वार्षिक रिपोर्ट ANNUAL REPORT 2000-2001

SILVER JUBILEE

1976 रजत जयंती 2001

CICR

केन्द्रीय कपास अनुसंधान संस्थान नागपुर

CENTRAL INSTITUTE FOR COTTON RESEARCH NAGPUR

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ICAR

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PREFACE

Historically, cotton has been one of the main sources of India's economic growth and a foreign exchange earner. India is currently first in area, second in yarn production and third in raw cotton production in the world. Nevertheless in productivity, we are far behind many countries, very minor and insignificant players in cotton economy. Besides, the productivity has almost remained stagnant around 300 kg lint/ha.

During the year, almost all the cotton growing states experienced deficit rainfall. The major fall is noticed in Maharashtra followed by Rajasthan, Karnataka and Tamil Nadu. The competitive crops have eroded the cotton area in South zone, while uncertainties and delay in the onset of monsoon and the devastating drought were the major reasons for area reduction in Gujarat, Maharashtra, Rajasthan and Southern A.P.

North zone states showed a revival of production for the past two years. There were no serious pest and disease outbreak, except bollworm (*H.armigera*) problem in a few pockets. By and large, the bollworm incidence had not crossed threshold levels. But, there are incidences of spotted and pink bollworms in southern states.

Government of India have announced an ambitious, progressive and forward looking textile policy recently to enable the Indian textile industry to withstand the onslaught of global competition when the quantitative restrictions will be totally phased out on December 31, 2001. The policy endeavours to achieve an export turnover from the present level of eleven billion dollars to fifty billion dollars by 2010. The market demand is estimated at 20 million bales of cotton lint by the year 2005 against current production level of 16 million bales. We have to double our resolution and strive hard to achieve the targets by producing globally competitive and quality cotton.

The institute has completed 24 years and is poised to enter into the silver jubilee year. Looking back the path it has treaded into, it can humbly claim that it has contributed its mite towards cotton development and qualitative improvement in the life of cotton cultivators in all these years. The years ahead will be still challenging, considering the wind of change sweeping across the world economic order with competition becoming the buzz word.

We too have to adapt ourselves and accordingly research efforts have to be reoriented to the demands of the user industry. Though the current year cotton situation was fairly better than the previous one, still there is a great shortfall in the target. But it was in tandem with the general agricultural performance in the country. The barrier has to be broken and all-out efforts have to be taken by combining traditional methods with new sciences. Improvement of *desi* cotton for yield, quality and pest resistance traits including exploitation of male sterility for hybrid seed production; identification, characterisation and patenting of indigenous genes; development of transgenics for major biotic and abiotic stresses; enhancement of area under hybrids and irrigation; improvement of irrigation efficiency in cotton farming areas of the northern part of the country; efficient rain water harvesting, recycling and integrated nutrient management; encouraging less intensive rainfed cotton farming patches to go organic; rationalisation of chemical inputs and natural resources; developmental thrust on new products and value addition-are some of the arsenals in the onslaught on the yield barrier.

Considerable infrastructure has been provided under various modes of NATP and Mini Mission – I. It has to be complemented with zeal and resolution from everybody- scientific, technical and administrative for the investment to fructify. The years work is presented in next few pages for scientific and critical appraisal and positive suggestions for improvement.

I shall take this opportunity to place on record our sincere appreciation for the patronage that we continue to receive from the Indian Council of Agricultural Research, with a note of personal gratitude to Padma Bhushan Dr. R S Paroda, Director General, ICAR and Secretary, DARE for his erudite guidance with innovative thinking. I am also thankful to Dr.Mangala Rai, Deputy Director General (Crop Sciences) and to Dr. K C Jain, Assistant Director General (Commercial Crops), for their kind and incessant help.

My appreciation is also due to the Project Coordinator and Head, Regional Station, Coimbatore, Head Regional Station, Sirsa, Heads of Divisions/Sections, Scientists, Technical, Administrative and Supporting Staff, for their active support in conducting research and for their contribution and assistance in brining out this edition of the annual report.

(C D Mayee)
Director

अधिदेश

- ★ कपास की उपज, रेशे की गुणता तथा उप–उत्पादों को सुधारने के लिए मूलभूत व अनुकूल अनुसंधान करना।
- ★ कपास – आधारित फसल पध्दतियों में स्थान विशेष व्दारा अपनाये जाने के लिए आनुवंशिक विविधता उत्पन्न करना।
- ★ उपयोग में लाने वाली एजेंसियों के लिए कपास उत्पादन की नवीनतम प्रौद्योगिकी के हस्तांतरण में सहायता करना।
- ★ उपर्युक्त अधिदेशों को पूर्ण करने हेतु परामर्श देना तथा अंतर्राष्ट्रीय एजेंसियों के साथ संपर्क करना।

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 the transfer of modern cotton production technology to various user agencies.
- To extend consultancy and link with international agencies to accomplish the above mandate.

CONTENTS

INTRODUCTION

This is the twenty fifth Annual Report of the Central Institute for Cotton Research, Nagpur and its Regional Stations Coimbatore and Sirsa. The Institute at Nagpur was established in April, 1976. The Regional Station, Coimbatore established in 1960 by ICAR as PIRRCOM Centre was transferred to the control of the Institute to serve as its Regional Station for the southern region. The erstwhile IARI Regional Station, Sirsa was also transferred to the institute in April, 1985 to serve as its Regional Station for the northern region.

Nagpur

The Institute is located about 15 kms, from the Nagpur Railway Station and about 5 kms, from the Nagpur Airport on the National Highway No.7 (Nagpur - Wardha Road).

Coimbatore

The Regional Station at Coimbatore is located on the Maruthamalai road, adjacent to the Tamil Nadu Agriculture University about 8 kms, from the Coimbatore Railway Station and about 20 kms, from the airport

Sirsa

The Regional Station, Sirsa is located about 3 kms, from the Bus Station.

Weather

The monthly weather data for the crop season during the year 2000-2001 at Nagpur, Coimbatore and Sirsa are presented in Table 1A, 1B and 1C respectively.

Table 1A - Nagpur

Month	Temperature (°C)		Relative humidity (%)		Rainfall
	Max.	Min.	Max.	Min.	(mm)
June -2000	34.6	24.9	77.8	61.3	177.6
July - 2000	31.1	23.9	86.0	71.7	399.0
Aug. - 2000	31.4	24.1	85.6	72.2	251.4
Sept. - 2000	32.9	23.2	83.4	60.5	121.0
Oct. - 2000	34.6	19.7	70.6	35.0	07.0
Nov. - 2000	32.4	15.4	65.7	27.6	00.0
Dec. - 2000	29.7	10.6	55.3	22.7	00.0
Jan. - 2001	30.2	12.3	63.1	26.9	3.2
Feb. - 2001	34.7	17.6	41.7	19.4	00.0

Table 1B - Coimbatore

Month	Temperature (°C)		Relative humidity (%)	Rainfall
	Max.	Min.	Max.	(mm)
Aug. - 2000	30.0	22.4	81.0	122.2
Sept. - 2000	31.5	22.3	88.5	210.4
Oct. - 2000	30.8	21.1	90.8	36.8
Nov. - 2000	29.6	20.7	90.3	83.5
Dec. - 2000	28.7	17.8	90.3	2.1
Jan. - 2001	30.3	20.0	87.2	-
Feb. - 2001	33.9	20.6	86.5	-
March -2001	35.6	22.5	79.8	-
April -2001	34.9	23.7	85.8	95.5

Table 1C - Sirsa.

Month	Temperature (°C)		Relative humidity (%)		Rainfall
	Max.	Min.	Max.	Min.	(mm)
April 2000	35.8	18.9	46	23	-
May 2000	41.2	23.5	49	32	-
June -2000	39.8	22.8	59	39	
July - 2000	35.6	22.0	72	55	209.2
Aug. - 2000	35.9	21.5	71	55	-
Sept. - 2000	36.1	19.1	67	45	-
Oct. - 2000	35.4	10.7	62	38	-
Nov. - 2000	28.6	5.4	64	28	-
Dec. - 2000	24.5	2.5	85	24	-

Introduction

National Cotton Scenario

State-wise area, production and productivity figures for the year of report and the preceding year are presented in Table - 2.

Table -2: State-wise cotton area, production and productivity

Zone/State	1999-2000			2000-2001		
	Area (Lakh ha)	Prod. (Lakh bales)	Pdy (Lint Kgs/ha)	Area (Lakh ha)	Prod. (Lakh bales)	Pdy (Lint Kgs/ha)
North Zone						
Punjab	4.75	8.00	286	4.74	10.00	359
Haryana	5.46	10.50	327	5.72	11.00	327
Rajasthan	5.83	13.00	379	4.82	11.00	388
Central Zone						
Gujarat	15.13	28.50	320	15.78	25.00	269
Madhya Pradesh	5.25	15.50	502	5.55	17.00	521
Maharashtra	32.54	36.50	191	27.93	22.00	134
South Zone						
Andhra Pradesh	10.40	22.00	360	8.87	26.00	498
Karnataka	6.00	8.00	227	5.35	8.50	270
Tamil Nadu	1.85	5.50	505	1.70	5.50	550
Others	0.67	1.50	381	0.76	1.50	336
Total	**87.91**	**149**		**81.22**	**137.50**	
Loose cotton consumed but not counted for in State-wise prod.	—	07.00	—	—	08.50	
Grand Total	**87.91**	**156.0**	**302**	**81.22**	**146.00**	**306**

Prod. = Production Pdy = Productivity 1 bale= 170 kg.

Source : Office of the Textile Commissioner, Mumbai.

2. PROGRESS OF RESEARCH

A. Research Highlights

CROP IMPROVEMENT

Nagpur

Through three explorations in NEH region, Melghat tribal region and Karnataka, 96 samples were collected. The cotton gene bank was enriched by 27 indigenous collections.

In Br 01 trial conducted at Nagpur (Rainfed), Sirsa and Coimbatore (Irrigated), 100 accessions each of *G. hirsutum* and *G. arboreum* were evaluated and superior genotypes identified for major economic attributes. Culture CNH 152 recorded second best seed cotton yield (1579 kg/ha) as compared to the check LRA 5166 (1236 kg/ha). In station trial, culture CNH 1012 was the best (1540 kg/ha). Out of 63 F_1 combinations tested, two superior combinations were identified. In NVET, entry CNH 36 recorded an average yield of 1374 kg/ha and ranked fifth at national level. Seeds of 46 F_2 progenies were distributed to six AICCIP centres.

A new high yielding, medium staple, early maturing cotton variety viz. CNH 120 MB was identified for release in south zone.

In genetic improvement of cotton seed oil programme, two superior cultures viz. CNO 131 and CNH 2124 were sponsored in AICCIP trial. Culture COE 26 (1533 kg/ha) was identified in station trial for high yield and oil. Another five high yielding lines viz. 26 B, 5H, 23 ES, 21 DA and 40 EP with yield range of 1200-1700 kg/ha were identified.

In *G. arboreum,* three superior cultures viz. CINA 310, CINA 323 A and CINA 323 B were identified and sponsored in AICCIP trials. CINA 323 A ranked fourth in south zone based on yield. Three new cultures viz. CINA 305, CINA 306 and CINA 309 were sponsored in National Trial.

Performance of *G. arboreum* was better than upland cotton under rainfed conditions. A *'desi'* genotype DLSA 17 recorded highest seed cotton yield of 1955 kg/ha as compared to *G. hirsutum* variety LRK 516 (931 kg/ha). Fibre quality characters were at par with the *G. hirsutum* genotypes.

In the varietal improvement programme of upland cotton, three drought tolerant cultures were identified and sponsored in AICCIP trials. Culture 301 performed well in south zone and ranked third. Other superior cultures were CNH 32 and CNH 380.

In male sterility programme, 36 CMS, 12 GMS and seven R-lines are maintained. Two new lines viz. LRA 5166 and SRT 1 have been successfully converted into GMS system. In all, 171 GMS and 149 CMS based hybrids were evaluated. Promising hybrids were NGMSH 19, 57, 99, 16, 97 and 15. One GMS based *'desi'* hybrid CINAA 101 was sponsored in AICCIP trial.

Mutation breeding study revealed that mutant character dwarf and bushy type was

controlled by a single recessive gene. Mutants of Suvin showed higher ginning outturn than the original parent.

Interspecific crosses involving five wild species viz. *G. aridum, G. somalense, G. raimondii, G. klotzschianum* and *G. anomalum* were attempted and colchiploidy was applied to three F_1s viz. SRT-1 x *G. harknessii, G. arboreum* x *G. raimondii* and *G. trilobum* x *G. raimondii.* Oil content ranged from 11 to 24% in wild species and races of *G. arboreum.*

Seed Technology experiment showed higher boll setting percentage in male sterile lines (GMS) in both the species i.e. *G. arboreum* and *G. hirsutum* against conventional (hand emasculated) method. Planting ratio of 1:1 (female:male) was found to be ideal.

Breeder seed production of LRA 5166 and Anjali exceeded the indent. Seed village programme was a success this year.

Coimbatore

Culture **CWROK 165** which recorded more than 30 per cent increased seed cotton yield over the check was released and notified as **Sumangala.** Variety **Sumangala** recorded the highest yield in the National Varietal Trial. Culture **M5KD 26** with a mean seed cotton yield of 9.7 q/ha under rainfed conditions was found to be superior to the Zonal check **LRA 5166** (7.4 q/ha) by 30 per cent. In the combined Institute trial, alternaria leaf spot disease resistant variety ALR-4 recorded the highest yield.

In the multilocation trial, cytoplasmic male sterility based hybrids (ms 2 x 19) x AK 2 and (ms 2 x RK) x AK 2 were found to be promising. Among the genetic male sterile hybrids, Gms J 34 x 19 and Gms 12 x P 115 were promising. A new source of cytoplasmic male sterility with *aridum* cytoplasm has been successfully developed. Among the conventional hybrids, RFF 9 x RFM 1 and L4 x T7 have consistently given higher yields over the check hybrid Savita and NHH 44. Interspecific hybrid V105 x B4 recorded 25 per cent increased yield over DCH 32 with better micronaire value.

Sirsa

The hybrid CSHH 29 (Om Shankar) gave the highest seed cotton yield of 3036 kg/ha in the demonstration trial. The highest 2.5% span length of 28.8 mm was recorded by the hybrid Sandcot 35. The ginning out turn ranged from 30.0 to 37.5 per cent.

In all 137 hybrids were evaluated against the check hybrids Om Shankar and LHH 144. The hybrids viz. CISHH 106 (2846 kg/ha), CISHH 110 (2812 kg/ha), CISHH 234 (2812 kg/ha), CISHH 198 (2790 kg/ha), CISHH 141 (2789kg/ha), CISHH 203 (2743 kg/ha), CISHH 135 (2698 kg /ha) and CISHH 151 (2629 kg/ha) recorded significantly higher seed cotton yield. The hybrid CSHH 198 ranked fifth in AICCIP trial and was promoted to Br 05 (a1) north zone.

In all, 45 GMS and 16 CMS based hybrids were tested and three superior GMS hybrids viz. CISHHG 41 (2812 kg/ha), CISHHG 53 (2744 kg/ha) and CISHHG 46 (2743 kg/ha), and one CMS hybrid CMSHH 15 (2950 kg/ha) were found promising. The ginning out turn of GMS based hybrids ranged from 28.5 to 33.5 per cent and the 2.5 % span length from 23.4 to 28.4 mm. Similarly for CMS based hybrids 2.5 % span length ranged from 24.0 to 28.7 mm.

The higher seed setting, boll setting and superior seed quality were observed in the crosses made between middle of August to end of September. The germination and vigour index were also higher in crossed seed received from this period. In the stored samples no significant reduction in germination was recorded up to nine months of storage. After that a gradual reduction in

germination per cent started but up to 15th month of storage all the hybrids maintained germination up to certification standard.

One thousand five hundred germplasm lines of *G. hirsutum* and 500 lines of *G. arboreum* were maintained and evaluated for quality and quantity parameters. Based on the evaluation, two high yielding entries sponsored for testing under AICCIP trials and three long linted entries were sponsored for testing in different zones. Three hundred and eighty new crosses have been attempted between long linted *desi* cotton lines and local varieties of *desi* cotton.

Seed Technology

Coimbatore

Period of storage, nature of container and seed treatment respectively, accounted for 59, 10 and 4 per cent loss of viability. Imidacloprid and Neem leaf powder or the combination of Imidacloprid and Iodine formulations with Carbendazim were effective in controlling the seed deterioration in LRA 5166 during storage.

CROP PRODUCTION

Nagpur

G. arboreum lines outyielded *G. hirsutum* and also possessed earliness.Considerable variability among the lines was evident for N and P uptake.

Field experiments clearly point out that maximum yield could be realized by providing two life saving irrigations at early boll and peak boll formation stages. In case of limited water supply, irrigating the crop at peak boll formation stage needs to be adopted.

Long term studies emphasize the importance of P fertilization. To realize the potential yield, a balanced fertilization approach has to be followed. Supplementing partial amount of N through organic sources is the most ideal treatment as it improves the soil physical and chemical properties.

In the fifth year of study 1.4-10.9 % yield reduction was evident in the reduced tillage treatments inspite of positive improvement in soil organic C, possibly due to high weed density (dicot weeds).

The prototype of bullock drawn seed drill cum planter for cotton sowing in vertisols was modified and tested under field capacity. Drilling was satisfactory i.e. seeds could be placed at a uniform depth of 5 cm below the soil surface.

With the drip system of irrigation, response to higher levels of fertilizers was obtained and the fertilizer use efficiency also improved.

On farm trials in Nagpur, Amravati and Yeotmal districts pointed out the advantage of INM approach compared to the farmers practice.

Varieties, PKV 081 and CSH 911 are suitable for mechanical picking of cotton due to their compact nature. NHH 44 is amenable to picking at a spacing of 90 x 10 cm. A picker with throat dimension of 22 cm on either side of row, total height of 75 cm with a ground clearance of 8.5 cm should take care of varieties tested under rainfed condition.

Coimbatore

Drip irrigation treatments realised higher yield than the flood irrigation treatments. Even 50 per cent water supply in drip irrigation maintained equal moisture as that of 100% in flood irrigation system.

Research Highlights

Highest seed cotton yield of 23.5 q/ha was obtained in normal fertilizer application (90:45:45 Kg NPK/ha) with micronutrients (12.5 kg/ha), emphasizing the importance of the latter in influencing the yields.

Prometryn @ 2.0 kg a.i. /ha and Gesagard @ 1.5 kg. a.i./ ha were effective in controlling the weeds and recording higher seed cotton yields.

Cotton-Jowar sequence produced more seed cotton yield than Cotton-fallow-Cotton sequence. The residual NPK left in the soil was found to be higher in C-J system than in C-F-C system.

Sirsa

Azotobacter strains of Ht 54(1) and AC-18 showed superior performance in terms of improvement of seed cotton yield in variety H 1098, where as in wheat variety PBW 343, Azotobacter strains Ht-57, Ht-54(1) and E-12 performed better in improving yield.

Studies on evaluation of tillage and residue management practices for cotton-wheat production systems showed higher seed cotton yield in case of mould board ploughing and when the residues were burnt before sowing.

PHYSIOLOGY AND BIOCHEMISTRY

Nagpur

Drought tolerance traits were evident in 15 cotton genotypes belonging to *G. arboreum, G.herbaceum* and *G. hirsutum. Desi* cotton genotypes possessed relatively higher osmoregulation and root shoot ratio, whereas *G. hirsutum* genotypes maintained higher leaf water status. *G. herbaceum* had leaf transpirational cooling and yield stability trends. *Desi* cotton had normal nitrate reductase activity under stress condition. Study of salinity tolerance in stable derivatives of a cross with wild species and germplasm lines, led to identification of tolerant lines. The tolerant lines had marginal decline in leaf area and biomass and accumulated high amount of osmotic solutes and K. SDS protein profile of the tolerant line showed a prominent extra band. In mild and severe waterlogged conditions, yield reduction was partial with mild stress, whereas it was drastically affected in severe stress condition. Asiatic cottons were more susceptible and *hirsutum* varieties had faster recovery of leaf area and biomass and showed yield stability.

Growth regulators and nutrients in two concentration levels significantly increased leaf relative water content. Delayed planting led to depression in growth and yield. These adverse trends may be due to low temperature effects. Sink manipulation in LRA 5166 and CWROK with ethrel and malic hydrazide at squaring resulted in square abscission by ethrel at low concentration, and senescence at higher concentration. Malic hydrazide on the other hand promoted growth. Combined application led to alteration of plant morphology. Higher concentration levels decreased photosynthesis and soluble protein content.

Leaf area and biomass production were faster in shallow soils as compared to deep soils. Application of Nitrogen increased leaf area upto 120 kg N level by 120 Days After Planting (DAP) in shallow soils, whereas in deep soils N response was noticed after 90 DAP. *Arboreum* cultivar responded upto 120 kg N/ha in both the soils whereas *hirsutum* and hybrid showed the response only upto 80 kg N/ ha. Better seed cotton yield was obtained under shallow soils. *G. arboreum* genotype AKA 8401 had higher sink aetivity as compared to LRA 5166 of *G. hirsutum* in investigations on physiological shedding of fruiting parts.

Metasystox and Fenvalerate sprays at 55 and 76 DAP respectively led to initial decrease of total phenol content and increased reducing sugar levels.

Normal value was restored after 168-192 hrs of the treatments. Insecticide application increased stomatal resistance and decreased transpiration rate as a reflex response. The leaf relative water content increased due to the treatment.

Coimbatore

Studies on the interaction effect of elevated CO_2 and temperature revealed that the cotton plants may receive a set back in photosynthetic activity if the atmospheric CO_2 levels exceeded 650 ppm and interacted with temperature above 40 ^{o}C.

Genotypes like H 777, Kgl 54620, IC 1356 and GS 625 were classified as drought tolerant and genotypes like CSH 683-6, Arogya, K 3475 as suited to irrigated conditions, through hysterisis curve method.

Reducing sugars and phenol play a greater role in fibre elongation. The ratio of fibre to seed reducing sugar showed a positive correlation with the fibre elongation, while the total phenol in the mechanical removal of squares at the early phase led to rapid reproductive phase and higher seed cotton yield than the normal plants.

The bollworm tolerant genotypes were seen to accumulate the protective enzyme peroxidase in the developing squares and young boll rinds much faster than the susceptible genotypes. The coupled reactive products of peroxidase action on the orthodihydroxy and totl phenolics in young bolls seem to confer resistance at early boll developmental phase. Similarly, the tolerant genotypes were seen to possess lesser quantity of nutritional principles than the susceptible genotypes.

The beneficial effect of seed dressing insecticides on the plant metabolism in the young seedling stage was observed. Repeated application of systemic insecticides lowered NR activity and enhanced gossypol content.

CROP PROTECTION

Nagpur

Twelve F_1s showed high level of resistance to sucking pests and tolerance to bollworms.

Proteins toxic to neonates, have been detected in *G.bikii* that inhibit the gut enzyme of *H. armigera*. A semilooper damaged cotton variety or hybrid was found to exert a significant reduction of weight in *H.armigera* because of the significantly lower levels of the essential nutrients for larval growth.

Commonality between varieties and hybrids in respect of phenology and insect pest infestation under protected and unprotected situations was confirmed. Protected situation favouring sucking pest build up in case of susceptible cultivars was confirmed. The jassids were observed above ETL during August first week. Looper population was seen from the first week of August with two peaks, one during 2nd week of August and second during mid September. Damage troughs and peaks were alternating and opposite between *Earias* and *Helicoverpa* from first week of September till 3rd week of October. While *H.armigera* withdrew from cotton by October 2nd fortnight, *Earias* continued to cause damage up to November first fortnight, a month more than *H.armigera*. *Pectinophora* build up had effectively started from October 2nd fortnight, a damage take over from *H.armigera* whereby the total fruiting structure damage was always above ETL, ranging between 10 and 92%.

Despite a low pest pressure, sucking pests caused 13.5 % losses, while *Helicoverpa, Pectinophora* and *Earias* caused 5.59, 4.86 and 3.53 % loss respectively.

Eight more entomopathogenic nematodes were isolated and evaluated against *Helicoverpa armigera*. The EPPIS were found effective at 15 infective juveniles per larva. The isolates were also

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Sumangala- A high yielding *hirsutum* variety released for southern zone.

CNH 120 MB- A high yielding,
early maturing and medium staple *hirsutum* variety released for southern zone.

effective against other insect pests of cotton. They were successfully mass cultured on dog biscuit and kidney peptone system with no decline in infectivity against *H. armigera.*

The plant parasitic nematodes, recorded loss of 8-10%. *R. reniformis* was also the most frequent and dominant species. Root knot nematode was associated with poorly growing patches of cotton fields.

Pyrethroid resistance was found to be semidominant. Nerve insensitivity was reccessive and metabolic mechanisms were dominant. Twenty four RAPD primers were identified to be used as SCAR based molecular markers to detect resistance.

One hybrid (CNHH 296) possessing multiple disease resistance has been entered in AICCIP for multilocation testing in irrigated area. Fourteen lines of *G. hirsutum* were found to be resistant to grey mildew.

Five cultures with resistance to Fusarium wilt, possessing good agronomic and fibre characters were developed.

Eight cotton fungi and bacterial blight pathogen *X.a.* pv. *malvacearum* were observed on bad seed-cotton lots belonging to varieties and hybrids.

Six races of *Xam* viz. 3, 6, 7, 10, 15 and 18 have been identified from the susceptible cultivars. Races 10 and 18 were predominant. Races 3, 5, 7, 10 and 18 have been identified from the samples collected from U.P. Out of 226 germplasm lines , three were disease free, six lines resistant against virulent race of *Xam.*

Out of 1649 germplasm lines of *G. hirsutum* evaluated under field conditions, 35 were found field immune, 118 resistant, 774 moderately resistant, 427 moderatly susceptible and 295 susceptible to Alternaria leaf spot while 1400 showed field immunity against grey mildew.

Nearly rupees five lakhs were generated through the sale of bioagents.

Coimbatore

Larval population which causes 5% fruiting bodies damage was 0.5 larva per plant and there was a strong and positive correlation (r=0.71) between larval number and damaged fruiting bodies.

Seed treatment with Imidacloprid and Thiomethoxam was effective in controlling jassids upto 45 days and aphids upto 35 days. Acetamiprid 10 g/ha as sprayable formulation was effective against jassids and recorded maximum yield.

Two new insecticides viz., Bifenthrin and F 6028 and two combination insecticides one with IGR (Match + Chlorpyriphos) and another with extracts of Actinomycetes (Spinosad + Chlorpyriphos) were found to be effective for control of bollworms and recorded higher yield.

The IPM and IRM strategies adopted in the farmers' participatory programme resulted in better pest control, use of lesser insecticides, better conservation and augmentation of natural enemies and consequently higher net return from unit area.

Bt. cotton (MECH 12) required three sprays, while its non-Bt. counterpart and check hybrids (NHH 44, Savita) required five sprays. The incidence of *H.armigera and Earias* and damage in bolls and locules were significantly less in Bt cotton hybrids (MECH 12, MECH 162 and MECH 184) as compared to their non-Bt hybrids and check hybrids. Leaf *Bio-assay* studies with neonates revealed that *H.armigera* larval mortality was 60.8% in Bt cotton after 96 hours exposure, 28.3% in non-Bt Cotton, 17.5 to 20% in check hybrids. The larval weight reduction in Bt cotton was 72.2% over non-Bt Cotton.

The new fungicides viz., Prochloraz and Tebuconazole as well as the bioagents *Trichoderma*

viride and *Pseudomonas fluorescens* Pf1 were as effective as Carbendazim in controlling the grey mildew disease if the spraying was undertaken immediately after the appearance of disease. Among the *G.arboreum* lines tested, 1314N, 30838 and 30841 were found to be highly resistant to Alternaria leaf spot. Culture CBR 21 with bacterial blight resistance, VLV 6 with Verticillium wilt resistance and ALR 4 with altrernaria resistance showed promise in the station trial. The alternaria leaf spot resistant line CCH 727 performed well in the Co-ordinated trial.

Sirsa

The boll damage was more in plots treated with botanicals and bioagents only, when compared to recommended insecticides and farmers' practice followed by IPM plots. The seed cotton yield was more in farmers' spray practice followed by IPM plots. The nuclear polyhedrosis virus of *Helicoverpa armigera* (56.500 LE) and *Trichogramma* egg cards (106) have been mass multiplied and popularised through FLD farmers and sold to other farmers as well.

Epidemiological studies indicated lower leaf curl disease incidence with higher temperature and lower relative humidity. Screening of 1040 germplasm lines of *G. hirsutum* showed that 686 lines were resistant to leaf curl disease under field conditions. Lines VV-772(early), SFA 243 and IH-144-3-62 were tolerant to root rot disease. Out of 202 germplasm lines screened for identification of resistant sources against CLCuV and whitefly, 68 lines remained free from leaf curl, and seven from whitefly incidence. Seed treatment with Imidacloprid 600 FS @9 ml/kg and the foliar spray of Triazophos 40 EC @750 g a.i./ha were found to be the most effective in the management of CLCuV, through the management of vector, whitefly.

Front Line Demonstration :

One hundred demonstration programmes of one hactare each in three states (Haryana, Punjab and Rajasthan) have been carried out under this programme. Suitable cultivars, effective and economical plant protection strategies, IPM/IRM practices for pest and disease control and techniques of hybrid seed production were demonstrated in farmers' fields.

ECONOMICS & EXTENSION

Nagpur

The percentage of cotton area to net area sown has decreased in the irrigated tract and remained stagnant in rainfed tract than what it was five years before. There was a positive correlation between cotton area and size of holding and the area under hybrid in rainfed tract increased with size of holding. The yield gap function fitted showed that soil dummy nitrogen, phosphorus and potash were significant in hybrid and plant density, phosphorus and potash gaps were significant in case of varieties under rainfed cotton. Non use of certified seeds, use of F_2 seeds, more non recommended number of sprays, less then recommended level of use of fertilisers, resort to natural farming, varietal combination are the risk aversion measures noticed in the rainfed cotton tract.

Pattern of diffusion showed that adoption was earlier in villages close to the propagator.

Coimbatore

All the crop production problems in the Institute Village Linkage Programme Project village were addressed through Integrated Crop Management strategies. The technologies demonstrated through on-farm trials in the Project village helped the farmers in realizing higher net returns from cotton, tomato and turmeric than the non-project farmers.

3. ALL INDIA COORDINATED COTTON IMPROVEMENT PROJECT (AICCIP)

All India Coordinated Cotton Improvement Project was started in 1967 to under take multi-disciplinary and multi-location research work on cotton. Centres of AICCIP are located in the State Agricultural Universities of major cotton growing states. The major research highlights of this project during 2000-01 are summarized as under.

Research Highlights

PLANT BREEDING

National Trails - Irrigated

- Among the *G. hirsutum* varieties, **GJHV** 370 (GAU, Junagadh) was the best entry in the Initial Evaluation Trial and recorded the highest yield in both Central Zone (1085 kg/ha) and South Zone (2210 kg/ha) and was far superior to the Zonal Check LRA 5166 (649 kg/ha in Central Zone; 1603 kg/ha in South Zone).
- In the National Elite Varietal Trial, Variety CWROK 165 (Sumangala) of CICR, Regional Station, Coimbatore recorded the highest yield of 1531 kg/ha and came within the top five.
- Among the *G. arboreum* varieties, CSA 310 (2584 kg/ha) of CICR, Regional Station, Sirsa in Central Zone and MDL 2452 in Central Zone (1229 kg/ha) and South Zone (1133 kg/ha) were identified as the best entries.
- Among the conventional hybrids, AHH 90-4 was the best (1998 kg/ha) and performed well in both the North Zone (1875 kg/ha; 4th rank) and South Zone (2214 kg/ha; 1st rank) locations.
- Among the male sterile based hybrids, KDCMH 9810 recorded the highest yield of 1820 kg/ha ranked third in North Zone (1915 kg/ha) and Central Zone (1576 kg/ha) and fourth in South Zone (2149 kg/ha) and an yield advantage of 150 to 300 kg/ha over the check .

National Trials - Rainfed

- Among the *G. hirsutum* varieties tested under rainfed conditions, RAH 101 of UAS, Raichur (1216 kg/ha) and CNH 380 (1149 kg/ha) of CICR, Nagpur were the best entries and performed well in both the Central and South Zone locations.
- Among the conventional hybrids, SNHCH 108 (1703 kg/ha) was the best in Central Zone and as many as four hybrids with yield ranging from 1796 to 1744 kg/ha were found promising in South Zone.
- Among the male sterile based hybrids, NCHH 570 (1229 kg/ha) was found to be the best in Central Zone and performed better than the control CAHH 468 (987 kg/ha).

Zonal Trials - Irrigated

- Among the *G.hirsutum* entries, GISV 97/13 (GAU, Surat) which recorded the highest yield

in both the Central and South Zones in the National Trial during 1999-2000, again recorded the highest yield in the Central Zone (1667 kg/ha) and South Zone (2454 kg/ha) in the Preliminary Varietal Trial. GJHV 337 (GAU, Junagadh) which recorded 3rd highest yield in the Central Zone and 2nd highest yield in the South Zone in the National Trial last year, again recorded the 2nd rank in the Central Zone (1457 kg/ha) and third rank in the South Zone (2162 kg/ha) in the Preliminary Varietal Trial.

- Conventional hybrid AHH 90-2 which occupied the 1st rank in the National Trial during 1999-2000, maintained its superiority in Central Zone during the current year with a mean seed cotton yield of 1931 kg/ha (3rd rank) as against 1693 kg/ha of NHH 44 (C) in the Coordinated Hybrid Trial.
- Similarly, conventional hybrid KDCHH 144 which occupied the 4th rank in the Central Zone in the National Preliminary Hybrid Trial during 1999-2000, recorded the 5th rank with a mean seed cotton yield of 1907 kg/ha as against 1693 kg/ha of NHH 44 (C) during the current year.
- Male sterile based hybrid NCHH 99 recorded the highest yield (2000 kg/ha) in the South Zone and the 2nd highest yield (1926 kg/ha) in the Central Zone as against 1831 and 1801 kg/ha of the Zonal Checks in the respective Zones. The same hybrid ranked first in Central Zone and second rank in the South Zone during the previous year in the National Trials.
- In the rainfed trials, RAH 2211 of UAS, Raichur which recorded the highest yield in the National Trial at the Central Zone during 1999-2000, again recorded the highest yield of 906 kg/ha in the Preliminary Varietal Trial and recorded as much as 100% increase in yield over LRA 5166 (452 kg/ha).

AGRONOMY

- Location specific agronomic packages have been developed for all the newly released varieties/ hybrids and pre-release cultures in all the AICCIP Centres.
- Deep tillage once in two years plus conventional tillage with cultivator and planking resulted in significantly higher seed cotton yield in Faridkot and Sriganganagar of North Zone.
- Use of Drip irrigation system in cotton at Surat and Dharwad Centres led to significantly higher yields, besides saving in irrigation water by 25%.
- Application of FYM and Vermicompost along with recommended dose of chemical fertilizers was found efficient in sustaining higher yields and higher Benefit: Cost ratio.
- Foliar application of nutrients viz.. Urea (2%), DAP (2%), KNO_3 (1%), $ZnSO_4$ (0.5%) and $MgSO_4$ (1%) were found superior in enhancing seed cotton yield by 15-20%.
- Cotton crop canopy management through detopping during peak vegetative growth in Hisar and Sriganganagar of North Zone was found beneficial in obtaining 15-20% enhanced seed cotton yield.
- Weedicides like Pendimethalin, Fluchloralin, Haloxyfop, Roundup and Prometryn have been found efficient in controlling weeds at reasonable cost.
- The following intercrops were found remunerative:
- Potato intercropping in cotton is a novel approach and gives higher profits in Dharwad of Karnataka
- Soybean, Greengram and Maize were found profitable for strip intercropping in cotton in Guntur of Andhra Pradesh

1976 रजत जयंती 2001

Shri Shivajirao Mane, MP, releasing the institute publication at Rashtriya Kapas Mela, 2000.

Distinguished dignitaries visiting the exhibition

Dr. C D Mayee, Director, CICR addressing the farmers in Kisan Mela at Coimbatore

Cotton farmers being felicitated by Dr. C D Mayee, Director, CICR in Kapas Mela at Sirsa

- Cotton - Wheat, Cotton - Raya cropping system for North Zone and Cotton - Sunflower and Cotton - Chickpea for Karnataka in the South Zone have been identified as efficient double crop sequences under cropping system research.
- Physiological and biochemical mechanisms of tolerance to biotic and abiotic stresses have been studied and tolerant genotypes have been identified.

ENTOMOLOGY

- More rainy days and continuous wet spell during September resulted in outbreak of American bollworm, *Helicoverpa armigera* in North Zone. Similarly, high rainfall and more rainy days (more than 10 days in a month) leading to a wet weather during November is observed to be prime cause for the epidemics of *H. armigera* in Andhra Pradesh and Tamil Nadu.
- With dry weather prevailing in most parts of the country, the overall pest problem was much less during the year 2000-2001.
- In Andhra Pradesh alone, the infestation of *Spodoptera litura* was high warranting chemical intervention.
- The seed treatment chemicals Imidacloprid and Thiamethoxam were equally effective against sucking pest upto 45 days in South Zone and upto 65 days in North Zone for the past three years. The seed treatment also reduced the cotton leaf curl virus disease (CLCuV) considerably in North Zone and recorded significantly higher seed cotton yield.
- The insecticide Spinosad and Indoxacarb were effective against bollworm particularly *H. armigera* and recorded significantly higher seed cotton yield for the past three years. The new chemicals Bifenthrin and F 6028 were effective against bollworms and recorded high seed cotton yield.
- The following IPM components were found more effective in reducing the use of pesticides and increasing the seed cotton yield significantly.

a. Seed treatment with insecticides (Imidacloprid and Thiamethoxam)

b. Intercrops and border crops such as cowpea, sorghum and maize

c. Trap crops such as castor, okra and redgram

d. Mechanical removal of affected parts, egg masses and larvae

e. Release of egg parasitoid *Trichogramma chilonis*

f. Monitoring through the pheromone traps for bollworms

g. Scouting pest and natural enemies

h. ETL based pesticide application at right time.

PATHOLOGY

- Cotton leaf curl virus disease continued to cause concern in the North Zone.
- Eight varietal entries and 23 hybrid entries entered in various AICCIP trials have shown resistance to CLCuV disease. In addition, eight lines developed at the Central Institute for Cotton Research centres and entered in Pathology trials for testing have shown resistance to CLCuV at five centres viz., Hisar, Sirsa, Sriganganagar, Faridkot and Ludhiana.
- Among the fungicides, *Tebuconazole* @ 750 ml / ha and *Prochloraz* @ 500 g a.i./ha have been found as effective as Carbendazim (0.1%) in the control of grey mildew at all the centres tested. *Prochloraz* was also found to be effective against Alternaria leaf spot at Dharwad.
- Among the bioagents, *Trichoderma viride* at Coimbatore and *Pseudomonas fluorescens* (Pfl & CHAO strains) at Dharwad hold promise for the management of the foliar disease of cotton.

4. TRANSFER OF TECHNOLOGY

A. EXTENSION

Nagpur

Rashtriya Kapas Mela - 2000

Rashtriya Kapas Mela-2000 was organised by CICR, Nagpur at its premises on December 3, 2000. The Mela was inaugurated by Shri Shivajirao Mane, M.P. and Member of ICAR Governing Body and Dr. N.G.P. Rao, Former Chairman of Agricultural Scientists Recruitment Board was the Chief Guest. Dr. A.M. Narula, Director, Directorate of Cotton Development, Govt. of India was also present.

Dr. Rao in his presidential address, asserted that *desi* cotton has immense potential in terms of production and quality cotton in the country. He added that increased use of pesticides has created environmental problems and cultivation of *desi* cotton can help to reduce insecticide use.

Shri Shivajirao Mane in his inaugural address, expressed hope that comprehensive Agricultural policy, planned to be introduced by the Union Government, may help to improve life of the farming community. Dr. A.M. Narula, informed the gathering about Technology Mission on Cotton launched by the Central Government.

Dr. C.D. Mayee, Director, CICR in his welcome address describing research as sacred work, mentioned that the Institute is actively engaged in providing technology to the farmers. He hoped that Mela would emerge as a turning point in developing synergy between scientists and the farmers.

On this occasion, several publications of CICR Nagpur were released at the hands of the Guests. The highlight of Mela was an exhibition in which latest cotton production, protection technologies, farm implements, cotton varieties/ hybrids, bio-fertilisers and bio-pesticides were displayed by different organisations.

Coimbatore

Kisan Mela

A Kisan Mela was organised at Veerappagoundanur on March 10, 2001 under the Technology Assessment and Refinement through Institute village linkage programme (TAR/IVLP). The function was presided over by Shri Shanmughan, Member of Legislative Assembly, Kinathukadavu, Coimbatore.

