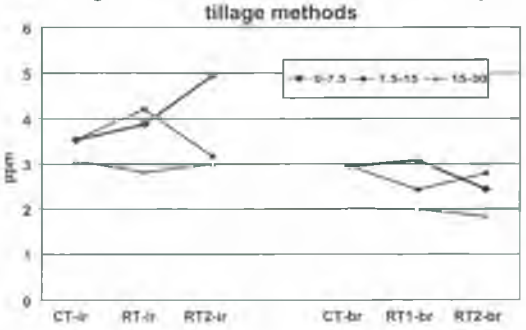



Fig. 2. NH4+ N stratification as affected by tillage methods




During the crop growth, residue recycled amounted to about 1.4 q/ha. This adds to the carbon pool and recycles the plant nutrients taken up by the crop.

Soil microbial biomass-C (SMB-C) content was higher in the reduced till plots compared to the conventional till plots. The mean SMBC content at peak boll formation in CT plots was 142.3 mg/kg, whereas the corresponding value was 173.8 – 23.1 mg/kg in the reduced till plots. Ant nesting sites were also greater in the RT than CT. These are pointers to improvements in the soil health when the RT system is adopted. However, there was no corresponding increase in yield. Factors responsible for this need to be elucidated.

### Development of bullock drawn seed drill cum planter for cotton sowing in vertisols

(G. Majumdar).

A two-row bullock drawn cotton planter for small farmers, especially for vertisols has been developed. The planter has been provided with various features like a simple tapping mechanism to clean the sticking soil on the drive wheel, thus maintaining accurate seed to seed spacing. Scrapers for cleaning the depth gauge wheel, so that the machine maintains uniform depth of seed placement. A marker has also been provided to lay the rows parallel to each other. It is possible to place fertilizer alongwith seed by an additional attachment.

The planter could cover about 0.2 ha. /hr with two rows at 60 cm spacing. In terms of energy requirement the planter uses 60.3 MJ/ha with a two-row spacing and 45.2 MJ/ha with a three-row spacing as compared to 78.5 MJ/ha for dibbling manually at 60x30 cm spacing, a saving of about 25-45% in energy. The unit was found easy to work and no special skill was required.

**Weather based models for cotton yield forecasting in the intensively cotton growing districts of Marathawada and Vidarbha regions** (C.D.Ravindran).

Three districts viz. Nagpur, Parbhani and Jalgaon were taken up for the study. Detailed data base for all the relevant parameter was collected and analysed. The results have been furnished district wise.

**Nagpur :** The model based on 12 independent variables was found to give a reasonably good fit. Seven of these variables, which were functions of maximum and minimum temperatures, had highly significant regression coefficients, the $R^2$ value being 0.91% significant at a p-level of 0.0047. The regression coefficients of the variables which were functions of rainfall were not significant. The trend variable did not show any significance, implying the non existence of any time trend.

**Parbhani :** The model based on 16 independent variable gave an adequate good fit, with an $R^2$ value of 0.91% with a p value of 0.0006. Nine of these variables which were functions of temperature as well as rainfall, had highly significant regression coefficients. The effect of the trend variable was very week (P = 0.253).

**Jalgaon :** The model based on 13 independent variables was found to give a good description of the observed yields. The $R^2$ value was 0.87 %, significant at P = 0.00046. Seven of these independent variables had significant regression coefficients, Unlike Nagpur and Parbhani at Jalgaon, the trend variable was highly significant and showed a strong, upward trend.

**Adhoc project**

**Improving the efficiency of cotton+arhar strip cropping** (A. Ravinder Raju).

In the studies on the competition and production efficiencies as influenced by 12, 8, 6 rows of cotton with 1or 2 rows of *arhar* differences between 6 or 8 rows of cotton were found to be non-significant while 12 rows of cotton produced 300 kg $ha^{-1}$ more seed cotton yield . The *arhar* with single row produced 85 kg $ha^{-1}$ more seed cotton yield than two rows. Similar trial was conducted with *desi* cotton AKA 8401. Significant differences were not evident with 6 or 8 row systems.

The nutritional needs of both *desi* and hybrid cotton based *arhar* strip cropping was studied. The results showed that biofertilisers in hybrid cotton improved seed cotton yield by 123 and 193 kg $ha^{-1}$ at 50% and 100 % recommended fertilisers with NHH 44 hybrid cotton whereas in *arhar* variety C-11 by 174 kg $ha^{-1}$ only at 50% recommended fertilisers. The foliar sprays did not produce any improvement in cotton or *arhar* yields. Similarly, in strip cropping with cotton AKA 8401 (12+2) it was found that use of biofertilizers could improve by 189 kg $ha^{-1}$ while foliar spray by 121 kg $ha^{-1}$ over 50% recommended fertilisers. The *arhar* yields were marginally improved by 36 kg $ha^{-1}$ with biofertilisers use at 50 % recommended fertilisers.

Soil moisture is one of the limitation in strip cropping. Soil moisture conservation treatments viz; physical barriers like BBF, R&F and opening furrows after the strip across the slope improved seed cotton yields by 46, 216 and 396 kg $ha^{-1}$ where as live erosion resistant strip crops green gram, black gram, *sorghum*, moth bean and soybean were in order of improving seed cotton yields by 519, 275, 253, 213, 164 kg $ha^{-1}$ seed cotton yield more than flat bed system respectively. The trends were although similar in *desi* cotton their yield

levels were below normal. The results need confirmation.

**Evaluation of organic vis-a-vis synthetic cotton** (Blaise).

A demonstration trial was initiated in 1994 to compare cotton cultivated under organic with the synthetic (mineral fertilizers) system. Seed cotton yield was 649 and 558 kg/ha in the organic and the synthetic plots respectively. Soil samples were collected to determine the effect of organic and synthetic systems on the soil status. The data of some of the soil properties is presented in Table 5. The soil samples of the organic plots had better biological activity (enzyme activity), chemical status (soil organic C, soil microbial biomass C, available P) and improved soil moisture content compared to the synthetic plots. The improved soil physical, chemical and biological property of the soil in the organic plots is reflected in the higher yield level than the synthetic plot.



**Table 5 : Soil status in the organic vis-à-vis the synthetic plots**

| | Organic | Synthetic |
|---|---|---|
| Soil organic C (g/kg) | 7.18 | 5.43 |
| $NaHCO_3$ – P (mg/kg) | 26.3 | 5.68 |
| Dehydrogenase (mg TPF/kg/d) | 277.7 | 89.4 |
| Phosphatase (mg/kg/h) | 198.1 | 72.9 |
| Soil moisture content (%) in 0 – 15 cm | | |
| 15-10-01 | 35.01 | 30.15 |
| 16-11-01 | 20.66 | 19.54 |

**Coimbatore**

**P1-85/1-ICR-F 25/0430:**

**Studies on the long term effect of nutrient management practices on the productivity, nutrient balance, soil physico-chemical properties and sustainability of cotton based cropping system** (P. Nalayini ).

Cotton – Jowar is the most sustainable cropping system and the increased yield ranged from 41.7 – 62.2 % as compared to Cotton – Cotton rotation. Characters like DMP/plant, bolls/plant and seed cotton yield were influenced significantly due to crop rotation and fertility levels in cotton hybrid, Savitha but not in variety Surabhi, indicating that hybrid cotton is more sensitive to monocropping than variety. Combined application of organics and inorganics @ $P_{45}$ $K_{45}$ and 15 t FYM /ha resulted in highest seed cotton yield of 1733 kg/ha in Savitha and 1686 kg/ha in Surabhi which was on par with $N_{45}$ $P_{45}$ $K_{45}$ + 7.5 t /ha and $P_{30}$ $K_{30}$ + 10 t FYM / ha.

**Adhoc Trial**

**Agronomic evaluation of Bt cotton hybrids under graded levels of NPK** (P. Nalayini).

The growth and yield attributes revealed that Bt cotton genotypes were in general shorter in stature with lesser leaf area index and lesser DMP/ plant at 90 DAS. The number of bolls/ plant ranged from 13.1 to 22.9 and among the genotypes, MECH 162 Bt, MECH 184 Bt and Savitha recorded significantly higher number of harvestable bolls and was found superior to other genotypes. The boll weight was in general lesser in Bt genotypes as compared to their non Bt counterparts. Among the genotypes, MECH 12 non Bt produced bigger bolls (5.90 g).

The growth attributes were not influenced significantly due to graded levels of NPK. However, the total number of harvestable bolls /plant were significantly higher (18.1 ) with 125 % RDF and was on par (16.6 bolls) with 100 % RDF but found superior (15.3

bolls) to 75 % RDF.

MECH 162 Bt recorded the highest seed cotton yield (1017 kg/ha ) and was on par with MECH 12 Bt ( 897 kg/ha ), Savitha ( 896 kg/ha ) and MECH 184 Bt ( 811 kg/ha). The national check, NHH 44 recorded the lowest ( 618 kg/ha ) seed cotton yield. The yield reduction with NHH 44 was to the tune of 64.5 % as compared to the best yielder, MECH 162 Bt.

The seed oil content ranged from 19.5 - 22.3 % and significant difference was observed among genotypes. The highest oil content (22.3 % ) was recorded with MECH 12 Bt and was on par with MECH 12 non Bt ( 21.7 % ). The seed oil content was the lowest ( 19.5 %) in the national check, NHH 44.

## National Agricultural Technology Project

### Nagpur

**PSR 4 : Studies on efficacy of bio-inoculants in cotton wheat based production system** (A.R.Raju).

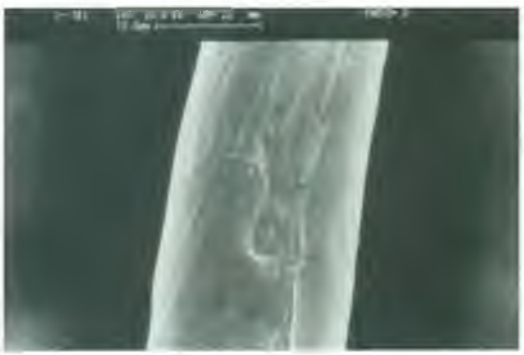
In cotton-wheat rotation under wheat crop the bio-inoculants *A. chrococcum* Ala-27, Ht-54 and Ht-54(1) improved wheat grain production by 110-623 kg $ha^{-1}$ over 65% recommended fertilisers. The superior performance of Nagpur *azotobacter* was due to higher temperature tolerance (48 $^{0}$C) and high biotine production, P solubilisation 978 u g of TCP with ammonia secretion of 38 u g $NH_3$ $ml^{-1}$ standing superior over all the existing strains. Neither the cotton species nor the bio-inoculants had any significant carryover effect like *Rhizobium* as confirmed by wheat grain yield and biomass in rotation. The development of new isolates having wider adaptability in cotton-wheat ecosystems isolated from the cotton/ rice-wheat system are showing good performance trends.

**RCPS 9: Develop and evaluate production technologies for the indigenous cotton in north-east region** (A.R.Raju).

The production constraints observed were sub optimal nutrition and severe soil moisture deficit in sandy loams, black and red soils. OFT's with introduction of INM packages are under evaluation at *Mudhol* and *Ponduru*. Seed cotton yield has shown an improvement 378 and 210 kg $ha^{-1}$ in *desi* cotton while it was 186 and 98 kg $ha^{-1}$ with hybrid cotton by INM and soil moisture conservation packages respectively. The varietal evaluation trial over two years found G-27 (*G.arboreum*) to be superior among all the released *desi* cotton varieties. The suitability of released varieties for hand spinning found AKA-5, Lohit and MDL 2452 for hill cotton


Scanning electron microscopic photograph of *Ponduru*-Red Cotton (*G. arboreum indicum*)

Scanning electron microscopic photograph of *Ponduru*-Punasa Cotton (*G.arboreum indicum*)



Scanning electron microscopic photograph of *Ponduru*-Hill Cotton (*G.arboreum indicum*)

and LD-230 in Punasa range. Scanning electron microscope photographs indicated the distinctness of Ponduru cotton.

### PSR 36: Adoption and refinement of cotton picker and cleaning system

(G. Majumdar).

Two genotypes namely PKV 081 and NHH 44 found suitable for mechanical picking from last year's trial were planted in wider row to row and closer plant to plant spacing to assess the effect of spacing on the plant physical parameters.

Observations were taken on the assessment of labour requirement to pick cotton by hand in the farmers' field. Economics of manual picking was worked out. In terms of labour it was found that 349.48 women-hr was required to pick cotton from one hectare, i.e., 0.47 women-hr per kg of cotton picked. Cost of operation worked out to Rs 1505.56 per ha and Rs. 1.94 per kg of cotton picked.

### Development of a Suction Type Cotton Picker

In order to study the suitability of developing a shoulder mounted suction type cotton picker trials were conducted by using a vacuum cleaner to pick the cotton off the plants. The efficiency of picking was way below that of manual picking. It took about 1 man-hr/kg of cotton to pick by machine as compared to 0.47 women-hr/kg for the manual picking. It was found that one of the limiting factors was the low capacity of the collection bag of the vacuum cleaner which had to be emptied after every 132.75 gm of cotton was picked. Another drawback is that this type of picker essentially engages one boll at a time, and a human is more dextrous with nothing between hands and the boll. Two bolls at a time can engage.

To improve the picking efficiency a hood was fabricated with a base diameter of 45 cm to envelop the plant of PKV 081. The bolls nearest the suction end of the hood only could be picked. The suction was found inadequate to pick the whole plant. The hood is being re designed and suction requirements are being worked out.

Trials were conducted with ethrel to see the effect of three concentrations of 0.1, 0.5 and 1% on the leaf shedding and maturity of bolls of cotton. The observations were taken on 5 and 10$^{th}$ day. None of the concentrations had any effect on the boll bursting, however, there was significant effect on the leaf shedding pattern due to different concentrations of the spray. The percentage leaf shed increased with the concentration. Ethrel at 1 % conc. gave 90.98% leaf shedding as compared to 46.87% for control. At 0.5% leaf shedding was 76.53% after 10 days of spray.

### RCPS 2: Optimising nutrient supply in relation to moisture availability for enhanced productivity and stability of rainfed cotton based production system

(Jagvir Singh, Blaise, T.P.Rajendran and K.B.Hebbar).

Trial was conducted to evaluate integrated nutrient supply system with reference to N and P that can improve synchrony between crop demand and supply for fertilizer use efficiency in rainfed cotton grown on vertisols. Incubation studies on soil P availability indicate that at any rate of fertilizer P treatment, the available P content at higher moisture content (100 and 200 % available soil moisture ASM) was significantly high compared to that of 0 % ASM through out the incubation period. Application of FYM + fertilizer P caused a significant increase in available P as compared to the control fert. P alone. The presence of added FYM promoted the recovery higher at higher moisture available.

The relative water content (RWC) % in leaf measured at 50, 80, 110 days after germination of crop (DAG) indicates that cotton grown in deep soils always had higher RWC in leaf as compared to cotton grown on shallow soils. Data at early growth stages (50 and 80 DAG) showed a positive relation of RWC with SWC (soil water content). This

was further improved by the application of FYM Zn + DAP (INM treatment) suggesting N and P fertilizers improved the water absorption efficiency of cotton plant. Higher seed cotton yield were realized in INM treatments. Treatment $N_{60}$ $P_{30}$ $Z_{30}$ + FYM 2 % DAP was found superior among different N and P levels with respect to soil available N (73.3 mg/kg soil) and available P (17.5 mg/kg soil) at 0 to 20 cm depth.

In pot culture experiment with 50 % and 75 % FC regimes, data on N transformation in soil indicated that $NH_4$ – N was marginally higher with 75 % FC moisture regimes as compared to 50 % FC moisture. The highest $NH_4$- N levels at different stages were associated with the RDF + 5 t FYM treatment. Incubation studies on P transformation in relation to soil moisture regimes indicated that at any given soil moisture regime i.e. 100 % or 200 % ASM, the mean P availability was higher in FYM + fertilizer P followed by added fertilizer P and FYM application alone.

Results of 40 on-farm trials conducted in Amravati and Yeotmal districts with INM technology indicate that the soil test based applied NPK with FYM + Green manure + $Zn_{30}$ was found superior over farmer's practice and University recommended NPK with respect to seed cotton yield and available nutrients N and P determined at 50 and 80 DAS of crop.

**RCPS 5: Rain water conservation, harvesting and recycling/recharging techniques for enhanced productivity of cotton based cropping system** (K.S.Bhaskar).

Each experiment is replicated on 10 farmer's field each one acre,with Randomised Block Design.

**Moisture management and yield potential in different toposequences**

**Upper plain**

Yield of cotton increased significantly by incorporation of sorghum as inter crop and sowing of cotton on flat bed as well as on ridges and furrows over sole cotton as well as flat bed over farmers practice. The yield of cotton increased significantly due to sowing of cotton and sorghum on ridges and furrow. Cotton yield increased by about 3 q due to formation of ridges and furrows over flat bed and by about 5 q over farmer's practice. The significant higher yield was mainly due to introduction of moisture conservation treatments, which were significantly supported by yield contributing characters such as number of bolls per plant, boll weight (g) and seed cotton yield (g) per plant. However, runoff water for irrigation was not available and hence life saving irrigation to crop as per treatments was not given except in few farmers field. The response of *arborium* var. Rajat in upper plain was better as compared to others.

**Middle plain**

Life saving irrigation from recharged wells has given significant impact on the yield of cotton which was increased by 4.74 q. The differences in yield contributing characters showed the same trend as that of seed cotton yield in case of sole cotton and cotton inter cropped with greengram.

**Lower plain**

Significant increase in seed cotton yield was recorded due to development of ridges and furrows and inclusion of soybean as inter crop over cotton (*hirsutum*) as sole crop. Introduction of soybean as interscrop was superior than cotton alone. Inclusion of soybean as leguminous crop has increased soil moisture as well as seed cotton yield over sole cotton.

**Excess moisture management in cotton**

Cotton crop suffers due to excess moisture when continuous and poor drainage conditions are prevail in the field and hence needs good drainage. Broad bed and sunken and raised and sunken bed moisture conservation systems were found beneficial for excess moisture management .

Results showed that providing moisture con-

servation measures to cotton crop was helpful in increasing seed cotton yield over flat bed sowing. Ridge and furrow on flat bed increased seed cotton yield significantly by about 4 q, over cotton on flat bed, while broad bed and sunken bed by about 5 q, while raised and sunken bed has increased seed cotton yield significantly by about 6.64 q ha-1 over sole cotton as well as cotton on flat bed.

**PSR 33 : Evaluation of tillage, residue and nutrient management practices for cotton-wheat system** (K.S.Bhaskar, Jagvir Singh, D. Blaise, S.M.Wasnik, G. Majumdar and O.P.Tuteja).

Field experiment was conducted during *Kharif* and *Rabi* seasons of 2000-01 and 2001-02 on Sandy loam soil of CICR, Research Station, Sirsa, Haryana under irrigated condition. The main plot treatments were tillage.

The mean maximum (16.37qha$^{-1}$) seed cotton yield was recorded in treatment $T_3$. Seed cotton yield due to deep tillage increased significantly over reduced tillage (Table 6).

**Table 6: Effect of tillage and residue management practices on the yield of cotton – wheat system**

| Treatments | Yield (q ha$^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | Cotton | | | Wheat | | |
| | 2000-01 | 2001-02 | Mean | 2000-01 | 2001-02 | Mean |
| **Tillage treatments** | | | | | | |
| $T_1$ One disc + double cultivator for cotton and Wheat (conventional tillage) | 13.79 | 17.34 | 15.56 | 30.81 | 55.19 | 43.00 |
| $T_2$ Reduced preparatory tillage with rotavator for cotton and wheat | 11.11 | 13.55 | 12.33 | 29.98 | 51.59 | 40.79 |
| $T_3$ Deep ploughing before cotton sowing once in two years + reduced tillage with rotavator + herbicide application for early season weed control | 16.11 | 16.62 | 16.37 | 28.98 | 52.15 | 40.57 |
| **CD(P= 0.05)** | 1.44 | 1.56 | - | NS | NS | - |
| **Residue treatments** | | | | | | |
| $T_4$ Cotton stalks and wheat straw removed | 13.27 | 14.08 | 13.68 | 31.19 | 50.82 | 41.01 |
| $T_5$ Cotton stalks removed and wheat straw retained | 14.23 | 16.63 | 15.43 | 30.89 | 53.08 | 41.99 |
| $T_6$ Cotton stalks retained and wheat straw removed | 13.27 | 15.72 | 14.27 | 31.23 | 54.97 | 43.10 |
| $T_7$ Wheat straw burned *in-situ* | 13.58 | 15.23 | 14.41 | 26.60 | 50.64 | 38.62 |
| $T_8$ Cotton stalks and wheat straw shredded & incorporated | 13.99 | 17.51 | 15.75 | 29.56 | 55.38 | 42.47 |
| **CD(P= 0.05)** | NS | 2.14 | - | NS | 4.35 | - |

Higher yield in $T_3$ was supported by yield contributing characters such as number of boll plant$^{-1}$ and boll weight (g) . In case of wheat, the mean maximum (43.00 q ha$^{-1}$ ) yield was recorded under $T_1$,which was significantly supported by test weight., number of grains ear$^{-1}$ and number of tillers plant$^{-1}$. The yield under $T_2$ and $T_3$ treatments was almost similar (Table 6). As regards the response of cotton and wheat to residue recycling is concerned, maximum (15.75 q ha$^{-1}$ ) seed cotton yield was recorded in plots where cotton stalk and wheat residue was shredded and incorporated in soil ($T_4$). This was due to the higher number of bolls plant$^{-1}$ and boll weight (g). Similar, yield was obtained in $T_5$ where cotton stalks were removed and wheat straw retained and incorporated in the soil.

Deep ploughing once in two years was found beneficial for improving the yield of cotton and wheat. Incorporation of shredded wheat straw and cotton stalk in the soil increased the yield of cotton as well as wheat. Complete removal of cotton stalk and wheat straw is not good the soil health. Burning of wheat residue *in-situ* should be stopped to reduce potential environmental problem in the region and improve soil health.

**RCPS 11: Impact of tillage, land treatment and organic residue management on drainage, soil health and crop productivity of rainfed cotton based system** (Blaise and G. Majumdar).

On-farm adaptive research (OFAR) trials were conducted in twelve farmers fields of Nagpur district in the villages of Saongi, Deoli, Monda, Kanoli and Rui with the main objective to assess the tillage and organic residue management systems on the productivity of cotton based cropping systems under rainfed conditions.

The results indicate that the weed biomass was significantly reduced with the reduced till systems compared to the farmer's practice and the plots receiving recommended dose of fertilizer (RDF). Herbicides were effective in controlling the weeds during the initial crop growth (upto 60 days). Reduced competition for the resources resulted in better plant growth and fruiting activity in the reduced till plots. Incorporating the green manure grown *in situ* (at around 45 DAS) along with the opening of furrows in alternate rows resulted in the better conservation of the soil moisture after cessation of rains. These factors would be responsible for the high seed cotton yields observed in the reduced tillage systems. Seed cotton yield was significantly better in the RDF plot than the farmer's practice.

**ROPS 10 : Identification of research gaps in inter-cropping systems under rainfed conditions in India** (M.R.K.Rao and Blaise).

The survey conducted in 10 villages on 100 farmers covering 6 major cotton growing tahsils of Nagpur district (Target district) has brought out the following points:

- The total area of the 100 surveyed farmer is 403.3 ha and the total cropped area is 416.25 ha out of which 202.3 ha (48.60%) is under different inter cropping systems.
- Out of 202.3 ha area under different intercropping systems near about 193.7 ha (95.74 %) is under cotton + tur intercropping system but out of the total cropped area near about 46.53 % area is under cotton + tur intercropping system while the % adoption of cotton + tur intercropping system is 92.61 % with wide variations in different categories of farmers.
- Near about 8.6 ha (4.26 %) is under different intercropping systems
- Majority of the farmers follow strip intercropping with tur (pigeonpea) in the ratio of 8 : 2 (42 %), 6:2 (20%), 10 : 2 (15%), 10:1 (10%), 6 : 1 (8%), 12:2 (2%) and 24 : 1 (1%).
- Row intercropping as such is not being practiced in the cotton based production system in the district.

- In general, awareness about the research findings on intercropping with green gram, black gram, soybean etc is negligible and this could be a reason for the lack of adoption of the latest technologies.
- Another major reason indicated by the farmer is the difficulty, which they may face for effective interculture in the event of an intercrop between rows of cotton. Farmer's resort to intensive interculture under typical vertisol situation ranging from 6 times or even more in both the directions (i.e. cross interculture) and consider it as a must for raising good crop.
- Many farmers have pointed out that they are following the strip intercropping as a traditional practice, without any improvement over the years through scientific intervention in terms of either row ratios or input management.

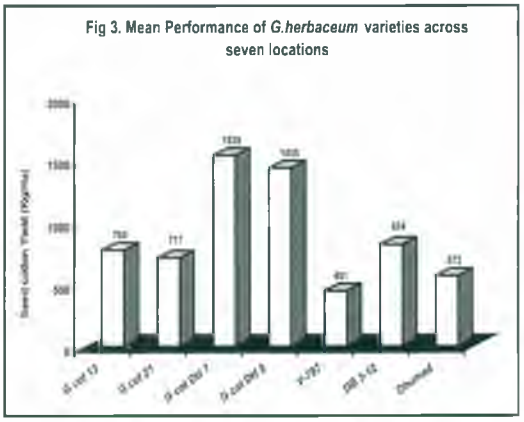
**Coimbatore**

**PSR 16: Exploitation of *G.herbaceum* cotton for improving agricultural output and economy of the coastal agroecosystem** (K. Venugopal, N. Gopalakrishnan, K. N. Gururajan and S. E. S. A. Khader).

The performance of G.Cot. 17 and G.Cot 21 was found superior with the yields ranging from 17-20 q/ha at Porbandar, Gujarat. *Desi* hybrids G.Cot DH-7 and G.Cot DH-9 exhibited high yielding potential in coastal areas of Gujarat besides establishing superiority in the trials conducted at Bramhavar ( Karnataka), Konanki and Uppugundur (A.P.), Karaikal ( Pondichery) and Pattukottai ( Tamil Nadu) Fig. 3.

The drought tolerance nature of *G. herbaceum* genotypes was evident under dryland conditions at Paramakudi (Tamil Nadu), wherein 10-12 q / ha of seed cotton yield could be realized. In the large-scale demonstrations conducted at Karnataka, *G. herbaceum* cultures were seen yielding above 8 q/ha even under dry rainfed situation, as compared to 5 q/ha recorded by *G.hirsutum*. The potentiality of *herbaceum* cottons as a group could be realised in the dryland situation as well as under protective management situations in trials conducted in coastal areas of Karnataka as compared to *hirsutum* cotton.

Fig 3. Mean Performance of *G.herbaceum* varieties across seven locations



# Technology Mission on Cotton

**Nagpur**

**MMC1 : Nutrient dynamics in cotton and establishment of critical limits for secondary and micronutrients** (Blaise and Jagvir Singh).

A field experiment was conducted at the farm of CICR employing a factorial block design with three replications and the following treatments : two levels of factor A + FYM and – FYM and five levels of factor B – control, NP, NK, PK and NPK. Seed cotton yield was 427 kg/ha in the FYM applied plots and was significantly better than the plots not receiving FYM (298 kg/ha). The low yield level was due to the high infestation of bollworms and early cessation of rain.

A laboratory incubation study was conducted at 35 °C and maintained at –33 kPa, to study the N and P transformation in the vertisols. Applied P fertilizer was not available after one month of incubation at the lower level (40 kg $P_2O_5$/ha). At 160 kg $P_2O_5$/ha after one month hardly 2 ppm was available. This indicates the high P fixation capacity of the soils. On the other hand, N applied as urea

was completely nitrified within 15 days. At the end of one month of incubation, 92 % of the applied N was recovered.

**MMC2: Evaluation of bio inoculants for ecofriendly and economic nutrient management in cotton** (A.R.Raju).

The bio inoculants improved Seed Cotton Yield (SCY) by 55 and 300 kg $ha^{-1}$ in rainfed and with 2 supplemental irrigations in vertisols. The two supplemental irrigations could improve the SCY by 445 kg $ha^{-1}$. There is no significant responses for applied inorganic fertilisers beyond 75% rec. dose for NHH 44 hybrid cotton. The effect of seed dressing agrochemical's toxicity on colonization of Rhizosphere bacteria was studied in both pot and field trials. Some agrochemicals Stomp and Carbendazim are affecting soil biological activities and limiting nutrient uptake and seed cotton yields. Result needs confirmation. The effective blending and formulation of liquid fertiliser (*Azt.+Azosprillum*) is explored suitable to use as for seed treatment, seed soaking and soil/ foliar application. Pink pigmented plant growth promoting rhizobacteria was evaluated in pot trials and results will be confirmed in field trials.

**MMC3 : Evaluation of soil-site and series suitability for cotton based cropping systems in India** (K.S.Bhaskar and S.M.Wasnik).

Field survey was done and farmers were identified at different locations for field experimentation. Finally, shallow, medium deep and very deep vertisols and associated soils at various locations were identified. Field experiments were conducted on shallow (< 45 cm deep) medium deep (45-90 cm deep). and very deep (> 90 cm deep) soils. Two, variety Rajat (*hirsutum*) and Hybrid NHH 44 (*hirsutum*) genotypes were tested with 4 (F1 : Control, F2 ; 50 % recommended and practices of the area, F3; 75 % package and practices of the area and F4; 100 % recommended package and practices of the area) levels of management. Each genotype was grown on 0.4 ha land area. The sowing of the crop was started w.e.f. 16/6/2001 and it was completed upto 27/6/2001 depending upon the moisture availability in the soil and feasibility of the farmer.The plant to plant and row to row distance each for variety and hybrid was kept uniform in all the soils to evaluate the effect of soils and management levels.

The soils of study area in Maharashtra and Andhra pradesh are very shallow to very deep, gravelly clay loam to silty clay loam in texture, varies place to place in soil-site characters, total rainfall and its distribution with growing period. Soil samples from different places has been collected and physical and chemical properties of some soils has been completed and some are still under process, and will be completed in due course of time.

**Fertilizer response to cotton**

It is very clear from the data that with increasing level of fertilizer, the seed cotton yield was increased accordingly of both the genotypes. It was highest with 100 % (80 : 40 : 40 kg NPK $ha^{-1}$) fertilizer level, and the lowest under control. Yield differences between 100 % and 75 % level of fertilizers were not significant.

**Response of genotypes to soils**

The crop yield performance of both (Rajat and NHH 44) the genotypes varied from soil to soil under uniform level of management. It was highest under 100 % recommended dose of fertilizer in all the three soils and the lowest under control. The performance of hybrid cotton NHH 44 was highest under deep, followed by medium deep and the lowest under shallow soil. Similarly, the yield performance of variety, Rajat was highest in medium deep followed by shallow and the lowest or almost at par under very deep soil.

**MMD1 : Methodologies for yield prediction by integrating remote sensing geographical system and crop models**

**Nagpur** - (M.R.K.Rao and K.B.Hebbar).

A field experiment was conducted with three dates of sowing and three fertility levels to create variable data base pertaining to crop phonology, growth dynamics, yield attributes etc. Considerable variability was recorded for all the parameters and this data will be utilised for comparing and validating the model output parameters.

Crop canopy reflectance in the red and infra-red wave lengths were recorded at fortnightly intervals and vegetative indices were worked out for utilising in the analysis of satellite imagery data obtained at the macro level.

Spectral reflectance parameters were also recorded in 12 reference plots in the farmers' fields, each plot having an area more than 4 hectares for generating ground truth data for interpreting the satellite imagery data.

