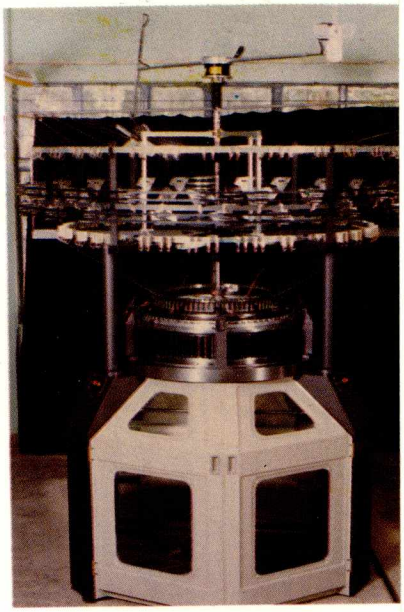

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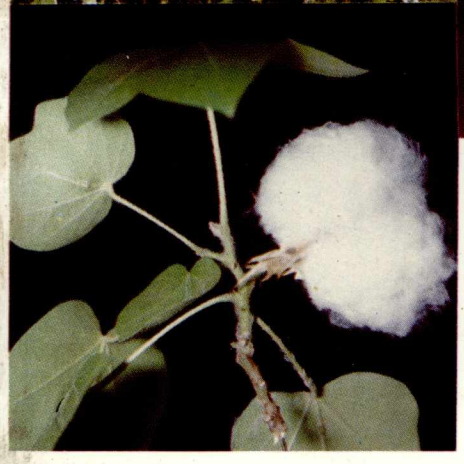
ANNUAL REPORT 1991-92



CENTRAL INSTITUTE FOR RESEARCH
ON COTTON TECHNOLOGY

BOMBAY

CIRCOT

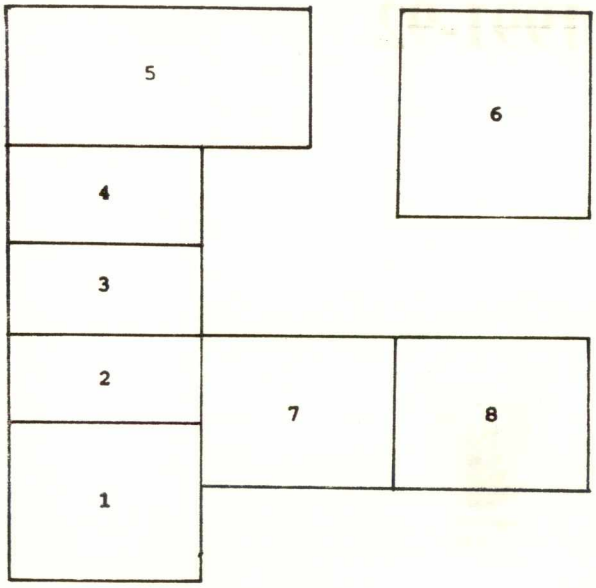
Annual Report
1991-92

Central Institute for Research on Cotton Technology
Indian Council of Agricultural Research
Adenwala Road, Matunga, Bombay 400 019

Cover Theme : ... though our economic potential is great, its conversion into finished wealth will need much mechanical and technological aid ..... We believe that this may well help in larger solution of the problems that confront the world.

— **Pandit Jawaharlal Nehru**

Cover Scheme :



1. Cotton Boll on the Plant
2. Cotton Crop
3. Kapas Heap in Ginning Factory
4. Pressed Bales of Cotton Lint
5. HVI System Installed at CIRCOT
6. A Modern Knitting Machine at CIRCOT
7. Writing Grade Paper Roll Prepared using Pulp from Cotton Plant Stalk
8. Particle Boards Prepared from Cotton Plant Stalk

Published by :	**Dr. N. B. Patil**, M.Sc., Ph.D. Director, CIRCOT, Bombay.
Edited and compiled by :	**Shri T. K. M. Das** and **Shri M. Mohan**
Cover Design and Layout :	**Shri T. K. M. Das**

CONTENTS

1

Introduction

This sixty-eighth Annual Report of the Central Institute for Research on Cotton Technology (CIRCOT), covers the period April 1, 1991 to March 31, 1992.

CIRCOT was established by the Indian Central Cotton Committee (ICCC) in the year 1924 under the name of Technological Laboratory of the ICCC. The objectives then were to undertake spinning tests on various cotton strains received from agricultural departments in the country and to test them for fibre properties and relate them with their spinning values. To carry out these activities, the Institute had established co-ordination with the Departments of Agriculture and Agricultural Universities located in major cotton producing tracts in India. All the commodity Committees including the ICCC were abolished in 1966 and the Indian Council of Agricultural Research (ICAR) took over the administrative control of this Institute and its name was changed to "Cotton Technological Research Laboratory" (CTRL). Since then, the research activities were re-oriented and intensified to meet the challenges in respect of production and quality of cottons grown in the country. Side by side, research efforts were also directed towards better utilisation of cotton plant and agricultural and processing wastes, etc. so as to make cotton cultivation more remunerative and provide gainful self-employment avenues among the rural massess.

The name of the Institute was changed to **Central Institute for Research on Cotton Technology** (CIRCOT) with effect from April 1, 1991.

The important functions of CIRCOT are listed below:

1. To participate actively in the programmes for improvement in the production and quality of cotton in India by evaluating the quality of new strains evolved by agricultural scientists and giving them necessary technical guidance.

2. To carry out research on physical, structural and chemical properties of cotton in relation to quality and processing performance.

3. To carry out research investigations on the ginning problems of cotton.

4. To investigate the greater and better utilisation of cotton, cotton wastes, linters, cottonseeds, etc.

5. To help the trade and the industry by providing reliable and accurate data on quality of representative trade varieties of Indian cottons.

6. To issue authoritative reports on the samples received for tests from Govern-

ment departments, the trade and other bodies.

7. To collect and disseminate technical information on cotton.

Organisation : As seen from the organisational chart in Annexure I, the Director is the head of the Institute, assisted by a team of Scientists and Technical Personnel. An Administrative Officer and two Assistant Administrative Officers provide him assistance in the general administration, while the Finance & Accounts Officer looks after matters concerning accounts and audit of the Institute.

Library : An up-to-date library of books on cotton, cotton technology and allied subjects is maintained at CIRCOT. During the reporting period, the total number of books was 4597 wih the addition of 90 books during 1991-92. Similarly, the number of bound volumes added to the library was 200 making the total number to 5673. Out of 200 journals pertaining to textiles and allied subjects being received by the library, 94 journals were obtained through subscription (54 foreign journals and 40 Indian journals) and the remaining were received as complimentary or on exchange basis. The total expenditure of the library for 1991-92 was Rs. 4,34,701.00. Besides the staff of this institute, the library facilities were availed of by students and research workers from various colleges affiliated to Bombay University and the sister institutions. Inter-library loan facilities are also maintained with other libraries in Bombay.

New Equipments : A list of major equipments acquired from April 1, 1991 to March 31, 1992 are given in Annexure II.

Distinguished Visitors : Various officials from ICAR headquarters and other organisations visited the Institute on various occasions. The names of some of the distinguished visitors during the year have been given in Annexure III.

Management Committee : The Thirty-fourth meeting of the Management Committee was held on February 29, 1992. Apart from regular items such as confirmation of the minutes of the previous meeting, action taken on the recommendations of the Committee, progress of expenditure, progress of works, action taken on the recommendations of the Institute Joint Council and Grievance Committee, etc., on-going projects and research highlights, appointment of AMA's for the Regional Quality Evaluation Unit of Sirsa were considered and recommendations made.

Renaming of CTRL : Making a humble beginning as a laboratory for testing cotton fibres and yarns in 1924 with the prime objective of furnishing data for the use of cotton breeders, CTRL had grown to an Institute of national importance conducting research on various facets of cotton technology. To reflect this transformation into a national research body, the last Quinquennial Review Team recommended a change of name for the laboratory. Accordingly, in consultation with the Council, this laboratory was rechristened as the **Central Institute for Research on Cotton Technology** (CIRCOT) at a function organised on April 1, 1991. Dr. A. B. Joshi, Retd. Director General, ICAR was the Chief Guest at this function. A publication entitled **CIRCOT — Toward 2000 AD and Beyond** was released on this occasion.

The Marble Plaque Unveiled during the Renaming Function

Address by Dr. A. B. Joshi, former Deputy-Director General (CS), ICAR and Vice-Chancellor, MPKV, Rahuri at the Renaming Function

Dr. A. B. Joshi Releases the Publication "CIRCOT Toward 2000 AD and Beyond"

A Section of the Invitees at the Function

National Science Day Celebration : National Science Day which falls on February 28 every year. was celebrated during this year with a talk on 'Antarctica Expedition' by Shri A. P. Sathe, Scientist, BARC who was one of the members of the Indian team for Antarctica expedition. This function was jointly sponsored by CIRCOT and the ARS Forum, and was attended by all the staff of this Institute.

Awards : Shri S. K. Chattopadhyay, Scientist has been awarded a cash prize of Rs. 600/- for his essay on **Problems Relating to Ring Spinning of Quality Yarns with Low Maturity Cottons** and Shri H. S. Jayaprakash Narayana Rs. 500/- for his essay **Modern Trends in the Sizing of Blended Yarns,** at the 47th All India Textile Conference held at Indore. The essay contest had been organised by the Textile Association, Bombay.

Internal Seminar : During April 1, 1991 to March 31, 1992, the following three Seminars were held :

Sr. No.	*Topic*	*Date*	*Name of the Speaker*
1.	Problems Relating to Ring Spinning of Quality Yarns from Low Micronaire and Low Maturity Cottons.	6-2-1992	Shri S. K. Chattopadhyay
2.	Modern Trends in Sizing of Blended Yarns.	6-2-1992	Shri Jayaprakash Narayana
3.	Development of High Strength Strains in Medium Staple *Hirsutum* Cottons.	19-2-1992	Dr. Munshi Singh Professor, Genetics Division, IARI, New Delhi

Staff Research Council (SRC) : The ninety-first meeting of SRC was held on September 4, 5 and 7, 1991. Progress of research work during the period April 1, 1990 to March 31, 1991 and new project proposals for 1991-92 were discussed and a programme of work for 1991-92 was finalised. The joint session of SRC with the Management Committee was held on October 22, 1991.

Research Projects : In all, there were 37 on-going research projects grouped under six Thrust Areas, the details of which were as follows :

	Thrust	*No. of Research Projects*
1.	Technological Research for Cotton Quality Evaluation and Improvement	11
2.	Post-Harvest Technology of Cotton	4
3.	Structure, Property and Their Inter-Relationships in Textile Materials	9
4.	Chemical Processing and Finishing Treatments	3
5.	Utilisation of By-products of Cotton and Processing Wastes	9
6.	Origin of Cotton Dust and its Control	1

Implementation of Official language (Hindi) : With the passing of qualifying examinations in Hindi by staff members in the scientific, technical and administrative categories, the Institute has achieved the goal set by the official language Implementation Committee and the Institute's name has been listed in the Govt. Gazette.

During this year, 88% of typing staff have acquired Hindi typing skill and 80% proficiency in Hindi shorthand. Smt. Sandhya Parab, Hindi Typist underwent Hindi translation training and has successfully completed the course securing 74% marks. Shri S. M. Gogate, Sr. Technical Assistant has been awarded a cash prize of Rs. 200/- for securing 63% in the Hindi Pragya examination by the Rashtrbhasha Prachar Samithi.

Shri Muntazir Ahmed, Scientist (S.G.) was awarded second prize for his essay **Bana Bunai Ke Rcop,** in the All India Technical Essay Competition organised by the Kendriya Sachivalaya Hindi Parishad.

Hindi Day : Hindi Day was celebrated with different programmes during the period from September 17, 1991 to October 1, 1991 both at the headquarters and in the Ginning Training Centre (GTC), Nagpur. The following competitions were held during the occasion :

1. Poetry (Kavya Lekhan)
2. Essay Competition
3. Kavya Pathan
4. Fill in the blanks (only for group D and T-1 staff)
5. Quiz Programme
6. Noting and Drafting
7. Elocution Contest
8. Extempore Speech

The final day function at headquarters was presided over by Dr. N. B. Patil, Director with Shri Narayan Mehta, Deputy Director (Hindi Implementation), West Zone as the Chief guest. Prizes were distributed by the chief guest to winners of various competitions.

Post Graduate Training : The recognition granted to CIRCOT by the University of

CHINESE DELEGATION VISITS CIRCOT

Dr. N. B. Patil, Director Receiving the Delegates

At the Mechanical Processing Division

At the Physics Division

NATIONAL SCIENCE DAY

Shri A. P. Sathe, Scientist of BARC, Bombay giving a Lecture on "Antartica Expedition"

VISIT

Shri Ardhanareeswaran, Secretary, Ministry of Textiles, Govt. of India in Discussion with Dr. N. B. Patil, Director on the Technology of Particle Board Preparation from Cotton Plant Stalk

Bombay as a Post Graduate Institution was continued during the period. Thirteen students were being guided for M.Sc. (8) and Ph.D. (5). Eleven scientists of the Institute are recognised for guiding students for M.Sc. and Ph.D. in disciplines such as Physical Chemistry, Organic Chemistry, Bio-Physics, Microbiology, Spinning and Textile Physics and Textile Bio-Physics.

During this period, Shri S. J. Guhagarkar was awarded M.Sc. in Organic Chemistry and Shri R. P. Nachane and Smt. J. K. S. Warrier have been awarded Ph.D. Degree in Textile Physics.

Membership on other Organisations :

The Director, CIRCOT continued to be a member of the following Committees/ Bodies during the reporting period :

1. Cotton Advisory Board of the Office of the Textile Commissioner, Government of India, Ministry of Commerce, Bombay.
2. Board of Directors of the Cotton Corporation of India, Bombay.
3. Research Advisory Committee of the South India Textile Research Association (SITRA), Coimbatore.
4. Various Standing Committees of VJTI, Bombay.
5. Indian Cotton Development Council (Government of India) and Member of the Sub-Committees on Research and Development.
6. Textile Commissioner's Cotton Certification Committee.
7. ICAR Scientific Panel for Post-Harvest Technology.

In addition, the Director and scientists of CIRCOT continued to represent CIRCOT/ ICAR in various Committees of the Bureau of Indian Standards and other organisations.

Institute Joint Council (IJC) : Four meetings, on April 16, September 6, December 7, 1991 and on February 18, 1992 were held during the period to discuss various matters of general interest to the staff. The last meeting of February 18 was the inaugural meeting of the newly constituted Council.

Grievance Committee : Three meetings of the Grievance Committee were held on July 26, 1991, March 5, 1992 and October 1, 1992 to consider individual grievances of the staff members for their redressal.

Finance : A statement showing sanctioned budget grant of CIRCOT and the actual expenditure for the financial year 1991-92 has been furnished in Annexure IV. As could be seen from the statement, the actual expenditure under non-plan was Rs. 1,49,91,480 as against sanctioned grant of Rs. 1,50,00,000 for 1991-92. Further, an expenditure of Rs. 42,11,899/- was incurred under the plan budget as against sanctioned grant of Rs. 40,00,000 for 1991-92. During the year 1991-92, an expenditure of Rs. 40,608 was incurred for the Emeritus Scientist Scheme of ICAR.

Significant findings : At the appropriate panel meetings of AICCIP, one long staple cotton variety CNH.36 was recommended for release in Maharashtra, Gujarat and South Rajasthan.

An investigation into the anatomy of 40s combed export yarns emphasised the

need to prevent the generation of fly and spinning faults if high quality has to be ensured in the yarns intended for export. Further, an improved relationship between the frequency of yarn faults and combined effect of uniformity ratio and trash content has been established.

A study on attachment of fibres to the cotton seed revealed that cotton fibres are more firmly attached at the micropylar region of the seed than in the side or the chalazal region.

A method for estimating the number of seed coat fragments (SCF) in cotton from the weight percentage has been developed. This estimate has been found to agree with the number of SCF actually obtained by counting.

A cryostat with all the necessary attachments to measure the electrical conductivity through different textile fabrics/yarns was devised.

High correlation was established between the fabric stiffness determined by Shirley instrument and fabric drape determined using BTRA Drapemeter.