Dr. C.D. Mayee, Director, CICR, Nagpur in his key note address emphasised the need for decreasing the cost of cultivation to make Indian cotton more competitive in the information market. Emphasizing importance of computers in this era of modern information technology, he consented to install a computer in the project village itself and urged the educated youth in the village to make best use of it. He inaugurated the Eco-Green Club and

urged the farmers to go in for organic farming.

Shri Shanmugham in his presidential address appreciated various village and farmers oriented programmes implemented by Government of India which have gone a long way in improving the living standards of Tamil Nadu farmers.

Dr. K. Venugopal, Project Coordinator & Head, CICR, Regional Station, Coimbatore explained the genesis of the project. Dr. K. Ramamurthy, Sr. Scientist (Agril. Economics) explained salient fatures of the project.

Sirsa

Cotton Day

Cotton Day was organised at CICR, Regional Station, Sirsa on September 3, 2000. Dr. C.D. Mayee, Director, CICR, Nagpur was the Chief Guest on this occasion. Dr. J.S. Kolar, Director (Extension Education). PAU, Ludhina presided over the function. Two hundred and fifty farmers from Haryana, Punjab and Rajasthan participated in the programme. Dr. L.S. Randhawa, Head, CICR, Regional Station, Sirsa stressed the need for adopting hybrid seed production and IPM in north India and suggested various ways and means for reducing the cost of production and improving the income of the farmers. The information were imparted to farmers by Dr. R.A. Maheshwari and Dr. A.P. Singh, RAU, Bikaner, Dr. P.D. Sharma and M.S. Chauhan, HAU, Hisar, Dr. N.S. Bhuter, PAU, Ludhiana, Dr. U.G. Patel, GAU, Surat, Dr. Brent Zehr, Mahyco, Jalna and Dr. O.M. Bambawale, NCIPM, New Delhi.

Dr. Kolar expressed concern about the cultivation of large number of varieties, indiscriminate use of insecticides and lack of water management in north India and advised the farmers to adopt scientific farming.

Dr. Mayee informed the gathering that Central Government has increased the amount for cotton research under technology mission which is currently on and announced that Sirsa centre of CICR will be further strengthened. He suggested that collaborative efforts of CICR and SAU's of Northern zone will help in curtailing use of fertilizer and pesticides.

Kapas Mela

A Kapas Mela was organised at CICR, regional Station, Sirsa on March 28, 2001. Dr. C.D. Mayee, Director, CICR was the Chief guest and Dr. B.S. Duggal, JDA (Cotton), Haryana presided over the function. Dr. A.P. Singh, Senior Entomologist and Dr. P.L. Nehra, Senior Agronomist, Agricultural Research Station, Sriganganagar also participated in the programme as experts.

Dr. C.D. Mayee, Director, CICR in his address emphasised that to compete in the world market, cotton quality will have to be improved. He advised the farmers for judicious use of irrigation water as the northern states are facing acute shortage of water and exhorted them to adopt cotton cultivation in a scientific manner. Dr. B.S. Duggal in his address highlighted the importance of State Department of Agriculture in disseminating new cotton technologies to the doorstep of farmers.

Dr. L.S. Randhawa, Head, CICR, Regional Stations, Sirsa discussed about the problems encountered in cotton cultivation.

Large number of cotton farmers from Haryana and neighboring states participated in the fair. Various new agricultural equipment were displayed in the fair and bio-pesticides and hybrid seed developed by CICR made available to the farmers.

B. TRAINING

Training course on Integrated Cotton Production Technology

A training course on Integrated Cotton Production Technology was organised at CICR, Nagpur during September 21-27, 2000. The training course sponsored by the Directorate of Extension, Ministry of Agriculture and Cooperation, Govt. of India, was attended by 20 participants from Punjab, Haryana, Andhra Pradesh, Karnataka, Tamil Nadu and Maharashtra. The training course was inaugurated by Dr. R.N. Singh, Director, NEERI, Nagpur. In his inaugural speech, Dr. Singh said that with the impending globalization of Indian agriculture, scientists should work for new models of technology for sustainable agriculture. He further mentioned that these new models which contain genomics and information technology can bring new revolution not only in cotton but all facets of agriculture in the country.

Dr. C.D. Mayee, Director, CICR in his presidential address observed that manifold increase in cotton production in the country over the last five decades was brought about by improved fertilizer responsive and water responsive genotypes. However, he said the cotton growing system needs to be changed in tune with the change in consumer preference, modernization of textile machinery, pest dynamics and entry of internationals players in cotton trade.

Dr. K. Venugopal, Project Coordinator, AICCIP, Coimbatore was the guest of Honour on this occasion. In this address, Dr. Venugopal informed that India was the largest exporter of cotton yarn in the world and quality of Indian cotton was comparable to the best in the world.

Dr. H.L. Gajbhiye, Head, Extension Section and I/c training course, suggested for improving the data base and information systems to enable agriculture to cope with the requirement of modernization.

National training course on Administrative procedures and financial rules

The eight day National training course on Administrative procedures and financial rules in ICAR was organised at Central Institute for Cotton Research (CICR), Nagpur during June 21-28, 2000. The training course was organised with the objective of updating the knowledge of clerical staff on administrative procedures, enhancing their skills in dealing with rules and regulations and sensitizing them to the new concepts of research administration. Twenty one Junior and Senior clerks from eight ICAR institutes participated in the course.

Dr. K. Bharadwaj, General Manager, National Research Development Corporation, New Delhi inaugurated the course. In his inaugural address he observed that India was making steady progress in research and development activities and her achievements in science are outstanding. He added that without proper support of administrative staff, no research organisation can contribute significantly to the growth of the nation.

Dr. M.S. Kairon, Director, CICR, in his presidential address, expressed that working environment in research Institute should be flexible in order to accommodate the needs of the scientists.

State level training courses for officers of Maharashtra state under TMC Mini Mission II

More than 175 officers of Maharashtra State were trained in advances in cotton production technology during Nov.2000-Feb.2001 under Technology Mission on Cotton, Mini Mission II. Thirteen training courses of three days duration were organized and were attended by 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.

Sisra

Training programme on hybrid seed production and integrated pest management

A training programme on practical aspects of hybrid seed production and Integrated pest management for farmers of north India was organised on June 25, 2000. About 200 farmers from Punjab, Haryana, and Rajasthan participated in the training programme. Dr. B.L. Jalali, Director Research, CCS HAU, Hisar was the chief guest. Joint Director, Agriculture (Cotton), Haryana along with officials from other departments such as Haryana Seed Development Corporation and Cotton Corporation of India took part in the deliberations. Dr. M.S. Kairon, Director, CICR advised farmers to adopt low input technology of cotton production and emphasized on use of biological control for management of insect pests. Dr. L.S. Randhawa, Head, CICR, Regional Station, Sirsa presented an overview of the hybrid seed production and IPM training programme.

An exhibition depicting production of bio-agents was also organised.

Training programme on Bio-pesticides and bio-agents

A two days training programme on bio-pesticides and bio-agents was organised on 29th and 30th July, 2000. Twenty officers from state departments of agriculture Haryana, Punjab and Rajasthan and CCI participated in the programme.

EXHIBITIONS :

1. State Level Agriculture fair

CICR Nagpur had put up an exhibition stall depicting transferable technologies developed by the Institute at the State Level Agriculture Fair organized by Dr. Punjabrao Krishi Vidyapeeth, Akola on the campus of College of Agriculture, Nagpur during Dec.27-29, 2000. More than 10,000 visitors paid visit to CICR pavilion including several High level government Officers, Members of Legislative Assembly and Ministers of Maharashtra State.

2. National Agri-Vision-2001

CICR was invited to participate in ICAR pavilion at the National level exhibition Agri-Vision 2001 organized on the occasion of National Science Congress held at Pusa Campus, New Delhi during Jan.3-7,2001. Dr. R.S. Paroda, Secretary, DARE & DG, ICAR and large number of scientists, professors, students and general public visited the CICR exhibits.

C. KRISHI VIGYAN KENDRA

1.Training achievements

S.No.	Discipline	Farmers & Rural Youth			Extension Functionarie	
		No. of Courses	No. of Participants	SC/ST Participants	No. of Courses	No. of Participants
1.	Agronomy	4	96	40	3	42
2.	Horticulture	29	224	107	2	22
3.	Pl. Protection	13	136	88	-	-
4.	Vet. Science	17	233	96	1	11
5.	Home Science	10	254	175	-	-
6.	Extension	5	97	26	13	240
	Total	78	1040	532	19	315

2. No. of Demonstrations other than FLD

S. No.	Discipline	KVK Farm	Farmers Field	Total
1.	Agronomy	5	5	10
2.	Horticulture	4	20	24
3.	Pl. Protection	1	10	11
4.	Vet. Science	2	10	12
5.	Extension	1	5	6
6.	Home Science	1	-	1
	Total	14	50	64

3. Frontline Demonstrations on Oilseeds & Pulses

S.No.	Crop/ Variety	Components	Area (ha)	No. of	Name of farmers village
1.	**Oil crops** Soybean (JS-335)	I.N.M.	8.0	20	Kaldongari
2.	Soybean (JS-335)	I.P.M.	8.0	20	Banwadi
3.	**Pulse crops** Pigeon pea (BSMR-736)	Introduction of improved genotype	8.0	20	Kaldongari Banwadi
4.	Chickpea (Vikas)	—— do——	4.0	10	Kaldongari
		Total	28.0	70	

Transfer of Technology

4. Adaptive trials

S.No.	Discipline	No. of Trials	No. of Farmers
1.	Agronomy	1	1
2	Crop protection	1	1
3	Horticulture	3	3
4	Vet. Science	1	2
	Total	6	7

5. Radio Talks:

S.No.	Name of Speaker	Topic	Date of broadcast
1.	Sh. A.S. Tayade	"Answer to agriculture related question." (Marathi)	24.05.2000
2.	Sh. A.S. Tayade	"Pre-sowing tillage for cotton."	10.04.2000
3.	Sh. Gulbir Singh	"Answer to agriculture related questions."	29.08.2000
4.	Dr. U.V. Galkate	"Rabbit and Duck rearing"	09.03.2001
5.	Sh. S. S. Patil	"Vermicompost production a profitable side business."	30.08.2000 18.12.2000
6.	Ms.Sunita Chauvan	"Women participation in agriculture."	23.06.2000
7.	Ms.Sunita Chauvan	"Cultivation of Kitchen garden"	09.03.2001
8.	Dr. P.V. Deulkar	"Answer to agriculture related questions."	28.08.2000

C. RESEARCH PAPERS PRESENTED IN SEMINARS / SYMPOSIA / CONFERENCES AND PUBLISHED IN THE FORM OF ABSTRACT

AUTHOR (S)	TITLE OF PAPER & ABSTRACT NO.	PRESENTED AT	VENUE & DATE
Balasubramani G Amudha, J Dongre AB	Genetic transformation on Indian cotton cultivar with Bt Cry I (b) gene.	First International Conference on Global Sustainable Biotech. Congress, 2000 A.D.	Nagpur 27th Nov. - 1st Dec., 2000
Bhaskar KS Kairon MS	Impact of watershed based resource management studies on cropping pattern in black cotton soils of Maharashtra for sustainable land use planning - Case studies.	Workshop on Purna River sub-basin integrated water, soil, human, live stock and allied Resources Development System and Planning Approach.	Amravati 26th June, 2000
Bhaskar KS Raju AR Majumdar G Sawaji BV	Rain water conservation and recycling of harvested rain water for rainfed cotton production in vertisols Abstract 2 : 434	65th Annual convention of the Indian Society of Soil Science	Nagpur Nov. 14-18, 2000
Bhaskar KS Raju AR Singh JV Majumdar G	IPNS for rainfed cotton grown on varying soil depths under supplemental irrigation. pp. 24	International Conference on "Nature Farming and Ecological Balance (ICNFEB-2001)"	CCS HAU, Hisar March 7-10, 2001
Bhaskar KS Sawaji BV Raju AR Majumdar G Singh JV	Rain water management for rainfed cotton production in soils of varying depth for sustainable land use planning in Vidarbha Region. pp 106-107	Seminar on "Soil Health management for Sustainable Agriculture"	Akola Dec.8-9,2000
Chakrabarty PK Sheo Raj	Molecular basis of pathogenicity of (1) *Xanthomonas campestris* pv. *malvacearum* and use of cloned pathogenicity gene as diagnostic tools. pp. 2-3	National symposium on Role of Resitance in intensive agriculture	Karnal, Feb. 15-17, 2000,

Reserch Papers Presented In Seminars/ Symposia/Conferences

AUTHOR (S)	TITLE OF PAPER & ABSTRACT NO.	PRESENTED AT	VENUE & DATE
Dongre AB Mayee CD	Genetically tailored Bt. cotton plant in India.	First International Conference on Global Sustainable Biotech. Congress, 2000 A.D.	Nagpur 27th Nov.-1st Dec, 2000
Gajbhiye HL Mayee CD	Organic cotton:a niche market or a must market." pp:11	National Seminar on Organic Farming System; An Eco-friendly Approach for Evergreen Revolution"	Nagpur Feb. 13-14,2001
Gokte-Narkhedkar Nandini, Lavhe NV Banerjee SK Sheo Raj Mayee CD	On potential of entomo-pathogenic nematodes for management of American bollworm, *Helicoverpa armigera* in cotton.	National Symposium on Cotton Research Strategies in New Millenium,	April 16, 2001
Gopalakrishnan,N Khader SESA Gururajan KN Venugopal K	Metabolic parameters as influenced by the abiotic stress conditions in the genotypes of cotton.	National Seminar on Plant Physiology and biotechnology in the new millennium	IISR, Lucknow 7-9, Nov. 2000
Gururajan KN Manickam P Waghmare VN	Induced mutations for quality improvement in Egyptian cotton (*Gossypium barbadense* L.) pp. 237-239	DAE-BRNS Symposium on the use of nuclear and molecular techniques in crop improvement,	BARC, Mumbai, Dec.6-8,2000,
Jadhav DR Kranthi KR Tawar KB Russell DA	Insecticide resistance scenario on cotton pests in India. pp:103-118.	Regional consultation on Insecticide resistance management.	CCRI, Pakistan 28 June-1 July, 1999
Khader SESA Gopalakrishnan N Ravichandran V	Effect of elevated and super elevated CO_2 on diurnal variation in photosynthetic rate of cotton cv. LRA 5166.	National seminar on plant physiological paradigm for fostering agro and biotechnology and augmenting environmental productivity in new millennium 2000	Lucknow 7-9, Nov. 2000

Reserch Papers Presented In Seminars/ Symposia/Conferences

AUTHOR (S)	TITLE OF PAPER & ABSTRACT NO.	PRESENTED AT	VENUE & DATE
Khader SESA Gopalakrishnan N Anderson A Kumar.	Interaction effect of elevated carbon dioxide and temperature on photosynthesis and nitrate reductase activity of cotton.	National seminar on plant physiological paradigm for fostering agro and biotechnology and augmenting environmental productivity in new millennium 2000	Lucknow 7-9, Nov. 2000
Khader SESA Gopalakrishnan N Ravichandran V	Effect of elevated carbon dioxide on growth, development and reproduction of cotton leaf worm.	-do-	Lucknow 7-9, Nov. 2000.
Khader SESA Gopalakrishnan N Shoba R Uma Devi TK	Physiological evaluation of the impact of elevated CO_2 on cotton genotypes	-do-	Lucknow 7-9, Nov. 2000.
Manickam S Gururajan KN Rathinavel K Venugopal K	Commercial Cultivation of F Cotton Hybrids-A Distinct Possibility pp. 118-119	88th Ind. Sc. Cong. Part III (Advance Abstracts),	New Delhi, Jan. 3-7, 2001
Nalayini P Kandasamy OS Kailasam C	Watkinson weed model for the weeds grown under interspecific Cotton Hybrid - TCHB 213 Part III p.:70	88th Ind. Sc. Cong	New Delhi, Jan. 3-7,2001,
Nandeshwar SB Dongre AB	Regeneration of diploid cotton for use in genetic transformation	First International Conference on Global Sustainable Biotech. Congress, 2000 A.D.	Nagpur 27th Nov.-1st Dec, 2000
Natarajan K Babu S	Pheromone technology for the management of cotton bollworm	National Conference on recent trends in Biotechnology and Biocontrol Approaches of the New Millennium	IICT, Hyderabad July 18-20,2000

Reserch Papers Presented In Seminars/ Symposia/Conferences

AUTHOR (S)	TITLE OF PAPER & ABSTRACT NO.	PRESENTED AT	VENUE & DATE
Natarajan K Venugopal K Rathinavel K Babu S	The Transgenic cotton -Prospects and Problems.	National Conference on recent trends in Biotechnology and Biocontrol Approaches of the New Millennium	IICT Hyderabad. 18-20 July, 2000.
Raju AR Monga D Meshram MK Lakshminarayana K Wasnik SM Uma B	Integrated Nutrient Management of Cotton based Cropping Systems under Irrigated and Rainfed Agro eco systems	National seminar on Organic farming systems-An Eco friendly approach for evergreen revolution	Nagpur Feb. 13-14, 2001
Raju AR Meshram MK Chakrabarty M	Local isolates of Bio-inoculants in advance sown hybrid cotton. Vol. II 661-662.	International conference on managing natural resources for sustainable agricultural production in the 21st century	New Delhi, Feb. 14th-18th 2000.
Raju AR Meshram MK Chakraborty M	Eco friendly bioinoculants for sustainable cotton production of central India	International Conference on Natural Farming and Ecological Balance,	CCS, HAU, Hissar March, 7-10 2001.
Shanmugham K Venugopal K Nalayini P	Comparative studies on the efficacy of drip and furrow irrigation in cotton. Part III p.70.	88th Ind. Sc. Cong	New Delhi Jan. 3-7, 2001,
Singh, Jagvir	Direct, cumulative and residual effects of sulphur on yields and sulphur content in cotton-wheat sequence.	Workshop on Purna River sub-basin integrated water, soil, human, live stock and allied Resources Development System and Planning Approach.	Amravati 26th June, 2000,
Singh, Jagvir Blaise D Rao MRK Bhaskar KS	Availability of micro nutrient and organic carbon as influenced by FYM in rainfed cotton based cropping system. pp 79	Seminar on "Soil health Management for Sustainable Agriculture"	Akola Dec. 8-9, 2000.

Reserch Papers Presented In Seminars/ Symposia/Conferences

AUTHOR (S)	TITLE OF PAPER & ABSTRACT NO.	PRESENTED AT	VENUE & DATE
Singh VV Punit Mohan Singh SB	Economics of managing cotton genetic resources in India	International Conference on Science and Technology for Managing Plant Genetic Diversity in the 21st century.	Kuala Lumpur, Malaysia, 12-16 June, 2000.
Singh, Jagvir	Effect of organic and inorganic fertilizer on yield, nutrient uptake and fibre quality of rainfed cotton in cotton based cropping systems Vol. 1 : 143.	National Seminar on "Development in Soil Science - 2000"	Nagpur Dec. 27-30, 2000
Waghmare VN Gururajan KN Punit Mohan Singh P	Induced mutations for improvement of *desi* cotton (*Gossypium arboreum* L.) pp.258-263.	DAE-BRNS Symposium on the use of nuclear and molecular techniques in crop improvement,	BARC, Mumbai Dec.6-8,2000,
Waghmare VN Deshpande LA	Cultivation of *Gossypium arboreum* for sustainable cotton production under rainfed ecosystem.	IX th Vasantrao Naik Memorial National Agriculture Seminar on Organic Farming Systems - An ecofriendly approach for evergreen revolution	Nagpur, Feb. 13-14, 2001.
Waghmere VN Gururajan KN Punit Mohan Singh P	Induced mutations for improvement in Desi cotton. pp.258-63.	In: Proceedings of DAE-BRNS Symposium on the Use of Nuclear and Molecular Techniques in Crop Improvement,	Mumbai, Dec. 6-8, 2000,
Wasnik SM	Front-Line Demonstrations - a powerful tool of mass communication for oilseeds and pulses technology.	National Seminar on Farm Communication through Mass Media in next Millenium	Rahuri Nov.25-26, 2000
Wasnik SM Bhaskar KS Raju A.R Barabde NP	Approaches for creating awareness among cotton growers for eco friendly cotton cultivation practices	National Agricultural Seminar on "Organic Farming System on Eco friendly Approach for Evergreen Revolution"	Nagpur Feb. 13-14, 2001

D. Technical Bulletins published in 2000

Title of Bulletin	Bulletin No.	Author (s)
Organic Cotton farming	No.01	Rajendran TP Venugopalan MV Tarhalkar PP
Abiotic stresses in cotton - A physiological approach	No.02	Perumal NK Hebbar KB Kairon MS
Root rot of cotton and its management	No.03	Monga D Sheo Raj
Naturally Coloured Cotton	No.04	Singh P Singh VV Waghmare VN
Wild and cultivated species of cotton	No.05	Gotmare V Singh, Phundan Tule BN
Nutrient management in rainfed cotton.	No.06	Jagvir Singh Blaise
Cotton IPM and its Current Status	No.08	Vennila S Ramasundaram P Sheo Raj Kairon MS
An evolving systems approach of IPM: Perceptions and Prescriptions.	No.09	Vennila S Kairon MS
'Cotton biotechnology'	No.10	Kranthi KR Kranthi S Dongre AB Kairon MS
Glanded and Glandless Cottons	No.12	Punit Mohan Singh P Dongre AB
Cotton varieties and hybrids	No.13	Singh, Phundan Kairon MS
Breeding Hybrid Cotton	No.14	Singh, Phundan Kairon MS Singh, Suman Bala

Technical Bulletins Published In 2000

Title of Bulletin	Bulletin No.	Author (s)
Use of rainfall analysis in the planning and management of rainfed cotton	No.15.	Ravindran CD
Cotton genome mapping for crop improvement,	No.16	Amudha J Balasubramani G Dongre AB
Biotechnological approaches for cotton improvement	No.17.	Balasubramani G Amudha J Dongre AB
Plant Cell and Tissue Culture - practical approach	No.18	Nandeshwar SB Dongre AB Mayee CD
Constraints to Cotton Production in India	No.19	Ramasundaram P Gajbhiye HL
Insecticide Resistance Management based cotton IPM: A success story		Narula AM Kranthi KR Banerjee SK Munje SS Wanjari RR
"*Kapus Lagwadi che Sudharit Tantra*." (Marathi)		Gajbhiye HL Tayade, Arjun Patil, Subhas
Hybrid seed production and integrated pest management (In Hindi) Cotton in the North Zone (in English & Hindi)		Randhawa LS Monga D Meena RA Tuteja OP Jeyakumar P

2. INSTITUTE COMMITTEE/COUNCIL MEETINGS

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 June 6-9, 2000 under the Chairmanship of Director, CICR, to discuss the results of the work carried out during 1999-2000. All the scientists of Nagpur, eight from Coimbatore and three from Sirsa participated in the meeting.

All the scientists presented the results of their on-going programme carried out during 1999-2000 and discussed. The programme for the year 2000-2001 was finalised.

New project proposals were also presented and after a lot of deliberations and interactions, the house approved some projects. Scientists also expressed the constraints faced by them in implementation of the technical programme and chairman, took a note of those so that necessary measures may be taken.

3. SEMINARS/WORKSHOP/ MEETINGS ORGANISED

Workshop of Mini Mission - I of Cotton

The workshop of Mini Mission-I of Technology Mission on cotton (TMC) was held at CICR, Nagpur on December 19-20, 2000. The workshop was inaugurated by Dr. M. Velayutham, Director, National Bureau of Soil Survey & Land Use Planning, Nagpur. Dr. Velayutham in his inaugural address felt that reduction in the cost of cultivation with emphasis on resource inventory and utilisation, which are the objectives of TMC, would provide the cotton farmers of the country a good leverage to face the expected global challenges in the near future.

Dr. C.D. Mayee, Director, CICR presented an overview of Technology Mission and enlightened the delegates about the various aspects of the Mini Mission. Dr. Mayee informed the gathering that the ICAR standing Committee on Mini Mission I has accorded approval for the Technical and financial documents of MM I.

In his concluding remarks, Director, CICR exhorted the various lead centres and the associated centres of each project to commence the work immediately.

कपास की खेती की विभिन्न प्रौद्योगिकियों पर हिन्दी में तकनीकी संगोष्ठी

केन्द्रीय कपास अनुसधान संस्थान में राजभाषा हिन्दी की स्वर्ण जयती के उपलक्ष्य में कपास उत्पादन प्रौद्योगिकी पर हिन्दी में दि. 14 जून, 2000 को एक दिवसीय तकनीकी सगोष्ठी का आयोजन किया गया । नागपुर विश्वविद्यालय के कुलपति डा. अरुण सातपुतले ने इस सगोष्ठी का उद्घाटन किया । कपास संस्थान के निदेशक डा. एम.एस. कैरों ने अपने स्वागत भाषण में सस्थान व्दारा किये जा रहे कपास अनुसंधान कार्यों का विस्तृत ब्यौरा पेश किया तथा देश में कपास अनुसधान एव उत्पादन में संकर किस्मों के महत्वपूर्ण योगदान पर प्रकाश डाला और कपास निर्यात बढ़ाने व विदेशी मुद्रा अर्जित करने के लिए कपास के रेशे की गुणता में सुधार व कपास की उत्पादन लागत कम करने की आवश्यकता पर जोर दिया।

डा. अरुण सातपुतले ने कपास सस्थान में चल रहे अनुस– धान एव अन्य कार्यों की सराहना की और कपास सस्थान और नागपुर विश्वविद्यालय के अनुसधान एव तकनीकी कार्यो के सहयोग एव आदान–प्रदान के वर्तमान विशेष सबधों के बारे में अवगत कराया।

सगोष्ठी के दो सत्रों में वैज्ञानिकों ने कपास प्रौद्योगिकी के विभिन्न पहलुओं पर हिन्दी में व्याख्यान दिए । प्रथम सत्र में कपास उत्पादन में कपास सस्थान की भूमिका एव महत्व, कपास के

राजभाषा गतिविधियाँ

सकरों का योगदान, पराजीनी कपास, कपास में जल प्रबध, समन्वित पोषक तत्व प्रबधन, कपास में जैविक खादों का उपयोग आदि विषयों पर क्रमशः डा. एम.एस. कैरों, डा. पी. सिंह, डा. ए.बी डोंगरे, डा. के.एस. भास्कर, डा.जगवीर सिह एव डा. ए.आर. राजू ने व्याख्यान दिए गए।

सगोष्ठी के व्दितीय सत्र में कपास के हानिकारक कीटों एव रोगों की रोकथाम व प्रौद्योगिकी हस्तातरण में कृषि विज्ञान केन्द्र की भूमिका पर क्रमशः डा. एन.के. तनेजा और श्री टी.वी. कठाणे व्दारा व्याख्यान दिए गए । कपास के रेशे की गुणता में सुधार के लिए कपास की कटाई के बाद की प्रौद्योगिकी में यत्रीकरण के योगदान पर बजाज स्टील कंपनी, नागपुर के श्री एम. के. शर्मा व्दारा प्रकाश डाला गया ।

संगोष्ठी में अंतिम निष्कर्ष के रूप में निम्न बातें सामने आई –

- कपास के रशे की गुणता के सुधार पर जोर दिया जाए जिससे कपड़ा उद्योग की माग पूरी हो सके ।
- कपास उत्पादन लागत कम करने के लिए तकनीकी/ प्रौद्योगिकी के विकास पर बल दिया जाए ।
- यात्रिक कपास चुनाई के लिए उपयुक्त कपास की किस्म/ संकर का विकास किया जाए ।
- कपास के हानिकारक कीटों एव रोगों के समन्वित प्रबधन पर अधिक ध्यान देने की आवश्यकता है ।
- कम वर्षा व जल उपलब्धता वाले क्षेत्रों में आवश्यक जल प्रबधन को प्राथमिकता दी जाए ।

4 राजभाषा गतिविधियाँ

सस्थान में राजभाषा हिन्दी की स्वर्ण जयती के उपलक्ष्य में कपास की खेती की विभिन्न प्रौद्योगिकियों पर हिन्दी में दि. 14 जून 2000 को एक दिवसीय तकनीकी संगोष्ठी का आयोजन किया गया।

सस्थान में राजभाषा हिन्दी की स्वर्ण जयती वर्ष के उपलक्ष्य में 1 से 14 सितंबर, 2000 तक हिन्दी पखवाड़े का आयोजन किया गया। इसका समापन समारोह 14 सितबर 2000 को हिन्दी दिवस के दिन सपन्न हुआ। हिन्दी पखवाड़े के अतर्गत अँग्रेजी–हिन्दी शब्द अर्थ, सामान्य ज्ञान, लिखित परिचर्चा और चित्र विचार स्पर्धाओ का आयोजन किया गया। हिन्दी दिवस के अवसर पर एक प्रश्न मच स्पर्धा का आयोजन किया गया। सभी विजेता प्रतियोगियों को प्रमुख अतिथि के कर–कमलो व्दारा पुरस्कार व प्रमाणपत्र प्रदान किए गए ।

सस्थान की राजभाषा कार्यान्वयन समिति की तिमाही बैठकें नियमित रूप से आयोजित की जा रही हैं । हिन्दी के प्रगामी प्रयोग से सबंधित तिमाही प्रगति रिपोर्ट परिषद को समय–समय पर प्रपत्र में भरकर भेजी जा रही है ।

सस्थान की कपास समाचार नामक समाचार पत्र (तिमाही) एव राष्ट्रीय कपास मेला के अवसर पर 'स्मारिका' (वर्ष 2000) का प्रकाशन किया गया। दूरदर्शन व आकाशवाणी में हिन्दी अथवा स्थानीय भाषा मराठी में वार्ताएँ प्रस्तुत की गई । वार्षिक रिपोर्ट के साराश का हिन्दी रूपांतर प्रकाशित किया गया । सस्थान के वैज्ञानिकों व तकनीकी अधिकारियों व्दारा हिन्दी में लिखे गए तकनीकी लेख विभिन्न कृषि पत्रिकाओं में प्रकाशनार्थ भेजे गए । प्रशासनिक कार्य में भी हिन्दी का प्रयोग बढ़ाने के लिए अधितम प्रयास किए गये । कृषि विज्ञान केन्द्र व प्रक्षेत्र अनुभाग में अधिकतम कार्य हिन्दी में किया गया। विभागीय परिपत्र भी हिन्दी में जारी किए गए । हिन्दी में प्राप्त सभी पत्रों के उत्तर हिन्दी में दिए गए ।

5. PARTICIPATION IN SEMINARS / SYMPOSIA/ CONFERENCES/ TRAININGS / MEETINGS / WORKSHOPS

Sr.No.	SEMINARS / SYMPOSIA/ CONFERENCES / TRAININGS / MEETINGS / WORKSHOPS	PLACE & DATE	PARTICIPANT (S)
1.	Annual group meeting of AICCIP	ANGRAU, Hyderabad April 2-4, 2000	Dr. MS Kairon Dr. Sheo Raj Dr. S K Banerjee Dr.K Venugopal Dr.K Ramamoorthy Dr.T Gunaseelan Dr. KN Gururajan Dr. A.Kannan. Dr. P Chidambaram Dr. T Surulivelu Dr. N Gopalakrishnan Dr. AH Prakash Dr. LS Randhawa Dr. D Monga Dr. OP Tuteja Dr. P Jeyakumar
2.	Zonal Meetings of NATP Plant Biodiversity (Zone IX)	KKV, Dapoli 23rd May, 2000 & JNKVV, Gwalior 14th-16th Jan. 2001	Dr. VV Singh Dr. Punit Mohan
3.	Group Meeting on Assessment and Effectiveness of the Bt genes for developing transgenics	NRCPB, New Delhi June 1, 2000	Dr. AB Dongre
4.	Workshop on Purna river sub basin integrated water, soil, human, livestock and allied resource development system and planning approach.	Amravati 26th June, 2000	Dr. KS Bhaskar
5.	Workshop for NATP - Rainfed Agro-eco system production systems Research programme	CRIDA, Hyderabad, June 28-29, 2000	Dr. M Chakrabarty

Participation In Seminars/Symposia/Conferences/Trainings/Meetings/Workshops

Sr.No.	SEMINARS / SYMPOSIA/ CONFERENCES / TRAININGS / MEETINGS / WORKSHOPS	Place & Date	Participant (s)
6.	Discussion-cum-Training Programme on Identification and Symptoms of Seed Borne Disease.	New Delhi Sept. 6-15, 2000	Dr. PM Mukewar
7.	Workshop on All India Launching of Agriculture Technology Information Center (ATIC),	CRIDA, Hyderabad Oct.18-19, 2000	Dr. HL Gajbhiye
8.	ICDP Meeting on Breeder / Foundation / Certified seeds	Mumbai 20th - 21st Oct, 2000	Dr. VV Singh
9.	Standing Committee Meeting of TMC	New Delhi 3 Oct., 2000	Dr. C D Mayee
10.	Director's Conference	New Delhi Oct.11-14, 2000	Dr. C D Mayee
11.	Meeting of ICDP of TMC	Mumbai Oct. 20, 2000	Dr. C D Mayee
12.	65th Annual convention of the Indian society of soil science	Nagpur Nov. 14-18, 2000	Dr. KS Bhaskar Jagvir Singh
13.	International Conference on Global Sustainable Biotech. Congress, 2000 A.D.	Nagpur 27th Nov. to 1st Dec, 2000,	Dr. AB Dongre Dr. SB Nandeshwar
14.	Seminar on "Soil health management for sustainable agriculture"	Akola Dec. 8-10, 2000	Dr. KS Bhaskar Dr. Jagvir Singh
15.	National Workshop on Planning and Management of Agriculture Extension Training	New Delhi. Jan.16-17, 2001	Dr. HL Gajbhiye
16.	National Symposium on pest management strategies - current trends and future prospects	Chennai Feb.1-2,2001	Dr. S Vennilla
17.	Seminar on Organic farming system - and eco-friendly approach for evergreen revolution	Nagpur Feb 5-6, 2001.	Dr. CD Mayee Dr. HL Gajbhiye Dr. AR Raju

Participation In Seminars/Symposia/Conferences/Trainings/Meetings/Workshops

Sr.No.	SEMINARS / SYMPOSIA/ CONFERENCES / TRAININGS / MEETINGS / WORKSHOPS	Place & Date	Participant (s)
18.	Seminar on Relevance of Ginning in the production of trash free cotton	Nagpur on 13th Feb, 2001.	Dr. VV Singh Dr. SB Singh
19.	Review Meeting of TMC-MM1	New Delhi Feb.23-24,2000	Dr. C D Mayee
20.	State Level Workshop on Medicinal and Aromatic Plants/Floriculture	Ramtek Mar.6,2001	Dr. HL Gajbhiye
21.	International Conference on nature farming and ecological balance (ICNFEB 2001)	CCS, Hisar. March 7-10, 2001	Dr. KS Bhaskar Dr. AR Raju Dr. Jagvir Singh
22.	XVI Annual group meeting of National seed project (Crops)	TNAU, Coimbatore March 8-10, 2001	Dr. K Venugopal. Dr. PM Mukewar Dr. K Rathinavel
23.	Workshop on "Action Learning Tools"	CRIDA, Hyderabad Mar.19-20,2001	Dr. HL Gajbhiye
24.	Annual Workshop on "NATP-TAR-Institute Village Linkage Program under Rainfed Agro-Ecosystem	CRIDA, Hyderabad Mar. 21-22,2001	Dr. HL Gajbhiye
25.	Workshop on TMC Project MMA3-Characterization of plant ideotypes suited for different agro climatie	UAS, Dharwad 22-23 March, 2001.	Dr. T. Gunaseelan.
26.	Monitoring and Evaluation Committee Meeting	DBT, New Delhi March 30,2001	Dr. C D Mayee
27.	अखिल भारतीय राजभाषा स्वर्ण जयंती महा सम्मेलन	बेंगलूर, 17 व 19 मार्च 2001	डा. एन.के. तनेजा,

6. VISITORS

Name & Designation	Organisation	Date
Nagpur		
• Dr. Debendra Pradhan, Union Minister of State for Agriculture	Govt. of India, New Delhi	27.8.2000
• Shri Sompal, Member, Planning Commission	Go' t. of India, New Delhi	3.7.2000 27.8.2000
• Prof. N.D. Patil Chairman	Rayat Shikshan Sanstha Satara, Maharashtra	
• Dr. Xiaoping Guo	Cotton & Oil Crop Institute China	13.10.2000
• Dr. E.A. Siddiq National Professor (ICAR)	Directorate of Rice Research, Hyderabd	
• Dr. A.S. Khera, Former V.C., PAU & Chairman, QRT	Ludhiana	17.11.2000
• Dr. G.M. Bharad, Former, V.C., Dr. PDKV & Member, QRT	Akola	17.11.2000
• Dr. R. Jayraj, Retd. Professor Pathology and Member, QRT	Coimbatore	17.11.2000
• Dr. S. Lingappa, Prof. & Head, Entomology & Member, QRT	UAS, Dharwad	17.11.2000
• Shri Shivajirao Mane, Member of Parliament & Member of ICAR Governing body	New Delhi	3.12.2000
• Dr. N.G.P. Rao Former Chairman	Agricultural Scientists Recruitment Board, New Delhi	3.12.2000
• Shri Shivajirao Deshmukh Secretary (Agriculture)	Govt. of Maharashtra, Mumbai	6.12.2000
• Shri Dhongde Joint Secretary (Agri)	Govt. of Maharashtra, Mumbai	6.12.2000
Coimbatore		
• Dr. Mangala Rai , Deputy Director General (Crops),	Indian Council of Agricultural Research, New Delhi	4 .11.2000
• Dr. R.K. Samantha, Zonal Coordinator	(TOT), ICAR, Bangalore	10.11.2000
• Dr. S. Jayaraj, Former Vice Chancellor,	TNAU, Coimbatore	24.11.2000
• Dr. A. M. Narula , Director	Directorate of Cotton Development, Mumbai.	24.11.2000
• Dr. K.R. Krishna Iyer, Director,	CIRCOT, Mumbai	24.11.2000
Dr. A.K. Basu Consultant,TMC	CCI, Mumbai	24.11.2000

Visitors

Name & Designation	Organisation	Date
• Dr. K. Arulmozhi, Director of Agriculture	Government of Tamil Nadu, Chennai	25.11.2000
Sirsa		
• Dr. B. L. Jalali, Director of Research	HAU, Hisar.	25.6. 2000
• Dr. A.K. Dhawan Senior Entomologist,	PAU Ludhiana.	26.6.2000
• Dr. A.K. Dhawan, Senior Entomologist	PAU Ludhiana.	26.6.2000
• Dr. R.K.Joshi, Head, Entomology,	RAU, ARS Sriganganagar.	29-30.7.2000
• Dr. Amerika Singh, Director	NCIPM, New Delhi.	4.8.2000
• Dr. O. M. Bambewale, Principal Scientist	NCIPM, New Delhi.	4.8.2000
• Dr. U.G.Patel, Sr. Scientist(cotton)	G.A.U., Surat	31.8.2000
• Dr. Brent E. Jehr Research Director	Mahyco life Sciences Research Center.	3 9.2000
• Dr. R.A. Maheswari, Associate Director of Research	RAU,ARS Sriganganagar.	3.9.2000
• Dr. J.S. Kolar, Director Extention Education	PAU, Ludhiana.	3.9.2000
• Dr. A.P.Singh, Sr. Entomologist	RAU,ARS Sriganganagar	3.9.2000
• Dr. Amarjit Singh Khera, Former Vice-Chancellor Chairman QRT	PAU, Ludhiana	12.10.2000
• Dr. G.M.Bharad, Former Vice chancellor Member QRT	Akola 'Sujalam' 16, Vidyanagar Akola	12.10.2000
• Dr. S. Lingappa, Professor & Head, Member QRT	Department Of Agrl. Ent. University Of Agrl. Sciences, Dharwad	12.10.2000
• Dr. R. Jeyarajan Retd. Prof. of Plant Pathology, Member QRT	Coimbatore	12.10.2000
• Dr. K. Venugopal Project Coordinator (Cotton) & Head ,	CICR, RS, Coimbatore.	12.10.2000
• Dr. S. Sreenivasan, Director	CIRCOT, Mumbai	9.12.2000
• Dr. P.L. Nehra, Agronomist,	RAU ARS Sriganganagar.	28.3.2001

QRT Visits CICR

Quinquennial Review Team (QRT), constituted for the CICR and AICCIP, comprising Dr. A.S. Khera, Chairman & Former Vice-chancellor, PAU, Ludhiana, Dr. G.M. Bharad, Member Agronomy & former Vice-chancellor, Dr. PDKV, Akola, Dr. V.N. Shroff, Member Breeding & Dean (Retd.), Agriculture College, JNKVV, Indore, Dr. R. Jeyrajan, Member Pathology and Prof. & Head (Retd.), TNAU, Coimbatore, Dr. S. Lingappa, Member, Entomology and Porf. & Head, Department of Entomology, UAS, Dharwad and Dr. K. Venugopal, Convener & facilitator and Project Coordinator (AICCIP) & Head, CICR, Regional Station, Coimbatore visited CICR, Nagpur and its Regional Stations during cropping season for reviewing of research programmes being carried out by the Institute and assess progress of research made between 1995 to 1999. The QRT members visited various field experiments and laboratories and had discussions with the scientists. The QRT members were given the compiled documents of progress of research work carried out by the Institute between 1995 to 1999 and other information and publications of the Institute.