GOSSYM model was validated with the field data and to bring the predicted values near to the observed. Some of the model parameters were calibrated, which in turn had led to the model output parameter. In terms of yield, simulation almost tally with the observed yield data for different dates of sowing. However, the other parameters such as height, leaf area index etc need to be calibrated further. The detailed soil data and weather data of Nagpur district was utilised in running the model.

**Coimbatore** - (A.H. Prakash).

Field experiment was undertaken to generate basic data on the influence of time of sowing with graded levels of nitrogen on cotton growth and development.

Date of sowing had a positive effect on plant height, number of monopodia and sympodia produced. The fertility level also had an impact on the vegetative growth with significant increase in monopodia with increase in N level.

There was a significant variation in fruiting points and bolls/plant with time of sowing. The $D_2$ treatment produced higher fruiting parts and good harvestable bolls, while least number of fruiting activity was observed in $D_3$ treatment. In the sub-plot treatment, application of 90 kgN/ha registered highest fruiting activity.

The fertility levels and time of sowing also influence individual boll weight. Among the treatments $D_2$ was found optimum with the boll weight of 4.04 g/boll and it was significantly higher than $D_1$ (3.65 g/ boll) and $D_3$ (3.73 g/boll). The final yield realized was the net effect of all the changes in the physiological processes. The $D_2$ treatment produced the highest yield (18.18 q/ha) and was significantly superior to $D_1$ (16.78 q/ha) and $D_3$ (15.71 q/ha).

**MMD2: Mechanization of tillage, sowing, interculture and spraying operations in cotton cultivation** (G.Majumdar).

Seed Drill for Cotton sowing in vertisols

The prototype of cotton seed drill, was modified this year by redesigning the hopper and seed delivery mechanism, was tested for its performance. Acid delinted seeds of LRA 5166 were drilled at a row-to-row spacing of 60 cm. With a pair of bullocks the field capacity of the machine was found to be 7.7 bullock pair man hr/ha or 0.3 ha/hr. Compared to the dibbling which took 50 woman-hr/ha or 0.02 ha/hr maintaining a row to row spacing of 60 cm. Depth of seed placement could be maintained at five cm in friable soil but with increasing stickiness of wet soil, the soil stuck to gauge (depth) wheels, increasing the diameter thus running the implement shallower. Providing scrapers of MS flats on the depth gauge wheels modified this. Seed rate was found to be 14.31 kg/ha. The field trials are going on.

**Development of a manual cotton planter**

**cum fertiliser drill**

A commercially available manual cotton planter, being distributed free by hybrid seed dealers to encourage use of hybrid seeds in the north, was tested at Regional Station. Principle of the machine was that it injects seed 1-2 no. in the soil. By pressing the handle a wooden roller rotates by 90 degrees, collecting 1-2 seeds from the hopper where it remains submerged in seeds, and dropping the seeds in the seed tube. It was found to be only 10 % accurate, i.e., for 10 dibbles only 1 hill received seeds.

Sensing the utility of such a device and its lack of availability, in the northern cotton growing zones, a manual cotton planter cum fertiliser drill has been designed and developed at CICR Nagpur. The prototype of the implement is ready and will be tested this season.

**Study of the variables involved in pesticide spraying operation for improving the efficiency of pesticide application in cotton**

Application procedure of a hand operated knapsack sprayer is being studied with a view to identify the limits within which variables involved in spraying like walking speed, swath width, estimates of field size, amount of product added to spray tank etc. will produce an acceptable predefined (say 20%) variation in dosage applied to the crop. Knapsack sprayer was chosen because it was found from the survey that 1/3rd farmers used it for plant protection at later stages and almost entirely in the initial stages of crop growth. Different nozzles commonly used with knapsack sprayers like NMD-26450, NMD-80450 and Navin (variable rate nozzle) are being evaluated for their variation of swath width and flow rate with varying height and pressure.

The crop dimensions like height of first node from ground, total height, maximum width of plant and height from ground at which maximum width occurs have been recorded for 100 plants each of LRA 5166, PKV 081 and NHH 44 at four intervals i.e., 30, 60, 90 and 120 DAS, in order to arrive at a shape of the plant at different stages of crop growth so that nozzles with certain flow rate and angle of spray at a certain height and pressure only may be used for the particular stage thus saving in the pesticide and guarding against insecticide resistance. Regression equations have been worked out and are being tested with observations from previous and current years to see if the variability introduced by the climate and management factors over different years will still produce the plants with dimensions within 20% either way. The droplet sizes and numbers from the said nozzles at different pressures and height are being analysed under Microscope.

**Coimbatore**

**MMC 2: Bio–inoculants Technology for economical nutrient management in cotton** (P. Nalayini ).

**Study on response of *Azospirillum* and *Phosphobacteria* in reducing respective N and P fertilizer application in cotton under irrigated condition.**

**Effect on growth components :**

Crop response studies of cotton cv LRA 5166 to various strains of ***Azospirillum*** cultures along with Phosphobacteria under graded levels of N and P (100, 75 and 50 % recommended levels) were conducted during winter 2001-2002 in soil with medium N (434.5 kg/ha), high P (33.2 kg/ha) and high K (772 kg/ha) with pH 8.61. The results revealed that application of N and P at 75% recommended level gave the highest seed cotton yield ( 1169 kg/ha ), however, it was on par with 100 % and 50 % levels. The lowest seed cotton yield ( 792 kg /ha ) was recorded under unfertilized control.

The bio-inoculants treatments did not influence the ancillary characters, yield attributes and seed cotton yield.

### Enumeration of Azospirillum and phosphobacteria in cotton rhizosphere soil

The rhizosphere population of *Azospirillum* and Phosphobacteria during the growth of cotton cv LRA 5166 at 45,90 and 135 DAS under field condition revealed that application of 75 % N and P recorded significantly highest population of *Azospirillum* and phosphobacteria at all the stages studied. Increasing the fertilizer level from 75 % to 100 % recorded reduction in rhizosphere population as compared to unfertilized control.

Among the bio-inoculants, *Azospirillum* (TNAU ) + PSB ( TNAU ) recorded significantly higher population load of *Azospirillum*, irrespective of the stages studied and at 45 and 90 DAS for phosphobacteria.

## MMD 3: Development of efficient farming techniques for higher productivity

(P.Nalayini ).

### Effect of irrigation scheduling through drip on cotton productivity

Field experiment was conducted with hybrid Savitha to find the effect of scheduling of irrigation on alternate days through drip, based on ETc as compared to conventional ridges and furrow irrigation. The crop received 408.4 mm rainfall during the cropping period and because of heavy downpour, the crop at early stages suffered due to poor aeration in drip method as the crop was raised in flat bed ( paired row technique ). However, in conventional ridges and furrow method, root aeration was better and plants were taller with higher DMP. However, the plants grown under drip method picked up growth during later stages and the biometric observations were on par at 120 DAS. The initial vigour of crop under ridges and furrow system during rainy season promoted better growth and yield attributes as evidenced from significantly more number of heavier bolls and higher seed cotton yield and was on par with 1 ETc.

The consumptive use of water ranged from 381.8 to 624.3 mm with the water use efficiency of 11.6 to 16.1 kg of seed cotton / ha cm of water and the highest WUE was recorded with drip irrigation scheduled at 1 ETc

### Effect of fertigation on cotton productivity

To find out the effect of fertigation on cotton cv. Savitha, field experiment was conducted with 100% and 75 % RDF( N and K through drip in four and six splits and P as soil application) and compared against conventional method in two splits. The study revealed that application of 75 % RDF through drip ( N and K) in six splits with soil application of P resulted in on par yield with 100 % RDF of conventional method with the highest water use efficiency of 16.6 kg seed cotton / ha cm water ( Table 7).

**Table 7: Effect of Fertigation on yield attributes, Seed cotton yield and Water Use Efficiency of Cotton cv. Savitha**

| Treatments | Bolls/plant | Boll weight (g) | Seed Cotton Yield (kg/ha) | WUE |
|---|---|---|---|---|
| $T_1$: 100 % RDF (4 Splits – Drip) | 14.2 | 4.5 | 617 | 12.9 |
| $T_2$: 75% RDF (4 Splits – Drip) | 13.0 | 4.4 | 615 | 12.9 |
| $T_3$: 100 % RDF (6 Splits – Drip) | 15.1 | 3.9 | 714 | 15.0 |
| $T_4$: 75% RDF ( 6 Splits – Drip) | 16.4 | 4.2 | 789 | 16.6 |
| $T_5$: Control 100% RDF (2 Splits) | 19.8 | 4.5 | 912 | 14.6 |
| **SEd** | 1.47 | 4.5 | 101 | |
| CD (p = 0.05) | 3.12 | 0.20 | 215 | |

# Crop Protection

**Nagpur**

**P1-93/1-ICR-H10/0430 :**

**Screening of cotton germplasm against key pests to find out morphological and biochemical basis of resistance** (T.V.Kathane and Sandhya Kranthi).

Thirty two parent lines, 228 new $F_1$s and 11 $F_1$s were tested against sucking pests and bollworms of cotton under natural field condition. Thirty eight $F_1$s were found promising against sucking pests as well as bollworms. The incidence of bollworms ranged between 8.8 to 26.2%. Average number of fruiting bodies ranged from 22 to 83 and boll weight from 3.4 to 5.2 gm. All parental lines were found to be tolerant to sucking pests and bollworms, bollworms incidence ranging between 8.22% to 20.61%. Last year 11 best $F_1$s were sown in three replications in single row. Among them 2 x 8, 5(A)x8 and 7 x 8 showed earliness, good average number of fruiting bodies i.e. 44.22, 42.00, 52.36 and incidence of bollworm 8.38, 10.08 and 11.67% respectively. Total fruiting bodies in the parent lines ranged from 23 to 101.

Twenty five promising lines including the one with diverse sources of origin were tested for their tolerance to bollworm, *Helicoverpa armigera* that consistently proved tolerant to bollworms and sucking pests for the last six years.

Neonates released on terminal leaves for a period of 48 hrs recorded a mortality of 0-50%. with. Ambassador at 50% and LRA 5166 (as control) at 11.78% and 24 lines showing a mortality of less than or on par to control.

Allelochemicals belonging to five broad groups-phenols, tannins, terpenoid aldehydes, reducing sugars and free amino acids were estimated. The phenol content ranged from 60 mg/g to 358 mg/g, tannins from undetected levels to 381.88 mg/g, terpenoid aldehydes from 0.027-0.143 mg/g, reducing sugars from undetectable levels to 10.27 mg/g free amino acids from 1.84-3.08 mg/g, while digestibility was positively correlated to the reducing sugars in the food ($R^2 = 0.58$) efficiency of conversion of digested food and gossypol content showed negative correlation ($R^2 = 0.66$).

Molecular markers for jassid tolerance : Trichome numbers and distribution was studied in at least 10 known jassid susceptible and three tolerant lines. There was significant interaction between the germplasm lines and the portion of the leaf sampled. Some susceptible lines were as or more hairy than the tolerant ones indicating that all tolerant lines are hairy but the reverse need not be true. Crosses are being made to generate $F_1$ population between jassid tolerant and jassid susceptible lines for marker studies.

**P1-93/1-ICR-F-60/0430 :**

**Biochemical basis of induction of defense related proteins in cotton against the gram pod borer *Helicoverpa armigera***

(S.Kranthi and S.B.Nandeshwar).

**Isolation of the protease inhibitor gene from cotton**

*Designing of primer*- Forward and reverse primers were designed to amplify the region of protease inhibitor gene in cotton. These

sequences were derived from published sequences of the amino acids that are conserved in the tomato protease inhibitor I, Potato protease inhibitor 1, barley inhibitor, broad bean inhibitor and the Eglin inhibitor of leech. An 18 base pair forward primer for the conserved amino acid region with the sequence of 5'Trp-Pro-Glu-Leu-Ile-Gly3'was designed. The primer sequence was 5'- TGG-CCA-GAA-C/GTT-A/GTA/T-GGT 3'. The reverse primer was designed on the basis of the amino acid conserved region in all the PIs as mentioned above. Its amino acid sequence was 5' -Asp- Arg- Val- Arg- Leu-3' and the primer sequence was 5' AAG/C- AC/AG/A-AAC-ACG-A/G-AC/T -3'.

*Reverse transcriptase RT-PCR*- Isolation of mRNA from aseptically germinated seedlings of Pee Dee 0695, was according to Chomczynkski and Sacchi.RT – PCR was performed using the oligo18 primer for DNA synthesis and subsequently using the forward and reverse primers in a PCR reaction with the following conditions.

The PCR product was run on an agarose gel 1.3%. The presence of a single amplified band corresponding to 450bp was purified and has been sent for sequencing.

*Genomic DNA*- Isolation of genomic DNA was according to a modified protocol of the CTAB method. Intactness was checked on 1% agarose gel and subsequently subjected to PCR with the conditions mentioned above. A single band corresponding to approximately 450bp was amplified, purified and has been sent for sequencing. This confirms the presence of protease inhibitor gene in the cotton germplasm pool. Once the partial gene sequence is obtained it can be used to design cotton specific primers, to screen cotton germplasm pool for the presence of proteins toxic to *Helicoverpa.*

**P1-94/1-ICR-H10/0430 :**

**Interaction effects of cultivars, agrotechniques, insect pests and entomophages in cotton ecosystem**

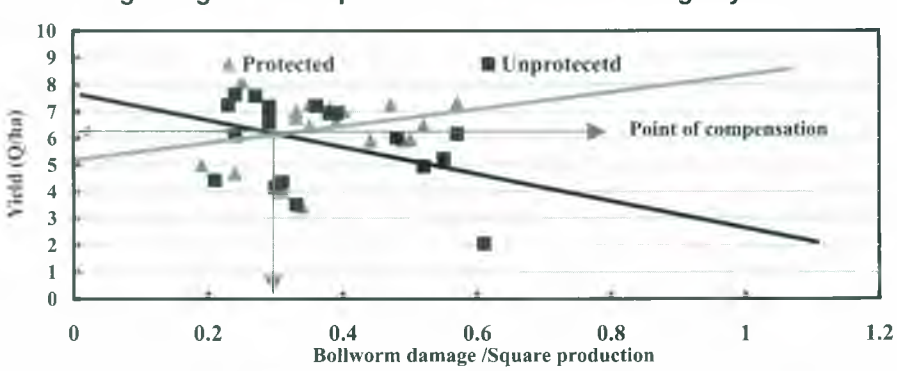
(S.Vennila).

**Study on crop-pest interactions:**

During the cotton production season 2001-2002, three cotton cultivars *viz*, the hybrid NHH 44, and the varieties of *G. hirsutum* LRK 516 and *G. arboreum*, AKA 8401 were planted in a split plot design with subplots of control methods (protected and unprotected) having five replications, to study and validate the crop pest interactions. The phenological and bollworm damage estimates were higher for hybrid NHH 44 and AKA 8401 and did not differ between themselves, but for number of bad bolls contributing to yield and the yield *per se*. Yield of AKA 8401 was higher than the hybrid and variety.

Analysis of the data sets of cotton phenology and of bollworm damage collected over past five years indicated the varying patterns of crop formation, however similar within a year for the trends of crop phenology among cultivars under different management practices. The degree of compensation in response to bollworm damage by LRA 5166 was estimated to be 30% (Fig. 4).

**Fig 4.Degree of compensation to bollworm damage by LRA 5166**



Dynamics of cotton insect pests and their natural enemies :

Jassid nymphal population was high during the last week of July, and continued up to 1st week of August. The second peak was during mid September. Aphid infestations were sporadic over the season . Protected plot succumbing to further attack by jassids and aphids was obvious.

*H. armigera* oviposition on cotton had commenced from mid August and the larval population was above ETL (> two/plant) between mid October-November. *Earias vittella* had five generations, with highest incidence of two per plant during mid December. Pink incidence was observed from October end.

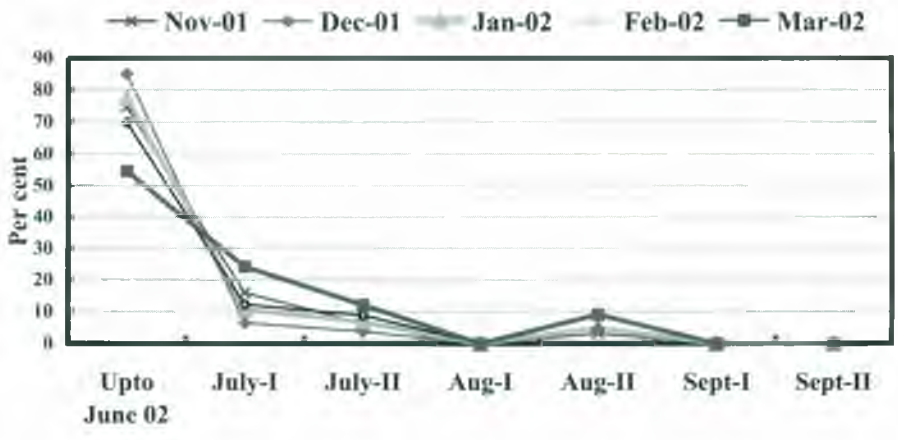
Coccinellids during the very early season, chrysopids and spiders throughout the season, and mirids during the late season executed natural control of sucking pests and bollworms. The larval parasitisation of *H.armigera* by *Campoletis chlorideae* was 29.1 and 2.56 per cent in respect of September-October and October – November months, respectively. The fungal pathogen *Nomuraea releyi* infection on larval *H.armigera* was 15.96% between October and November months. The parasitisation of larval *E.vittella* and *P.gossypiella* by *Rogas aligarhensis* and *Apanteles angaleti* was 3 and 2.3 per cent, respectively.

**Studies on *P. gossypiella* :**

Field studies towards assessing the onset and age classes of flowers attacked by pink bollworm revealed that larval infestation occurred in bolls set after 41st standard week (1st week of October ) at the age of 25 days.

Pattern of moth emergence from diapausing larvae indicated that the latest emergence of 3-9% of the diapausing population during August second fortnight had effectively contributed to the initial generation of *P. gossypiella* under field conditions Fig. 5.

**Fig 5. Pattern of emergence of diapausing *P.gossypiella* population**




**P1-96/1-ICR-H10/0430:**

**Estimation of losses due to major pests of cotton** (S. K. Banerjee).

A field experiment was carried out to assess avoidable losses due to major pests of cotton with eight treatments including untreated control in hybrid NHH 44. The treatments included, insecticides and mechanical control. Avoidable loss due to all the major pests collectively was estimated to be 41.82 per cent . Sucking pests caused a loss of 8.37 per cent and bollworm complex to the tune of 24.13 per cent. Maximum square damage of 19.62% was caused by bollworms in untreated control compared to 14.85 per cent

in plots of *H. armigera* control. Green boll damage was 25.05 per cent in untreated control which could be brought down to 9.71 per cent due to adoption of different control measures.

**AICCIP TRIALS:** (S.K.Banerjee).

**Identification of resistance sources against cotton pests**

Twelve entries were screened for their resistance to key pests of cotton. SPR V2, SPR V1, SPR V3, SPR V4 and CPD 423 showed marginal tolerance to aphid, SPR V3, SPR V4, SPR V2, and SPR V1 for jassid , SAHANA, SPR V2, SPR V3 and CPD 462 for thrips and CPD 423, SPR V4, SPR V1, and CED 423 for whitefly whereas, entry PA 183 was found to harbour the lowest population of jassids, thrips, whiteflies and bollworm infestation and gave highest yield.

**Evaluation of combination products of pesticides against cotton pests**

Thirteen treatments were replicated thrice in a Randomised Block Design with plot size of 78.03 sq. m. LRK-5166 was sown with spacing 60 cm x 45cm. The crop was monitored at weekly intervals and as soon as the pest incidence reached threshold levels, at 80 DAS, treatment sprays were initiated. In total four sprays were given at 15 days intervals. Pre and post treatment observations were recorded. The average sucking pest population as well as average percentage of bollworm damage to square and loculi of open bolls was worked out. All the treatments were significantly superior in controlling sucking pests and bollworms compared to untreated block. Bulldock Star 262.5 EC, Spinosad + Chlorpyriphos (Emperor) , Quinalphos 25 EC and Bulldock 2.5 SC were found to be better in sucking pest control. While, Cypermethrin 25 EC , Cypemethrin 5% DF, Spinosad 2.5 EC and Bulldock 2.5 SC were found to be the best for bollworms, and among the combination products, Virat Super 23 EC, Spark 36 EC and Bulldock Star 262.5 EC were the best treatments. Bulldock 2.5 SC, Spinosad + Chlorpyriphos (Emperor), Bulldock Star 262.5 EC and Spark 36 EC recorded highest yields.

**Efficacy of newer insecticides against cotton bollworms**

The experiment was laid in Randomised Block Design with three replications and twelve treatments including different doses of the five chemicals . LRK 516 was sown with spacing 60 cm x 45 cm . The plot size was 42.12 sq. m. Insecticide sprays were initiated at 75 DAS when the pest reached threshold levels. In total, five sprays were given at an interval of fifteen days.

All the treatments were effective over untreated control in reducing bollworm damage. Talstar 10 EC @ 60 g a.i./ ha, Emamectins Benzoate @ 9.5 g a.i./ha and F6028 20EC @150 g a.i./ha recorded lower percentage of square damage, while Reldan 50EC @750 g a.i./ha, Talstar 10 EC(@ 80 g a.i./ha and Cypermethrin 5% DF @70 g a.i./ ha were found effective in checking the damage to the green bolls. Furthermore, the treatment spray of F 6028 20SC (150 g a.i./ha) , Cypermethrin 5% DF ( 60 g a.i./ha) and Talstar 10EC (60 g a.i./ha) recorded lowest loculi damage. Emamactins Benzoate (9.5 g and 11.0 g a.i./ha) and F 6028 20SC (100g and 150 g a.i./ha ) recorded the highest yields.

**P1-89/1-ICR-H20/0430 :**

**Studies on multiple disease resistance in upland cotton**

(Sheo Raj, N.K.Taneja and V.V.Singh).

Ten single plant selections made from a 3 way cross possessed multiple disease resistance. Four single plant selections possessed multiple pest resistance. Seven bulk selection possessing resistance to bacterial leaf blight, Myrothecium leaf spot, Alternaria leaf spot and leaf curl have been made. Two selec-

tions were made possessing multiple disease and jassid resistance. Three back crosses are made for transferring leaf curl resistance.

One hybrid entry (CINHH 296) was promoted to Br 05a (1) in AICCIP trial for north zone and another hybrid (CCHH 9012) with resistance to diseases and tolerance to sucking pests and bollworms was entered in the National trial on hybrids under AICCIP (multilocational trial) during 2002-03.

**PI-89/3-ICR-H.20/0430 :**

**Studies on seed transmitted pathogenic infections and other seed microflora of cotton** (P.M.Mukewar).

The field collected diseased cotyledonary leaves were subjected to laboratory isolations wherein infection due to various fungi viz., *Alternaria macrospora, Colletotrichum indicum, Myrothecium roridum, Phoma tropica* and *Macrophomina phaseolina* (=*Rhizoctonia bataticola*), *Phoma tropica* and the bacterial blight pathogen *X.a.* pv. *malvacearum* was observed.

During October 2001, severe boll infection was observed due to various fungi viz., *A. macrospora* (NAS-5), *Botryodiplodia theobromae* (LRK 516), *Cercospora gossypina* (LH 886, H 777, PKV 081), *C. indicum* (LH 886, H 777, SIMA 1, G. Ageti), *M. roridum* (H 6, H 8, Suman, PKV 081) and bacterial blight pathogen *X.a.* pv. *malvacearum* in 17 *hirsutum* varieties and seven intra-*hirsutum* hybrids.

The lint infection due to *Exosporiella fungorum*, a newly observed fungus, was found in bolls of intra-*hirsutum* hybrid H 6.

Seed-cotton separated from diseased bolls due to infection by *A. macrospora* in *G. arboreum* varieties AKH 4, LD 327, G 27, Chandrolla and germplasm line NAS-5 collected from 2000-2001 crop season, was evaluated. Detection of *A. macrospora* in these varieties by Blotter method revealed, 8% internally – borne infection in G 27 and Chandrolla.

**P1-92/1-ICR-H20/0430 :**

**Studies on evolution of races of *Xanthomonas axonopodis* pv. *malvacearum* (*Xam*) and utilization of UVS in identification of resistant sources** (M.K.Meshram & Sheo Raj).

Pathotypes : One hundred and fifty isolates made from infected leaves of five susceptible cultivars viz. Ganganagar Ageti, LRA 5166, LRK 516, PKV 081 and Rajat having varying degree of susceptibility were tested for their reaction. Six races viz. 4,5,7,8,10 and 18 were identified from these isolates. Races 10 and 18 were most predominant and 66.67, 73.33, 80.00, 80.00 and 83.33 per cent isolates belonged to these races in Ganganagar Ageti, LRA 5166, LRK 516, PKV 081 and Rajat, respectively.

Identification of resistant sources: Two hundred and forty germplasm lines of *G. hirsutum* were artificially inoculated with virulent race 18 of the bacterial blight pathogen *X.a.* pv. *malvacearum* under pot culture test. Out of these, nine lines viz. AC 59, AC 117/2, AR 34, AR 47-CY, ATH x 442-2 CCB, B4-11-7-16 CC, B 56-265 LYC, BP 52-MB-2 CC and CB 2686 have exhibited the resistant reaction. Of the rest 21 lines were observed to be moderately resistant, 97 lines moderately susceptible and 113 susceptible.

Nine hundred and twenty seven lines of *G. hirsutum* were evaluated for bacterial blight reaction under field conditions. Of which, 79 have exhibited the disease free reaction, 46 were resistant and 62 moderately resistant and of the rest 346 were moderately susceptible and 394 susceptible.

Out of 203 lines of *G. hirsutum* of Br.01 trial evaluated for bacterial blight reaction under field conditions, three lines viz. Delcerro, 3G NR-25 and VC-17 were free from bacterial blight, whereas 18 lines exhibited the resistant reaction. Of the remaining lines 17 were moderately resistant, 47 moderately susceptible and 91 lines susceptible.

Upland cotton hybrids were evaluated for bacterial blight reaction under field conditions. Out of 98 hybrids, five were free from the bacterial blight incidence and two exhibited the resistant reaction. Of the remaining, seven were moderately resistant, 29 moderately susceptible and 55 susceptible.

**Utilization of resistant sources**

One hundred and seventy six single plant selections have been made for further evaluation based on their resistance and plant quality characters from the progenies involving four immune lines Tamcot SP 21, Tamcot SP 23, Tx ORH11 1-78 and Tx Bonham as resistant donors with susceptible cultivars Ganganagar Ageti, LRA 5166, LRK 516, PKV 081 and SRT 1. The seed cotton yield of these selected plants varied from 41.7 – 76.8 gm/plant, 14.3 – 21.7 bolls/plant and boll weight of 2.67-3.74 gm/boll.

Thirteen resistant selections have been identified for their plant quality parameters. The boll number of these selections varied from 16.7 – 26.5 per plant with an average boll weight of 2.84 – 3.67 gm/boll. The seed cotton yield varied from 54.3 – 67.1 gm/plant with the plant height of 89.2 – 112.8 cm. The average monopodia and sympodia varied from 0.9 – 3.1 and 14.6 – 22.4 per plant respectively.

**P1-93/2-ICR-H20/0430:**

**Evaluation of cotton germplasm against Alternaria and Myrothecium leaf spot diseases** (N.K.Taneja).

Out of 595 germplasm lines (core collection) belonging to *G. hirsutum* evaluated under natural incidence of diseases in the breeders field, two were resistant, 199 moderately resistant, 218 moderately susceptible and 176 susceptible to Alternaria leaf spot while 84 showed field immunity, 44 resistant, 250 moderately resistant, 115 moderately susceptible and 102 susceptible reaction against grey mildew.

Out of 197 *G. hirsutum* lines screened against fungal foliar diseases under pot culture, all five were susceptible to Alternaria leaf spot, five lines showed resistant, one moderately susceptible and 191susceptible to grey mildew while seven lines were resistant, 29 moderately susceptible and 161 susceptible to myrothecium leaf spot.

Out of 222 *G. hirsutum* germplasm lines of Br 01 trial evaluated under natural incidence of diseases, 46 were moderately resistant, 69 moderately susceptible and 107 susceptible to Alternaria leaf spot while 34 showed field immunity, 21 resistant, 121 moderately resistant, 30 moderately susceptible and 16 susceptible reaction to grey mildew.

Out of 188 *G. arboreum* germplasm lines of Br 01 trial evaluated under natural incidence of diseases, nine were field immune, 14 resistant, 152 moderately resistant and 13 moderately susceptible to Alternaria leaf spot while 19 showed field immunity, 18 resistant, 72 moderately resistant, 35 moderately susceptible and 44 susceptible reaction to grey mildew.

Out of 202 hybrids evaluated under natural incidence of diseases in the breeder's field, 54 moderately resistant, 74 moderately susceptible and 74 susceptible against Alternaria leaf spot, while 47 showed field immunity, seven resistant, 61 moderately resistant, 42 moderately susceptible and 45 susceptible reaction to grey mildew.

**P1-94/1-ICR-H20/0430:**

**Effect of mix-micro-antagonist on control of cotton foliar diseases** (R.C.Ukey).

The trial was conducted on LRK 516 cotton with four sprays of three treatments of mix micro antagonists, The first comprising viz., Trichoderma spp., Penicillium sp., Sterptomyces sp., Pseudomonas sp. and Mucor spp. at 0.25% in chemical and antibiotics. Second treatment had copper fungicide + streptomycin treatment concentration at 0.24% and 0.01% for comparison. Primarily, as in all the treatments, the water infu-

sion of bacterial blight caused by *Xanthomonas axonopodis* pv. *malvacearum*, *Alternaria macrospora* and Myrothecium leaf spot by *Myrothecium roridum* were sprayed four times during the cropping season.

All the above mentioned foliar diseases were controlled to the extent of resistant grades in mix-micro antagonist as well as chemical foliar treatments as compared to control treatments. But the seed cotton yield did not show any significant difference, unlike last year when mix micro antagonists had a significant impact over chemical treatments and control.

**Adhoc Project**

**Effect of Trichoderma biofungicide on control of seed decay, damping off and seedling blight diseases of Agricultural crops.**

Twenty six different crop viz. *Gossypium hirsutum* (L), *Gossypium arboreum* (L), *Solanum melongena* (L), *Lycopersicum esculantum* (mill), *Oryzae sativa* (L), *Penniselum typhoides (L), Sorghum bicolor (L) Moets, Abelmoschus esculentus (Mon), Triticum aestivum* (L), Zea mays (L), *Cyamopsis tetragonoloba*, (Taub), *Sesamum orientale* (L), *Glycine max* (L) *Merril, Vigna aureus* (Rob), *Vigna mungo* (L), *Cajanus cajan* (L), *Millsp, Capsicum annum* (L), *Vigna aconotifolius* (L), *Vigna sinensis* (Savi), *Arachis hypogaea* (L), *Vigna anguiculata* (L), *Cicer arietinum* (L), *Pisum sativum* (L), *Coriendum sativum* (L) were raised in double rows of 3 m length by sowing 4 seeds at each dibble on 60 x 30 cm spacing. Seeds were treated with soil born mix micro pathogenic inocula and then with *Trichoderma viride*. The results revealed that none of the seeds for the 26 crops in Trichoderma seed treatment showed infection to pre and post damping off and seedling blight diseases.

Therefore, seed treatment with *Trichoderma viride* as bio-control is found effective in controlling the inoculum build up of pathogenic fungi and bacteria and to maintain the health and vigour of the seedlings.

**P1-96/2-ICR-H10/0430:**

**Studies on plant parasitic nematodes associated with cotton** (Nandini Gokte-Narkhedkar and S.K. Banerjee).

A field experiment was laid out to estimate loss caused due to plant parasitic nematodes particularly *Rotylenchulus reniforms*. The estimated loss was worked out to be 8%.