Analytical study on the wax content in Indian cotton revealed wide variations in the wax content among varieties, varieties in the same species, and inter-hybrid varieties, etc.

2

Progress of Research

A brief account of the progress of research work done during 1991-92 at CIRCOT and its Regional Units including the Ginning Training Centre at Nagpur, is given below.

THRUST AREA I : TECHNOLOGICAL RESEARCH FOR COTTON QUALITY EVALUATION AND IMPROVEMENT

This thrust area encompasses three distinct facets of technological research (a) Evaluation of the quality of cotton samples received from agricultural trials and the All India Co-ordinated Cotton Improvement Project (AICCIP), (b) Tests on Standard and Trade varieties of Indian Cottons and (c) Research work on specific Agricultural and Technological aspects relevant to the cotton improvement.

(a) Evaluation of the Quality of Cotton samples received from Agricultural Trials and All India Co-ordinated Cotton Improvement Project

Large number of cotton samples are being received every year for technological evaluation from trials conducted by the AICCIP, Agricultural Universities and State Agricultural Departments. The number of samples received during 1991-92 for different tests has been given in Table 1(a). The total number of samples tested at each Regional Quality Evaluation Unit of CIRCOT is presented in Table 1(b).

The samples received were tested in the order of their receipt and test reports on them were sent soon after the tests were over. The test results on Trade Varieties and Standard Indian Cotton samples are reported in the form of periodical Technological Circulars and at the end of the year, these are compiled for the whole season and published as Technological Reports separately for Trade Varieties and Standard Varieties of Indian Cottons.

A few samples are also received for determination of quality of Ginning, oil content in cotton seed, etc. and reports on these tests are also sent immediately after the tests are completed.

The number of samples tested state-wise for various fibre characters and reports issued on them have been given in Table 2.

All India Co-Ordinated Cotton Improvement Project (AICCIP) :

The Indian Council of Agricultural Research launched the AICCIP in April, 1967 with a view to achieving closer collaboration between the scientists of various disciplines as well as bringing

TABLE 1(a) : NUMBER OF COTTON SAMPLES RECEIVED FROM AGRICULTURAL TRIALS FOR DIFFERENT TESTS A T THE HEADQUARTERS OF CIRCOT

Type of Test	Average for the quin-quennium 1984-88	1989	1990	1991
Fibre and Full Spinning	209	235	319	192
Fibre and Microspinning	1859	1886	1900	1600
Microspinning alone	55	10	—	—
Fibre Test alone	321	668	484	631
Mill Test	10	4	14	4
Standard Cottons	21	16	20	21
Trade Varieties				
— Lint	38	22	23	28
— Kapas	35	16	12	64
Technological Research	25	4	12	269
Miscellaneous	2	6	21	—
Total	2576	2867	2815	2809

TABLE 1(b) : NUMBER OF SAMPLES TESTED AT THE REGIONAL QUALITY EVALUATION UNITS OF CIRCOT

Regional Quality Evaluation Unit	Quality Parameters				
	Fibre length	Fibre fineness	Fibre strength	Fibre maturity	Micro spinning tests
Akola	1250	648	582	648	—
Coimbatore	1086	1086	1086	1086	647
Dharwad	1861	1861	1867	2083	—
Guntur	861*	778	861	778	—
Hisar	855	951	1100	957	—
Indore	402**	396	396	402	—
Ludhiana	2205	1941	1902	1941	—
Nagpur	1361	1316	1360	1202	—
Nanded	1218	1205	1205	1218	—
Rahuri	1594	1588	1572	1588	—
Sirsa	1084*	1001	1004	1004	—
Sriganganagar	941	933	935	862	—
Surat	16164	16164	16164	16164	—

* Baer Sorter

** From Sept. 91 the work was disturbed, due to shifting and installation of equipments to another building in College of Agriculture.

together Agricultural Universities, Central Institutes and the State Departments of Agriculture. The main objective of this project is to look into the problems of production, productivity and quality of cotton with a multi-disciplinary approach. The breeding material available with the cotton breeders of various states is systematically screened every year and only the promising material is subjected to further screening. Maintenance of 'Germ Plasm' and Initial Evaluation Trials are the preliminary stages of screening, while Co-ordinated Varietal Trial, Pilot Demonstration Trial, etc. are the advanced stages of trial under this Project. Yield is the main criterion in the Initial Evaluation Trial while both yield and quality are the criteria for further selections as well as subsequent trials.

As the cotton sowing and harvesting seasons differ widely in various regions of the country, the breeding programmes are formulated separately for each zone. Thus, three zones have been identified according to agro-climatic conditions. The North Zone comprises the States of Punjab, Haryana, Rajasthan and Uttar Pradesh; the Central Zone includes the States of Madhya Pradesh, Maharashtra and Gujarat, while the South Zone covers the States of Andhra Pradesh, Karnataka and Tamil Nadu.

This is the twenty-fifth year of the All India Co-ordinated Cotton Improvement Project. As many as 2012 samples were tested for fibre properties and spinning potential during the year. Test data on various trials were presented at the respective panel meetings held at Sirsa for North Zone

TABLE 2 : NUMBER OF SAMPLES TESTED AT REGIONAL UNITS AND REPORTS SENT DURING 1991-92

State	Fibre and Full Spinning	Fibre and Micro Spinning	Fibre Tests alone	Total
Punjab	60(12)	96(12)	26(2)	182(26)
Haryana	6(2)	86(13)	—	92(15)
Rajasthan	19(7)	18(3)	11(1)	48(11)
New Delhi (IARI)	2(2)	97(5)	192(5)	291(12)
Madhya Pradesh	3(2)	200(14)	78(6)	281(22)
Gujarat	46(29)	56(5)	—	102(34)
Maharashtra	54(11)	196(29)	277(14)	527(54)
Andhra Pradesh	10(4)	66(9)	—	76(13)
Karnataka	35(15)	343(23)	—	378(38)
Tamil Nadu	—	78(5)	—	78(5)
Total	235(84)	1236(118)	584(28)	2055(230)

Note : Figures in bracket indicate reports sent.

TABLE 3 : SUMMARY OF TEST RESULTS ON STRAINS TRIED IN CO-ORDINATED VARIETAL TRIAL OF G. HIRSUTUM IN NORTH ZONE

Location	No. of samples	Range of				Spinning Assessment			Control Variety
		2.5% Span length (mm)	Micronaire value	Maturity	Bundle tenacity (g/t)	Count	A	B	
1	2	3	4	5	6	7	8	9	10
Normal Plant Type — Br 04 (a)									
Faridkot	8 F	20.6 — 26.8 (24.8)	4.0 — 5.0 (4.7)	79 — 90 (84)	45.6 — 49.8 (47.4)	30s	3	5	F.505
Hisar	6 M	22.1 — 25.8 (23.9)	4.7 — 5.2 (4.8)	73 — 81 (78)	44.5 — 46.6 (45.7)	20s	2	--	H.777
Ludhiana	8 F	23.3 — 27.4 (25.6)	4.1 — 5.2 (4.5)	70 — 85 (78)	44.0 — 48.8 (46.4)	30s	6	5	LH.886
Muktsar	9 F	24.4 — 27.0 (25.9)	4.5 — 5.2 (4.8)	70 — 86 (80)	44.0 — 49.3 (45.8)	30s	8	6	LH.886
Sirsa	6 M	22.4 — 25.5	4.3 — 5.1	74 — 87	42.9 — 49.3	20s	5	--	H.777
Sriganganagar	7 F	22.1 — 25.2	3.8 — 4.9	70 — 81	46.1 — 49.3	20s	7	6	G.Ageti.

1	2	3	4	5	6	7	8	9	10
				Compact Plant Type, Short Duration — Br 04 (b)					
Faridkot	6 F	24.1 — 27.8 (26.6)	3.8 — 5.0 (4.5)	60 — 85 (75)	44.5 — 46.6 (45.8)	30s	5	5	LH.900
Hisar	6 M	22.4 — 27.3 (25.2)	4.2 — 5.2 (4.7)	78 — 86 (81)	45.0 — 47.7 (46.6)	20s	4	3	LH.900
Ludhiana	8 F	23.6 — 28.5 (26.9)	3.6 — 4.2 (3.8)	66 — 80 (72)	42.3 — 48.2 (45.5)	30s	6	7	LH.900
Muktsar	8 F	23.6 — 28.8 (26.4)	3.9 — 5.2 (4.5)	64 — 78 (74)	44.0 — 49.3 (46.9)	30s	5	7	LH.900
Sriganganagar	7 F	22.0 — 26.2	4.1 — 6.2	66 — 88	47.7 — 49.3	30s	3	5	G.Ageti.

A — Samples spinnable to the count chosen.

B — Samples having spinning performance on par with or better than the control.

M — Microspinning

F — Full spinning

Note : Values in brackets indicate averages.

and at Nagpur for Central and South Zones (combined).

North Zone :

North Zone comprises the states of Punjab, Haryana, Rajasthan, Uttar Pradesh and New Delhi. Most of the area in these states is under irrigation and hence the yield levels (to kg/ha) are generally higher than those of the cotton growing states in other zones.

Major emphasis is given in this zone to identify superior high yielding American type *G. hirsutum* strains. Attention is also given to identify strains which are early maturing (sowing to harvesting period around 150 days). Trials are also conducted to evolve high yielding *desi* varieties and adaptable short duration hybrids.

G. hirsutum Trial : The Co-ordinated Varietal Trial of *G. hirsutum* under Normal Plant Type was conducted at Faridkot, Hisar, Ludhiana, Muktsar, Sirsa and Sriganganagar, and under Compact Plant and Early Maturing Types at Faridkot, Hisar, Ludhiana, Muktsar and Sriganganagar.

The ranges of 2.5% span length, Micronaire value, maturity and bundle tenacity along with spinning potential of various strains under this trial have been compiled in Table 3.

Promising strains from these trials at different counts and locations were as follows :

Location	*Count*	*Promising strains*
		Normal Plant Type, Br 64 (a)
Faridkot	20s	F.1086, LH.1009, HS.164, H.1021 and F.505
	30s	F.846, B.N. and LH.1134
Hisar	20s	H.1021 and H.777
Ludhiana	20s	RS.716
	30s	LH.1082, LH.1097, LH.886, LH.1134 and B.N.
	40s	LH.1175
Muktsar	30s	FH.1031, F.846, F.965, H.1021, HS.145, HS.164, LH.886, LH.1134 and B.N.
Sirsa	20s	LH.1009, F.1086, H.1021, HS.164 and H.777
Sriganganagar	20s	RS.716, HS.164, LH.1009, H.1021, B.N. and G.Ageti
	30s	F.1086

Location	*Count*	*Promising strains*
	Compact and Short Duration Plant Type, Br 04 (b)	
Faridkot	20s	LH.900
	30s	F.1054, F.1122 and Pusa 49
	40s	LH.1342
	50s	LRK.516
Hisar	20s	Pusa.39, Pusa 49, H.1098 and LH.900
Ludhiana	30s	LH.1340, LH.1342, LH.1446, LH.1520, Pusa 39 and Pusa 49
Muktsar	20s	LH.1342 and HS(CP).69
	30s	F.1132, H.1098 and HS (CP).73
	40s	LH.1446 and Pusa 49
Sriganganagar	16s	RS.880
	20s	G.Ageti
	30s	RS.875, H.1098 and B.N.

Preliminary Varietal Trial was conducted at Faridkot, Hisar, Ludhiana, Muktsar, Sirsa and Sriganganagar. The following strains fared well in spinning performance at 20s and 30s counts at the locations indicated below :

Location	*Count*	*Promising strains*
Faridkot	30s	F.1184 and B.N.
Hisar	20s	CSH.385 and H.777
Ludhiana	30s	CH.1254, CH.1267, CH.1367, H.83-1, B.N. and LH.1134
Muktsar	30s	LH.1254, LH.1267, LH.1184, LH.1117, B.N., LH. 886 and LH.1134
Sirsa	20s	LH.1254, LH,1267, LH.1117, HS.183 and H.777
Sriganganagar	30s	LH.1117, HS.183 and F.1184

The Initial Evaluation Varietal Trial was conducted at Ludhiana, Muktsar and Sirsa. The following strains recorded satisfactory yarn strength at the counts and at the locations as indicated below :

Location	*Count*	*Promising strains*
Ludhiana	40s	LH.1318 and LH.1366
Muktsar	30s	LH.1318, F.1203, LH.1123, HS.193, Pusa 95, B.N., LH.886 and LH.1134
Sirsa	20s	LH.1318, F.1280, H.1123, HS.195 and H.777

G. arboreum Trial : Samples pertaining to this trial were received from Ludhiana and Sriganganagar for fibre test only. The object of this trial was to identify high yielding coarse and short staple varieties replacing the existing G.27 variety. The 2.5% span length of all the strains included in this trial ranged between 16.3 mm and 19.8 mm. The following strains recorded Micronaire values of 7.0 and above at the locations indicated below :

Location	*Promising strains*
Ludhiana	LD.405, LD.447, LD.451, LD.470, LD.484, LD.486, HD.137, HD.123, DS.29, CSA.9-10, LD.490 and LD.327
Sriganganagar	CSA.9-10, HD.123, DS.29, LD.447, HD.107, LD.484, LD.486, LD.451, and LD.327

Samples pertaining to Preliminary Varietal Trial were received from Ludhiana only for fibre tests. The 2.5% span length ranged between 16.3 mm and 24.0 mm. The Micronaire value of 7.0 and above was recorded by the following eleven out of fourteen strains: LD.491, LD.493, LD.494, LD.542, LD.156, HD.203. HD.217, RG.18, RG.19, DS.35 and LD.327.

Hybrid Cotton Trial : The object of hybrid trials was to identify hybrids superior to those of the local varieties, in yield and technological characters. Samples belonging to Intra-hirsutum Hybrid Trial involving *G. hirsutum* × *G. hirsutum* crosses were received from Faridkot, Hisar, Ludhiana, Muktsar, Sirsa and Sriganganagar. The following hybrids recorded promising

performance at the counts and the locations mentioned below :

Location	*Count*	*Promising strains*
Faridkot	30s	FHH.5, G.Cot.Hyb.8 and LH.1134
Hisar	20s	G.Cot.Hyb.8, HHH.11, HHH.81, HHH.121 and H.777
Ludhiana	30s	PCHH.13, PCHH.31, FHH.3, FHH.5, RAJ.HH.14 and LH.1134
Muktsar	30s	PCHH.13, PCHH.31, FHH.5, G.Cot.Hyb.8 and LH.1134
Sirsa	30s	PCHH.13, RAJ.HH.14, FHH.5 and H.777
Sriganganagar	30s	PCHH.31 and G.Cot.Hyb.8

Samples pertaining to Interspecific Hybrid Trial involving *G. hirsutum* × *G. barbadense* crosses were received from Ludhiana and Sriganganagar. The range of 2.5% span length was between 23.4 mm and 32.8 mm. Micronaire value ranged between 3.9 and 5.1. Maturity was good. Bundle tenacity values varied from 44.5 g/t to 49.3 g/t. Of the hybrids, Pusa. HB.6 from Ludhiana fared well in spinning performance at 60s count, while the control varieties, B.N., LH.900 and LH.1134 recorded good CSP values at 30s count.

Miscellaneous Hybrid Cotton Trial : An *Intra-hirsutum* hybrid trial was conducted for the local hybrids under irrigated conditions at Hisar. All the hybrids belonged to the medium staple category of cotton with good length uniformity, average Micronaire value, good maturity and bundle tenacity at both the gauge lengths. As many as three out of six hybrids, viz. HHH.81, HHH.28, HHH.29 and the local control, H.777 recorded encouraging spinning performance at 20s count.

A set of 116 samples from *Intra-barbadense* hybrid trial under irrigated conditions was received from IARI, New Delhi for fibre test only. The range of 2.5% span length was between 27.5 mm and 37.4 mm. Maturity was good and bundle tenacity at zero gauge varied from 43.4 g/t to 54.7 g/t.

Three interspecific hybrids, viz. Pusa Hy.5, Pusa Hy.6 and Pusa Hy.15 received from IARI, New Delhi for microspinning test recorded good CSP values at 60s count. However, when Pusa Hy.5 which recorded encouraging CSP value of 2752 against the standard CSP value of 2210 for 60s count by microspinning, was further subjected to full spinning test, it gave satisfactory yarn strength at 80s count and the yarn was found to be good in respect of irregularity and imperfections when tested on the Uster Evenness Tester.