Union Agriculture Minister & Member, Planning Commission Visit CICR

Union Minister of State for Agriculture, Dr Debendra Pradhan and Shri Sompal, Member Planning Commission visited CICR to review the latest development made by the Institute in the field of cotton research, particularly in reference to transgenic cotton, biological control of insect pests and Insecticide Resistance Management.

In a function organised on the occasion, Dr, C.D. Mayee, Director, CICR briefly outlined the mandate of the Institute. He further mentioned that establishment of cotton germplasm collection, development of transgenic cotton, Insecticide Resistance Management and use of biocontrol agents for control of cotton pests as important milestones achieved by the institute. He added that recently initiated Cotton Technology Mission would help in further increasing productivity and quality of Indian cotton. Hon'ble Minister released a booklet in English while, Shri Sompalji released a booklet in Hindi on the profile of the Institute.

Dr. Pradhan and Shri Sompalji were shown around wild species garden, bio-control laboratory, watershed and rain water harvesting, germplasm laboratory, hydroponics and Krishi Vigyan Kendra. They also visited few laboratories such as Instrumentation Cell, Transformation Lab, Tissue Culture, Insecticides Resistance Management and Molecular Pathology.

In his address, Shri Sompalji complimented agricultural scientists for their contribution in increasing agricultural production to present levels and also endorsed the suggestion that the finest cotton grown in Koraput, Kalahandi and Bolangir, the three districts in Orissa, should be notified for export. Dr. Pradhan, in his Presidential address, expressed his appreciation for developments in cotton research. He also promised all help to CICR in its further endeavor.

7. LIBRARY

Additions

The library procured 109 books, 65 scientific reports and bulletins, 60 reprints on cotton and subscribed to 40 Indian and 24 foreign journals.

Documentation Services

A. Bibliographic database on cotton

Library has developed computerized bibliographic database on cotton to provide comprehensive and update information on cotton. About 1560 bibliographic references along with abstracts have been stored in it. Documentation Service such as Current Awareness Service, SDI service, Specific

Farm Development Works

subject search service have been provided by sorting out the database. A documentation bulletin is also brought out by using the database 'Cotton Research Abstracts'.

B. Current Title Service

Library has subscribed to the current contents with abstracts on disk from I.S.I. Philadelphia and provided Current Title Service on cotton.

C. CD-ROM database Retrieval Service

Bibliographic information on cotton and other crops on various aspects are being retrieved and downloaded and provided to the users as per their demand. The following CD-ROM database were used to retrieve:

1.	CAB CD	1972-2000
2.	CROP CD	1973-1998
3.	AGRICOLA	1975-2000
4.	AGRIS	1975-2001

D. Newspaper Clipping Service

Clippings on various aspects related to cotton from local and national newspapers have been compiled and made available for references.

8. FARM DEVELOPMENT WORKS

1. Land shaping and field levelling by bulldozer and farm tractors.

   Field levelling - 12.82 ha.

   Field bundling - 2737 running meters covering about 15 ha. field area.
   Road formation - 1642 running meters with 4 mtrs. width

2. Digging of one farm pond having 30 m x 15 m x 1.30 m dimensions with a capacity of 5.51 lakh liters.

3. Deepening of one old well by 10 feet for increasing recoupment capacity.

4. Digging of one new well having 6 meter dia meter and 35 feet depth completed.

5. Construction of one bullockshed to house 8 pairs of farm bullocks and also a chaff cutter shed completed.

6. Erection of overhead electric line in about 150 mtrs length done to connect well of S.N. 128.

7. Two threshing floor sheds with dimention 8 m x 30 m provided to save crop material on threshing floor from rains.

8. The marginal land of about 13.5 ha. area not suited to field crops was developed and planted with fruit plants like Ber, Amla,Chiku and custard apple during the year.

9. HUMAN RESOURCE DEVELOPMENT

Dr. Nandini Gokte-Narkhedkar, Scientist (SS) Division of Crop Protection, CICR, Nagpur attended winter school on "Physiological and Molecular Nematology at IARI, New Delhi from November 14-December 4, 2000.

• Dr. P. Ramasundaram attended short course on Economic Evaluation of Productivity Improvements and Technical Changes in Agricultural Sector held at Indian Agricultural Statistical Research Institute, New Delhi between 24th August and 2nd September, 2000.

• Dr. P. Ramasundaram attended winter school on Decision support in Agriculture at National Academy of Agricultural Research Management, Hyderabad between 24th September and 14th October, 2000.

• कार्यालयीन कार्य हिन्दी में करने हेतु प्रेरित करने तथा उनकी झिझक दूर करने के लिए राष्ट्रीय कृषि अनुसधान प्रबध अकादमी (नार्म), हैदराबाद में दि. 22–27 जनवरी, 2001 को आयोजित कार्यशाला में श्री वी.आर. जावलकर, सहायक, भडार अनुभाग ने भाग लिया।

Human Resource Development

• Dr. M.R.K.Rao and Dr. L S Randhawa participated in the IV Management development programme for newly appointed Head of the Divisions, organised at NAARM, Hyderabad, from 30/11/2000 to 6/12/2000.

• Dr. Jagvir Singh and Dr. S Vennila attended a short training course on "System analysis and crop growth simulation in agriculture", organised by CASS, IARI, New Delhi from 20th March - 8th April, 2001.

• Dr. Blaise, participated in the Summer School on "Field experimental techniques in Integrated Nutrient Management studies" organised by Division of Agronomy, IARI, New Delhi from 28th May to 17th June, 2000.

• Dr. V.N.Waghmare under went SERC Visiting Fellowship in the area of Molecular Marker Techniques sponsored by the Department of Science and Technology, GOI from February 7 to May 6, 2000 at NRCPB, New Delhi.

• Dr. Suman Bala Singh attended three days training programme in Windows 98 and MS Office organized by M/s. Siemens between 1-3, November, 2000 at NBSS & LUP, Amravati Road, Nagpur.

• Dr. Vinita Gotmare attended a training programme on "Techniques in Plant Genetic Engineering" from February 26 to March 18, 2001 at National Research Centre for Plant Biotechnology, New Delhi.

• Dr. Punit Mohan participated in "Trainers Training Programme on Plant Genetic Resources under HRD Component of National Agricultural Technology Project on Sustainable Management of Plant Biodiversity" organized by the NBPGR, New Delhi from 2nd-21st March, 2001.

• Nalayini, P. Attended Summer School on " Field Experimental Techniques for Integrated Nutrient Management Studies" organized by the Division of Agronomy, IARI, New Delhi from 28th May to 17th June, 2000.

• Prakash, A.H. Attended training programme on 'Bio conversion of cellulosic wastes" conducted by Centre of Advanced Studies in Agricultural Microbiology, Tamilnadu Agricultural University, Coimbatore from 31-1-2001 to 20-2-2001.

• Rathinavel, K. and Manickam, S Attended the training programme on "Faculty Development Program in Research Management" conducted by Academy of Agricultural Research and Education Management , CCSHAU, Hisar from 03-11-2000 to 30-11-2000.

• Sabesh, M. Attended the Foundation Course of Agricultural Research Service at NAARM, Hyderabad from 1st December, 2000 to 30th March, 2001.

• Dr.P. Jeyakumar, attended the 69th batch on Foundation Course for Agricultural Research Service at NAARM, Hyderabad, from 6th January, 2000 to 4th May, 2000.

• Dr.Surender Kumar, underwent the DBT Associateship training at CCS Haryana Agricultural University from 1st June, 2000 to 31st May, 2001.

10. PERSONNEL AND BUDGET

Name of the Post	Sanctioned				Filled			
	NGP	CBE	Sirsa	Total	NGP	CBE	Sirsa	Total
SCIENTIFIC STAFF								
Director (RMP)	1	-	-	**1**	1	-	-	**1**
P.C. & Head	-	1	-	**1**	-	1	-	**1**
Principal Scientist, Sr.Scientist and Scientists	54	26	5	**85**	41	17	7	**65**
TECHNICAL STAFF								
Category I (T-1-3,T-2,&T-1)								
Category II (T-5,T-4,T-II-3)								
Category III (T-8,T-7,T-6)	54	39	12	**93**	48	33	11	**92**
ADMINISTRATIVE STAFF								
Administrative Officer	1	-	-	**1**	1	-	-	**1**
Finance & Accounts Officer	1	-	-	**1**	1	-	-	-
Aux. Asstt. Director (OL)	1	-	-	**1**	1	-	-	**1**
Asstt Administrative Officer	2	-	-	**2**	2	-	-	**2**
Sr. P A	1	-	-	**1**	1	-	-	**1**
Superintendent	1	1	-	**2**	1	1	-	**2**
Assistant	7	7	3	**17**	7	7	3	**17**
Stenographer II	2	1	1	**4**	2	1	1	**4**
Senior Clerk	5	4	2	**11**	5	4	2	**11**
Stenographer III	3	-	-	**3**	1	-	-	**1**
Junior Clerk	9	1	2	**12**	9	1	2	**12**
SUPPORTING								
SS. GR. - I To 1V	75	60	24	**146**	75	49	17	**141**

FINANCE :

The budget grant and actual expenditure at CICR, Nagpur and its Regional Station, Coimbatore and Sirsa for the year 1999-2000 are furnished below:

Budget Sanctioned and Expenditure

(Amount in Lakh Rupees)

Scheme	Sanctioned	Expenditure
Non-Plan	841.000	834.814
Plan	130.000	129.926
PLAN SCHEME		
NSP Crop	003.590	000.170
AICCIP	325.000	325.000
KVK Scheme	021.750	021.320
AP CESS FUND		
Regional Committee	003.500	001.605
CO_2 Scheme	-	005.596
Transgenic Cotton	—	002.658
IRM/IPM Project	007.000	007.000
ENBCHABC	001.497	002.691
R DEPOSIT SCHEME		
Front Line Demonstration	006.875	007.296
DBT Scheme	004.906	005.061
EPS EC (Donaij)	—	001.286
IRM/IPM Project	003.550	004.445
NCIPM Scheme	001.832	003.486
TMC Scheme	094.500	001.501
NRI Scheme	017.632	000.941

NATP Schemes

(in Lakhs Rupees)

	Scheme	Sanctioned	Expenditure
A	**Plan Schemes (Pis) NATP-Remittances**		
	1. Development of Hybrid Cotton Project	67.230	2124000
B	**'R' Deposit Schemes (CCPIs)**		
	1. ARIS Cell	-	-
	2. Library Information System	00.144	-
	3. ATIC	01.275	12724
	4. Development of Hybrid Cotton Project		
	a) Central Institute for Cotton Research, Nagpur	31.500	481362
	b) Central Institute for Cotton Research, Regional Station, Coimbatore	03.910	36387
	5. Plant Biodiversity Project	03.675	19967
	6. Bt. Transgenics Cotton Project	18.500	288503
	7. Rainfed Cotton Based	05.300	17830
	8. Exploitation of G.H. Project (Cbe.) 16	15.070	102268
	9. SEA & CC Based Project (PSR-24)	03.200	68739
	10. Leaf Curl Virus Project (PSR-26)		
	a) Central Institute for Cotton Research, Nagpur	14.730	108397
	b) Central Institute for Cotton Research, Regional Station, Sirsa	09.890	14006
	11. Tolerant Compact Cotton Project (PSR-27)	09.500	107077
	12. Evaluation Tillage Residue Management Project (PSR-33)	17.760	22561
	13. Adoption & Refinement Project (PSR-36)	04.380	51628
	14. Cotton-Wheat Based Production System Project (BNF) PSR-4	05.680	24750
	15. RCPS-1	05.237	70388
	16. RCPS-2	17.778	85204
	17. RCPS-3	16.959	384907
	18. RCPS-4	04.361	7821
	19. RCPS-5	15.256	1121
	20. RCPS-7	04.816	77874
	21. RCPS-8	06.799	98303
	22. RCPS-9	04.360	10333
	23. RCPS-10	08.302	242650
	24. RCPS-11	06.343	104437
	25. ROPS-10	00.630	6260
	26. CGP-1(NIC)	13.358	613734
	27. IRFIVLP-15		
	a) Central Institute for Cotton Research, Nagpur	13.520	11000
	b) Central Institute for Cotton Research, Regional Station, Coimbatore	13.520	54109

STAFF POSITION

SCIENTIFIC

Nagpur

MS Kairan	Director retd on 3-8-2k
CD Mayee	Director wef 4.8.2K
Sheoraj	Head Crop Prot
Phundan Singh	Head Crop Imp
MRK Rao	Head Crop Prod
SK Banerjee	Principal Scientist
RG Dani	"
VV Singh	Senior Scientist
PM Mukewar	"
NK Taneja	"
ST Temburnikar	"
AB Dongre	"
NK Perumal	"
HL Gajbhiye	"
RK Deshmukh	"
KS Bhaskar	"
MK Meshram	"
TV Kathane	"
TP Rajendran	"
Jagvir Singh	"
P Ramasundaram	"wef 28.03.2001
RC Ukey	Scientist (Sr.Scale)
Suman Bala Singh	"
Mukta Chakrabarty	"
SB Nandeshwar	"
SM Wasnik	"
Nandini Gokte	"
CD Ravindran	"
Punit Mohan	"
PK Chakrabarty	"
PR Vijaya Kumari	"(On deputation wef 01.04.99)
KR Kranthi	Scienitst Sr. Scale
Sandhya Kranthi	"
S Vennila	"
Vinita Gotmare	Scientist
AR Raju	"
Gautam Majumdar	"
VN Waghmare	"
G Balasubramani	"
Blaise	"
KB Hebbar	"
J Amudha	"

Combatore

K Venugopal	PC & Head
K Shanmugam	Principal Scientist
T Gunaseelan	Sr.Scientist
KN Gururajan	"
T Surulivellu	"
K Natarajan	"
A Kannan	"
P Chidambaram	"
K Ramamoorthy	"
N Gopalakrishnan	"
SESA Khader	"
B Dhara Jothi	Scientist Sr Scale
AH Prakash	"
K Rathanivel	"
P Nalayini	Scientist
S Manickam	"
Usha Rani	"
M Sabesh	"

Sirsa

LS Randhawa	Head
SL Ahuja	Scientist (Sr. Scale) on deputation
Dilip Monga	Scientist (Sr.Scale)
RA Meena	"
OP Tuteja	"
SK Verma	Scientist
P Jeyakumar	

TECHNICAL

Nagpur

NVS Gaur	T-9
PP Bhajani	T-7

Staff Positation

VV Katare	T-6
KB Chaudhari	"
Prahlad Singh	"
MS Yadav	"
BN Tule	"
KG Dewale	"
CK Shastry	"
MC Gawande	Deceased on 21.10.2000
DS Naitam	T-5
PG Ghangare	"
PP Gokulpure	"
KR Kanherkar	"
RV Nimje	"
RB Bagde	"
BR Rode	"
MT Naphade	"
DJ Mukade	"
NR Tandulkar	"
GC Gajbhiye	"
NP Kate	"
RM Lokhande	"
WU Parahate	T-4
Swati Dixit	"
DG Bhongale	"
BB Bhumber	"
PM Kawalkar	"
DD Kothe	"
BG Meshram	"
RG Dolas	"
GR Kene	"
Asore Mohanlal	"
SA Matikhaye	"
RV Salame	T-II-3
SP Muchali	"
DP Ingle	T-I-3
VP Masurkar	"
JP Patel	"
Prakash Mishra	"
JL Dongre	T-2
RT Varchaye	"
MS Kawale	T-1
RK Gaikwad	"
RT Bhagat	T-1
SK Wase	"
SN Ingle	"
VV Katole	"

Coimbatore

KN Indirakutty	T-6
M Kanagarajan	"
K Sundaravadivelu	"
SR Govindswami	T-5
A Ugravelu	"
G Gunasekaran	"
TS Govindan	"
K Rangaswamy	"
SK Palani	"
P Palaniappan	T-4
R Venkataswamy	"
Maria Joseph	"
V Muthuswamy	"
K Kaniappan	"
P Balasubramanian	"
KK Balasubramanian	T-II-3
V Palaniswamy	T-I-3
N Palaniappan	Retd on 30.06.2K
CK Surya Narayanan	"
VM Mylswamy	"
C Sundarajan	"
M Krishnan	"
BRX Pushparaj	"
T Seniappan	"
R Raman	"
K Krishnaswamy	T-2
N Sabapathy	"
N Venugopal	"
Roche Stephen	T-1
K Chinna Palaniswamy	"
S Prabhakar	"
R Murugesan	"
T Selvarajan	"

Sirsa

SK Sidana	T-6
AK Singh	"

Staff Positation

Veer Singh	T-5
Netrapal Singh	"
Suresh Kumar	"
Mohanlal	T-II-3
Banwari Lal	"
Jai Prakash	"
Purushottam Das	T-1
Rohtash	"
Om Prakash	"

ADMINISTRATIVE

Nagpur

UC Prasad	A.O.
Mithilesh Kumar	F.A.O.Trd. on 31.10.2000
Kumudini Nautiyal	Asstt. Director O.L.
Bhanu Narayanan	A.A.O.
SM Sahare	"
Uma Vaidyanathan	Sr.P.A.
VR Salame	Supdt.
VR Jawalkar	Assistant
KK Joy	"
RK Nair	"
HP Ingle	"
WU Dupare	"
MN Borle	"
Shylaja Sasidharan	"
NV Dhande	Steno - II
RG Iyer	"
MC Tiwari	Jr. Steno
SS Kulkarni	Sr. Clerk
CM Wakodkar	Senior Clerk
RR Kulkarni	"
EAM Ismail	"
AN Khan	"
DN Gudhane	"
ST Wakade	Jr. Clerk
UM Narkhede	"
DJ Mathe	"
NP Tupte	"
NP Wasnik	"
N Ramesh	"
VD Bende	Jr. Clerk
SP Kharche	"

Coimbatore

JP Gurubatham	Supdt.
TK Palaniswamy	Assistant
S Palaniswamy	"
V Rathanasabapathy	"
R Palniswamy	"
G Vairavaswamy	"
R Mayandi	"
M Madaswamy	"
S Natarajan	Sr.Clerk
K Ramalingan	"
AK Mohan	"
Lakshmi Krishnamurthy	Steno-I
Sundaravalli M Kumar	Jr.Clerk

Sirsa

Ved Prakash	Assistant
Narender Kumar	"
Jagdish Kumar	"
Surender Kumar	Steno-II
Dilip Singh	Sr.Clerk
Rajbir Singh	"
Richpal Singh	Jr.Clerk
Satbir Singh	"

SUPPORTING

Nagpur

WT Khanpasole	SS.Gr-IV
VH Solanki	SS.Gr-III
MS Panchabai	"
RD Dohare	"
HS Charde	"
SS Maraskolhe	"
HS Sawalkar	"
UK Raut	"
BZ Niswade	"
SU Patil	SS.Gr-II
LS Narkhede	"
RJ Kharche	"

Staff Positation

PN Avhad	SS Gr.II
AJ Thakur	"
PV Patil	"
Y Asore	"
SV Patil	"
MB Amale	"
VD Dokrimare	"
SM Shende	"
SG Kadu	"
HS Kanfade	"
BB Kothekar	"
RH Wagde	"
DV Maraskohle	"
DL Nagose	"
SN Lambat	"
EC Bhagat	"
ST Bhoyar	"
WM Uparkar	"
RN Nanwatkar	"
SS Dorle	"
BW Atram	"
DS Ganorkar	"
TG Harkhel	SS.Gr-1
BT Khanpasole	"
IS Kumbhare	"
SM Kumbhare	Deceased on 23.03.2001
GG Madan	S.S. Gr.I
SL Gorghate	"
MD Kamble	"
SM Bhalavi	"
BP Gawai	"
UK Borde	"
SS Sardar	"
LR Tekam	"
BP Chandrapure	"
GL Nawaye	"
AR Kamble	"
KR Rokade	"
RB Wagde	"
MB Wagde	"
AB Bhoyar	"
SB Nagdwane	"
ND Ingle	S.S.Gr.I
CV Nemade	"
BD Shelke	"
Badri Prasad	"
AD Belsare	"
VB Balbudhe	"
VL Rakhade	"
NR Titarmare	"
SS Sahare	"
MB Lute	"
MG Koram	"
GN Hataghare	"
DW Thool	"
CS Wagde	"
HS Masram	"
TD Parate	"
LS Kanfade	"
RG Ramtake	"

Coimbatore

N Arumugham	SS.GR-IV
M Shanmugham	"
Kalaichelvan	"
N Marudachalam	Retd on 30.6.2K
M Palaniswamy	"
V Palani	"
C Palaniswamy	"
K Arumugham	"
N Palaniswamy	"
K Natarajan	"
M Arumugham	"
K Maran	SS.GR.-III
C Swaminathan	"
N Chinnaswamy	"
S Palaniswamy	"
P Subramaniam	"
R Kandaswamy	"
V Raman	"
P Kanagasabesan	"
A Sundaram	"
R Pannerselvam	"
Periya Pappa	SS.GR-II

Staff Positation

N Subramanian	SS.GR.-II
Rami Rangan	"
R Palaniammal	"
R Arumugham	"
P Chidambaram	"
L Doraiswamy	"
K Rangaswamy	"
L Karuppuswamy	"
R Doraiswamy	"
N Narayanan	"
S Esakki	"
R Ramaswamy	"
SV Palaniswamy	"
D Yellappan	SS.GR-I
K Rajamanickam	"
A Manickaraj	"
Pappa Maran	"
A Dhanalakshmi	"
R Subalakshmi	"
P Marudathal	"
Marammal Chinnaswamy	"
M Palaniammal	"
R Sakunthala	"
B Leelavathi	"
R Nagaraj	"
William Raja	"
R Lakshmi	"

Sirsa

Ramkanwar	SS.Gr-IV
Piara Singh	"
Lal Chand	SS.Gr-IV
Bir Singh	SS.Gr.III
Rohtash	"
Bharto Devi	SS.Gr-II
Satwati	"
Jogi Ram	Vol. retd on 30.11.2K
Goma	"
Ami Lal	"
Bakhtawari	SS.Gr-I
Ashok Kumar	"
Sarbati	
Ramesh Chander	Retd on 31.03.2K
Bahadur Singh	"
Darshan Lal	"
Urmila	"
Bhaghwanti	"

KRISHI VIGYAN KENDRA

Ram Ratan	Training Associate
Gulbir Singh	"
AS Tayade	"
SS Patil	"
UV Galkate	"
Sunita Chauhan	"
PB Deulkar	T-II-3
AS Sherkar (Driver)	T-1
S S Mandape	Supdt.
S S Chalkhure	Jr.Steno-cum-comp.operator
S N Gorghate	SS Gr.I
S S Kharche	"

6. अनुसंधान की उपलब्धियाँ

फसल सुधार

नागपुर

उत्तर पूर्वी पर्वतीय क्षेत्र, मेलघाट आदिवासी क्षेत्र और कर्नाटक में किए गए तीन सर्वेक्षणों से 96 नमूने संकलित किए गए। कपास जीन बैंक में 27 देशी संकलन सम्मिलित किए गए।

नागपुर (बारानी), सिरसा तथा कोयबतूर (सिंचित) में किए गए बी आर 01 परीक्षणो में *जी. हिर्सुटम* व *जी. अर्बोरियम* कपास प्रत्येक की 100 वंशावलियों का मूल्यांकन किया गया और प्रमुख आर्थिक गुणों के लिए बेहतर जीन प्ररूपों की पहचान की गई। सवर्धन सी एन एच 152 की कपास की उपज (1579 कि.ग्रा./है.) एक बार फिर चैक किस्म एल आर ए 5166 (1236 कि.ग्रा./है.) की तुलना में दूसरे स्थान पर आँकी गई।

केन्द्र परीक्षणों में सवर्धन सी एन एच 1012 सर्वश्रेष्ठ (1540 कि. ग्रा./है.) पहचाना गया। परीक्षित 63 एफ 1 सयोजनों में से दो बेहतर संयोजन पहचाने गए। एन ई वी टी में हुई प्रविष्टि सी एन एच 36 की कपास की औसत उपज 1374 कि.ग्रा./है. आँकी गई और यह राष्ट्रीय स्तर पर पाँचवे स्थान पर रहा। 46 एफ 2 संततियों के बीजों को 6 अखिल भारतीय कपास सुधार परियोजना केन्द्रों (तीन क्षेत्रों में प्रत्येक में 2) को वितरित किया गया।

एक नई अधिक उपज, मध्यम रेशे व शीघ्र तैयार होने वाली कपास की किस्म जैसे सी एन एच 120 एम बी दक्षिणी क्षेत्र में जारी करने के लिए पहचानी गई।

कपास बीज तेल के आनुवंशिक सुधार कार्यक्रम में दो बेहतर संवर्धन जैसे सी एन ओ 131 तथा सी एन एच 2124 अ.भा.स.क.सु.प. के परीक्षण में लिए गए। केन्द्र परीक्षण में एक शीघ्र तैयार होने वाला अधिक तेल का सवर्धन सी ओ ई 26 (15.33 कि.ग्रा./है.) पहचाना गया। अन्य पाँच अधिक उपज वाली वशावलियाँ जैसे 26 वी, 5 एच, 23 ई एस, 21 डी ए व 40 ई पी उपज श्रृखला 1200–1700 कि. ग्रा. / है. के साथ पहचानी गई ।

जी. अर्बोरियम में तीन बेहतर सवर्धनो जैसे सी आई एन ए 310, सी आई एन ए 323 ए तथा सी आई एन ए 323 वी की पहचान की गई और इन्हें अ.भा.स.क.सु.प. के परीक्षणों में शामिल किया गया। सी आई एन ए 323 ए सवर्धन दक्षिणी क्षेत्र में उपज के आधार पर चौथे स्थान पर रहा । तीन नए सवर्धन जैसे सी आई एन ए 305, सी आई एन ए 306 तथा सी आई एन ए 309 राष्ट्रीय परीक्षण में सम्मिलित किए गए।

बारानी परिस्थितियों में अपलैंड कपास जीन प्ररूपों की तुलना में *जी. अर्बोरियम* जीन प्ररूप बेहतर पाए गए। एक देशी जीन प्ररूप डी एल एस ए 17 की *जी. हिर्सुटम* किस्म एल आर के 516 (931 कि.ग्रा. /है.) की तुलना में अधिकतम कपास की उपज 1955 कि.ग्रा./है. आँकी गई। रेशे की गुणता *जी. हिर्सुटम* जीन प्ररूपों के समान थी ।

अपलैंड कपास के किस्म सुधार कार्यक्रम में तीन सूखा सहिष्णु सवर्धन पहचाने गए और अ.भा.स.क.सु.प. के परीक्षणों में सम्मिलित किए गए। सवर्धन 301 का प्रदर्शन दक्षिणी क्षेत्र में अच्छा था और यह तीसरे स्थान पर रहा। अन्य बेहतर संवर्धन सी एन एच 32 व सी एन एच 380 थे।

नर बंध्य कार्यक्रम में 36 सी एम एस, 12 जी एम एस तथा सात रिस्टोरर वशावलियों का अनुरक्षण किया गया। दो नई वशावलियों जैसे एल आर ए 5166 व एस आर टी 1 को सफलतापूर्वक जी एम एस पध्दति में परिवर्तित किया गया। कुल 171 जी एम एस और 149 सी एम एस आधारित संकरों का मूल्यांकन किया गया। आशाजनक संकर एन जी एम एस एच 19, 57, 99, 16, 97 व 15 थे । जी एम एस आधारित संकर सी आई एन एच एच 109 को जारी करने का प्रस्ताव इसकी पहचान करने के लिए प्रस्तुत किया गया। एक जी एम एस आधारित देशी संकर सी आई एन ए ए 101 को अ.भा.स.क.सु. प. के परीक्षण में सम्मिलित किया गया ।

अनुसंधान की उपलब्धियाँ

उत्परिवर्तन प्रजनन अध्ययन से पता चला कि उत्परिवर्ती गुण बौना व झाड़ीनुमा एक एकल अपगामी जीन व्दारा नियत्रित होता है। सुविन के उत्परिवर्तन में मूल जनक की तुलना में अधिक औटाई क्षमता देखी गई।

अंतर्जातीय संकर जिनमें पाँच जंगली जातियाँ शामिल हैं जैसे *जी. एरिडम, जी. सोनालेंस, जी. रेमोंडी, जी. कलोजसचिएनम* व *जी. एनोमालम* को लिया गया और तीन एफ 1 जैसे एस आर टी 1 X *जी. हर्कनेसी, जी. अर्बोरियम* X *जी. रेमोंडी* तथा *जी. त्रिलोबम* X *जी. रेमोंडी* में कोलचिपलोइड का अनुप्रयोग किया गया। जंगली जातियों और *जी. अर्बोरियम* की प्रजातियों में तेल की मात्रा 11 से 24% थी।

बीज प्रौद्योगिकी के प्रयोगा से प्रकट हुआ कि पारंपरिक (हाथ से विपुसन) की पध्दति की तुलना में *जी. अर्बोरियम* व *जी. हिर्सुटम* दोनो में नर बध्य वंशावलियों (जीएमएस) में गूलर लगन का प्रतिशत अधिक था। पौध अनुपात 1:1 (मादा:नर) उपयुक्त पाया गया।

एल आर ए 5166 तथा अँजलो के जनक बीज का उत्पादन बढ़ा और भारत सरकार का बीज गाँव कार्यक्रम इस वर्ष सफल रहा।

कोयबतूर

सवर्धन सी डब्लू आर ओ के 165 जिसकी चैक की तुलना में कपास की उपज 30 प्रतिशत अधिक आँकी गई, इसे जारी किया गया और सुमगल के रूप में अधिसूचित किया गया। सुमगल किस्म की राष्ट्रीय किस्म परीक्षण में अधिकतम उपज आँकी गई। संवर्धन एम 5 के डी 26 की बारानी परिस्थितियों में कपास की औसत उपज 9.7 कु./हे. थी जो क्षेत्रीय चैक एल आर ए 5166 (7.4 कु./हे.) की अपेक्षा बेहतर था और उपज 30 प्रतिशत अधिक थी। संयुक्त संस्थान परीक्षणों में अल्टरनेरिया पत्ती धब्बा रोग अवरोधी किस्म ए एल आर–4 की अधिकतम उपज आँकी गई।

बहुस्थानीय परीक्षणा में, कोशिकाद्रव्यीय नर बध्यता आधारित सकर (एम एस 2 X 19) X ए के 2 तथा (एम एस 2 X आर के) X ए के 2 आशाजनक पाए गए। आनुवंशिक नर बध्य सकरों में जी एम एस जे 34 X 19 तथा जी एम एस 12 X पी 115 आशाजनक थे। एरिडम कोशिकाद्रव्य सहित कोशिकाद्रव्यीय नर बंध्यता के नए स्रोत का सफलतापूर्वक विकास किया गया। पारपरिक सकरों में आर एफ एफ 9 X आर एफ एम 1 तथा एल 4 X टी 7 ने चैक संकर सविता तथा एन एच एच 44 की तुलना में लगातार अधिक पैदावार दी। अतर्जातीय सकर वी 105 X बी 4 की डी सी एच 32 की तुलना में बेहतर माइक्रोनियर वेल्यू के साथ 25 प्रतिशत अधिक उपज आँकी गई।

सिरसा

प्रदर्शन परीक्षण में सकर सी एस एच 29 (आम शंकर) ने 3036 कि.ग्रा./हे. की अधिकतम उपज दी। संकर सेंडकोट 35 व्दारा रेशे की 2.5% स्पान लंबाई 28.8 मि.मी. आँकी गई। औटाई क्षमता 30.0 से 37.5 प्रतिशत थी ।

कुल 137 सकरों का चैक सकरों ओम शंकर और एल एच एच 144 के लिए मूल्याकन किया गया। सकरों की उपज सी आई एस एच 106 (2846 कि.ग्रा./हे.), सी आई एस एच एच 110 (2812 कि.ग्रा./हे), सी आई एस एच एच 234 (2812 कि.ग्रा./हे), सी आई एस एच एच 198 (2790 कि.ग्रा./हे.), सी आई एस एच एच 141 (2789 कि.ग्रा./हे.), सी आई एस एच एच 203 (2743 कि.ग्रा./हे), सी आई एस एच एच 135 (2698 कि.ग्रा./हे.) और सी आई एस एच एच 151 (2629 कि.ग्रा./हे.) आँकी गई। संकर सी एस एच एच 198 का अ.भा.स.क.सु.प. परीक्षण में पाँचवा स्थान रहा तथा इसे उत्तरी क्षेत्र के बी आर ओ 5 (ए1) में लिया गया।

कुल 45 जी एम एस तथा 16 सी एम एस आधारित संकरों का परीक्षण किया गया और तीन बेहतर जी एम एस संकर जैसे सी आई एस एच एच जी 41 (2812 कि.ग्रा./हे.), सी आई एस एच एच जी 53 (2744 कि.ग्रा./हे.), व सी आई एस एच एच जी 46 (2743 कि.ग्रा./हे.) तथा एक सी एम एस संकर सी एम एस एच एच 15 (2950 कि.ग्रा./हे.) आशाजनक पाया गया ।जी एम एस आधारित संकरों की ओटाई क्षमता 28.5 से 33.5 प्रतिशत और 2.5% स्पान लंबाई 23.4 से 28.4 मि.मी. थी। इसी तरह सी एम एस आधारित संकरों की 2.5% स्पान लबाई 24.0 से 28.7 मि.मी. थी। मध्य अगस्त से सितंबर अत के बीच किए गए संकरणों में बीज बनने, गूलर लगने व बेहतर बीज की गुणता देखी गई। इस दौरान संकरित बीजों में अंकुरण और संकर ओज सूचकांक भी अधिक था। भंडारित नमूनों में 9 माह तक रखे गए बीजों के अंकुरण में कोई उल्लेखनीय कमी नहीं देखी गई। उसके बाद धीमी कमी देखी गई लेकिन 15 माह तक भंडारित संकरों का अंकुरण प्रमाणित मानक तक था।

जी. हिर्सुटम की 1500 जननद्रव्य वंशावलियों और *जी. अर्बोरियम* की 500 वंशावलियों का अनुरक्षण किया गया और गुणता व मात्रा प्राचलों के लिए उनका मूल्यांकन किया गया। मूल्यांकन के आधार पर दो अधिक उपज वाली प्रविष्टियों को अ.भा.स.क.सु.प. परीक्षणों में जाँच के लिए लिया गया और तीन लंबे रेशे की प्रविष्टियों को विभिन्न क्षेत्रों में टी एम सी– एम एम ए 2 परियोजना के अंतर्गत जाँच के लिए लिया गया। लंबे रेशे की देशी कपास वंशावलियों और देशी कपास की स्थानीय किस्मों से 380 नए संकरण बनाए गए ।

अनुसंधान की उपलब्धियाँ

बीज प्रौद्योगिकी

कोयबतूर

भडारण की अवधि, कटेनर का प्रकार और बीज उपचार के अनुसार अकुरण क्षमता में क्रमश: 59, 10 और 4 प्रतिशत की कमी देखी गई। इमिडेक्लोप्रिड और नीम की पत्तियों का पाउडर या कार्बडाजिम के साथ इमिडेक्लोप्रिड और आयोडीन फार्मुलेशन का सयोजन एल आर ए 5166 के भडारण में बीज ह्रास के नियत्रण के लिए प्रभावी थे।

फसल उत्पादन

जी. हिर्सुटम और *जी. अर्बोरियम* की अनेक जननद्रव्य वंशावलियों का मूल्याकन किया गया। अधिकाश *जी. अर्बोरियम* वंशावलियों की *जी. हिर्सुटम* से अधिक उपज थी और शीघ्र तैयार होने वाली थी। वशावलियों में नाइट्रोजन व पोटाश ग्रहण करने में व्यापक भिन्नता देखी गई।

खेत परीक्षणों से स्पष्ट देखा गया कि गूलर लगने की प्रारंभिक अवस्था और अधिकतम गूलर लगने के समय दो जीवन रक्षक सिचाई करने से अधिकतम उपज प्राप्त की जा सकती हैं। सीमित जल आपूर्ति के मामले में अधिकतम गूलर लगने के समय फसल की सिंचाई करनी चाहिए।

दीर्घकालीन अध्ययनों में फास्फोरस उर्वरक के महत्व पर जोर दिया गया। अच्छा उपज प्राप्त करने के लिए उर्वरकों का संतुलित उपयोग करना होगा। नाइट्रोजन की आशिक मात्रा का कार्बनिक स्रोत व्दारा अनुपूरक उपयोग करना सबसे अच्छा उपचार है क्योंकि इससे मृदा के भौतिक व रासायनिक गुणों में सुधार होता है।

अध्ययन के पाँचवे वर्ष में मृदा में कार्बनिक सी में सुधार के बावजूद उपज में 1.4 – 10.9% की कमी देखी गई, सभवत: अधिक खरपतवार सघनता के कारण (डिकाट खरपतवार) काली मृदा में कपास की बुवाई के लिए बैल चलित सीड ड्रिल कम प्लांटर का परिष्करण किया गया और खेत में उपयोग कर जाँच की गई। इससे की गई ड्रिल संतोषजनक थी जैसे बीज भूमि की सतह से 5 सें.मी. की समान गहराई पर रखे गए।

ड्रिप सिचाई पध्दति से उर्वरकों का अच्छा स्तर देखा गया तथा उर्वरक उपयोग क्षमता भी बढ़ी।

नागपुर में किए गए (100 किसानों) सर्वेक्षण में देखा गया कि अंत: फसल पध्दतियों को अपनाया गया और मुख्य कठिनाइयों को समझा गया।

नागपुर, अमरावती व यवतमाल जिलों के खेत परीक्षणों में किसानों व्दारा अपनाई जा रही प्रक्रिया की तुलना में समेकित पोषक प्रबध की उपयोगिता की ओर ध्यान दिलाया गया।

उत्तर भारत के कपास–गेहूँ क्षेत्र में गेहूँ की कटाई के बाद खेत में फसल के काफी अवशिष्ट रह जाते हैं, इन्हें खेत में इकठ्ठा कर जला देना चाहिए। छोटे किसान हाथ से गेहूँ की फसल की कटाई करते हैं और अवशिष्ट का उपयोग पशुओं के आहार के लिए करते हैं।

किस्में पी के वी 081 तथा सी एन एच 911 सुगठित होने के कारण कपास की यांत्रिक चुनाई के लिए उपयुक्त हैं। एन एच एच 44, 90 X 10 अतराल पर चुनाई के लिए उपयुक्त है।

बारानी परिस्थितियों के अतर्गत की गई जाँच से पता चला कि चुनाई यत्र (पिकर) का परिमाप पक्ति के दोनों तरफ 22 से.मी., जमीन से 8.5 सें.मी. और कुल ऊँचाई 75 सें.मी. होनी चाहिए।

कोयबतूर

जलमग्न सिचाई की अपेक्षा ड्रिप सिंचाई अधिक उपज प्राप्त करने में सहायक रही। 100% जल आपूर्ति से जलमग्न सिंचाई और उसके 50% जल की ड्रिप सिंचाई में समान आर्द्रता देखी गई।

उपज को बढ़ाने में सूक्ष्म पोषक तत्वों पर जोर देते हुए सूक्ष्म पोषक तत्वों (12.5 कि.ग्रा./है.) के साथ सामान्य उर्वरक (90:45:45 कि.ग्रा. ना.फा.पो./है.) के उपयोग से कपास की 23.5 कु./है. की अधिकतम उपज आँकी गई।

प्रोमेट्रान 2.0 कि.ग्रा. सक्रिय तत्व/है. और गेसगार्ड 1.5 कि.ग्रा. सक्रिय तत्व/है. की दर का अनुप्रयोग खरपतवार नियंत्रण के लिए प्रभावी था और इससे कपास की बेहतर उपज आँकी गई।

कपास–परती–कपास की अपेक्षा कपास–ज्वार फसल चक्र में कपास की उपज अधिक हुई। मृदा में ना.फा.पो. का अवशिष्ट कपास– परती – कपास की अपेक्षा कपास–ज्वार चक्र में अधिक पाया गया।

सिरसा

एजोटोबैक्टर स्ट्रैन एच टी 54 (1) और ए सी 18 ने कपास की किस्म एच 1098 में कपास की बेहतर उपज दी जबकि गेहूँ में किस्म पी बी डब्लू 343 में एजोटोबैक्टर स्ट्रैन एच टी 57, एच टी 54 (1) तथा ई–12 से बेहतर उपज हुई।