Three plant species viz. marigold, custard apple and bitter gourd were found to exert repellant effect on plant parasitic nematodes in their rhizosphere. This effect was recorded up to one meter from the base of plant.

All available (16) isolates of entomopathogenic nematodes applied before, at the same time or after inoculation of reniform and lesion nematodes were found to suppress root invasion by plant parasitic nematodes. *Heterorhabditis, bacteriophora* reduced invasion of reniform and lesion nematode by 70 and 82% respectively with 1 x $10^6$ dose level. *H. bacteriophora* which is cruiser type was most effective at simultaneous application while ambusher type *Steinernema glaseri* was most effective as pre-application. Extract of EPN applied as soil drench was able to reduce invasion of reniform nematode by 38 to 42% indicating roll of metabollites produced by EPN.

Effect of three tillage systems viz. conventional, reduced and minimum on population of plant parasitic nematodes were studied. Results indicate that their population were lowest in conventional tillage while higher population were recorded under minimum tillage. Incorporation of organic residues led to reduction in phytonematode population with corresponding increase in fungal and bacterial feeder nematodes. Rapidly changing soil environment under conventional tillage is more suited for *Rotylenculus reniformis* while relatively stable condition of minimum tillage is more conducive for *Pratylenchus spp.* and *Hoplolaimus spp.*

**Coimbatore**

**P1-72/1-ICR-H10/0430:**

**Studies on the population dynamics of cotton pests and their natural enemies in the cotton ecosystem** ( K. Natarajan and B. Dhara Jothi).

**Sucking Pests**: Aphid population was recorded throughout the cropping period. Population was high during October and December- January. High jassid population was recorded in the month of November-December. Five to six jassids per plant were recorded during the last week of December. Whitefly infestation was low. Higher population of 34 per plant was recorded during the last week of December.

**Bollworm**: Bollworm incidence was generally low. *Helicoverpa armigera* was the dominant species and it appeared in the month of October and peak incidence of 28.8 per cent was recorded during the last week of December.

**Beneficial insects**: Coccinellid beetles and spiders were recorded during the crop season. The parasitism on *H. armigera* was upto 47 per cent during the month of December.

**P1-89/6-ICR-H10/0430:**

**Studies on the host-plant relationship and identification of resistant genotypes to insect pests of cotton** (T. Surulivelu, K. Natarajan and S. Manickam).

**Bollworms** (T.Surulivelu and S. Manickam).

Hundred germplasm accessions were screened for bollworm resistance without protection (for bollworm). Three accessions viz., M52-953, EC 104326 and G3 x Laxmi were found to be tolerant (7-10 % damage) and another 10 accessions were moderately tolerant (13-19 % damage). They are CP 15/2, Delcerro, Delcot 3, Deltapine 14, ELS 134, EWLS X TIDE Water; Glandless High GP, KW –64-1246-B, LO 313W and Lockett 4789-4.

None of the twenty long fibre (high length) accessions screened was found to be even moderately tolerant. All of them were highly susceptible and recorded 51-100 % damage.

Twelve popular cultivars (Abadhita, Anjali, BRS 23, BWR 39-AP-1, CWROK 165-2, CWS –69-AF-2, IRH –2-15-4, LRA 5166, MCU 5, Sumangala, Surabhi and Suvin) were screened under unprotected conditions for bollworms. Abhadita and BRS 23 were the only promising cultivars, which recorded moderately low damage (21-28 %) as compared to very high damage 42-97 % in rest of the cultivars.

**Sucking pests** (K.Natarajan and S. Manickam).

Thirty lines resistant to jassid have been identified. They are in $F_6$ and $F_7$ generation. Lines resistant to jassid will be further evaluated for yield potential and resistance.

**P1-89/4-ICR-H10/0430:**

**Studies on the role of insecticides in cotton ecosystem**

(T. Surulivelu and K. Natarajan).

**Testing of new insecticides for bollworm control** (T. Surulivelu).

(i) Chlorpyriphos methyl, F6028, Bifenthrin and Cypermethrin 5 DF were tested for their efficacy against bollworms. The results revealed that Bifenthrin at 60 and 80 g a.i./ha and F 6028 at 150 g a.i./ha recorded low damage in the fruiting bodies (3.9 – 8.6 %) and locule (11.1 – 22.8 %) as compared to control which had 54.7 and 44.2 % damage, respectively. The above treatments registered significantly higher yield over control.

(ii) Among the combination insecticides tested against bollworms complex, Spinosad + Chlorpyriphos at 1.0 l/ha and Bulldock Star at 1.5 l/ha recorded low fruiting bodies damage (0.6 – 14.5 %), higher number of good opened bolls (10.3 – 12.3 bolls / plant) and significantly higher seed cotton yield over control. Against pink bollworm,

Cypermethrin recorded significantly low damage (5.7 %), followed by Chlorpyriphos (7.9 %), Bulldock star (7.7%), Viratsuper (8.9%), Quinalphos (10.7%) and Spinosad + Chlorpyriphos (12.1 %) as compared to control (21.2 %). Against *Heliothis* bollworm, Spinosad recorded low damage (11.6 %) followed by Spinosad + Chlorpyriphos (14.6 %), Bulldock star (18.4 %), Chlorpyriphos (18.7 %) and Quinalphos (19.2 %) as compared to control (24.3 %).

**Testing of new insecticides for sucking pests control** (K. Natarajan).

The seed treatment chemical thiamethoxam and chlothianidine were tested against jassids and aphids for their efficacy. Thiamethoxam and chlothianidine remained effective against jassids and aphids upto 40 days. All the seed treatment chemicals significantly recorded higher seed cotton yield than untreated check.

**P1-2001/1-ICR-H-10/0430:**

**Studies on biology and management of cotton stem weevil *Pemphereulus affinis* Faust** (B. Dhara jothi and T. Surulivelu).

Survey on stem weevil infestation at different places of Tamil Nadu revealed that there was 6-45 % infestation and the highest infestation was recorded in Kovilpatti. Screening of germplasm lines against *P. affinis* revealed four entries with nil damage and 15 entries with 0-10% damage. Among the cultivated varieties, MCU 7 recorded nil damage and Supriya recorded the highest infestation of 42 %. The peak emergence of adults was observed to be during June second week. Hence, the destruction of stalks in the second fortnight of May will help in reducing the population substantially in the next season. Treatments Neem cake, Neem oil, Nuvacron, Chlorpyriphos, Thiamethoxam, Imidacloprid, Metasystox, Neem cake + early earthing up + Neem oil were found to be on par but superior to control .

**Adhoc trial**

**Evaluation of Bt cotton hybrids**

( T. Surulivelu).

Three Bt cotton hybrids namely MECH 12, 162 and 184 were evaluated against major pests of cotton along with their non-Bt counterparts and two check hybrids namely Savita and NHH 44. The Bt cotton hybrids showed higher retention of first formed bolls and balanced plant growth due to low damage by bollworms. This also resulted in early boll opening (by 15 to 20 days) and required lesser number of pickings to complete the harvest. Bt cotton hybrids crossed ETL for bollworms only once after 90 days whereas the non- Bt and check hybrids crossed the ETL more than 3 times from 60 days after sowing. Further, the population of all the three bollworms were significantly low in number in Bt cotton hybrids as compared to non-Bt and check hybrids.

Bollworm damage in the bolls, locule and in the seed cotton was significantly less in all the three Bt cotton hybrids (MECH 12, 162 and 184) as compared to their non-Bt counter parts as well as check hybrids –Savita and NHH 44 in both protected (ETL based protection for bollworms and sucking pests) and unprotected crop. However, the seed cotton yield showed no significant differences among the Bt, non-Bt and check hybrids in ETL based protection, while in unprotected condition, MECH 162 Bt registered significantly higher yield over other two Bt, non-Bt and check hybrid Savita.

**P1-89/3-ICR-H20/0430 :**

**Studies on the epidemiology and management of fungal foliar diseases** (P. Chidambaram, A. Kannan, K.N. Gururajan and N. Gopalakrishnan).

**A. Survey**

Alternaria leaf spot was observed throughout the winter cotton season. Only mild to moderate incidence of grey mildew was noticed during the season.

**B. Evaluation of germplasm**

One hundred new germplasm lines each of *G.hirsutum* and *G. arboreum* were separately evaluated in pot culture for their reaction to Alternaria leaf spot and grey mildew. Similarly, another set of 100 old germplasm lines of *G.hirsutum* and *G.arboreum* were also evaluated. Thirty one new *G.arboreum* and 11 *G.hirsutum* lines showed resistant reaction to grey mildew. Among the old germplasm lines, only the *G.arboreum* accession 1314N again showed resistance to grey mildew. Since Alternaria leaf spot incidence was low on the plants, assessment could not be made.

**C. Management of foliar diseases:**

**i) Management through fungicides and bioagents**

The new fungicide Tebuconazole (Folicur 250 w) was evaluated for its efficacy against Alternaria leaf spot in the field trials in comparison with Copper Oxychloride, Propiconazole and also bioagents viz. *Trichoderma viride* and *Pseudomonas fluorescens*. During this year, the test fungicide viz., Tebuconazole was significantly superior in controlling the Alternaria leaf spot disease

**ii) Development of resistant lines**

**a) Grey Mildew**

Sixty-one single plant selections involving the crosses between the germplasm lines (IC 629, 710, 751 and 1017) and LRA 5166 and RKR 4145 and also the crosses between RR 1017 and L 629 (grey mildew resistant lines developed earlier) were selected and advanced for further testing.

The grey mildew resistant culture GMR 5 (RR 1017/312) performed well in the Institutional trial (Rank 6) giving a mean seed cotton yield of 854 kg/ha and it has since been entered in the National rainfed trial (Br.02b) of 2002-2003 as CCH 5.

**b) Alternaria leaf spot:**

The $F_{12}$ and $BC_1F_{10}$ progenies of several resistant selections were tested in the field against alternaria leaf spot. Based on resistance and quality parameters, 28 single plant selections were advanced for further testing.

The resistant selection CCH 4 (RR 1007/124-3 (ALR 4) performed well in the IET of AICCIP (Br.02a), first in Central Zone and second in South Zone. It has been advanced to the PVT (Br.03a) of both zones. CCH 727 has been retained in the PVT (Br.04a) for one more year in the South Zone trials.

The resistant culture ALR 10 (AA 1007/54-1) was second in ranking in yield (982 kg/ha of seed cotton) in the Institutional trial and has since been entered as CCH 10 in National Initial Evaluation trial – Irrigated (Br.02a).

**c. MAR Lines**

Several $F_6$ and $BC_1F_6$ progenies of multiple crosses involving lines having resistance to bacterial blight, grey mildew and alternaria leaf spot were tested in the field. Based on their performance against the above three disease and also on other quality parameters, 25 single plant selections were advanced for further test.

**P1- 89/1- ICR- H20/0430:**

**Studies on soil borne diseases of cotton**

(A Kannan, K. N. Gururajan and N. Gopalakrishnan).

Three Verticillium resistant cultures viz., VLV 3, VLV 6 and VTV 6 were yield tested along with MCU 5 VT and Surabhi as checks. All the cultures yielded better than the check MCU5 VT. However, VLV 6 was the only culture yielding better than Surabhi.

Several single plant progenies from the crosses Surabhi x Mian 8, Surabhi x MCU 7, Surabhi x Anjali B, Surabhi x Nazili 85, Suman x Nazili 85, VRS 16 x Nazili 85 have

been selected for screening against Verticillium resistance and plants combining resistance and requisite fibre standards will be advanced. Verticillium wilt resistant culture CCH 342 (VLV 3) recorded a mean seed cotton yield of 10.3 q/ha as against 7.6 q/ha of LRA 5166 in the national trial at South zone and has been promoted to Preliminary varietal trial in South Zone.

**P1-89/2-ICR-H20/0430 :**

**Studies on bacterial blight of cotton**

(A. Kannan, P. Chidambaram and K.N. Gururajan).

One hundred progenies resistant to various diseases viz., Bacterial blight, Alternaria leaf spot and Grey mildew were evaluated for yield and other economic attributes apart from screening for multiple disease with LRA 5166 as susceptible check in intermittent rows. Sixty seven progenies showed resistant reaction to various diseases. Single plant selections have been made.

**Sirsa**

**Evaluation and refinement of IPM module for irrigated cotton in north zone**

(P.Jeyakumar, D.Monga and S.K.Banerjee).

The IPM practice in cotton was evaluated in comparison with farmers' spray, recommended practice and pure biological control. The jassid population was more in IPM plot (2.93 nymphs / leaf) followed by pure biological control plot (1.84), which may be due to spray of only NSKE in both these treatments. The jassid remained less than ETL for the remaining part of the season. The whitefly population was less than 3 adults/leaf up to the beginning of September. Thereafter, it started increasing and the maximum of 12.41 adults / leaf was observed in the farmers' spray practice, which may be due to the spray of more amount of synthetic pyrethroids and mixtures in this treatment.

The bollworm damage was less till middle of August. After that the bollworm damage started increasing in all the treatments. The maximum damage (25.28 %) was observed in pure biological control followed by farmers spray (23.21 %), recommended insecticides (19.33 %) and IPM (16.46 %). The yield was more in farmers' spray practice (41.97 kg/plot) compared to IPM practice (38.83 kg / plot), but the benefit was more in IPM (1.45 for 1)than that of farmers' spray practice (1.19 for 1) due to more number of sprays and in turn increased plant protection costs.

**Studies on the cotton leaf curl virus disease and development of resistant varieties and hybrids for its management.**

(D.Monga, O.P.Tuteja, P.Jeyakumar, R.A.Meena and Surender Kumar ).

**Disease progress**

The appearance of disease was noted on 25th June. The incidence of CLCuV was 3.11 per cent on 5th July and reached maximum during this month with 76.45% incidence on 1st August. There after the progress of disease slow down during August and September with maximum incidence of 90.66% on September 19. No further progress was recorded subsequently. The population of whitefly remained low and was less than one per leaf for most part of the season. The maximum temperature in July remained around 35 °C with a maximum RH of around 80%. The sunshine hours during the period ranged between 5.2 to 7.4. These factors appear to be favourable for the development of cotton leaf curl disease.

**Screening of germplasm**

The germplasm available at the station was screened against cotton leaf curl virus disease for the fifth consecutive year. A total of 1233 lines were screened of which 170 lines remained free from disease. The disease incidence ranged from 11.11-100 % in remaining lines and whitefly incidence varied from 0 .16-14.5 / leaf. Based on five years data 65 lines resistant to CLCuV have been identified.

**Breeding for Disease Resistance**

One 8 x 8 half diallel ( LRA 5166, Tx maroon 2-78, LH900, BJR 592, FS 128, PIL 8, LRK 516 and RS 810 ) was attempted during 2000 crop season and F crosses were evaluated during 2001 crop season. Out of 28 crosses 12 have shown resistant reaction with seed cotton yield ranging from 761 to 2390 Kg/ha.

In addition to that 173 $F_1$ crosses were also evaluated out of which 80 crosses have shown resistant reaction against CLCuV. The highest seed cotton yield of resistant crosses was noted in cross CSHH 1x11 ( 68.39 q/ha) followed by crosses CSHH 11x 2 (49.38 q/ha) and CSHH11x5 (44.32 q/ha ).

F seed of one hundred and thirteen crosses was sown in unreplicated trial with four rows of 19 plants each during 2001 season. Cotton leaf curl virus disease free single plants (145) were selected from 85 $F_2$ generation. The highest seed cotton yield of 46.91q/ha ( F846 x RS 810 ) followed by 41.48 q/ha ( SLT 7-97 x PIL 8, H 1098 x IET 154, HS 6 x JLH 168 ) and 40.99 q/ha ( F846 x PIL 8 ) were recorded. These will be further advanced to next generation.

Performance of 105 crosses was studied in $F_3$ generation with two replications and two rows (19 plants/row) of plants in each replication in RBD. Observation on the yield and quality parameters were recorded. Thirty-eight crosses remained completely free from leaf curl virus disease. Boll number in these crosses varied from 10.5 to 34.5. Boll weight in disease free crosses ranged from 2.7 to 4.85 gm and seed cotton yield from 383.1 to 1587.3 Kg/ ha. Seed cotton yield in check varieties RST 9, H 1098 and HS 6 was 1082.9, 1211.7 and 1169.6 Kg/ ha respectively. Eleven crosses have shown seed cotton yield higher than check variety RST 9.

# National Agricultural Technology Project

**Nagpur**

**RCPS 4: Delineating the efficient productive zones for cotton production system using GIS based crop models**

(S.Vennila and K.B.Hebbar).

Data collection and preparation of data base of crop growth and yield parameters were done in relation to the selected genotypes of cotton viz., LRA 5166 (*G. hirsutum*), AKA-8401 (*G. arboreum*) and NHH 44 (Intra *hirsutum* hybrid) from the Central zone AICCIP centers. The cotton efficient rainfed districts, cotton crop growth in relation to climate (dry spell periods and their coincidence with growth stages of cotton and moisture stress experienced by the cotton crop during total life phase and maturity), performance of the different cultivated species of *Gossypium* over different soil of rainfall conditions of the rainfed state, the influence of time of sowing, spacings, and fertilizer levels on the yield at different rainfed cotton growing environments were compiled. The physiological aspects of cotton growth and development such as growing degree days for the phenological phases of varieties and hybrids and the model parameters like leaf area index, canopy radiation reflectance, transpiration rate, stimulate conductance, total dry matter production and harvest index besides the yield contributing characters such as boll numbers/plant and boll weight for use in crop growth models were compiled and reported.

**PSR 26 : Control of leaf curl viral disease in cotton and development of protocols for mass multiplication of predators, parasites and insect pathogens** (Sheo Raj).

**Standardization of protocol for isolation of DNA from cotton plant** : By adopting a modified Murry and Thompson (1980), protocol for isolation of DNA from cotton and brinjal plants was standardised. Random Amplified Polymorphhic DNA (RAPD) analysis was carried in varieties LRA 5166 and F 1378 to see polymorphism in CLCuV resistant and susceptible genotypes. Of the 10 random primers tested, the RAPD marker OPA-1, 2 and 5 were found to be useful for amplification.

**Development of molecular probe** : Molecular cloning of whitefly transmitted gemini virus was attempted using a PCR based technique. The complete DNA-A of the virus was amplified as a single fragment (2.7 kb) from the infected cotton plant and subsequently cloned in PUC-18 plasmid vector. Apart from full length DNA component obtained by using primers for C' terminal region of AC3 genes, many fragment of different sizes ranging from 2.7 Kb to 0.6 Kb were amplified with primers for the intergenic region including the non-nucleotide sequence in it.

**Detection of CLCuV in cotton and weed hosts :** Nucleic acid hybridization test for the detection of CLCuV in cotton and weed hosts was conducted. In nucleic acid analysis using Radio labelled probe, the DNA-A of different genotypes (with symptoms and without symptoms) collected in North India was detected. The probe could detect CLCuV infection in naturally infected and apparently healthy plants of cotton and weed Cymoposis spp. The results are given in Table 8:

**Table 8 : Dot blot result (NASH test)**

| Sl. No. | **Samples tested** | | **Dot Blot Result** | |
|---|---|---|---|---|
| | A (with symptoms) | B (without symptoms) | A | B |
| 1 | HS 6 | HS 6 | ++ | ++ |
| 2 | F 846 | F 846 | ++ | + |
| 3 | RST 9 | RST 9 | + | + |
| 4 | LH 1556 | LH 1556 | + | + |
| 5 | H 1098 | H 1098 | + | + |
| 6 | Unknown hybrid | Unknown hybrid | + | + |
| 7 | Cat 214 | Cymopsis sp. | - | - |
| 8 | Cat 202-1 | Healthy control | + | - |
| 9 | - | Positive control | - | + |

**Standardization of protocols for isolation of DNA from whitefly (*Bemisia tabaci* Genn.):** The protocol for isolation of DNA from whitefly has been standardized. Some molecular marker for biotypes studies have been identified. Ramdom Amplified Polymorphic DNA (RAPD analysis of whitefly DNA was carried out to study polymorphism in whitefly populations. Twenty random primers of OPA kit Operon Tech., USA were tested. The RAPD markers OPA 5, OPA 9, OPA 11 were found better as compared to OPA 1, 7,8 and 13 for amiplification of whitefly DNA.

**Development of mass production protocols with critical automation** (T . P. Rajendran).

Seventy-two trays of size 25 x 23 cms are stacked in this frame, 3 in each row with two lines. The brown canvas cloth that permit air movement restrict the light up to 98%. The egg-laying PET jar is the receptacle for moths that are attracted to the fluorescent lights provided on the hopper.

The biology of the grain moth is studied under the new set up. There is an apparent enhancement of developmental period (DP) that is being studied over months. The standard DP is 42 days in the present system. The ambient temperature of the room was maintained at 30± 1 °C.

**Biological parameters of the Unit-1 for grain moth egg production**

This unit was commissioned in October 2001. The number, size and stacking of trays and filtering of lights was as above. The 22 cm glass window is fitted with 14 W fluorescent bulb. The moth attraction was measured on 24 hour basis. The egg yield was also determined.

The second unit commissioned in December 2001 had 31 on glass window fitted with 18 W fluorescent bulb. A long term evaluation is in progress in both the units for final standardization.

**Sirsa -** (D.Monga and P.Jeyakumar)

**Screening of cotton germplasm for resistance against CLCuV and whitefly :**

Based on two years screening of 202 germplasm lines only 25 lines remained resistant. White fly incidence per leaf varied from 0.66-4.33 and the seed cotton yield ranged from 1.62 to 479.72 Kg / ha. These lines have shown good fiber length, fineness and bundle strength ranging from 24.3 to 29.1 mm, 3.9 to 5.0 and 17.8 to 22.1 g/tex.

During 2001, 401 germplasm lines were screened against leaf curl and white fly. Observations on the incidence of leaf curl virus disease, incidence of white fly and yield were recorded. Sixty nine lines have shown resistant reaction to leaf curl disease. The leaf curl incidence in remaining varieties varied from 7.60 to 100 per cent. The white fly population ranged from 0.33 to 27.60 per leaf. There was one line namely B 57-740 on which no white fly was recorded. In addition to that thirty more lines with white fly population less than 1/leaf were also identified.

The concentrations of coating buffer, antiserum and conjugate were standardized. These antisera were tested and diseased samples of HS-6 variety (susceptible to CLCuV) were collected from field and simultaneous controls were taken from field and plants maintained in polyhouse. Antisera at 1: 250 dilution and conjugate at 1:750 dilution were taken for testing. The differences in absorbance in samples of diseased and control plants from field were not visible. However, there were distinct differences in infected plants and controls maintained in polyhouse. It appears that the control plants taken from field look healthy but apparently carry the virus.

**Management of CLCuV through whitefly management :**

The whitefly population in the month of October 2001 was not significantly different between treatments. The population was less than six adults / leaf in treatments up to 6$^{th}$ October, 2001, whereas in untreated control it was less than 7.2 adults /leaf. Thereafter the population increased and in last lag of observation, i.e. 16$^{th}$ October, 2001, went up to 15.9 adults / leaf.

The CLCuV incidence in the last lag of observation was not significantly different between treatments. The maximum incidence (15.24 %) was recorded in Triazophos treated plot and the minimum (8.12 %) in *Beauveria bassiana* (800 g a.i./ha) treated plot. Among the seed treated plots, imidacloprid (9 ml/kg) treated plot recorded 13.47 % incidence of CLCuV, whereas the thiomethoxam (4.2 g/kg) treated plot recorded 9.32 % disease incidence. The yield was 4.54 kg / plot in triazophos (400 g a. i./ha)) treated plot followed by ethion treated plot (4.27 kg / plot).

**Nagpur**

**Evaluation bioefficacy of the product through lab and field assays** (N K Taneja).

*In vitro* studies were made with *M. anisopliae* against *H. armigera*. Cent per cent mortality was observed in 1st instar while 73, 60 and 33% mortality was seen in 2nd, 3rd, and 4th instar larvae respectively.

In an experiment laid out in the field, HaNPV, Bt alone as well as with UV protectant together with endosulfan and control were tested for their efficacy against *H. armigera* on gram. Treatment wise spraying was done when the larval population on 10 plants ranged between 16 to 18. After 1st spray, the population reduced to 11 in NPV treated plot, 13 in Bt and 14 in endosulfan but increased to 19 in control. After 2nd spray, the population further reduced to four in NPV, 7-8 in Bt and 8 in endosulfan while the control plot showed the highest population of 25 larvae/10 plants.

**Sirsa**

MM2 :**Development of weather based forewarning system for crop pests and diseases** (P.Jeyakumar and D.Monga).

Historical incidence data of insect pests for 1990-2000 and bacterial leaf blight and incidence of *Alternaria* leaf spot for 1990-1994 of this station and the insect pest incidence data from 1988-2000 from CCS HAU Hisar, were collected and computerised. Likewise, weather data of Sirsa from 1990-2001 and that of CCS HAU Hisar from 1988-2000 were also collected and computerised.

Apart from this the incidence of insect pests and diseases from station field trial as well as, from 10 farmers fields was recorded regularly at weekly interval. The forecasting model for jassid was developed. The jassid data was available from 33rd standard week to 39th standard week. Thus for each week there are about 10 data points. The lagged weather variables were used as independent variables and up to two weeks prior weather parameters were used. Step-wise, Multiple regression models were fitted (Table 9).

**Table 9. Models developed for standard weeks 33-38.**

| Std. Week | Model Developed | $R^2$ |
|---|---|---|
| 33 | $Y = 4.451-0.374*Rain_{31}$ | 0.600 |
| 34 | $Y = 73.192+2.324*Rain_{33}-2.633*TMIN_{32}$ | 0.855 |
| 35 | $Y = 2.557+1.516*Rain_{34}$ | 0.659 |
| 36 | $Y = 52.835-.245*RHEven_{35}-0.171*Rheven_{34}-0.641*Tmax_{34}$ | 0.979 |
| 37 | $Y = 2.170 + 0.503*Rain_{35}$ | 0.639 |
| 38 | $Y = 4.123 + 0.756*Rain_{37}$ | 0.486 |

# Technology Mission on Cotton

**MME-1: Evaluation of location specific IPM modules for eco-friendly and sustainable cotton production.**

**Nagpur-** (T.P.Rajendran).

Socio-economic survey regarding baseline information on the status of knowledge and practice of plant protection and cotton cultivation was conducted in the selected in this watershed. The current crop management and protection practices that were seen from the pre-project survey were : Application of urea as top dressing once in late August and next two times in early September and mid-September, as per the rainfall. The total top dressed N was 65-87 kg provided in a span of 30 days. Application of monocrotophos, tank-combinations of monocrotophos/dimethoate/methyl demeton/thioxacarb + BHC for sucking pest management.

- Application of quinalphos, endosulfan, indoxacarb, monocrotophos and BHC was mixed with every spray. Other common combinations were monocrotophos or phosphamidon with endosulfan, deltamethrin, fenvalerate, decamethrin,

alfamethrin, l-cyhalothrin and indoxacarb.

- No fungicides or antibiotics were applied in their cotton crop to manage bacterial blight or grey mildew. Some farmers applied ash for grey mildew management.
- A meeting of the villagers of these villages was conducted in June and explained them our strategies of low cost production techniques through integrated crop management. CICR provided them Anjali variety as a test cultivar for the first time.
- The importance of NSKE and other neem-based pesticide preparations were explained to villagers.
- By July, when one spray of Methyl demeton, monocrotophos or endosulfan in cotton crop was over. Three farmers' field schools were held. The village men and women taught to identify the life stages of jassids, American bollworm, Spotted bollworms and Pink bollworms in addition to the ladybird beetles, green lace-wings and such other predatory insects.

**Coimbatore -** (T. Surulivelu).

The success of location specific IPM/IRM strategies developed at this centre has been evaluated at Chinnaputhur village near Dharapuram. The adoption of location specific IPM/IRM strategies in the irrigated cotton ecosystem of Chinnaputhur village have helped the farmers in efficient management of cotton pests including the resistant pest *H.armigera*. In addition, it has also resulted in substantial reduction in use of pesticides by 50 per cent and savings on plant protection of Rs. 3326 per hectare. Further, it was observed that the bollworms damage was 10 to 11 per cent in project village as compared to 24 to 29 per cent in control village. The seed cotton yield was higher by 25 per cent (18.74 q/ha) as compared to control village (15 q/ha). There was an increase of net income of Rs. 12056 per hectare over control village.

**Sirsa -** (P.Jeyakumar and D.Monga).

**IPM components**

The IPM components have been practised under this programme by the participatory farmers.

FYM, application instead of chemical fertilizers, cultivation of released instead of non-descript varieties, sowing between middle of April to middle of May, sowing of Bajra in the bunds at 50-60 days after sowing to serve as live bird perch, clipping off of 4-5 top leaves to reduce the egg laying by the middle of July, pheromone traps for all the bollworms @ 40 traps for 125 acres for monitoring purpose, mechanical collection of eggs and larvae of bollworms, spraying NSKE 5% was done in the last week of June and beginning of August. Two releases of *Tricogramma chilonis,* Spray of HaNPV with strength of 2 x $10^9$ POIBs/ml @ 100 LE/acre, and application of selective insecticides such as Endosulfan, Quinalphos, Chlorpyriphos, Cypermethrin, Fenvalerate and Nurelle D (Chlor + Cyper) were made.

**Pest Incidence :**

The load of sucking pests was less compared to the previous years. On one occasion i.e. August first week the egg population of *Helicoverpa armigera* in IPM was more (6.4/plant) than non IPM (1.8/plant). In the month of July though the larval population in both these plots were on par. The egg population in the IPM plots (0.1-2.8/plant) was significantly less than non IPM plots (2.9-3.6/plant).The population of adult moths of *Earias* spp. (maximum of 60.4 males/ week) and *P. gossypiella* (maximum of 93.9 males / week) was observed and the maximum was found up to the middle of season .The population started declining from September onwards and almost zero population was noted by the middle of October. The damage on reproductive parts was also more and has crossed the ETL in most of the observations.

The *Chrysoperla* population was found more towards the end of the season. The bacterial blight and *Alternaria* leaf spot incidence was more in the beginning of the season and then it started decreasing towards the end of the season . The CLCuV incidence was less in the beginning of the season and reached upto 42% towards the end of the season.

The average yield of seed cotton in IPM plots is low (342 kg / ha) compared to that of non IPM plots (380 kg / ha). This is because of the reason that some area in IPM were ploughed down in advance by farmers due to the heavy infestation of bollworm as only around 8 sprays that too mainly NSKE and NPV alone were sprayed along with 1-2 insecticide sprays. This has caused the reduction in average yield. Though the yield is less the expenditure by IPM farmers on plant protection aspect was Rs. 3270 and that of non IPM was Rs. 4500. The cost : benefit ratio was more in IPM farmers (1:1.91) than non IPM farmers (1:1.5) (Table10).

**Table 10 : Number of pesticide sprays made /pesticide consumption, and yield of seed cotton.**

| Area | No. of sprays | Quantity of pesticide used | | Yield of seed Cotton(kg/ha) | Cost Benefit ratio |
|---|---|---|---|---|---|
| | | Commercial Grade(kg/ac) | a.i. (kg/ac) | | |
| IPM | 8-15 | 9.37 | 2.52 | 342 | 1:1.9 |
| Non IPM | 20-25 | 13.8 | 3.17 | 380 | 1:1.5 |

**Nagpur**

**MME 2 : Development of pest and disease forecasting system (Bacterial blight).**

**Nagpur** - (M.K.Meshram).

The development of bacterial blight was monitored since its initial appearance on susceptible cultivars. The progress of the disease was observed during the month of August and September and highest disease intensity was recorded during the second week of October. From first week of July to second week of October, the weather parameters of average weekly maximum temperature ranged between 28.9 -34.0 $^{0}$C, minimum temperature 23.2 -25.6 $^{0}$C, maximum RH 76-92 per cent, minimum RH 39-82 per cent and weekly rainfall of 3.0-94.4 mm (except fourth week of August and September) with 1-6 rainy days appear to be favourable for the development of bacterial blight.