Miscellaneous Trial : During the period a good number of trials having different objectives were conducted at different locations, viz. Faridkot, Hisar, Ludhiana and New Delhi. The details of the trials and the test results are given below :

Two sets of samples of eight and six each from two different State Co-ordinated Trials conducted under irrigated conditions were received from Faridkot for assessment of spinning potential. It was observed that four out of eight strains, viz. F.846, F.1086, F.1084 including the control LH.1134 fared well in spinning performance at 50s count, while from another trial, three out of six strains, viz. F.1132, LH.1318 and LH.1444 recorded encouraging CSP values at 30s count.

A set of five samples from *G. hirsutum* trial raised under irrigated conditions, received from Hisar was subjected to full spinning test. It was observed that as many as four strains, viz. H.1098, H.1134, H.974 and the control, H.777 were satisfactorily spinnable at 20s count. In another trial of *G. hirsutum* of Initial Evaluation Trial received from the same location, six strains were subjected to microspinning test. However, none of the strains, except the control, H.777 fared well in spinning performance at 20s count.

Two trials of FYT, one for *G. hirsutum* and the other for *G. arboreum,* were conducted under irrigated conditions at Hisar. All the seven strains of *G. hirsutum* trial were coarse in Micronaire value and only one strain, viz. H.1129 along with the control H.777 fared well in spinning performance at 20s count, while none of the twelve strains from *G. arboreum* trial recorded satisfactory spinning performance at 20s count. However, as many as nine strains, viz. HD.131, HD.135, HD.145, HD.167, HD.174, HD.178, HD.226 and HD.327 and the control DS.5 recorded Micronaire value of 7.0 and above.

A set of eight samples was received from Ludhiana from the State Co-ordinated Trials conducted for the exotic germ plasm material of *G. hirsutum* obtained from Pakistan. The following strains fared well in spinning performance at the counts indicated in bracket : NAIB.12 (30s); RH.1 (50s), S.12(30s), SUNIAB.IG(30s), along with the local controls, LH.886(30s), LH.900(20s) and LH.1134(30s).

A *G. arboreum* trial was conducted at Ludhiana under irrigated conditions. Only four out of sixteen strains. viz. LD.533, LD.534, LD.583 including the control LD.327 recorded Micronaire value of 7.0 and above and none of the strains was found to be satisfactorily spinnable at 20s count.

A few trials covering *G. hirsutum* and *G. barbadense* cultures and interspecific hybrids continued to be conducted at IARI, New Delhi, where high strength *G. hirsutum* culture as well as interspecific hybrids recorded appreciably good spinning potential of 80s count under the agro-climatic conditions of North Zone. The details of the trials and the test results were as given below :

A set of 27 samples of Pusa cultures of *G. hirsutum* grown under summer conditions of New Delhi was received for screening in respect of fibre characters. The range of 2.5% span length was between 22.9 mm and 26.3 mm. Micronaire value

ranged between 2.8 and 4.9. Bundle tenacity at 3.2 mm gauge length varied from 24.7 g/t to 33.7 g/t.

A trial of nineteen different selections of high strength Pusa 2 cultures of *G. hirsutum* was conducted and the samples were collected from three different pickings for fibre tests. It was observed that the ranges of Micronaire value and bundle tenacity at 3.2 mm gauge length improved significantly from first picking to third picking. However, when the same set of nineteen Pusa 2 cultures of *G. hirsutum* of high fibre tenacity received as a separate lot was subjected to microspinning test, it was observed that as many as fourteen cultures fared well in spinning performance at 60s count.

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In another set of 46 cultures of Pusa 2 of high fibre strength received for microspinning test, as may as thirty cultures recorded satisfactory yarn strength at 60s count.

In a *G. hirsutum* trial of three Pusa cultures, viz. Pusa 15-2-L1-6-2-2, Pusa 16-2-L1-6-3 and Pusa 19-27-L7-P12-1, samples were collected from three different pickings. It was observed that there were significant differences between the first picking and the second picking of these three cultures in respect of fibre length, Micronaire value, maturity and bundle tenacity at 3.2 mm gauge length, except in the case of Pusa 16-2-L1-6-3 for fibre length. It was also observed that only the first picking of the three cultures recorded satisfactory spinning performance at 40s count.

A sample of Pusa 2-95 was subjected to screening for full spinning test by ring spinning as well as open end spinning techniques. It was observed that Pusa 2-95 recorded good spinning performance at 80s count by ring spinning and the yarn was found to be good in respect of irregularity and imperfections (i.e. thin places, thick places and neps) when tested on the Uster Evenness Tester, while the open end spun yarn with a CSP value of 2806 at 20s count was better in respect of yarn evenness, imperfections, yarn elongation, etc. as compared to the ring spun yarn at 60s count.

A set of 26 samples from the trial of *G. barbadense* selections conducted under irrigated conditions was received. The range of 2.5% span length was between 28.3 mm and 32.7 mm. Micronaire value ranged between 3.5 and 4.5. Maturity was good. The bundle tenacity at zero gauge length varied from 46.6 g/t to 53.1 g/t. As many as nineteen selections, fared well in spinning performance at 60s count.

Central Zone :

The states of Madhya Pradesh, Gujarat and Maharashtra comprise the Central Zone. This zone has the largest area under cotton cultivation. Although emphasis is given to improve the existing American type *G. hirsutum* cottons, a sizeable percentage of cottons from *G. arboreum* species is also under cultivation due to the area being under rainfed conditions. For the last many years, hybrids such as Hybrid 4, Hybrid 6, JKHy. 1, Godavari are being commercially cultivated in this zone. Attempts are being made to identify early maturing hybrids without sacrificing the yield. Considering the increasing demand for the medium and superior medium category cottons, attempts are directed to evolve *desi* hybrids.

G. hirsutum Trial : The Co-ordinated Varietal Trial was conducted at Padegaon, Rahuri and Surat under irrigated conditions, while this trial was conducted under rainfed conditions at Adilabad, Akola, Badnawar, Indore, Jalgaon, Khandwa and Nanded.

The ranges of 2.5% span length, Micronaire value, maturity and bundle strength along with spinning potential have been compiled in Table 4.

The promising strains from the spinning point of view were as follows :

Location	*Count*	*Promising strains*
		Irrigated
Padegaon	30s	G.1707 and G.Cot.10
Surat	30s	CNH.34 and G.Cot.14
	40s	G(T).538, CNH.36, JK.119 and G.Cot.10
	50s	LRK.516
		Rainfed
Badnawar	40s	G.4406, KH.100-2237, 79.BH.5-3, WH.216, JK.276-4-1, 82.BH.3 and Vikram
Indore	30s	79.BH.5-3
Jalgaon	40s	79.BH.5-3

Preliminary Varietal Trial was conducted at Rahuri and Talod under irrigated conditions and at Adilabad, Akola, Amreli, Badnapur, Jalgaon, Khandwa and Nanded under rainfed conditions.

Promising strains which recorded desired yarn strength at the counts selected, were as given below :

Location	*Count*	*Promising strains*
		Rainfed
Akola	40s	G.3907 and AKH.8649
Amreli	30s	NH.425 and AKH.8635
Badnapur	30s	JK.345-3-3, AKH.8632 and JLH.168
Khandwa	40s	JK.345-3-3, G.Cot.10 and Khandwa 3
Nanded	30s	JLH.168

TABLE 4 : SUMMARY OF TEST RESULTS OF STRAINS TRIED IN CO-ORDINATED VARIETAL TRIAL OF G. HIRSUTUM IN CENTRAL ZONE

Location	No. of samples	Range of				Spinning Assessment			
		2.5% Span length (mm)	Micronaire value	Maturity	Bundle tenacity (g/t)	Count	A	B	Control Variety
1	2	3	4	5	6	7	8	9	10
				Irrigated Trial, Br 04 (a)					
Padegaon	7 M	24.8 — 26.9 (26.2)	3.4 — 4.8 (4.2)	63 — 84 (75)	39.7 — 45.6 (42.1)	30s	2	6	KOP.498
Rahuri	16 FT	25.1 — 29.9 (27.1)	3.4 — 4.5 (4.1)	56 — 83 (75)	38.1 — 48.8 (44.8)	—	—	—	KOP.498
Surat	7 F	24.4 — 30.8 (27.0)	3.6 — 5.0 (4.5)	76 — 88 (80)	44.0 — 49.3 (47.2)	40s	5	5	G.Cot.14
Talod	7 M	24.1 — 24.4 (25.6)	3.9 — 4.9 (4.6)	64 — 84 (73)	43.4 — 48.8 (45.9)	30s	2	—	G.Cot.10
				Rainfed Trial, Br 04 (b)					
Adilabad	5 FT	25.5 — 29.7 (26.7)	3.8 — 4.6 (4.3)	66 — 80 (76)	43.4 — 47.2 (44.9)	—	—	—	G.Cot.10
Akola	6 M	26.4 — 28.9 (27.5)	3.8 — 4.9 (4.3)	69 — 83 (75)	39.1 — 46.1 (43.0)	40s	—	—	DHY.286

Contd.

1	2	3	4	5	6	7	8	9	10
Badnawar	6 M	24.0 — 31.4 (26.5)	3.2 — 4.8 (3.8)	60 — 88 (69)	38.6 — 49.3 (44.3)	40s	7	4	Vikram
Indore	15 M	21.8 — 28.4 (23.7)	2.4 — 3.6 (3.0)	43 — 63 (51)	39.7 — 45.0 (42.2)	30s	1	3	Vikram
Jalgaon	15 M	25.9 — 29.4 (26.9)	4.2 — 5.3 (4.4)	75 — 89 (82)	41.3 — 49.8 (44.5)	—	—	—	G.Cot.10
Khandwa	16 M	23.6 — 29.2 (26.0)	2.8 — 4.7 (3.4)	51 — 75 (62)	40.7 — 48.8 (44.0)	40s	1	6	Khandwa 3
Nanded	5 M	24.5 — 25.8 (25.3)	4.5 — 5.2 (4.8)	74 — 86 (82)	41.3 — 46.1 (44.5)	30s	—	1	G.Cot.10

A — Samples spinnable to the count selected

B — Samples having spinning performance on par with or better than the control

M — Microspinning

FT — Fibre Test only

F — Full Spinning

Note — Values in bracket indicate averages

Initial Evaluation Varietal Trial was conducted at Badnapur and Rahuri under irrigated conditions and at Adilabad, Akola, Badnapur, Jalgaon and Khandwa under rainfed conditions. Only three strains, viz. NH.380, NH.392 and the control, LRA.5166 from Badnapur under irrigated conditions recorded encouraging spinning performance at 30s count.

G. arboreum Trial : Co-ordinated Varietal Trial was conducted at Akola, Amreli, Indore, Jalgaon, Nanded and Ujjain. The promising strains at different locations were as listed below :

Location	*Count*	*Promising strains*
Akola	20s	KWA.3 and AKH.4
Amreli	20s	G(AM).31, G(AM).20, JLA.129, NA.377, NA.416, PA.141, PA.85/160, KWA.3, IA(90).1, UA(90).1, UA(90).2, AKA.8401, AKA.8715, 1867, 1875, AKH.4 and G.Cot.15
Indore	30s	G(AM).31, G(AM).22, NA.377, NA.416, PA.85/160, 1867, AKH.4, PA.141 and KWA.3

Hybrid Trial : The *intra-hirsutum* hybrids involving *G. hirsutum* × *G. hirsutum* crosses were tried for the conventional hybrids and male sterility based hybrids separately under both irrigated and rainfed conditions.

Conventional Hybrid Trial : The Conventional Hybrid Trial was conducted at Jalna, Khandwa and Nanded under rainfed conditions.

Following hybrids gave encouraging performance at the counts and the locations as indicated below :

Location	*Count*	*Promising hybrids*
		Irrigated
Jalna	30s	CICR.HH.11 and G(T).HH.42
	40s	G(T).HH.15 and Hybrid 4
Nanded	40s	G(T).HH.15, T.13 × M.12, NHH.302 and Savitha
Talod	40s	T.13 × M.12, NHH.302, Hybrid 8 and Hybrid 6

Location	*Count*	*Promising hybrids*
		Rainfed
Akola	40s	WHH.90, GHH.662, WHH.224, PHH.231 and G.Cot.10(CMS).
Bharuch	40s	PHH.253, JKHy.2, WHH.90 and WHH.204
	50s	JKHy.1
Indore	40s	GHH.662, JKHy.1, WHH.90 and MLC.9
Jalna	30s	WHH.90, PHH.231 and GHH.662
	40s	JKHy.1
Khandwa	40s	GHH.756, HCHH.104, NHH.90, NHH.204, SGC.HH.2, CAHH.468,, JKHy.1, Hybrid 4 and G.Cot.Hy.6 (CMS)

Male Sterile Hybrid Trial : The Male Sterile Hybrid Trial was conducted at Indore, Jalna, Padegaon and Rahuri under irrigated conditions and at Akola, Indore, Jalgaon, Jalna, Nanded and Nagpur under rainfed conditions.

The following hybrids recorded satisfactory spinning performance at the counts and the locations mentioned below :

Location	*Count*	*Promising strains*
Indore	30s	WHH.15, HCM.HH.19, VCHH.1, JKHy.2 and CMS.G.Cot.Hy.6
Jalna (MAHYCO)	30s	RHH.20
	40s	MECH.12 and MECH.14
	50s	MECH.13
Jalna (VSPL)	30s	MECH.13 and LRA.5166
		Rainfed
Akola	40s	CAHH.2, G.Cot.Hy.6(CMS) and G.Cot.Hy.6
Indore	40s	CAHH.2, CIN.HH.105 and G.Cot.Hy.6
Jalna	40s	CAHH.2 and MECH.15

Location	*Count*	*Promising hybrids*
Nanded	40s	CAHH.468, JKHy.1, NCM.HH.20, MECH.12, MECH.13, MECH.19, RNH.2, NCM.HH.19 and G.Cot.Hy.6
Nagpur	20s	WHH.198
	30s	CAHH.4
	40s	NCM.HH.20, CAHH.468, JKHy.1, Hybrid 4 and LRA.5166
	50s	CIN.HH.106, MECH.144, CAHH.2, MECH.15, NCM.HH.20, G.Cot.Hy.6 and G.Cot.Hy.6(CMS)

Inter specific Hybrid Trial : Hybrids involving *G. hirsutum* × *G. barbadense* crosses were tried at Badnawar, Padegaon, Parbhani and Rahuri under irrigated conditions and hybrids involving *G. arboreum* × *G. herbaceum* crosses at Indore, Jalna and Ujjain.

The promising hybrids from the spinning point view for the counts and the locations were as indicated below.

Location	*Count*	*Promising hybrids*
		G. hirsutum × *G. barbadense*
Badnawar	80s	GHB.410, GHB.420, MECH.112, DHB.115, DCHB.224, NBHB.11, NBHB.419, BHB.40, BHB.41 and NHB.12
Jalna	60s	MECH.112, DHB.115, BHB.41, DCHB.224, MECH.111, NBHB.419, CNHB.7, NHB.12 and DCH.32
Padegaon	60s	MECH.111, MECH.114, DCHB.224, NBHB.11 BHB.41, CAHB.7 and NHB.12
Parbhani	60s	PHB.55, NBHB.11, GHB.418, NHB.12 and DCH.32
		G. arboreum × *G. herbaceum*
Indore	30s	GDH.160, PHA.46, G.Cot.DH.9 and Maljari
Jalna	16s	PA.32
	20s	MDCH.201 and PHA.46

Evaluation of Dwarf and Compact Material: Dwarf and Compact type of plants have certain advantages in respect of yield over the normal type of plants. In order to study the technological aspects of such plant types, trials were conducted at Akola, Khandwa and Nanded. The following strains recorded desired yarn strength at the counts and the locations mentioned below :

Location	*Count*	*Promising strains*
Akola	40s	LRK.516
Khandwa	40s	LRK.516 and G.2531
Nanded	30s	LRK.516, NISD.5 and CNHPT.1

District Varietal Trial : Samples pertaining to this trial were received from Indore only. All the six entries, viz. K.2, K.3, Vikram, Maljari, 79.BH.5-3 and Sarvottam fared well in spinning performance at 20s count.