कपास–गेहूँ उत्पादन पध्दति के लिए जोत व अवशिष्ट प्रबंध के मूल्यांकन के अध्ययन से पता चला कि मिट्टी पलटने वाले हल से जुताई करने पर कपास की उपज बेहतर हुई और जब बुवाई से पूर्व अवशिष्ट को जला दिया गया था।

अनुसंधान की उपलब्धियाँ

पादप कार्यिकी एव जैव रसायन

नागपुर

जी. अर्बोरियम, जी. हर्बेरियम व जी. हिर्सुटम के 15 जीन प्ररूपों में सूखा सहिष्णु विशेषताएँ स्पष्ट थीं। देशी कपास के जीन प्ररूपों में सापेक्षतः अधिक ओस्मोरेगुलेशन और जड़ तना अनुपात था जबकि जी. हिर्सुटम जीन प्ररूपा में अधिक पत्ती जल क्षमता बनी रही। जी. हर्बेरियम में पत्ती वाष्पोत्सर्जन कलिग तथा उपज स्थायित्व की प्रवृत्ति देखी गई।

देशी कपास में प्रतिबल परिस्थितियों में सामान्य नाइट्रेट रिडेक्टेज एक्टिविटी थी। 25 सकरणों की एफ 2 सतति में पी 1 X एस पी 3939 तथा पी 7 X एस पी 3895 म सापेक्षतः अधिक सूखा सहिष्णुता देखी गई।

लवणता सहिष्णुता के अध्ययनों में जगली जातियों और जर्मप्लाजम वंशावलियों के संकरण की स्थाई संततियों में सहिष्णु वशावलियों की पहचान की गई। सहिष्णु वंशावलियों में पत्ती क्षेत्रफल व बायोमास तथा सिंचित आसमेटिक सोल्यूटस व पोटाश की अधिक मात्रा में थोड़ी कमी पाई गई। सहिष्णु वशावली की एस डी एस प्रोटीन प्रोफाइल से सुस्पष्ट एक्सट्रा बेंड प्रकट हुआ।

सामान्य या अधिक जलमग्न परिस्थितियों में सामान्य प्रतिबल में उपज ह्रास आंशिक था जबकि अधिक प्रतिबल परिस्थितियों में यह बहुत अधिक प्रभावित हुआ। एशियाई कपास अधिक सुग्राह्य थी और हिर्सुटम किस्मों में पत्ती क्षेत्रफल और बायोमास में तोव्र प्रति लाभ देखा गया और उपज में स्थिरता देखी गई।

वृध्दि नियामकों और पोषक तत्वों की साद्रता के दो स्तरों में पत्ती सापेक्ष जल मात्रा में उल्लेखनीय वृध्दि हुई। देरी से पौध लगाने पर वृध्दि व उपज में कमी हुई। यह प्रतिकूल प्रवृत्तियाँ कम तापमान के प्रभाव से हो सकती हैं। एल आर ए 5166 व सी डब्लू आर ओ के में कलियाँ लगते समय इथ्रेल और मेलिक हाइड्राजिड के साथ सिंक मेनिपुलेशन से इथ्रेल की कम साद्रता से कलियों में विगलन देखा गया जबकि इथ्रेल की अधिक साद्रता ने पत्ती संवेदनशीलता को प्रेरित किया। मेलिक हाइड्राजिड से पौधे की वृध्दि हुई। दोनों को मिलाकर अनुप्रयोग करने पर पौध की आकृति में बदलाव आया । इसकी अधिक सांद्रता से प्रकाश सश्लेषण और घुलनशील प्रोटीन की मात्रा में कमी आई।

गहरी मृदा की अपेक्षा उथली मृदा में पत्ती क्षेत्रफल और बायोमास उत्पादन अधिक था। उथली मृदा में पौध लगाने के 120 दिनों तक 120 कि.ग्रा. तक नाइट्रोजन के अनुप्रयोग से पत्ती क्षेत्रफल में वृध्दि हुई जबकि गहरी मृदा में नाइट्रोजन का प्रभाव पौध लगने के 90 दिनों बाद देखा गया। अर्बोरियम किस्म में दोनों प्रकार की मृदाओं में 120 कि.ग्रा.ना./है. तक प्रभाव देखा गया जबकि हिर्सुटम व सकर में केवल 80 कि.ग्रा.ना./है. तक प्रभाव देखा गया। कपास की बेहतर उपज उथली मृदा में प्राप्त हुई। फलन अगों के कार्यिकी झड़न की जाँच में जी. अर्बोरियम जीन प्ररूप ए के ए 8401 में जी. हिर्सुटम के एल आर ए 5166 की तुलना में अधिक सिंक एक्टिविटी देखी गई ।

पौध लगने के 55 व 76 दिनों बाद मेटासिस्टाक्स व फेनवलरेट के छिड़काव से क्रमशः कुल फिलोन मात्रा में प्रारंभिक कमी और रिड्यूसिंग शूगर स्तरों में वृध्दि देखी गई। उपचारों के 168–192 घंटों बाद सामान्य प्रभाव था। कीटनाशकों के अनुप्रयोग की प्रतिक्रियास्वरूप रंध्रीय अवरोधता में वृध्दि हुई और वाष्पोत्सर्जन दर कम हुई। उपचारों के कारण पत्ती सापेक्ष जल मात्रा में वृध्दि हुई।

कोयबतूर

बढ़े हुए सी ओ2 व तापमान के परस्पर प्रभाव के अध्ययनों में उद्घाटित हुआ कि यदि वातावरण में सी ओ2 स्तर 650 पी पी एम से अधिक होता है और तापमान 40^{0} सें. से अधिक तो फोटोसिथेटिक एक्टिविटी से कपास के पौधो को नुकसान हो सकता है।

जीन प्ररूप जैसे एच 777, के जी एल 54620, आई सी 1356 व जी एस 625 को सूखा सहिष्णु के रूप में वर्गीकृत किया गया और जीनप्ररूप जैसे सी एस एच 683–6, आरोग्य, के 3475 हिस्टेरिसिस कर्व पध्दति से सिंचित परिस्थितियो के लिए अनुकूल थे।

रिड्यूसिंग शूगर और फिनोल रेशे की लबाई में वृध्दि के लिए महत्वपूर्ण भूमिका निभाते हैं। रेशा और बीज रिडयूसिंग शूगर का अनुपात रेशे की लंबाई में वृध्दि के साथ सकारात्मक संबध प्रकट करता है।

प्रारभिक अवस्था में कलियों का यात्रिक विधि से तोड़ने से फलन अगों के लगने में तेजी से वृध्दि हुई और इससे सामान्य पौधों की तुलना में कपास की उपज बेहतर हुई।

सुग्राह्य जीन प्ररूपो की तुलना में बालवर्म सहिष्णु जीन प्ररूपों में विकसित कलियों और गूलर की परतों में प्रोटक्टिव एजाइम पेरोक्सीडेज का सचय देखा गया। अनुमान है कि छोटे गूलरों में आर्थोडाइहाइड्राप्सी एव कुल फिनोलिक्स पर पेरोक्सीडेज प्रक्रिया की दोहरी प्रतिक्रिया से बने पदार्थ ने छोट विकासशील गूलरों में बालवर्म के प्रति सहिष्णुता प्रदान की। इसी प्रकार यह भी देखा गया कि सुग्राह्य जीन प्ररूपों की तुलना में सहिष्णु जीन प्ररूपों में पोषक तत्वों की मात्रा कम थी।

छोटी पौध अवस्था में पौध मेटाबालिज्म पर कीटनाशक बीज उपचार का लाभकारी प्रभाव देखा गया । नियमित कीटनाशकों के बार–बार उपयोग से एन आर एक्टिविटी में कमी और गॉसीपाल की मात्रा में वृध्दि हुई।

अनुसंधान की उपलब्धियाँ

फसल सरक्षण

नागपुर

बारह एफ 1 ने चूसक कीटों के प्रति अधिक अवरोधता और बालवर्म के प्रति सहिष्णुता दर्शाई।

गौसीपियम बिकी में *हे. आर्मीजेरा* की छोटी इल्लियों के लिए जहरीले प्रोटीन पाए गए हैं जो गट एजाइम को रोकते हैं। सेमिलूपर से क्षतिग्रस्त कपास की किस्म या संकर के उपर *हे. आर्मीजेरा* की इल्लियों के वजन में उल्लेखनीय कमी पाई गई। इल्लियों की वृध्दि के लिए कार्बोहाइड्रेट और प्रोटीन जैसे आवश्यक पोषक तत्वो के स्तर में उल्लेखनीय कमी होने के कारण *हेलिकोवर्पा आर्मीजेरा* के वजन में कमी पाई गई इसके अतिरिक्त फीडिंग डिटरेंट जैसे रूटिन व क्लोरोजेनिक एसिड की बढ़ी हुई सादता भी *हे. आर्मीजेरा* की कम वृध्दि का कारण थी।

किस्मों व संकरों दोनों में सरक्षित और असरक्षित परिस्थतियों में फिनालाजी और नाशीकीटों के प्रभाव का पता लगाया। सुग्राह्य किस्मों में संरक्षित परिस्थितियाँ चूसक कीटों के उदगम के लिए अनुकूल थीं। अगस्त प्रथम सप्ताह में जैसिड आर्थिक नुकसान सीमा से अधिक देखे गए। लूपर की सख्या अगस्त प्रथम सप्ताह से देखी गई जिसमें अगस्त के दूसरे सप्ताह और मध्य सितंबर में सर्वाधिक थी। सितबर प्रथम सप्ताह से अक्तूबर के तीसरे सप्ताह तक *इएरिस* और *हेलिकोवर्पा* के बीच नुकसान और इनका सर्वाधिक होना अलग-अलग समय में थे। *एस. आर्मीजेरा* अक्तूबर के दूसरे पखवाड़े से कपास में नही था जबकि *इएरिस*, एच. आर्मीजेरा के एक माह बाद नवबर के पहले पखवाड़े तक था। *पेक्टिनोफोरा* अक्तूबर के दूसरे पखवाडे से शुरू हुआ और *एच. आर्मीजेरा* से कुल फलन अंगों की क्षति हमेशा आर्थिक नुकसान सीमा से अधिक 10 और 92% के बीच थी। नाशीकीटों के कम दबाव के बावजूद चूसक कीटो से 13.5% की क्षति हुई जबकि *हेलिकोवर्पा* पेक्टिनोफोरा तथा इएरिस से क्रमशः 5.59, 4.86 और 3.53% की क्षति हुई।

आठ और एटोमोपेथोजेनिक नेमाटोड्स का विलगन किया गया और *हेलिकोवर्पा आर्मीजेरा* के लिए उनका मूल्याकन किया गया। ई पी पी आई एस 15 इनफेक्टिव जुवेनिल्स प्रति लार्वा प्रभावी पाया गया। ये एकल कपास के अन्य नाशीकीटो के लिए भी प्रभावी थे। इनका बहुस वर्धन डॉग बिस्किट व किडनी पेपटान पर सफलतापूर्वक किया गया और *हे. आर्मीजेरा* के ऊपर इनके प्रभाव में कोई कमी नहीं पाई गई।

उष्ण प्रदेशों से लिए गए एकल अधिक तापमान और शीत प्रदेशों के एकल कम तापमान में अधिक प्रभावी थे।

खेत परीक्षणों में पौध परजीवो नेमेटोडस से 8-10% नुकसान आँका गया। *आर. रेनिफोर्मिस* भी बहुत बार होने वाली और प्रभावी जाति थी। खेत के ऐसे हिस्से जहां पर कपास के पौधों में कम वृध्दि हुई उनमें रूट नाट नेमेटोड पाया गया।

पाइरेथ्राइड अवरोधता अर्ध प्रभावी पाई गई। नर्व असंवेदनशीलता कम प्रबल और मेटाबोलिक मैकेनिज्म प्रभावी थे। चौबीस आर ए पी डी प्राइमर्स अवरोधता का पता लगाने के लिए एस सी ए आर आधारित मोलीकुलर मार्कर्स के रूप में उपयोग के लिए पहचाने गए।

एक कई रोगों के लिए अवरोधी संकर को अ भा.स.क.सु.प. के सिंचित क्षेत्रों में बहु स्थानिक परीक्षण के लिए शामिल किया गया। *जी. हिर्सुटम* की 14 वशावलियाँ दहिया के लिए अवरोधी पाई गई ।

फ्यूजेरियम उकठा के लिए अवरोधी, अच्छी खेती व रेशे के गुणों वाले पाँच सवर्धन विकसित किए गए।

किस्मों और संकरों की खराब कपास में आठ कपास फफूंद और जीवाणु झुलसा रोगजनक *एक्स ए पी वी माल्वासिएरम* देखे गए।*अल्टर्नेरिया मेक्रोस्पोरा* से ग्रसित नमूने कपास की तुलनात्मक बीज जाँच हेतु लिए गए।

सुग्राह्य किस्मों से एक्स ए एम की छः प्रजातियाँ जैसे 3, 6, 7, 10, 15 व 18 पहचानी गई। प्रजातियाँ 10 व 18 पूर्वप्रभावी थीं । प्रजातियाँ 3, 5, 7, 10 व 18 उत्तर प्रदेश से एकत्रित नमूनों में से पहचानी गई । 226 जननद्रव्य वशावलियों में से तीन वशावलियाँ एक्स ए एम की उग्र प्रजाति के लिए रोग मुक्त और छः वशावलियाँ अवरोधी थीं।

जी. हिर्सुटम की 1649 जननद्रव्य वंशावलियों का खेत में परीक्षण किया गया। जिनमें अल्टरनेरिया पत्ती धब्बों के लिए 35 असक्राम्य, 118 अवरोधी, 774 मध्यम अवरोधी, 427 मध्यम सुग्राह्य व 295 सुग्राह्य पाई गई जबकि 1400 दहिया के लिए असक्राम्य थीं।

जैवकारकों की बिक्री से लगभग पाँच लाख रुपये प्राप्त हुए।

कोयंबतूर

कोयंबतूर में लगातार दो शीतकालीन कपास के मौसमों में *हेलिकोवर्पा* के लार्वा और उससे होने वाले नुकसान पर किए गए अन्वेषण से प्रकट हुआ कि जहाँ पर लार्वा से फलन अंगों का नुकसान 5% हुआ वहां प्रति पौध 0.5 लार्वा था और लार्वा की सख्या और फलन अगों के नुकसान के मध्य ठोस धनात्मक सहसंबंध (आर = 0.71) था।

इमिडेक्लोप्रिड और थिओमेथाक्सम जैसिड को 45 दिनों और एफिड

अनुसंधान की उपलब्धियाँ

को 35 दिनों तक नियंत्रण करने में प्रभावी थे। एसेटामिप्रिड का 10 ग्रा./है. छिड़काव फार्मुलेशन जैसिड के लिए प्रभावी था और इससे अधिकतम उपज आँकी गई।

दो नए कीटनाशक जैसे बिफेंथ्रिन और एफ 6028 तथा दो संयोजी कीटनाशक एक आई जी आर (मैच + क्लोरपाइरिफास) के साथ तथा दूसरा एक्टिनोमाइसेटस (स्पिनोसेड + क्लोरोपाइरिफास) के साथ बालवर्म के नियंत्रण के लिए प्रभावी पाए गए और बेहतर उपज आँकी गई।

किसान प्रतिभागिता कार्यक्रम में आई पी एम और आई आर एम रणनीति अपनाने पर बेहतर नाशीजीव नियंत्रण, कीटनाशकों का सीमित उपयोग, प्राकृतिक शत्रुओं का बेहतर सरक्षण व सवर्धन के परिणाम सामने आए और प्रति इकाई क्षेत्रफल से निरतर बेहतर कुल लाभ प्राप्त हुआ।

आर्थिक नुकसान सीमा पर छिड़काव सरक्षण के आधार पर, बी टी कपास (एम ई सी एच 12) को तीन छिड़काव की आवश्यकता है जबकि इसके प्रतिरूप नान बी टी (एम ई सी एच 12) और चैक संकर (एन एच एच 44, सविता) को पाँच छिड़काव की आवश्यकता है।

बी टी कपास सकरों (एम ई सी एच 12, एम ई सी एच 162 और एम ई सी एच 184) में इनके प्रतिरूप नान बी टी सकरों और चैक सकरों की तुलना में *एच. आर्मीजेरा* व *इएरिस* का प्रकोप और गूलरों व लाक्सूल्स में होने वाला नुकसान उल्लेखनीय रूप से कम था। नेओनेटस के साथ पत्ती बायोएसे अध्ययनों से प्रकट हुआ कि बी टी कपास में 96 घटों के बाद *एच. आर्मीजेरा* की मृत्यु दर 60.8:, नॉन बी टी कपास में 28.3%, चैक सकरों में 17.5 से 20% थी। नान बी टी कपास की अपेक्षा बी टी कपास में लार्वा वजन में कमी 72.2% थी।

रोग के दिखते ही तुरंत छिड़काव करने पर नए फफूँदनाशक जैसे, प्रोक्लोराज व टेब्यूकोनाजोल और जैव कारक *ट्राइकोग्रार्मा विरिड* और *स्यूडोमोनास फ्लूरोसेंस* पी एफ आई दहिया रोग के नियंत्रण के लिए कार्बेन्डाजिम के समान प्रभावी थे, जाँच की गई *जी. अर्बोरियम* वशावलियों में 1314 एन, 30838 और 30841 अल्टरनेरिया पत्ती धब्बा के लिए अत्यधिक अवरोधी पाई गई। केन्द्र के परीक्षणों में संवर्धन सी बी आर 21 जीवाणु झुलसा के लिए वी एल वी 6 वर्टिसिलियम मुरझान और ए एल आर 4 अल्टरनेरिया के लिए अवरोधी देखे गए। अल्टरनेरिया पत्ती धब्बा अवरोधी वंशावली 727 समन्वित परीक्षणों में अच्छी पाई गई ।

सिरसा

जब सस्तुत कीटनाशकों और किसानों की प्रक्रियाओं से तुलना की गई तब केवल वानस्पतिक और जैव कारकों से किए गए उपचारित प्लाटों में गूलर क्षति अधिक थी और उसके बाद आई पी एम प्लाटस में थी कपास की उपज किसानों व्दारा अपनाई जा रही छिड़काव पध्दति में अधिक थी उसके बाद आई पी एम प्लाटस की थी। *हेलिकोवर्पा* आर्मीजेरा (56,500 एल ई) व *ट्राइकोग्रामा* एग कार्डस के न्यूक्लियर पालिहेड्रोसिस विषाणु का बहुउत्पादन किया गया तथा एफ एल डी किसानों व्दारा प्रचार किया गया और अन्य किसानों को भी बेचा गया।

एपिडेमिआलाजी के अध्ययनों से प्रकट हुआ कि अधिक तापमान और कम सापेक्ष आर्द्रता में पर्ण कुंचन रोग कम था।

जी. हिर्सुटम की 1040 जननद्रव्य वंशावलियों की जाँच से प्रकट हुआ कि खेत की परिस्थितियों में 686 वशावलियाँ पत्ती मोड़क रोग के लिए अवरोधी थीं। वंशावलियाँ वी वी–772 (शीघ्र), एस एफ ए 243 व आई एच 144–3–62 जड़ गलन रोग के लिए सहिष्णु थीं। एन ए टी पी परियोजना के अंतर्गत कपास पत्ती मोड़क विषाणु व सफेद मक्खी की अवरोधता के लिए छाँटी गई 202 जननद्रव्य वंशावलियों में से 68 वंशावलियां पत्ती मोड़क रोग और 7 वंशावलियाँ सफेद मक्खी रोग के लिए रोगमुक्त थीं। इमिडेक्लोप्रिड 600 एफ एस 9 मि.ली./कि.ग्रा. की दर से बीज उपचार तथा ट्राइजोफास 40 ई.सी. 750 ग्रा. सक्रिय तत्व/है. का पर्णिल छिड़काव सफेद मक्खी वाहक के प्रबधन व्दारा कपास पत्ती मोड़क रोग प्रबधन के लिए बहुत प्रभावी था।

अग्रपंक्ति प्रदर्शन

इस कार्यक्रम के अंतर्गत तीन राज्यों (हरियाणा, पजाब व राजस्थान) में प्रत्येक में एक हैक्टर में सौ प्रदर्शन कार्यक्रम किए गए। इस कार्यक्रम के अंतर्गत उपयुक्त किस्मा, प्रभावी और किफायती फसल सरक्षण रणनीति, कीट व रोग नियत्रण के लिए आई पी एम/आई आर एम प्रक्रियाएँ और सकर बीज उत्पादन की तकनीकों का किसानों के खेतों में प्रदर्शन किया गया।

अर्थशास्त्र

कोयंबतूर

संस्थान गाँव सपर्क कार्यक्रम में समन्वित फसल प्रबध रणनीति व्दारा फसल उत्पादन की सभी समस्याओं के सबंध में बताया गया। गैर परियोजना की तुलना में परियोजना में शामिल किसानों के खेतों में किए गए प्रौद्योगिकी प्रदर्शनों व्दारा कपास, टमाटर व हल्दी से अधिक कुल लाभ प्राप्त हुआ।

5. GENERAL

Research Publications

A. Research/Review papers published in journals

Author (s)	Title	Journal
Ahuja SL Tuteja OP	Association studies among yield and some physiological parameters in cotton (*Gossypium hirsutum* L.).	J. Cotton Res. & Dev., 2000 14 (1):102-106
Ahuja SL Tuteja OP Banerjee SK	Biochemical basis of resistance to bollworms and jassids in cytotypes of *Gossypium hirsutum* cotton.	J. Cotton Res. & Dev., 2000 15 (1):87-92.
Ahuja SL Tuteja OP	Heterosis and combining ability for yield and its component traits in upland cotton.	J. Cotton Res. & Dev., 2000 14:138-142.
Ahuja SL Tuteja OP	Variability studies for yield, its components and physiological attributes under stress condition in *Gossypium hirsutum* cotton.	J. Cotton Res. & Dev., 2001 15(1):15-18.
Ahuja SL Tuteja OP	Variability and association and analysis for chemical components imparting resistance in *Gossypium hirsutum*.	J. Cotton Res. & Dev., 2001 14 (1):19-22.
Ahuja SL Tuteja OP	Performance of F_2 hybrids from line x tester crosses in upland cotton (*Gossypium hirsutum L.*)	J.Indian Soc.Cotton Improv. 2000 ; 25:104-105.
Asanov K Eveleens KG Jadhav DR Jones KA	ICM in Cotton- A success story?	International Pest Control, 2001 ; 43 (1), 8-10.

Research Publications

Author (s)	Title	Journal
Kranthi KR Regupathy A Russell DA Sagenmuller A Singh J Verkerk RHJ		
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B. Projectwise Salient Achievements

CROP IMPROVEMENT

- Twenty seven new collections were added to the gene bank, 300 accessions have been evaluated and five have been sent for registration during the year.
- Two high oil content cultures CNO 131 and CNH 2124 were entered in AICCIP.
- Mutant character- dwarf bushy type controlled by single recessive gene.
- Culture CWROK 165 was released as variety **Sumangala.**
- A new high yielding, medium staple, early maturing cotton variety **CNH 120 MB** was identified for release in south zone.
- Two new lines viz LRA 5166 and SRT have been converted into GMS system.
- Boll setting percentage in male sterile lines (GMS) was higher than in conventional hybrids.
- Period of storage, nature of container and seed treatment accounted for 59,10 and 4 per cent of loss of viability.

Nagpur

P1-86/1-ICR-F30/0430: **Collection, conservation, evaluation, documentation and utilization of genetic resources of three cultivated species of *Gossypium*** (V.V.Singh and Punit Mohan).

G.hirsutum

Through three explorations undertaken in NEH region, Maharashtra, Karnataka and Andhra Pradesh during the year, 47 samples of *G. arboreum,* 46 samples of *G. herbaceum,* and three of *G. hirsutum* were collected.

Twenty seven new collections were added to the gene bank. All the accessions of *G. hirsutum* available in the gene bank (more than 5900) were grown during the crop season. Wide range of genetic variability was observed among the new collections for seed cotton yield/plant (2-137 g), boll weight (1.6-5.8 g), mean halo length (14.3 to 30.0 mm), ginning outturn (27.1 to 39.0%), plant height (96-139 cm), seed index (5.8-9.5 g).

Multilocation evaluation of 100 accessions of *G. hirsutum* was done at Sirsa and Coimbatore (irrigated) and Nagpur (rainfed). Ten best genotypes for individual economic characters were identified. Superior genotypes identified were Buri 0394 (1075), Deltapine 2J-13, LL 60, Delfos CC (Kapas yield), EL 174EBR, CTI 425-45R (y), Lassani 11B, K 3299, LU 313W (Boll weight), GP Pool, M 100 Sind, CTI 425-45R (y), Delcerro, CHB-5-80 (GOT) and EL 174 (YC), GC 32, EWLS x Tidewater, ST 405, ELS 103 (Y), K 40009 Sort 3151B (MHL).

In Common Station Trial, four superior cultures were sponsored and culture CNH 152 recorded second highest (1579 kg/ha) seed cotton yield as compared to the check LRA 5166 (1236 kg/ha).

Crop Improvement

In Station Trial, out of 13 cultures, four cultures viz. CNH 1012 (1540 kg/ha), CNH 152 (1415 kg/ha), CNH 1020 (1323 kg/ha) and CNH 1007 (1293 kg/ha) recorded seed cotton yield over the checks LRA 5166 (727 kg/ha) and CNH 36 (1015 kg/ha).

Out of 63 F_1 combinations tested, two were identified for further testing.

In AICCIP National Trial (Br 02 a), culture CNH 152 recorded 1320 kg/ha of seed cotton yield in North Zone, 998 kg/ha in Central Zone and 1513 kg/ha in South Zone.

CNH 1007 and CNH 36 were sponsored in National (Br 02 b) and NEVT trials respectively for 2001-2002 crop season.

In NEVT conducted at 17 locations, CNH 36 recorded an average seed cotton yield of 1374 kg/ha and 1655 kg/ha in national and zonal trials respectively (south zone) and ranked fifth.

CNH 120 MB was identified for release for the irrigated tract of south zone.

Seeds of 46 F_2 generation segregating materials involving exotics were distributed to six AICCIP centres i.e. HAU, Hisar and RAU, Sriganganagar (N.Z.), GAU, Surat and MAU, Nanded (C.Z.) and UAS, Dharwad and ANGRAU, Lam, Guntur (S.Z.).

More than 390 single plant selections were made from 63 F_2 progenies involving exotic germplasm. Further, 350 were selected from other breeding materials.

Nucleus seeds of cotton variety CNH 36 (1.0 q.) and parental lines of hybrid Kirti (CICR HH1) i.e. CP 15/2 (Sel.) male (5 kg) and Bikaneri Narma (Sel.) female (2 kg) were produced.

G. arboreum

Collection of germplasm : In *G. arboreum*, 33 accessions were collected from West Garo Hills of Meghalaya (Tribal area). Nine accessions of *G. arboreum* and three accessions of *Thespesia lampus* (close relative of *Gossypium*) were collected from Melghat region of Amravati district.

Evaluation of germplasm : 100 accessions of *G. arboreum* were evaluated under Br 01 trial in three zones for seed cotton yield, boll weight, GOT (%) and MHL (mm). Ten best genotypes were identified for yield which included 79/BH 111, 3058, 6187, 6481, 30813, 30797, 3058, 1011, 30785 and 6536.

Registration of germplasm : Proposal for registration of five germplasm lines of *G. arboreum* immune to grey mildew (EC No.174092, 30814, 30826, 30838 and 30856) was sent to NBPGR, New Delhi for registration. Another proposal for two germplasm lines of *G. hirsutum* namely CNH 123 and CNH 1012 resistant to cotton leaf curl virus (CLCuV) also was sent for registration.

P1-84/2-ICR-F30/0430 : **Genetic improvement of cotton seed oil content and quality with earliness and fibre productivity** (R.G.Dani).

Two cultures viz. CNO 131 and CNH 2124 were entered in AICCIP trial for the season 2000-2001. High yield performance of one early high oil culture COE 26 (15.33 q/ha) was recorded in station trial at Nagpur and entered in national trial Br 02 (b) for the season 2001-2002. Seven new advance generation crosses were developed and 136 new crosses were attempted (high linoleic/oleic acid parents x early cultivars). Over 1000 single plant selections were advanced. Five high yielding lines viz. 26B(1738.87 kg/ha), 5H (1411.10 kg/ha), 23ES

Crop Improvement

(1334.01 kg/ha), 21DA (1298.87 kg/ha), 40 EP (1278.46 kg/ha) were identified with LRK 516 as check which gave a seed cotton yield of 630 kg/ha. Five early cultures in HS and ES series performed well under rainfed condition which have 22 to 25% oil content.

P1-86/1-ICR-F50/0430 : **Conservation of wild species of Gossypium and introgressive hybridization for the improvement of cultivated cotton including the application of tissue culture** (Vinita Gotmare, M.K.Meshram, S.Vennila, G.Balasubramani and K.B.Hebbar).

During the year, one species, *G. nelsonii* was established in the garden and cuttings of another species, *G. armourianum* were obtained from Regional Station, Coimbatore.

The fertilized ovule at different stages examined for gossypol gland density, showed variation from 22 to 56 per unit area with 30 in *G. arboreum* and zero in *G. australe*. Segregants were also backcrossed with *G. australe* and *G. bickii* and very few seeds were obtained. Selfing and intermating were done to recover lines with delayed morphogenesis of gossypol glands.

F_1s obtained from crosses between wild and cultivated species were planted in the pots and hybrids were confirmed. No male sterile plant was obtained in F_1 of these crosses.

Six fresh interspecific crosses were attempted involving *G. aridum, G. somalense, G. raimondii, G. klotzschianum* and *G. anomalum* and seeds have been obtained. Colchiploidy to three F_1s has been applied : SRT1 x *harknessii*, *arboreum* x D5 and *trilobum* x D5. Single plant selection has been carried out in multispecies hybrid derivatives.

P1-2000/ICR-F30/0430 : **Breeding for high yielding, long staple genotypes of G. *arboreum* cotton with high fibre strength** (Punit Mohan and P.Singh).

Nine advanced generation promising cultures were evaluated. The highest yield (23.20 q/ha) was recorded by the culture CINA 323 B followed by CINA 306 (22.46 q/ha) and CINA 323 A (22.21 q/ha). Fifty seven progenies of segregating population (F_2-F_3) were planted in unreplicated plots and observations were recorded on yield contributing characters and halo length. Out of these populations, 143 single plant selections based on high yield, earliness, boll opening and medium and superior medium fibre length coupled with adequate strength were made from the existing breeding material.

Three cultures namely CINA 310, CINA 323 A and CINA 323 B were entered in AICCIP for testing. Culture CINA 323 A performed well (4^{th} rank) in Br 24 in South Zone and hence has been retained for second year. Three new cultures viz. CINA 305, CINA 306 and CINA 329 have been entered in National trial (Br 22) for testing during coming season.

Involving elite germplasm lines of diploid cottons (*G. arboreum* and *G. herbaceum*), 121 new crosses were effected for further evaluation.

P1-88/1-ICR-F30/0430 : **Genetical and anatomical studies for drought tolerance in cotton (*G. hirsutum*)** (Suman Bala Singh and N.K. Perumal).

During the season, 25 F_3 progenies, 18 F_4 and 23 advance cultures were evaluated. Out of 18 F_4 progenies tested, P8 X EL 500 recorded the highest kapas yield of 1307 kg/ha like last year indicating stability and recorded low drought susceptibility index. Crosses P8 X AV 3469, P6 X AV 3469, P10 X EL 500 and P6 X A 72-62 were other good combinations and recorded more than 11 q/ha seed cotton yield.

Sixty single plant selections were also evaluated in non-replicated trial and seeds multiplied for evaluation under replicated trial in the ensuing crop season. Crosses Texas 1050 x P3,

Texas 1050 x P2, Mysore Vijay x P3, B 58-1290 x P1 and M7 X P2 were the best combinations identified.

Three cultures viz. CNH 301, CNH 380 and CNH 32 were sponsored in AICCIP trial for testing in Central and South Zones. CNH 301 was sponsored in AICCIP Br 04 (a) trial of South Zone. It ranked third recording 2042 kg/ha seed cotton yield with 14.5% and 6.42% increase over zonal and common check respectively.

CNH 32 was sponsored in AICCIP trial Br 03 (b) of Central and South Zones. It ranked third in both the zones recording 847 and 1155 kg/ha seed cotton yield. Culture CNH 32 has been promoted to Br 04 (b) in both the zones. The other culture CNH 380 was sponsored in National trial. It ranked first in south zone (1655 kg/ha) and second in central zone (920 kg/ha).

A set of 25 F_1 progenies was raised under pot condition for evaluation under simulated drought. Leaf impressions were taken for recording stomatal density, stomatal length and width.

F_2 progenies of 25 specific crosses grown under control and moisture stress conditions in a pot experiment were screened for leaf relative water content and transpiration coefficient during flowering. The crosses P1 x SP 3939, P7 x SP 3895 were found to possess relatively higher tolerance.

P1-95/ICR-F25/0430: **Induced mutations for improving adaptability and yield attributes with reference to G. *barbadense* cv. suvin and G. *arboreum* cv. Y1** (V.N.Waghmare and K.N.Gururajan).

The selected M_4 progenies were grown in randomized block design (RBD) with three replications and evaluated for yield performance. The data revealed differences for seed cotton yield and other economic attributes between the progenies. Differences within the progenies have been marginalised. The mutant progenies require to be further tested for 2-3 generations so as to select better progenies.

The F_2 populations from the crosses between macromutants and varieties were grown on large plots. Segregation for mutant and normal plants were recorded in all the F_2 populations. The segregation ratio between normal and mutant plants in F_2 fitted well in 3:1 ratio indicating thereby that the mutant character - dwarf bushy type is controlled by a single recessive gene. From the segregating F_2 population, few promising dwarf plants were selected, and those shall be evaluated in further generations. At Coimbatore, performance of few Suvin mutants is appreciable and are being evaluated for yield and ginning outturn.

P1-2000/ICR-F30/0430: **Breeding cotton genotypes suitable for cultivation in shallow soils** (V.N.Waghmare, Punit Mohan, K.S.Bhaskar and N.K.Perumal).

About 65 genotypes of *G. arboreum* and 50 of *G. hirsutum* were procured for evaluation under varying soil types. The seed quantity was limited and therefore the genotypes were multiplied so as to get sufficient seeds for evaluation under different soil type situations. Few crosses among *desi* genotypes, which are known to be tolerant, were attempted.

P1-2000/ICR-F30/0430 **: Improvement of upland cotton for GOT and fibre properties through population improvement approaches** (V.N. Waghmare, Vinita Gotmare and Phundan Singh).

About 50 elite cultivars and germplasm lines were evaluated for yield performance, ginning outturn and fibre properties. Appreciable differences for GOT and seed cotton yield between the tested genotypes were observed. Genotypes possessing GOT above 36%, fibre length above 28 mm and strength above 22 g/tex were selected and shall be involved in crossing programme.

Crop Improvement

Crosses between already known elite upland genotypes were attempted and about fifty cross combinations were obtained.

Coimbatore

P1-75/2-ICR-F-30/0430: **Development of high yielding intra *hirsutum* hybrids** (K.N. Gururajan and S. Manickam).

Sixteen intra *hirsutum* hybrids were evaluated for yield in a replicated trial with NHH 44, Savitha and Surya as checks. None of the hybrids was statistically superior over the best check NHH 44. T1 x M55 recorded the highest yield of 14.6 q/ha and better ginning outturn (36.8%) over NHH 44 (33.5%).

Some of the RFF X RFM crosses performed consistently well over the past three years.

In a preliminary station hybrid trial, 64 hybrids were tested with their respective parents and commercial check hybrids in a randomized block design with three replications. None of the test hybrids was statistically superior in yield to the check hybrid, Surya.

In the initial evaluation trial, 45 intra *hirsutum* hybrids developed by crossing ten parental lines in a partial diallel mating design without reciprocal crosses were evaluated in RBD trial along with their parents. Six hybrids recorded significantly higher yield than the best check Surya (13.7 q/ha). Hybrid BWC 1 x 9 with a mean seed cotton yield of 21.9 q/ha and a ginning outturn of 38.7% was the best.

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).

In the Coordinated varietal trial of AICCIP, culture CWROK 165 recorded more than 30 per cent increased seed cotton yield over the respective local and zonal checks and was released and notified as Sumangala for commercial cultivation in South zone. During the current year, the variety Sumangala has been tested in the National Elite Varietal Trial of AICCIP. In this trial, the variety recorded the highest mean seed cotton yield of 20.1 q/ha in the South Zone and ranked first on a National scale with a mean seed cotton yield of 15.1 q/ha. In the Coordinated varietal trial also, variety Sumangala (10.2 q/ha) recorded 38 per cent increase in yield over the zonal check LRA 5166 (7.43 q/ha).

Culture M5KD 26, which was tested in the South Zone under rainfed conditions, recorded a mean seed cotton yield of 9.7 q/ha and was found to be superior to the Zonal check LRA 5166 (7.4 q/ha) by 30 per cent. Culture CCH 526612 which was tested in the National Evaluation Trial of AICCIP (Br-02 a) under irrigated conditions recorded a mean seed cotton yield of 16.5 q/ha as against 15.6 q/ha of local check and 15.0 q/ha of zonal check and occupied the fourth rank in the South Zone. Hence, it has been promoted to Preliminary Varietal Trial (Br-03 a) in the South Zone.

In the Station trial, out of 14 cultures developed with resistance to Alternaria leaf spot and grey mildew diseases, six were superior in yield to the check variety LRA 5166. However, culture RR 1007-1243 with a mean seed cotton yield of 18.4 q/ha and ginning outturn of 40 per cent was also superior to the variety Sumangala (15.8 q/ha).

In the second trial, 17 cultures were tested with LRA 5166 and Sumangala as checks. Culture RCH 5267-26 was found to be statistically superior to the variety Sumangala (14.1 q/ha) in yield (18.2 q/ha) and ginning outturn (41.1%).

In an early generation testing trial, 52 progenies involving 12 crosses in F_4 to F_5 generation were evaluated in a replicated trial with LRA 5166 and Anjali as checks. Of these, cross 5(1x2)

performed well with one of its progeny recording the highest yield of 18.4 q/ha as against 11.7 q/ha of LRA 5166. As many as four progenies of this cross recorded significantly higher yield over LRA 5166. Few progenies of the same cross had higher boll weight (4.5 and 4.7 g) as compared to that of LRA 5166 or Anjali (4.1 g).

In the combined institute trial conducted at Nagpur and Coimbatore, ALR-4 recorded the highest yield of 17.5 q/ha as against 16.4 q/ha of LRA 5166. This culture has been entered in the National Initial Evaluation Trial of AICCIP (Br02 a) under irrigated conditions. Culture VLV-3 with a mean seed cotton yield of 17.0 q/ha ranked sixth, but not statistically significant.

P1-89/1-ICR-F30/0430: **Development of extra long staple, high spinning hybrids of interspecific origin with wide adaptability** (S. Manickam and K.N. Gururajan).

Three hybrids viz., M 32 x B4, V 105 x B4 and T10 x P20 were evaluated in RBD with the check hybrids DCH 32, TCHB 213 and Sruthi in a confirmatory trial. The hybrids viz., M32 x B4 and V105 x B4 were found to be superior to all the three checks. Hybrid CCHB 1054 (V105 x B4) has been entered in the National Hybrid Trial (Br 15 a) of AICCIP.

In the Station trial, 72 interspecific hybrids developed by crossing 12 *G. hirsutum* lines as the female parents (four GMS lines and eight conventional lines) and six *G. barbadense* lines as males were evaluated in a replicated trial along with the checks in a line x tester mating design. Among the GMS based hybrids, hybrid G 2 x P 26 (104 g / plant) was the best and among the conventional hybrid, L 4 x P 30 (165 g / plant) was significantly superior to the best check hybrid DCH 32 (124 g / plant) in yield. It was observed that the performance of the conventional hybrid was better than the GMS based hybrid.

P1-89/3-ICR-F30/0430: **Development of high yielding and high spinning extra long staple cotton** (S. Manickam and K. N. Gururajan).

Single plants were selected from the segregating population of multiple cross derivative of *G. hirsutum* based on yield, earliness and other agronomic characters. The mean yield recorded in MCU-5VT [C] was only 63.6 g/plant, whereas the maximum yield recorded in the progeny of cross derivative L [RCH x T 13] was as high as 206 g/ plant. Similarly, the MHL of MCU 5VT [C] was only 30.4 mm, whereas upto 33 mm of MHL was noticed in several progenies. The progeny L [RCH x T 13] LB 510-4 recorded the maximum yield of 27 q/ha with 80% yield increase over the control MCU-5VT (15 q/ha).

Mutant population (M progeny) of Suvin was evaluated in a yield trial along with Suvin as control. Suvin [C] topped in yield (with 8.5 q/ha) followed by S-I/92-1 (with 6.2 q/ha). The progeny S-IX/4014 recorded 2.9 g/boll followed by S-III/2-11 with 2.7 g and Suvin [C] with 2.6 g. There was lot of variability for LI (g), SI (g) and also for GOT (%).