**Coimbatore –** (K. Natarajan)

Aphid, jassid and the bollworm *Helicoverpa armigera* were the dominant pests. Observations taken both in untreated check and treated fields with insecticides revealed that aphid was dominant during October. During the corresponding period, activity of coccinellid predator was observed. Jassid population was more during the month of October to December.

*Helicoverpa armigera* was the dominant bollworm. *H. armigera* was trapped throughout the cropping period and the peak incidence was during December. A maximum of 24.1 moths/trap was recorded during the middle of December when the crop was about 100 days old. There was no catch from April to July. Pink bollworm moths were more in the month of February.

Correlation studies between pest and weather factors revealed that aphids had negative relation with rainfall. Jassid had positive relationship with humidity. The *Helicoverpa* larvae had negative relation with temperature and positive relation with sunshine and solar radiation.

**Sirsa** - (P.Jeyakumar and D.Monga).

**Population dynamics of key insect pests and disease**

**Sucking pests:** The jassid nymphs were found high during the month of July (7.3-11.2/3 leaves ). The population subsequently became low and was found less than ETL throughout the season. In contrast to this, the population of whitefly adults was less than 5.7/3leaves throughout July and August.

**American bollworm (*Helicoverpa armigera*) incidence**

The population of eggs and larvae of *H. armigera* was very less during July, 2001. The egg population was found more i.e. up to 6 eggs / 25 plants during August, 2001 and remained high (1-5 eggs / 25 plants) in September the egg population came down to less than 2 / 25 plants and found nil in most of the occasions. The flower damage due to pink bollworm (rosetted flower) was found to be nil up to the end of August. The *H. armigera* adult moths were found less in the beginning of August and increased up to 14 moths / trap / 3 nights by the end of August. Whereas, in the beginning of September the population also went up to 35 moths. The population of *Earias* spp. moths was high throughout August and September and reached up to 89.5 moths on 14 September. The trap catches of pink bollworm also was showing the same trend. The highest trap catch (129.5 adults / trap / three nights) was recorded on 18th September.

The square damage (7.1-10.8%) was recorded in the month of August and green boll damage (5.9-27.6%) in the month of September. The open boll damage recorded during the end of September and beginning of October (18.5-24.3%) was also found to be high. In general from the beginning of September onwards the incidence started from 3.2% and it reached up to 50% on 21st September.

**Natural enemies in cotton**

The population of *Chrysoperla* and Coccinellid grubs and adults was very less throughout the season compared to spider adults (1-8 / 25 plants).

**Disease incidence**

The appearance of disease was noted on 25th June,2001 and the incidence of CLCuV was 3.11 per cent on 5th July. The maximum increase of disease was noted in the month of July and 76.45% incidence of leaf curl disease was observed on 1st August. Thereafter, the progress of disease became slow in the month of August and September and a maximum incidence of 90.66% was noted on September,19.

**MME 3: Development of diagnostic tools for differentiation of biotypes /races of pathogens and insect pests**

**Nagpur** -(C.D.Mayee, M.K.Meshram and S.Kranthi).

Twelve cultures of *R. areola* were isolated from infected tool samples of different varieties of *G. arboreum, G. herbaceum* and *G. hirsutum* and intra *hirsutum* hybrids collected from farmers fields as well as the experimental plots of CICR, Nagpur. The pathogenicity of two cultures was tested on *G. arboreum* cultivar AKA 8401 and *G. herbaceum* cultivar Jayadhar. There was no observable difference between plants inoculated with conidial suspension made from freshly infected leaves and the plants inoculated with conidial suspensia of isolated culture of *R. areola* with regards to incubation period and type of symptoms produced.

The size of the conidia of freshly infected leaves of cultivar AKA 5 of *G. arboreum* and SRT 1 of *G. hirsutum* were almost similar. However, the size of the conidiophores of *G. arboreum* cultivar was comparatively smaller in size than the conidiophores of the cultivar of *G. hirsutum* indicating the possible existence of physiological races.

The favourable range of temperature, RH and pH were 26-28 °C, 90-100% and 8.5-8.8 respectively.

**Cornutal spines as a taxonomic character for differentiation of cotton and non-cotton strain.**

Variability of cornutal spiner numbers in cotton and non- cotton strains of *H.armigera* was observed while the non cotton strain had a cornutal spine number of less than 12. Cotton strains characteristically had 12 or more cornutal spiner. A limitation was observed in the *texanomic* differentiation of strain.

Genomic DNA of cotton and non- cotton strains were quantified and checked for the absence of shearing before using them for RAPD analysis. Of the 80 primers tested, all but one resulted in the amplification of genomic DNA of *H.armigera*. Of the five individual DNA samples belonging to each of the cotton and non- cotton strains atleast four showed a similar banding pattern when amplified with a specific primer. This was true of both the cotton and non-cotton individuals. However, only three primers gave a distinct banding pattern specific to that group in all the individuals tested, while five other primers gave an amplification pattern similar and distinct to atleast three individual DNA samples of the group.

Of the ten primer sets (belonging to the Co 1, Co 11 and Co 111, NADH and cytochrome regions of the mitochondrial genome) designed, seven were capable of successful amplification of the mitochondrial genome. Six individual DNA preparations from individual moths of the cotton and non -cotton strains were subjected to amplification using the seven primer sets. A single band corresponding to the expected molecular weight was obtained and was identical for that primer set in all the three DNA preparations of the cotton and non- cotton group.

**Coimbatore** - (P.Chidambaram, B. Dhara Jothi and N.Gopalakrishnan).

Six cultivars of *G. arboreum* and seven cultivars of *G. hirsutum* were inoculated with spore suspension of *arboreum* and *hirsutum* isolates of grey mildew pathogen on 40, 45 and 55 DAS, of which four cultivars of *G. arboreum* were completely resistant to *hirsutum* isolate and none of the cultivars was found resistant to *arboretum* isolate, while five cultivars of *G. hirsutum* showed resistance to both the isolates.

Selected *G. arboreum* and *G. hirsutum* genotypes were used to study the biochemistry of interaction between the host plants and the isolates of *R. areola*. The loss of structural integrity of subcellular membranes due to disease development was accompanied by increase in the hydrolytic enzyme like Ribonuclease. The varied reaction to the isolates of *R. areola* in LRA 5166 and resistant genotype L 710 as regards accumulation of hydrolytic enzymes was clearly discernible. Similarly, the differential reaction of *G. arboreum* genotype AC 25 to isolates of *R. areola* also pointed out the differential presence of races / pathotypes of *R. areola*.

*Helicoverpa armigera* larvae collected from the variety Sumangala (*G.hirsutum*) were studied for the ovipositional preference on different hosts namely cotton, chick pea, tomato and pigeon pea under multiple choice and no choice conditions. In both the conditions pigeon pea was highly preferred followed by chick pea. Cotton and tomato were the least preferred.

**Sirsa** - (D.Monga and P.Jeyakumar).

Root rot affected samples of cotton plants collected from different areas of North zone were subjected to isolation, identification and maintenance .

**Study of differentiation of biotypes/ races of pathogens**

An experiment was conducted to differentiate different isolates of *Rhizoctonia solani*

on the basis of salt tolerance capacity. Four levels of salt concentration (0.0, 0.10, 0.25, 0.50 per cent) in the form of sodium chloride were maintained in potato dextrose agar medium in petridishes.

Results indicate that all the isolates differed significantly in their radial growth amongst themselves. Isolate HR-3 showed maximum growth at all levels of salt concentration including control (i.e. 0.0%) and at all time intervals i.e. 48, 72 and 96 hours. Maximum growth (7.92 cm) was recorded in control at 96 hours and minimum growth (0.20 cm) in 0.50 per cent salt concentration at 48 hours.

Minimum growth was found in isolate HR-5 at all salt concentration levels and at most time intervals. Result indicated that salt tolerance capacity of different isolates according to maximum level of salt concentration i.e. 0.50 per cent at all time intervals increase in following order:

HR-3 > HR-4 > HR-2 > HR-1> HR-6> HR-5

**Effect of different levels of pH on growth of different isolates of *Rhizoctonia solani***

An experiment was conducted to differentiate different isolates of *Rhizoctonia solani* on the basis of their radial growth on different levels of pH.

Minimum and significantly least radial mycelial growth was observed in isolate HR-6. This was followed by isolates HR-1, HR-2 and HR-3, which appeared to be statistically at par in growth. The maximum growth was noted in isolate HR-4 which was at par with isolate HR-5. At 24 hrs after inoculation, isolate HR-6 showed least growth at all pH levels where as the maximum growth was noted in isolate HR-3 at pH 4.0, isolate HR-5 at pH 6.0 and 10.0, HR-1in 8.0.

Results revealed that isolate HR-4 showed maximum growth (7.6, 7.21, and 6.34 cm) in medium having acidic pH i.e. 4.0, 6.0 and 10.0 at 48 hours after inoculation. Isolate HR-1 showed maximum growth (6.58 cm) at 48 hours after inoculation at pH level 8.0. At 72 hours after inoculation all the isolates at all time intervals showed maximum radial growth except in isolate HR-6 at pH 6.0 and isolate HR-1 at pH 10.0.

## MME 4 : Development of efficient strains of biocontrol agents through molecular manipulation/techniques

**Nagpur** - ( Nandini Gokte – Narkhedkar) .

Sixteen isolates of EPN belonging to *Heterorhabditis* and *Steinernema* sp. have been collected from different cotton zones of the country. Associated bacterium from all the EPN isolates was isolated from infected insect's haemolymph. The bacterium is known to exist in two forms, primary and secondary. Primary bacterial form is known to be better producer of insecticidal principles than secondary form. Therefore, both the forms were taken up for studies on isolation of toxic principle for all the bacterial isolates.

Results indicate that supernatant formed after sonication of pellet showed clear evidence of two bands in bacterial primary forms. These bands were not seen in secondary forms. Unsonicated pellet and supernatant did not show any band. This indicates that toxin is probably intracellular. This needs to be confirmed. Other supporting work suggests that proteases and lipases constitute toxins produced by symbiont bacteria.

**Coimbatore-**(B.Dhara Jothi, P. Chidambaram and N.Gopalakrishnan).

**Phylloplane microbes**

Three fungi (*Fusarium sp. Nigrospora* sp. one to be identified), one bacterium and one actinomycetes both to be identified isolated were found to regularly appearing in the phylloplane of cotton. The characteristic features of the microbes have been recorded.

**Rhizosphere microbes**

Number of fungal, bacterial and actinomycetes colonies have been isolated in artificial medium at $10^{-3}$, $10^{-6}$ and $10^{-4}$ dilutions. The cultures were purified and maintained in respective media.

Attempts were made to collect the bioagents of cotton pests for the molecular manipulations in the laboratory. The preliminary studies showed that there were two predominant species of *Trichogramma* namely *T. japonicum* and *T. chilonis*.

## Externally Funded Projects

**Development of sensitive molecular diagnostic tools for rapid detection and differentiation of races of *Xanthomonas axonopodis* pv. *malvacearum***

(P.K.Chakrabarty, C D Mayee, Sheo Raj and M.K.Meshram).

### Race-specific diagnostic tools

A simple, rapid and efficient protocol has been developed for isolation of low copy plasmids from exopolysaccharide producing bacteria like *Xanthomonas*. Using this protocol seventy-eight bacterial strains were screened for their plasmid profiles. All of them contained plasmids ranging in number from 1-3. Different members of *X. a.* pv. *malvacearum* exhibited variability with regard to their native plasmid profiles.

Restriction digestion of plasmid DNA showed polymorphism in DNA fragmentation pattern. Some isolates belonging to the same race exhibited polymorphism, thereby providing evidence for the existence of intra-racial variability (biotypes). Hence the DNA fragmentation patterns can prove to be a useful diagnostic tool for race/ biotype differentiation.

The plasmid DNA was also subjected to PCR amplification using a set of arbitrary primers to generate a Randomly Amplified Polymorphic DNA pattern as an additional tool for race differentiation. OPA-13 showed high potential for use as an important diagnostic tool for race-differentiation. Most of the members of *X. a.* pv. *malvacearum* could be amplified successfully using this particular primer, which also brought forth the highest degree of polymorphism among them.

**Sustainable control of the cotton bollworm *Helicoverpa armigera* in small scale production systems** (K. R. Kranthi and Sandhya Kranthi).

### Resistance Monitoring

Resistance monitoring carried out with LDP (log dose probit) assays on 53 strains of *H. armigera*, showed highest pyrethroid resistance in Sangaria and Warangal and endosulfan resistance in the Sangaria strain. High levels of resistance to methomyl and quinalphos were observed in *H. armigera* collected from Sirsa.

### Resistance mechanisms

While Jalgaon strains expressed pyrethoid resistance mediated through mixed function oxidases, Aurangabad strain exhibited the same through esterases. Pyrethroid resistant strains having nerve insensitivity as a predominant mechanism were isolated from Warangal, Guntur and Sangaria. Esterase and glutathione transferase enzyme levels were uniformly higher in the cypermethrin resistant strain as compared to the susceptible strain.

### Genetics of Resistance

Strains resistant to pyrethroids, methomyl, spinosad, endosulfan, quinalphos and Cry1Ac were developed through consistent selection pressure. The resistant strains were crossed (reciprocal) with the Oxford (world susceptible strain). Test crosses were performed and bioassays were carried out. Pyrethroid resistance was confirmed to be semi-dominant and autosomal. Nerve insensitivity was about 480-fold higher in the resistant strain. Resistance to endosulfan was semi-dominant and maternally inherited, whereas resistance to quinalphos was also semi-dominant but did not appear to be either maternally or autosomally inherited. Endosulfan resistance was found to governed by two alleles. Resistance to methomyl was governed

by dominant alleles. Alleles imparting resistance to spinosad were found to be recessive. Genetics of alleles conferring resistance to Cry1Ac was worked out with several independent crosses. Expression of resistance alleles was found to be dose dependent.

**Development of PCR-based pyrethroid resistance detection kit**

Out of the 80 random primers tested 24 unique DNA fragments could be associated with either resistant or susceptible strains. Sequencing was carried out using a fluorescent BIG-Dye Sequencing kit on an ABI PRISM 310 automated DNA sequencer and SCAR markers were (18-23-mer primers) synthesized. Some of the SCAR markers were found to amplify the designated DNA, and various resistant populations are being screened to validate the markers.

**Development of immunodiagnostic kits for Cry1Ac, pyrethroids, endosulfan and quinalphos**

Cypermethrin, endosulfan and quinalphos were modified, derivatised and conjugated with KLH (Keyhole limpet hemocyanin protein) and Ovalbumin independently with various functional groups of the insecticides. Antisera has been raised against immunogens (cypermethrin, endosulfan, quinalphos and Cry1Ac). Endosulfan (Endo-KLH) antisera was found to be efficient in detecting the insecticide at 20-50 ng levels. Dip-stick kits are being set up for the quality control of endosulfan. Cry1Ac dip stick (instantaneous test), ELISA and dot-blot detection kits have been developed and commercialised.

# AP CESS FUND

**Use of entomopathogenic nematodes for biological control of insect pests of cotton** (N.Gokte-Narkhedkar and S.K.Banerjee).

**Natural occurrence of EPN in cotton growing ecosystems**

Natural occurrence of EPN in cotton grow ing ecosystems was studied using *Corcyra cephatonica* and *Galleria mellonella* as bait. Heterorhabditis were recorded in Haryana both Steinernematids and Heterorhabditis were recorded and Southern regions yielded only Heterorhabditis. In general greater percentage of baited samples (8-10%) yielded EPN in irrigated areas.

**Efficacy of EPN isolates in relation to temperature, concentration and origin of infective juveniles**

25-30 $^{0}$C was optimum temperature for all the isolates. Most significant is the finding that isolate U6 was found to be tolerant to higher temperature of 35 $^{0}$C recording insect mortality and nematode population increase at higher temperature of 35 $^{0}$C.

For population build up, inoculum level of 30IJ per larva was effective for most of the isolates against 3$^{rd}$ instar larva while for 4$^{th}$ stage, 50IJ/larva gave good population build up. For pupa, greater population build up was recorded at 20IJ for most of the isolates. Significant insect mortality was recorded at 10IJ and higher. Therefore, standardization of spraying schedule and equipment will require delivery of 10-15 IJ at any given point.

*Heterorhabditis* are known to produce first generation of hermaphroditic females while next generation is amphimictic. Progeny from the hermaphroditic females and amphimicitic females were tested for efficacy against *H. armigera*. Results indicate that progeny from hermaphroditic females are more effective. This indicates that larvae obtained in first week of culturing are more effective for insect control.

**Studies on storage of EPN isolates**

Four isolates were taken up for studies on survival at different temperature regimes. All the four isolates survived very well at all the storage periods and temperatures and addition of glycerin was found to confer protection particularly at 6 and 13 $^{0}$C. There was no difference between infectivity of nematodes surviving different storage conditions.

**Standardization of mass production protocols**

Results indicate that dogfood medium and kidney are good mediums for multiplication of EPN without any adverse effect on their infectivity. In case of Wouts' medium there was found to be drastic reduction in infectivity. Reasons for this are being ascertained. Studies are underway on further modification and standardization of protocols with aim to get highest nematode production at least cost.

# Executive Summary



## Crop Improvement

### Nagpur

- In *G. hirsutum*, a core collection of 800 accessions was constituted out of 5948 germplasm lines and 446 accessions were stored for long term conservation (-20 °C) at NBPGR, New Delhi. Passport data of 4219 accessions of *G. hirsutum* and 527 lines of *G. herbaceum* were documented.
- In *G. hirsutum* and *G. arboreum* two sets each of 100 accessions were evaluated in coordinated trial (Br 01) at Nagpur (rainfed), Sirsa and Coimbatore (irrigated).
- A set of 550 germplasm lines of *G. herbaceum* was multiplied at Surat and Bharuch.
- In *G. arboreum*, the culture CINA 316 was sponsored in National Trial, CINA 329 was retained in Br 24 (b) and CINA 305 was promoted from NEVT to Br 24 (b) trial in South Zone.
- In deep soil and high rainfall as well as in shallow soil and low rainfall AK 8401, in deep soil and low rainfall – Arvinda, in medium soil and high rainfall, G.Cot Hy 8, in medium soil and low rainfall as well as in shallow soil and high rainfall NHH 44 were the best performers.
- Three intra-*hirsutum* Bt hybrids and their counterparts were evaluated. They recorded higher seed cotton yield than non Bt hybrids and check (NHH 44).
- Three-quintal breeder seed each of two varieties viz. Anjali and LRA 5166 was produced.
- In all, 130 samples of *G. hirsutum*, *G. barbadense*, *G. arboreum* and *G. herbaceum* were collected from Jharkhand, coastal region of Andhra Pradesh and Saurashtra region of Gujarat.
- In male sterility programmes, 36 CMS, 13 GMS and seven R-lines were maintained. Sixty three GMS and 200 CMS hybrids were tested in five different trials. Six promising hybrids viz. NGMSH 15-20, 14-02, 24-02, I23-02, 63-02 and 52-02 were identified.
- The dwarf and compact genotypes recorded highest seed cotton yield at 90 x 10 cm spacing as compared to other spacings.
- In large scale on farm trial of promising quality *G. arboreum* genotypes in rainfed ecology, PA 255 recorded higher seed cotton yield than both the checks (AKA 8401 and LRK 516).
- In *G. arboreum* the culture CINA 323 B was identified for higher seed cotton yield, PA 496 for good fibre properties and less short fibre content and CINA 316 B for high fibre strength, fibre elongation and uniformity ratio.
- Five genotypes viz. GJHV 370, LH 1948, PH 348, NH 545 and H 1252 and another five viz. LH 1948, NH 545, Khd. 122, CNH 155 and KH 11 were found promising under irrigated and rainfed conditions respectively. Two genotypes viz. LH 1948 and NH 545 were found promising both under irrigated and rainfed conditions.
- PKV 081, Rajat, MCU 10, Arogya, Coker 310, TxORSC 80 and M 18 recorded high yield and high GOT.
- Culture 3 HS recorded higher oil percentage of 24.9%. Five lines, viz. 17 SC, 25 K, 14 K, 34 K and 22 K recorded more than 25% seed oil content. Some lines of upland cotton received from Sirsa recorded

more than 27% seed oil content.
- Soaking of seed in potassium hydrogen phosphate improved the first emergence count and final germination percentage.
- Topping at 90 DAS gave the highest seed cotton yield.

### Coimbatore

- Intra *hirsutum* hybrid CCHH 1055 (1330 kg/ha) recorded 63 per cent increased yield over the zonal check LHH 144 (813 kg/ha) and has been promoted to Zonal trial.
- *G. hirsutum* culture CCH 516612 (1697 kg/ha) recorded the highest yield in South Zone.
- Interspecific hybrid CCHB 105 (1150 kg/ha) was superior to DCH 32 (898 kg/ha).
- Genetic male sterile based hybrid Gms J 34 x Sn and Cms based hybrids Cms Ali x A and Cms Suman x AK 2 showed promise.
- Differences were noticed in the contribution of component characters towards seed cotton yield between the compact and robust plant types.
- Genotypes combining extra long staple (30-33 mm) and higher fibre strength (26-30 g/tex) have been identified for further use in breeding programme.
- Imidacloprid and Neem leaf powder or the combination of Imidacloprid and Iodine formulation with carbendazim proved well in controlling the seed deterioration and maintaining viability and vigour.
- The reduction in germination was maximum and rapid, when cotton seeds were stored at higher relative humidity levels (80% and 60%) than at lower levels (40 and 0 per cent)
- The superior bulk and model bulk registered the highest values for various agronomic characters when compared with the ordinary bulk.

### Sirsa

- Lines with higher oil content i.e. DL 1 (28.1%), CISV 45 (26.50%), KH 2 (26.47%) and CISV 46 (26.27%) have been identified from germplasm.
- Cultures CISH 3, CISH 36 and CISH 40 with more than 22 g/tex fibre strength have been developed.
- The suitable crossing period in north zone was up to 30th September. The boll setting was higher in wider spacing. The seed number in crossed boll declined, if more than three female flowers were pollinated with one male flower.
- Cottonseed stored under north zone condition maintained germination above certification up to 15 months. The seed of first two picking was found superior. The topping of crop at 90 DAS was beneficial.

## Biotechnology

### Nagpur

- Twelve transformed positive plants of cv LRK 516 with Bt cry IA(c) regenerated by direct shoot organogenesis have been obtained.
- Around 50 nodular structures were induced in cotton by *Rhizobium fredii*.
- About 10 ELISA positive plants from *hirsutum* and *arboreum* with Cry1 A(b) and Cry1 A(c) were obtained.
- RAPD analysis were carried out to establish polymorphism among the CLCuV resistant and susceptible cotton genotype.
- Genetic variability and evolutionary basis has been revealed by RAPD markers among the wild species.
- Finger printing of 25 germplasm lines and 23 wild species were carried out for RAPD analysis.

## Crop Production

### Nagpur

- Response to irrigation at early and peak boll development phases was relatively more in deep soils as compared to mediumdeep and shallow soils.
- Higher plant stand (2 plants/dibble) was

found to be beneficial as compared to one plant per dibble under drip irrigation.

- Fertilizer N use efficiency was better in the rotation system (cotton – sorghum) as compared to mono-cropped *hirsutum* cotton.
- *G. arboreum* cultivar had higher agronomic efficiency than *G.hirsutum* cultivar. Balanced fertilization led to higher agronomic efficiency for fertilizer nutrients.
- Stratification of nutrients was observed in the soil profile and the immobile nutrient P was found to be concentrated in the surface layers.
- Two row bullock drawn planter developed earlier was modified to improve the over all efficiency. A seed drill was designed and developed for sowing varieties suitable for north India.
- Soil physico-chemical properties including organic carbon, mineral N, available P, bulk density and infiltration rate improved considerably under organic system as compared to synthetic.
- Bt cotton cultivars (MECH 184 and 162) were found to show earliness, lesser dry matter accumulation and higher yield as compared to their non-Bt counterpart and local check.
- On farm trials conducted at various locations of Amravati, Yavatmal, Nagpur and Nanded districts in Maharashtra, Mudhol, Ponduru and Adilabad in Andhra Pradesh emphasize the positive impact of integrated nutrient management and appropriate soil and moisture conservation practices including the watershed and toposequence approach.
- In the cotton-wheat sequential cropping system incorporation of wheat straw and cotton crop residue (stalks and leaves) left after harvest was found to improve the productivity of both wheat and cotton.
- Some of the strains of *Azotobacter chrococcum* were found promising in improving yield realization of both cotton and wheat as compared to 65% recommended fertilizer in the cotton-wheat sequential cropping system at Sirsa, Haryana.
- A manual cotton planter cum fertilizer drill has been designed and developed.
- Research gaps in intercropping were identified following a survey on 100 farmers carried out in six tehsils of Nagpur district. Strip cropping with pigeonpea is widely practiced. Lack of awareness about row to row intercropping and the barrier created by intercropping to intensive interculture were the major reasons hindering the adoption of recommended practices.
- In the studies on crop and yield modelling, three models CALGOS, COTTON and GOSSYM were tested and GOSSYM was found to be relatively better than the remaining three. Ground truth information were generated for Nagpur district in connection with the remote sensing work.

### Coimbatore

- Cotton yield in cotton-jowar cropping system was more by 42 to 62 per cent, as compared to cotton-cotton rotation. Combined application of organics and inorganics (P 45, K 45 and 15 t FYM) resulted in the highest yield of 1733 kg/ha in Savita and 1686 kg/ha in Surabhi.
- Scheduling of irrigation at 1 ET, through drip resulted in on par yield and a saving of 30% irrigation water as compared to conventional method. Application of 75% RDF through drip (NK) in six splits with soil application of P resulted in on par yield with 100% RDF of conventional method.

## Crop Protection

### Nagpur

- Out of 228 crosses made among *G. hirsutum* lines, 58 were found promising against sucking pests and bollworms under natural field conditions. The studies on morphological markers for jassid toler ance indicated that tolerant lines were hairy but all hairy lines were not tolerant.
- The presence of protease inhibitor gene in

the cotton germplasm pool was confirmed.

- The phenological and bollworm damage estimate were higher for hybrid NHH 44 and AKA 8401 and did not differ between themselves.
- Avoidable loss due to all the major pests collectively was estimated to be 41.82%.
- The estimated loss caused due to plant parasitic nematodes was worked out to be 8%.
- Frequency of occurrence of entomopathogenic nematodes was re corded to be 3-10% of baited samples.
- A molecular probe was developed which could detect CLCuV infection in naturally infected and apparantly healthy plants of cotton and weed (*Cymopsis* spp.).
- Pyrethroid resistance was highest in populations of *H. armigera* collected from Sangaria and Warangal. Endosulfan resistance was highest in the Sangaria strain. Resistance to endosulfan was semidominant, governed by two alleles, to methonyl was dominant.
- Village men and women were taught to identify the life stages of jassids, American bollworm, spotted bollworm and pink bollworm in addition to the ladybird beetles, green lace wings and such other predatory insects.
- A unit was designed for grain moth egg production. Mass production protocols for Bt and *Metarhizium* were refined.
- One hybrid entry (CINHH 296) was promoted to Br 05 a (1) in AICCIP trial for north zone and another hybrid (CCHH 9012) with resistance to diseases and tolerance to sucking pests and bollworms was entered in the National trial on hybrids under AICCIP during 2002-03.
- The lint infection due to *Exosporiella fungorum*, a newly observed fungus, was found in bolls of a hybrid H6.
- Out of 51 isolates of bacterial blight organism, race 18 was predominant. Out of 248 germplasm lines of *G. hirsutum*, nine lines showed resistant reaction to bacterial blight under pot culture studies. Out of 197 *G. hirsutum* lines screened against fungal foliar diseases under pot culture, five lines were resistant against grey mildew, seven lines against Myrothecium leaf spot and no line showed resistance against Alternaria leaf spot.
- The foliar diseases were reduced where mix micro antagonists and chemical were sprayed.
- The pathogenicity gene pthN cloned from *X. a.* pv. *malvacearum* was successfully demonstrated as a probe for specific detection of this pathogen.
- The grey mildew pathogen was successfully cultured.
- Three kits were developed to identify Bt toxin in cotton seed/plant.

**Coimbatore**

- Abhadita and BRS 23 recorded moderately low damage (21-28%) by bollworms as compared to 42-97 per cent in other cultures.
- Bifenthrin (60 and 80 g a.i/ha) and F 6028 (150 g a.i/ha), Spinosad + Chlorpyriphos (1 l/ha) recorded low damage due to bollworms and registered significantly higher yield over control.
- Seed treatment chemical Thiamethoxam and Chlothianidine were effective against Jassids.
- Adoption of IPM/IRM strategies in the irrigated ecosystem resulted in 50 per cent reduction in use of pesticides. The farmers obtained a net increase in income to the tune of Rs.12,000/- per hectare over the control village.
- Screening of advance cultures and germplasm accessions revealed varying levels of damage by *P. affinis*. The highest incidence was recorded in Supriya (42%) and the lowest in MCU 7 (nil).
- Thirty one accessions of *G. arboreum* and eleven accessions of *G. hirsutum* showed resistant reaction to grey mildew. Tebuconazole (Folicur 250 W) was found

effective in controlling Alternaria leaf spot.
- Grey mildew resistant line (GMR 5) and Alternaria resistant line (ALR 4) showed yield superiority in the AICCIP trials.

**Sirsa**

- The maximum boll damage (25.28%) was observed in pure biological control followed by farmers practice (23.21%), recommended insecticides (19.33%) and IPM (16.46%) ; but the cost : benefit ratio was more in IPM (1 : 1.45) than that of farmers' spray practice (1:1.19).
- The prediction model for jassid has been worked out from 33rd to 39th week. The positive correlation was found between jassid incidence and rainfall, whereas, with RH and temperature the correlation was negative.
- Studies on cotton leaf curl virus disease indicated its maximum progress during the month of July when maximum temperature remained around 35 °C with relative humidity around 80 %.
- Out of the 401 germplasm lines tested under NATP project for screening against leaf curl and whitefly, sixty nine lines have shown resistant reaction to leaf curl disease.
- Superiority of hybrid Om Shankar, IPM and IRM technologies delay of first spray and use of endosulfan as first spray, to encourage beneficial insects, restricting the use of pyrethroid up to 1 or 2 sprays, use of *Trichogramma* and NSKE for bollworm management and use of pheromone traps in field demonstrations were appreciated by farmers.

## Plant Physiology and Biochemistry

**Nagpur**

- Moisture stress during flowering significantly enhanced stomatal resistance, and decreased biomass production, transpiration rate and leaf water potential.
- *Desi* cotton genotypes had conspicuous reduction in leaf water potential, higher proline accumulation and yield stability trends.
- Hybrids and *G. hirsutum* genotypes were more susceptible to salinity as compared to *desi* cotton.
- Waterlogging at early seedling growth had significantly reduced plant height and biomass production.
- Lenticel formation was fast and more in waterlogged plants during flowering and later stages.
- Total phenol content in LRK 516 showed 8.55 % decline immediately after 24 hrs of insecticide spray except in Talstar 10 EC, which is a new insecticide under testing.
- Ethrel application as foliar spray at lower concentration levels enhanced square abscission and the treatments tended to increase seed cotton yield in LRA 5166 and H6.
- The gossypol content was observed to be highest in seed compared to squares, leaves, flowers and bolls.
- Seed oil content of 15-22 per cent was recorded and the fatty acid profile was studied in G. *hirsutum* and G. *arboreum* germplasm collections. Lines possessing high linoleic acid and oleic acid were identified.