Miscellaneous Hybrid Cotton Trial : A promising *intra-hirsutum* hybrid, NHH.302 alongwith the control hybrid, NHH.44 raised under rainfed conditions at Nanded was received for full spinning test. It was observed that NHH.302 was found to be superior to the control, NHH.44 in CSP values at both the counts, 30s and 40s. However, only the new hybrid, NHH.302 recorded good yarn strength at 30s count due to better length uniformity and bundle tenacity at 3.2 mm gauge length as compared to the control hybrid, NHH.44.

An *Intra-hirsutum* Hybrid Trial was conducted under rainfed conditions at Parbhani. Only one out of five hybrids, viz. PHH.231 fared well in spinning performance at 40s count.

Two medium staple *intra-hirsutum* hybrids, G(T).HH.15 and G(T).HH.30 were tried under irrigated conditions at Talod. The hybrid, G(T).HH.15 was found to be superior to G(T).HH.30 in fibre length, fineness and bundle tenacity at both the gauge lengths and this was reflected in their spinning performance. The hybrid, G(T). HH.15 was found to be satisfactorily spinnable at 50s count, while the hybrid, G(T).HH.30 recorded good CSP value at 30s count.

Miscellaneous Trial : These trials having different objectives were conducted at Nanded, Jalgaon, Parbhani, Surat, Sunderbans (W.B) and Talod. The details of the trials and the test results were as given below :

Two local trials, viz. Co-ordinated Varietal Trial and Preliminary Varietal Trial, belonging to *G. hirsutum* under rainfed conditions were conducted at Nanded. As many as six out of fourteen strains, viz. PH.99, NH.422, NH.380, NH.426, NH.429 including the control,

LRA.5166 recorded desired CSP values at 30s count.

Three sets of cotton samples belonging to different experiments of *G. arboreum* trial were received from Nanded. Only three out of fourteen strains, viz. NA.436, NA.376 and NA.431 recorded desired yarn strength at 20s count.

A new *G. arboreum* strain, JLA.187 alongwith the local control variety, Y.1 tried under rainfed conditions at Jalgaon was received for fibre and spinning tests. It was observed that the control variety, Y.1 was significantly better in fibre length, fineness and bundle tenacity at both the gauge lengths as compared to the new strain, JLA.187. In spinning performance, Y.1 recorded encouraging CSP value at 30s count, while the new strain, JLA.187 was not found to be spinnable even for 20s count due to the coarseness of the fibre.

A set of five strains was tried under the Multilocation Varietal Trial of *G. hirsutum* under irrigated conditions at Padegaon. Only two strains, viz. KOP.872 and JK.344 recorded good CSP values at 30s count.

A Dwarf and Compact Plant Type strain, Surat Dwarf, was raised along with the local control, G.Cot.10 at Surat. It was noted that the control, G.Cot.10 was significantly better in fibre length, Micronaire value, maturity and bundle tenacity at 3.2 mm gauge length as compared to the new strain, Surat Dwarf. In spinning performance, the control variety, G.Cot.10 was found to be spinnable to 40s count, while the new strain, Surat Dwarf recorded encouraging CSP value at 30s count.

Another Dwarf and Compact Plant Type strain, LRK.516 developed at Coimbatore was tried at Surat. This medium staple cotton strain was good in length uniformity, Micronaire value, maturity and bundle tenacity at both the gauge lengths. It recorded encouraging spinning performance at 40s count and the yarn was found to be average in respect of irregularity and imperfections determined on the Uster Evenness Tester.

A set of six samples of Dwarf and Compact Plant Type of *G. hirsutum* developed at Coimbatore was tried for their performance under the agro-climatic conditions of Sundarbans area of West Bengal. The range of 2.5% span length was between 27.4 mm and 31.3 mm with good length uniformity. All the cultures were average in Micronaire fineness (except KD (CAKD) being coarse), good in maturity and bundle tenacity at both the gauge lengths.

Another set of forty samples collected from two different pickings was received from Ramkrishna Ashram Krishi Vigyan Kendra, Sundarbans (W.B.) for fibre tests. All the samples had fibre length in the medium and long staple range with good length uniformity, Micronaire value, maturity and bundle tenacity at both the gauge lengths.

A *G. hirsutum* strain, GH.538 raised under irrigated conditions at Talod was received for test of spinning performance. This medium staple cotton strain was good in length uniformity, Micronaire value, maturity and bundle tenacity at both the gauge lengths and recorded good CSP value at 30s count.

South Zone :

South Zone comprises the states of Karnataka, Andhra Pradesh and Tamil Nadu. Cottons belonging to *G. hirsutum* species cover a large area under cultivation in this zone. Cottons from other species, viz. *G. arboreum, G. herbaceum and G. barbadense* are also grown in some tracts of this zone. In addition, hybrid cottons, especially of *G. hirsutum* × *G. barbadense* crosses, are largely cultivated in this zone.

G. hirsutum Trial : Co-ordinated Varietal Trial was conducted at Arabhavi, Guntur and Raichur under irrigated conditions, and at Dharwad, Nanded, Raichur and Shimoga under rainfed conditions. A separate trial for Compact Genotype was also conducted at Guntur. Ranges of 2.5% span length, Micronaire value, maturity and bundle strength along with their assessment of spinning performance have been compiled in Table 5.

Promising strains from this trial from the spinning point of view, were as given below.

Location	*Count*	*Promising strains*
		Irrigated
Arabhavi	40s	HLS.72, HLS.88, TCH.1005-1-8, HLS.321729, NA.1290, JK.276-82 and LRA.5166
Guntur	40s	NA.1325 and MCU.5
Raichur	40s	JK.345-3-63, HLS.72, HLS.88, TCH.1025-1-8, HLS.321729, NA.1290, JK.276-82, AH.133-5-1, MCU.5 and LRA.5166
		Rainfed
Dharwad	40s	JK.345-3, HLS.88, T.13-HLS.72, HLS.321729, NA.1325, JK.276-4, T.12-TECH.1025-8, JK.260-2, TKH.650, JK.276-8-2, NA.1290, NA.1269, TKH.497, HLA.321729, JK.276-4 and LRA.5166
Nandyal	40s	JK.260-2, TKH.650, JK.276-8-2, NA.1290, NA.1269, TKH.497, HLS.321729, LRA.5166, Laxmi and RAS.299.1
Shimoga	40s	JK.276-8-2, NA.1290, HLS.321729, TKH.650 and LRA.5166
		Compact Genotype
Guntur	40s	CNHPT.1, CNHPT.2, LH.1446 and LRA.5166

TABLE 5 : SUMMARY OF TEST RESULTS OF STRAINS TRIED IN CO-ORDINATED VARIETAL TRIAL OF G. HIRSUTUM IN SOUTH ZONE

Location	No. of samples	Range of				Spinning Assessment			Control Variety
		2.5% Span length (mm)	Micronaire value	Maturity	Bundle tenacity (g/t)	Count	A	B	
1	2	3	4	5	6	7	8	9	10
				Irrigated, Br 04 (a)					
Arabhavi	18 M	25.0 — 36.1 (29.3)	2.8 — 3.7 (3.2)	53 — 69 (62)	38.1 — 50.4 (43.1)	40s	7	10	ACP.71
Guntur	8 M	24.5 — 31.5 (27.3)	3.1 — 4.4 (3.8)	72 — 84 (77)	40.2 — 45.6 (44.0)	40s	2	5	LPS.141
Raichur	18 M	25.3 — 34.4 (29.4)	3.0 — 4.6 (3.9)	63 — 84 (72)	37.5 — 46.6 (43.2)	40s	10	17	Sharada
				Rainfed, Br 04 (b)					
Dharwad	18 M	25.6 — 34.6 (29.2)	2.9 — 4.4 (3.7)	60 — 76 (69)	39.7 — 46.6 (44.5)	40s	7	9	MCU.5
Dharwad	16 M	23.5 — 32.5 (27.9)	3.7 — 5.1 (4.5)	66 — 85 (77)	38.1 — 49.3 (44.6)	40s	9	1	LRA.5166

1	2	3	4	5	6	7	8	9	10
Nandyal	7 M	21.3 — 27.6 (25.3)	3.4 — 4.2 (3.8)	70 — 79 (74)	45.0 — 47.7 (45.7)	40s	3	6	NA.920
Raichur	18 M	21.8 — 26.4 (24.5)	3.0 — 4.5 (3.7)	55 — 85 (69)	40.2 — 46.6 (45.0)	30s	10	6	RAMPBS.155
Shimoga	16 M	23.6 — 28.6 (25.6)	2.8 — 4.2 (3.7)	58 — 75 (67)	38.6 — 47.2 (42.4)	40s	5	11	Sharada
			Compact Genotypes, Irrigated, Br 04 (d)						
Guntur	10 M	24.0 — 28.6 (25.7)	3.4 — 4.2 (4.0)	62 — 74 (70)	39.1 — 43.4 (41.3)	40s	4	—	—

A — Samples spinnable to the count selected
B — Samples having spinning performance on par with or better than the control
M — Microspinning
Note — Figures in bracket indicate averages

Samples pertaining to Preliminary Varietal Trial were received from Arabhavi, Dharwad and Guntur under irrigated conditions and from Dharwad, Raichur and Shimoga under rainfed conditions. The following strains recorded desired CSP values at the counts and the locations as mentioned below.

Location	*Count*	*Promising strains*
		Irrigated
Dharwad	30s	TCH.1005-1-7
Guntur	40s	HLS.79, TCH.1005-1-7, LRA-5166 and MCU.5
		Rainfed
Dharwad	40s	CPD.89-5, 2-182-8-7, LRA.5166 and JK.276-4
Raichur	30s	LRA.5166 and Laxmi
Shimoga	40s	CPD.895, LRA.5166 and JK.276-4

Samples pertaining to Initial Evaluation Varietal Trial was received from Guntur, Raichur and Shimoga under irrigated conditions and from Dharwad under rainfed conditions. Promising strains which have recorded desired yarn strength at the count and the locations were as given below :

Location	*Count*	*Promising strains*
		Irrigated
Guntur	40s	MCU.5
Raichur	40s	HLS.79, TCH.1005-1-7, MCU.5 and LRA.5166
Shimoga	40s	NA.1393, ICMF.16, NA.1325, 102.RB, NA.1291, 22-29-HS, CNH.115.MB, NA.1363, CNHPT.1 and LRA.5166
		Rainfed
Dharwad	40s	NA.1291, NA.1235, NA.1348, NA.1393, Pusa 39, ICMF.16, CNH.200, CNH.115.MB, CNH.PT.3, JK.276-4 and LRA.5166.

Hybrid Cotton Trial (i) *Intra-hirsutum Hybrid Trial* : Intra-hirsutum hybrid trials involving *G. hirsutum* × *G. hirsutum* crosses were conducted at Guntur and Nandyal under irrigated conditions and at Dharwad, Nandyal, Raichur and Shimoga rainfed conditions. The following hybrids recorded satisfactory spinning performance at the count and the location as indicated below :

Location	*Count*	*Promising hybrids*
		Irrigated
Guntur	50s	MCU.5
Nandyal	40s	NHH.198, NHH.39, NHH.176 and Savita
		Rainfed
Dharwad	40s	DHH.502, DHH.503, DHH.505, DHH.507, DHH.509, DHH.510, NHH.39, ICMF.HH.10, T.13 × M.12, ARCHH.90, ARCHH.53, MECHH.15, MECHH.19, MECHH.144, MLC.19, JKHy.1, Savitha and JK.276.4
Nandyal	40s	DHH.505, DHH.509 and Savitha
Raichur	40s	DHH.502, T.13 × M.12, MECHH.15, MECHH.19, MECHH.144 and Savitha
Shimoga	40s	MECHH.15, DHH.502, MECHH.144, NHH.39, DHH.509, ARCHH.90, DHH.503, ARCHH.53, DHH.505, DHH.510, T.13 × M.12, ICMF.HH.10, MLC.9 and Savitha

(ii) *Interspecific Hybrid Trial* : The hybrids involving *G. hirsutum* × *G. barbadense* crosses were tried at Coimbatore, Guntur and Ranibennur under irrigated conditions and *desi* hybrids involving *G. arboreum* × *G. herbaceum* crosses at Dharwad and Raichur under rainfed conditions. The following hybrids recorded desired yarn strength at the counts and the locations as listed :

Location	*Count*	*Promising hybrids*
		G. hirsutum × *G. barbadense*
Coimbatore	80s	TCHB.213, TCHB.223, HB.224, NHB.12, HB.226 and AP.NHB.116
Guntur	60s	DHB.100
Ranibennur	50s	DHB.100, DHB.105, Pusa Hy.6 and TCHB.223
	60s	DHB.155, DHB.270, TCHB.214, AP.NHB.116, ICMF.HB.2, NIHB.87, NHB.89, MECHB.111, MECHB.115, HB.226 and HB.224
		G. arboreum × *G. herbaceum*
Dharwad	20s	MDCH.203, MDCH.208, GDH.149, DDH.2, DDH.1 and Jayadhar
Raichur	20s	MDCH.208, GDH.149 and NCA.176

(iii) Miscellaneous Hybrid Cotton Trial : Two sets of eight samples each of DCH.32 and TCHB.213 collected from various farmers in Karnataka and Tamil Nadu, respectively were received from Coimbatore for assessment of spinning potential. It was observed that as many as four different samples of DCH.32 from Karnataka recorded encouraging spinning performance at 80s count, while only two samples of TCHB.213 from Tamil Nadu gave satisfactory yarn strength at 80s count.

A set of four samples, two each tried at Tiruputtur and Mukund Foundation from the farmers of Tamil Nadu were received from Coimbatore. It was observed that at Tiruputtur, MCU.5WT was significantly better in fibre length and Micronaire value as compared to the hybrid, Savitha, while both these cotton samples were *on par* in maturity and bundle tenacity at both the gauge lengths. In the case of spinning performance, although MCU.5WT was superior to Savitha in CSP values, both the cottons recorded encouraging yarn strength at 60s count.

In the case of interspecific hybrid, TCHB.213 along with Savitha at Mukund Foundation, the hybrid, TCHB.213 was significantly better in fibre length, Micronaire value and bundle tenacity at both the gauge lengths as compared to the *intra-hirsutum* hybrid, Savitha. The interspecific hybrid, TCHB.213 was found to be satisfactorily spinnable at 80s count, while the *intra-hirsutum*, Savitha recorded good CSP value at 60s count.

Miscellaneous Trial : A good number of trials having different objectives were conducted at Aduthurai, Coimbatore, Dharwad, Guntur, Mudhol, Nandyal and Raichur. The details of the trials and test results are as given below :

With a view to developing an early maturing cotton variety superior to MCU.7, a promising strain. TADH.8656 was tried under rice fallows and summer conditions in the Main Strain Trial at Tamil Nadu Rice Research Institute, Aduthurai. It was noted that the control variety, MCU.7 was significantly superior to the new strain, TADH.8656 in respect of fibre length, Micronaire value, maturity and bundle tenacity at 3.2 mm gauge length. In the case of spinning performance, the control MCU.7 recorded satisfactory CSP value at 40s count, while the new strain TADH.8656 was found to be suitable for 30s count.

Two sets of twenty samples each of *G. hirsutum* culture one for medium staple and the other for long staple, were received from Coimbatore. It was observed that the medium staple group of cottons had fibre length covering medium and long staple categories, while the long staple group of cotton was covered by superior long and extra-long staple categories. It was also observed that as many as thirteen cultures from the set of medium staple, viz. glx.221, Jgl × SRT.LB.2 RKR × D1.134, EK.157-131, 610(LGL × 22), LMJ.2347, LRK × D1.134, LRK × D1 — 7553, Jgl (M.5 × 610).151, 610(M.5 × 610).26, R.K × LRA.141, L(L × IC.384).62, LRA.5166 and Kanchana fared well in spinning performance at 40s count, while as many as fourteen cultures from the set of long staple, viz. HLS.72, HLS.83, HLS.88, HLS.39, HLS.98-5, MCU.5 WT, Z-2-2-1, HLS.50-2, LMJ.31311, M.5 × 2-2-102-4, M.S. × 2-2-102-5, H.5 × 2-2-104-1 and M.5 × 2-2-104-3 recorded good yarn strength at 60s count.