In an intra-*barbadense* hybrid trial, five hybrids were tested against Suvin as control. The hybrid B 4 x B 5 topped with 9 q/ha with 313% yield over Suvin (with 2.2 q/ha). Comparison of the hybrids for the last two years indicated better performance over Suvin for yield and other characters (Table 3).

Table 3. Performance of intra-*barbadense* hybrids for yield and quality

Hybrid	Yield (q/ha)			2.5% SL	Micro-naire	Bundle Strength (g/tex)	Elong-ation (%)
	1999-00	2000-01	Mean				
B4 X B5	6.5*	9.0*	7.8	33.9	3.9	24.6	8.3
B1 X B5	7.0*	7.3*	7.2	33.6	3.8	26.0	8.8
B5 X B7	4.3	7.9*	6.1	33.2	3.9	27.3	8.0
Suvin [C]	3.0	2.2	2.6	37.5	3.2	28.8	5.2
CD 5%	2.4	1.9					

Crop Improvement

Maintenance and evaluation of cotton germplasm (S. Manickam).

One hundred germplasm accessions in each of *G. hirsutum* and *G. arboreum* were evaluated. Results indicated a wide range of variability in both the species for yield/plant, boll weight (g), number of monopodia, number of sympodia, plant height (cm), number of bolls/plant, LI (g), SI (g) and GOT (%). In *G. hirsutum* accessions, the highest yield of 127.8 g/plant was noted in MCU 1 (1039) as compared to 76.0 g/plant recorded in the control variety, LRA 5166. Similarly in *G. arboreum* accessions, the maximum yield recorded was 38.3 g/plant in GA 6 (1395) as compared to 34.1 g/plant recorded in the control variety K 10.

P1-89/5-ICR-F30/0430: **Development, maintenance and utilization of cytoplasmic and genetic male sterility for hybrid seed cotton and fertility restoration in cotton** (T. Gunaseelan).

A total of 35 cms lines were maintained and promising genotypes identified were included for conversion. Promising varieties at the multilocation testing viz., HLS 329, HLS 72 and 29F were initiated for conversion.Promising inter racial cross derivatives viz., IRH 1-4, IRH 1-6 and the already released varieties are initiated for conversion into gms lines.

Diversification of male sterile source and restorer lines

A. Transfer of 'R' gene for fertility restoration in both *hirsutum* and *barbadense* backgrounds

Transfer of fertility 'R' gene from Pima restorer (*barbadense*) and Deshaff 277 and Mex (*hirsutum*) to 13 promising *hirsutum* varieties was undertaken.They are in the various stages of backcrosses. In addition to the Suvin restorer developed earlier, four other *barbadense* varieties viz., SB 289 E, SB 425 YF, P4 and C17 are utilized for the transfer of the 'R' gene from Pima restorer.

B. Diversification of male sterile source

A synthetic hexaploid derivative involving *G. aridum* with a *hirsutum* variety has given sterile plants. The *aridum* source of cytoplasm has been successfully developed and it is crossed with many varieties viz., 19, J, 6, 29F, Sn, P39, LH 14, IRH 1-4, HLS 3 and HLS 72. They are in the BC_1 cross stage. Several test crosses were done to study whether the fertile ones of the *G. aridum* restore the fertility under *G. harknessi* background.

Thirty five Cms hybrids developed at Coimbatore were tried in an RBD trial along with control Savita. Hybrid (ms 6 x AK2) recorded the highest yield of 40.1 q/ha as against 17.1 q/ha in the control hybrid Savita.

Eight Gms hybrids developed at Coimbatore were tried in an RBD trial along with control Savita. Hybrid Cms J 34 x 19 recorded the highest yield with 26.7q/ha as against 18.1 q/ha of Savita.

P1-89/6-ICR-F30/0430: **Inter specific and inter racial hybridization and gene transfer in *Gossypium*** (T.Gunaseelan).

A trial was conducted with the inter racial cross derivatives involving the races *Palmeri* and *Morrilli* with the cultivated varieties. Promising combination derivatives were advanced further. The per cent increase for boll number, boll weight, lint index, ginning per cent, and yield (Table 4) were 59, 34, 45, 17.6 and 81.3 respectively.

Twenty nine advanced cultures were tried along with LRA 5166. The per cent increase for boll number, boll weight, seed index, lint index, ginning per cent and yield (q/ha) were 87.5, 70.3, 39, 89, 36 and 125 respectively.The highest value of 33.3 (q/ha) was observed in (19 x G) x D2 followed by (19 x Mic 4) (31.7 q/ha) compared to the value of 14.7 q/ha of LRA 5166 .

Table 4. Salient features of the promising cultures in the cross derivatives of the non cultivated races with the cultivars

Sr. No.	Culture	Bolls/ plant	Boll Weight (g)	Ginning per cent	Yield (q/ha)
1	IRH 1-6	22.8	4.6	41.1	26.1
2	IRH 1-1	22.0	4.1	37.9	25.8
3	IRH 1-9	22.1	4.0	38.2	25.8
4	IRH 1-10	20.0	4.8	44.5	23.3
5	IRH II-1	17.0	4.9	39.5	21.0
6	LRA 5166 (c)	14.3	3.7	38.1	14.4
	SE	2.5	0.25	0.71	0.9
	CD @ 5%	8.2	0.84	2.34	2.9

Based on the 10 x 10 full diallel crosses, four combinations were advanced further.The percentage increase for boll number, boll weight, seed index, lint index, ginning percent and cotton yield (q/ha) over LRA 5166 were 76.9, 64.8, 34.8, 50.5, 20 and 111 respectively. The combination (4 x 13) yielded of 34.4 q/ha and 40.1 ginning per cent compared to LRA 5166 value of 14.4 q/ha and 35% ginning per cent.

The three way cross derivative IRH 1-10 recorded the highest yield of 35.5 q/ha as against 14.6 q/ha of LRA 5166 (Control).

In another trial,17 advanced three way cross derivatives were tested along with LRA 5166 as control. Culture (19 x I) recorded the highest yield of 24.8 followed by culture (F5 x 19) x K2 (23.1 q/ha) compared to 14.7 q/ha of LRA 5166 (Table 5).

Table 5. Salient features of the promising three way cross derivatives

Sr. No.	Culture	Bolls/ plant	Boll Weight (g)	Ginning per cent	Yield (q/ha)
1	(19 x I)	19.0	4.6	40.9	24.8
2	(F5 x 19) x K2	18.0	3.7	38.7	23.1
3	IIRH -2 x 15	17.5	5.0	38.5	20.2
4	13 x (19x6)	15.0	4.8	39.3	20.2
5	13 x (9x2)	17.1	3.9	36.2	20.1
6	LRA 5166	14.6	3.1	34.1	14.7
	SE	1.5	0.3	2.1	0.4
	CD @ 5%	4.5	0.9	6.4	1.1

Sirsa

P1- 85/2- ICR- F 30/0430: **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

A demonstration trial consisting of twelve hybrids and five cvs. released for the North zone was conducted. The hybrid CSHH 29 (Om Shankar) gave the highest seed cotton yield of 3036 kg/ha. followed by CSHH 30 (2726 kg/ha) and CSHH 25 (2723 kg/ha) as compared to 2972 kg/ha, of hybrid LHH 144. The highest 2.5% span length of 28.8 mm was recorded by the hybrid Sandcot 35. The ginning out turn ranged from 30.0 to 37.5 per cent.

Evaluation of crosses attempted during 1999-2000 was conducted depending on the availability of seed material.

Local Conventional Hybrid Trial 1

The trial comprised 26 hybrids and was evaluated in comparison with H 1098, LHH 144 and Om Shankar, the popular cultivars of North Zone. Only two hybrids CISHH 106 (2846 kg/ha) and CISHH 110 (2812 kg/ha) recorded significantly higher seed cotton yield over the local checks. The highest 2.5 % span length of 28.0 mm was recorded by CISHH 106 and the highest ginning out turn of 34.6 per cent was recorded by the hybrid CISHH 131.

Local Conventioal Hybrid Trial 2

This trial comprised 36 hybrids evaluated against local checks H 1098, RS 810, LHH 144 and Om Shankar, in randomized block design with three replications of two rows each. Hybrids CISHH 141, CISHH 135 and CISHH 151 recorded the seed cotton yield of 2789, 2698 and 2629 kg/ha as compared to 2286 kg/ha, the highest yielding local check, Om Shankar. The 2.5 % span length ranged

from 23.6 to 27.3 mm. Similarly the ginning out turn ranged from 29.3 to 34.0%.

Local Conventional Hybrid Trial 3

Forty two hybrids were tested against the local checks H 1098, RS 810, LHH 144 and Om Shankar in randomized block design with three replications. Hybrid CISHH 198 recorded the highest seed cotton yield of 2790 kg/ha and CISHH 200, CISHH 201 and CISHH 203 recorded 2743 kg/ha as compared to highest yielding check hybrid Om Shankar (2286 kg/ha).The hybrid CISHH 169 recorded the highest ginning out turn of 34.6 per cent, whereas the 2.5% span length ranged from 23.9 to 27.3 mm.

Local Conventional Hybrid Trial 4

The trial comprised 33 hybrids evaluated in comparison with H 1098, RS 810, LHH 144 and Om Shankar in unreplicated trial of two rows each. The hybrids CISHH 234 recorded the highest seed cotton yield of 2812 kg/ha followed by CISHH 216, CISHH 218 and CISHH 217 as compared to highest yielding check Om Shankar (2286 kg/ha). The 2.5% span length ranged from 23.6 to 27.3 mm, whereas the ginning out tun ranged from 29.0 to 36.3 per cent.

Selections from the segregating generations

One hundred and twenty F_3 populations were grown and 500 single plant selections having desirable traits for yield, quality characters, and resistance to CLCuV were made. From F_3 progenies, 139 selections were advanced to F_4 generation. Two hundred and fifty plants selected from the F_5 generation were advanced to F_6 generation. One hundred and fifty plants selected from the F_6 generation will be tested in the progeny row trials in comparison with highest yielding check varieties.

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

Local GMS based Hybrid Trial 1

The trial comprised 45 GMS based hybrids that were evaluated in comparison with RS 810, H 1098 and Om Shankar in randomized block design with two replications. The highest yield of seed cotton was recorded by the hybrid CISHHG 41 (2812 kg/ha) followed by CISHHG 53 (2744 kg/ha) and CISHHG 46 (2743 kg/ha), as compared to 2212, 1503 and 1783 kg/ha of Om Shankar and RS 810 and H 1098, respectively. The ginning out turn of GMS based hybrids ranged from 28.5 to 33.5 per cent and the 2.5 % span length from 23.4 to 28.4 mm.

Local CMS based Hybrid Trial 1

In this trial, 16 CMS based hybrids were evaluated against the conventional hybrids Om Shankar and LHH 144 in randomized block design with three replications. While the hybrid CMS 15 significantly out yielded the checks, the other two hybrids CMS 4 and CMS 12 were found to be at par with the check hybrids. The boll weight ranged from 2.7 to 4.3 g and the 2.5 % span length ranged from 24.0 to 28.7 mm. The hybrid CMS 12 has given the ginning out turn of 33.8 per cent.

Collection, conservation and maintenance of genetic resources (R.A. Meena).

The Br 01 trial consisting of 100 lines each of *G. hirsutum* and *G. arboreum* was evaluated for yield per plant, boll weight, boll number per plant, plant height, mean halo length, GOT, seed index, lint index, number of sympodia, number of monopodia, reaction to disease, Jassid, bollworm etc. The best five entries for each parameters were identified. In addition to that 1500 germplasm lines of *G.hirsutum* and 500 lines of *G.arboreum* were also maintained and evaluated for above parameters.

Crop Improvement

Seed Technology

Nagpur

Improvement of seed yield and its quality in hybrids and varieties (R.K.Deshmukh).

Boll setting percentage was 12.5% in conventional and 17.5 % in GMS based *desi* hybrids, while in intra-*hirsutum* hybrids, the values were 33 % in conventional and 42.5 % in GMS.

Performance of new genotypes of straight varieties : Out of 21 cultures tested, five cultures viz. GMR 3, CIHS 97-9, CNH 152, COE 26 and CCHV 3 gave significantly higher yield than all other new genotypes tested .

Of the 16 released varieties tested, NH 544 and G.Cot 18 gave highest seed cotton yield. Genotypes CNCT 3 and CNCT 11 were significantly superior compared to remaining 18 genotypes.

Performance of LRA 5166 and Anjali under irrigated condition and its impact on seed quality

Variety LRA 5166 and Anjali were provided with one or two irrigations in October and November as per the treatment and was compared with rainfed.The once irrigated crop gave significantly higher yield as compared to rainfed. Giving two irrigations did not have any additional advantage. One irrigation significantly improved the ginning outturn. Seed index was more when the crop was raised under rainfed condition. Good seed percentage and germination percentage were higher when the crop was irrigated once compared to rainfed condition.

Impact of boll damage on seed quality

Seed cotton was collected from fully opened undamaged bolls, from two damaged locules, three damaged locules and four damaged locules. Good seed number per boll was 25.4, 11.9, 9.5 and 8.8 respectively. Seed index of good seed was 6.82, 5.36, 5.29 and 4.37 g/100 seeds respectively. Ginning outturn was 43.95, 40.76, 41.12 and 38.72% respectively. Good seed percentage was 92.9, 44.9, 35.6 and 27.4 respectively based on seed number.

Impact of acid delinting and seed grading on seed quality

Five quintals of Anjali fuzzy seed was acid delinted at MSSC, Akola. Good seed weight was 1.39 quintals. Seed was classified into five grades namely floaters high grade, floaters low grade, sinkers high grade, sinkers low grade and fuzzy composite lot. Initially high grade floaters had germination percentage of 62% ; low grade floaters had germination percentage of 50%; high grade sinkers had germination percentage of 95% and low grade sinkers had germination percentage of 85%. Composite seed lot had germination percentage of 75%. At the end of nine months' storage, high grade floaters had 46% germination, low grade floaters had around 18% germination, high grade sinkers had 92% germination and low grade sinkers had 75% germination. Fuzzy composite lot had 60% germination.

Impact of delinting method on seed quality

Three varieties namely Anjali, LRA 5166 and PA 143 were acid delinted (T1) and gas delinted (T2). Fuzzy seed (T3) of same lot was also stored to study the performance. Initial germination was 70, 67.5, 71% in Anjali 74.0, 76.3, 77.3% in LRA 5166 and 76.3, 71.3 and 79.0% in PA 143 in T1, T2 and T3 respectively. At the end of 18th month, there was drastic reduction in the germination percentage of gas delinted and acid delinted seeds while fuzzy seed retained around 50% germination in Anjali and LRA 5166 whereas it was 10% in PA 143.

Adhoc trial **: Evaluation of cotton genotypes for low and recommended input condition** (R.K.Deshmukh).

Two experiments were conducted, one under

recommended nutrient management condition and other with low input condition. When the crop was raised under recommended management condition, four genotypes namely CNCT 7, CNCT 17, CNCT 29 and CNCT 31 gave significantly highest yield. Under low input condition, CNCT 17 and CNCT 29 gave the highest yield. These were far superior to other genotypes tested.

Coimbatore

P1-97/1-ICR-F-25/0430: **Studies on Viability, vigour and longevity of cotton seeds** (K. Rathinavel, P. Chidambaram and K. Natarajan).

Studies on the effect of seed treatment, storage container and period of storage on the viability and vigour of cotton seeds revealed that the loss in viability of 59, 10 and 4 per cent was due to period,container and seed treatment, respectively. Among the containers, gada cloth bag was found most suitable in which, the viability loss was 47% compared to 61% and 69% in polylined bag and PAF pouch, respectively. Neem kernel powder maintained the viability of 34 % after 27 months of storage, whereas it was 24% in the untreated control. Similar trend was also observed for vigour index.

Among the combination treatments, Imidacloprid and Neem leaf powder or Imidacloprid and Iodine formulation with carbendazim proved well in controlling the seed deterioration in LRA5166.

Studies on the effect of storage period, container and genotypic influence on the viability and vigour of cotton seeds revealed that the loss of viability was 60, 4, and 8 % due to period of storage, storage container and genotypes, respectively. The relative merit of containers over genotypes in maintaining the viability and vigour are LRA 5166 in paper bag, Surabhi in paper bag and PAF pouch, H777, AKH 4 and LD 327 in polythene bag.

Studies on the effect of sowing time on production and quality of cotton hybrid seeds showed that among different sowing dates (first week of August, third week of August and first week of September), delayed sowing of parents increased the hybrid boll setting efficiency in all the female parents. The time of sowing has much influence on the cross boll weight and seed weight per boll in Savita, Sruthi, LHH 144 and NHH 44. In all the hybrids, the seed index and lint index of the bolls from first sowing was superior over other sowings.The hybrid seeds of Surya, HB 224, LHH 144 and NHH 44 produced in the first sowing; Sruthi, Kirthi in the second sowing; and Savitha in the third sowing registered higher germination and vigour.

Sowing of 50% of restorer population 10 days earlier than the rest of male and 100 % female resulted in an increase of 21.2% in hybrid boll setting and may be recommended for the Cms based hybrid DMSHH 4.

Sirsa

Studies on seed technological aspect of hybrid and varietal seed production under north zone (R. A Meena).

Hybrid seed production

Crosses were made in Om Shankar and LHH 144 from beginning to completion of flowering for five days duration each at 15 days interval.The higher seed setting, boll setting, superior seed quality, higher germination and vigour index were observed in the crosses made between August middle and September end.

Varieties seed production

The effect of different picking on seed quality was studied in 10 popular north zone varieties. In all the varieties, the seed setting percentage, seed index, germination percentage and

vigour index were highest in first two pickings and least in third picking.

Seed storage studies

Seed of hybrids and varieties were packed in cloth bags and stored under room condition and germination percentage and vigour index were recorded quarterly. No significant reduction in germination was recorded up to nine months of storage, after which gradual reduction in germination per cent started but germination was maintained to certification standard up to 15th month of storage. In variety LRA 5166 germination percentage reached below certification standard at this stage. The germination (%) in other varieties was also noticed near to certification standard during 15th month of storage. At 18th month of storage in almost all the cultivars the germination percentage reached below/ near to certification standard.

NATIONAL AGRICULTURAL TECHNOLOGY PROJECT (NATP)

NATP - MM : Development of hybrid crops - cotton

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

Thirty CMS lines were evaluated for second year for yield, morphological and economical characters. The seed cotton yield ranged from 6.20 g. to 60.16 g/plant. Lines LRA 5166, Buri Nectariless and Deviraj performed better. Conversion programme is in progress and seventy genotypes are under conversion for CMS, 32 for R lines and 14 into GMS background. Two lines, LRA 5166 and SRT 1 have been converted into GMS background.

Some of the promising GMS hybrids identified were NGMSH-19, 57, 99, 16, 97, 15, 7, 104, 88 and 130. Thirty seven CMS hybrids were evaluated in replicated trial and NCMSH 196 recorded highest seed cotton yield of 501.38 kg/ ha. One hundred and twelve CMS hybrids were tested in non-replicated trial in order to test the extent of fertility restoration and yield potential of fertile hybrids for preliminary evaluation. Seventy hybrids were found to be sterile. Among the fertile hybrids, NCMSH 263 recorded seed cotton yield of 1027.77 kg/ha.

During the year, 72 GMS and 129 CMS new crosses were attempted and F_1 seeds obtained. An AICCIP trial viz. Br 05 (b)-2 was conducted. Hybrid 767 recorded the highest seed cotton yield of 1491.76 kg/ha followed by 765 and 763.

Twenty five CMS/GMS hybrids were evaluated under sprayed and unsprayed conditions. Hybrid NGMSH 102 (1019.43 kg/ha seed cotton yield) was the best followed by NHH 44 and DMSHH 73 performed better under sprayed while GMSH 7 (2025 kg/ha) followed by CAHH 8 and GAHH 214 performed better under unsprayed conditions respectively.

One GMS line was maintained alongwith nine lines received under NATP Common Trial for evaluation.These nine lines were tested under replicated trial in RBD.The highest seed cotton yield per plant was recorded by GAK 8615 A (65.9 g) followed by GAK 423 A (53.6 g) and 824 (45.2 g).

Twenty two F_1 crosses were evaluated under Institute trial in RBD with two replications.The highest seed cotton yield was recorded by Hybrid CIAA 2 (67.3 g.) followed by CIAA 1 (64.6 g) and CIAA 9 (62.9 g.). In these crosses, heterosis ranged from 23.82% to 110.97% over AKH 4 and from 6.76 to 81.89% over AKA 8401. The highest estimate of useful heterosis was reported by the entry CIAA 2 over both the checks.

Crop Improvement

In second trial, 13 F_1 crosses were evaluated in RBD under NATP Common Trial. The highest seed cotton yield per plant was recorded by AKDH 7 (63.5 g.) followed by AKDH 36 (56.6 g.), GSGDH 7 (55.3 g.) and RAJDH 15 (54.4 g.). These hybrids exhibited high level of useful heterosis over check AKH 4 and AKA 8401.

Three new crosses were attempted during the season and the F_1 seeds were collected. The species involved were *G. capitis viridis, G. gossypioides* and *G. stocksii.* As a part of maintenance of wild species, one more species *G. nelsonii* was established.

Two F_1 crosses viz., CAK 32 (*ari.*) x A 106 (*hark.*) and BN (*hark.* CMS) x AK 06 (*ari.* R) were crossed. The R lines were found to restore fertility in *aridum* and *harknessii* based CMS lines.

Forty two CMS and 190 GMS hybrids alongwith parents and checks were screened against Alternaria leaf spot, grey mildew and bacterial blight under field condition. None of the CMS hybrids and one GMS hybrid NGMSH 51 was found immune to Alternaria leaf spot.

For grey mildew, 34 CMS hybrids alongwith five checks and 24 GMS hybrids, 6 parents and 4 checks showed immune reaction. Hybrids NCMSH 193 and 20 GMS showed resistant reaction. In case of bacterial blight, 11 CMS hybrids including NCMSH 121, 129 and 163 and two CMS and 6 GMS hybrids were resistant. None of the CMS and GMS hybrids were resistant to all these diseases.

Out of 24 CMS lines evaluated, NISD-3A, CAK 3456, Laxmi and LCMS-2 were moderately tolerant to both jassids and aphids. GCMS-1A and CAK 3456 A showed high susceptibility to pink bollworm on the basis of open boll and loculi based damage. About 50% of the B lines under unprotected conditions were moderately tolerant to bollworm and four entries viz. DMSB 1, Supriya, DMSB 23 and H 777 B against pink bollworm. The order of bollworm tolerance among promising B lines is Supriya > DMSB 23 > DMSH 1.

All R lines were susceptible to jassids although they showed varying levels of tolerance to aphids. Surat Dwarf and AKH 07 were found tolerant to aphids while Demeter III (2), Des 146 and DHY 286 were found susceptible. Under unprotected condition, GMS lines viz. LRA 5166, MCU 5 and Laxmi were moderately tolerant to sucking pests.

A total of 190 GMS hybrids including parents and checks were assessed for their susceptibility/tolerance to jassids, aphids and bollworm complex. Only check PKV Hy2 was found to be tolerant to jassids while 25% of the entries showed moderate tolerance to jassids. Nearly 75% of the entries were moderately tolerant or tolerant to bollworm.

All *arboreum* hybrids were found tolerant to aphids. Hybrid 202 and 203 were found to be tolerant to both aphids and jassids. Six hybrids were found to be moderately tolerant to *Earias vitella* or *Helicoverpa armigera.*

All GMS lines (*desi*) were tolerant to aphids. GMS 1 and Sujay were susceptible to jassids while all other lines were tolerant to jassid.

Coimbatore : (T. Gunaseelan)

In an intra-*hirsutum* hybrid trial conducted with twenty two entries and three control hybrids, hybrid DMSHH 73 gave the highest seed cotton yield (30.2 q/ha) followed by (ms 2 x 19) x AK2 with 29.0 q/ha and (ms 2 x RK) x AK2 with 27.4 q/ha. The last two hybrids showed better values for lint index (4.9 and 5.6) and ginning out turn (38.6% and 40.8%) compared to that of DMSHH 73 (4.8 LI and 35.6 GP).

Crop Improvement

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).

G. arboreum genotypes were evaluated for their yield performance and fibre quality characters for rainfed ecology. Results on economic characters of 21 genotypes indicated that performance of *G. arboreum* genotypes was better and seed cotton yield ranged between 1145 to 1955 kg/ha compared to 931 kg/ha of LRK 516, a well adopted *G. hirsutum* cultivar. A *desi* genotype DLSA 17 recorded highest yield of 1955 kg/ha followed by PA 464 with 1703 kg/ha and PA 405 with 1666 kg/ha. DLSA 17 also recorded highest GOT of 38.9% followed by PA 414 and PA 183. The *arboreum* genotypes had boll weight ranging between 2.16 to 2.82 g.

The genotypes under testing had medium to long staple fibres. KWAN 3 recorded fibre length of 31.1 mm at 2.5% span length which is higher than even upland cotton varieties. Fibre strength of most of the genotypes was comparable to upland cotton varieties.

Three genotypes, two of *G. arboreum* viz. Turab and AKA 8401 and a *G. hirsutum* cultivar LRK 516, were grown in non-replicated larger plots with a view to demonstrate comparative yield performance. The yield data indicated better performance of *G. arboreum* than that of upland cotton variety. Turab recorded seed cotton yield of 12.7 q/ha while LRK 516 could yield 6.0 q/ha under similar situations.

The introgressed genotypes were also tested for their yield performance. A genotype PAIG 22 recorded seed cotton yield of 1867 kg/ha. GOT of introgressed genotypes ranged between 36.6 to 40.4% and lint index ranged between 6.3 to 7.0. All the genotypes were early maturing (150 days) and the quality characters were comparable to the best *hirsutum* genotype. The overall result shows that *arboreum* genotypes were best suited to rainfed ecosystem.

RCPS-8 : **Characterization and identification of productive and high quality cotton species / genotypes and cultivation practices suitable for different agro-ecological situation through farmers participatory programmes** (Vinita Gotmare).

The project was carried out at Akola, Hinganghat, Washim, Yavatmal, Sawangi and Bhandara. Major achievement of this project was that performance of upland cotton genotypes in the paddy grown district (Bhandara) was excellent and cotton could be considered as an alternative crop which would give some remuneration to the farmers of this region in case of low rainfall when paddy crop fails.

Plant Biodiversity-survey / exploration, collection, evaluation, characterization, conservation and utilization of global collection of *Gossypium* species for sustained production and productivity (V V Singh, Punit Mohan and Nandini Gokte Narkhedkar).

During the crop season, explorations were undertaken in West Garo Hills of Meghalaya, Melghat Tribal region of Maharashtra, North Karnataka and Kurnool district of AP and 46 samples of *G.arboreum*, 47 of *G.harbaceum* and three of *G.hirsutum* were collected and characterised besides, twenty seven (27) collections from Malwa Plateau and adjoining Banswara district of Rajasthan. Seed cotton yield/plant ranged from 14-137 g., Boll weight 1.6 to 5.3 g., Mean halo length 16.6-28.7 mm, Ginning outturn 32-39%, Bolls/plant 11 to 52, Seed index 5.8 to 9.5 g and Plant height 96 to 139 cm.

Crop Improvement

Characterization of more than 1500 existing accessions were completed. Seeds of 346 accessions were deposited in long term cold storage at NBPGR, New Delhi. Twenty five (25) herbarium specimen (10 of *G. hirsutum* - genetic marker accessions and 15 of *G. arboreum*) were prepared and sent to the Zonal Leader (Zone IX).

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

Screening of exotic germplasm

Of the fifty exotic accessions screened against sucking pests and bollworms, a few accessions showed tolerance. They include 814 AZ, FOX 4,K Stoneville 508, CB 4008, SK 32, UK 64, TAM 1033, TAM 87 N-4, TAM 87 N-5 (against sucking pests) and Chapman Clean Seed, *G. hirsutum* Tashkent, K 3103 var. Marad, Sikes W.R. Staple and Acala 1517-SR 3 against bollworm.

Regional Trial of Compact Plant Types

Under station trial, fifteen elite cultures including two checks viz. CNH 36 and LRA 5166 were tested in replicated trial. Cultures CNH 1012, 1007, AKH 8635 and SA 1601 were found promising.

Common Evaluation Trial of Compact Plant Types

Best five entries identified for seed cotton yield in three different spacings are given in Table 6:

Table 6 : Best entries for seed cotton yield (kg/ha)

Entry name	90x30 cm.	Entry name	90x20 cm.	Entry name	90x10 cm.
LH 1948	987	CNH 120 MB	938	HISAR 3	1593
HISAR 3	953	GSH 4	920	CNH 123	1408
CNH 123	941	CNH 123	914	CNH 152	1364
GSH 2	871	HISAR 4	863	LH 1899	1308
CNH 152	848	CNH 152	854	LH 1948	1281
CNH 36 (CHECK)	493	CHECK	695	CHECK	736

Sucking pests damage and bollworm infestation were more in 90 x 10 cm spacing than 90 x 30 cm.

The genotypes showing some degree of tolerance against bollworm and sucking pests were - GSH 4, CNH 152, PIL 8, LH 1899, LH 1948, SGNR 4 and CPD 447 for bollworms, GSH 1, CNH 121, LH 900 and RACH 11-3 for sucking pests. Observations were also recorded for thirteen more characters including compactness, height, canopy, angle of sympodia etc. Single plant selections were made from the F_2 segregating populations for further testing.

TECHNOLOGY MISSION ON COTTON (TMC) PROJECTS

Sirsa

MMA-3: **Characterization of plant ideotypes suitable for different agro-climatic zones** (O.P.Tuteja).

Major varietal trial 1

In this trial, 23 cultures were evaluated in a replicated trial against local check LH 900. Only two cultures CISV 27 and CISV 48 recorded significantly higher seed cotton yield as compared to the check. The ginning out turn of these cultures ranged from 30.8 to 34.2 per cent, and the 2.5% span length from 21.1 to 26.0 mm.

Major Varietal Trial 2

In this trial, 20 cultures were evaluated in a replicated trial along with local check varieties, LH 1556, H 1098, F 846 and RS 810. Only two cultures CISV 53 (1849 kg/ha) and CISV 54 (1755 kg/ha) recorded seed cotton yield at par with the check varieties. The highest ginning out turn of 38.2 % was recorded by the culture CISV 55 as compared to 34.9 % of RS 810. The 2.5% span length ranged from 21.6 to 25.5 mm.

Major Varietal Trial 3 (compact type)

In this trial, 18 cultures were evaluated in a replicated trial along with local check varieties H 1098 and H 777. CISV 21-69 recorded the highest seed cotton yield of 2517 kg/ha compared to check varieties and none could out yield the check varieties. The highest ginning out turn of 39.4 per cent was recorded by the culture CISV 3 followed by CISV 1 (37.8 %) as compared to 34.8 % of H 1098. The 2.5% span length from 23.3 to 28.0 mm.

Major Varietal Trial 4 (compact type)

In this trial, 16 cultures were evaluated in a replicated trial along with local check varieties LH 1556, HS 6 and H 777. CISV 19 recorded highest seed cotton yield of 1874 kg/ha as compared to 1610 kg/ha of the highest yielding check variety LH 1556. Two compact cultures CISV 13 and CISV 16 were found to be promising as compared to the check varieties. The highest ginning out turn of 36.2 per cent was recorded by the culture CISV 15 as compared to 34.6 % of HS 6. The 2.5% span length from 21.5 to 27.9 mm.

Identification and development of diploid cotton with yield and fibre quality suitable for high speed spinning (R. A Meena).

Evaluation of promising entries

The Advance Varietal Trial-1, 2 and progeny, row trial were conducted to evaluate promising entries for yield and quality parameters. In each trial, the entries were sown at 67.5 X 30 cm spacing in RBD. Based on the evaluation, two high yielding entries were sponsored for testing under AICCIP trials and three long linted entries were sponsored for testing in different zones.

Evaluation of F_2 generation

F_2 generation of 15 hybrids was evaluated and from the population, 30 single plants have been selected based on earliness, yield potential and fibre properties and are being advanced to F_3.

Conversion of popular varieties into GMS

Crosses were made between 15 popular varieties and DS 5 (GMS) for their conversion into GMS.

New Crosses

Three hundred and eighty new crosses have been attempted between long linted *desi* cotton lines and local varieties of *desi* cotton. These crosses will be evaluated for yield and its component traits and also will be advanced to F_2 generation for making selections.

Crop Improvement

Breeder Seed Production

Breeder seed production targets were met in full. The following quantities of breeder seeds were produced during 2000-2001 through the institute, Central and State seed farms and distributed (Table 7).

Seed Village

Ghorad village in Nagpur district was selected as 'Seed Village' where foundation seed is being produced under technical guidance from CICR, Nagpur. A Seed Production and Processing Society has been registered and its members are predominantly farm women.

Table 7: Details of Breeder Seed Production 2000-01 **(Quintals)**

Sr. No.	Name of Variety/ Parent of Hybrid	Production Centre (s)	2000-01		2001-02
			Indent	Production	Indent
1	**Savita**	CICR, Coimbatore			
	T7		0.75	0.75	0.66
	M12		0.38	0.38	0.36
2	**LRA 5166**	CICR, Nagpur		3.99	
		CICR, Coimbatore		0.72	
		SSF, Pongalur		2.00	
		SSF, Sathy		0.80	
		TOTAL	**7.66**	**7.51**	**8.67**
3	**Anjali**	CICR, Nagpur		3.99	
		CSF,Chengam		4.68	
		TOTAL	**7.83**	**8.67**	**5.50**
4	**MCU5 VT**	CICR,Coimbatore	1.45	1.80	2.66
5	**Surabhi**	-do-	0.20	0.69	1.51
6	**Supriya**	-do-	-	1.12	0.60
7	**Suvin**	-do-	-	0.30	-
8	**Sumangala**	-do-	-	1.14	-

BIOTECHNOLOGY

- RAPD is more useful for molecular characterization of cultures.
- Protein banding pattern along with isozyme banding pattern can be used for studying cotton genetic variation.

Molecular evaluation of cotton germplasm (A.B.Dongre,S.B.Nandeshwar,V.V.Singh, J.Amudha and G.Balasubramani).

DNA Fingerprinting

Germplasm lines with different characters were subjected to DNA isolation. To study genetic variation among the cultivars, a pot culture experiment was conducted with eight cultivars viz. H8, H6, MCU 5, MCU 7, Khandwa 2, PKV Hy2, LRK 516 and LRA 5166. Intact DNA was tested through electrophoresis and spectrophotometry and subjected to amplification with five random primers (decamer) i.e.OPA 7, OPA 11, OPA 3, OPA 5 and OPA 6. The amplified bands with random primer OPA 7 vary across the cultivars ranging from 3 to 6. Ten bands are showing polymorphism. Primer OPA 11 had shown presence of single band in all the eight cultivars except one polymorphic band in cultivar MCU 6 .

With primer OPA 3, a total 48 bands were scored and amplification varied from cultivar to cultivar ranging from three to eight bands. However, cultivar LRK 516 did not show any amplification pattern with OPA 3 while LRA 5166 showed least number of amplified bands. Twelve polymorphic bands are observed among the varieties.

Primer OPA 5 could give amplification only in three varieties viz.H 8, Khandwa 2 and PKV 081, 24 amplified products were scored among three varieties ranging from 6 to 9 bands. However, six bands showed polymorphism.

Primer OPA 6 gave good amplification and showed highest number of bands. However, cultivar LRK 516 did not show any amplification. Remaining all the seven cultivars showed amplification with bands ranging from three to nine. Total 54 amplified bands were observed out of which twenty showed polymorphism. Highest degree of polymorphism was observed among the eight cultivars taken for study with primer OPA 6.

Collective data are subjected for similarity index studies. Study revealed that RAPD analysis is a very useful tool for molecular characterization of cultivars.

Determination of genetic purity of cotton seed using protein and isozyme marker

Isozymes and protein banding patterns were scored on the basis of presence and absence of each locus using SDS PAGE. The cultivars used for RAPD analysis were taken for protein and isozyme banding pattern studies. The protein banding pattern had showed very little difference.Though protein banding pattern alone cannot be used for determining genetic variation, it along with isozyme banding pattern can be used to study genetic variation. Isozyme banding pattern of eight cultivars showed significant difference in respect of esterase and Glutamate dehydrogenase which can be used for determining genetic variation.

P1-91/1-ICR-F30/0430 **: Development of tissue culture protocol for use in breeding and genetic transformation** (S.B.Nandeshwar and A. B. Dongre).

Performance of R_1 plants (*G. hirsutum*)

Plants of the varieties LRA 5166, LRK 516, PKV 081, Indore 2, Khandwa 2, Coker 312 and Stoneville obtained from multiple shoots induced from shoot tip were grown as R_1 plants in earthen pots.

The height of the plant was 51.7 to 75.0 cm. The plants were straight growing and without any sympodial branching. The fruiting efficiency of the plant was quite low with boll number per plant

ranging from 3.2 to 7.0 and seed number per boll from 8.5 to 18.0 respectively.

Regeneration of diploid cotton Callus inducing efficiency of hypocotyl explant

Three promising cultivars of *G. arboreum* i.e. AKH 4, AKA 5 and RG 8 were used for *in-vitro* studies. Hypocotyl explants from eight day old seedling was cultured in MS medium supplemented with IAA + Kin, 2,4-D + Kin and 2,4-D alone. Callus proliferation was evident within a week. The nature of callus was mostly compact and hard in IAA + Kin combination while in 2,4-D combination callus was mostly friable. In cultivars AKH 4 and RG 8, presence of meristemoid was observed.

Multiple shoot induction in tetraploid cotton

For multiple shoot induction, eight cultivars of *G. hirsutum* were selected. Cotyledonary node explants from seven days old seedlings were cultured in MS medium supplemented with BAP + Kin (2:1 mg/L). The cultivars NHH 44, Khandwa-3, LRA 5166 produced higher number of multiple shoots. In case of NHH 44 and LRA 5166, the shoots per explant were in the range of 12-16. The lowest shoot number per explant was observed in H 777 and LRK 516 (Table-8).

Interspecific hybridization

Four crosses were made between *G. hirsutum* and *G. arboreum*. The crosses involved the following cultivars : LRA 5166 x AKH 4, PKV 081 x AKH 4, MCU 5 x AKH 4 and LRK 516 x AKH 4. In all, 1064 crosses were made out of which two bolls containing six seeds were set.

Embryo culture

Pollinated buds (15 DAP) were harvested in field and their ovules were removed aseptically from the crosses MCU 5 x AKH 4, LRA 5166 x AKH 4 and PKV 081 x AKH 4. The ovules were cultured in MS medium containing 2,4-D and Kinetin (0.1 mg/L). The cultures were grown under 16:8 hours photoperiod and observations were recorded after two weeks. Response of ovules to growth was highest in MCU 5 x AKH 4 (72.0%) followed by LRA 5166 x AKH 4 (32.5%). The response of ovules to growth was mostly of callusing type.

Table-8 : Multiple shoot induction in tetraploid cotton

Sr. No.	Name of variety	No. of explant cultured	Age of explant (days)	Medium	Response to multiple shoot induction	Shoots/ explant
1.	NHH 44	254	7	MS + BAP + Kin	+++	12 to 16
2.	H 777	176	7	MS + BAP + Kin	+	4 to 6
3.	MCU 5	200	7	MS + BAP + Kin	——	———
4.	MCU 7	150	7	MS + BAP + Kin	——	———
5.	Khandwa 2	215	7	MS + BAP + Kin	++	6 to 9
6.	Khandwa 3	307	7	MS + BAP + Kin	+++	10 to 14
7.	LRA 5166	400	7	MS + BAP + Kin	+++	12 to 16
8.	LRK 516	250	7	MS + BAP + Kin	++	5 to 8

+++ = High, ++ = Medium, + = Low

NATIONAL AGRICULTURAL TECHNOLOGY PROJECT (NATP)

NATP (MM) : Development of Bt transgenic cotton (A.B.Dongre, S. B. Nandeshwar, Keshav Kranti and G. Balasubramani).

Meristematic tissues were taken for transformation from LRK 516, LRA 5166, PKV 081, MCU 5, H 777, Khandwa 2, Khandwa 3, Om Shankar and NHH 44 seven days after aseptic germination in half strength Murashige and Skoog medium.

LBA 4404 carrying Cry I A (b) and *A. tumefaciens* EHA 105 Cry I A (c) and NPT II genes was taken after 48 hours of incubation. Embryonic axis and meristematic cells were co-cultivated with diluted *Agrobacterium* cells. After co-cultivation the *Agrobacterium* cells were decontaminated with Carbenicillin 250 µg/ml for six hours on the orbital shaker. The explants were inoculated with 50 µg/ml Kanamycin with BAP and Kin. In all, 5475 explants of meristematic tissue and 1643 of embryonic axis were co-cultivated with Cry I A (b) and 42 putative transformed shoots have been obtained.