**Coimbatore**

- Hormonal combination IAA (5.0 mg/l) + GA (5.0 mg/l) + BA (1.0 mg/l) was found to be the best for fibre initiation. TM culture medium with IAA (1.0 mg/l) + GA (1.0 mg/l) + BA (1.0 mg/l) for the first 15 days and later on TM + IAA (2 mg/l) + BA (0.5 mg/l) led to the fibre development upto 17 mm.
- Application of maleic hydrazide @ 0.1% on 35 DAS activated the axillary buds and lateral branching and led to maximum yield.
- The pattern of developmental regulation of phenol metabolism was found on the positive side with higher level of accumu-

lation in case of bollworm tolerant genotypes.

- The bollworm tolerant selections developed were seen to accumulate protective phytochemicals such as gossypol, tannin and catechin at a higher level.
- Adverse influence of repeated applications of insecticides like endosulfan and monocrotophos during crop growth was evident in lowering nitrate reductase activity.
- A modified method of Cold Percolation for estimation of oil content in small quantities of cottonseed has been developed and standardized.

## Extension and Economics

- Quality of life as perceived by the cotton growers in Nagpur district is negatively and significantly correlated with their indebtedness.
- Farmers Entrepreneurship behavior has a positive and significant correlation with perceived quality of life.
- Distance from propagator of agriculture technology on spatial distribution has a negative and significant correlation with adoption behavior.
- Health status of cotton grower has a significant correlation with adoption behavior.
- The biotic and abiotic constraints in cotton-wheat system have been identified and quantified.
- Under rainfed condition, stability in yield promotes varietal discipline; varietal proliferation increases with farm size.
- Both, institutional (irrigation) and technological (research) contributions to cotton productivity increase are significant.
- Hybrid technology is size neutral, but resource biased and it's indiscriminate cultivation in resource poor conditions induce instability.
- Though the actual price offered under monopoly is the highest in the country, the economic price realised by farmers is less than non-monopoly markets determined prices.
- Delay in payment, hassels in tendering and tied-up credit, than price, determine commodity diversion in monopoly regime.
- Significant enhancement in knowledge and adoption of recommended cotton technology practices was observed on FLD participating farmers.

# Extension and Economics

**Nagpur**

**A study on structure of agriculture and social dynamics of cotton production** (Hemchandra Gajbhiye).

This study was initiated to document the socio-economic changes occurring in the predominantly cotton growing areas. As a part of this study, following model is being tested for the explanation of perceived quality of life of cotton growers.

**Y = X1 + X2 + X3 + X4 + X5 +X6 + X7 + X8 + i**

Where Y = Perceived quality of life

X1 = Age, X2 = Education, X3 = Land holding , X4 = Economic condition of a family, X5 = Indebtedness, X6 = Family size, X7 = Health status, X8 = Entrepreneurship

Data collected from 107 cotton growers from Mangli, Mohagaon, Kawadas, and Adegaon villages in Hingna Taluka of Nagpur district reveal that Quality of life which means the degree of satisfaction with all aspects of life has a strong positive and significant correlation with education (r = 0.19). It is further observed that as the age increases, perceived quality of life decreases. Economic condition of a family has a positive and significant correlation with quality of life (r = .26). The correlation between land holding and quality of life is positive but non-significant (r =0.10). As the size of family decreases quality of life seems to increase ( r = -.23). Health of farmer seems to have positive correlation with perceived quality of life. Indebtedness has negative and significant correlation with perceived quality of life (r = -.34), whereas, entrepreneurship has a positive and significant correlation (r = .20).

**A study on technology adoption behaviour of cotton growers : Structural perspective** (Hemchandra Gajbhiye).

This study was undertaken to understand the pattern of diffusion of some selected technologies related to cotton production through Market and Infrastructure perspective. Two technologies selected are 1. Hybrid cotton and 2. IPM in cotton. Following model is being tested for the explanation of adoption behaviour of the cotton growers.

**Y = X1 + X2 + X3 + X4 + X5 +X6 + X7 + X8 + i**

Where Y = Technology adoption behaviour

X1 = Spatial distribution, X2 = Financial resources, X3 = Availability of Technology, X4 = Entrepreneurship, X5 = Family size, X6 = Health status, X7 = Land holding, X8 = Marketing strategy

Data collected from 107 cotton growers from Mangli, Mohagaon, Kawadas, and Adegaon villages in Hingna Taluka of Nagpur district reveal that spatial distribution has a negative and significant correlation with adoption behaviour (r = -0.29). Financial resources, availability of technology, entrepreneurship, financial resources, size of family, and land holding have positive correlation with adoption behaviour. Health of the farmers has a negative and significant correlation with adoption behaviour of cotton growers ( r = -0.22).

**P1-94/1-ICR-E10/0430:**

**Economic analysis of cotton cultivation in India** (P Ramasundaram and H L Gajbhiye).

Data were collected from 300 farms in Gujarat state and 240 irrigated farm samples of last year were revisited. Secondary data on cotton production and procurement and primary data from eighty farmers were collected from the bordering talukas of Nagpur and Chindwada district to assess the quantum of cotton diversion. Fifteen Bt cotton cultivator's data were obtained from across nine talukas in two districts (Nagpur and Wardha).

Varietal discipline was more pronounced in Surendranagar district dominated by *desi*

(*G.herbaceum*) and more than 70 per cent of the farm were single variety farms compared to Baroda district samples, which too show relatively less of varietal proliferation vis-a-vis their counterparts in Maharashtra.

The compound annual growth rate for all India showed higher growth in production and productivity in the post hybrid period. A regression model estimated with all India productivity as dependent variable and the % of irrigated area and dummy for hybrid indicated that both have contributed significantly to cotton productivity.

The survey revealed that the pre media hype awareness about Bt among Navbharat 151 cultivators and dealers in Nagpur and Wardha district was nil. The average size of holding of the adopters was 14.25 acres and the average education (years of Schooling) was 9.6. The average cost of the seed bought was Rs. 535/- per packet of 450 gm. The perceived advantage were: difference in cost of cultivation was nil as the cultivators were not aware that the cotton they were cultivating was different from normal cotton, increase in yield was 2 q/ac. earliness in maturity and no difference in pest load. The total variable cost per ha was Rs. 3691/- the average yield 5.12 q/ha, gross returns Rs. 5410 and net returns Rs. 4119. The lower variable cost was mainly because of economy in plant protection expenditure and picking cost.

The data on cotton marketing revealed that the prices received by the *desi* cotton cultivators in Gujarat selling through the cooperatives in real terms was higher than the highest price received by the farmers selling through the federation in Maharashtra, considering the loss incurred by way of tendering cost, transport cost, loss of interest, etc. Only 58% of the produce of the sample farmers' produce has been sold through the federation. The big farmers who managed to get higher prices exceeding Rs.2000/-, ended up getting only an economic price of Rs.1450/q when discounted for the above mentioned losses. The reasons for cotton diversion are-non-cash payment, faulty grading, avoidance of credit recovery, uneconomical produce, tied up credit, etc. However, more than 80 per cent of the farmers favoured the continuance of the scheme, apprehending exploitation of traders by depressing the prices in the absence of the scheme. Institutional efforts like cooperative marketing in Gujarat fashion may allay the apprehension.

**Impact of cotton front-line demonstrations on technological advancement of cotton growers** (S.M.Wasnik, H.L.Gajbhiye and Usha Rani).

The study was carried out in CICR, Nagpur and its Regional stations Sirsa and Coimbatore to assess the impact of Technology Transfer of proven and viable cotton production technology through Front-line Demonstrations ( F.L.Ds).Out of 300 randomly selected cotton growers covering all the three coordinating centers,data were collected for 148 growers i.e,76(38 each FLD participating and non-participating/Fellow farmers) in the villages Darbi, Barwala, Farmain khurd, Rangarikhera ,Vaidhwala, Mirpur under coordinating center Sirsa in Haryana and 72 (36 each from FLD and non -FLD growers) cotton growers from villages Rui, Panjari, Kaldongari, Banwari, Ghorad under coordinating center Nagpur in Maharashtra with the help of well structured and pre-tested interview schedules.

The results of these investigations revealed that the significant enhancement in the knowledge and adoption of recommended cotton technological practices was observed on FLD- participating farmers. The mean overall knowledge was recorded as 61.36 and 68.02 per cent in case of FLD participants, while that of non-FLD growers it was 47.47 and 56.02 per cent at CICR, Nagpur and Sirsa, respectively with on increase of 13.84 and 12 per cents in the level of knowledge of FLD beneficiary over that of fellow farmers. Similarly, the mean overall adoption was

53.89 and 55.28 in case of FLD beneficiary while 42.7 and 42.25 in case of non-beneficiary growers in Sirsa and Nagpur, respectively with the overall increase of 11.29 and 13.08 per cent in FLD growers in both the centers. The highest increase in level of adoption was observed in improved varieties/hybrids followed by plant protection and irrigation management in Sirsa irrigated zone while timely sowing followed by plant protection, intercultural operations, seed rate and picking in Nagpur rainfed zone. This may be because of intensive efforts made by the scientists to transfer the technologies under their direct supervision through participating/contact farmers.

The differences between the FLD participating and non-FLD cotton growers on all the 11 cotton cultivation practices studied as well as overall knowledge levels and adoption of cotton production technologies was found to be highly significant in both irrigated Sirsa and rainfed Nagpur locations.

## National Agricultural Technology Project

### Nagpur

IVLP : **Technology assessment and refinement of rainfed cotton based production system in Nagpur district (M.S.) through institute village linkage programme**
(H. Gajbhiye, M.K.Meshram, P. Ramasundaram, G. Majumdar, Gulbir Singh, S.S.Patil, A.S. Tayade, U. V. Galkate).

The IVLP Project is being executed at two villages viz. Telegaon and Tishti in Kalmeshwar Taluka of Nagpur district. More than 300 farmers are involved in this programme for implementing 25 technological interventions. The technology interventions in cotton include short duration varieties, optimal plant density, sowing on ridges and furrows, early varieties of soybean for inter-cropping, alternate crop under delayed sowing of cotton, Integrated nutrient management in cotton, Management of bacterial blight and grey mildew, pesticide application technology, and IPM in cotton. Besides there were 3 interventions related to Nutrient management, 2 related to IPM, 6 related to Horticulture and 4 Animal Science based interventions. All the technologies were tested for refinement.

**PSR 24: Socio-economic analysis and characterisation of cotton based cropping systems** (P.Ramasundaram, D.Blaise and M.Sabesh).

Primary data collection of 160 farms for the Kharif and Rabi 1999 and 2000 in Bathinda and Muktsar District and in 128 farms for three years ending 2001-02 in Sirsa and Hisar districts was completed. In a follow up visit in Sriganganagar and Bathinda districts data were collected for Kharif 2001-02 from the same farm households.

**Cotton trends:** The farm composition of cotton species showed a progressive decline in case of *desi* cotton area from 54.21% of the farm cotton area before ten years, to 47.84% before five years to the present 35.01% in Hisar district. On the contrary in the rest of the districts it declined but again started increasing. The hybrid area has increased progressively from a negligible one per cent to the present seven per cent in Muktsar sample, where as in other it ranges from 0.21% in Sirsa to 2.45% in Hisar district from practically zero area earlier.

**Constraints:** During 2001-02 season, the late release of water delayed the sowing, led to reduction in *desi* cotton area and the later epidemic outbreak of bollworm that greatly affected the yield and enhanced the plant protection cost.

In case of Sirsa and Hisar, Raja Sikandar and RG 8 dominated in 60 per cent of the crop's area but the rest had under it more than 10-12 genotypes. The number of varieties cultivated ranged from 13 in Sriganganagar to 23

in Bhatinda. The number of varities constituting seventy per cent of the samples farms' crop area ranged from three in Sringanganagar (RG 8, RST 9 and Sinkandarpuri) to six in Bhatinda (LD 227, RG 8, Sikandarpuri, LH 1556, F 846 and LD 1378). While in case of wheat, a single variety occupied more than 80% of the crop area on an average – Raj 1482 in case of Sriganganagar and PBW 343 in case of the other districts. Maximum number of wheat varieties cultivated were five in the rest of the crop area.

**Seed :** Sirsa and Hisar respondents had better access to certified seeds of cotton, compared to their counter parts in Punjab and Rajasthan. Atleast 35% of the respondents got certified seeds on time. Seed replacement was more than 50 per cent in case of cotton. While seed availability and its price was mentioned as a constraint, the quality is a factor often doubted and widely complained in Rajasthan and Punjab.

**Quantification of constraints:** Hence quantification of constraints was tried working out the average losses through participatory survey, absolute losses from the experimental fields and their probabilities. At present only the loss percentages were calculated in cases of technological constraints. The major constraints in cotton with loss percentages as per importance are bollworms (19.04 to 55.08%), sucking pest (6.18 to 12.20 %), physiological shedding (11.30 to 17.42%), delayed sowing (1.00 to 9.53%), leaf curl (1.43 to 10.00 %), bacterial blight ( 0.078 to 0.20 %), to cite a few. In case of wheat the major constraints were weed infestation (12.72 to 39.68 %), delayed sowing (4.13 to 16%), less turn around time (4.01 to 9.88 %), rust (5-10%), Zn deficiency (5 to 8.73 %), etc.

In socio-economic constraints, erratic power supply, tied-up credit, spurious chemicals and seeds, labour shortage during peak seasons, high yield and price risk in cotton were the major ones.

**RCPS 1 : Agro-economic characterisation and constraint analysis of cotton based production systems in relation to soil, rainfall and socio-economic factors** (P.Ramasundaram and N.K.Perumal).

Secondary data collection since 1949-50 to 1998-99 has been completed for the districts of Surenderanagar and Vadodara. Growth rates were worked out for three periods viz., 1949-50 to 1969-70, 1970-71 to 1998-99 and the pooled period for both the districts and the whole state. Productivity growth was significant in all the periods in the districts and the state, but was very high during the II period indicating hybrids' contribution ranging from 3.84 % in Baroda to 2.221 in Surendranagar, dominated by *desi* cotton. Area growth has shown deceleration in the second and pooled periods for the Baroda district and the state, while it was positive throughout in Surendranagar district but significant only in the first and the pooled periods. Coefficient of variation was progressively increasing in all parameters in tune with the periods indicating more instability during hybrid era and least in Surendranagar, having more of *desi* cotton area. While in the rest of the Maharashtra the post-hybrid instability in cotton productivity has increased, Jalgoan district witnessed the reverse trend due to the well endowment of resources in terms of soil and protective irrigation. In Gujarat, Banaskantha, Baroda, Meshana, Sabarkantha and Surat districts have shown declining trend in instability and the remaining districts increase in instability in productivity.

The first three genotypes that accounted for more than 90% of the sample farms cotton area were G.Cot13, H-6, and Deviraj in Surendranagar, Digvijay, H 6 and H 8 in Baroda district and NHH 44, Ankur 151 and Banni in Jalgaon districts. While the rest 10 per cent of the area was occupied by just 9 genotypes in Gujarat samples, it was more than 25 genotypes in Jalgoan sample.

This was further corroborated by the fact that more than 90 per cent of the sample farms in Gujarat districts were single variety farms against only 41 percent in Jalgoan samples, followed by 31 percent of two variety farms and 20 per cent of three variety farms and eight per cent of more varieties. This indicated the relatively more pronounced varietal discipline in Gujarat.

**Constraints in cotton cultivation:** The general bio-physical constraints observed were bollworms, sucking pests, improper plant density, indiscriminate use of pesticides, varietal multiplicity, boll shedding, etc., while major socio-economic constraints were poor quality and high cost of chemicals and seeds, unscientific plant protection, non-availability of labour during the peak season, high wages, tied-up credit and delay in cash payment. Among the quantifiable biotic constraints bollworm damage, poor seed quality, sucking pests damage, improper spacing and boll shedding ranked in the order with their contribution to the yield loss as 18.89, 7.95, 6.24, 3.63 and 3.16 per cent respectively. Among abiotic constraints adverse weather and soil problems topped with 36.25 and 9.31 per cent respectively.

**Coimbatore**

**TAR 18: Technology assessment and refinement of irrigated agro-eco system for coimbatore region** (S. Usha Rani).

During the year 2001-2002, nearly 28 interventions were demonstrated in the farmers' fields through On Farm Trials and Verification Trials in an integrated manner on crops like Cotton, Tomato, Turmeric, Groundnut and Maize.

Under the Livestock Improvement Intervention, two health campaigns for livestock were conducted. Fifteen pairs of improved goats and six cross bred heires were procured and distributed to the identified resource poor farmers. Under the conservation of natural resources intervention, 150 soil samples were collected and analysed. Based on the fertility level, balanced nutrition was recommended for different crops.The Results are given in Table 11.

**Table 11: Results of integrated crop management trials**

| Crop | Mode OFT/ VT | No.of farmers covered | Yield Q/ha (Avg.) | % Increase in yield | Net return (Rs.) | B:C ratio |
|---|---|---|---|---|---|---|
| Cotton | OFT | 20 | 18.08 | 40.00 | 22,236 | 1:2.06 |
| Tomato | OFT | 10 | 325 | 30.00 | 80,847 | 1:2.64 |
| Turmeric | OFT | 4 | 61.75 | 50.00 | 32,626 | 1:1.8 |
| Ground nut | OFT | 4 | 18.50 | 20.00 | 16,260 | 1:2.85 |
| Maize | OFT | 4 | 19 | 15.00 | 5,035 | 1:1.64 |

# Technology Mission on Cotton

## MMG 1: Technology intervention and socio-economic analysis in cotton based cropping system, Nagpur

**Nagpur** - (H. Gajbhiye, S. M. Wasnik, S.S.Patil, A.S.Tayade).

This study is initiated with on objective of developing a new model for technology utilization pattern in cotton based cropping system. The project is operating in 14 co-operating centres and Central Institute for Cotton Research, Nagpur as the lead centre. All the operating centres have identified and documented the cotton based technologies developed/refined by their respective Institutes/ SAUs since 1980. The total number of 182 technologies were documented by the centres. Out of these, more than 130 technologies which were recently developed but partially rejected or with very low rate of adoption were assessed for the refinement. This exercise was done on farmers fields involving more than 1100 cotton growers. The instrument was developed to study the adoption pattern and data is being collected from more than 1500 cotton growers across the country. Several publications on cotton were brought out in regional languages by many centres. CICR, Nagpur has produced one audio cassette and one video film on advances in cotton production in Marathi language for the benefit of cotton growers in Maharashtra.

**Coimbatore** - (S. Usha Rani).

The benchmark survey conducted in the adopted Chinnaputhur village of Erode district in Tamil Nadu showed that more than 40 per cent (43.33 %) of the respondents were cultivating LRA 5166 and 30 per cent were growing RCH 23. More than 85 per cent (86.67%) of the respondents were not following seed treatment and acid delinting of seeds and none had done soil testing. Nearly 70 per cent (73.33%) of the farmers were growing cotton as mono crop. None of the farmers had applied growth regulators as foliar spray dopted IPM.

Hence, to popularize the latest CICR, Coimbatore varieties viz., Surabhi and Sumangala, Popularisation of Varieties and Hybrids intervention, Seed Treatment, Fertilizer Application Based on Soil Test, Inter Cropping with Cowpea, Foliar Spray of Nutrients, Integrated Pest Management and Disease Management interventions were selected for the study. For implementing each intervention in the farmer's fields, on Farm Trials (OFTs) were conducted at the rate of 10 OFTs per intervention in one acre of their farm holding.

**Sirsa** - (Surender Kumar, D.Monga, R.A.Meena, O.P.Tuteja and P.Jeyakumar).

Om shankar recorded more yield (11 q/ha) than existing varieties (5.65 q/ha). Observation recorded on yield indicate the beneficial effect of DAP foliar spray during peak flowering and boll formation stages on cotton yield. More than 7 % yield increase was realized due to foliar spray of DAP. In case of delay of the first insecticidal spray up to 45 days, 6.2 % more yield was recorded than control plot, giving an Rs. 722 additional income. So it can be stated the resistant/ tolerant varieties/hybrids gave good yield (20 per cent more). Although number of pesticides spray was same in both plots.

**Coimbatore**

## MMH 1: National Cotton Information and Documentation System (M Sabesh).

The information include primary and secondary aspect of cotton viz. basic information on cotton cultivation; pest and diseases; industry - growth of textile industry, sector-wise yarn/cloth production, count-wise yarn/blend yarn production; information on economic importance - import/export, support price of the major varieties cultivated; international scenario - area, production, productivity, import/export of lint/yarn/cloth. Different database for the collected data have been designed using the software MS-ACCESS.

# Technologies Assessed and Transferred



- Very few farmers adopt soil and water conservation measures. inspite of the dire need for efficient soil and moisture conservation practices under rainfed condition. No farmers is adopting *in situ* and excess runoff water management practice. So, the technologies developed by CICR, Nagpur for *in-situ* moisture conservation and excess runoff collection, storage and recycling to the crops were evaluated/tested at farmers field in the NATP programme.
- *In situ* moisture conservation practices like ridge and furrow, broad bed and sunken bed, raised and sunken bed were developed and found effective in increasing biomass as well as gross yield in different toposequences. An increased 2-3% moisture within treatments and 4-5% moisture within toposequence was recorded. Among all the moisture conservation practices, ridge and furrow system was found the best and enabled an increase in seed cotton yield by about 3 q ha $^{1}$ over flat bed and about 5 q ha $^{1}$ over farmers practice in upper plain.
- Inclusion of green gram as intercrop also increased seed cotton over sole cotton. Sowing of cotton on contour has also increased seed cotton yield significantly over sole cotton and cotton + greengram in middle plain toposequence.
- Irrigation through runoff water harvested and from recharged well water was found very effective in increasing seed cotton yield on upper plain (very shallow soil) by about 4.74 q over control.
- In lower plain, ridge and furrow + soybean as intercrop not only increased soil moisture but also increased seed cotton yield by about 9 q over cotton *hirsutum* as sole crop.
- Intercropping of green gram and soyabean is more profitable than cotton alone on upper toposequence. *Arboreum* cotton is more suitable than *G.hirsutum* in the upper toposequence.

# Education and Training

## Training Received

### INTERNATIONAL

- Dr. G. Balasubramani, Scientist, Biotechnology Section, was deputed for three months training under NATP Mission Mode programme on 'Genetic transformation in Cotton at USDA College Station, Texas in Dr. R.J. Kohel's Laboratory from July 5 to October 5, 2001.
- Dr. Keshav Kranthi, Senior Scientist, Division of Crop Protection was deputed for two months from August 2 to September 30, 2001 at the IACR – Rothamstead Experiment Station, Harpenden, UK to carry out sequencing of insecticide resistance associated unique RAPD fragment and to detect pyrethroid resistance linked mutation in the sodium channel of *H. armigera*.

### NATIONAL

- Dr. P. Singh, Head and Dr. Punit Mohan, Sr. Scientist of Division of Crop Improvement attended training programme on Intellectual Property Rights (IPR) and World Trade Organisation (WTO) organised by ICAR at Central Institute of Fisheries Education, Mumbai from 18th September to 20 September, 2001.
- Dr (Mrs) Isabella Agarwal, Scientist (Agri. Eco.) attended training course on Sustainable Agricultural Development for Food Security organised by the centre of Advanced Studies in Agricultural Economics, Division of Agr. Econ., IARI, New Delhi from October 9th to 29th, 2001.
- Dr. P. Ramasundaram, Sr. Scientist (Agri. Economics) attended a training programme on Statistical packages for Social Sciences organised by Indian Statistical Research Institute, New Delhi from 24. 09. 2001 to 29.01.2002.
- Er. G. Majumdar, Scientist, Division of Crop Production attended six days training on Pro-E foundation (Computer Aided Designing) at M/s Rolta India Ltd., Calcutta during 24-31 December, 2001
- Dr. N.K. Perumal, Head, Plant Physiology & Biochemistry Section and Dr. Jagvir Singh, Sr. Scientist, Division of Crop Production attended training on Vigilance awareness programme from February 1-4, 2002 at CIFE, Mumbai.
- Dr. P. Jeyakumar, Scientist attended a training course on Recent advances in baculovirus research at centre for Advanced Studies in Entomology, TNAU, Coimbatore from January 18 to February 7, 2002.

# Training Imparted

### Training programme on Hybrid Seed Production

CICR Regional Station, Sirsa organised a training programme on Hybrid Seed Production for IPM project farmers on 9th August, 2001 at Sirsa. Dr. C.D. Mayee, Director, CICR, Nagpur was the Chief Guest. Dr. Mayee advised the farmers to go far hybrid cotton cultivation and production of hybrid seed in North India. He advocated the farmers to follow IPM technology properly. The farmers were also addressed by Shri B.S. Duggal, Joint Director of Agriculture (Cotton), Haryana, Dr. O.M. Bambawale, Principal Scientist, NCIPM, New Delhi, Dr. T.P. Rajendran, Principal Scientist (Entomology), CICR, Nagpur and Dr. D. Monga, I/C Head, CICR, Regional Station, Sirsa. Scientists of CICR, Regional Station, Sirsa imparted training to the farmers on various aspects of hybrid seed production.

### National Training Course on Integrated Cotton Production Technology

Central Institute for Cotton Research, Nagpur organised a National Training Course on Integrated Cotton Production Technology from Sept 19-26, 2001. This training programme was sponsored by the Govt. of India, Ministry of Agriculture, Directorate of Extension, New Delhi. Objective of this course was to update the knowledge, enhance the skills and sensitize the participants to the integrated approach to cotton production, which is more eco-friendly. The course was inaugurated by Dr. A.T. Sherikar, Vice Chancellor, Maharashtra University of Animal and Fisheries Sciences, Nagpur and Dr. C.D. Mayee, Director, CICR chaired the proceedings. Twenty four senior level state officers underwent this training. More than 24 sessions were conducted during the training period involving 29 resource persons. Dr. Hemchandra Gajbhiye, Principal Scientist and Head, Extension Section was the course coordinator.

### Short Term State Level Training Courses on Advances in Cotton Production

CICR Nagpur organized short term training courses on Advances in cotton production for extension personnel of Maharashtra state during August 2001-December 2001. This training programme was sponsored by Technology Mission on Cotton, Mini Mission II, Ministry of Agriculture, Govt. of India.

Eleven training courses of three days duration were organised and were attended by 164 middle level officers of Agriculture Department. The course content included latest varieties and hybrids for Maharashtra, Crop Production technologies and Crop Protection measures particularly Integrated Pest Management. Dr. Hemchandra Gajbhiye, Principal Scientist and Head, Extension Section was the course coordinator assisted by Sh. S.S. Patil, Training Associate, Krishi Vigyan Kendra.

# Awards and Recognitions

## Vasantrao Naik Krishi Award for Dr. C.D. Mayee

Dr. C.D. Mayee, Director, CICR, Nagpur has been honoured by Vasantrao Naik Pratisthan, Mumbai with Vasantrao Naik Krishi Puraskar for his overall contributions in the field of Agriculture. The award was given at the hands of Hon. Shri Sharad Pawar, Member of Parliament in a glittering ceremony on 1st July, 2002. The recipient of several academic awards, Dr. Mayee has worked for nearly 25 years in Marathwada Agricultural University (MAU), Parbhani in various capacities and he was also Vice Chancellor of the University before joining as Director, CICR, Nagpur. His contribution in the field of Crop Disease Management based on forewarning systems has been acknowledged not only by the scientific community but also by the farmers. Dr. Mayee was also a visiting professor for a long time in Germany and has visited many European Countries. He was also President of Indian Phytopathological Society. He was also involved in the overall development of the MAU, Parbhani and has guided more than 20 Ph.D. and 30 M.Sc. students. He is also recognized for his mega demonstration project on cotton technology and development of tissue culture commercial unit. As Director of CICR, he has brought several changes and today watershed programme of CICR is considered as an excellent example for water conservation technologies. Under his leadership CICR has developed Bt detection kit and is also in the process of development of Insecticide Resistance Management kits for practical use of farmer. Under his tutelage the basic research in cotton technology are being pursued with vigour under the technology mission.

## Dr. Mahendra Singh bags first prize

Dr. Mahednra Singh, Technical Officer, RCM Unit of CICR, Nagpur has won the first prize in the 21st All India Technical Article Competition in Hindi on Science and Technology – 2001, which was conducted by the Kendriya Sachivalaya Hindi Parishad, New Delhi. Dr. Singh bagged the prize for his article entitled *"Bharat mein maujuda Kapas Paridrishya evam bhavishya ki prathamiktaen"* (Current cotton scenarion in India and future priorities).

He was awarded a shield, certificate and shawl by the Hon'ble Union Minister for Law, Justice and Company Affairs, Shri Arun Jaitely at a function organised by Kendriya Sachivalaya Hindi Parishad, New Delhi on 27th June, 2002 at Speaker Hall, Vithalbhai Patel House, New Delhi.

## PROFESSIONAL RECOGNITIONS

### • Dr. C.D. Mayee Honoured

Indian Society of oilseed Research, Hyderabad has admitted Dr. C.D. Mayee as 'Fellow of the ISOR' for his outstanding contribution in the field of Oilseeds Research and Development in India for the last 25 years initially as Professor & Head, Plant Pathology and later as Associate Director and Vice Chancellor.

• Dr. C.D. Mayee, Director, CICR was designated as Member Secretary of the Organic and Biodynamic Farming Team constituted by Planning Commission to prepare a comprehensive report on 'Organic and Biodynamic Farming in India'. The report was presented to the committee on August 28, 2001.

• Dr. P.M. Mukewar, Senior Scientist was elected as one of the Members of Editorial Board of Indian Phytopathological Society, IARI, New Delhi in discipline of fungal pathology for the year 2001-2003.

Dr. C D Mayee, Director receiving the Vasantrao Naik Award at the hands of Shri Sharad Pawar, MP & Ex CM, Maharashtra.

Dr. M S Yadav receiving the Award at the hands of Shri Arun Jaitley, Union Minister for Law, Justice & Company Affairs, Govt. of India.


Winner Cricket team of CICR with the Director and QRT Members


All India Kavi Sammelan organised during the Silver Jubilee Celebration.

# Linkages and Collaborations in India and abroad including External Aided Projects

## NATIONAL

| Areas for Linkages | Institutions |
|---|---|
| • Fibre testing and quality evaluation | CIRCOT |
| • Multi-location testing of promising cultures | AICCIP Centres |
| • Germplasm collection and maintenance | NBPGR |
| • Seed technological research and breeder seed production | NSP programme |
| • Development of Cry IA (a) gene construct | NBRI |
| • Supply of gene construct and molecular evalution of transgenic plant | NRC Plant Biotechnology |
| • DNA finger printing of cotton | NRC DNA finger printing |
| • Testing of indigenous cotton bollworms pheromones | BARC |

## INTERNATIONAL

| | |
|---|---|
| • Sustainable control of the cotton bollworm *Helicoverpa armigera* in small scale production systems | Central Cotton Research Institute, Pakistan ; Narjing Agricultural University, China; Rothamstead Agricultural Experimental Station, UK; Natural Resources Institute, UK |
| • Development of gene construct | International Center for Genetic Engineering & Biotechnology (ICGEB) |
| • Germplasm collection, conservation and documentation | International Plant Genetic Re sources Institute |

# All India Coordinated Cotton Improvement Project

## Brief Report of Activities

### Plant Breeding

- In the National trials F 1945 (Br 2a), Krishi Ratan (Br.05a-1), NTHH 2003 (Br.05a-2), JKHB 211 (Br 15), CISA 318 (Br.22), KDCMHH 9821 (Br.05 b-2) and AAH.11 (Br.25) out yielded the other entries in the respective trials and have been promoted to Zonal trials.
- In the North Zone trials, CA52 and HS 1226 among the *G.hirsutum* entries, Navkar 5 among the intra *hirsutum* hybrids, AAH-1 among the *desi* hybrids and CSA 310 among the *G.arboreum* entries performed better than the check varieties/ hybrids.
- In the Central Zone, entries F 1946, GJHV 337, PSCH 504, PSCH 801 in irrigated trials and entries GBHV 139, KH 113, RCH 144 and SWADESHI 5 among the rainfed trials were the high yielders.
- In the South Zone Irrigated trials, CCH 526612 and GJHV 337 among the *G.hirsutum* cultures, PSCH 504 and PSCH 809 among the intra *hirsutum* hybrids showed promise. Under rainfed conditions, culture SCS 101 was the best .