A Multiple Pest Resistant Trial of *G. hirsutum* was conducted under rainfed conditions at Dharwad and two sets of twenty samples each were received for the protected and the unprotected conditions, separately. It was observed that only two strains under the protected conditions, viz. LK.861 and JK.276-4, fared well in spinning performance at 50s count, while as many as fourteen strains under the unprotected conditions, viz. JK.259-7, JK.345-3-2, K.260-2, JK.276-10-5, JK.276-10-1, JK.345-1-2, JK.345-3-3, LK.861, LRA.5166, Laxmi, JK.276-4, TCH.1002, TCH.1003 and JK.119 recorded satisfactory CSP values at 50s count.

Another set of five samples under a Miscellaneous Trial was received from Dharwad. Only three cottons, viz. Sharada, Abadhita and Laxmi fared well in spinning performance at 30s count.

A set of three samples of long staple of American *G. hirsutum* raised under rainfed conditions was received from Guntur. It was noted that the control, MCU.5 was significantly better in fibre length, fineness and bundle tenacity at both the gauge lengths as compared to the new strain L.389, while it was *on par* with LK.861 in fineness, maturity and bundle tenacity at both the gauge lengths. In the case of spinning performance, the CSP values of MCU.5 were *on par* with LK.861 at both the counts, viz. 50s and 60s and both these cottons were satisfactorily spinnable at 60s count, while L.389 recorded good CSP value at 40s count.

Under the scheme Improvement of Gaorani Cotton by evolving early maturing cotton varieties better in yield and quality for the Gaorani tract under rainfed conditions of Andhra Pradesh, two *G. arboreum* strains, alongwith the control, Saraswathi were received from Mudhol. It was observed that the control, Saraswathi was significantly better than the other two new strains, viz. 1867 and 1875 in respect of fibre length, Micronaire value and bundle tenacity at 3.2 mm gauge length. In the case of spinning performance, the control variety, Saraswathi recorded better CSP value at 30s count as compared to that at 20s count of 1867 and at 16s count of 1875.

With a view to evolving high yielding short duration American *G. hirsutum* varieties with tolerance to pest and diseases, two strains, viz. NA.1325 and NA.1290 alongwith the control, Priya (NA.920) were raised under rainfed conditions at Nandyal. The control variety, Priya recorded superior CSP values to those of the new strain, NA.1325 at 30s and 40s counts, while the strain, NA.1290 was superior to the control. Priya in CSP values at these two counts (30s and 40s). It was also noted that the strain, NA.1290 alongwith the control was found to be suitable for spinning at 40s count, while the other strain, NA.1325 recorded encouraging CSP values at 30s count.

In order to evolve high yielding early maturing medium staple *desi* cotton varieties for cultivation under rainfed conditions in Mungari area of scarce rainfall zone of Rayalseema, two *G. arboreum* strains, 2708 and 2631 alongwith the control, Saraswathi were tried under rainfed conditions at Nandyal. It was observed that the CSP values recorded by the control variety, Srisailam were better than those recorded by the two new strains, 2708 and 2631 at both the counts, viz. 16s and 20s. However, the strain, 2631 alongwith the control Srisailam, was found to be suitable for spinning 16s count.

A set of fourteen samples of *G. hirsutum* raised at Raichur under a Multilocation Trial, was received. As many as five strains, viz. CPD.8-1-LL, K.276-4, LRA.5166, Laxmi and MCU.5 fared well at 40s count.

Mill Test

The new strains which are promising in yield and technological performance after being subjected to full spinning test for two to three seasons successively, are tested under mill conditions before these are released for large scale cultivation. CIRCOT arranges mill test on new promising strains in co-operation with some of the textile mills in the country.

During the period, mill tests were arranged for samples received from Jalgaon and Khandwa and the test results are compiled in Table 6.

It may be seen from the Table that the new strain, JLH.168 recorded CSP values *on par* with those of the control variety, SRT.1 at the mill as well as at the Institute at both the carded counts of 30s and 40s. The improved strain recorded good spinning performance at 30s count at the mill and at the Institute. The yarn properties, viz. evenness, imperfections and appearance of JLH.168 were better than those of the control, SRT.1 at the mill and at the Institute.

The new strain, 79.BH.5-3 raised under

TABLE 6 : COMPARATIVE SPINNING TEST RESULTS AT MILL AND AT CIRCOT FOR THE YEAR 1991-92

Location	Variety	Mill Test				Institute Test			
		Count (Ne)	Strength (lb)	CSP	Twist Multiplier	Count (Ne)	Strength (lb)	CSP	Twist Multiplier
Jalgaon	JLH.168	30s	79.3	2320	4.5	30s	83.4	2373	4.0
		40s	51.4	2021	4.9	40s	55.2	2172	4.0
	SRT.1(C)	30s	75.6	2315	4.5	30s	77.7	2316	4.0
		40s	50.2	1981	4.9	40s	50.7	2012	4.0
Khandwa	79.BH.5-3	30s	79.7	2394	4.2	30s	80.9	2451	4.0
		40s	54.7	2187	4.7	40s	56.8	2240	4.0
	Vikram(C)	30s	81.2	2435	4.2	30s	86.0	2649	4.0
		40s	57.4	2296	4.7	40s	56.7	2284	4.0

C — Control Variety

rainfed conditions was received from Khandwa alongwith the local control variety, Vikaram. In spinning performance, the control, Vikram was superior to the new strain, 79.BH.5-3 with respect to values at both the counts, viz. 30s and 40s at the mill as well as at the Institute. Both these cottons recorded encouraging yarn strength at 40s count at the mill and at the Institute.

Promising strains/hybrids :

The following strains and hybrids have shown promising technological performance.

State	*Promising strains/hybrids*
Punjab	F.846, F.1054, LH.1446, PCHH.13, PCHH.31, LD.484 and FHH.5
Haryana	HS.145, HS.164, DS.29, HHH.81 and HHH.121
Rajasthan	Raj.HH.14 and RS.875
Uttar Pradesh	CSA.9-10
New Delhi	Pusa 2-95 and Pusa Hyb.5
Gujarat	G(T).538, G.4406, LRK.516, GHH.662 and G(T).HH.15
Maharashtra	CNH.36, JLH.168, AKH.8649, PA.85-160, PHA.46, NHH.302, WHH.90, WHH.224, PHH.231 and MDCH.201
Madhya Pradesh	79.BH.5-3, JKHy.2, KWA.3, UA(90).1 and UA(90).2
Andhra Pradesh	LK.861, L.389, NA.1290, NA.1325, NHH.39, APN.HB.116, 1867 and 1875
Karnataka	TKH.497, TKH.650
Tamil Nadu	HLS.321729, HLS.72, HLS.88, LRK.516, TCHB.223, HB.226

Varieties/hybrids recommended for release

LRK.516 :

This is a medium staple cotton strain having spinning potential of 40s count. This is a short duration (145 days) and compact plant type variety suitable for spacings of 60 cm × 10 cm and with superior yield as compared to the local as well as common checks. This variety was released for areas in Maharashtra, Gujarat and South Rajasthan where wheat is grown.

(b) Tests on Standard and Trade Varieties of Indian Cottons

(i) Standard Indian Cottons : To assess seasonal fluctuations in the characteristics of Indian cottons and to gauge comparative superiority of the newly evolved strains, a number of selected varieties of Indian cottons called Standard Indian Cottons are tested every year. These varieties are grown in Government farms and cotton research stations under the supervision of Senior Cotton Scientists of Agricultural Universities, every year under identical conditions. Extensive fibre and spinning tests are regularly being done on such samples and the test results are published as Technological Circulars for information of cotton breeders and other research workers as early in the season as possible. During 1991-92, 18 such circulars were issued.

(ii) Trade Varieties of Indian Cottons : Lint samples of fair average quality of the major Trade Varieties of Indian Cottons are being obtained for each season through East India Cotton Association, Bombay. Representative *Kapas* samples of these varieties are also procurred from the State Departments of Agriculture for determination of ginning percentage. The fibre and the spinning test results, ginning percentage and other test results on each variety of cotton are being published as Technological Circulars as early in the season as possible for information to cotton trade and industry. Information on such Circulars issued during 1991-92 on 28 Indian Cottons is given in Chapter 3.

(c) Research work on Agricultural and Technological Aspects Relevant to Cotton Improvement Work

Technological Evaluation of Germ Plasm Material

During 1991-92, about 650 Germ plasm samples belonging to *G. hirsutum* collected from CICR, Nagpur, were technologically evaluated for the purpose of documentation. The samples Si-series were of Sirsa, Haryana and S_4-Series were from Surat, Gujarat origin.

The overall range of values for the 650 samples tested varied from 18.1 mm to 31.3 mm for 2.5% span length, from 2.5 — 5.0 for Micronaire fineness and from 15.9 to 28.5 g/t for strength at 3 mm gauge length. Most of the cultivars had Micronaire values below 3.0. Similarly, tenacity at 3 mm gauge length was low for the most of lea cultivars.

Samples received from Nagpur under different accession numbers were of medium staple; 2.5% span length ranging from 22.0 mm to 28.6 mm, Micronaire value from 2.6 to 5.0 and tenacity from 17.4 to 27.0 g/t. Cultivar No. 2132(29.1 mm), 2155, 1690 and 2156 (28.6 mm), 2160 and 2173(28.2mm) and 2135, 2138, 2143 and 2173 (27.0) only

had more than 27.0 mm span length. Accn. No. 1348(5.0) and 1331 (4.7) were coarse. Only No. 2155(27.0 g/t) and 2160 and 2167 had tenacity more than 26.0 g/t.

In IC-series, 2.5% span length ranged from 18.1 mm (IC.777) to 29.1 mm (IC. 140-CC), Micronaire value from 2.5 (IC.951 and IC.979) to 4.8 (IC.1547) and tenacity from 15.9 (IC.777) to 28.5 g/t (IC.1892).

IC.777 was short stapled (18.1 mm) with very low Micronaire value (2.6) and very low tenacity (15.9 g/t).

In AK-series, the range of values was from 26.1 mm to 30.4 mm for span length; the Micronaire value was from 2.7 to 4.8 and the tenacity was from 20.9-26.1 g/t. AK.183 recorded 30.4 mm span length, 2.7 Micronaire value and 25.6 g/t tenacity at 3 mm gauge length, whereas AK.163 recorded 29.7 mm, 2.5% span length with 3.0 Micronaire value and 25.8 g/t strength at 3 mm gauge length. AK.55 had 29.4 mm, 2.5% span length, 3.5 Micronaire value and 26.1 g/t tenacity at 3 mm gauge length.

In respect of Si-series, span length varied between 21.3 mm to 27.4 mm, Micronaire value between 2.6 to 4.8 and tenacity between 17.4 to 20.7 g/t, showing very low tenacity at 3 mm gauge length.

In S4 series. 2.5% span length ranged from 21.5 mm to 31.5 mm (S4-26), Micronaire value from 2.5 to 4.8 and tenacity from 16.5 to 26.3 g/t. A few cultivars, S4-26, S4-144, S4-99, S4-232, S4-125, S4-20, S4-239 and S4-137 had span length more than 28.0 mm. A few of them had Micronaire value more than 4.5.

S4-26(31.3 mm 2.5% S.L., 3.4 Micronaire value, 19.2 g/t S4-99 (30.1 mm 2.5 S.L., 3.0 Micronaire value, 18.0 g/t), S4-144 (31.1 mm 2.5% S.L., 3.9 Micronaire value, 19.0 g/t), S4-125 (29.5 mm 2.5% S.L., 3.5 Micronaire value, 21.0 g/t) though had long staple, locked in tenacity.

Assessment of Fibre Quality Parameters by HVI and their Influence on Spinnability of Cotton

In order to arrive at the regression equations for predicting the spinnable count from HVI data, 35 cotton samples widely varying in fibre properties were selected. Each cotton was spun to four different counts ranging from 20s to 100s. The optimum count was related with respective FQI. The following regression equations were arrived at based on high correlation (0.82) obtained between FQI and count. Optimum Count = 0.638 FQI — 12.07.

Inheritance of fibre length in G. hirsutum cottons

The study was conducted on crossings carried out between ten parental lines enumerated below by line and tester method.

Lines (Female parents) in long staple group	*Testers (male parents) in medium staple group*
P1 : Gujarat 67	P5 : FP.332
P2 : Deviraj	P6 : SA.540
P3 . G.Cot.100	P7 : A-51-D
P4 : MCU.5	P8 : F.414
	P9 : Sharada
	P10 : STC.2

The lint samples for 10 parents, 24 crossings of F1 material and 24 crossings of F2 material were tested for their fibre length.

The variance due to crosses were significant for fibre length in both F1 and F2 generations. The variance due to parents, Parents vs. crosses and lines vs. crosses were also found to be significant in both the generations. The lines differed significantly among themselves for fibre length in F2 generation only, indicating considerable diversity among the female parents in F2 generation. But the variance due to testers were non-significant suggesting uniformity among themselves for the character studied. The magnitude of variance for general combining ability (gca) due to lines was larger than due to testers in F1 generations.

The magnitude of specific combining ability variance (sca) was larger than that of general combining ability variances (gca) for fibre length. This suggested the possibility of capitalising on non-additive gene effects for the fibre length which was also supported by Salam and Khan (1968), Patil and Mensinkai (1971), Singh and Chahal (1974), Chahal and Singh (1975) and Singh. Bhardwaj and Dhillon (1976).

In F1 generation none of the lines recorded significant gca effects.

Among the testers, P5 and P6 were found to be good general combiners. These parents can be utilized in crossing programmes to develop good fibre length.

A comparison of the parental and F1 means showed that the mean values of the majority of the hybrids lie in between their parents indicating positive heterosis. Out of 24 hybrids, sixteen showed positive heterosis. The fibre length was maximum for the cross MCU.5 × A.51-D followed by MCU.5 × F.414, Deviraj × A.51-D and G.Cot 100 × SA.540. The extent of heterosis ranged from 16.2% (MCU.5 × A.51-D) to −8.1% (Gujarat 67 × STC.2). The extent of heterobeltiosis ranged from 9.4% (MCU.5 XA.51-D) to −18.2% (Gujarat 67 × STC.2)

The genetic parameters are yet to be evaluated.

Effect of Exposure to Weather Conditions on the Quality of Fibre in Matured Cotton Bolls

The experiment consisted of two parts.

1. Effect of exposure of cotton on the Plant to sunlight

Varieties	*Pickings*
1) G.Cot.10	P1 : One Week
2) G.Cot.10	P2 : Two Weeks
3) G.Cot Hyb.6	P3 : Three Weeks
4) G.Cot Hyb.9	P4 : Four Weeks

During the year, colour tests of the cotton "Rd" and "b" were done for the samples of 1990-91 season. The mean values of the fibre characteristics and colour values are presented over leaf.

Both the colour values had given significant differences between the pickings when cotton was exposed to sunlight on the plant. The extent of deterioration was more or less the same in all the cottons. Other fibre parameters were not influenced by exposure to sunlight.

About 350 "just opened" bolls were tagged for each variety. The collection of the bolls were done on similar lines as those of earlier

Variety	Picking	2.5% S.L.	M.V.	Tenacity 3 mm	Mature fibre %	Colour Rd.	Colour b
1	2	3	4	5	6	7	8
G. Cot. 10	P1	25.0	3.7	23.4	68	74.0	9.9
,,	P2	26.1	3.8	23.4	80	72.0	9.6
,,	P3	26.6	3.7	24.0	76	68.6	8.8
,,	P4	26.6	3.7	23.4	69	67.2	8.8
G. Cot. 11	P1	25.7	5.3	26.2	79	72.8	9.1
,,	P2	25.2	5.5	22.4	84	70.0	8.6
,,	P3	25.0	5.2	22.8	86	68.6	8.3
,,	P4	24.6	4.7	24.1	74	67.1	7.8
Hyb. 6	P1	29.0	3.2	30.4	62	75.5	9.8
,,	P2	29.0	3.5	30.0	70	74.8	9.4
,,	P3	28.2	3.4	28.4	70	72.8	9.4
,,	P4	28.2	3.6	29.9	74	70.0	8.9
Hybrid 9	P1	30.8	4.6	27.6	88	76.2	9.4
,,	P2	31.6	4.6	27.6	82	75.0	9.2
,,	P3	32.0	5.0	26.5	88	72.7	8.8
,,	P4	30.8	4.8	26.9	86	69.9	8.2
	C.D.	N.S.	NS	N.S.	N.S.	1.96	0.34

season. After ginning, the lint was tested for 2.5% span length, Micronaire value, 3mm gauge strength and mature fibre percentage. The samples were, lateron subjected for colour tests. Analysis of the test results of 1991-92 and testing for convoluations are under progress.