***Agrobacterium* mediated transformation with Cry I A (c)**

Meristematic and embryonic tissue excised from seven day old germinated seedling were co-cultivated with *Agrobacterium* containing Cry I A (c) gene for 48 hours. The explants were subjected to screening of Kanamycin medium. In all, 4694 meristematic tissue explant and 850 embryonic axis explants were co-cultivated. In all, 101 putative transformed shoots have been selected on Kanamycin medium.

Molecular evaluation and bioassay of transgenic cotton plants

Three transgenic cotton plants with synthetic Cry I A (b) were raised and confirmed with gene integration by PCR and southern blot analysis.The expression was analysed by ELISA Test and protein was found to be 0.003 to 0.005% of the total protein. The insect bioassay was carried out under glass house conditions. *Helicoverpa armigera* neonate larvae were released on a single sympodial branch of two of each T0-Cry I A (b) LRK 516 transgenic plant. The bioassay results were not satisfactory.

RCPS 10 **: Development of Bt transgenic diploid cotton against bollworms** (S B Nandeshwar and A.B.Dongre).

Three promising cultivars viz. AKH 4, AKA 5 and RG 8 were used for standardization of regeneration protocol.

For callus induction, hypcotyl explant of seven day old *in-vitro* germinated seedlings were used. These explants were cultured on modified MS medium supplemented with 2,4-D (0.1 mg/L) and Kinetin (0.1 mg/L), Gamborg B5 vitamins, inositol and glucose (30 g/L). The cultures were incubated at 27 + 2 ^{o}C and 16 : 8 hours photoperiod. Within 25-30 days of culture, 50 % of the explant produced callus. The callus is being manipulated for the induction of somatic embryogenesis.

Regeneration by shoot tip and meristem culture

Shoot apical meristem explants were cultured on semisolid MS Medium. The following growth regulator combinations were tested for regeneration.

Half MS + 50 mg/L mesoinositol + 5 mg/L thiamine + 15 gm/L glucose

Full MS + 100 mg/L inositol + 10 mg/L thiamine + 30 gm/L glucose

Full MS + 100 mg/L inositol + 10 mg/L thiamine + 30 gm/L glucose + BAP (0.5, 1.0, 1.5, 2.0 mg/L) + Kinetin (0.5, 1.0 mg/L)

The cultures were incubated at 27 + 2 ^{o}C and 16: 8 photoperiod. In each combination, 30 explants were cultured while in case of RG 8, 47 explants in full MS and 362 explants in BAP + Kin combination

were cultured.

There was no response of shoot tip under 0.5 BAP +1.0 Kin combination. However, response of explant to growth regulators increases with the increasing concentration of BAP. The multiple shoot induction frequency was 67% in AKH 4 and AKA 5 under BAP + Kin (2:1 mg/L) combination.

Therefore, BAP 2 mg/L and Kinetin 1 mg/L was the best combination for multiple shoot induction. Some of the shoots in both the cultivars were isolated carefully and rooted in half MS medium.

Shoot tip in MS and half MS medium regenerated into plants directly (Table 9).

The response of shoot tip in BAP + Kin (2:1 mg/L) was tested in popularly grown *G. arboreum* RG-8. The explant in full MS produced shoot directly while the explant cultured in BAP + Kin 2:1 mg/L combination produced mass of shoot buds. These buds elongated into well defined shoots during subsequent passages.

Transformation of shoot tip with Cry I A (b)

For shoot tip transformation, *Agrobacterium* mediated gene transfer technique was used. For this, highly regenerative varieties AKH 4 and RG 8 were used. One thousand and nine explants (shoot tip) were co-cultivated with *Agrobacterium tumifaciens* carrying Cry 1 A (b) + npt II genes. So far, 39 putative transformed shoots have been obtained. These are being tested for gene integration.

Table 9 : Response of shoot tips to multiple shoot induction

Sr. No.	AKH 4	AKA 5	Hormone Combination		No. of shoot responded to multiple shoot induction		Regeneration Response
			BAP	Kin	AKH-4	AKA-5	
1.	30	30	0.5	1.0	No response	No response	Nil
2.	30	30	1.0	1.0	5 (17%)	No response	+
3.	30	30	1.5	1.0	12 (40%)	10 (33%)	++
4.	30	30	2.0	1.0	18 (60%)	20 (67%)	+++
5.	30	30	MS + No hormone	MS + No hormone	Direct plant regeneration	Direct plant regeneration	Direct plant regeneration
6.	30	30	1/2 MS+ No hormone	1/2 MS+ No hormone	Direct plant regeneration	Direct plant regeneration	Direct plant regeneration

CGP-I : **Induction of paranodules in cotton plant with nitrogen fixing bacterium A*zorhizobium caulinodans*** (G. Balasubramani and J. Amudha).

Isolation and characterization of Azorhizobium and Rhizobium isolates :

Isolation

Azorhizobium and *Rhizobium* strains from stem nodulating *Sesbania rostrata* and root nodulating *Dolichos lablab* (Bean) were isolated as per standard protocol. The fast growing as well as slow growing colonies were selected in the congo red - yeast extract mannitol agar medium (YEMA with congo red) . The non-absorbing congo red colonies were picked out and plated repeatedly for confirmation of isolates for stability in growth. These isolates were then subjected to characterization.

Characterization

The change of colour in the Bromothymol blue - YEMA medium was recorded and the results showed that *Azorhizobium* strains are alkaline and *Rhizobium* strains are acidic natured.

The absence of hydrogen sulphide gas production indicated the positive reaction for the *Rhizobium*. *Agrobacterium* contamination with *Rhizobium* was identified by their characteristic growth on lactose agar medium with or without yellow zone respectively.

Restricted or no growth observed on glucose peptone agar medium, indicate the presence of *Rhizobium*. The absence of growth observed in Hofers alkaline broth is also an indication for positive reaction to Rhizobium.

The isolates were categorized as fast growing and slow growing cultures. These pure cultures of *Azorhizobium caulinodans* and *Rhizobium phaseoli* were selected and named as *Azorhizobium caulinodans* CICR-I (fast growing), *Azorhizobium caulinodans* CICR-II (slow growing), *Rhizobium phaseoli* CICR-I (fast growing) and *Rhizobium phaseoli* CICR-II (slow growing).

1976 रजत जयंती 2001

Institute QRT in session

Shri Ranjit Deshmukh, Minister of Agriculture,
Govt of Maharashtra State
laying the foundation stone of ATIC building.

Shri. Ranjit Deshmukh,
Minister of Agriculture and
Shri.Ganapatrao Deshmukh,
Minister of Cooperation, Maha. Govt.
addressing the scientists and
state Govt. officials

QRT members interacting with
the scientists in the experimental field.

CROP PRODUCTION

- The life saving irrigation at early boll and peak boll stages result in realization of maximum yields.
- Drip irrigation elicited response to higher levels of fertilizes and improved fertilizer use efficiency.
- Prometryn @ 2.0 kg a.i./ha and Gesagard @ 1.5 kg a.i./ha were effective in controlling the weeds.
- Cotton-Jowar sequence produced more seed cotton yield than cotton-fallow-cotton sequence.

Nagpur

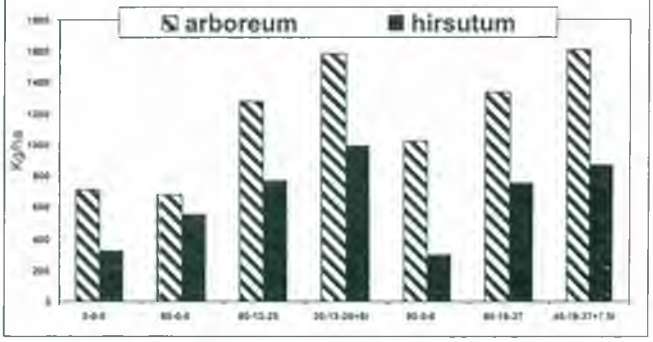
Studies on use of harvested rain water for recycling at critical stages of rainfed cotton for augmenting its production in vertisols (K.S.Bhaskar).

Field experiments were conducted in shallow, medium deep and deep soils to study the effect of life saving irrigations at critical crop growth stages using the harvested rain water. Maximum yield of seed cotton was recorded when irrigation was provided at early boll and peak boll development stages. The yield increased with depth of soil and yield trend showed that effect of two irrigations on seed cotton yield was more explicit as compared to one irrigation as observed during the last 5 years.

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

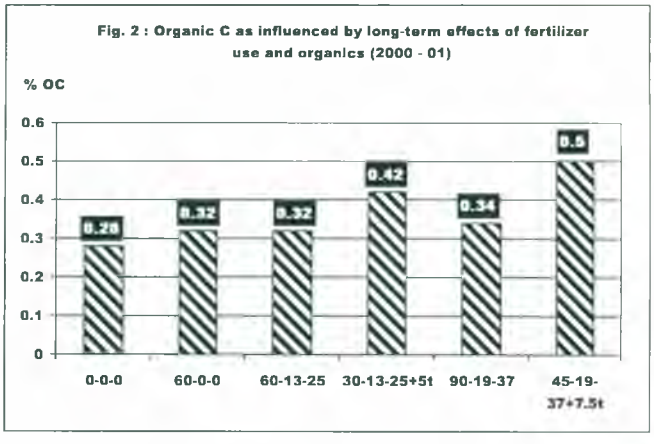
A field experiment was conducted for the 16th consecutive year to study the effect of long term application of nutrients on the productivity and sustainability of cotton in cotton based cropping systems viz. C_1. *G. arboreum* (monocropping), C_2: *G. hirsutum* (monocropping) and C_3: *G. hirsutum* cotton-jowar (rotation). Over the cropping systems, different nutrient combinations were studied. Mean yield of *G. arboreum* (AKA 8401) was higher by 126% over *G. hirsutum* yield (Fig 1).

Fig. 1 : Seed cotton yield as influenced by long-term fertilizer



Significant increase in fruiting points, boll number, seed cotton and dry matter yield, total N and P uptake was observed in plots with integrated nutrient management practices (N_{30} P_{13} K_{25} + 5 t FYM, N_{45} P_{19} K_{37} + 7.5 t FYM) and balance fertilization (N_{60} P_{13} K_{25} and N_{90} P_{19} K_{30}) over N alone applied plots and control in both the genotypes. Application of P in combination with N and K increased seed cotton and jowar yields significantly. Plant population and biomass of jowar and grain yield was reduced significantly in plots where no P was applied.The N and P use efficiency and soil organic carbon level were higher in the FYM treated plots (Fig 2).

Fig. 2 : Organic C as influenced by long-term effects of fertilizer use and organics (2000 - 01)



The plot receiving P fertiliser showed increase in the available P status of surface soil. Bulk density of surface soil was lower in the FYM applied plots compared to the plots receiving no FYM.

Tillage and crop residue effects on soil, nutrient and cotton crop behaviour (Blaise, C.D.Ravindran and N. Gokte - Narkhedkar).

The experiment was conducted for the fifth consecutive year. Results indicate no differences among the tillage treatments (conventional vs. reduced tillage with two interculture and reduced tillage with no interculture). The seed cotton yield ranged from 12.3 to 13.9 q/ha. Although the difference was not significant, yield reduction of 1.4 to 10.9% was evident with the reduced tillage treatments. Greater reduction was noticed in the treatment with no interculture. This was due to high weed density in the reduced tillage treatment. The grassy weeds were significantly lower in the reduced tillage treatments compared to the conventional tillage treatment at 30 and 60 days after sowing (DAS). However, the broad leaf weed density was significantly higher in the reduced tillage treatment with no intercultures than the conventional tillage treatment at 60 DAS. The litter fall (leaves and fruiting parts) amounted to 12 q/ha. By way of recycling, about 13 kg N and 3.4 kg P is recycled back into the ecosystem.

Seed cotton yield was significantly higher in the leaf (14.3 q/ha) than the stem amended soils (12.2 q/ha) and control plots with no residue applied (13 q/ha). Significant improvement in the organic C content was also noticed in the leaf and stem amended soil (0.69%) compared to non amended soil (0.62%) in the 0-5 cm soil depth. No differences were noticed in the lower layers. Reduced tillage is a soil and moisture conservation practice. Although there was no significant difference in the organic C content between the tillage treatments, reduced tillage had 7.2 % more organic C in the 0-5 cm soil layer. Soil moisture content was greater in the 0-15 cm soil layer in the reduced tillage plots compared to conventional tillage in mid October (coinciding with peak boll formation stage).Soil bulk density was determined and no significant differences were noticed among the treatments. The mean bulk density of the 0-15 cm soil layer was 1.35 g/cc.

Development of bullock drawn seed drill cum planter for cotton sowing in vertisols (G. Majumdar).

The modified prototype was put to trial in this season. Planting of seed at 60 x 30 cm could not be achieved uniformly as the modified seed plate of seed metering plate resulted in choking of plate due to seeds getting stuck between the hopper base and the plate. The drilling was found satisfactory with uniform placement depth of seeds. The field capacity of drilling was found six times higher than dibbling with 0.13 ha/hr. Energy spent in the drilling was found much higher than dibbling at 22.04 MH/ha.The reason was that using a bullock pair for drilling two row of cotton amounted to under utilizing the energy of the bullock pair. A simple seed covering device and a scrapper for depth guage wheels were added that worked satisfactorily. The modified seed delivery system in laboratory trials for the seed rate, worked out to 14.3 kg/ha.

Studies on water use efficiency (WUE) of harvested rain water, through drip irrigation and fertigation (K.S.Bhaskar, A.R.Raju, Jagvir Singh and G. Majumdar).

Field studies were conducted to study the possibility of applying fertilizers (fertigation) through drip and the WUE of harvested rain water. Higher seed cotton and dry matter was recorded with application of higher dose of 150 : 75 : 75 (NPK) than recommended dose of (120 : 60 : 60) as soil and fertigation. Application of NPK as basal dose (150 : 75 : 75) improved seed cotton yield by about

208 kg/ha and when applied through drip, seed cotton yield increased by 250 kg/ha and improved fertilizer use efficiency. It was found that 38% more water was applied by scheduling at IW/CPE ratio of 0.75 which in turn increased the seed cotton yield significantly over irrigation at 50% FC by gravimetric method.

Adhoc trials : **Weather-based models for cotton yield forecasting in the intensively cotton growing districts of Marathwada and Vidarbha regions** (C.D.Ravindran).

The study being based on historical (district-wise) meteorological and cotton yield data for the past 25-30 years, the first step was to collect the required data. The study focuses on the intensively cotton growing districts of Marathwada and Vidarbha regions. These districts have since been identified and the process of data collection has already been initiated

Adhoc trials : **Evaluation of agronomic requirements of GMS hybrid in rainfed condition in shallow soils** (A. Ravinder Raju).

GMS hybrid is short in duration, compact and erect type, recorded highest yield at 60 x 60 cm spacing followed by 90 x 60 cm spacing, both were statistically at par and significantly superior over 75 x 75 cm and 90x90 cm with 2 pl/hill. There is no significant response for higher dose of fertiliser level 120:60:60 kg N, P, K /ha over recommended dose of fertiliser 90:45:45 kg N, P, K /ha.

Adhoc trials :**Evaluation of Prometryne in rainfed cotton** (A.Ravinder Raju).

In two years study the pre emergence application of prometryne @ 1.0 kg a.i /ha with two intercultures at 21 and 42 DAS (Days after sowing) in medium deep black soils controlled the monocot weeds effectively. The performance was at par with recommended practice as trifluralin PPI 1.0 kg a.i /ha with two intercultures at 21 and 42 DAS and one hand weeding. Glyphosate as lay by application in post directed spray controlled weeds effectively.

Adhoc trials **:Evaluation of poultry manures as a component of INM in rainfed and irrigated cotton in shallow soils** (A.Ravinder Raju).

Field experiments were conducted to evaluate INM package (poultry litter manure, FYM, vermi compost and *Azospirillum* as seed treatment) in eroded shallow to medium deep soils with soil and moisture conservation practices and two supplemental irrigations in AHH 468 hybrid cotton. Two foliar sprays of Urea 2% at 80 and 90 DAS along with ½ dose of recommended fertiliser and either thermal pelleted poultry litter manure @ 1250 kg / ha or fresh poultry litter @ 625 kg / ha Vermi compost 250 kg /ha yielded significantly higher than recommended fertilisers. However, foliar sprays along with FYM @ 1675 kg / ha every year or thermal pelleted poultry litter manure @ 650 kg / ha + *Azospirillum* seed treatment resulted in yield similar to recommended fertilisers.

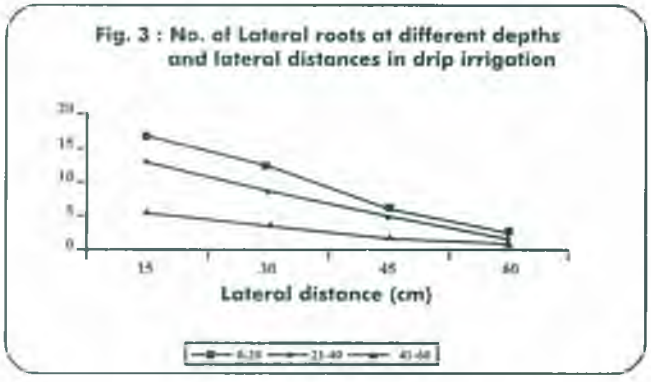
Coimbatore

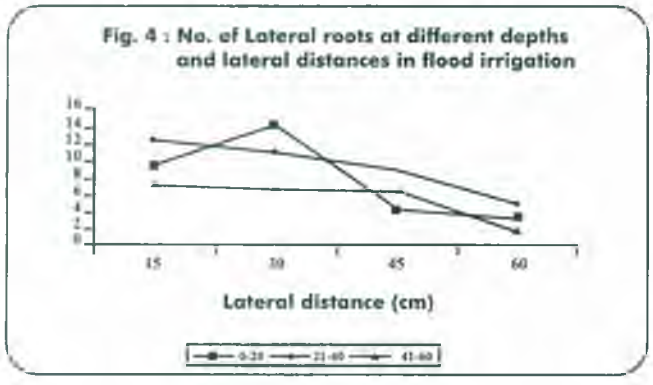
Investigations on the economics and efficiency of drip irrigation as compared to the conventional irrigation (K. Shanmugham and P. Nalayini).

Drip irrigation treatments enhanced the seed cotton yield (11.6 to 16.4 q/ha) of cv. Anjali as compared to the flood irrigation treatments (6.7 to 8.5 q/ha). Supply of 75% of dose NPK (45:22.5:22.5 kg/ha) gave better yields and NPK uptake was higher in fertigation treatment with same dose.The maximum seed cotton yield of 16.4 q / ha was obtained in drip with 100% water and 75% NPK fertigation.

In the drip irrigation treatments, the roots of cotton plants tended to congregate as a dense clump in the first 30 cm depth with more lateral

roots, while the root distribution in flood system was seen upto 60 cm with longer lateral distribution (Fig. 3 and 4). Germination of seeds in drip system was quick than in flood irrigation due to formation of soil sediment as a thin sheet over the sown dibbles.





Even 50% water supply in drip and 100% water supply in flood systems maintained same soil moisture.

Testing new herbicides for their weed control efficiency in irrigated cotton (K. Shanmugham and K. Nalayini).

Pre emergence herbicides, (2.0 kg a.i. /ha) Prometryn and Gesagard (@ 1.5 kg a.i. /ha) tested with Pendimethalin and manual weeding as check treatments were effective in controlling the weeds and recorded higher seed cotton yield and did not cause any phytotoxicity on the Cotton plant.

Studies on the influence of micronutrients in the presence or absence of FYM/Compost under varying levels of NPK application on the yield and quality of cotton under irrigated conditions (K. Shanmugham).

High seed cotton yield of 23.5 q/ha was obtained with normal fertilizer dose + Micronutrients. Application of micronutrients individually had no influence on yield indicating the need for many micronutrients

Micronutrient supply helped in more NPK absorption and DM production. The nutrient content ranged between 2.11 - 3.83 g, 1.31 - 1.59 g, and 2.76-3.84 g/plant of NPK, respectively and micronutrient contents ranged between 20-38 ppm, 13-29 ppm, 9-28 ppm, 6-23 ppm, 5-16 ppm, 7-12 ppm for Fe, Mn, Cu, Mo and B respectively in different treatments.Though specific micronutrient deficiency symptoms were not visible in the plants, the higher yields obtained with their application indicated the presence of hidden hunger for the micronutrients. FYM application supplements micronutrients to some extent.

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** (K. Shanmugham).

Cotton - jowar sequence produced more seed cotton yield (9.71-12.14 q/ha in Surabhi and 12.6-15.6 q/ha in Savita) than cotton - fallow - cotton sequence (9.3 - 10.8 q/ha in Savita and 7.31-9.67 q/ha in Surabhi) (Table 10). The treatment differences within the cropping sequences were also significant in both cultivars. Low as well as high NPK doses gave lower yields in cotton - fallow - cotton system; but supplemental FYM slightly improved the yields. N alone at any level was not useful and at higher doses it reduced the yields. Low P and K (30-30 kg) alone increased the yields.

Crop Production

Table 10 : Seed Cotton yields of Savita and Surabhi in two cropping sequences and different fertilizer treatments (2000-2001) (q/ha)

Treatment	Savita		Surabhi	
	C-J	C-F-C	C-J	C-F-C
1. Control	12.6	9.5	9.71	7.31
2. N 60	13.6	9.6	11.30	8.61
3. N 60-P30	14.5	10.4	10.70	8.21
4. N60-K30	15.6	9.6	11.55	7.87
5. P30, K30 + FYM 10t	15.5	10.8	11.80	8.69
6. N60 P30 K30	14.2	10.0	12.14	9.67
7. N30 P30 K30 + FYM 5t	15.9	10.8	11.89	8.70
8. N 90	10.3	8.5	10.65	7.90
9. N90 P45	15.6	9.9	10.86	8.56
10. N90 K 45	14.0	10.8	10.46	9.40
11. P45 K45 + FYM 15 t	17.5	10.9	12.15	8.92
12. N90 P45 K45	13.2	9.3	11.60	8.15
13. N 45 P45 K45 + FYM 7.5 t	14.4	10.1	10.89	8.22
Mean	**14.4**	**10.0**	**11.21**	**8.48**
S.E	**CD at 5%**			
Main plots	0.449	1.307	(Fertiliser Treatments)	
Sub Plots	0.234	0.659	(Cultivar x Sequence)	

Low PK + FYM produced 15.5 and 10.8 q seed cotton / ha compared to 17.5 and 10.9 q/ha in high PK (45-45) + FYM in C-J and C- fallow - cotton systems respectively.

The residual NPK in the soil after cotton harvest showed significant differences between treatments and cropping sequences. In C-J system 312.9 - 334.0 Kg N, 10.1-10.8 Kg P and 397.5 - 426 Kg K / ha was found comparable to 305.8 - 319.9 Kg N, 10.1 - 12.1 Kg P and 380.0 - 387.5 Kg K/ha in cotton - fallow - cotton system. Addition of FYM did not help in higher N and P accumulation but helped more K build up. Omission of P and K did not result in serious reduction in P and K residues. Comparison of the two cropping sequences showed insignificant differences in N and P residues (327.9 - 328.0 Kg N, 12.9 - 15.1 Kg P) but significant increase of 40.0 Kg K in cotton - fallow - cotton sequence indicated that either cotton did not effectively absorbed K or fixed K from soil mineral was converted into available K due to dynamic action. Almost the same higher quantities of N (328.7 - 330.6 Kg) and low P (13.0 - 15.7 Kg) residues were recorded during the previous season also in both cropping series .

The highest jowar straw yield of 17.8 t/ha was recorded in N90 P45 treatment followed by 17.4 t/ha in P 30 K30 + FYM 10 t / ha treatment. Highest grain yield of 15 t/ha was recorded in N30 P30 K30 + FYM 5 q/ha and P45 K45 + FYM 15 q/ha treatment and the lowest of 6.4 q/ha in N90 treatments.

NATIONAL AGRICULTURAL TECHNOLOGY PROJECT (NATP)

Nagpur

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

The survey was conducted in six Tahsils of Nagpur district and data were collected from 100 farmers. Some of the preliminary findings are as follows :

Majority of the farmers follow strip cropping with Pigeonpea (*Cajanus cajan)* in the ratio of 6:2, 8:2, 10:1, 6:1 etc.

Row intercropping is not practiced in the cotton based production system in the district.

Awareness about the research findings on intercropping with green gram, black gram, soyabean, etc., is negligible.

The major constraint pointed out by the farmers with regard to row intercropping is the difficulty for intensive interculture for cotton crop and possibility of higher pest build up which may affect cotton yield.

RCPS-2 : **Optimising nutrient supply in relation to moisture for enhanced productivity and stability of rainfed cotton based production system** (Jagvir Singh and Blaise).

Two on-station field experiments were conducted to evaluate the requirement and response of cotton grown in different soil types. Results indicated higher biomass and moisture content in balance fertilized plots with cowpea (intercropped) grown as green manure compared to high dose of nitrogen with or without P. Similar trend was obtained in the case of seed cotton yield in shallow soil. Application of ½ N through FYM and ¼ N at squaring and ¼ N at flowering stages with 2% DAP spray was found to improve synchrony of nitrogen supply and plant demand. Analysis of surface soil samples (0-0.15 m) indicate that the organic carbon, CEC and available N and P contents were low. The nature and extent of P sorption showed clear differences in different vertisols.

The relative water content (RWC) of leaf in LRK 516 grown on shallow soil was relatively higher in balanced nutrient + green manuring (cowpea) and least in the treatments without P. There was no significant aphid and bollworm damage in any treatment during the crop season.

On farm trials conducted in the farmer's fields at Amravati and Yeotmal districts indicate that the IPNS treatment was superior to the farmer's practice and the existing fertilizer recommendations.

RCPS-10 : **Impact of tillage, land treatment and organic residue management on productivity and soil health of cotton based systems in rainfed region** (Blaise and G. Majumdar).

Farmer participatory on-farm trials were conducted with the objective of improving the soil health and cotton productivity. Results indicate that with the use of recommended fertilizer doses, the seed cotton yield was enhanced by 272 kg/ha over the farmer practice (sub optimal level of fertilizer usage : 50% of N and P). Use of green leaf manure (GLM) in combination with inorganic fertilizer resulted in a yield increase of 388 kg/ha. The contribution of GLM was 116 kg seed cotton/ha + saving of 25% of fertilizer - N cost. Boll retention was also greater in the GLM plots over the farmer practice. The N balance was positive only in plots where organic residue was recycled back into the soil. Soil mineral - N content was higher in the *Leucaena leucocephala* plots. The green leaf manure releases N at slow rates over extended time and therefore meets the crop demand. However, no significant differences were observed in the organic carbon, available N and P at the end of the crop season.

Crop Production

RCPS-5 : **Rain water conservation, harvesting and recycling/recharging techniques for enhanced productivity of cotton based system** (K.S.Bhaskar, S.M.Wasnik, A.R.Raju and G. Majumdar).

Soil Moisture : Moisture content varied with the toposequence and soil depth. Soil moisture was 3-4 % higher under valley floor and 1-2 % under lower plain as compared to upper plain toposequence resulting in higher grain and seed cotton yields.

Physico-chemical properties of the soils in different toposequence indicated that numerically there is no difference in bulk density and EC values of surface (0-15 cm) and subsurface soils (15-30 cm). However, the higher values of pH, $CaCO_3$, organic carbon and available N, P and K was noticed with decreasing slopes i.e. upper plain to valley floor.

The productivity ranged from 3.87 to 8.09 q/ha in case of cotton desi and hybrid (H4). The profit and output input ratios worked out to Rs. 793 and 1.29 in H4, and Rs. 512 and 1.33 in local cotton respectively. Among the other crops grown in the area, highest profit /ha (Rs. 1481) was obtained in hybrid jowar followed by tur (Rs. 1065).

The yield of seed cotton, grain sorghum and pigeonpea from 20 farmers fields grown on different toposequences was recorded. It was found that yield of all the three crops showed an increase with decrease in the slope and change of toposequence from upper plain to valley floor

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

On-station trial was conducted at CICR (RS) Sirsa. Maximum (21.13 q/ha) seed cotton yield was recorded in treatment T_3 followed by T_2 (19.44 q/ha) and the least in T_1 (19.07 q/ha).

Similarly, the maximum (25.82 q/ha) seed cotton yield was recorded under R_3 (residue management) followed by R_4 (20.31 q/ha) and the minimum (15.98 q/ha) under R_1.

Energy required for seedbed preparation of cotton

The observations were recorded on the time taken, fuel consumed and manpower used under each of the three treatments for primary tillage and preparation of seedbed. The treatments utilising different implements i.e., the tractor hours, manpower used and the fuel consumed are summarized in Table 11.

The treatment T_2 (two operations with cultivator followed by one planking) was found to be least energy intensive as compared to the other two treatments. Treatment T_1 was found 50% more energy intensive than T_2 and T_3 was 100% more energy intensive than T_2. However , treatment T_3 was 33% more energy intensive than T_1

Table 11: Tractor, man and fuel consumed in different treatments

Treatments		Tractor (hrs.)	Man (hrs.)	Fuel (lit.)	Energy consumed (MJ)		
					Fuel	Manual	Total
T1	One disc+ two time cultivator + one planking	0.500	0.500	3.937	221.720	0.980	222.700
T2	Two cultivator + one planking	0.333	0.333	2.625	147.813	0.653	148.467
T3	M.B. plough + two times cultivator + herbicide application ppi	0.666	0.669	5.250	292.627	1.312	296.939

Crop Production

Studies on cotton stalk decomposition

Laboratory incubation experiment was conducted to study the decomposition pattern of cotton leaves and stalks. The Leaf C mineralized much faster than the stem pieces initially. Within five days, 11% of leaf -C was mineralized compared to only 9% of stem-C. After 35 days, the mineralization of leaf-C slowed down. Between 35 and 84 days, stem mineralized 4.6% of its residue - C compareds to only 1.7 % for leaf-C.Due to the increased mineralization of stem-C from 21 to 84 days, the cumulative amount of stem-C mineralized was greater than the leaf-C. At the end of 84 days (12 weeks), the cumulative C mineralized from leaves was 17.9% of the applied-C. The corresponding value for stem pieces was 19.1%. The result indicated that cotton stalks degraded better than the leaves on the cumulative basis.

Wheat biomass production :

The productivity of wheat biomass and the wheat residue remains in the field after crop harvest has been recorded at different locations. It ranged from 3-5 t/ha at Regional Research Farm, Sirsa, Haryana to 5-6 t/ha in the fields of PAU, Ludhiana in Punjab where wheat is harvested by combine harvester.

PSR-36 : **Adoption and refinement of cotton picker and cleaning system** (G.Majumdar).

Three varieties and one hybrid, considered for their suitability for mechanized picking and popularity, were selected and sown. NHH 44 was sown in the spacing of 120 x 10, 120 x 20, 120 x 30, 90 x 10, 90 x 20, 90 x 30 and 90 x 90 under rainfed conditions, and at 120 x 60-cm spacing in the irrigated condition. LRA 5166 was sown at 90 x 10, 90 x 15 and 90 x 30 cm spacing under rainfed conditions. PKV 081 and CSH 911 (a culture under trial at CICR and found to be amenable to mechanical picking) were sown at 90 x 15 cm spacing under rainfed conditions.

Techno-economic study of manual cotton picking system under different farming situations

The closely spaced crops, were more compact, and thus offered more accessibility to pick by hand. Average cost of picking per hectare basis worked out to Rs.3826.6 for all varieties and spacing.

Study on cultural practices and plant characteristics affecting mechanical harvesting system

In general, height of plant increased as the spacing decreased. The shortest plant height was observed in PKV 081. NHH 44 at 120 x 10 cm spacing gave the tallest plants with the maximum height of 94.14 cm under rainfed conditions. Width (spread) of plant was found to increase as plant to plant spacing within the row was reduced.

There was a decrease in the number of monopodia with decreasing plant to plant spacing. NHH 44 gave the least number of monopodia with only 0.1 monopodia per plant at a spacing of 90 x 10 cm. Length of sympodia at 50% height was found lowest for CSH 911 at 20.62 cm, followed by PKV 081 with 21.02 cm. Number of bolls at 50% height increased with spacing.

The size of boll among varieties was found to be at par for LRA 5166 and CNH 911 with 7 and 6.9 cm diameter respectively. Spacing had no effect on the size of the boll.

Among the varieties, CSH 911 and PKV 081 both have a horizontal spread of bolls across row to a maximum of 16.4 and 17.4 cm for a spacing of 90 x 15 cm. The maximum height upto which 95% bolls are concentrated is only 54.8 cm in case of PKV 081 and 65.9 cm for CSH 911. NHH 44 at 90 x 10 cm was equally compact with a maximum horizontal spread of bolls across row of only 16.9 cm but the height of concentration of bolls was a little high at 74 cm.

Dr. Debendra Pradhan, Hon'ble Minister of State for Agriculture, GOI, visiting Biocontrol Lab.

Dr. R S Paroda, Secretary, DARE & DG, ICAR
evincing keen interest in the CICR stall at National Agri. Vision 2001

Shri Sompal, Member, Planning Commission, GOI, releasing Institute publication.

Crop Production

PSR-4 : **Studies on the efficacy of bio-inoculants in cotton-wheat production system** (A.Ravinder Raju, D. Monga and M.K.Meshram).

The screening of mutants and isolates in H-1098 *hirsutum* cotton in cotton-wheat system showed that Azt. Ht 54 (I) and Ht 54 (2) were superior among mutants and that AC-18 and Pseudomonas among isolates. Similarly, for wheat crop in cotton-wheat system the best isolates were HT 54 and Ala-27 which improved wheat yields by 2.0 q/ha. Some of the new isolates from Haryana, Punjab and Nagpur were found to be promising.

Under rainfed conditions, the bioinoculants (Mst-9, Ala-27), HT 541 and 2. IS-16, AC-1, Azospirillum FS and Pseudomonas as seed treatment with 50% recommended fertilisers alongwith 2 foliar sprays of 2% urea at 60 and 80 DAS produced yields similar to recommended fertilisers.

RCPS-9 : **Develop and evaluate production technologies for the indigenous cottons of North-East region** (A. Ravinder Raju, V. N. Waghmare, M. K. Meshram, K. S. Bhaskar, G. Majumdar, and S. M. Wasnik).

Survey was conducted in Srikakukam and Vijayanagaram districts of coastal Andhra Pradesh. Cotton is sown in broadcasting (pure cotton) or dibbling in groundnut without any particular planting patterns. Ratoon cropping is usually practiced. Although the farmers apply suboptimal level of fertilizers, 15-45 cartloads of FYM/ha is applied every year and, therefore, is ideally suited for organic cotton production.

In Mudhol (hill ecosystems) sheep pennings are major source of organic manures every year. The level of organic manure use is 5-6 cartloads applied on an average once in three years. The fertilisers use in cotton is 75% of recommended N 97% of recommended P_2O_5 and 18% recommended K_2O.

Sheep pennings 7.5-15 days/ha with 200 flock , FYM application @ 15-45 cart loads/ha every year is typical to Ponduru. Application of sub optimal fertilisers of 12:29:50 and 40:29:0 N : P : K in red and white cotton in cotton+groundnut strip cropping was observed.

Varietal introduction trial was conducted at ARS Mudhol. *Heliothis* tolerant LD 230 and popular G-27 were statistically similar to MDL 1875 in medium deep black soils. In farmers field, 10 q seed cotton/ha was obtained with the introduction of INM package (biofertilizer seed treatment), seed cotton yield was enhanced by 110 kg/ha.

CROP PROTECTION

- Proteins toxic to neonates have been detected in *G. bikii*, that inhibit the gut enzyme of *H.armigera*.
- Commonality within but distinction between varieties and hybrids in respect of phenology and insect pest inhabitation was confirmed.
- Sucking pests caused 13.5% losses, while *Helicoverpa, Pectinophora* and *Earias* caused 5.59, 4.86 and 3.53% loss, respectively. Plant parasitic nematodes recorded a loss of 8-10%
- Eight entomopathogenic nematodes were isolated and evaluated effective against *H. armigera*.
- Pyrethroid resistance was found to be semi-dominant; nerve insensitivity was recessive and metabolic mechanisms were dominant.
- Larval population which causes 5% fruiting bodies damage was 0.5/plant.
- Seed treatment with Imidacloprid and Thiomethoxam was effective in controlling jassids and aphids.
- Bt. cotton required less sprays, recorded less incidence of *H.armigera* and *Earias* and less boll and locule damages but no yield superiority compared to non Bt. Cotton.
- Leaf curl disease incidence was low with high temperature and low relative humidity.

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).

Of the thirty new germplasm lines screened, seven were found to be promising in respect of resistance to sucking pests (aphids, jassids and thrips) and tolerance to bollworms (10-20% incidence). These lines were utilized for effecting crosses with twelve promising lines identified earlier and two varieties.

Seventy eight F_1s obtained from the crosses between twelve promising lines and two varieties were screened under natural field conditions to know their reaction to key pests. All the F_1s were observed to be resistant to all the sucking pests and tolerant to bollworms (10-15% incidence). Out of these F_1s, twelve were found to be promising and showed earliness (120-150 days), having boll weight (3.5 to 4 gm), boll number (28- 53), tolerance to aphids, jassids, thrips and bollworms (incidence on total fruiting bodies ranging from 11.42 to 20.60%). Ginning out turn was observed between 34 to 39%. Yield was worked out to be 44 q/ha in 5(B) x 7 followed by 40 q/ha in 5(A) x 8 and 5 (D) x 7.

Br 01 (*G. hirsutum*) : Of the one hundred lines screened under the protected condition for their reaction to sucking pests and bollworms, four showed upto 10% incidence of bollworms.

Br 01 (*G. arboreum*) : Of the one hundred lines screened for their reaction to key pests under protected condition, eleven were found to show upto 10% bollworm incidence.

Biochemical basis of resistance

Three germplasm lines observed to be promising in field testing and sixteen lines belonging to the JBWR group were tested under net house condition of which three were found to possess bollworm tolerance. Feeding of individual square parts to 5 mg larvae indicated that *H.armigera* larvae preferred to feed and develop on anthers of these lines. Correlation of cotton allelochemicals was made with the food consumed and the weight gained by larvae. Rutin significantly influenced the food consumed and the weight gained, negatively ,while reducing sugars and free amino acids in the anthers influenced the weight gained by larvae negatively, without interfering with the food consumed.

Crop Protection

P1-93/1-ICR-F60/0430 : **Biochemical basis of induction of defense related proteins in cotton against the gram pod borer *Helicoverpa armigera*** (Sandhya Kranthi and S.B.Nandeshwar).

Of the five species and one race tested, *G.bickii* was found to produce protease inhibitors in response to larval injury. The protease inhibitor was found to be toxic to neonates. The results indicate that increase in the quantity of protease inhibitor was required to inhibit the gut enzyme of larvae differing in their ages (Table 12). The protease inhibitor produced by 10 day old bolls was found to be the most effective in inhibiting gut proteases as indicated by the low I_{50} (Table 13).

Table 12: Protease inhibition of gut proteases from three larval stages differing in their weight by injured boll protein of *G.bickii*

Gut enzyme of *H. armigera* from	I_{50} (ng)	Slope
10 mg larva	2.13	2.44±0.39
100 mg larva	75.66	1.453±0.19
300 mg larva	118.27	4.296 ± 0.68

Table 13 : Protease inhibition of gut proteases from injured bolls / squares of different ages

Age of Boll in days	Injured boll protein I_{50}(ng)	Slope ± SE(m)
5	400.05	3.49 ± 0.65
10	62.68	1.437 ± 0.20
15	220.36	0.70 ± 0.19
7 day square	No inhibition	-

Characterization of the induced biochemical changes in LRA 5166 and NHH 44

NHH 44 and LRA 5166 were studied in detail with regard to the biochemical changes that they undergo when attacked by the cotton semilooper *Anomis flava* and the effect on the cotton bollworm *H.armigera*. *Anomis flava* damaged plant was very unfavourable for the growth of *Helicoverpa*. A significant decline in the total phenols, total carbohydrates, reducing sugars, proteins and a significant increase in the free amino acid composition and chlorogenic acid were observed, but varied over time. No significant induction of tannin, rutin and quercetin was observed. A significant induction of lipoxygenases and peroxidases was observed, while there was no significant difference in the catalase activity of the injured and uninjured plants. No induction of protease inhibitors was seen when the leaf proteins were tested in single radial diffusion assays.

P1-94/1-ICR-H10/0430 : **Interaction effects of cultivars, agrotechniques, insect pests and entomophages in cotton ecosystem** (S.Vennila and C.D.Ravindran).

Validation of the interaction effects of cultivars and pest management methods

A field experiment consisting of three cotton cultivars (one hybrid : NHH 44 and two varieties : CNH 36 and LRA 5166) was conducted under protected and unprotected conditions in a split plot design having five replications (3X2X5) to validate the need for formulation of pest management decision support systems for varieties and hybrids separately under rainfed cotton farming.