### Agronomy, Physiology & Biochemistry

- Deep tillage once in two years plus conventional tillage with cultivator and planking resulted in significantly higher seed cotton yield. Deep tillage facilitated better root growth and efficient foraging of nutrients.
- Cotton- Wheat, Cotton – Barley at Ludhiana and Mathura and Cotton – Wheat, Cotton – Gram at Faridkot were the most sustainable cropping systems. Cotton + Potato (4:2) is the most profitable intercropping system at Dharwad. Cotton + Garlic, Cotton + Potato, Cotton + Bhendi are the sustainable intercrops under rainfed condition of Dharwad. Cotton + Soybean, Cotton + Red gram and Cotton + Green gram are the suitable intercrops at Guntur.
- Application of 50 % N through inorganic fertilizer + 50 % N through organics like FYM @ 5 t / ha + Azotobacter + Azospirillum + PSB resulted in higher seed cotton yield, net return and B: C ratio at Rahuri.
- Fertilization for targeted yields at Rahuri revealed that a fertilizer dose of 169: 97: 89 kg NPK / ha is to be applied to get yield of 30 q / ha.
- Sulphur application at 60 kg / ha improved the seed cotton yield to the tune of 28.9 % at Khandwa and 18.2 % at Nanded.
- Foliar application of $KNO_3$, DAP, Urea and KCl at 2 %, $MgSO_4$ 1 % or combination of $MgSO_4$ (1%) + $ZnSO_4$ (0.5%) enhanced the seed cotton yield appreciably in North and Central zone. Foliar spraying of KCl (1%) improved the seed cotton yield remarkably under rainfed condition

of Srivilliputhur. At Coimbatore, combined spraying of 2 % DAP, 1% KCl, 1% micronutrient mixture at 45, 60, 75, 90 and 105 DAS along with recommended NPK +NAA 40 ppm enhanced the seed cotton yield to the tune of 53 % over control.

- The new weedicide, trifloxysulfuron @ 7.5 g a.i. / ha (Faridkot) and 10 g a.i. / ha (Rahuri) controlled the weeds efficiently and produced yield on par with existing methods. Selective weedicides like pendimethalin, fluchloralin, prometryn, diuron and alachlor were efficient in controlling weeds associated with cotton. Non-selective herbicides like paraquat and glyphosate can be safely used as direct spray for post-emergent weed control.
- Physiological parameters during growth and development of cotton have been evaluated. Maximum seed cotton yield was found associated with higher dry matter production and crop growth rate.
- Cotton genotypes with higher relative water content, chlorophyll stability index and drought tolerance have been identified for further breeding programme.
- Biochemical mechanisms of resistance to biotic and abiotic stresses have been worked out and cotton genotypes possessing desirable biochemical attributes vis-a-vis tolerance to stresses have been identified.

**Entomology**

- There was an epidemic outbreak of *Helicoverpa armigera* in the northern states of Punjab, Haryana and Rajasthan during September- October. The estimated crop loss was 27 % in Punjab, 50% in Haryana and 70% in Rajasthan.
- Several chemicals such as new formulation of Thiamethoxam 35 FS, Poncho 600 FS were found effective in controlling sucking pests upto 45 days. In Sriganganagar, the effectiveness remained up to 60 days.
- Among the foliar spray formulation tested for sucking pests, calypso (Thioclopird) was found effective against jassids, aphids and thrips.
- There was a resurgence of whitefly in Northern zone. Among the chemicals tested for the control of whitefly, acetamiprid recorded less population of whitefly.
- Among the chemicals tested for bollworm control, Emamectin benzoate and F 6028 were found effective.
- In the combination products trial, individual chemical remained on par with combination products. Hence, there is need for revised strategies for testing of combination products

# Krishi Vigyan Kendra

Two villages Banwadi and Kaldongri in Nagpur district were adopted to undertake the following major activities

- Conducting practical training on horticultural crops, agricultural crops, Animal husbandry, Home science and plant protection.
- On campus and off campus demonstrations, front line demonstrations, on cotton based cropping systems as well as component demonstrations on IPM, INM and IWM were undertaken.
- For diversification of agriculture, promotion of mushroom production, sericulture, goatary, rabitary, poultry, floriculture, fruit nursery, introduction of new improved varieties of fruit crops, vegetables and cotton has been done.
- For rural women empowerment programmes like smokeless *chullah,* fruit preservation training, child care campaign, nutrition garden for solving malnutrition problem were undertaken.

## Achievements

### Training:

Three major types trainings programme were conducted:

1. Training for practicing farmers, 2. Training for rural youth and 3. Training for extension functionaries

Thirty seven trainings were conducted for 886 practicing farmers, 30 trainings for 493 rural youth and 31 trainings for 560 extension functionaries.

### Front Line Demonstrations (Oilseed and Pulses)

FLDs on major oilseed and pulse crops were undertaken. The farmers in the Nagpur districts were lacking in awareness of latest technologies in oilseed and pulses. Through FLDs awareness among the farmers were created about new varieties and hybrids, IPM and INM technologies and biopesticides etc. The major oilseed and pulses crop of Nagpur such as Soybean and pigeonpea were included in these demonstrations and the improved technologies gave better yields in the demonstrations.

### Technology Evaluation and Impact Assessment Project (TEIAP)

Four entries of pigeonpea were tested and it was observed that 99v46 recorded the highest yield of 1680.55 kg/ha. On the same line nine hybrids and 12 varieties were also tested. Amongst the hybrids SPH 1148 recorded the yield of 3869 kg/ha and in case of varieties SPV-1474 gave the highest yield of 4330 kg/ha.

### Adaptive trials and client oriented trials

Nine adaptive trials on production and protection aspects of cotton, chickpea, soybean were undertaken. The production and protection technologies were tested in adopted villages and it was found that, these technologies boosted the production of crops and livestock. These technologies were also popularized amongst the farmers belonging to SC/ST categories under the client-oriented trials. In addition, cows, goats, rabbits and poultry were also the integral part of these trials.

### Crop demonstrations (on campus)

Fourty six crop demonstrations on cotton, chickpea, soybean, fodder crops viz. Lucerne, maize, vegetables and fruits were undertaken. The production and protection technologies of these crops were demonstrated on area ranging from 0.2 to 1 hectare. Many farmers from Nagpur district visited these demonstrations and were benefited.

### Advisory Services

Advisory services to the farmers were provided on goats, fruits, vegetables, field crops, IPM, INM, IWM of crops, mushroom and other production technologies. In all 1065 farmers were benefited during the period.

### Extension Activities

Five field days were organised during 2001-02 wherein 500 farmers have participated. Five *Kisan goshsthis* were arranged and 250 farmers participated in them. Ten radio talks and one television show on various topics of agriculture, animal science and other allied subjects were given. One vegetable production gyan week was observed. Considering the non-availability of veterinary clinics in remote rural areas, two animal treatment camps were arranged. Women play an important role in agriculture hence four women in agriculture days were arranged. The KVK activities were depicted in three agriculutural exhibitions. A large number of farmers (3000) visited the stall. Apart from these activities, number of other activities viz., calf ralleyes, world food day, hygiene and health day, national nutrition week, vegetable production gyan diwas were organised.

### Women empowerment

Skill oriented training to farm and tribal women was provided to enhance their skills in various agricultural operations and allied enterprises to enhance their income and socio-economic status.

Several skill oriented training programmes on processing of fruits and vegetables and also preparation of indigenous dairy products and mushroom based recipes were organised.

As far as mushroom cultivation is concerned, eleven tribal women were provided technical know-how in mushroom cultivation. They were also provided with a window for the sale of quality produce in view of the marketing problems. This has enabled them to realize higher returns.

### Agriculture diversification

In agriculture, fruit plantation other than citrus has been promoted. Also series of new activities such 'as mushroom cultivation sericulture, goat unit establishment, floriculture, cultivation of fruit crops and establishment of rose nursery and vermicompost unit were initiated. Goat unit and floriculture activities have been well received by farmers of all the villages and they are now in demand.

### Resource generation

While imparting the trainings and demonstrations to the farmers, resource to the tune of Rs. 48,762/- was generated through sale of goats, eggs, fruits, flowers and vegetables, mushroom and preserved products etc.

**Commercialization of technology:** The technologies of oyster mushroom, scientific livestock production, cotton production, vegetable and fruit production etc. are being disseminated.

### Publications

The publications in local language as well as in Hindi and English on the technologies developed by the CICR during the period 2001-02 given below. These publications are distributed to the trainees, farmers, visitors.

| Discipline | Popular articles | | Booklets/leaflets | |
|---|---|---|---|---|
| | English | Marathi | Hindi | Marathi |
| Agronomy | — | 1 | 1 | - |
| Plant protection | 1 | 4 | 7 | 2 |
| Horticulture | - | 3 | 4 | - |
| Veterinary science | - | 3 | 4 | - |
| Live Stock production & Management | - | 2 | 17 | - |
| Home science | - | 2 | 1 | - |
| Total | 1 | 15 | 30 | 3 |

# List of Approved On-going Research Projects

## Institute Projects

### Nagpur

#### Crop Improvement

1. Collection, conservation, evaluation, documentation and utilization of genetic resources.
2. Genetical and anatomical studies on drought tolerance in cotton.
3. Conservation of wild species of *Gossypium* and introgressive hybridization for the improvement of cultivated cottons.
4. Breeding for high yielding and long staple genotypes of *arboreum* cotton with high fibre strength.
5. Breeding cotton genotypes suitable for cultivation in shallow soils
6. Improvement of seed yield and its quality in cotton hybrids and varieties.

#### Biotechnology

7. Development of tissue culture protocols for use in breeding and genetic transformation.
8. Evaluation of Cotton germplasm through molecular techniques.

#### Crop Production

9. Studies on use of harvested rain water for recycling at critical stages of rainfed cotton for augmenting its production in vertisols
10. Studies on water use efficiency in rainfed cotton through drip irrigation in vertisol.
11. Studies on long term effect of nutrient management practices on the productivity, nutrient balance and sustainability of cotton based cropping systems.
12. Tillage and crop residue effects on soil, nutrient and cotton crop behaviour.
13. Development of bullock drawn seed drill cum planter for cotton sowing in vertisols.
14. Weather based models for cotton yield forecasting in the intensively cotton growing districts of Marathawada and Vidarbha regions.

#### Crop Protection

15. Screening of cotton germplasm against key pests to find out morphological and biochemical basis of resistance.
16. Biochemical basis of induction of defense related proteins in cotton against the gram pod borer *Helicoverpa armigera*.
17. Interaction effects of cultivars, agrotechniques, insect pests and entomophages in cotton ecosystem.
18. Estimation of losses due to major pests of cotton.
19. Studies on multiple disease resistance in upland cotton.
20. Studies on seed transmitted pathogenic infections and other seed microflora of cotton.
21. Studies on evolution of races of *Xanthomonas axonopodis* pv. *malvacearum* (*Xam*) and utilization of UVS in identification of resistant sources.
22. Evaluation of cotton germplasm against

Alternaria and Myrothecium leaf spot diseases.

23. Effect of mix-micro-antagonist on control of cotton foliar diseases.
24. Studies on plant parasitic nematodes associated with cotton.

### Plant Physiology and Biochemistry

25. Physiological evaluation of cotton germplasm under rainfed conditions.
26. Physiological studies on abiotic stress with particular reference to heat and drought in cotton.
27. Physiological and biochemical basis of salinity tolerance in cotton plants.
28. Physiological and Biochemical adaptation of cotton plant to waterlogging.
29. Effect of insecticides on secondary metabolites in cotton.
30. Source-sink alteration with reference to flower induction as a tool to improve physiological efficiency and productivity in cotton.

### Extension & Economics

31. A study on structure of agriculture and social dynamics of cotton production .
32. A study on technology adoption behaviour of cotton growers : Structural perspective.
33. Economic analysis of cotton cultivation in India.
34. Impact of cotton front-line demonstrations on technological advancement of cotton growers.

### Regional Station, Coimbatore

35. Development of early high yielding intra *hirsutum* hybrids.
36. Breeding *G.hirsutum* cotton varieties with new plant types – Development of medium staple varieties.
37. Development of extra long staple high spinning hybrids of interspecific origin.
38. Development of high yielding and high spinning extra long staple cotton.
39. Maintenance and evaluation of cotton germplasm.
40. Inter-specific and inter-racial hybridization and gene transfer in *Gossypium*.
41. Development, maintenance and utilization of cytoplasmic and genetic male sterility for hybrid cotton seed production and fertility restoration in cotton.
42. Studies on viability, vigour and longevity of cotton seeds.
43. Studies on the long term effect of continuous application of NPK and FYM on the physicochemical properties of soil and its relations to yield and nutrient uptake of cotton in fixed crop rotation.
44. Studies on the response of elevated carbon-di-oxide on physiology and productivity.
45. Identification and utilization of adaptive responses to abiotic stress in cultivated species of cotton.
46. Physiology of fibre growth and development.
47. Callus induction and growth measure or apparent stress tolerance to screen cotton genotypes for drought / tolerance.
48. Studies on biochemical mechanisms of resistance to bollworm of cotton.
49. Studies on development Biochemistry of cotton pest/ Disease interaction.
50. Studies on the role and effect of insecticides in cotton ecosystem.
51. Studies on the host plant relationship and development of resistant/tolerant varieties to insect pests of cotton.
52. Studies on population dynamics of cotton pests and their enemies.
53. Studies on Bioecology and management of cotton stem weevil *Pempherulus affinis*.

54. Bio ecological Studies in Pink Bollworm.

55. Studies on soil borne diseases of cotton.

56. Studies on Bacterial Blight of cotton.

57. Studies on the epidemiology and management of fungal foliar diseases of cotton.

58. Role of Women in cotton based cropping system of Tamil Nadu.

### Regional Station, Sirsa

59. Evaluation of parents in *Gossypium hirsutum* for heterotic potential and useful heterosis for replacement of existing cultivars under north Indian conditions.

60. Identification and development of *G.arboreum* cotton for high yield, long staple with fibre strength for high speed spinning.

61. Development of male sterility based hybrids for north India.

62. Studies on seed technological aspects of hybrids and varietal seed production under north zone.

63. Evaluation and refinement of IPM module for irrigated cotton in north zone.

64. Studies on cotton leaf curl virus disease and development of resistant varieties and hybrids for its management.

65. Collection, conservation, evaluation and maintenance of genetic resources.

## Externally Funded Projects

1. Development of sensitive molecular diagnostic tools for rapid detection and differentiation of races of *Xanthomonas axonopodis* pv. *malvacearum*.

2. Sustainable control of the cotton bollworm *Helicoverpa armigera* in small scale production systems.

## AP Cess Fund

1. Use of entomopathogenic nematodes for biological control of insect pests of cotton.

## National Agricultural Technology Project

### I. Mission Mode

MM 1: Development of Hybrid Crops-Cotton.

MM 2: Development of weather based forewarning systems for crop pests and diseases – cotton.

MM 3: Sustainable management of plant biodiversity-Cotton.

MM 4: Bt. Transgenic for insect resistance-Cotton, Pigeonpea and Rice.

### II. Irrigated Agro-Ecosystem

PSR 4: Studies on efficacy of bioinculants in cotton-wheat based production system.

PSR 24: Socio economic analysis and characterisation of cotton-based cropping systems.

PSR 33: Evaluation of tillage, residue and nutrient management practices for cotton-wheat system.

PSR 26: Control of leaf curl viral disease in cotton and development of protocol for mass multiplication of predators, parasites and insect pathogens.

PSR 27: Evaluation and identification of suitable pest tolerant compact cottons amenable to mechanical harvesting.

PSR 36: Adoption and refinement of cotton picker and cleaning system.

TAR: Technology assessment and refinement ( TAR ) of irrigated Agro Ecosystem for Coimbatore Region TN.

### III. Rainfed Cotton Production System (RCPS)

RCPS1: Agro economic characterisation and constraint analysis of rainfed cotton based production systems in relation to soil, rainfall and socio economic

factors.

RCPS2: Optimising nutrient supply in relation to moisture availability for enhanced productivity and stability of rainfed cotton based production system.

RCPS3: Assessment of Gossypol content in cotton Germplasm.

RCPS4: Delineating the efficient productive zones for Cotton production system using GIS based crop models.

RCPS5: Rainwater conservation, harvesting and recycling/recharging techniques for enhanced productivity of cotton based cropping system.

RCPS7: Promotion of productive high quality *G. arboreum* cotton to meet the needs of marginal cultivators of rainfed ecosystem vis-à-vis textile industry.

RCPS8: Characterisation and identification of productive and high quality cotton species/genotypes including *G. herbaceum* for different rainfed agro-ecological situations adopting suitable approaches through farmers participatory programmes.

RCPS9: Develop and evaluate production technology for the indigenous cotton of NE Region.

RCPS10: Development of Bt. transgenic diploid cotton.

RCPS11: Impact of tillage, land treatment & organic residue management on soil health, drainage & crop, productivity of rainfed cotton based system.

ROPS10: Identification of research gaps in inter-cropping systems under rainfed conditions in India.

IVLP: Technology assessment and refinement of rainfed cotton based production system in Nagpur district through institute village linkage programme under rainfed Agro Eco-system.

### IV. Agro Ecosystem (Coastal)

PSRC16: Exploitation of *G. herbaceum* cotton for improving agricultural output and economy of the coastal agro ecosystem.

### V. Competitive Grant Programme

CGPI : Induction of para nodules in cotton with $N_2$ (nitrogen) fixing bacterium *Azorhizobium caulinodans.*

# Technology Mission on Cotton

| Proj. Code | Project Name | Centre(s) |
|---|---|---|
| MMA-1 | Identification and development of promising genotypes from introgressed materials. | Nagpur Coimbatore, Sirsa |
| MMA-2 | Identification and development of diploid cotton with high yield and fibre quality suitable for high speed spinning. | Nagpur Coimbatore, Sirsa |
| MMA-3 | Characterisation of plant ideotypes suitable for different agroclimatic zones. | Nagpur Coimbatore, Sirsa |
| MMA-4 | Improvement of medium long and extra long staple fibre quality suitable for high speed spinning. | Nagpur Coimbatore, Sirsa |
| MMA-5 | Quantitative and qualitative improvement of cotton seed oil. | Nagpur Coimbatore, Sirsa |
| MMA-6 | Overcoming incompatibility barriers in interspecific hybridisation. | Nagpur Coimbatore |
| MMB-1 | Maintenance of genetic purity of released varieties and parents of hybrids. | Nagpur Coimbatore, Sirsa |
| MMB-2 | Molecular characterisation of released varieties and parents of hybrids. | Nagpur |
| MMB-3 | Pre and post harvest management techniques for the improvement of seed quality. | Nagpur Coimbatore, Sirsa |
| MMC-1 | Nutrient dynamics in cotton and establishment of critical limits of macro and micro nutrients. | Nagpur |
| MMC-2 | Evaluation of bioinoculants including VAM & PSB for eco-friendly and economical nutrient management. | Nagpur Coimbatore |
| MMC-3 | Evaluation of soil site and series suitability for cotton based cropping system. | Nagpur |
| MMD-1 | Methodologies for production of regional level cotton yield by incorporating remote sensing, GIS and crop models. | Nagpur Coimbatore |
| MMD-2 | Mechanisation of tillage, planting, interculture and plant protection operations in cotton cultivation. | Nagpur |
| MMD-3 | Development of precision farming techniques for higher productivity. | Coimbatore |
| MME-1 | Evaluation of location specific IPM modules for eco-friendly and sustainable cotton production. | Nagpur Coimbatore, Sirsa |
| MME-2 | Development of pest and disease forecasting system. | Nagpur Coimbatore, Sirsa |
| MME-3 | Diagnostic tools for differentiation of biotypes/ races in pathogens and insect pests. | Nagpur Coimbatore, Sirsa |
| MME-4 | Development of efficient strains of biocontrol agents through molecular techniques. | Nagpur Coimbatore |
| MMG-1 | Technology evaluation, assessment and refinement. | Nagpur Coimbatore, Sirsa |
| MMH-1 | National Cotton Informatics and Documentation System. | Nagpur Coimbatore |
| MMH-2 | Monitoring and Coordination Cell. | Nagpur |

# Consultancy, Patents, Commercialisation of Technology

Consultancy for mass production of *Trichogramma chilonris* was offered to 1) Pooja Biotech, Nanded and 2) KNS Biotech, Degloor. They have been advised on all the production process and were helped to established bio-factories. Quality evaluation of their trichocards was done and could be channelised for various user agencies. An amount of Rs.30,000/- was accrued to the institute as consultancy charges.

# Significant Decisions of Research Advisory Committee, Institute Management Committee, Staff Research Council, Quinquennial Review Team meetings

## Research Advisory Committee (RAC)

The Council constituted 3rd Research Advisory Committee for the CICR for next 3 years. The first meeting of Third Research Advisory Committee was held on 25th June, 2001 at CICR, Nagpur under the Chairmanship of Dr. Y.S. Nerkar. The following members attended the meeting.

Dr. K.R. Krishna Iyer, Dr. S.S. Narayanan, Dr. V.C. Patil, Dr. Joginder Singh, Dr. K.C. Jain, Dr. C.D. Mayee and Dr. M.R.K. Rao, Member Secretary

Dr. M.R.K. Rao, Member Secretary welcomed the Chairman and members of the Research Advisory Committee, for the first meeting. Dr. C.D. Mayee, Director, CICR initiated the meeting with a comprehensive overview of the achievements made by CICR during the past few years. This is followed detailed presentation by the Heads of Divisions/Sections on the ongoing programmes in their respective Divisions/Sections. During the presentation and in the discussions that followed, the following suggestions were made by the Chairman and the members of the RAC. The proceedings were approved by the ICAR.

**The following are some of the major recommendations:**

1. The Institute should undertake systematic characterisation of germplasm by using the new molecular techniques.
2. By reducing priority on breeding efforts in a phased manner, emphasis should be laid on basic and fundamental studies.
3. In view of the significant progress made in the field of insect resistance management, it was felt that these studies should be extended to more centers, covering all the three major cotton growing zones.
4. The screening technologies for insect

pest and diseases need to be further improved and refined.

5. The Institute should undertake work on development of package of practices for reducing the cost of cultivation without affecting the yield and quality. This approach attains relevance, so as to make the Indian cotton production cost effective and competitive.

6. The scope of biotechnology efforts in the Institute should be enhanced to cover other areas such as abiotic stress resistance, pest and disease resistance, in addition to the development of Bt. Transgenic cotton.

7. Material developed through introgressive hybridization be distributed to different centers for evaluation.

8. CICR Regional Station at Sirsa should be strengthened with scientific manpower along with infrastructural support.

9. Work on development of computer simulation models for crop modeling be accorded high priority.

Dr. Y.S. Nerkar, Chairman, RAC in his concluding remarks, appreciated the quantum as well as the quality of work being done at the Institute and desired that some of the major points which have emerged during the deliberation, be considered for implementation to the extent possible, looking to the fact that a large number of projects are already in progress at the Institute.

## Institute Management Committee (IMC)

Institute Management Committee meeting twice during 2001-2002 on 10.07.2001 and 06.02.2002 under the Chairmanship of Dr. C.D. Mayee, Director, CICR, Nagpur. The proceedings of the meetings were approved by the ICAR. The following are the major decisions.

- IMC approved the expenditure on security beyond Rs. 5.00 lakhs and below Rs. 10.00 lakhs. ICAR suggested for going Ex-servicemen through D.G. Resettlement (DGR).
- A type IV quarter to be reserved for the Finance & Account Officer of the Institute as and when it will be vacant.
- Replacement of photosynthetic system by LCD Projector, modern conference system and furniture for Seminal Hall.
- Addition of computer (17 Nos.), Printers (24 Nos.) and UPS (23 Nos.) to be included in the X plan EFC memo.

## Staff Research Council (SRC)

The Annual Staff Research Council meeting of CICR, Nagpur and its two Regional Stations Coimbatore and Sirsa was held at CICR, Nagpur during May 24th to 26th, 2001 under the Chairmanship of Dr. C.D. Mayee, Director, CICR to discuss the results of the work carried out during 2000-2001. All the scientists from Nagpur, Coimbatore and Sirsa participated in the meeting and presented their work individually of their on going projects carried out during 2000-2001. Each project was critically evaluated and technical programme for the year 2001-2002 was finalised.

Three new projects were also presented and after discussions and interactions, the house approved them.

Felicitations to Dr. K Venugopal, PC & Head, CICR, Regional Station, Coimbatore, Dr. K Ramamurthy, Sr. Scientist and Dr K. Shanmughan, Principal Scientist, CICR, Regional Station, Coimbatore and Dr. S.T. Tembhurnikar Sr. Scientist, CICR, Nagpur were given for their forthcoming superannuation during 2001.

## Quinquennial Review Team (QRT)

The Indian Council of Agricultural Research, New Delhi constituted Quinquennial Review Team (QRT) under the Chairmanship of Dr. A.S. Khera, Former Vice Chancellor, PAU, Ludhiana to review functioning and progress of research in CICR as well as AICCIP for the period 1995-2000. Other members of QRT were Dr. G.M. Bharad, former Vice Chancellor, Dr. PDKV, Akola, Dr. V.N. Shroff, Dean (Retd.), JNKVV, Indore, Dr. S. Lingappa, Director of Research, UAS, Dharwad, Dr. R. Jeyarajan, Prof. of Plant Pathology (Retd.), TNAU, Coimbatore and Dr. K. Venugopal, Project Coordinator (Cotton & Head), as convener. The QRT under took review of Institute work during 2000 and reviewed the AICCIP in 2001. The QRT met under the chairmanship of Dr. A.S. Khera at CICR, Nagpur from 19.02.2002 to 01.03.2002 and finalize the report alongwith recommendations which was submitted to the Council later.


Dr. Mangala Rai
DDG (CS), ICAR releasing
institute's publications during
Group discussion on Bt cotton


Dr. Y S Nerkar,
Chairman, RAC
addressing the scientists

QRT Members in
discussion with
Dr. C D Mayee, Director.


Dr. M Mahadevappa,
Chairman, ASRB delivering
the Silver Jubilee Lecture

# Participation of Scientists in Seminars/ Symposia/ Conferences/ Workshops/ Meetings

| Sr. No. | Seminars/Symposia/Conferences Workshops/Meetings | Place & Date | Participant (S) |
|---|---|---|---|
| 1. | Annual Group Meeting of AICCIP | Hisar 13-15 April 2001 | Dr. C.D. Mayee<br>Dr. P. Singh<br>Dr. V.V. Singh<br>Dr. P.M. Mukewar<br>Dr. P. Chidambaram<br>Dr. N. Gopalakrishnan<br>Dr. S. Manickam |
| 2. | National Symposium on Cotton Research Strategies in new millennium | Hisar, 16 April 2001 | Dr. C.D. Mayee<br>Dr. P.M. Mukewar<br>Dr. N. Gopalakrishnan<br>Dr. D. Monga<br>Dr. P. Jeyakumar<br>Dr. S. Manickam |
| 3. | A Review meeting of NATP MM project on Development of hybrid crop cotton | 21 April 2001 | Dr. C.D. Mayee |
| 4. | National Symposium on Biodiversity vis-à-vis resource exploitation : an introspection | Port Blair 23-24 April 2001 | Dr. S. Manickam |
| 5. | Group meeting of the project scientist TMC–MMB 1 Maintenance of genetic purity of released varieties and parents of hybrid | Surat 4 May 2001 | Dr. K. Rathinavel |
| 6. | Workshop on Agro-technology and thrust areas for agricultural development | Nagpur 7-10 May 2001 | Dr. Blaise |
| 7. | Half Yearly Workshop of Krishi Vigyan Kendra | Dapoli 16-18 May 2001 | Dr. H L Gajbhiye |
| 8. | Sub group meeting on textiles and apparel and their raw material | Mumbai 7 June 2001 | Dr. C D Mayee |
| 9. | Sensitizing Workshop of TMC MMG-1 Project Technology Intervention and Socio-Economic Analysis of Cotton based Cropping System. | Nagpur 12 July 2001 | Dr. H L Gajbhiye<br>Dr. S Usha Rani |

| | | | |
|---|---|---|---|
| 10. | International Symposium on Biotechnology | New Delhi 17-19 July 2001 | Dr. C D Mayee |
| 11. | Review meeting of MMA-4 and MMA-5 | Mumbai 27 July 2001 | Dr. C D Mayee<br>Dr. P Singh<br>Dr. V N Waghmare<br>Dr. R K Deshmukh |
| 12. | Annual NATP Coastal Agro Eco System Project meeting | Bangalore, 30-31 July 2001 | Dr. N Gopalkrishnan<br>Sh. K N Gururajan |
| 13. | National Seminar on Seed Science and Technology in the New Millennium : Vistas and Vision | Mysore, August 6-8 2001 | Dr. P M Mukewar |
| 14. | Meeting on MM1 of Technology Mission on Cotton | New Delhi 7-8 Aug., 2001 | Dr. C D Mayee |
| 15. | National Seminar on Vedic Agriculture | Jaipur, 10 Aug., 2001 | Dr. C D Mayee<br>Dr. P Singh<br>Dr. Punit Mohan |
| 16. | National Seminar on Gender Issues-Women in Agriculture & Management | Coimbatore 20-22 Aug., 2001 | Dr. S Usha Rani |
| 17. | Cotton Advisory Board Meeting | Mumbai 24 Aug., 2001 | Dr. C D Mayee |
| 18. | Sensitization Workshop for NATP Rainfed PSR projects | Hyderabad 27-28 Aug., 2001 | Dr. Jagvir Singh<br>M. Chakrabarty |
| 19. | Zonal Workshop (West Zone) on Training planning | Jaipur 28 Aug.– Sept.1, 2001 | Dr. H L Gajbhiye |
| 20. | National Seminar on Sustainable cotton production technology and future strategies | Nagpur 10-11 Sept. 2001 | Dr. C D Mayee<br>Dr. P M Mukewar<br>Dr. H L Gajbhiye<br>Dr. A R Raju<br>Dr. Jagvir Singh |
| 21. | Annual Workshop of Krishi Vigyan Kendra | Nagpur 14-16 Sept. 2001 | Dr. H L Gajbhiye |
| 22. | Sustainable cotton production to meet the future requirement of industry | Mumbai 3-4 Oct. 2001 | K N Gururajan<br>Dr. D Monga |

| | | | |
|---|---|---|---|
| 23. | National seminar on Emerging Trends in Pest and Diseases and their Management | Coimbatore 11-13 Oct. 2001 | Dr. P Chidambaram |
| 24. | National Seminar on Development in Soil Science | Udaipur 30 Oct – Nov.2 2001 | Dr. Jagvir Singh |
| 25. | Diamond Jubilee Symposium on Hundred Years of Post-Mendelian Genetics and Plant Breeding Retrospects and Prospects | New Delhi 6-9 Nov. 2001 | Dr. P Singh<br>Dr. V V Singh<br>Dr V N Waghmare<br>Dr. Vinita Gotmare<br>Dr. S. Manickam |
| 26. | National Group Meeting on Bt cotton in India | Nagpur 24 Nov. 2001 | Dr. P Singh<br>Dr H L Gajbhiye<br>Dr Surendra Kumar |
| 27. | National Symposium on Plant Physiology and Biochemistry in Transgenic era and beyond | Kolkata 1-3 Dec. 2001 | Dr. K B Hebbar |
| 28. | International symposium on Importance of potassium in nutrient management for sustainable crop production in India. | New Delhi 3-5 Dec. 2001 | Dr. Jagvir Singh<br>Dr. Blaise |
| 29. | National symposium on Role of Plant Physiology for sustaining quality and quantity of food production in relation to environment | Dharward 5-7 Dec 2001 | Dr. A H Prakash |
| 30. | National Symposium on Metabolic pathway studies for Crop Improvement | Coimbatore 13-15 Dec. 2001 | Dr. N Gopalakrishnan<br>Dr. A H Prakash |
| 31. | Indo-American Millennium seminar on Green to Gene revolution | Hyderabad 8 Jan. 2002 | Dr. M R K Rao |
| 32. | National Workshop on All India Coordinated Research Project on long term fertilizer experiments | Ranchi 14-16 Jan. 2002 | Dr. Blaise |
| 33. | XI National Seed Seminar on Quality seed to enhance agriculture profitability | Dharwad 18-20 Jan. 2002 | Dr. R A Meena |
| 34. | National Workshop on Planning and Management of Agriculture Extension Training | New Delhi 22-23 Jan. 2002 | Dr. H L Gajbhiye |
| 35. | National level meeting on Integration of development efforts on cotton | Mumbai 24 Jan. 2002 | Dr C D Mayee |

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| 36. | National Seminar on Agricultural Heritage of India | Udaipur 10-13 Feb. 2002 | Dr. C D Mayee<br>Dr. P Singh<br>Dr. Punit Mohan |
| 37. | Technologies for increasing cotton production. Government of India sponsored workshop on Research–Extension Linkage. | Coimbatore 12-13 Feb. 2002 | Dr. Blaise<br>Dr. P. Nalayini |
| 38. | National Symposium on Perspectives in Integrated Plant Disease Management | Nagpur 3-14, Feb. 2002 | Dr. P M Mukewar |
| 39. | National Seminar on New opportunities and challenges for improving crop productivity through Biotechnology | 13-15, Feb. 2002 | Dr. Surendra Kumar |
| 40. | Core group meeting on Bt cotton to assess and evaluate the current status. | New Delhi 20 Feb. 2002 | Dr. C D Mayee |
| 41. | National Seminar on the Protection of plant varieties under the UPOV convention | Hyderabad 25-26 Feb. 2002 | Dr. K. Rathinavel |
| 42. | Annual Workshop of TMC MMG-1 Project Technology Intervention and Socio-Economic Analysis of Cotton Based Cropping System | Coimbatore 27 Feb. 2002 | Dr. H L Gajbhiye<br>Dr. S Usha Rani |
| 43. | National Seminar on Entrepreneur-ship Development in Agriculture | Parbhani 1-3 Mar. 2002 | Dr. H L Gajbhiye |
| 44. | Cotton Advisory Board Meeting | Mumbai 5 Mar. 2002 | Dr. C D Mayee |
| 45. | Annual Breeder Seed Review Meeting | New Delhi 11 Mar. 2002 | Dr. C D Mayee |
| 46. | Annual Group Meeting of All India Coordinated Cotton Improvement Project | Nagpur 22-24 Mar. 2002 | Dr. C D Mayee<br>Dr. K N Gururajan<br>Dr. N Gopalakrishnan<br>Dr. P Chidambaram<br>Dr. S Manickam<br>Dr. K Rathinavel<br>Dr. S Usha Rani<br>Dr. Blaise<br>Dr. P Nalayini |
| 47. | Genetic Engineering Approval Committee | New Delhi 26 Mar. 2002 | Dr. C D Mayee |


Shri Sompal, Member, Planning Commission, GOI, delivering the inaugural address.