II Effect of exposure of cotton to sunlight after picking

About 1.5 kg seed cotton was collected separately for each variety and exposed to sunlight daily. The lint was tested at three stages keeping an interval of one month between stage.

Varieties	*Stages*
1) G.Cot.10	1) immediately after picking
2) G.Cot.11	2) after one month
3) G.Cot Hyb.6	3) after two months
4) G.Cot Hyb.9	

The test results of 1990-91 season, are presented below :

Variety 1	Stages 2	2.5% S.L. 3	M.V. 4	Tenacity 3 mm 5	Mature fibre % 6	Colour Rd. 7	Colour b 8
G. Cot. 10	S1	25.3	3.8	22.6	74	76.2	10.55
,,	S2	25.5	3.8	22.5	74	76.2	9.7
,,	S3	25.4	3.9	22.9	77	74.9	9.1
G. Cot. 11	S1	25.9	5.7	20.2	86	75.5	8.5
,,	S2	25.4	5.5	20.0	85	77.3	7.9
,,	S3	25.4	5.6	19.0	85	72.0	8.0
Hyb. 6	S1	29.3	3.9	28.4	70	74.4	10.1
,,	S2	30.4	4.0	28.6	72	75.9	9.7
,,	S3	29.6	3.9	27.0	75	76.7	8.7
Hyb. 9	S1	31.7	5.0	28.3	82	80.2	8.2
,,	S2	31.0	4.9	26.0	79	79.0	8.0
,,	S3	31.0	4.9	25.7	83	78.0	7.7
C.D.	NS	NS	NS	NS	NS	NS	1.05

As could be seen from the table above the fibre parameters were not affected by exposure to sunlight. In the case of colour values, the reflectance percentage (Rd) was numerically reduced in all the varieties except G.Cot. Hyb.6. The other colour value "b" was significantly reduced in the later stages of long exposures.

Fibre testing for 1991-92 season is over and the samples are being tested for colour in HVT.

Effect on Fibre Qualities and Yield Levels of Cotton due to Hormone-Biozyme Treatment

To study effect of hormones (growth regulators) and Biozyme treatments on fibre qualities and yield levels of cotton, two hybrids, viz. Eknath (*G. arboreum*-Diploid) and PH.93 (*G. hirsutum* tetraploid) and NHB.12 (Inter species hybrid) were sown on 25th June, 1991 in three replications in R.B.D. at Cotton Research Station, Nanded.

In each replication, there were three sub-plot treatments :

T1 — Control

T2 — Biozyme after 45, 60 and 75 days after sowing.

T3 — a) Cycocil 250 ppm, 60 days after sowing.

b) Additional 20 kg N/ha 10 days after CCC spray

c) Irrigation after additional 'N' application.

d) NAA 20 ppm 3 days after irrigation.

e) GA 10 ppm 7 days after NAA sprayings.

f) Etherol 500 ppm after 1/3 picking of cotton.

The observations for the number of bolls per plant, boll weight, seed index, *kapas* yield and GOT were taken. Replication-wise, 36 lint samples were analysed for detailed fibre quality parameters. From a perusal of the analysed data, it is observed that the treatment T3, i.e. spraying of hormone (growth regulator) defolients and additional 'N' application with irrigation produced significantly higher seed cotton yield over rest of the treatments.

The effect of spraying different hormones (growth regulators) becomes significant if sufficient moisture is available in the soil.

The interaction effect of varieties/hybrids × spraying hormones (growth regulators), defoliants and additional 'N' application with irrigation were significant.

The treatment combination V4 T3, i.e. Eknath with all sprayings of hormone defoliant and addition of 'N' with irrigation produced the highest seed cotton yield (1594 kg/ha) with almost identical technological performance.

Spraying of hormone (T3) was found to be beneficial for getting better yield attributes with similar technological performance.

Collaborative work at Regional units :

1. **Akola :**

(i) For a study on *The effect of Defoliants on yield and Quality of Cotton, AHH.468* the treatments given were as follows : D1 — Control (water spray); D2 — Ethephon 39% (2500 ppm), D3 — Ethephon 39% (5000 ppm), D4 — NaCl 10%, D5 — NaCl 20%. The spraying was done at three stages, viz. (a) at 25% boll bursting (S1) (b) at 50% boll bursting (S2) and at 75% boll bursting (S3). It was observed on analysis of the data that the effect is non-significant.

(ii) Another study was on *The effect of Micronutrient Formulation on Yield and Quality of Rainfed Cotton AHH.468.* These experiments which insisted of eight treatments with different number of sprays, exhibited no effect in respect of micronutrient formulation either on yield or on quality of fibres.

(iii) Yet another investigation was to assess *The influence of Different Picking Intervals on Quality of Cotton.* The study which was conducted with 18 varieties belonging to desi American cottons and hybrids at three different picking intervals, revealed that the quality parameters were unaffected by picking intervals.

(iv) *Effect of Different Form of Fertilisers on Quality and Yield of AHH.*468 *cotton* was another experiment taken-up and the inference in this study has been that the fibre quality did not differ due to treatments.

2. **Coimbatore :**

For a study on *The effect of Pyrethroids on Fibre Quality of LRA.5166,*

various pyrethroids were tried. The highest FQI and lowest boll damage coupled with highest whiteness index was recorded by cypermethrin. Cypermethrin and Fenvalerate were found to be better for the control of boll worms and to maintain optimum fibre quality parameters for the variety LRA.5166.

3. **Dharwad :**

An investigation on *The effect of Sowing Dates and Fertiliser Levels on Fibre Properties of Sharada Cotton* was taken up and it was found that early sowing upto second fortnight of June has beneficial effect on boll yield and fibre quality. Another investigation taken up was regarding *Increasing the Plant Density of Rainfed Cotton using two Genotypes, JK 410 and JK.416* and these varieties did not show much response either to population or for higher NPK levels.

4. **Guntur :**

Two investigations (i) *Effect of Nitrogen and Phosphorous on Fibre Quality of Cotton,* and (ii) *The effect of spacing and Number of Plants per Hill on Yield and Fibre Quality of Cotton Hybrids* were completed during the reporting period.

5. **Hissar :**

In an investigation on the *Response of N and K and their Effect on Fibre Quality of Cotton Variety, H.777,* three levels of N(0,60, and 120 kg/ha) and four levels of K(0,30,60, and 90 kg/ha) were used in trials and on statistical analysis of the data. it was observed that the effect of N and K was non-significant.

In another study on the *Relative Efficiency of the Sources of Sulphur and Its Effect on the Fibre Quality of the Variety, H.777,* three levels of Sulphur (0,12.5 and 2.50 kg/ha) and two sources of Sulphur applications (SSP and Gypsum) were tried with basal application of recommended dose of N,P and Zn. It was found that sulphur had no effect on 2.5% span length, whereas Micronaire value, Maturity and Tenacity showed increase with increase in Sulphur levels and a sources of Sulphur application.

Use of pheromone for the control of pink boll worm was tried in the form of impregnated beads and their effect of fibre quality of H.777. There were 8 treatments in three replications including control. The results indicated that use of pheromone alone is not sufficient for effective pest control, but when used in combination with other recommended insecticides, the results are quite promising in controlling pink boll worm, with no apparent adverse effect on the fibre quality parameters.

6. **Ludhiana :**

Effect of Different Dates of Picking on Fibre Quality in Hybrid Cottons was studied and it was observed that fibre quality in second picking was comparatively superior.

7. **Nagpur :**

A study on the *Effect of Picking on Fibre Characteristics of Different*

Cottons Cultivated under Rainfed Conditions in Nagpur Region revealed that while the 2.5% span length was high for first picking than the second picking, the third picking had very low 2.5% span length. There was no consistancy about other quality characteristic values.

8. **Rahuri :**

Effect of Defoliants on Yield and Quality of KOP.498 *Variety* was studied using two defoliants Ethrel and Dropp and it was observed that both the defoliants, when sprayed at the stage of 40% boll bursting not only hastened the maturity but also gave significantly high yield, with no adverse effect on the quality of fibres.

THRUST AREA II : POST HARVEST TECHNOLOGY OF COTTON

This thrust area encompasses precleaning and ginning of *Kapas* and further mechanical processing of ginned lint into yarns. Full realisation of the quality of cotton produced by the farmer can be achieved only through proper post harvest operations and thus, it has a direct bearing on the income of the agricultural community. Several research investigations with various objectives have been taken-up/continued during the reporting period and a brief account of each of those investigations is summarised below.

Survey of Conditions of Ginning Factories in Andhra Pradesh

A list of ginning and pressing factories from all the cotton growing area of Andhra Pradesh was collected. In all, there are 70 pressing factories in the state.

Even though several attempts were made to get the questionnaires distributed to ginning factories and collect them back duly filled up through the Director of Industries, Hyderabad or the Ginning Factory Association at Guntur, the whole endeavour remained unsuccessful. It was, therefore, decided that personal visits would be made by the investigator/s to each of the factories, district-wise and collect all the relevant data by on-the-spot filling up of questionnaire. Accordingly, 77 questionnaires, 45 from factories in Adilabad district and 32 from factories of Bhainsa district which are closer to Maharashtra border, were got filled up, so far.

Strength of Attachment Between Cotton Fibre and Seed : Tests have been carried out on 18 varieties of cotton to determine the ballistic work necessary for separating fibres from the seed. The method of measurement standardised last year in respect of the Shirley Attachment Strength Tester has been used to arrive at (i) the average energy (E/n) required to pull out a single fibre from the seed and (ii) the energy required to extract unit mass of lint. Since the energy requirement is location-specific, separate determinations have been made for the micropylar, side and chalazal regions of the seed surface in respect of E/n.

The procedure adopted for the work is such that all the fibres on a given seed are pulled out in five bunches — two from the micropylar regions, two from the side regions and one from the chalazal end. The ballistic energy required to separate each bunch is determined by shirley instrument. Knowing the weight of fibres in the bunch and the average fineness and mean length of the variety, it is possible to calculate the energy required to separate a single fibre as well as the energy for extracting 1kg of lint.

Table 7 gives the results of energy measurement on 18 varieties of cotton, so far tested. The following are some of the salient features of the data :

(i) In all varieties, the energy required to extract a fibre from the micropylar region is the highest. In some varieties, the side region fibres have the second place while in others the chalazal region assumes the second place in respect of attachment energy.

(ii) The CV (%) among 12 seeds tested from each variety is very high in the case of data for micropylar side and chalazal regions, but the mean energy per fibre shows very low CV (%) values justifying the procedure of testing all the fibres on a given seed.

(iii) Energy (Mean E/n) required to extract a single fibre and the energy needed for removing unit mass of lint need not always show correspondence inasmuch as the latter would depend on fibre length and fineness, as well.

(iv) Fibre extraction from seed seems to require very little effort in varieties belonging to *G. barbadense* and *G. arboreum* species.

TABLE 7 : RESULTS OF TEST FOR BALLISTIC WORK REQUIRED TO EXTRACT FIBRES FROM COTTON SEED

Sl. No.	Variety	Species	Mean E/n (erg)	E/n for different regions (erg) M	S	C	Mean E/n (J/kg)
1.	Suvin	G. barbadense	34(23)	55(30)	24(31)	28(76)	1076(22)
2.	Sujay	G. herbaceum	49(13)	59(28)	47(29)	38(30)	1254(14)
3.	Jayadhar	G. herbaceum	55(14)	69(21)	55(17)	43(18)	1338(14)
4.	Varalaxmi	G. hirsutum x G. barbadense	61(32)	81(40)	55(43)	46(46)	1782(32)
5.	TNB.1		64(24)	73(37)	59(35)	66(30)	1520(25)
6.	Hybrid 6	G. hirsutum	70(20)	76(27)	73(50)	69(20)	2140(14)
7.	Y.1	G. arboreum	75(15)	93(20)	57(23)	68(41)	1592(14)
8.	Khandwa 3	G. hirsutum	76(20)	106(32)	69(28)	58(24)	1968(17)
9.	SRT.1	G. hirsutum	77(17)	99(30)	77(27)	58(20)	1901(16)
10.	LRA.5166	G. hirsutum	81(17)	132(24)	65(32)	62(38)	2002(12)
11.	Deviraj	G. hirsutum	82(9)	110(29)	71(42)	78(39)	2227(10)
12.	AKH.5	G. arboreum	83(13)	98(40)	79(26)	72(44)	1802(11)
13.	Laxmi	G. hirsutum	89(14)	94(32)	85(30)	95(42)	2466(14)
14.	DHY.286	Hybrid	93(18)	125(37)	86(26)	70(22)	2377(19)
15.	Hybrid 4	G. hirsutum	95(26)	127(37)	88(34)	80(21)	2082(25)
16.	Virnar	G. arboreum	102(15)	132(40)	89(29)	98(39)	1985(16)
17.	MCU.5	G. hirsutum	105(24)	140(40)	85(37)	98(27)	2777(23)
18.	G.12	G. arboreum	106(12)	98(22)	101(33)	101(33)	2738(11)

M : Micropylar Region
S : Side Region
C : Chalazal Region

Incidence of Seed-Coat Fragments in Ginned Cotton

It was mentioned earlier that about 7 samples of cotton were already investigated for this purpose. During the period, another 25 samples of cotton were taken up for study. All these samples were hand cleaned to remove trash particles and about 100 g of each sample was ginned by using the laboratory model gin. From the lint lot, three samples, each weighing 3-4 gms, were separated and the seed coat fragments were carefully counted. Later on, the fragments were weighed in a sensitive balance to the nearest milligramme.

An estimation of the seed coat fragments is attempted from the external parameters of the cotton seeds such as average seed weight, seed coat surface area and the weight of seed coat fragments assuming that the average area of the seed coat attached to the fibres of the fragments is 1 sq.mm. The number of seed coat fragments per gram of the lint were extrapolated from the calculations.

The results pertaining to the 32 samples of cotton are presented in Table 8. The results show that cottons belonging to *G. arboreum*, *G. herbaceum* and *G. barbadense* species gave relatively fewer number of seed coat fragments. Hirsutums showed wide variation in fragment weight ranging from 0.07% to 3.33%. A statistical analysis for correlating the calculated and observed number of seed coat fragments gave an r value of 0.96 indicating a high degree of agreement. This method, it is hoped, will be of use for estimating the number of seed coat fragments by the conventional weighing methods.