Results confirmed the commonality within varieties distinct from the hybrids in respect of phenology and insect pest infestation under protected and unprotected situations. Protected situation favouring sucking pest (jassids and thrips) build up in case of susceptible cultivars was confirmed. Tolerant cultivar had less effect due to sucking pests under protected as well as unprotected conditions, besides being responsive to protection. With the *Helicoverpa armigera* incidence being

minimal during 2000-01, differences in entomological shedding of fruiting structures (squares & bolls) between protected and unprotected conditions were non-significant. Although protected situation showed higher number of damaged open bolls, the per cent damage was non-significant between protected and unprotected conditions.

Population dynamics of sucking pests, bollworms and their damage

Looper population was seen from the first week of August with two peaks, one during 2nd week of August and second during mid September. Damage troughs and peaks were alternating and opposite between *Earias* and *Helicoverpa* from first week of September till 3rd week of October. While *H.armigera* withdrew by October 2nd fortnight, *Earias* continued to cause damage up to November first fortnight. *Pectinophora* build up had effectively started from October 2nd fortnight, a damage takeover from *H.armigera* whereby the total fruiting structure damage was always above ETL, ranging between 10 and 92%.

Larval populations of *Pectinophora gossypiella* collected during various periods of the crop season are being observed for their diapause under laboratory conditions and the observations are in progress. Diapause commenced from November and the incidence progressed with the season. More than 65% of the March population are on diapause. Mortality of the diapausing population ranged between 6-33% and the parasitisation by *Apanteles angaleti* ranged from 2 to 5%.

P1-96/I-ICR-H.10/0430 : **Estimation of loss by major insect pests in rainfed cotton** (S. K. Banerjee).

The incidence of major insect pests was comparatively less, particularly bollworms due to drought like situation at flowering period of the crop. Avoidable loss due to major pests was estimated as 26.17 per cent in which loss due to sucking pests was 13.50 per cent and due to bollworms it was 11.23 per cent. Avoidable loss due to *Helicoverpa, Pectinophora* and *Earias* was estimated as 5.59, 4.86 and 3.53 per cent respectively. Loculi damage was 5.60 per cent in control compared to 2.01 per cent in complete control. Highest yield of 16.70 q/ha was recorded in the treatment to control all the major pests compared to 12.33 q/ha in untreated control.

AICCIP Trial (S. K. Banerjee)

1. Effect of seed treatment with insecticides against sucking pests of cotton

Imidacloprid 600 FS at three different doses, (5 ml, 9 ml and 12 ml/kg seed) and carbosulfan at 50 g/kg seed were tested as seed treatment for testing their efficacy on sucking pests. Imidacloprid 70 WS @ 7.5 g/kg seed was kept as check. Bolls, the seed dresser were found significantly effective in reducing the jassid population, however no significant reduction in aphid, thrip and whitefly population was observed in any of the treatments compared to control.

2. Chemical control of bollworms

Five new insecticides were tested for their efficacy on bollworms. All the insecticides except Bull 2.5 SC @ 18 g ai/ha reduced the square damage. However, only alphamethrin 5 EC @ 30 g a.i./ha was most effective insecticide in reducing the bollworm incidence in green as well as open boll. Though there was no significant increase in yield in any of the treatments, numerically highest yield of 9.13 q/ha was obtained from the plots with alphamethrin @ 30 g ai/ha.

3. Evaluation of combination products of insecticides against major pests of cotton

Eight combination products of insecticides

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were evaluated against major insect pests of cotton. The combination products tested were Quinalphos + Cypermethrin, Endosulfan + Hostathion, Cypermethrin + Phosalone, Spinosad + Chlorpyriphos, Match + Profenophos, Bulldock star, cypermethrin + acephate and L-cypermethrin + Diflubenzuron. Significantly less square damage was observed in Endosulfan + Hostathion, Bulldock star and cypermethrin + acephate treated plots whereas green boll damage was significantly less in cypermethrin + phasalone and Match + profenophos treated plots compared to control. Highest yield of 9.75 Q/ha was obtained from cypermethrin + phosalone treatments followed by Quinalphos + cypermethrin (9.33 Q/ha) and spinosad + chlorpyriphos (9.24) compared to 7.33 q/ha in untreated control.

PI-96/2-ICR-H10/0430 **: Studies on plant parasitic nematodes associated with cotton** (Nandini Gokte-Narkhedkar and S.K. Banerjee)**.**

Yield loss assessment due to plant parasitic nematodes associated with cotton in Nagpur region

Field experiment laid out to estimate loss caused due to plant parasitic nematodes, particularly *Rotylenchulus reniformis* recorded a loss of 8-10%.

Damage potential of *R. reniformis* was evaluated on cotton under pot conditions. *R. reniformis* infective females were inoculated at different inoculum levels and at different age of seedlings. Shoot and root weights were taken and data were analyzed using Seinhorst equations. Cotton was most susceptible at 15 DAS. Damage to shoot was recorded at 2 j/g soil while root damage was evident at 1 j/g soil.

Cotton growing areas of Wardha were surveyed for association plant parasitic nematodes. *R. reniformis* was the most frequent and dominant species.

Villages around Sirsa were found to have tracts of cotton fields showing the presence of root knot nematode, Meloidogyne. Nematode population from rhizosphere of plants from poorly growing patches ranged between 125-450 nematodes/250 cc soil while nematode populations growing at interface recorded 400-960 N/250 cc soil.

P1-89/1-ICR-H20/0430 **: Studies on multiple disease resistance in upland cotton** (Sheo Raj, N.K.Taneja and V.V.Singh).

Two cultures selected last year were grown this year. The culture CNH 2713 yielded 14.7 Q/ha whereas CNH 4736 produced 13.7 Q/ha with 60 x 60 cm spacing and are resistant to bacterial blight and moderately resistant to *Myrothecium* leaf spot. The seeds have been sent to PAU, Ludhiana and CICR Regional Station, Sirsa for testing against leaf curl virus.

All the F_1s made during 1999-2000 to incorporate the resistance to insect pests, showed resistance to bacterial blight, *Myrothecium* leaf spot and tolerance to sucking pests and bollworms. One F_1 appeared to be good in respect of boll number, boll weight (4.7 gm), yield (23 q/ha), and fibre quality parameters (2.5% SL-29 mm, UR-53, Mic 4.9, S(3.2 mm)- 24.6, FQI-322). One hybrid (CNHH 296) has been entered in AICCIP for multilocation trial in irrigated areas.

One hundred and sixteen single plant selections have been made from progenies of a three way cross based on disease resistance and desirable plant characters.

Out of 39 *G. hirsutum* germplasm lines screened in the pot house, 14 showed tolerance against grey mildew. These are A 7262, AC 53 CY, Acala 9-75, B 57-980, B 58-1320, B 59-1513, BC 68 x MOCO, BC 177 CY, CC 29-2-3-20, DP 16, EL 389 A, EL 415, EL 628, G 489 LYC.

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Pl-89/3-ICR-H20/0430 : **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 *Alternaria macrospora, Colletotrichum capsici, Myrothecium roridum, Phoma tropica* and *Macrophomina phaseolina* (*Rhizoctonia bataticola*) was observed. The higher infection of *A. macrospora* (leaf and boll spot) was observed in *G. arboreum* varieties and germplasm lines as well as in interspecific diploid (*G. herbaceum x G. arboreum*) hybrids DH 7 and DH 9. The infection due to anthracnose pathogen *C. capsici* was more severe in *G. herbaceum* cultivars DB 3-12 and Jayadhar. The bad seed-cotton lots from 1999-2000 crop season, belonging to varieties and hybrids of all the four commercially cultivated *Gossypium* species were analysed for the presence of pathogenic infections and associated seed microflora wherein presence of eight cotton fungi and the bacterial blight pathogen *X.a pv. malvacearum* was observed.

P1-92/1-ICR-H20/0430 : **Studies on evolution of races of *Xanthomonas axonopodis* pv. *malvacearum* (*Xam*) and utilization of HVS in identification of resistant sources** (M.K.Meshram and Sheo Raj).

One hundred and fifty isolates were made from the bacterial blight infected leaf samples of five susceptible cultivars viz. Ganganagar Ageti, LRA 5166, LRK 516, PKV 081 and SRT 1 to know the pathogenic variability. Six races viz. 3, 6, 7, 10, 15 to 18 were identified of which races 10 and 18 were predominant.

Five races viz. 3, 5, 7, 10 and 15 were identified from the sixty four isolates made from the infected leaf samples collected from Uttar Pradesh.

Thirty six isolates were made from the infected leaves of *G. herbaceum* collected from CICR, Nagpur. All the isolates belonged to race 18.

Identification of resistant sources :

Two hundred and twenty six germplasm lines of *G. hirsutum* were screened in pot culture for their reaction by using the virulent race 18 of *Xam.* Out of these, three viz. Sea Island 7 white Flower, Frego cluster and Stoneville 3202 have exhibited the disease free reaction and six lines viz. Delfos 719 (339) T 105-7, Stoneville 5AT 226-11, CB 2480, Guatemala 14, white gold wilt and saenz pena 85 were observed to be resistant. Of the remaining lines eight were moderately resistant, 125 moderately susceptible and 84 susceptible.

Of the 1357 germplasm lines of upland cotton evaluated for bacterial blight reactions under field conditions, 122 were free from incidence, 154 were resistant, 108 were moderately resistant, 521 moderately susceptible and 442 were susceptible.

Observations were recorded on 127 lines of upland cotton of Br 01 trial under field conditions. Out of these, one line 103 No. was observed to be disease free whereas six lines viz. C-2-3(4), C-4-B-5-8, C-4-B-5-8©, L 11, L11A and line-3 reacted as resistant. Remaining 10 were moderately resistant, 61 moderately susceptible and 49 susceptible.

Utilization of resistant sources :

One hundred and eighty seven single plant selections have been made from the population involving four immune lines Tamcot SP 21, Tamcot SP 23, Tx ORH15 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 36.2 - 66.9 gm/plant with an average number of bolls/plant and an average boll weight of 2.56 - 3.32 gm/bolls.

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Fourteen resistant selections have been identified for their plant quality parameters. The average boll number of these selections varied from 15.58 - 24.96 per plant with an averaged boll weight of 2.92 - 3.59 gm/boll. The average yield of seed cotton varied from 47.8 - 68.3 gm/plant with an averaged height of 85.4 - 110.7 cm/plant. The average monopodia and sympodia varied from 0.7 - 2.6 and 15.0 - 20.5 per plant, respectively.

PI-92/2-ICR-H 20/0430 : **Studies on Fusarium wilt resistance in diploid cotton and development of resistant breeding material** (S.T.Tembhurnikar).

Crosses were made between susceptible and resistant varieties of desi-cotton and their F_2, F_3, F_4 and onward generations were studied in the sick plot and in the field and selection was made. Thus 10 lines of F_2, 14 lines of F_3, 10 lines of F_4 40 lines each of F_5 and F_6 generation, 40 lines of F_7 and 30 lines of F_{10} were tested in sick plot and in the field. Selection of resistant cultures was made taking into consideration of high yield, medium staple length and more number of bolls per plant. Thus five resistant culture to Fusarium wilt have been developed viz. Dhulia 2 x AKH 590, Dhulia 2 x JLA 101, Dhulia 2 x CC-1-1-3.5, G 27 x NA 3, G 27 x AKH 590. The cultures yield trial was conducted and yield was recorded as Dhulia 2 x AKH 590 - 24.75 q/ha, Dhulia 2 x JLA 101 - 22.88 q/ha ,Dhulia 2 x CC-1-1-3.5 - 10.81 q/ha, G 27 x NA 3 - 23.29 q/ha, G 27 x AKH 590 - 22.88 q/ha, Control AKH 4 - 10.56 q/ha.

One hundred and five (105) germplasm lines were tested in the Fusarium sick plot, out of which 23 were found resistant and 82 were susceptible.

P1-93/1-ICR-H20/0430 : **Molecular basis of pathogenicity and race specificity in *Xanthomonas axonopodis* pv. *malvacearum* (*Xam*) and molecular characterization of antagonists of *Xam*** (P.K.Chakrabarty, Sheo Raj and M.K.Meshram).

Sixty Rif. resistant mutants were developed at three stages by selecting them on increasing doses of antibiotics. The bacterium was grown in broth and spread on PYGM plates, supplemented with 30 ug/ml Rifampicin. The Rif. Resistant mutants are being used as molecular antibiotic resistance marker for selection of test strains.

Survey and collection of *Xam* isolations :

One hundred and fifty isolates of *Xam* were collected from different cotton growing states of India. Each of these isolates were purified.

Isolation of plasmids : Seventy eight bacterial strains were screened for their plasmid profiles. All of them contained 1-3 plasmids ranging between 55-7.4 kb. Although no correlation could be observed between the number of plasmids and virulence of the races, the highly virulent races invariably harboured a plasmid of 31.2 kb. This particular plasmid can be considered as a marker for higher virulence.

Identification of antagonists of *Xam* : Forty five phylloplane bacteria were isolated and screened against *Xam in vitro* on YGCA medium. Four bacteria were highly (10 mn) effective in exhibiting the inhibition of the pathogen. The bactrerial strain p/b 10 produced purplish fluorescent pigments in the culture medium.

P1-93/2-ICR-H20/0430 : **Evaluation of cotton germplasm against Aiternaria and Myrothecium leaf spot diseases** (N.K.Taneja).

Out of 1649 *G. hirsutum* germplasm lines evaluated under natural incidence of diseases in the breeders field, 35 were field immune, 118 resistant, 774 moderately resistant, 427 moderately susceptible and 295 susceptible to *Alternaria* leaf spot while 1400 showed field immunity, 74 resistant, 121 moderately resistant, 26 moderately susceptible and 28 susceptible reaction against grey mildew.

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Out of 39 *G. hirsutum* lines screened against fungal foliar diseases in pot culture, all the lines were susceptible to *Alternaria* leaf spot while 14 lines showed resistant reaction against grey mildew.

Br 01 trial : Out of 100 *G. arboreum* lines evaluated six were field immune, 32 resistant, 59 moderately resistant and three moderately susceptible against *Alternaria* leaf spot while 23 were field immune, 33 resistant, 22 moderately resistant, nine moderately susceptible and 13 susceptible to grey mildew. Out of 97 *G. hirsutum* lines evaluated, three showed field immunity, 8 resistant, 51 moderately resistant, 24 moderately susceptible and 11 susceptible reaction against *Alternaria* leaf spot.

Ad-hoc **: Testing of new molecules (fungicides)** (N.K.Taneja and Sheo Raj).

All the fungicides were effective in reducing *Alternaria* leaf spot and grey mildew but Bavistin treated plots gave significantly higher yield followed by octave and copper oxychloride.

P1-94/1-ICR-H20/0430 **: Effect of mix-micro-antagonists on control of cotton foliar diseases** (R.C.Ukey).

The five micro-antagonist viz. Mucor sp. Penicillium sp., *Trichoderma viride, Sterptomyces* sp. and *Pseudomonas* sp. isolated from the phylloplane of LRK 516 cotton were compared with chemical spray to assess their efficacy against foliar diseases. The antagonists and the chemical gave almost equal control of the foliar diseases, *Alternaria* leaf spot and *Myrothecium* leaf spot

Coimbatore

P1-72/1-ICR-H10/0430 : **Studies on the population dynamics of cotton pests and their natural enemies in the cotton eco-system** (K. Natarajan and B. Dharajothi)

A. Sucking pests

Aphid and jassid population was observed throughout the year, but the peak was during October (80 per 3 leaves) and January (70-80 per 3 leaves) for the former and November-December for the latter.Whitefly appeared in the month of October and maximum recorded was 96 per 3 leaves when the crop was 150 days old. Maximum thrips population was noticed in the month of September-October. Coccinellid predator population was high in November.

B. Bollworms

Helicoverpa armigera was the dominant bollworm and maximum activity was in the month of November. Bollworm damage appeared in the month of October and the maximum damage recorded was only 15.0% in the last week of January.

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).

(i) Sucking pests

Thirteen cultures assessed for aphids showed that, population was high in Acala glandless, MCU 5, LRA and 70 E and considerably less in Suvin and K 9. A very low population of 21.7 aphid was recorded in G 27. About 50 cultures resistant to jassid have been identified.

(ii) Larval incidence and damage relationship of *Helicoverpa armigera* in cotton

The study revealed that there was a strong and positive correlation between larval number and damaged fruiting bodies. It was seen that 43 - 57 % of sampled plants were infested with single larva and 30 - 37 % with two larvae and 18 - 21 % with three to four larvae during the peak infestation periods *viz.*, 77 - 100 days after sowing. The fruiting bodies damage was 10.13, 20.44, 30.25 and 38.61

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% respectively. A larval population of 0.5 larva per plant causes 5 % fruiting bodies damage.

(iii) Screening of promising cultures and parental genotypes of *G.hirsutum* and *G.barbadense* for resistance to bollworms

Thirty two promising genotypes of *G hirsutum* were screened for bollworm resistance. Eight genotypes *viz.*, IRH 2-15,CW ROK 165, BRS 22, BRS 23, Abadhita, BWR 39, IRH II/1 and CWS 69 registered below 10 % boll damage. Of the fourteen genotypes of the of *G.barbadense* screened, three (GB 22, GB38 and GB 49) registered less than ten per cent damage as against 17.5 % in Suvin.

P1-89/4-ICR-H10/0430: **Studies on the role of insecticides in cotton ecosystem** (T. Surulivelu and K. Natarajan).

(i) Testing of new insecticides for the control of sucking pests.

Imidacloprid at all the doses and Thiomethoxam recorded less jassids upto 45 days after sowing. However, with regard to aphid they were effective only upto 35 days. All the seed treatments registered significantly higher seed cotton yield ranging from 1590 kg / ha to 1680 kg / ha as compared to 1370 kg / ha in untreated check.

Seven sprayable formulations were tested against the sucking pests viz., jassid, aphid and thrips. Acetamiprid and Imidacloprid recorded less jassid and remained on par with other insecticides. Diafenthuran recorded minimum aphid population of 4.8 per 3 leaves and remained on par with Thiomethoxam 50 g / ha. With regard to seed cotton yield, Acetamiprid 10 g / ha recorded the maximum of 1033 kg / ha and remained on par with other insecticides.

(ii) Testing of new insecticides for bollworms control

Three new insecticides *viz.*, Zetamethrin, Bifenthrin and F 6028 were tested for their effectiveness against bollworms. The results revealed that *Helicoverpa armigera* larval incidence, fruiting body damage, boll and loculi damage at harvest were significantly less in F 6028 and Bifenthrin treatments, while Zetamethrin was found ineffective. The seed cotton yield was also significantly higher in Bifenthrin (20.0 to 20.4 Q/ ha) and F6028 (18.7 to 19.3 Q/ha) as against 11.8 Q/ha in control. Zetamethrin (10.5 to 12.4 Q/ha) was on par with control.

Eight combination insecticides were tested against bollworms. Two combination insecticides which involved IGR (Match+Chlorpyriphos) and extracts of Actinomycetes (Spinosad + Chlorpyriphos) registered significantly less incidence of *H.armigera* (4 larvae per 5 plants as against 10 larvae per 5 plants in control) and significantly less fruiting body damage (4.7 to 6.9 % as against 20.0% in control). They also registered significantly higher yield of seed cotton (20.6 to 21.82 Q/ha as against 13.55 Q/ha in control).

Ad-hoc trial: **Field and laboratory studies with Bt - cotton** (T. Surulivelu).

(i) Testing of Bt cotton hybrid MECH 12 for its field effectiveness against bollworms

Based on the ETL spray protection, Bt-cotton (MECH 12) required three sprays on 100, 110 and 121 days after sowing (DAS) while its counterpart non-Bt (MECH 12) and check hybrids (NHH 44, Savita) required five sprays on 75, 89, 100, 110 and 121 DAS. There was significantly less larval infestation of *H. armigera* in Bt hybrid MECH 12 (0.03 to 0.45 larva per 5 plants) while Non-Bt MECH 12 had 3 to 3.4 larvae per 5 plants. The regional check (NHH 44) and National check (Savita) had 4.98 and 5.10 larvae per 5 plants respectively. *Earias* damaged plants were significantly less in Bt cotton (7.3 to 8.1%) as compared to non-Bt cotton (16.5 to 18.4%) and check hybrids (30 to 34%).

Boll and loculi damage at harvest were significantly less in Bt cotton (25.3 to 26.6% and 8.1 to 8.7% respectively) as compared to non-Bt cotton (48.9 to 58.2% and 33.5 to 35.9%) and check hybrids (44.4 to 55% and 27.6 to 42%). However, there was no significant difference among the treatments with regard to seed cotton yield.

(ii) Evaluation of three Bt cotton hybrids

Three Bt cotton hybrids viz., MECH 12, MECH 162 and MECH 184 and their non-Bt counterparts were tested against bollworms along with check hybrids (NHH 44, Savita) in replicated field trial. Bt cotton hybrids had significantly less fruiting bodies damage (0.2 to 2.7%) as compared to non-Bt cotton (4.2 to 10.2%) and check hybrids (7 to 9.5%). Boll and loculi damage were also significantly less in Bt cotton hybrids (16.8 to 23.3% and 7.7 to 11.3% respectively) as compared to non-Bt cotton (36 to 51% and 19 to 29%) and check hybrids (35 to 49% and 17 to 27%). Earias shoot damage were also significantly less (2.2 to 5.7%) in Bt cotton hybrids as compared to non-Bt cotton (9.1 to 18.2%) and check hybrids (17.6 to 23.8%). However, there was no significant difference with regard to seed cotton yield among the treatments

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

There was wide spread occurrence of Alternaria leaf spot during the early part of the winter cotton season. Due to the prevalence of dry weather later, there was negligible or low incidence of grey mildew disease.

B. Evaluation of Germplasm

One hundred new germplasm lines of *G.arboreum* and *G.hirsutum* were evaluated both in the field and in pots for their reaction to *Ramularia areola* and *Alternaria macrospora*. Three lines of *G.arboreum* viz., 1314N, 30838 and 30841 showed highly resistant reaction (Grade O) and 64 lines of *G.arboreum* and 24 lines of *G.hirsutum* showed resistant reactions (Grade 1) against Alternaria leaf spot.

C. Disease Management

i) Management through fungicides and bioagents

The new fungicides viz. Prochloraz (Octave 50 WP) and Tebuconazole (Foliar 250 W) were tested against grey mildew and Alternaria leaf spot diseases in separate field trials with Carbendazim 50 WP and Copper oxychloride, respectively as standards. The test chemicals as well as the bioagents *Trichoderma viride* and *Pseudomonas fluorescens* Pf 1 were as effective as Carbendazim in containing the grey mildew disease, when sprayed immediately after occurrence. The chemicals and bioagents were not effective against alternaria leaf spot, since the initial disease incidence itself was high and the development of the disease was faster.

ii) Development of resistant lines

a) Grey mildew : Eleven lines of F_{11} and BC_1F_9 progenies evolved from the crosses between the resistant germplasm (IC 629, 710, 751 and 1017) and LRA 5166 and RKR 4145 were tested in the field and 28 single plant progenies were advanced. In addition, the F_1 progenies of the crosses involving RR 1017 and L 629 (grey mildew resistant lines) were also evaluated in the field and 49 single plant progenies were selected.

b) Alternaria leaf spot : The F_{11} and BC_1F_9 progenies of the 11 resistant selections were tested in the field against alternaria leaf spot. Based on resistance and quality parameters, 31 single plants were selected for further evaluation.

Eight Alternaria leaf spot resistant lines and three grey mildew resistant lines were compared with LRA 5166 and Anjali for their yield potential

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in field trials. In addition, ALR 4 and GMR 3 were also entered in the Common Institute Trial. In both the trials, ALR 4 gave the highest yield (22.57 q/ha and 17.53 q/ha, respectively) and were significantly superior to LRA 5166 and Anjali. ALR 4 (CCH-4) has since been entered in the National Initial Evaluation Trial (Br 02 a) of AICCIP. The Alternaria leaf spot resistant line CCH 727 has been advanced to the Co-ordinated Varietal Trial in the All India Coordinated Project.

c) MAR Lines: Several F_4 and BC_1F_4 progenies of multiple crosses evolved for resistance to bacterial blight, grey mildew and Alternaria leaf spot were tested in the field and based on their performance, 12 single plants were selected for further study.

Seven Alternaria leaf spot and grey mildew resistant lines were tested in the AICCIP Plant Pathology trials at 12 centres during 2000-2001 and most of them have shown multiple resistance at varying degrees (Table 14).

Table 14: Reaction of selected grey mildew and Alternaria resistant lines at different Centres of AICCIP

S.No.	Line	BLB	ALB	GM	CLCuV
1	RR 1007 (ALR 4)	R	R	MR	R
2	LR 1007(ALR 8)	R	R	R	R
3	CCH 727(ALR 9)	R	R	R	R
4	AA 1007(ALR 10)	MR	MR	R	R
5	J 1007 (ALR 12)	MR	MR	MR	S
6	CCH 18(GMR 1)	R	R	R	R
7	LIC 629(GMR 12)	R	MR	R	R

d) Biochemical aspects of fungal foliar disease resistance:

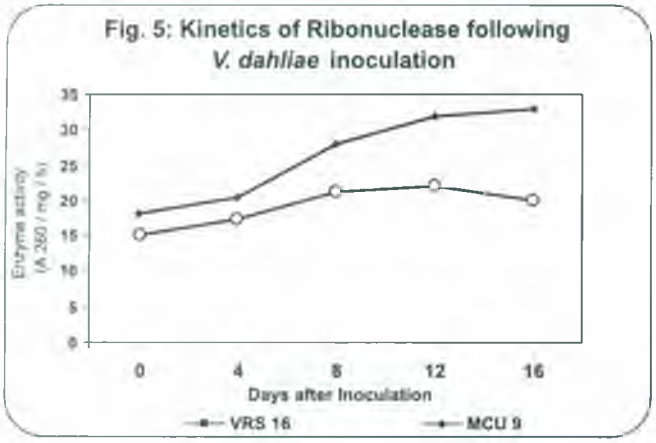
Higher constitutive levels of total and orthodihydric phenols were seen in leaves of grey mildew and Alternaria leaf spot resistant germplasm lines. Significant reduction in nitrogen metabolism enzymes was seen in case of infection due to fungal foliar diseases. Compatible host-pathogen interaction brought about characteristic decrease in nitrate reductase activity (40-50%) and peroxidase activity (30-45%) in susceptible cultivars, while the tolerant genotypes to grey mildew exhibited near normal activity of NR and accelerated activity of peroxidase. The effect was evident in lowered soluble protein content due to pathogenesis. Reduction to the extent of 20-35% in case of flavanols and 15-20% reduction in case of gossypol were noticed due to disease development.

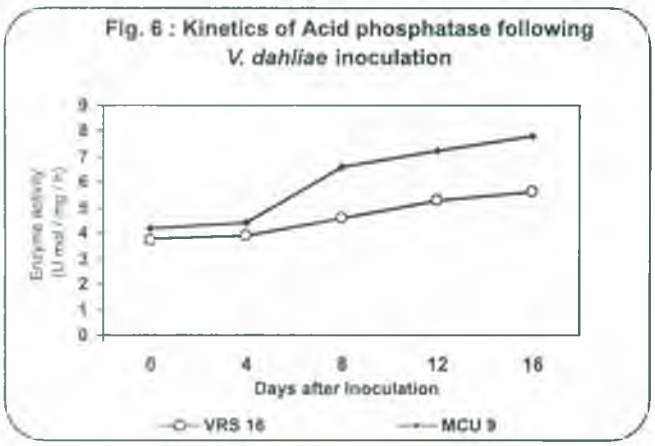
P1-89/1- ICR- H20/ 0430 : **Studies on soil borne diseases of cotton** (A Kannan , K. N. Gururajan and N. Gopalakrishnan).

In the station trial, select *Verticillium wilt* resistant cultures viz. VLV 3, VLV 6, VTV 6 were evaluated along with Surabhi and MCU 5 VT as checks. Culture VLV 6 and VLV 3 recorded mean seed cotton yields of 19.57 and 17.21 q/ha, respectively, as against 17.63 q/ha of Surabhi and 14.63 q/ha of MCU 5 VT. Culture VLV 3 has been entered in the National Irrigated trials under AICCIP. New source of wilt resistance from Nazili 85 is being transferred to VRS 16, Surabhi and Suman.

The progress of the disease upon stem inoculation with *V.dahliae* has been studied by closely monitoring the impact on biochemical constituents and enzymes in select tolerant

genotypes and susceptible check MCU 9. Characteristic increase in peroxidase activity was seen during post inoculation phase which closely followed Indole acetic acid oxidase activity in tolerant genotype VRS 16. The enhancement in the activities was observed to the extent of 20-25% which helped in checking the disease. The role of hydrolytic enzymes in hastening the development of *V. dahliae* in disease manifestation was again confirmed (Fig. 5 and 6).





P1-89-2/ICR-H20/0430: **Studies on bacterial blight of cotton** (A. Kannan, P. Chidambaram and K.N. Gururajan).

Eleven Germplasm accessions viz., IC 629, IC 727, IC 1338, IC 1340, IC 1342, IC 1351, IC 1444, IC 1762, IC 1804, IC 1987 and IC 2029 were found to be resistant to bacterial blight. Three bacterial blight resistant cultures developed at Coimbatore *viz.*, CBR 1, CBR 2 and CBR- 3 when tested at twelve locations, confirmed resistance.

Twenty progenies involving CNH 7/94, CBR 3, Badnawar 1, RKR 4145, 101-102B, C 1412, MCU 10, IC 1007 and LRA 5166 were screened against bacterial blight . Nine progenies viz., C3UL 75-3-1, C3UL 75-3-6, C3 UL 71-3-4, C3 UL 71-3-6, C3 UL 71-6-3, RB 8/2-2-1, ABJRB 10-5-1, CNH 7/94 C3 6 and RBRRM 4-1-16 have been found resistant.

In the station trial, CBR 21 and CBR 22 were evaluated for seed cotton yield with LRA 5166 as check. Culture CBR 22 recorded the highest yield of seed cotton (21.65 q/ha) as against 15.01 q/ha of LRA 5166. Culture CBR 22 has been entered in the Institute's common trial for yield evaluation.

Sirsa

Evaluation and refinement of IPM module for irrigated cotton in north zone (P Jeyakumar).

A field trial was conducted for evaluating IPM module suitable for irrigated cotton agro-ecosystem. There were six treatments and each treatment was laid out in an un-replicated half an acre plot. Botanicals, bio-agents,IPM, recommended insecticides, and spraying practice adopted by farmers were the treatments against (untreated) control.

The incidence of sucking pests in general was found to be less throughout the season. The variety LH1556 is tolerant to sucking pests. The jassids population crossed the ETL limit of two

jassids /leaf at some occasions in all the treatments and control. Square damage by bollworms was less than 10 per cent. The green boll damage was less compared to open boll damage, which may be due to pink bollworm incidence and it was more when the botanicals and biologicals were used.

Mass production of biocontrol agents (P Jeyakumar).

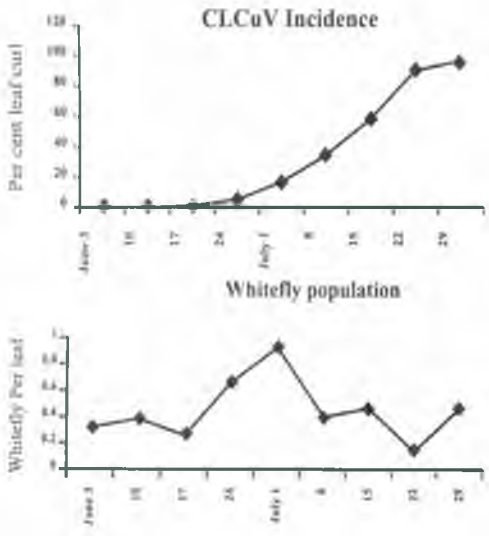
Under this project the bioagents such as Nuclear Polyhedrosis Virus of *Helicoverpa armigera* and *Trichogramma*, an egg parasitoid of bollworms are mass multiplied. In the year 2000-2001, 55,000 LE of Ha NPV and 106 Tricho cards (worth of Rs.105,000) have been produced and distributed to FLD farmers and sold to other farmers.

Studies on the cotton leaf curl virus (CLCuV) disease and development of resistant varieties and hybrids for its management (D Monga).

Epedemiological Studies

The susceptible variety HS-6 was observed for disease appearance, development and grades. The appearance of disease was noted on 3rd June (Fig. 7.)

Fig.7: Incidence of CLCuV and whitefly in HS-6



The development was slow upto 2nd July, then rapid upto 22nd July and again slow later on. Almost 68% plants developed symptoms within a period of twenty days i.e. between 3rd July to 22nd July. The losses in general were more when the disease appeared early and when there were more plants in higher disease grade. No correlation was seen between CLCuV disease and whitefly, but the correlation between disease and maximum and minimum temperature was negative (-0.472 & -0.454) and the correlation between disease incidence and maximum and minimum relative humidity was positive (0.498 and 0.578).

Germplasm screening

Of the 1040 lines of *G.hirsutum* screened under field conditions against CLCuV disease and whitefly incidence, 354 lines showed incidence of disease ranging from 7.69 to 71.40%. Whitefly incidence varied between 0.17 to 7.5 per leaf and thirty seven lines were free from whitefly.

Fifty seven CLCuV resistant lines were tested under polyhouse conditions . Symptoms of disease was observed in three lines with disease ranging from 20-66.7% as compared to 40.0% in check HS-6 where as remaining lines were free from disease.

Breeding for disease resistance

Sixty four F_1s from crosses between CLCuV resistant lines and local cultivars were sown. Leaf curl incidence was recorded only on four entries. Maximum seed cotton yield of 161 g/plant was recorded in case of hybrid CISH 27 followed by 141.1, 135.0 and 131.7 g/plant in hybrids CISH 26, 61 and 52 respectively as compared to 88.3 and 83.3 g/plant in local checks LHH 144 and Omshanker. Highest GOT of 39.3% was noted in hybrid CISH 101 followed by 38.7% in CISH 36 and 38.3% in CISH 102 respectively. In second trial 71 F_1 crosses

Crop Protection

were evaluated. All the entries except one, CISH 20 remained free from leaf curl virus disease. Maximum seed cotton yield of 290 g/plant was recorded in case of hybrid CISH-23 followed by 180 and 171.67 g/plant in hybrid CISH 32.

One hundred and ten single plants selected from F_2 generation were sown during the season. Thirty one (BC_2) back crosses were planted during the season and further BC_2 back crosses were made in the selected disease free plants. The crosses using resistant varieties and local cultivars were attempted in 8 x 8 diallel fashion for studying the genetic basis of resistance against CLCuV disease and other traits and F_1 seed has been collected.

Studies on the management of root rot of cotton (D. Monga)

Fourty seven germplasm entries were sown in root rot sick field with three replications in a randomized block design with H-1098 and LH-900 as checks. Minimum root rot incidence was noted in line VV-772 early (12.97%) followed by lines SFA 243 (22.17%) and IH-144-3-62 (22.88%) as compared to 41.55% in check variety H-1098. However, line Plain showed the highest seed cotton yield of 1 .64 q/ha followed by 1.56 q in SP glandless and 1.45 q in line 1443 EC.

In another experiment, the seeds of variety RG 8 were treated with different cultures of *Azotobacter* to see their efficacy in the management of root rot of cotton. The disease incidence in all the treatments was higher than control except in case of treatment HT-54 where it was slightly less as compared to control. Maximum seed cotton yield of 0.44 q/ha was also recorded in treatment HT-54.

A half diallel of 8 x 8 varieties for studying the inheritance of important diseases with special reference to root rot of cotton was attempted during the crop season and F_1 seed has been procured.

NATIONAL AGRICULTURAL TECHNOLOGY PROJECT (NATP)

Control of leaf curl virus disease in cotton and development of protocols for mass multiplication of predators, parasities and insect pathogens

Out of 202 germplasm lines, 41 were observed to be highly resistant to leaf curl virus under natural as well as artificial screening.

Different pesticides were tried to record their efficacy to manage whitefly. It was observed that seed treatment with Imidachloprid was effective in the management of whitefly in the beginning and thereby reducing the incidence of leaf curl.

Different predators, parasites and insect pathogens were collected from cotton fields. Efforts were made to refine the protocol for production of Bt. in the laboratory. The modified process enables enhanced production of endotoxin.

A field trial was conducted to evaluate the efficacy of the products of HNPV and Bt alongwith UV protectant against *Helicoverpa armigera*. The results were encouraging however, the incidence of *Helicoverpa* was low.

RCPS-4 :**Delineating the efficient production zones for the cotton system using GIS based crop models** (S.Vennila and K B Hebbar).

Secondary data related to varietal scenario and of physiological parameters of cotton in relation to productivity of rainfed cotton zones were collected and are being computerised

The parameters for testing/adapting CALGOS model of cotton were collected and supplied to the lead center.

Crop Protection

AP CESS FUND

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

Eight more isolates of EPN were detected, isolated, maintained and multiplied on larvae of *G. mellonella* and *C. cephalonica* making total of sixteen isolates available. EPNs isolated were identified as belonging to *Heterorhabditis* and *Steinernema spp.*

H. bacteriophora isolates from Wadi, Nagpur were very effective against all stages of *H. armigera* with 15 EPN juveniles per *H. armigera* causing 88-100% mortality of different stages. Variation in susceptibility to EPN was recorded with different life stages of *H. armigera.* Ten isolates of *Heterorhabditis spp.* and *Steinernema sp.* were tested against pink bollworm, Spodoptera, Armyworm, Semilooper and Leaf folder larvae. Significant insect mortality was recorded with all the isolates tested. However, Spodoptera and pink bollworm larvae did not record population build up for any of the isolate.

H. bacteriophora isolates recorded less infectivity at 20 ^{o}C while *S. glaseri* recorded higher mortality at lower temperature of 20 ^{o}C. Isolates from hot tropical ecosystems were found to be more infective at higher temperatures (35-30 ^{o}C) while isolates from cooler areas were more infective at lower temperatures.

In laboratory, EPN isolates were maintained and multiplied on *C. cephalonica.* Peaks in almost all isolates coincided with prevalence of congenial temperatures while higher temperatures led to rapid population decline.

Studies were taken up on bacterial symbiont as these have significance in standardization of protocols for mass multiplication. Primary and secondary forms of bacterial symbionts were isolated from all the 15 EPN isolates. To test the pathogenicity, the bacterial cells isolated from *H. bacteriophora* were injected in *Galleria* and *Helicoverpa* last instar larvae and 98-100% mortality was recorded with 12 CFUs (Coloring Farming Unit). Mass culturing of three isolates was tried and found to be successful on dog food biscuits and animal kidney - peptone medium system.

ICAR Adhoc research scheme

Areawide implementation of IRM/IPM strategies through farmers participation

Nagpur : (S.K.Banerjee and K.R.Kranthi)

IRM strategies were disseminated in nine villages of Wardha district with the participation of 1000 farmers and covering about 1700 hectares. Insecticide applications was reduced by more than 90% compared to the pre-project period. The average yield in the nine participating villages was 5.45 Q/acre while it was 3.25 Q/acre in a non participating village.

Sirsa : (D.Monga and P.Jeyakumar)

Fifteen farmers from three villages (Rangri, Darbi and Vaidwala) covering an area of 60 acres participated in the programme. The use of pesticides was reduced from 6-7 sprays to 4-5 sprays and the use of pyrethroid spray was restricted to one only. The average yield of seed cotton in participating farmers field was 7.5 q/acre compared to 5.8 q/acre in case of non-participatory farmers. The cost benefit ratio was 1:33 in case of participatory farmers whereas in non-participatory farmers it was 1:26.

Coimbatore : (T. Surulivelu)

The project farmers followed the IRM strategies and effectively managed the cotton pests including *H.armigera.* and saved a few number of sprays (2.7), the quantum of pesticide used per unit area (2.84 kg a.i./ha) and cost on plant protection

(Rs.3657/ha). Further, they harvested 41 % higher seed cotton yield resulted in higher net returns of Rs.12300/ha and obtained better sucking pests control (26 - 46 %), less incidence of *H.armigera* (32 - 41 %) and less bollworm damage (55 %) as compared to farmers of control village.

Adhoc Scheme (NCIPM)

Development of cotton diseases and pest data base and reporting system and establishment of National IPM Network (K. Natarajan).

Jassid and the bollworm were the dominant pest in both IPM and non-IPM villages. In the IPM field, larvae of *Helicoverpa armigera* appeared when the crop was 60 days and persisted upto 150 days of crop growth. A maximum damage of 13% was recorded during the last week of October and thereafter the population declined. In the non-IPM village, the damage appeared in the month of September when the crop was 50 day old. Maximum damage of 18.6% was recorded during last week of October. Among the natural enemies, *coccinellid* alone was observed in the early stage of crop growth.

In general the disease incidence was less and did not require any fungicide spraying both in IPM and non-IPM villages. The cost of plant protection in IPM village was Rs. 3926 / ha as compared to Rs. 5761 / ha in non-IPM village. The yield in the IPM village was 2016 kg / ha as compared to 1835 in non-IPM field.