Shri Anil Deshmukh, Excise Minister of Maharashtra, addressing the farmers at Rashtriya Kapas Mela

Dr. C D Mayee, Director addressing the delegates.


Dr. S A Patil, Vice Chancellor, UAS, Dharwad delivering the inaugural address.

# Workshops/ Seminars/ Summer Institutes/ Farmers' Day Organised

## कपास उत्पादन प्रौद्योगिकी एवं भावी रणनीति विषय पर आयोजित राष्ट्रीय संगोष्ठी

संस्थान के रजत जयंती वर्ष के उपलक्ष्य में संस्थान में दि. 10–11 सितबर 2001 को 'प्रौन्नतिशील कपास उत्पादन प्रौद्योगिकी एवं भावी रणनीति' विषय पर एक राष्ट्रीय संगोष्ठी का आयोजन किया गया। संगोष्ठी का उदघाटन श्री सोमपालजी, सदस्य याजना आयोग, भारत सरकार के कर–कमलों द्वारा संपन्न हुआ। उन्होंने संगोष्ठी के अवसर पर सभा को संबोधित करत हुए कहा कि देश के कुछ भ्रष्ट अधिकारियों और राजनेताओं के स्वार्थ की वजह से कृषि क्षत्र पर बंधन लगाये गये हैं। भ्रष्टाचार व स्वार्थ में आकठ डूबे अधिकारियों के विरोध में अब किसानों को आवाज उठानी चाहिए। लकिन किसान हिंसक आंदोलन न कर क्योंकि आज तक एक भी नेता को आदोलन में गोली नहीं लगी। बलि सिर्फ किसानों की हुई है। उन्होंने आग कहा कि भारत की परपरागत कृषि तकनीकी को आधुनिक रूप देने के लिए अब जानकारी व तकनीकी जैस साधनों का उपयोग करना होगा । इसके अलावा उत्पादन क्षमता सहित गुणवत्ता भी सुधारनी होगी । कपास के उत्पादन व गुणता दोनों मामलों में भारत अन्य दशो से पीछे है । आज देश में 300 कि.ग्रा./हैक्टर कपास उत्पन्न होती है जबकि महाराष्ट्र म केवल 150 कि.ग्रा. कपास होती है । अन्य राज्यों में कपास उत्पादन अधिक होता है । इसलिए राज्य सरकार को इस पर ध्यान देना चाहिए ।

संगोष्ठी के उदघाटन सत्र की अध्यक्षता महात्मा फुले कृषि विद्यापीठ, राहुरी के कुलपति डा. एस.एन. पुरी ने की । इस अवसर पर डा. पजाबराव देशमुख कृषि विद्यापीठ, अकोला ने कुलपति डा. एम.एल. मदन, केन्द्रीय कपास प्रौद्योगिकी अनुसंधान संस्थान, मुंबई के निदेशक डा. एस. श्रीनिवासन, राष्ट्रीय नींबू वर्गीय फल अनुसंधान केन्द्र, नागपुर के निदेशक डा. श्याम सिंह एवं कृषि विज्ञान केन्द्र, हैदराबाद के आँचलिक समन्वयक डा. सी. श्रीराम विशेष अतिथि के रूप में उपस्थित थे। प्रास्ताविक भाषण एवं स्वागत संस्थान के निदेशक डा. चारुदत्त मायी ने किया एवं आभार संगोष्ठी के सह–अध्यक्ष डा. शिवराज ने दिया।

संगोष्ठी के उदघाटन से पूर्व श्री सोमपालजी ने संस्थान के रजत जयंती द्वार तथा कृषि सूचना प्रौद्योगिकी केन्द्र (एटिक) का उदघाटन किया। इस अवसर पर राष्ट्रीय संगोष्ठी की स्मारिका, 'काटन मार्च टुवार्डस न्यू मिलेनियम' नामक पुस्तक, 'काटन सीड प्रोडक्शन इन इंडिया', 'आर्गेनिक काटन फार्मिंग', 'इंटीग्रेटेड न्यूट्रिएंट मनेजमेंट' बुलेटिन तथा सी आई सी आर न्यूज लेटर व कपास समाचार आदि संस्थान के प्रकाशनों का विमोचन संपन्न हुआ ।

इस दो दिवसीय राष्ट्रीय संगोष्ठी में देश के विभिन्न भागों से आये कपास विशेषज्ञों ने भाग लिया। संगोष्ठी के अंतर्गत तकनीकी सत्र I में मुख पत्र, तकनीकी सत्र II में फसल सुधार एवं प्रसार तथा तकनीकी सत्र III में फसल उत्पादन एवं संरक्षण विषयों पर शोध पत्र प्रस्तुत किए गए। संगोष्ठी के समापन सत्र में इन तीनों में की गई सिफारिशों को प्रस्तुत किया गया।

## National Symposium on Perspective in Integrated Disease Management

A two day National Symposium on 'Perspective in integrated plant disease management' was organised jointly by CICR, Nagpur and NRC for Citrus, Nagpur in collaboration with the Indian Society of Plant Pathologists, Ludhiana (ISPP) on February 13-14, 2002.

The National Symposium was inaugurated by Dr. M. Mahadevappa, Chairman, Agricultural Scientist Recruitment Board, New Delhi. Addressing the gathering he said that the disease management in plants need to be tackled with integrated approach. He added that private and public sectors should work in parallel to develop new technologies particularly for marginal farmers as they are the major sufferers. Dr. Mahadevappa further urged the experts to educate the farmers regarding the merits and demerits of the technologies developed by them so that they can analyses choice available in a more precise manner.

Dr. C.D. Mayee, Director, CICR and Co-chairman of the organizing committee informed that about 18 to 20 per cent production of crops is affected by various diseases. He further mentioned that plant pathology needs to be innovative and pay serious attention towards use of pathogens for insect management.

Dr. R.N. Singh, Director, NEERI, Nagpur, in his presidential address, said that insecticides and pesticides holds the key in disease and pest management but care should be taken that the environment is least affected. He urged that the biological aspects of plant and organism should be studied in proper manner. Dr. P.S. Thind, President of ISPP, Speaking on the occasion mentioned in brief about various activities carries out by the Society. Dr. Pushpendra Singh, Secretary of the Society, said that the Indian Society of plant pathologists has witnessed spectacular growth since its establishment in the year 1984. Dr. K.S. Gajbhiye, Director Incharge, NBSS & LUP, Nagpur, mentioned that diversity in the nature of soils has to be integrated with crop production and disease management.

A number of souvenirs were released on the occasion including silver jubilee issues of CICR Newsletter and Kapas Samachar

## National Group Discussion on Bt Cotton in India

The National Group discussion on development of Bt cotton in India was organised jointly by CICR, Nagpur and Nagpur Chapter of Indian Society for Cotton Improvement, (ISCI), Mumbai on November 24, 2001. The group discussion was inaugurated by Dr. Mangala Rai, Deputy Director General (Crop Science), with Dr. V M Pawar, Vice Chancellor, Marathwada Agricultural University, Parbhani as Chairman of the function.

The Bt. Group discussion was organised to assess the present status of transgenic cotton using Bt gene and release of cultivars by public and private sector. The group discussion mainly focussed on the current progress and future co-operation between private and public sector for evolving a promising transgenic cotton hybrid/variety and problems related to the release of certified Bt Cottons to safeguard consumers' interest.

The Technical Session - I was chaired by Dr. Managla Rai, Deputy Director General (Crop Science), and Co-chaired by Dr. C D Mayee, Director, CICR, Nagpur. Papers in session–I were presented by Dr. P Anandkumar, Principal Scientist, NRCPB, New Delhi, Dr. Sanjeev Kumar, Delhi University, Dr. A B Dongre, CICR, Nagpur, Dr. P K Singh, NBRI, Lucknow and Dr. Raju Barwale, MAHYCO, Mumbai.

The technical session - II was Chaired by Dr. V M Pawar, Vice Chancellor, Marathwada Agricultural University, Parbhani and co-chaired Dr. K R Kaundal, Project Director, NRCPB, New Delhi. Dr. Dagaonkar, Ankur

Seed Pvt. Ltd., Dr. T M Manjunath M/S Monsanto, Dr. Kategiri, UAS, Dharwad, Dr. Gopal Naik, IIM, Ahmedabad, Dr. K R Kaundal and Dr. A K Basu, presented their papers.

The Plenary Session was Chaired by Dr. Mangala Rai, Dr. V M Pawar and Dr. C D Mayee Co-chaired the session.

## Annual Workshop of Zone IV KVKs

The Annual workshop of Krishi Vigyan Kendra (KVK) in Maharashtra and Andhra Pradesh (zone IV) was organised by CICR at Nagpur during September 14-16, 2001. The workshop was inaugurated by Shri Diwakar Rawate, Member of Legislative Assembly, Executive Councillor, MAU, Parbhani and former Minister for Co-operation, Maharashtra State. In his inaugural address, Shri Rawate mentioned that agriculture research in public sector be addressed to the real interest of farmers and not simply for academic interest. He further stressed the need for reorientation of research and extension programmes in farm sector so as to make the Indian farming competitive enough to with stand international competition coming with new world order.

In his presidential address Dr.B.S. Hansra, Assistant Director General (Agricultural Extension) ICAR, informed that considering the great impact of KVK on farm sector, the planning commission has approved additional 66 KVKs to be added to existing 261 KVKs. He expressed hope that by the end of X$^{th}$ plan, every district in the country will have at least one KVK which will take care of information and training needs of farmers.

Speaking on this occasion, Dr. C.D. Mayee, Director, CICR pointed out that unless the quality of our farm produce is enhanced and cost of production brought down considerably, our farmers will find it difficult to compete in world market.

Dr. C. Sriram, Zonal Coordinator, ICAR, emphasized more involvement of rural youth and farm women for faster dissemination of science based information and its adoption. Dr. Hemchandra Gajbhiye, Principal Scientist conducted the proceedings. More than 100 participants presented their annual progress report for current year and discussed action plan for the next year. On this occasion, two bulletins in Marathi published by the KVK were also released at the hands of Shri Rawate and Dr. Hansra.

## Rashtriya Kapas Mela at Nagpur

One day Rashtriya Kapas Mela was organised at its premises, Panjri farm, Wardha Road, Nagpur on December 2, 2001. This was organised as part of Institute's Silver Jubilee celebrations. The Mela was inaugurated by Shri Anil Deshmukh, Minister of State for Excise, Government of Maharashtra. In his inaugural address, Shri Deshmukh desired that commercialization of Bt cotton should be permitted as it would reduce pesticide consumption and help cotton cultivators. He also pointed out the importance of quality seed, fertilizers and insecticides for enhancing cotton production.

Dr. C.R. Hazra, Agriculture Commissioner, Govt. of India in his presidential address, spoke about the Cotton Technology Mission for increasing productivity of cotton in the country. Dr. S.N. Puri, Vice Chancellor, MPKV, Rahuri in his address stressed concern over the fact that WTO agreement may lead to greater competition in the agriculture sector. Citing example of research done by his University, he said that they were successful increasing cotton production from 110 kilograms per acre to 330 kilograms per acre.

Dr. C.D. Mayee, Director, CICR, in his introductory remarks informed that nearly 10,000 accessions of cotton were available with the Institute which are being utilized for cotton research.He called upon the farmers to take advantage of the research work done

by the Institute to increase cotton production.

Dr. Hazra also inaugurated exhibition at Rashtriya Kapas Mela in which 24 stalls were put up by various Agriculture related companies.

On this occasion, several publications of CICR, Nagpur were released at the hands of the Guests. Dr. Sheo Raj, Head, Crop Protection Division proposed the vote of thanks and Dr. Hemchandra Gjbhiye, Head, Extension Section conducted the proceedings.

Large number of farmers, delegates from all over India including Punjab, Haryana and Andhra Pradesh, Agricultural Scientists, Agriculture and industry officials participated in the mela.

## Cotton Day at Coimbatore

The CICR, Regional Station, Coimbatore organised a Cotton Day at Kallapuram village on Nov. 17, 2001 under the Technology assessment and refinement through Institute village linkage programme (TAR/IVLP).Dr. C.D. Mayee, Director, CICR, Nagpur, Prof. S. Kannaiyan, Vice Chancellor, TNAU, Coimbatore, Dr. Terry P.Towansend, Executive Director, International Cotton Advisory Committee, Dr. Sietse Van Der Werf, Project Leader Common fund for commodities, Amsterdam, Netherlands and Dr. K. Venugopal, Project Coordinator (Cotton) & Head, CICR, Regional Station, Coimbatore attended the function.

# Distinguished Visitors



| Name & Designation | Organisation | Date |
|---|---|---|
| **Nagpur** | | |
| Dr. Y.S. Nerkar<br>Ex-Vice Chancellor &<br>Chairmans RAC, CICR | Mahatma Phule Krishi Vidyapeeth,<br>Rahuri | 25.06.2001 |
| Dr. Punjab Singh<br>Director General | Indian Council of Agricultural<br>Research, Krishi Bhavan, New Delhi | 06 .07.2001 |
| Dr. A. Alam<br>DDG, (Agril. Engg.) | Indian Council of Agricultural<br>Research, Krishi Bhavan, New Delhi | 11.07.2001 |
| Shri A.K. Chauhan<br>IAS, Director (Crops) | Ministry of Agriculture, Govt. of India,<br>Krishi Bhavan, New Delhi | 03.08.2001 |
| Shri Sompalji<br>Member | Planning Commission Govt. of India,<br>New Delhi | 10.09. 2001 |
| Dr. M.L. Madan<br>Vice-Chancellor | Dr. P.D.K.V, Akola | 10.09.2001 |
| Dr. S.N. Puri<br>Vice-Chancellor | Mahatma Phule Krishi Vidyapeeth,<br>Rahuri | 10.09.2001 |
| Shri Diwakar Rawate<br>MLA, Former Minister | Maharashtra Government, Mumbai | 14.09.2001 |
| Dr. A.T. Sherikar<br>Vice-Chancellor | Maharashtra Animal and Fisheries<br>Science, University, Nagpur | 21.09.2001 |
| Dr. V.M. Pawar<br>Vice-Chancellor | Marathwada Agriculture University,<br>Parbhani | 30.10.2001 |
| Dr. S.S. Baghel<br>Vice-Chancellor | Central Agricultural University, Imphal | 30.10.2001 |
| Dr. Mangla Rai<br>DDG, (CS) | Indian Council of Agricultural Research<br>Krishi Bhavan, New Delhi | 24.11.2001 |
| Shri Anil Deshmukh<br>State Excise Minister | Govt. of Maharashtra, Mumbai | 02.12.2001 |
| Dr. C.R. Hazra<br>Agricultural<br>Commissioner | Govt. of India, Ministry of Agriculture,<br>Krishi Bhavan, New Delhi | 02.12.2001 |

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| Dr. S.N. Puri<br>Vice-Chancellor | Mahatma Phule Krishi Vidyapeeth,<br>Rahuri | 02.12.2001 |
| Dr. Sandeep Bajoria<br>Chairman<br>Dr. Y.S. Yawalkar<br>Secretary | All India Cotton Seed Crushers<br>Association, Mumbai | 03.12.2001 |
| Dr. A.G. Sawant<br>Member | Agricultural Scientists Recruitment<br>Board, New Delhi | 11.12.2001 |
| Dr. S.A. Patil<br>Vice-Chancellor | University of Agriculture Sciences,<br>Dharwad | 22.03.2002 |
| Dr. A.S. Khera<br>EX Vice-Chancellor &<br>Chairman, QRT | Punjab Agriculture University,<br>Ludhiana | 03.02.2002 |
| Dr. G.M. Bharad<br>EX Vice-Chancellor &<br>Member, QRT | Dr. Punjabrao Deshmukh Krishi<br>Vidyapeeth, Akola | 03.02.2002 |
| Dr. S. Lingappa<br>Director of Research &<br>Member, QRT | University of Agriculture Sciences,<br>Dharwad | 03.02.2002 |
| Dr. R. Jeyrajan<br>Retd. Professor &<br>Member, QRT | Tamil Nadu Agriculture University,<br>Coimbatore | 03.02.2002 |
| **Sirsa** | | |
| Dr. A.K. Chauhan, IAS<br>Director (Crops) | Ministry of Agriculture, Govt.<br>of India, New Delhi | 03.08.2001 |
| Dr. S. Sreenivasan<br>Director | CIRCOT, Mumbai | 03.03.2002 |
| Dr. R.C. Maheshwari<br>Associate Director<br>(Research), Sriganganagar | Agriculture Research Station, RAU, | 03.03.2002 |

# Personnel



| Name of Officers/Scientists | Designation |
|---|---|
| C D Mayee | Director |
| K Venugopal (Retd. On 31.3.02) | Project Coordinator (Cotton) & Head, CICR, RS, Coimbatore |
| **Plant Breeding** | |
| **Nagpur** | |
| Phundan Singh | Head, Crop Improvement Division |
| R G Dani | Principal Scientist |
| V V Singh | " |
| Mrs. S B Singh | Senior Scientist |
| T R Loknathan (wef. 1.3.02) | " |
| Dr. D K Agarwal (wef. 23.7.01) | Scientist (SS) |
| **Coimbatore** | |
| KN Gururajan | Principal Scientist |
| **Sirsa** | |
| S L Ahuja (on deputation) | Senior Scientist |
| O P Tuteja | " |
| S K Verma | Scientist (Sr. Scale) |
| **Genetics & Cytogenetics** | |
| **Nagpur** | |
| S B Nandeshwar | Senior Scientist |
| V N Waghmare | Scientist (Sr. Scale) |
| Mrs. V Gotmare | " |
| **Coimbatore** | |
| T Gunaseelan (Expired on 4.12.01) | Principal Scientist |
| S Manickam | Scientist (Sr. Scale) |
| **Seed Technology** | |
| **Nagpur** | |
| R K Deshmukh | Principal Scientist |
| Mrs. P R V Kumari (on deputation) | Scientist (Sr. Scale) |
| Mrs. V Santhy | Scientist |
| **Coimbatore** | |
| K Rathnivel | Senior Scientist |
| **Sirsa** | |
| R A Meena | Senior Scientist |
| **Economic Botany** | |
| **Nagpur** | |
| Punit Mohan | Senior Scientist |

## Agronomy

**Nagpur**

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|---|---|
| K S Bhaskar | Principal Scientist |
| Blaise | Senior Scientist |
| A R Raju | Scientist |

**Coimbatore**

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|---|---|
| K Shanmugham (Retd. On 31.10.01) | Principal Scientist |
| Mrs. P Nalayani | Scientist (Sr. Scale) |
| K Shankaranarayanan (Joined on 4.3.02) | ,, |

## Soil Science

**Nagpur**

| | |
|---|---|
| Jagvir Singh | Senior Scientist |

## Agricultural Engineering

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|---|---|
| G Majumdar | Scientist (Sr. Scale) |

## Plant Pathology

**Nagpur**

| | |
|---|---|
| Sheo Raj | Head, Crop Protection Division |
| M K Meshram | Principal Scientist |
| P M Mukewar | ,, |
| N K Taneja | ,, |
| R C Ukey | Senior Scientist |
| P K Chakrabarty (On Post Doctoral Fellowship) | ,, |

**Coimbatore**

| | |
|---|---|
| A Kannan | Principal Scientist |
| P Chidambram | ,, |

**Sirsa**

| | |
|---|---|
| Dilip Monga | Senior Scientist |

## Entomology

**Nagpur**

| | |
|---|---|
| S K Banerjee | Principal Scientist |
| T P Rajendran | ,, |
| T V Kathane | Senior Scientist |
| K R Kranthi | ,, |
| Mrs. S Kranthi | ,, |
| Mrs. S Vennila | ,, |

**Coimbatore**

| | |
|---|---|
| T Surulivellu | Principal Scientist |
| K Natarajan | ,, |
| Mrs. B Dhara Jyothi | Scientist (Sr. Scale) |

**Sirsa**

| | |
|---|---|
| P Jeykumar | Scientist |

## Nematology

**Nagpur**

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|---|---|
| Mrs. Nandini Narkhedkar | Senior Scientist |

**Plant Physiology**

**Nagpur**

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|---|---|
| M R K Rao | Head, Crop Production Division |
| N K Perumal | Principal Scientist |
| K B Hebbar | Senior Scientist |

**Coimbatore**

| | |
|---|---|
| S E S A Khader | Senior Scientist |
| A H Prakash | Scientist (Sr. Scale) |

**Biochemistry**

**Nagpur**

| | |
|---|---|
| A B Dongre | Principal Scientist |
| Mrs. M. Chakrabarty | Senior Scientist |

**Coimbatore**

| | |
|---|---|
| N Gopalakrishnan | Principal Scienist |

**Biotechnology**

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| G Balasubramani | Scientist (Sr. Scale) |
| Mrs. J Amudha | Scientist |

**Agriculture Extension**

**Nagpur**

| | |
|---|---|
| H L Gajbhiye | Principal Scientist |
| S M Wasnik | Senior Scientist |

**Coimbatore**

| | |
|---|---|
| Usha Rani | Scientist |

**Agricultural Economics**

**Nagpur**

| | |
|---|---|
| P Ramasundaram | Senior Scientist |
| Mrs. Isabella Agarwal (Joined on 23.7.01) | Scientist (Sr. Scale) |

**Coimbatore**

| | |
|---|---|
| K Ramamoorthy (Retd. on 28.2.02) | Principal Scientist |

**Computer Application**

**Coimbatore**

| | |
|---|---|
| M Sabesh | Scientist |

**Agriculture Statistics**

**Nagpur**

| | |
|---|---|
| C D Ravindran | Scientist (Sr. Scale) |

**KVK**

| | |
|---|---|
| S N Rokade | Senior Scientist |

**Administrative Officer**

U C Prasad

**Finance and Accounts Officer**

Prashant Kumar

# Other Information

## Insectary and Bio-control lab

The Insectary and Bio-control laboratory was upscaled as an advanced facility for rearing of bollworms and various natural enemies including antagonists such as *Trichoderma*. A modern lecture hall was also developed. This centrally cooled hall can accommodate about 90 persons. The facility at this centre is put to use for research on mass production of bio-agents as well as for imparting training.

## Farm development works

Land shaping of farm area acquired in 1985-88 was continued during the period and following works were got done.

- Making of fields with 0.5% to 1% uniform gradient and field bunding about 10 ha.
- Formation of new farm roads.

  4 Mtrs. wide -310 mtrs length

  3 Mtrs. wide - 245 mtrs length
- Formation of grass water wayes – about 215 meters and drainage channels.
- Digging out of root stamps of subabool and development of area 2.16 ha.
- Repair of existing of farm road block I and III total about 2275 meters.
- Construction of farm road in block I and III about 1825 meters.
- Muram laying in road block II and III about 4 meters wide and 1280 meter long.
- Renovations of old farm fencing by constructing wall-cum fence in about 965 meters by CPWD.
- Argumentations of water resource and Irrigation facilities at farm.
- Digging and construction of one open well (S.N. 34 block I).
- Digging and preparation of three farm ponds one block I and two in block III having following catchments area and capacity.

| | Catchment Area | Capacity |
|---|---|---|
| Block III | 21 ha | 96 lakh ltrs |
| Block III | 10 ha | 19 lakh ltrs |
| Block I | 35 h. | 67 lakh ltrs |

- Construction of sump well and pump house in A block civil work has been completed by CPWD.
- **Development of other farm facilities**

a) Purchase of Chaff cutter two Nos

b) Purchase of Land leveling plate two Nos.

c) 400 teak and 200 Neem plants were planted along fencing line and KVK area.

## Agricultural Technology Information Centre (ATIC)

The newly constructed building of Agricultural Technology Information Centre was inaugurated by Shri Sompalji, Hon'ble Member of Planning Commission, Govt. of India on 10th Sept. 2001. The centre will provide an active interface between the Institute and the farming community for the dissemination of latest technologies in the field of Agriculture through discussions, presentations, publications and products.

## Library

**Additions :** The library procured 129 books, 70 scientific reports and bulletins, 42 reprints

on cotton and subscribed 35 Indian and 26 foreign journals and CD-ROM database.

**Documentation Service**

**Bibliographic database on cotton**

About 1560 bibliographic references along with abstract have been stored in computerised bibliographic database. Documentation Service such as Current Awareness Service, SDI service, Specific subject search service have been provided by sorting out the database. Using the database also brings out 'Cotton Research Abstracts' a documentation bulletin.

**Current Title Service**

Library has provided Current Title Service by subscribing Current Contents with abstracts on disk from I.S.I. Philadelphia.

**CD ROM database Retrieval Service**

Bibliographic information on cotton and other crops on various aspects are being retrieved and download as per the demand. The following CD-ROM database were used to retrieve the information:

1. CABCD 1972-2000
2. CROPCD 1973-1998
3. AGRICOLA 1975-2000
4. AGRIS 1975-2001.

**Newspaper Clipping Service**

Clippings on various aspects related to cotton from local and national newspapers have been compiled and made available for references.