TABLE 8 : RELATION BETWEEN OBSERVED AND CALCULATED SEED-COAT FRAGMENTS

Variety/ Hybrid	Wt. of SCF as a percentage of Lint (N_f)	Observed No. of SCF (N_o)	Calculated No. of SCF (N)
G. Arboreum			
1. AK.235	0.56	11.1	7.73
2. AKH.5	0.21	2.1	3.58
3. Maljari	0.73	13.1	14.44
4. Virnar	0.28	9.7	6.20
G. Barbadense			
5. Suvin	0.77	8.2	16.92
6. TNB.1	0.55	10.1	13.61
G. Herbaceum			
7. Digvijay	0.34	6.2	6.16
8. Jayadhar	0.11	3.0	2.81
9. Sujay	0.47	13.5	8.89
10. Suyodhar	0.14	2.5	3.75
11. Wagad	1.47	20.0	22.71
G. Hirsutum			
12. Abadhitha	1.02	17.0	12.03
13. Deviraj	0.18	3.3	3.56
14. DHY.286	3.30	45.8	55.36
15. F.414	0.88	11.1	14.05
16. Gujarat 67	0.41	9.7	8.44
17. G.Cot. 10	2.44	28.1	32.14
18. H.777	1.30	31.1	29.98
19. Khandwa 2	0.58	9.1	9.66
20. Khandwa 3	0.33	4.3	6.53
21. Laxmi	1.13	23.0	29.39
22. LRA.5166	1.44	24.1	28.69
23. MCU.5	0.65	11.5	12.41
24. MCU.7	0.07	0.5	1.43
25. Sharada	3.33	45.8	57.81
26. SRT.1	0.77	9.7	14.50
27. Vikram	0.30	6.7	6.51
Hybrids			
28. DCH.32	1.84	20.5	34.28
29. HY.6	1.05	23.7	19.66
30. HY.4	1.63	22.8	30.96
31. JKHY.1	1.03	16.3	18.83
32. Varalaxmi	0.16	2.0	3.31

Suitability of Hybrid cotton TCHB.213 for Blending with Polyester Fibre

Suvin cotton and the interspecific hybrid TCHB.213 were blended with 1.2D × 38 mm polyester in the ratios 20:80 and 40:60 and processed on the SMS Microspinning unit at Coimbatore to obtain 80s count of yarn. The CSP values for pure Suvin cottons were superior to that of TCHB.213. However, in blends of 20:80 cotton:polyester, the differences between Suvin and TCHB.213 tended to be narrowed down; both recorded CSP values *on par*. The 40:60 Suvin: polyester blend recorded higher CSP than the corresponding hybrid. polyester blend due to inherent superiority of Suvin cotton. Both Suvin and TCHB.213, recorded minimum number of neps for 40:60 blend.

Anatomy of Yarn Faults, Their Source of Occurrence and Mechanism of Formation

During this period, 4,000 samples of yarn faults belonging to A1 to D4 classes were segregated from 40s carded and 40s combed export yarns and were analysed physically according to the three broad sources of occurence as mentioned in the earlier report. Besides, measurements of length and diameter of faults according to sources in various classes were carried out. Work was also carried out to find out the effect of reduced fault-levels in yarn on the quality of single-jersey fabrics. The fabric samples were knitted from yarns produced during combing experiments on noil-extraction, as reported earlier.

Analysis of 40s combed export yarns revealed that about 58% faults are fly-originating, about 21% trash-originating and another 19% are of purely spinning origin. The implication of this finding is that measures are to be taken during spinning so as to avoid generation of fly as well as purely spinning faults in order to maintain high quality standard in export-yarns.

In the combing experiment, an improved relationship between the frequency of faults and the combined effect of uniformity ratio and trash content has been established. This will be verified with a large number of samples.

Appearance of grey knitted single-jersey fabrics continues to improve with increase in the noil extraction beyond the optimum level of 14% for the cotton under study at which different yarn properties, such as strength, elongation. U% and resultant yarn quality index optimised. This is largely because of continued reduction in A-and B-type of faults.

Yarn Tension Behaviour in Rotor Spinning and its Relation to Yarn Characteristics

During the reporting period, slivers of polyester and Suvin cotton were used for production of yarns by rotor spinning. Tension measurements were carried out during yarn formation with varying rotor speeds and twist-multipliers. Evaluation of recorded tension charts for different experimental combinations are in progress. Besides, a few samples were tested for dynamic modulus

Yarn Bundle Strength Test : Redesigning Improvement of Bundle Making and Clamping Devices

Modifications are being done in the fabricated apparatus for preparing parallelised yarn bundles and in the jaw attatch-

ments to the lea tester for testing parallelised yarn bundles.

Mechanical Properties and wear Comfort of Apparel Fabrics and their Inter-Relationships

The current year's work comprised preparation/procurement of fabrics and measurement of some of their physical properties. In all, 48 fabrics have been made ready for the measurements. These include pure cotton fabrics as well as polyester-cotton and polyester-viscose blends. While the list of measurements to be made on these fabrics is long, the current year's work was limited to those of fabric weight, drapeability and bending stiffness.

Some fabrics for this work were selected from the range manufactured by Century Mills in Bombay. They varied in yarn count as well as in the density of ends and picks. There were also fabrics of plain weave and twill weave in the selected range. Choice was made in such a manner that for a given type of weave, the yarn count and ends/picks could be independently varied. As a result, the fibre weight covered a wide range from 40g/m² to 220g/m² in the case of fourteen cotton fabrics in the first set. Another set of sixteen fabrics received from Century Mills had a particular 20s cotton yarn, as warp. The weft yarn, also 20s, was spun from cottons of different levels of fibre fineness. This set had nearly constant fabric weight and density of ends and picks. Thus, the only variable was the fineness of cotton in the weft yarn.

A third set of fabrics procured for the project work was specially woven at Man-Made Textile Research Association (MANTRA), Surat. These fabrics were 100% polyester, polyester-cotton and polyester-viscose blends. These three types of fabric which together numbered 18 had 80 d, 36 filament polyester yarn as warp. The 100% polyester fabrics in this set were prepared with filaments of different deniers and pick densities in the weft. The blended fabrics in this set had polyester-viscose or polyester-cotton yarns of different pick densities in the weft. The fabric weight ranged from 56 g/m² to 70 g/m² in the case of 100% polyester fabrics, from 66 g/m² to 122 g/m² for polyester-cotton and from 95 g/m² to 120 g/m² for polyester-viscose fabrics.

As noted earlier, fabric drape, bending stiffness and fabric weight have been measured so far on these 48 fabric samples. The BTRA Drapemeter was used for drape measurement. The recommended procedure for the use of this instrument involves ammonia printing of fabric shadow, cutting of paper along the shadow profile, weighing the paper, etc. which are time consuming and inconvenient. Instead, the shadow cast by the fabric was marked with pencil on a sheet of paper and the area was measured by an electronic planimeter. The new procedure is found to be convenient, neat and more accurate. Two fabric specimens were tested from each sample. Fabric weight per unit area was determined by weighing the circular fabric pieces cut for drape measurement.

For measurement of fabric stiffness, an Indian instrument similar to the well-known British instrument the Shirley Stiffness Tester, was used. Fabric stiffness expressed as the "bending length" was determined on four specimens from each fabric (2 along warp and 2 along weft).

The results in respect of the tests so far made are not amenable to any serious analysis as yet. However, it has been possible to ascertain that draping quality and fabric stiffness go hand in hand. The former represented by the "drape coefficient" ranged from about 27% to 80%, while fabric stiffness expressed as the "bending length" ranged between 2.5 cm and 4.7 cm for the 48 fabrics. The correlation coefficient between the two quantities is found to be as high as 0.94.

THRUST AREA III : STRUCTURE, PROPERTY AND THEIR INTER-RELATIONSHIPS IN TEXTILE MATERIALS

The morphological and fine structural parameters collectively determine the physical and mechanical properties of the fibre as well as of the yarn and the fabrics produced from them. Further manufacturing processes and the resultant layout of fibres in the yarn and of the yarn in the fabric. The advent of newer cotton varieties and modern processing technologies have brought to fore, a wide range of combinations of fibre quality, yarn geometry and fibre design. A true understanding of structure-property relationship is essential for developing varieties suitable for various specific uses and also for determining the process sequences for the manufacture of end-products having different applications. Several research investigations are under way in this thrust area, a brief summary of which is given below :

Physical, Structural and Biochemical Studies on Cotton Fibres During Boll Development

During the period under report, bolls of G.Cot.10, collected on every alternate day from 18 days postanthesis from flowers tagged on the same day, were subjected to physical, structural, chemical and biochemical investigations. It was observed that there are three distinct phases in the secondary cell wall development. In the first phase of growth, the crystallinity measured by both x-ray and infrared methods increased with increase in age of the boll. In the second phase comprising about a week, the crystallinity decreased with increasing age. In the final phase, the crystalline content recorded a further increase with age. Moisture regain values closely followed those of crystallinity. The tenacity of the fibres belonging to the second phase was lower than that of the first phase. On the other hand, the cellulose deposition quantified by measurements of maturity, crystallite orientation, etc. gradually increased with maturation of the boll until a saturation value was reached.

In order to get a further insight into the fibrillar organisation in the secondary cell wall during development, fibres were subjected to enzyme hydrolysis. The degree of polymerisation was also measured on selected samples. The amount of reducing sugar increased and the degree of polymerisation showed a decrease for the corresponding samples belonging to the intermediate phase. All the measurements thus, suggest that the cellulose deposited in this phase had a poorer crystalline and molecular order as compared to those of the other two phases. However, further work on enzyme hydrolysis and degree of polymerisation are required before arriving at the above conclusion. Hence, a fresh set of bolls collected is being subjected to various measurements.

A Study of Morphological Deformities in Cotton Fibres in Relation to Space Constraint in the Developing Boll

Sixteen varieties of cotton covering all the four cultivated species and also *desi* and hirsutum hybrids were chosen for the study. Unopened mature bolls from Athwa Farm, Surat from the crop year 1991-92 were collected for the purpose. Average space constraint for growing fibres in the developing boll for a variety was determined by taking necessary measurements on five unopened bolls as listed below :

(i) Outer volume and mass of the unopened boll,

(ii) Volume and mass of the locules,

(iii) Volume and mass of the seeds, and

(iv) Volume and mass of the fibres before drying.

Volume measurements were carried out using water displacement method and mass determined using a sensitive single pan balance. It has been noted that the bolls from some of the hirsutum and hirsutum hybrids weighed nearly three to four times more than those from among the *desi* cottons and this may have some influence on the 'Space constraint' index. Experimental work, for determination of the index for space constraint for the sixteen above mentioned varieties have been completed.

From the data collected, two measures of space constraints C_1 (ratio of mass of the fibres before drying to the space available in the boll) and C_2 (ratio of volume of the fibres before drying to the space available in the boll) have been worked out. It is observed that these two indices C_1 and C_2 were ranging from 0.459 to 0.887 and from 0.358 to 0.813, respectively among the varieties selected for the study.

Measurement of Frictional Characteristics of Cotton Fibres

The influence of normal load on the frictional behaviour of textile fibres was investigated. According to Amonton's law of friction, the frictional force (F) should increase in proportion with normal load (N) in such a way that the ratio F/N, which is termed as "coefficient of friction" (μ), remains constant. But in the case of textile fibres Amonton's law does not hold good. The coefficient of friction does not remain constant as the normal load increases. On the other hand it decreases as the latter is increased.

Experiments were conducted on polyester, cotton, wool, mulberry silk, viscose and ardil fibres to ascertain the effect of normal load on coefficient of friction. The normal load was increased in sets of 20 g from the dead load 13 g, which is the weight of upper fibre holder, to 113 g. For each load (N) 5 pairs of tufts were tested and the average value of μ determined. Table 9 summarises the results obtained on polyester, cotton and wool which do not exhibit "stick-slip" effect, i.e. their static and dynamic friction coefficients are almost equal. It is clear from the Table 9 that the coefficients of friction decreases as normal load increases. This means that at higher normal loads, less frictional force comes into play as a tuft of fibres slides over another tuft of the same fibre. In other words, it is easy to slide one tuft over another under high normal loads.

TABLE 9: EFFECT OF NORMAL LOAD (N) ON STATIC COEFFICIENT OF FRICTION

Material	Coefficient of friction (μ) at 13 g	at 113 g	% decrease of
S.H.T. polyester 1.2 D	0.71	0.54	24
Cotton Suvin	0.34	0.28	17
Wool USDA 80s count	0.44	0.34	23

The results obtained on mulberry silk, viscose and Ardil are summed up in Table 10. These fibres exhibit "stick-slip" effect since their static coefficient of friction μ are higher than dynamic coefficient of friction μ'. It is observed that both μ and μ' decreased as normal load increased. But the drop is more severe in the case of dynamic coefficient of friction. For instance, in the case of polyester, as load is increased from 13 g to 113 g, μ decreases from 0.86 to 0.73 and μ' from 0.80 to 0.62. With respect to the values at 13 g load, μ decreases 15% and μ 23%, for an increase in load of 100 g. As a result, the difference between μ and μ' expressed in percentage of μ increases from 7% at 13 g to 15% at 113 g. For viscose μ decreases by 7.5% and μ' by 17.5%. The corresponding figures for ardil are 3.8 and 13.7, respectively.

Analysing the relationship between frictional force (F) and normal load (N) it is found that the power law type of expression holds good, i.e. $F = aN^b$, where a and b are constants characteristics of the material. Table 11 gives the expressions for various materials investigated. Though values of constant a is more or less equal in static and dynamic cases, value of b is considerably higher for static friction compared to dynamic friction.

TABLE 11: EQUATIONS LINKING NORMAL LOAD WITH FRICTIONAL FORCE FOR TEXTILE FIBRES

Material	Expression between frictional force (F) and normal load (N) Static	dynamic
Polyester	$F=1.05\ N^{0.86}$	—
Cotton	$F=0.41\ N^{0.92}$	—
Wool	$F=0.65\ N^{0.87}$	—
Mulberry silk	$F=1.03\ N^{0.93}$	$F=1.05\ N^{0.89}$
Viscose	$F=0.74\ N^{0.97}$	$F=0.71\ N^{0.92}$
Ardil	$F=0.56\ N^{0.98}$	$F=0.61\ N^{0.94}$

Some Aspects of Electrical Properties of Cotton Fibres/Yarns

In continuation of the earlier work, the measurement of I.V. characteristics was extended to cotton fabrics and different textile fibres such as acrylic, silk, wool, polyester, viscose, etc. The I.V. characteristics were obtained on single fibres in open condition with and without vacuum. However, current values of the fibres could not be recorded accurately due to limitations of measuring instruments. About 10 cotton samples with different blends were also studied for conductivity. A sandwich type arrangement was made and the current across the width of a fabric recorded.

TABLE 10 : EFFECT OF NORMAL LOAD ON STATIC AND KINETIC COEFFICIENTS OF FRICTION

Material	Static coefficient of friction (μ)		% decrease w.r.t. value	Dynamic coefficient of friction (μ')		% decrease w.r.t. value	Difference between static and dynamic coefficients as % of static value	
	at 13g	at 113g	at 13g	at 13g	at 113g	at 13g	at 13g	at 113g
Mulberry silk 0.9D	0.86	0.73	15	0.80	0.62	23	7	15
Viscose 1.5D	0.67	0.62	7.5	0.57	0.47	17.5	14.5	24.2
Ardil 5D	0.53	0.51	3.8	0.51	0.44	13.5	3.8	13.7

Conductivity through the fabrics was then calculated.

Structure and Properties of Natural Cellulosic Fibres other than Cotton

The cellulosic fibres taken up for study in the current year included pineapple, flax, ramie, jute and arecanut. Evaluation of tensile, physical and morphological properties besides some fine structural characteristics were carried out.

Dry (65% rh) and wet tenacity, extensibility and elastic moduli were determined from the load elongation data and the tex value of individual fibres. The results showed that ramie has the highest tenacity followed by pineapple, flax and jute. Arecanut fibres showed the lowest tenacity ($\simeq$ 12 mN/d tex) and highest extension ($\simeq$ 35%). Both the moduli values were also the lowest for the arecanut fibres.

On wetting the fibres, both tenacity and extension improved in the case of ramie and pineapple while jute and flax showed a decrease in both the parameters. For arecanut fibres wetting had very little effect on tenacity but extension showed a marginal increase. At test lengths higher than that of the ultimate units, breakage mainly occurs by slippage of the cells decided by the bonding between them. However, at test lengths lower than the average single cell length, strength of the units become important, as there is chance that in addition to slippage, the cells themselves may rupture during tensile loading and this should lead to higher tenacity. If this assumption is correct, then even at a given test length, fibres having a longer length for the ultimate units should show higher tenacity. However, eventhough the average single cell length for the fibres followed the order ramie > flax > pineapple > jute > arecanut, flax showed lower tenacity than pineapple because of the poor binding among the units of flax. This is also the reason for the very low wet strength of flax as in water, the slippage becomes more easy because of the poor binding among the units, mostly decided by the extent of retting. Jute too showed lower wet tenacity due to increased slippage on wetting. However the binding material in arecanut seems to be little affected by water and the tenacity does not show any change on wetting. Flax should show higher tenacity on wetting at small test lengths of say, 10 mm or less as the average single cell length is about 30 mm and this aspect is being studied.

Another interesting observation was that the ultimate units of pineapple are the finest, the diameter being only about half of that observed for the single cells of other fibres. Polarised light microscopic observation of the single cells failed to show any reversal although convolutions were observed along the length in some cases.