Externally funded projects

DBT Project

Development of sensitive molecular diagnostic tool for rapid detection of *Xanthomonas axonopodis pv. malvacearum (Xam)* strains and differentiation of its races (P.K.Chakrabarty and Sheo Raj).

Plasmid DNA Isolation : A fourth protocol has been standardised for isolation of low copy plasmids from EPS producing bacterium - *Xanthomonas axonopodis pv. malvacearum* giving yields between 10-20 kb/ml. Plasmid profiles of all isolates (N 70) of *Xam* were screened in an attempt to develop a race specific diagnostic tool.

Restriction fragmentation patterns : The plasmid DNA were subjected to restriction digestion with various enzymes from which *Xam* H1 was selected to be used with isolates. A distinct polymorphism was observed between isolates of various races useful in development of a race-specific diagnostic probe. DNA fingerprinting and RFLP is being done.

PCR Analysis : A pathovar specific probe has already been developed using PCR. A 20 mer primer based on the sequence of the pthN gene (cloned by Chakrabarty et.al.) is specific for *Xam* infecting cotton. For development of a race specific diagnostic tool, a 17 mer primer (also based on pthN sequence) was used to amplify the plasmid DNA of all *Xam* isolates.Specific polymorphism was observed between and within different races. Analysis and interpretation of the data obtained are being compared with the race differentiation data from conventional method (viz. Infection of cotton differentials) to identify a consensus probe. RAPD-PCR has also been performed with Ramdom Primer kit 'A'. A number of polymorphic bands were delineated ranging from 0.5 - 4.0 kb.

ICAR/NRI/ICAC/CFC-14

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

Monitoring for resistance to seven insecticides was carried out on *Helicoverpa armigera* (Hubner) collected from various parts of India. Pyrethroid resistance was the highest in Warangal and Guntur districts, moderate in Tamilnadu and low in some parts of Central India

A field strain was selected and developed

for seven generations using cypermethrin to generate a resistant strain. The strain exhibited 80,000 fold resistance to cypermethrin that was subjected to reciprocal crosses with the susceptible field strains and the progeny was subjected to toxicological and biochemical studies. Pyrethroid resistance was found to be a semi-dominant or dominant character.Enzyme preparations were made from each of hundred resistant and susceptible larvae. The esterase and glutathione-S-transferase titres were uniformly higher in the cypermethrin resistant strain as compared to the susceptible strain. Insecticide vs iso-enzyme kinetics revealed specific inhibition profiles based on which the dot-blot cypermethrin resistance detection kit has been refined. Electrophysiological studies clearly showed that the resistant strains were characteristically nerve insensitive with a minimum level of 250-fold LC_{50} insensitivity.The progeny displayed neurophysiological sensitivity to cypermethrin almost akin to that of the susceptible strains thereby indicating that nerve insensitivity allele is recessive. The information on genetics of resistance and the resistance mechanisms offer definite clues for the development of specific resistance management strategies. RAPDs were carried out using 80 random primers on DNA isolated from cypermethrin resistant and susceptible strains. Distinct polymorphisms were identified between the strains with at least twenty four primers. The primers which showed extreme polymorphism were designated to be used as detection tools.

Collaborative Project with BARC

Adhoc : Research on pheromones from BARC for the three bollworms (T.P.Rajendran)

A field trial for testing the BARC septa/trap design was laid. The pest incidence was very low during the season.The indication regarding the damage and moth catch of *Helicoverpa armigera* is analyzed and found that there was strong correlation with the trap catch per night of five consecutive nights for giving larval incidence of 2 per plant after 12 days in chickpea. The moth catch is found to be more in the traps that are kept near pigeonpea and chickpea fields rather than that of cotton. Attempt to study mating disruption of *H. armigera* was done at Sirsa using certain plant derived organic compounds that have been known to possess pheromone mimic action.The preliminary on-farm trial indicates that there is a good chance to continue this exploratory trial since there is 57.7% decrease in trap catch over control traps.

A thirty day mating disruption trial using a plant-derived gossyplure-mimic has shown that there is about 72% decrease in trap catch over control at 24 g/ha dosage. Another field experiment showed that at lower concentrations, it increased trap catch.

This is a unique compound that at higher rate acts as disruptant and at lower rate acts as trap catch enhances and increases the utility of mass trapping.

Development of diagnostic tools for differentiation of biotypes / races in insect pests and pathogens (Sandhya Kranthi).

Primers capable of distinguishing a cotton strain and a non cotton strain of *H.armigera* have been identified through RAPD.

Resource Generation

More than 9.0 lakh LEs of HNPV were supplied to various agencies, of which more than 1.0 lakh LEs were produced at the Institute. The Institute earned more than Rs. 4.5 lakhs being the cost of HNPV as also consultancy and supervision charges from the consultantees. The Trichoderma preparation worth Rs.35000/- was sold to the state departments of Agriculture and KVKs in India with literature and detail information to the farmers.

AGRICULTURAL ECONOMICS AND EXTENSION

- There was positive correlation between cotton, area, under hybrid with size of holding in rainfed tracts; the percentage of cotton area to net area sown decreased in the irrigated tract.
- Number of sprays and yield realized (in irrigated American cotton) were scale natural.
- Soil dummy, nitrogen, phosphorus and potash were significant in hybrid and plant density, phosphorous and potash gaps were significant in case of varieties in yield gap analysis.
- Pattern of diffusion showed that adoption was earlier in villages close to the propagator.
- The percentage of womenfolk and their proportion of time spent in farm has increased over years because of unfavorable terms of trade towards agriculture.

Nagpur

P1-94/1-ICR-E10/0430: **Economic analysis of cotton cultivation in India** (P.Ramasundaram and H.L.Gajbhiye).

The study was conducted during 2000-2001 in two ecosystems - irrigated (Sriganganagar District) and rainfed (Amravati District). The percentage of cotton area to net area sown has decreased in the irrigated tract and remained stagnant in rainfed tract than what it was five years before. There was positive correlation between cotton area and size of holding and the area under hybrid in rainfed tract increases with size of holding.

Usage of certified seeds and varietal discipline were more in the northern irrigated zone. The use of 'K' was totally absent in the irrigated zone and in general the fertiliser use in majority case was more than the recommended level. This has serious implication in that either the farmers need to economise its use or that the blanket recommendation need a relook. In the rainfed tract the average N:P:K ratio is 4:2:0.5 against the ideal 4:2:1. Non use of certified seeds, use of F, seeds, more than recommended number of sprays, use of less than recommended level of fertilisers, resort to natural farming, varietal combination are the risk aversion measures noticed in the rainfed cotton tract.

Number of sprays and yield realised were scale neutral. Correlation between N applied and realised yield was negative but non-significant in irrigated cotton.

The yield gap function fitted showed that soil dummy, nitrogen, phosphorus and potash were significant in hybrid and plant density, phosphorus and potash gaps were significant in case of varieties under rainfed cotton.

The details of the comparative economics of rainfed (hybrid and variety) and irrigated (American and *desi*) are shown in the Table 16.

The returns over variable cost was maximum in American irrigated cotton with Rs. 13903 followed by desi irrigated with Rs. 6346. The input-output ratio was 1:2.12 in american followed by 1: 1.72 in rainfed hybrid cotton.

Agricultural Economics and Extension

Table 16 : Economics of cotton cultivation 2000-2001

	Rainfed		Irrigated	
	Hybrid	Variety	American	Desi
Genotypes cultivated	NHH-44, Ankur-651, PKV-468	LRA-5166	RST-9	RG-8
Average yield (qt./ha)	5.62	3.78	15.50	11.35
Gross income (Rs./ha.)	11802.00	7938.00	26273.00	17593.00
Returns over variable cost (Rs./ha.)	4932.93	2296.12	13903	6345.55
Input:output ratio	1:1.72	1:1.41	1:2.12	1:1.56

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

Data collected from 107 cotton growers in Hingna Tahsil of Nagpur district in Maharashtra reveal that although the cost of agriculture inputs have gone up significantly in last five years, there is no significant change in annual income of cotton growers. Majority of cotton growers have reported that their current income is not enough to live on. More than 80 per cent cotton growers have taken loan for agriculture and majority of them (61%) are very concerned about returning the loan. For 42 per cent of farmers, perceived quality of life during last five years remained the same. However, during next five years it is likely to become somewhat worse for half of respondents. Currently 88 per cent of womenfolks from surveyed families work on farm besides doing their household chores and they may increase their amount of labour after five years to earn more. More than 50 per cent farmers spend Rs.1000 - 5000 towards pesticides and 65 per cent of them think consumption of pesticide will remain same for next five years.

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. Data collected from 107 cotton growers in four villages situated at different distances from propagator, revealed early adoption in case of cotton hybrid in villages, closer to propagator than the ones at a distance. Since awareness about IPM is found to be quite low, this could not be further probed.

Impact of cotton front-line Demonstrations on technology adoption of cotton growers (S.M. Wasnik, H. Gajbhiye and S. Usha Rani).

This study is initiated to assess the impact of cotton front-line Demonstrations (FLDs) on level of knowledge, adoption and productivity of beneficiary farmers.

NATIONAL AGRICULTURAL TECHNOLOGY PROJECT (NATP)

Nagpur

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

The trend and growth analysis showed that while production growth ranged between 3.02% (Hisar) and 7.34% (Sirsa) and area between 1.88% (Hisar) and 6.02% (Sirsa), productivity between 1.14 (Hisar) and 1.90 (Sriganganagar).

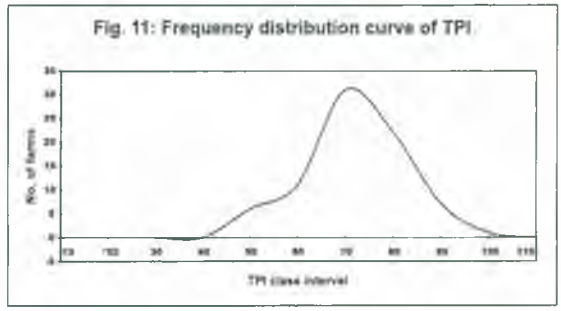
Primary data collection in 160 farms for Kharif 1999 and 2000 in Sriganganagar and Bhatinda districts has been completed. The correlation between cotton and wheat area of the sample farms was 0.97 indicating that the sampling has adequately represented the cropping system being studied. The crop trends reveal that there is a fall of 18% in cotton area in the small farms over the last 10 years against 7% and 11% increase in case of medium and large farms while the wheat area has increased by 3%, 10% and 26% respectively. The proportion of desi replacement by American cotton was inversely related to the size of farm with small farms going in for more of the latter in the last decade.

RG-8 variety occupied 44.28% of the total farm cotton area followed by RST-9 (16.59) and Sikandarpuri (10.23) and the rest 30% under 11 varieties in Sriganganagar. In case of wheat, Raj-1482 occupied 72.16 % followed by PBW 343 (22.39%) of the crop area and the rest 5.44 % was under five varieties indicating a better varietal discipline. The major varieties of cotton under cultivation in Bhatinda sample were LH 1556 (24%), LD-327 (21%), F-846 (9%), and LD-1378 (8%) and the rest under 17 varieties. PBW 343 occupied 89% of the wheat area.The results indicate cause for concern in cotton varietal discipline considering its commercial status and the need to maintain quality and uniformity.

The correlation between the number of sprays and the size of holding was 0.36, while there was non-significant negative correlation between the fertiliser use and the yield of cotton and wheat on account of use of more than the recommended dose of fertiliser.

The farm technological progress index as a proxy for factor productivity was calculated as the sum of the product of the ratio of the realized yield of the crops to the potential yield and the weight (share of the crop in the cropping pattern) of the crops in the farm .

The TPI was observed to be as in fig.11 below.



More than 92% of the sample farms have registered more than 50% of the potential TPI indicating a very high level of progressiveness as can be seen through the frequency distribution curve representing a positive skew ness in technology realisation. While the cropping intensity was inversely proportional and the commercial crop index was directly proportional to the farm size, the technological progress index was scale neutral.

The technological progress index for the three groups of the farmers is shown in the Fig. 12.

Agricultural Economics and Extension

The extent of TPI realisation increased with farm size with 64.68 in small farms and 71.41 in large farms in case of desi cotton, while it was almost uniform in case of American cotton (48.21 to 51.32) across the size groups. Accordingly, yield gap was more in case of American cotton (13.57 to 14.5 q/ha) than in desi cotton (6.88 q/ha in large farms and 8.48 in small farms). The TPI of wheat realized was 79.96 to 81.92 and the yield gap range was 8.67 to 9.62 q/ha.

Constraints in cotton-wheat cultivation: The major biophysical and socio-economic constraints in the cotton-wheat system identified and documented as per the ranks are in the Table 17.

During the survey year there was less severity of the pest and diseases problem due to the dry weather prevalent, compared to previous years.

Table 17 : Constraints in cotton-wheat cultivation

S.No	Bio-physical constraints		Socoi-economic constraints
	Cotton	Wheat	
1	Bollworm	Late sowing	Non release of canal water on time
2	Sucking pests	Philaris minor	Erratic power supply
3	Seedling burn	Brackish water	Non availability of quality seed
4	Leaf curl virus	Leaf blight	High cost for plant protection chemicals
5	Less turn around time	Low population	Tied -up credit
6	Rising water table	Water Logging	Non availability of labour during the peak season
7	Problem soils	Zinc deficiency	Price risk
8	High temperature during September	Rust	
9	Boll shedding	Cloudy weather during milky stage	
10	Resistance to insecticides	Smut	
11	Bacterial blight		
12	Wilt		

Agricultural Economics and Extension

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

Secondary data collection has been completed for the districts of Amaravati, Yavatmal, Nanded and Jalgaon in Maharashtra since 1960-61. Amaravati, Nanded and Yavatmal districts recorded the lowest SD and CV in area, production and yield respectively whereas highest of both in all the three parameters was witnessed in case of Jalgaoan district.

The current cotton area in the sample farms across the districts and size groups has decreased. The percentage of hybrid cotton in the total farm cotton and decreased with size. The average yield realized was inversely proportional to the size in Amaravati and Yavatmal districts and directly proportional in Nanded district. The average price realized, though supposed to vary as per the grades technically under procurement scheme, increased with size group, indicating that large farmers having the capacity to hold and stock got relatively better prices compared to their small and medium counter parts.

While the Nanded sample, dominating with hybrid cultivation, has totally sourced its seed requirement from private companies, the rest have meted out the same mainly from the companies, followed by own seeds, primary agricultural credit societies and others (relatives, neighbours and friends). Twenty percent in Yavatmal and seven in Amravati have cultivated F_1 seeds, though not recommended and advisable, as it is cheap and because marketing is not a problem. The varietal proliferation was rampant, though hardly 2-3 genotypes accounted for more than 70% of the sample farms' cotton area. Only 2-18% samples have reported that they cultivate sole cotton, while the rest always practice cotton:pigeon pea, a strip crop of replacement series with one row of pigeon pea interceding every few rows of cotton. While seventy per cent of the farms followed 10:1, followed by 8:1 in Nanded, 45 % followed 10:1, 21% 10:2 and 11% followed 8:1 in Yavatmal and 19% followed 10:1, 16% 10:2 and 15% 12:1 in Amravati. Besides, there were more than a dozen ratios in vogue.

Twenty six per cent of the respondents in Amravati reported that they cultivate cotton sans any chemical pesticides, followed by 8% in Yavatmal and five percent in Nanded. The former sample farms exhibited a controlled use of pesticides with more than 75% of the farms reporting less than four sprays during the crop period, while Nanded with maximum hybrid area reported that 46% of the samples have used five and more number of sprays, followed by Yavatmal.

Constraints in cotton cultivation: The general bio-physical constraints observed were boll worms, sucking pests, improper plant density, indiscriminate use of pesticides, varietal multiplicity, boll shedding, wilt, 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.

Coimbatore

TAR 18 : **Technology assessment and refinement of irrigated agro-eco system for Coimbatore region** (K. Ramamoorthy).

The crop production problems in the IVLP village were addressed through integrated crop management technologies (ICM). These technologies were demonstrated on farm in one acre each. The crop enterprises included for the trial

were i) Cotton, ii)Tomato, iii)Turmeric, iv) Groundnut and v) Maize .

I. Impact of ICM on Cotton : While the project farmers invested Rs. 31,355.42/ha the non-project farmers invested Rs. 39,181.61. The yields recorded were 12.72 Q/ha and 8.65 Q/ha, respectively and the gross income earned were Rs.45, 657.95/ha and Rs. 27,664 / ha. The estimated net income show that the control farmers incurred a loss of Rs.11, 517.61/ha whereas the project farmers earned a net profit of Rs.14, 201.3. The benefit cost ratio was 1.45:1.00 and 0.70:1.00. With minimum cost and need based application of inputs, the profit of the cotton farmers increased by adopting integrated crop management practices in cotton cultivation.

II. Impact of ICM on Tomato : The project farmers invested an average of Rs.42, 204.89/ha whereas the non-project farmers invested an average of Rs.63, 088.74/ha. The average per hectare yield were 198.34 Q/ha and 172.9 Q/ha respectively. The gross income earned were Rs. 79,368.51/ha and Rs. 69,160/ha. The average net income estimated were Rs.37, 163.62 and Rs. 6,072.495 respectively and the benefit: cost ratio was 1.90:1.00 and 1.10:1.00.

III. Impact of ICM on Turmeric : The project farmers invested Rs. 41,473.77 whereas the non project farmers invested Rs. 44,460. The average yields were 61.75 Q/ha and 19.76 Q/ha respectively and gross income earned were Rs.74, 100/ha and 19,200/ha.

The estimated net income show that the control farmers incurred a loss of Rs. 24,700/ha whereas the project farmers earned a net profit of Rs.32, 626.23/ha. The B:C ratio was 1.80:1.00 and 0.56:1.00.

IV. Livestock Development Project : Health campaigns for livestock like Control of Foot and Mouth diseases for Cattle, Artificial Insemination for Cattle, Control of Foot and Mouth Disease for Sheep and Goat, Control of Eco Parasites for Sheep and Goats were conducted. Ten pairs of improved goats were procured and distributed to the identified resource poor farmers.

V. Conservation of Natural Resources : Under this programme, two Eco-Green Clubs have been established to save the agro-eco system by educating the rural people on soil, water and environment and merits of pure cotton cloth vis a vis chemical fibre cloth synthetics.

The following Training Programmes were organised to familiarize the farmers on the recent production technologies.

S. No.	Title of Training / Field visits
1.	Integrated crop production technology for cotton
2.	Integrated soil fertility and nutrition management for crops
3.	Labour saving equipments
4.	Raring parasites of cotton, coconut and tomato pests and diseases
5	Post harvest technologies for vegetables
6	Seed production in cotton
7	Animal husbandry for enhancing milk production
8	Home science technology for farm women
9	Farm women on fruit and vegetable processing

PLANT PHYSIOLOGY & BIOCHEMISTRY

- Analysis of drought tolerance mechanism, showed that *desi* cotton genotypes possessed higher osmoregulation, root-shoot ratio and normal nitrate reducatase activity under stress, whereas *G. hirsutum* maintained higher leaf water status.
- Asiatic cottons were more susceptible for water logging, while *hirsutum* varieties had faster recovery of leaf area and bio mass and showed yield stability.
- Sink manipulation in LRA 5166 and CWROK with ethrel at low concentration led to square abscission and senescence at higher concentration, but malic hydrazide promoted growth and combined application altered plant morphology.
- Leaf and biomass production were faster in shallow soils as compared deep soils.
- N response was more in shallow soil.
- *Arboreum* responded more to 'N' application.
- Insecticide spray led to initial decrease of total phenol, increased reducing sugars, increased stomal resistance, decreased transpiration rate and increased leaf water content.
- Atmospheric CO_2 exceeding 650 ppm and temperature above 40 ^{0}C decreased photosynthetic activity in cotton.

Nagpur

Physiological evaluation of cotton germplasm under rainfed conditions (M.R.K.Rao and N.K.Perumal).

Hundred lines of *G. hirsutum* and 50 lines of *G. arboreum* were evaluated during the year under rainfed situations.Though the total rainfall was normal since its absence middle of September subjected the crop to moisture stress during the active boll development stage and beyond. Under this type of severe adversity most of the *G. arboreum* lines out yielded the *G. hirsutum* lines with earliness as well. In both the species considerable variability was evident for different growth attributes and relative water content along with seed cotton yield. In general *G. arboreum* lines had lower RWC as compared to *G. hirsutum* lines.The correlation study indicated significant positive correlation of the dry matter component with seed cotton yield. Some selected lines in both the species were mapped to elucidate plant architecture in relation to growth attributes and yield and good amount of variability was recorded. In some selected lines belonging to both the species nutrient uptake in respect of N and P is being studied.Variability was evident for N and P uptake in *G. arboreum* as well as *G. hirsutum* lines.

P1.89/ICR-F-60/0430 **Physiological studies on abiotic stress with particular reference to heat and drought in cotton** (N.K.Perumal and M.Chakrabarty).

Three experiments were conducted :

(a) Studies on moisture stress tolerance in 15 genotypes belonging to *G. arboreum, G. herbaceum* and *G. hirsutum* were made in a pot experiment under controlled conditions.The genotypes were inducted with moisture stress during flowering.

The drought tolerance mechanism in the genotypes belonging to the three cotton species distinctly varied. *G. arboreum* and *G. herbaceum* genotypes had relatively lower stomatal resistance and leaf water potential. High root/shoot ratio and osmoregulation traits prevailed. Transpirational cooling of leaves and yield stability were conspicuous in *G. herbaceum.G.hirsutum* genotypes on the other hand possessed relatively higher stomatal resistance and maintained higher leaf water status in response to the inducted stress.

With regard to nitrate reductase activity,*G. arboreum* and *G. herbaceum* maintained normal activity under stress condition.

b) Foliar sprays of growth regulators and nutrients were given during squaring stage to LRA 5166 and LRK 516 in a field experiment. IAA, IBA, GA, Kinetin, Glucose, Sucrose, Urea, Suphala and Potassium nitrate were sprayed in two concentration levels.Morpho-physiological and yield attributes were recorded. Most of the treatment effects were non-significant. However, the treatments significantly increased leaf relative water content.

c) In the fortnightly planting trial, it was noticed that delay in planting dates adversely affected growth, development and yield in LRA 5166 and LRK 516. The depression in growth and yield were particularly conspicuous in winter planting dates. These trends were found to be more related to temperature regimes particularly the minimum temperature.

Physiological and biochemical basis of salinity tolerance in cotton plants (K.B.Hebbar and M.R.K.Rao).

Thirty two stable derivatives of a cross between *G. raimondii x G. hirsutum* and 24 advanced germplasm lines were screened for their salinity tolerance at 0,2.5, 5,7.5 and 10 dSm^{-1}. Rai 15 A, Rai 16, Rai 17, Rai 18 and Rai 29 showed least reduction in yield under stress condition while Rai 3, Rai 4A, Rai 4B, Rai 7 A, Rai 13 and Rai 20 recorded highest reduction in yield.

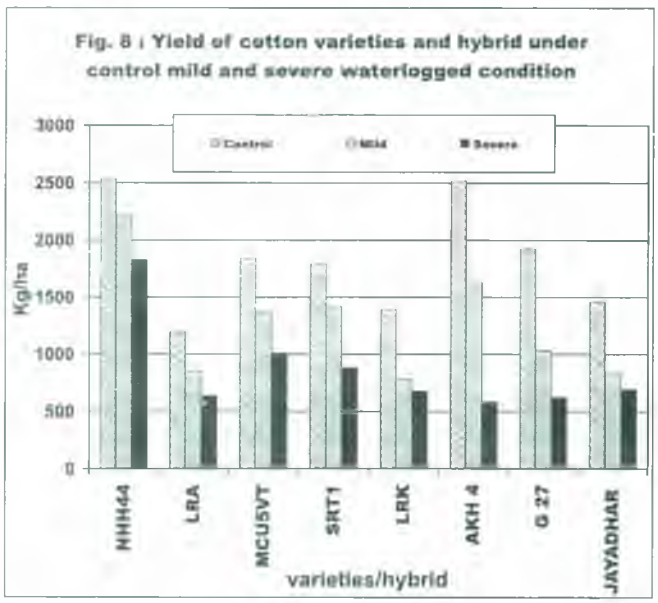
Similarly amongst germplasm lines, Vikram, Badnawar, JK-345, MCU 5 VT, EL 958, 76 IH 22 yielded high both under control and stress. On the other hand, yield was drastically reduced under stress condition in Stoneville-20, Soubhagya, EWLS x TN, DCI 116, DCI 120.

Salinity tolerant lines showed only a marginal decline in leaf area and biomass.The square production per plant was reduced with increase in salinity levels. The relative water content of leaf did not vary significantly between the lines across the salinity levels.Tolerant plants accumulated higher amount of osmotic solutes and K compared to susceptible lines. SDS protein profile of the tolerant lines had a prominent extra band which was missing in susceptible lines suggesting that osmolytes and K accumulation might have helped to sustain the metabolic activity of the plant under salinity. The yield under salinity was found to be depending on the bolls produced per plant and not on boll weight because the boll weight did not differ significantly at various salinity levels.

Adaptation of cotton plant to waterlogging (K.B.Hebbar).

An experiment was carried out in the field having graded slope. Varieties belonging to *G. hirsutum, G. arboreum* and *G. herbaceum* were grown in strips along the slope. A portion of the field was completely flooded with rain water twice at 15 and 45 DAS for a period of 7 and 15 days respectively. Plants on the higher elevation were normal growing (control), middle of the strip were partially waterlogged (mild stress) and in the down were completely waterlogged (severe stress). Asiatic cottons were more susceptible compared to *hirsutums*. Yield reduction was partial with mild stress whereas severe stress drastically reduced the yield (Fig. 8). Yield reduction ranged from 25 to 75 per cent with least reduction in NHH 44 and highest in AKH 4. Upon withdrawal of waterlogging the recovery in leaf area and biomass was found to be higher in *hirsutum* genotypes compared to asiatic cottons.Further, in *hirsutum* genotypes fruiting activity was delayed till a minimum growth was attained whereas in *arboreum* and *herbaceum* genotypes irrespective of the growth attainment fruiting activity was initiated, hence there was a stiff competition between vegetative and reproductive

growth for the assimilates. This had resulted in very poor growth and yield of *arboreum* and *herbaceum* genotypes.



Source-sink alteration with reference to flower induction as a tool to improve physiological efficiency and productivity in cotton (K.B.Hebbar).

A field experiment was conducted to study the efficacy of ethrel and malic hydrazide (MH) for sink manipulation in LRA 5166 and culture CWROK. Ethrel was effective in abscising squares at low concentration (0.1%) and inducing leaf senescence at higher concentration (0.5%). MH did not have effect on square shedding. It showed growth promoting trends. Combined application of ethrel and MH altered the plant morphology with stunted growth, reduction in internode distance and increase in number of monopodia. The chemicals reduced photosynthesis, whereas ethrel treatment led to decline in soluble protein content also.

Adhoc Trial : **Effect of insecticides on secondary metabolites in cotton** (M. Chakrabarty and N.K.perumal).

In a field experiment conducted with PKV 081, Metasystox and fenvalarete (0.1 and 0.2 per cent) were sprayed at 55 and 76 DAP respectively. The study revealed that total phenol content had an initial decrease from 24 h onwards which continued to decline. The reducing sugar content on the other hand increased immediately after 24 hrs of insecticide application and then started to decline slowly. With passage of time, 168 to 192 hrs was needed to reach the normal status.

With regard to the physiological traits, the stomatal resistance increased and transpiration rate showed a decline as a reflex response to the insecticide application. The treatments enhanced leaf relative water content.

Coimbatore

P1-92/1-ICR-F60/0430: **Response of elevated carbon dioxide on physiology and productivity attributes of cotton genotypes** (S.E.S.A. Khader and N. Gopalakrishnan).

The studies on the interaction effect of elevated CO_2 and temperature on photosynthetic rate and nitrate reductase activity of cotton cv.Anjali undertaken in a polyhouse revealed that irrespective of temperature, photosynthetic activity was maximum at 650 ppm. Optimum temperature for maximum photosynthetic rate was 40 ^{0}C and further increase in temperature only lowered the photosynthetic rate. Nitrate reductase activity trend also was same as that of photosynthetic activity (Table 15).

Table 15. Effect of elevated CO_2 and temperature on photosynthetic and Nitrate Reductase activity of cotton cv. Anjali

Tem. ° C (T) → / CO_2 (C) (ppm) ↓	Photosynthetic Activity (μ mol CO_2 m^{-2} sec^{-1})				Nitrate Reductase activity (μ mol NO_2/hr/gm fr. wr.)			
	35	40	45	Mean	35	40	45	Mean
Ambient	14.9	16.9	15.8	15.9	3.724	4.025	3.824	3.857
650	16.9	17.7	15.3	16.7	4.192	4.693	4.459	4.448
850	13.3	14.6	14.3	14.1	3.340	3.440	3.373	3.384
Mean	**15.0**	**16.4**	**15.2**		**3.752**	**4.053**	**3.885**	
CD at 5%	**C = 5, T = 0.4, CXT = 0.8**				**C = 0.068, T = 0.041, CXT = 0.136**			

P1-95/1-ICR/0430 : **Identification and utilisation of adaptive response to abiotic stress in cultivated species of cotton** (S.E.S.A. Khader, N. Gopalakrishnan, K. Venugopal and K.N. Gururajan).

Hysteresis Curve of genotypes like H 777, Kgl 54620, IC 1356 and GS 625 had smaller area while genotypes like CSH 683-6, Arogya, K 3475 and PMC recorded larger area, projecting the degree of drought tolerance exhibited by each genotype.

Effect of NaCl and Na_2SO_4 salinity stress on cotton seed germination was studied. Beneficial effect of phytohormones like GA_3 and benzyl adenine was evident by way of enhancing the free radical quenching through mediation of higher peroxidase activity in cv. LRA 5166. On the other hand, quantum increase in activities of hydrolytic enzymes was seen at higher levels of salinity attributing to the negative influence on the biomembranes in select cultivars of *G.hirsutum*. Distinguishing trend of reduction in the fresh weight and length of five day old cotton seedlings was observed due to heavy metal ion toxicity. A sharp fall in reducing sugar content was seen due to Hg ion and Cd ion explaining the deleterious effect during seedling growth.

P1-95/ICR-F-25/0430: **Physiology of fibre growth and development** (A.H. Prakash, S.E.S.A. Khader, N. Gopalakrishnan, K.B. Hebbar and V.N. Waghmare).

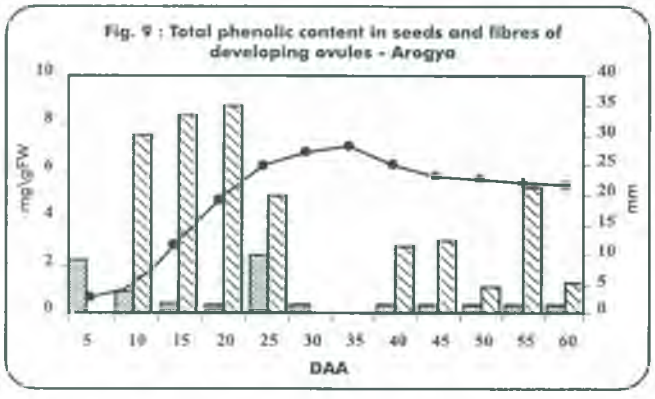
In vivo studies

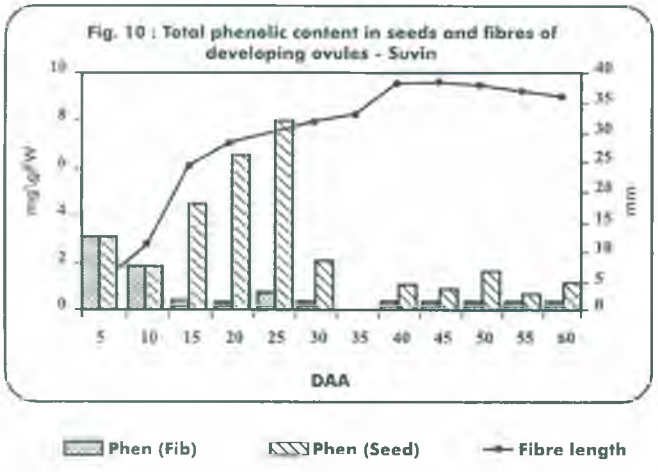
The fibre growth had a set pattern with a slow initial growth of only 3 mm by 5th day. By 25th DAA, fibre length of 17-19 mm was observed. The fibre elongation in the medium staple variety LRA 5166 was initially fast and reached 28 mm by 15th DAA and later elongated marginally to reach 32 mm and at boll bursting, the dry fibre length was 28 mm. Similar trend was observed in hybrid NHH 44 and varieties MCU 5 and Suvin.

In Arogya, the reducing sugar content in seeds gradually increased till 15 DAA and thereafter started to decline. In LRA 5166 and NHH 44, the reducing sugar content was maintained at higher levels till 25 DAA. In case of MCU 5 and Suvin there was an initial shoot-up in the reducing sugar content to 82 mg / g FW by 5 DAA and reached 133.5 mg / g FW by 10 DAA. Later it gradually reduced.

The total phenol content in the fibres showed variation. In Arogya, the phenol content was

maintained at 0.41 mg / gFW through out the boll development stage (Fig. 9 and 10).





In LRA 5166 and NHH 44, the phenol content in the fibre was higher till 25 DAA (0.88-1.98 mg/ gFW). By 30 DAA, the content reduced to 0.40 mg/gFW and in the later part it was maintained at 0.25 mg/gFW. In MCU 5 and Suvin, the phenol content in the fibre was maintained at 0.3-0.4 mg / gFW through out the growth period.

The short staple Arogya and medium staple LRA 5166 and NHH 44 maintained higher phenol content (7.5-9.0 mg/gFW), while MCU 5 (Long staple) and Suvin (Extra Long Staple) maintained low phenols (1.5-4.0 mg/gFW) till 20 DAA.

It was observed that reducing sugar and phenol had a greater role to play in fibre elongation.

***In vitro* ovule culture**

In case of unfertilized ovules the presence of Gibberilic acid was prerequisite for fibre initiation and elongation. Only when the ovules were dark incubated, the fibre elongation was seen and reached a length of 12 mm.The fertilized ovules showed good growth in presence of IAA and Gibberielic acid and a fibre length of 17 mm was achieved.

Source sink alteration with reference to flower induction as a tool to improve physiological efficiency and productivity in cotton (A.H. Prakash, N. Gopalakrishnan, K.B. Hebbar and V.N. Waghmare).

Ethrel at 0.1% inhibited square production and induced shedding of squares produced earlier but did not affected the photosynthesis. A good vegetative growth and spurt in the root activity were seen.

Application of Maleic hydrazide did not induce square shedding but stopped the apical meristem activity. It activated the axillary bud and lateral branching.

Mechanical removal of squares from 35 DAS for 10 days led to higher vigour in growth of plants and maximum root volume and leaf area (3500 cm^2/plant) against control (2245 cm^2/plant) .

The mechanical removal of squares was the best treatment with good boll number and boll weight and recorded the highest seed cotton yield of 272 g/plant in Sumangala (73.8 g in control) and 209 g/plant in LRA 5166 (53.2 g in control).

P.1-97/1-ICR-F60/0430 : **Studies on developmental biochemistry of cotton - pest/disease interaction** (N. Gopalakrishnan, T. Surulivelu, K. Natarajan and P. Chidambaram).

Biochemical aspects of cotton plant metabolism due to the influence of seed treatment, insecticides, fungicides, biological agents and repeated application of specific insecticides were investigated.

Effect of seed treatment insecticides

Application of Imidacloprid at 5 g / kg and 7.5 g / kg led to enhanced activity of nitrate reductase (NR) to an extent of 15 - 25% during 20, 30 and 40 days after sowing as compared to control. Similarly, Carbosulfan and Thiomethoxam used in the control of early season sucking pests also enhanced NR activity during early growth phase. These chemicals also had positive influence on the accumulation of soluble protein content and enhanced peroxidase activity in the leaves with concomitant increase in gossypol and total phenols to an extent of 10 - 15% during later stage of growth. The beneficial effect of seed dressing insecticides on the plant metabolism in the young seedling stages could again be observed.

Effect of insecticidal sprays on plant metabolism

Systemic insecticide like Oxydemeton methyl brought moderate rise in the activity of nitrate reductase and soluble protein content after two sprays during squaring and peak flowering. However, repeated applications of insecticides like Endosulfan and Monocrotophos lowered NR activity to an extent of 10 - 15%. Variable response was seen with regard to insecticidal applications in case of phenols and gossypol. Systemic insecticides enhanced gossypol content to an extent of 10 - 15% as compared 30 - 40% in previous years.

Influence of fungicides on phytochemical accumulation

A moderate rise in phenolics and terpenoid aldehyde was seen due to interaction of bio control agents like *Pseudomonas* and *Trichoderma sp.* as well as Carbendazim. Similarly, these biocontrol agents ensured a steady state kinetic presence of enzymes involved in defense response.

P1-89/1-ICR-F60/0430 : **Studies on biochemical mechanisms of resistance to bollworms of cotton** (N. Gopalakrishnan and T.Surulivelu).

Evaluation of ten *G. arboreum* genotypes tolerant to bollworms revealed the presence of higher levels of condensed tannin in squares with a range of 5-9, 11-17, 9-13 O.D. units / 10 mg, at 40, 60 and 80 DAS, respectively. Moderately bollworm tolerant *G. hirsutum* genotypes like Sumangala, RBC 39, HGIPS 542 and Abhadita were seen to possess uniform distribution of condensed tannin at progressive stages of growth. Even though the tolerant genotypes had higher levels of gossypol in young squares (8-12 mg / g), the relative distribution could not be maintained with the age of the plants. However, the susceptible genotypes were characterized with uneven distribution in gossypol content in squares during developmental stages of the crop.

The accumulation of phenols increased in *G. arboreum* genotypes. The moderately tolerant *G. hirsutum* lines possessed around 18-22 mg/g, while the highly susceptible germplasm lines had only 8-13 mg / g.

The bollworm tolerant selections were consistent in the accumulation of protective phytochemicals. The rate of synthesis of protective peroxidase was faster in developing squares and young boll rinds in case of BRS 23 (tolerant selection) as compared to Khandwa 2. The coupled reactive products of peroxidase action on the orthodihydroxy and total phenolics in developing young bolls seem to confer the defensive protection at early boll developmental phase. The bollworm tolerant selections viz., BRS 3, BRS 5, BRS 22 and BRS 23 possess lesser quantity of nutritional principles as compared to susceptible genotypes. The derivatives synthesized from wild species possess higher constitutive levels of secondary metabolites in squares and young bolls and had lesser bollworm damage as compared to popular cultivars.

NATIONAL AGRICULTURAL TECHNOLOGY PROJECT (NATP)

Nagpur

RCPS - 3 : **Assessment of gossypol content in cotton germplasm** (M. Chakrabarty and K.B. Hebbar).

One hundred and nine samples of *G. hirsutum* and *G. arboreum* were analysed for Gossypol content. A wide variability was observed with various plant parts viz. leaves, squares, flowers, bolls and seeds of some proven *G. arboreum* lines. The results signify that the gossypol content increases from leaves to squares to flowers to bolls and seeds.

Collaborative project with NBSS & LUP

Growth and yield modelling of cotton (MRK Rao and K.B.Hebbar)

A split plot field experiment was conducted with cultivars AKH-4, LRK 516 and NHH-44 as main plot and nitrogen levels (0,40,80,120 kg/ha) as sub plot treatments in deep and shallow soil condition. At germination and early seedling growth LA and biomass accumulation was faster in shallow soil compared to deep soil. Biomass accumulation compared to LA production was more in NHH 44 and LRK 516 whereas it was vice versa in AKH 4 in both soil types.

N applied at thinning had increased LA and biomass in all the varieties. Application of N increased LA upto 120 kg in AKH 4 whereas it plateaued in NHH 44 and LRK at 80 kg N/ha. On the other hand, LA responding to N only after 90 DAS in deep soil, could be due to excessive soil moisture prevailed during early growth stages. Biomass accumulation was more in NHH 44 and LRK 516 at early stages and it gradually increased in AKH 4.

NHH 44 and LRK 516 produced more squares in shallow soil whereas AKH 4 produced more squares under deep soil. Square production responded upto 80 kg N/ha under deep soil whereas it was only upto 40 kg N/ha under shallow soil.

Physiological shedding was more in shallow soil compared to deep soil. Positive correlation was seen between square production and shedding.

Boll weight responded upto 40 kg N/ha in all the varieties beyond which it was plateaued. LRK 516 responded to N only upto 40 kg N/ha in both soil types whereas AKH 4 responded upto 120 kg N with more response under shallow soil. Under shallow soil AKH 4 had produced the highest yield while under deep soil at high N, AKH 4 yield was on par with NHH 44.

CICR REGIONAL STATIONS