## Major events organised during Silver Jubilee Year (2001-02)

To commemorate the completion of 25 years of its existence, the institute has organised the following major activities during the year long Silver Jubilee Celebrations:

i. A National seminar on "Sustainable cotton production technology and future strategies" (in Hindi) was organised on 10th & 11th September, 2001 and it was inaugurated by Shri Sompalji, Hon'ble Member of Planning Commission, Govt. of India, New Delhi.

ii. Agricultural Technology Information Centre (ATIC) and Silver Jubilee Main gate of the institute were inaugurated on 10th September, 2001 at the hands of Shri Sompalji, Hon'ble Member of Planning Commission, Govt. of India, New Delhi.

iii. Silver Jubille Rashtriya Kapas Mela was organised on 2nd December, 2001 which was inaugurated by Shri Anil Deshmukh, Minister of State for Excise, Govt. of Maharashtra.

iv. A special publication entitled " Cotton - March Towards New Millennium" alongwith other technical publications were released on 10th September, 2001 at the hands of Shri Sompalji and other dignitaries.

v. A *Rashtriya Kavi Sammelan* was organised on 10th September, 2001 as a part of the Silver Jubilee Celebrations.

vi. The National Group discussion on development of " Bt. cotton in India" was organised jointly by CICR, Nagpur and Nagpur Chapter of Indian Society for Cotton Improvement, (ISCI), Mumbai on November 24, 2001. The group discussion was inaugurated by Dr. Mangala Rai, Deputy Director General (Crop Science), with Dr. V M Pawar, Vice Chancellor, Marathwada Agricultural University, Parbhani as Chairman of the function

vii. A Silver Jubilee memento was prepared and presented to the distinguished dignitaries and eminent scientists visiting the institute during the silver jubilee year.

viii. A Silver Jubilee Cricket Tournament was organised for the ICAR institutes based at Nagpur in the month of 9th February to 24th February 2002. CICR team won the Silver Jubilee Cup.

ix. The Annual workshop of AICCIP was organised at CICR during March 22 – 24, 2002 as a finale to the year long Silver Jubilee Celebrations. Many eminent scientists were honoured with memento during the workshop.

v. A series of Silver Jubilee Lectures were delivered by eminent scientists during the year.

| Name of the topic | Lecture delivered by |
|---|---|
| i. Bio-intensive Pest Management-Promising Approach on Nov. 8, 2001. | Dr. O P Dubey, Asst. Director General (PP), ICAR, New Delhi. |
| ii. Indian Cotton Seed Processing Industry : Retrospects and Prospects on Dec. 3, 2001. | Dr. Sandeep Bajoria, Chairman, All India Cotton Seed Crushers' Association, Mumbai. |
| iii. Parthenium-A Dreaded Weed on Feb. 13, 2002. | Dr. M Mahadevappa, Chairman, ASRB, New Delhi. |
| iv. Some Aspect of Insecticide Research at Rothamstead on Mar. 15, 2002. | Dr. Bhupinder Khambay, Team Leader, Insecticide Synthesis and Organic UK. Chemistry Group, IACR Rothamstead, |

# राजभाषा उन्नयन गतिविधियाँ

राजभाषा कार्यान्वयन समिति की तिमाही बैठकें डा. चारुदत्त मायी की अध्यक्षता में दि. 07.4.2001, 04.07.2001 व 27.10.2001 को आयोजित की गईं।

सस्थान के रजत जयंती वर्ष के उपलक्ष्य में प्रौन्नतिशील कपास उत्पादन प्रौद्योगिकी एवं भावी रणनीति विषय पर दि. 10–11 सितंबर 2001 को राष्ट्रीय संगोष्ठी का आयोजन किया गया। इसमें देश के कपास विशेषज्ञों ने अपने शोध पत्र हिन्दी में प्रस्तुत किए। संगोष्ठी में प्रस्तुत किए गए शोध पत्रों का सारांश स्मारिका में प्रकाशित किया गया। इस अवसर पर एक राष्ट्रीय कवि सम्मेलन का आयोजन भी किया गया।

डा. महेन्द्र सिंह, तकनीकी अधिकारी ने केन्द्रीय सचिवालय हिन्दी परिषद द्वारा आयोजित अखिल भारतीय विज्ञान लेख प्रतियोगिता (वर्ष 2001) में प्रथम पुरस्कार प्राप्त किया।

संस्थान में 1 से 14 सितंबर 2001 तक हिन्दी पखवाड़ा का आयोजन किया गया जिसमें विविध प्रतियोगिताएँ व कार्यक्रम आयोजित किए गए।

डा. कुमुदिनी नौटियाल, सहायक निदेशक (राजभाषा) ने राजभाषा विभाग, गृह मत्रालय, भारत सरकार द्वारा दि. 28–29 जनवरी 2002 को मुबई में आयोजित पश्चिम तथा मध्य क्षेत्रीय राजभाषा सम्मेलन मे भाग लिया।

'श्वेत स्वर्णिमा' (वार्षिक), 'कपास प्रगति' (वार्षिक) व 'कपास समाचार' (तिमाही) का प्रकाशन किया गया।

# कार्यकारी सारांश

## फसल सुधार

### नागपुर

*जी. हिर्सुटम* की 5948 जननद्रव्य वंशावलियों में से 800 उपयोगी वंशावलियों का संकलन किया गया तथा 446 वंशावलियों को दीर्घकालीन संरक्षण (–20° सें.) के लिए राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो, नई दिल्ली में संग्रहीत किया गया । *जी. हिर्सुटम* की 4219 वंशावलियों तथा *जी. हर्बेशियम* की 527 वंशावलियों के आँकड़ों का प्रलेखन किया गया।

*जी. हिर्सुटम* व *जी. अर्बोरियम* प्रत्येक की 100 वंशावलियों का दो समूहों के समन्वित परीक्षण (बीआर 01) के अंतर्गत नागपुर (बारानी), सिरसा व कोयंबतूर (सिंचित) में परीक्षण किया गया।

*जी. हर्बेशियम* की 550 जननद्रव्य वंशावलियों का सूरत व भरौंच में बहुगुणन किया गया।

*जी. अर्बोरियम* में संवर्धन सी आई एन ए 316 को राष्ट्रीय परीक्षण में सम्मिलित किया गया और दक्षिणी क्षेत्र में सी आई एन ए 329 को बी आर 24 (बी) में ही रखा गया और सी आई एन ए 305 को एन ई वी टी से बीआर 24 (बी) परीक्षण में बढ़ाया गया।

गहरी मृदा व अधिक वर्षा और उथली मृदा व कम वर्षा में ए के 8401, गहरी मृदा व कम वर्षा में अरविंद, मध्यम मृदा व अधिक वर्षा में जी. कॉट संकर–8, मध्यम मृदा व कम वर्षा और उथली मृदा व अधिक वर्षा में एन एच एच 44 सबसे अच्छे रहे।

तीन अतः *हिर्सुटम* की टी संकरों और उनके पूरकों का मूल्यांकन किया गया। उन्होंने गैर बी टी संकरों और सामान्य (एन एच एच 44) से अधिक कपास की पैदावार दी।

अँजली तथा एल आर ए 5166 प्रत्येक के तीन कुंतल प्रजनक बीज का उत्पादन किया गया।

झारखंड, आंध्रप्रदेश के तटीय क्षेत्र व गुजरात के सौराष्ट्र से *जी. हिर्सुटम, जी. बार्बडेंस, जी. अर्बोरियम* व *जी. हर्बेसियम* सभी के 130 नमूने एकत्रित किए गए।

नर बंध्यता कार्यक्रमों में 36 सी एम एस, 13 जी एम एस व 7 आर वंशावलियों का अनुरक्षण किया गया। पाँच विभिन्न परीक्षणों में 63 जी एम एस व 200 सी एम एस संकरों का परीक्षण किया गया। एन जी एम एस एच 15–20, 14–02, 24–02, 123–02, 63–02 व 52–02 नामक छः आशाजनक संकरों की पहचान की गई।

बोने व सुगठित जीनप्ररूपों ने अन्य अंतरालों की तुलना में 90x10 सें.मी. अंतराल में कपास की अधिकतम उपज दी।

बारानी परिस्थिति में आशाजनक *जी. अर्बोरियम* जीन प्ररूपों के खेतों में बडे पैमाने पर परीक्षण किए गए जिनमें पी ए 225 की दोनों सामान्य (ए के ए 8401 व एल आर के 516) की तुलना में कपास की अधिक पैदावार आँकी गई।

*जी. अर्बोरियम* में संवर्धन सी आई एन ए 323 बी कपास की अधिक उपज के लिए, पी ए 496 अच्छे रेशे के गुणों व छोटे रेशे की कम मात्रा तथा सी आई एन ए 316 बी रेशे की अधिक मजबूती, रेशे के दीर्घीकरण और अनुपात में समानता के लिए पहचाने गए।

पाँच जीनप्ररूप जैसे जी जे एच वी 370, एल एच 1948, पी एच 348, एन एच 545 व एच 1252 तथा अन्य पाँच जैसे – एल एच 1948, एन एच 545, के एच डी 122, सी एन एच 155 तथा के एच 11 क्रमशः सिंचित व बारानी परिस्थितियों में आशाजनक पाए गए। दो जीन प्ररूप जैसे एल एच 1948 व एन एच 545 सिंचित व बारानी दोनों परिस्थितियों में आशाजनक पाए गए।

पी के वी 081, रजत, एम सी यू 10, आरोग्य, कोकर 310, टी एक्स ओ आर एस सी–80 व एम 18 की उपज व ओटाई क्षमता अधिक आँकी गई।

सवर्धन 3 एच एस का तेल प्रतिशत अधिक (24. 9%) आँका गया। पाँच वंशावलियों जैसे 25 के, 14 के, 34 के, 22 के व 17 एस सी के बीजों में 25% से अधिक तेल आँका गया। सिरसा से प्राप्त अमरीकन कपास की कुछ वंशावलियों के बीज में तेल की मात्रा 27% से अधिक थी।

बीज को पोटेशियम हाइड्रोजन फास्फेट में भिगोने से प्रथम अंकुरण संख्या और कुल अंकुरण प्रतिशत में सुधार हुआ।

बुवाई के 90 दिनों बाद पौध के ऊपरी हिस्से को तोड देने से कपास की अधिकतम उपज प्राप्त हुई।

### कोयंबतूर

अंतः *हिर्सुटम* संकर सी सी एच एच 1055 (1330 (कि.ग्रा./है.) की क्षेत्रीय संकर एल एच एच 144 (813 कि.ग्रा./है.) की तुलना में 63 प्रतिशत अधिक उपज आँकी गई और इसे क्षेत्रीय परीक्षणों के लिए चुना गया।

दक्षिणी क्षत्र में *जी. हिर्सुटम* संवर्धन सी सी एच 516612 की अधिकतम (1697 कि.ग्रा./ है.) उपज आँकी गई।

अंतरजातीय संकर सी सी एच बो 105 (1150 कि. ग्रा./है.) डी सी एच 32 (898 कि.ग्रा./है) से उपज में बेहतर था।

आनुवशिक नर बध्यता आधारित संकर जी एम एस जे 34 x एस एन तथा सी एम एस आधारित संकर सी एम एस अली x ए तथा सी एम एस सुमन x ए के 2 आशाजनक पाए गए।

सुगठित व सामान्य पौध प्रकार में उपज के घटकों के लक्षणों के योगदान के कारण कपास की पैदावार में भिन्नता देखी गई।

प्रजनक कार्यक्रम में आगे उपयोग के लिए ऐसे जीन प्ररूपों को पहचाना गया जिनके रेशे अत्यधिक लंबे (30–33 मि.मी.) व अधिक मजबूत (26–30 ग्रा./टैक्स) थे।

*इमिडाक्लोप्रिड* व नीम की पत्तियों का चूर्ण या *इमिडाक्लोप्रिड* व *कार्बेंडाजिम* के साथ आयोडीन के घोल का उपयोग बीज गुण ह्रास के नियंत्रण तथा जीवितता व ओज के अनुरक्षण में अच्छे पाए गए।

कपास के बीज को जब अधिक सापेक्ष आर्द्रता स्तर (80% व 60%) में भंडारित किया गया तो कम सापेक्ष आर्द्रता (40व 0%) की तुलना में अंकुरण में अधिकतम व तेजी से गिरावट देखी गई।

सामान्य ढेर की तुलना में श्रेष्ठ ढेर व मॉडल ढेर का विभिन्न सस्य लक्षणों के लिए अधिकतम मान आँका गया जो प्रजनक बीज के समान थे और इसलिए हम श्रेष्ठ व मॉडल ढेर को प्रजनक बीज उत्पादन में उपयोग कर सकते हैं।

### सिरसा

जर्मप्लाज्म वंशावलियों डी एल–1 (28.1%), सी आई एस वी–45 (26.50%), के एच 2 (26.47%) व सी आई एस बी 46 (26.27%) बेहतर बीज तेल क्षमता वाली पहचानी गई।

संवर्धन सी आई एस एच 3, सी आई एस एच 36 व सी आई एस एच 40 के रेशे की मजबूती 22 ग्रा./टैक्स से अधिक पाई गई।

उत्तरी क्षेत्र में सकरण का उपयुक्त समय 30 सितबर तक था। देरी से बोई गई फसल में अतिम अवस्था के समय प्रति पौध फूलों की सख्या थोडी अधिक थी। इस वर्ष संकरण से बनने वाले गूलरों का प्रतिशत ओम शकर में 33.65% और सकर एल एच एच 144 में 42.37% अधिकतम देखा गया। अधिक अंतराल में गूलर जमाव अधिक था। जब तीन मादा फूलों का एक नर फूल के साथ परागण किया गया संकरण गूलरों में बीज सख्या में कमी आई।

उत्तरी क्षेत्र की परिस्थितियों में कपास के बीज को रखने पर 15 महीनों तक प्रमाणिकता से अधिक अंकुरण बना रहा। पहली दो चुनाई का बीज बेहतर पाया गया। बुवाई के 90 दिनों बाद पौध के ऊपरी हिस्से को तोड़ देना लाभदायक रहा।

## जैव प्रौद्योगिकी

### नागपुर

एल आर के 516 किस्म जिसमें बी टी क्राइ 1 ए (सी) जीन का समावेश है। इसके तने से सीधे अग विकास द्वारा पुनर्जनित कर बारह हस्तातरित बी.

टी. क्राई 1 ए (सी) जीन वाले पौधे प्राप्त हुए।

*राइजोबियम फिरंडी* द्वारा कपास में लगभग 50 मॉडयूलर संरचना को प्रेरित किया गया।

*हिर्सुटम* व *अर्बोरियम* से क्राई 1 ए (बी) तथा क्राई 1 ए (सी) वाल लगभग 10 एलिसा पोजिटिव पौधे प्राप्त किए गए।

कपास पत्ती माडक अवरोधी व सुग्राहय जीन प्ररूपा में पॉलिमार्फिज्म का प्रमाणित करने के लिए आर ए पी डी विश्लषण किया गया।

जंगली जातियों में आर ए पी डी मार्कर्स द्वारा आनुवंशिक विविधता और उदविकास के आधार का पता लगा।

आर ए पी डी विश्लषण के लिए 25 जननद्रव्य वशावलियों और 23 जंगली जातियो के फिंगर प्रिंट तैयार किए गए।

## फसल उत्पादन

### नागपुर

मध्यम गहरी व उथली मृदा की तुलना में गहरी मृदा में प्रारंभिक व अधिकतम गूलर विकास की अवस्था में सिचाई का प्रभाव अपेक्षाकृत अच्छा था।

ड्रिप सिंचाई में एक पौध / डिबिल की अपेक्षा 2 पौध / डिबिल लाभदायक पाया गया।

*हिर्सुटम* कपास की अकेली फसल की तुलना में फसल चक्र पद्धति (कपास–ज्वार) में नाइट्रोजन उर्वरक की उपयोग क्षमता बेहतर रही।

*जी. अर्बोरियम* किस्म में *जी. हिर्सुटम* किस्म की तुलना में सस्य संबधी क्षमता अधिक थी।

उर्वरकों के संतुलित उपयोग से उर्वरक पोषक तत्वों के लिए सस्य दक्षता अधिक थी।

पोषक तत्वो का स्तरीकरण मृदा परिच्छेदिका में दखा गया और सुस्थिर पोषक फास्फोरस का एकत्रीकरण ऊपरी सतह पर अधिक था।

संस्थान द्वारा विकसित दो पक्ति बैलचलित रोपाई यत्र में संशोधन किया गया जिससे उसकी क्षमता में सुधार हुआ। उत्तरी क्षेत्र में उगाई जा रही किस्मों की बुवाई के लिए उपयुक्त बुवाई यत्र का नमूना तैयार कर विकसित किया गया।

संश्लषित की तुलना में जैविक पद्धति में मृदा भौतिक–रासायनिक गुणों के अंतर्गत कार्बनिक कार्बन, खनिज नाइट्रोजन, उपलब्ध फास्फोरस, अंबार सघनता और अंतः स्पंदन दर में काफी सुधार हुआ।

बी टी कपास की किस्में (एमईसीएच 184 व 162), अपने गैर बी टी प्रतिरूपों और स्थानीय सामान्य की तुलना में शीघ्र तैयार, कम शुष्क पदार्थ संचय और अधिक उपज वाली पायी गई।

महाराष्ट्र के अमरावती, यवतमाल, नागपुर व नांदेड, आध्रप्रदेश के मुढोल, पुडरू व आदिलाबाद जिलों में विभिन्न स्थानों पर किए गए खेत परीक्षणों में समंकित पोषक प्रबंध और जलसभर व स्थलाकृति के साथ उपयुक्त मृदा व नमी संरक्षण पद्धतियों पर अधिक जोर दिया गया।

कपास–गेहूँ फसल पद्धति में गेहूँ का भूसा व चुनाई के बाद बच गए कपास की फसल के अवशिष्ट (तना व पत्तियाँ) को मृदा में मिला देने से गेहूँ व कपास दोनों की उपज में वृद्धि हुई।

सिरसा (हरियाणा) में कपास–गेहूँ फसल पद्धति में 65% संस्तुत उर्वरकों की तुलना में *एजोटोबैक्टर क्रोकोकम* की कुछ विभेद कपास व गेहूँ दोनों की उपज वृद्धि के लिए आशाजनक पाई गई।

कपास की रोपाई व उर्वरक ड्रिल करने के लिए एक हस्तचलित यंत्र का डिजाइन तैयार कर उसका विकास किया गया।

नागपुर जिले की छः तहसीलों में 100 किसानों पर किए गए सर्वेक्षण से अतः फसल में अनुसधान की कमियों का पता लगाया गया। कपास के साथ पट्टियों में अरहर की खेती अधिक पैमाने पर अपनाई गई है। पक्ति से पंक्ति में अतः फसल लगाने के लिए जागरूकता की कमी और अंतः फसल में गहन अतः सस्य क्रियाओं में आने वाली बाधा ही संस्तुत पद्धतियों को अपनाने में मुख्य रुकावट है।

फसल व उपज मॉडलिंग पर किए गए अध्ययनों में केलगांस, कॉटन व गॉसिम पर की गई जाँच में गॉसिम तीनों में से अपेक्षतया बेहतर पाया गया। दूर संवेदी कार्य हेतु नागपुर जिले के लिए फसल से उचित आँकड़े एकत्रित किए गए।

### कोयंबतूर

कपास–कपास फसल चक्र की अपेक्षा कपास–ज्वार फसल पद्धति में कपास की उपज

42 से 62 प्रतिशत तक अधिक थी । कार्बनिक तथा अकार्बनिक के सयुक्त रूप से उपयोग (फा. 45, पो. 45 व 15 टन फार्म यार्ड खाद) से सविता की 1733 कि.ग्रा. / है. तथा सुरभि की 1686 कि.ग्रा. / है. की अधिकतम उपज देखी गई ।

ड्रिप सिचाई पद्धति से 1 ई टी सी सिचाई से समान पदावार मिली और पारंपरिक सिचाई में किए गए जल के उपयोग के 30% की बचत भी हुई । मृदा में फास्फोरस के अनुप्रयोग के साथ 75% आर डी एफ के ड्रिप (एन के) द्वारा छ किस्ता में उपयोग से पारपरिक पद्धति की 100% आर डी एफ के बराबर उपज प्राप्त हुई ।

## फसल संरक्षण

### नागपुर

*जी. हिर्सुटम* वंशावली से बनाये गए 228 संकरणों म से 58 खेत की परिस्थितियों में चूसक कीटों व बालवर्म के लिए आशाजनक पाए गए ।

जैसिड सहिष्णुता के लिए आकृतिक चिहनों के लिए किए गए अध्ययनों से प्रदर्शित हुआ कि सहिष्णु वंशावलियाँ रोयेंदार थीं लेकिन सभी रोयेंदार वशावलियाँ सहिष्णु नहीं थीं ।

कपास जननद्रव्य म प्रोटीज इनहिबिटर जीन की उपस्थिति की पुष्टि की गई ।

सकर एन एच एच 44 व ए के ए 8401 में ऋतु जैविक चर्या विज्ञान (फिनालॉजीकल) तथा बालवर्म का नुकसान अधिक आँका गया और उनमें आपस में कोई भिन्नता नहीं थी । मुख्य कीडों से होने वाला ऐसा नुकसान जिसे टाला जा सकता है, 41.82% आँका गया । पौध परजीवी नेमेटोड से होने वाला नुकसान 8% आँका गया ।

नमूना में एटोमोपेथोजेनिक नेमेटोड्स की उपस्थिति की बारबारता 3–10% आँकी गई ।

लोफ कर्ल विषाणु स प्राकृतिक रूप से संक्रमित व प्रत्यक्ष रूप से स्वस्थ कपास व खरपतवार (साइमाप्सिस स्पीशीज़) के पौधों का पता लगाने के लिए एक मालिकुलर प्रोब का विकास किया गया ।

सगरिया व वारगल से इकट्ठा किए गए *एच. आर्मीजेरा* की सख्या म पायरेथ्राइड अवरोधता अधिकतम थी । सगरिया विभेद म एंडोसल्फान अवरोधता अधिकतम थी । एंडोसल्फान के लिए प्रतिरोधता अर्धप्रभावी थी जो दो विकल्पी (एलील्स) द्वारा होती है, मथोनल के लिए प्रभावी थी ।

ग्रामीण पुरुषों व स्त्रियों का जैसिड, अमरीकन बालवर्म, धब्बेदार बालवर्म व गुलाबी बालवर्म के जीवन की विभिन्न अवस्थाओं को पहचानने के अतिरिक्त लेडीबर्ड बीटल्स, ग्रीन लेस विंग्स तथा एसे अन्य परभक्षी कीटों के सबध म शिक्षित किया गया ।

ग्रेन मोथ एग उत्पादन के लिए एक एकक तैयार किया गया । बी टी व *मेटाराइजियम* के लिए बहु उत्पादन प्रोटोकोल परिष्कृत किए गए ।

एक सकर प्रविष्टि (सी आई एन एच एच 296) का उत्तरी क्षेत्र के अखिल भारतीय समन्वित कपास सुधार परियोजना परीक्षण म बीआरओ 5 ए (1) में आग बढाया गया और रोगों के लिए अवरोधी और चूसक कीटों व बालवर्म के लिए सहिष्णु अन्य संकर (सी सी एच एच 9012) को अ.भा.स.क.सु.प. के 2002–2003 के सकरों पर राष्ट्रीय परीक्षणों के अंतर्गत सम्मिलित किया गया ।

सकर एच 6 के गूलरों म एक नई पहचानी गई फफूँद *एक्सोस्पोरिएला फंगोरम* के कारण रूई सक्रमण देखा गया ।

जीवाणु झुलसा के 51 एकलों म से प्रजाति 18 पूर्वप्रभावी थी । *जी. हिर्सुटम* की 248 जननद्रव्य वशावलियों में से 9 वंशावलियों ने गमला संवर्धन परिस्थितियों में जीवाणु झुलसा के लिए अवरोधता प्रदर्शित की । गमलों की परिस्थितियों में पर्णिल फफूँद रोगों के लिए छाँटी गई *जी. हिर्सुटम* की 197 वंशावलियों में से 5 वंशावलियाँ दहिया रोग व 7 वंशावलियाँ मायरोथीसियम पत्ती धब्बा के लिए अवरोधी थीं और अल्टरनरिया पत्तीधब्बा रोग के लिए कोई वशावली अवरोधी नहीं थी ।

जहा पर मिश्रित रोधी सूक्ष्म जीव व रसायन के छिडकाव किए गए वहा पर पत्तियों के धब्बा रोग कम थे ।

*एक्स. ए. पी वी माल्वासिएरम* से क्लोनित रोगजनकता वाले जीन, पी टी एच एन का विशेषकर इस रोगजनक का पता लगाने के लिए प्रोब के रूप में सफल प्रदर्शन किया गया ।

दहिया रोगजनक का सफलतापूर्वक सवर्धन किया गया ।

संस्थान ने कपास के बीज / पोध में बी टी का पता लगान के लिए तीन किट का विकास किया।

### कोयबतूर

अबाधिता व बी आर एस 23 में अन्य संवर्धनों के 42–97 प्रतिशत बालवर्म के नुकसान की तुलना में सामान्यतः कम नुकसान (21–28%) आंका गया।

बिफेन्थ्रिन (60 व 80 ग्रा. सक्रिय तत्व प्रति हेक्टर) तथा एफ 6028 (150 ग्रा. सक्रिय तत्व प्रति हैक्टर), स्पिनोसेड + क्लारपाइरिफास (1 ली. / है.) में बालवम का नुकसान कम आंका गया और सामान्य की तुलना में उल्लेखनीय रूप से अधिक उपज दर्ज की गई।

रसायन थाइमेथॉक्सम व क्लोथिएनडाइन से बीज उपचार जैसिड के प्रति प्रभावी पाया गया।

सिंचित पारिस्थितिक में आई पी एम / आई आर एम रणनीतिया को अपनान से कीटनाशकों के उपयोग में 50 प्रतिशत की कमी आई। इनका अपनान वाले किसानों ने सामान्य गाँवों की तुलना म 12,000 / – रु. प्रति हैक्टर की अधिक आय प्राप्त की।

विकसित सवर्धनो और जननद्रव्य वशावलियों की छँटाई से उदघाटित हुआ कि पी. एफिनिस द्वारा नुकसान क स्तर में भिन्नता थी। सुप्रिया में अधिकतम (42%) और एम सी यू 7 में न्यूनतम (शून्य) प्रकोप था।

*जी. अर्बोरियम* की इकत्तीस और *जी. हिर्सुटम* की ग्यारह वंशावलियों ने सलेटी धब्बा के लिए अवरोधता प्रदर्शित की। टेबुकोनाजोल (फालिकर 250 डब्लू) अल्टरनेरिया पत्ती धब्बा राग के लिए प्रभावी थी।

सलेटी धब्बा अवरोधी वशावली (जी एम आर 5) तथा अल्टरनेरिया अवरोधी वंशावली (ए एल आर 4) ने अ.भा.स.क.सु.परीक्षणां में उत्कृष्टता दर्शाई।

### सिरसा

पूर्णतः जैविक नियत्रण में ग्लर का नुकसान अधिकतम (25.28%) था उसके बाद किसानों द्वारा अपनाई जा रही पद्धति (23.21%), सस्तुत कीटनाशकों (19.33%) और आई पी एम (16.46%) में था लेकिन किसानों द्वारा अपनाई जा रही कीटनाशक छिडकाव पद्धति (1:1.19) की अपेक्षा आई पी एम (1:1.45) में लागत : लाभ का अनुपात अधिक था।

जैसिड के लिए 33 से 39 वें सप्ताह के लिए भविष्यवाणी मॉडल तैयार किया गया। जैसिड के प्रकोप व वषा में सकारात्मक संबंध देखा गया जबकि सापक्ष आर्द्रता व तापमान में ऋणात्मक सबध था।

जुलाई माह में जब अधिकतम तापमान लगभग 35° से. और सापक्ष आर्द्रता लगभग 80% थी तब कपास पत्ती मोड़क विषाणु रोग पर किए जा रहे अध्ययनों में काफी प्रगति प्रदर्शित हुई।

एन ए टी पी परियोजना के अंतर्गत पत्ती माडक व सफेद मक्खी के संवीक्षण के लिए जाँच की गई 401 जननद्रव्य वशावली में से 69 ने पत्ती मोड़क रोग के लिए अवरोधता दर्शाई।

संकर आम शकर की उत्कृष्टता, आई पी एम व आई आर एम तकनीक, पहले छिड़काव में देरी व एंडोसल्फान का पहले छिडकाव के रूप में उपयोग लाभकारी कीटों के प्रोत्साहन के लिए, बालवर्म प्रबध के लिए पाइरथ्राइड के 1 या 2 छिडकाव, ट्राइकोग्रामा व एन एस के ई का उपयोग तथा खेत प्रदर्शनों में फेरोमोन ट्रेप का उपयोग किसानों द्वारा सराहा गया।

## पादप कार्यिकी व जैव रसायन

### नागपुर

फूल लगने के समय नमी की कमी से रधीय अवरोधता बढी तथा बायोमास उत्पादन, वाष्पोत्सर्जन दर तथा पत्ती जल क्षमता में कमी हुई।

देशी कपास के जीन प्ररूपों में पत्ती जल क्षमता, अधिक प्रोलीन संचय तथा उपज स्थिरता प्रवृत्ति में स्पष्ट रूप से कमी देखी गई।

देशी किस्मों की तुलना में संकर तथा जी. हिर्सुटम जीन प्ररूपों में लवणता के लिए अधिक सुग्राह्यता थी।

पौद वृद्धि की प्रारंभिक अवस्था में जलमग्नता से पौध लंबाई व बायोमास उत्पादन में उल्लेखनीय कमी आई।

फूल लगने के समय और उसके बाद की अवस्था में जलमग्नता से पौधों में वातरध्र का बनना तीव्र तथा अधिक था।

एल आर के 516 में टालस्टार 10 ई सी जोकि एक नया कीटनाशक है और अभी जाँच के अतर्गत है इसको छोड़कर अन्य कीटनाशकों के छिडकाव के 24 घंटो बाद कुल फिनोल की मात्रा में 8.55: की गिरावट दिखाई दी ।

ईथ्रेल की कम सादता का पर्णिल छिडकाव करने से कलियों में विगलन बढा और इन उपचारों से एल आर ए 5166 व एच 6 में कपास की उपज में वृद्धि हुई ।

कलियों, पत्तियों, फूलों व गूलरों की अपेक्षा बीजों में गॉसीपाल की मात्रा अधिकतम देखी गई।

जी. हिसुंटम व जी. अर्बोरियम से जननद्रव्य वशावलियों में बीज तेल की मात्रा 15–22 प्रतिशत आंकी गई और वसा अम्ल परिच्छेदिका का अध्ययन किया गया। अधिक लिनोलिक अम्ल और ओलिक अम्ल वाली वशावलियों की पहचान की गई ।

कोयबतूर

हार्मोन संयोजन आई ए ए (5.0 मि.ग्रा. / ली) + बी ए (1.0 मि.ग्रा. / ली.) रेशे के बनने की शुरुआत के लिए अच्छे पाए गए। आई ए ए (1.0 मि.ग्रा. / ली.) + जी ए (1.0 मि.ग्रा. / ली.) + बी ए (1.0 मि. ग्रा / ली.) के साथ टी एम संवर्धन मीडियम पहले 15 दिनों में और उसके बाद टी एम + आई ए ए (2 मि.ग्रा. / ली.) + बी ए (0.5 मि. ग्रा. / ली.)से रेशे की वृद्धि 17 मि.मी. तक हुई।

बुवाई के 35 दिनों बाद मैलिक हाइड्रेजाइड का 0. 1: की दर से उपयोग करने पर सहायक कलियों और पार्श्वशाखाओं की सक्रियता बढ़ी और इससे उपज में वृद्धि हुई।

बालवर्म सहिष्णु जीनप्ररूपों में फिनाल मेटाबॉलिज्म के वृद्धि नियामक की प्रवृत्ति सकारात्मक देखी गई और इसका सचय भी अधिक था ।

बालवर्म सहिष्णु वरणों में प्रोटेक्टिव फाइटोकैमिकल्स जैसे गॉसीपाल, टेनिन व केटीचिन का सचय अधिक था।

फसल वृद्धि के समय एंडोसल्फान व मोनोक्रोटोफास कीटनाशकों के बार–बार उपयोग से नाइट्रेट रिडक्टेज एक्टिविटी कम हुई ।

कपास के बीज की कम मात्रा में तेल की मात्रा के आकलन के लिए कोल्ड परकोलेशन सुधारित पद्धति का विकास कर उसे मानकीकृत किया गया।

## प्रसार व अर्थशास्त्र

नागपुर जिले के कपास उत्पादकों के जीवनस्तर का ऋणग्रस्तता से ऋणात्मक व उल्लेखनीय सबध है ।

किसानों में ठेकेदारी की प्रवृत्ति का उनक जीवनस्तर के साथ धनात्मक व उल्लेखनीय संबध देखा गया है ।

कृषि तकनीकों के स्थानीय प्रसार के लिए प्रचारकों व किसानों के बीच की दूरी का इन्हें अपनाने के लिए ऋणात्मक व उल्लेखनीय संबध देखा गया ।

इन तकनीकों को अपनाने की प्रवृत्ति में कपास उत्पादकों के स्वास्थ्य का भी उल्लेखनीय संबध है।

कपास–गेहूं फसल प्रणाली में जैविक व अजैविक रुकावटों को पहचाना गया और इसका परिमाणन किया गया ।

बारानी परिस्थितियों में किस्मों की कम संख्या पैदावार में स्थिरता को बढाती है और फार्म के आकार के साथ किस्मों की संख्या में वृद्धि होती है।

कपास उत्पादकता के लिए सस्थागत (सिचित) व तकनीकी (अनुसधान) दोनों का योगदान उल्लेखनीय है ।

संकर प्रौद्योगिकी का उसके आकार के साथ कोई सबध नहीं है लेकिन ससाधनों के उपयोग के साथ इसका सबध है और कम ससाधनों की परिस्थितियों में इसकी खेती करने से इसमें अस्थिरता आती है ।

यद्यपि देश में एकाधिकार के कारण वास्तविक कीमत अधिकतम है लेकिन किसान यह महसूस करता है कि यह आर्थिक मूल्य गैर एकाधिकार बाजार की कीमतों की तुलना में कम है ।

भुगतान में देरी, बेचने में कठिनाई और ऋण की वसूली के कारण अधिक कीमत के बावजूद भी किसान एकाधिकार योजना से बचते हैं ।

अग्रिम पंक्ति प्रदर्शन कार्यक्रमों में भाग लेने वाले किसानों में कपास की संस्तुत तकनीकों को अपनाने और इसकी जानकारी में उल्लेखनीय रूप से वृद्धि देखी गई ।

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# वार्षिक रिपोर्ट

# Annual Report

## 2001-2002




केन्द्रीय कपास अनुसंधान संस्थान नागपुर

CENTRAL INSTITUTE FOR COTTON RESEARCH NAGPUR