Birefringence measurement of single cells gave the least value for arecanut fibres (0.02). Ramie and flax showed almost identical values (0.067) while pineapple gave a value of about 0.052. It would appear that the orientation of the molecular chains about the fibre axis is the least for arecanut fibres. Birefringence was found to be highly correlated with tenacity ($r = +0.82$).

Infrared spectroscopic measurements on both technical fibres and single cells have been completed. Results showed variation in amorphity levels for single cells coming from

different types of fibres. Technical fibres always showed poorer crystallinity than that shown by the ultimate units recorded separately. But for variations in the relative intensities of some bands, the spectra of all single cells were identical and resembled that of cotton. Technical fibres showed additional peaks in different regions, the intensities of which depended on the extent of non-cellulosic matter present in the fibres.

Data on torsional rigidity showed that the torque required per unit twist per unit area of cross-section was the least for flax and highest for arecanut. Circularity measurements showed flax to be least circular and arecanut most circular. Cross-sectional photomicrographs of the technical fibres and the single cells have been obtained by the light microscopy. The surface features have been recorded with the scanning electron microscope.

THRUST AREA IV : CHEMICAL PROCESSING AND FINISHING TREATMENTS

Although mechanical processing converts cotton fibres into yarns and fabrics, the end-products have limited utility value, unless they are subjected to chemical processing and finishing treatments to impart desirable properties and aesthetic appeal. The research work on the aspects of processing and finishing taken-up during the year is summarised below.

An Analytical Study of Wax in Indian Cottons

During the period, quantitative as well as qualitative analysis of cotton was carried out on different cotton samples.

Quantitative Analysis : Quantitative estimation of wax was carried out on 54 samples of cotton drawn from the Trade Varieties of the crop season 1990-91. The samples consisted of different varieties of cotton obtained from different locations from all over India and represented all the four botanical species. The details of the cotton samples along with their percentage wax contents are given in Table 12. It is pertinent to point out here that, though the number of samples in each variety may not be adequate enough for a conclusive interpretation, they do throw some light on the pattern of variation of wax content among the different varieties. The wax content of the samples when considered species-wise, showed general variations as given below.

1) *G. hirsutum*	—	0.46% to 0.88%
2) *G. herbaceum*	—	0.53% to 0.76%
3) *G. arboreum*	—	0.22% to 0.75%
4) *G. barbadense*	—	0.50% to 0.68%

Hybrid Varieties

1) Hybrid 4	—	0.47% to 0.83%
2) Hybrid 6	—	0.60% to 1.21%
3) NHH.44	—	0.44% to 0.58%
4) MECH.1	—	0.52% to 0.82%
5) DCH.32	—	0.50% to 0.51%

It can be seen that considerable variation in the wax content exists among the various varieties in all the four species of cotton. It is also seen that the same variety from different locations showed considerable variation. On the whole, the data obtained emphasises the need for determination of the wax content of every variety of cotton sample before taking up for processing as the amount of wax on the fibres are known to play a crucial role during the processing phase.

Compositional Analysis : Seven samples of cotton wax belonging to different varieties of cotton were analysed for their composition by thin layer chromatographic technique. The wax samples were saponified as per the modified method reported earlier using methanolic hydrochloride. After several trials, various components of wax were separated satisfactorily on a T.L.C. plate using a solvent system of hexane and ether in the ratio of 90:10. Each of the fractions (hydrocarbons, methyl esters, alcohols and sterols and ethers) were separated and purified by rechromatography. The purified fractions were weighed and the percentage composition calculated. Details of the percentage composition of the wax samples of different varieties are shown in Table 13. The data indicated the existance of variation in the composition of the wax

TABLE 12 : QUANTITATIVE ESTIMATION OF WAX IN DIFFERENT VARIETIES OF COTTON FOR THE CROP SEASON 1990-91

Sl. No.	Variety	Location	Wax (%)
1	2	3	4
	Hybrids		
1.	Hybrid 4	Bhainsa (A.P.)	0.53
2.	Hybrid 4	Habnapur (A.P.)	0.54
3.	Hybrid 4	Echoda (A.P.)	0.64
4.	Hybrid 4	Boath (A.P.)	0.47
5.	Hybrid 4	Chindwara (M.P.)	0.83
6.	Hybrid 4	Khargone (M.P.)	0.63
7.	Hybrid 4	Arvi (M.S.)	0.53
8.	Hybrid 4	Coimbatore (T.N.)	0.49
9.	Hybrid 4	Ankleshwar (GJ)	0.80
10.	Sankar 6	Kaledia (GJ)	0.74
11.	Sankar 6	Trent (GJ)	0.60
12.	Sankar 6	Manavdar (GJ)	0.67
13.	Sankar 6	Trent (GJ)	0.71
14.	Sankar 6	Rampura (GJ)	0.79
15.	NHH.44	Niwgha (M.S.)	0.44
16.	NHH.44	Parbhani (M.S.)	0.59
17.	NHH.44	Parbhani (M.S.)	0.58
18.	MECH.1	Badnawar (M.P.)	0.52
19.	MECH.1	Jafarabad (M.S.)	0.54
20.	MECH.1	Rajur (M.S.)	0.82
21.	DCH.32	Bellary (KN)	0.51
22.	DCH.32	Aurangabad (M.S.)	0.50
23.	Hybrid 6	Baroda (GJ)	1.21
	hirsutum		
24.	J.34	Karanpur (RJ)	0.57
25.	J.34	Bijaynagar (RJ)	0.55
26.	J.34	Dabwali (HN)	0.54
27.	J.34	Bariwal (PN)	0.46
28.	LRA.5166	Wardha (M.S.)	0.48
29.	LRA.5166	Adilabad (A.P.)	0.46
30.	LRA.5166	Dhanej (M.S.)	0.68
31.	LRA.5166	Salem (T.N.)	0.48
32.	LRA.5166	Adilabad (A.P.)	0.56
33.	H.777	Sirsa (HN)	0.41
34.	H.777	Sirsa (HN)	0.57
35.	MCU.5	P.N. Padu (A.P.)	0.73
36.	MCU.5	P.N. Padu (A.P.)	0.59
37.	MCU.5	Bellary (KN)	0.58
38.	MCU.5	Madurai (Kovilpatti) (T.N.)	0.87
39.	F.414	Kotkapura (PN)	0.62
40.	F.414	Fargilka (PN)	0.50
41.	G. Ageti	Shrikaranpur (RJ)	0.74
42.	B.1007	Pandhurna (M.S.)	0.85
43.	B. Narma	Chitogarh (RJ)	0.88
44.	Sharada	Dharwad (KN)	0.83
	barbadense		
45.	Suvin	Pollachi (T.N.)	0.68
46.	Suvin	Pollachi (T.N.)	0.50
	herbaceum		
47.	V.797	Dhanduna (M.P.)	0.53
48.	Digvijay	Baroda (GJ)	0.63
49.	Digvijay	Bharuch (GJ)	0.75
50.	G.Cot. 11	Bharuch (GJ)	0.76
	arboreum		
51.	AKH.4	Akola (M.S.)	0.75
52.	Maljari	Khargone (M.P.)	0.64
53.	B. Desi	Suratgadh (RJ)	0.41
54.	B. Desi	Giddarbha (PN)	0.22

TABLE 13 : PERCENTAGE COMPOSITION OF COTTON WAX

Sl. No.	Variety	Hydro-carbon	Methyl esters	Alcohols	Others including sterols
1.	Suvin	16.04	20.62	46.01	17.32
2.	Bikaneri Narma	23.59	21.33	35.71	19.37
3.	SRT.1	21.00	27.14	28.08	23.78
4.	H.6	15.49	29.03	29.93	25.55
5.	Digvijay	15.04	27.92	36.45	20.59
6.	Jayadhar	17.60	23.08	41.52	17.80
7.	Maljari	19.07	22.12	34.77	24.04

of different varieties of cotton. The full profile of the composition of wax can be obtained through the analysis of the individual fraction in gas-liquid chromatography.

Development of Durable Soil-Release Finish

Cotton and cotton : polyester blended fabrics were finished under conventional and modified anti soiling treatments. Two different crosslinking agents, viz. dimethylol dihydroxy ethylene urea (DMDHEU) and glyoxal, were used separately in the finishing treatments along with carboxymethyl cellulose, vasrang PE, wetting agent and ammonium aluminium sulphate. Apart from these conventional additives, other chemicals like zinc acetate and sodium hydroxide were used in the treatments to enhance the wash fastness of the finish.

The treated fabrics were evaluated for retention of breaking and tearing strengths using standard methods. Addition of CMC and zinc acetate to the finishing treatment improved the strength of cotton fabric considerably. Improvement was higher in the case of zinc acetate treated fabric. Among the two finishing agents, glyoxal and DMDHEU, the latter recorded higher retention of strength. A similar trend was observed in the case of cotton:polyester blended fabrics. Here, both glyoxal and DMDHEU treated fabrics recorded almost the same level of strength values.

The evaluation of the wash fastness of the finish was done by the estimation of carboxyl group content of the fabric. Conventional antisoiling finishes were reduced to 50% after 20 washes, whereas some of the above mentioned modified treatments retained higher amounts of finish after 20 washes.

Effect of Laundering on Physical and Mechanical Properties of Chemically Treated Apparel Fabrics

From the earlier work, it was established that washing parameters like temperature, drying conditions and soap/detergent used, affect the washing performance and that different conditions are necessary for laundering different types of fabrics. The present study was undertaken to optimise the temperature-soap/detergent combination for washing different types of fabrics.

For optimisation, three types of fabrics, viz. cotton (C), Polyester/Cotton (67P/33C) and Polyester (P), were selected and artificially soiled by BIS procedure (IS 5785-1970). The soiled samples were washed separately using 2 detergent powders, 2 detergent cakes and 2 soaps on launderometer at three temperatures 40°, 60° and 80°C, respectively. The washed samples were tested for reflectance percentage and abrasion resistance.

In order to study the effect of laundering on physical and mechanical properties of fabrics treated with antisoiling and softner finishes, two fabrics, viz. cotton (C) and Polyester/Cotton (67P/33C) were selected, desized and were given antisoiling treatment (using 2% softner, 10% DMDHEU and 2% CMC). The control, desized and chemically treated samples were soiled by the BIS method. Reflectance %, abrasion resistance, tear strength and crease recovery are being determined on these samples.

THRUST AREA V : UTILISATION OF BY-PRODUCTS AND PREPARATION OF NEW PRODUCTS FROM CELLULOSE AND RELATED MATERIALS

Full exploitation of by-products generated during post harvest technological operations on *Kapas* would increase the returns to the cotton growers and producers of value added products from cotton and therefore, this area had been one of the priority items in CIRCOT's research programms for the past one decade. The on-going research work in this thrust area during 1991-92 is as follows :

Fermentation Studies on the Production of Cellulase by Penicillium Funiculosum

Earlier studies on the production of cellulase by *Penicillium funiculosum* in 5 litre modular fermenter showed that the organism could produce cellulase having filter paper (F.P.) activity equivalent to 800-1200 μg per ml of reducing sugars (R.S.) in T.V. medium under the optimum conditions of aeration and agitation. The cellulase production was further increased to a F.P. activity equivalent to 1800-2000 μg/ml of R.S. when inoculum concentration was increased from 2% to 10% and aeration rate from 1.5 lit/min. to 3 lit/min. Further enhancement in cellulase production could not be achieved by controlling environmental factors. Therefore, attempts were made to enhance the cellulase production by making alterations in two important carbon and nitrogen sources of T.V. medium, viz, cellulose and peptone.

In the initial experiments, cellulose concentration was kept constant at 1% and peptone concentration increased to 0.1%, 0.2%, 0.25% and 0.4%. The maximum cellulose production equivalent to F.P. activity of 2500 μg/ml of R.S. was obtained at 0.25% peptone concentration. The use of higher concentration of peptone resulted in reduction in the cellulase production. Further studies were carried out by keeping peptone concentration at 0.25% and employing cellulose at 0.5%, 1.0%, 1.5%, 2.0% and 2.5%. The results showed that the cellulose and peptone at 1.0% and 0.25%, respectively gave optimum cellulase production. When *P. funiculosum* was grown in plain T.V. medium and in the T.V. medium containing 0.25% peptone and 1.0% cellulose, it was observed that the soluble protein of the medium increased from 0.15 mg/ml to 0.35 mg/ml in the latter case. This suggests that the enhanced protein corresponds to

the increase in cellulase content. However, this trend was not constant. At higher than 0.25% peptone concentration the soluble protein in the medium increased further, but there was no corresponding increase in cellulose. This suggests that at higher concentration of peptone, the organism may be synthesizing some other soluble proteins.

Studies were carried out in the flasks on various combination of C/N sources, i.e. cellulase and peptone.

Table 14 shows these combinations, cellulase production in terms of F.P. activity and soluble protein of the medium at each combination. It is evident that the soluble protein, as expected, increased with increase in peptone concentration. However, maximum cellulase production occurred in the system containing 2% cellulose and 0.6% peptone. The F.P. activity of this system was found to be 3000 μg/ml of R.S. All other systems showed lower cellulase production. This suggests that by increasing both cellulose and peptone concentrations, enhanced cellulase production could be achieved; but to get maximum cellulase production, a ratio of cellulose to peptone has to be maintained. Otherwise, it adversely affects the release of cellulase protein in the medium by the organism. Under the given conditions, the optimum ratio of cellulose to peptone seems to be 1 : 0.3.

TABLE 14 : EFFECT OF VARIOUS COMBINATIONS OF CELLULOSE AND PEPTONE (C/N) ON THE PRODUCTION OF CELLULASE AND SOLUBLE PROTEIN

Cellulose %	Peptone %	C/N ratio	F.P. Activity R.S. μg/ml	Protein mg/ml
1	0.6	1:0.6	1000	0.54
2	0.6	1:0.3	3030	0.57
1	0.75	1:0.75	875	0.6
2	0.75	1:0.375	2300	0.6
1	1.0	1:1	500	0.68
2	1.0	1:0.5	1175	0.68

Thermal Stability of Cottonseed Oil

Fifty ml portion of cottonseed oil, coconut oil, groundnut oil, til oil, corn oil and mustard oil were taken in 100 ml glass beakers and heated at 200°C for varying periods upto 24 hours. Viscosity, colour, specific gravity, U.V. and Infrared spectra of these samples were studied.

Kinamatic viscosity of all the oil samples increased with the increase in heating time.

Viscosity of cottonseed oil increased from 61.47 to 118.25 centistokes during 24 hours of heating while the viscosity of coconut oil increased from 50.10 to 67.78 centistokes, groundnut oil from 68.45 to 124.79 centistokes, til oil from 64.48 to 109.77 centistokes, corn oil from 61.04 to 118.25 centistokes and mustard oil from 82.43 to 148.39 centistokes.

Specific gravity of the oil samples remained almost unchanged during heating. Colour of the oil samples generally darkened, except in the case of til and groundnut oils. Polymers were detected in heated oils with the help of gel permeation chromatography. U.V. Spectra of the heated oils showed new peak at 232 nm which increased with heating time. Infrared spectra of the heated oils did not show any change.

Amino Acid Analysis of the Cottonseed Proteins and Cottonseed Meal Hydrolysates

Cottonseed samples received from the Germplasm collections of C.I.C.R., Nagpur were defatted and characterised for the amino acid profile on an Amino acid analyser. Analysis were completed for 35 samples drawn from *Gossypium arboreum* species and ES series from 1-15. The results indicated, in general, that the percentage of glutamic acid was maximum in all the cases (upto 45 μ moles/100 mg of the sample) and the least was the sulphur containing amino acid, cystine. Analysis of the samples drawn from other cultivated species are underway.

Effect of Pretreatments on the Properties of Linters of Different Cotton Varieties

Ginned cottonseeds of four varieties, viz. Laxmi, K.2, H.4 and C-Indore-1 (10 kg each), were delinted on a laboratory model delinter and the linter so obtained was cleaned on a Shirley Cleaner. Linter %, trash % and cage loss % values were determined for each variety.

The cleaned linter samples were then subjected to kiering in 2.5% sodium hydroxide solution (M:L ratio 1:20) at 15 lb/sq inch pressure for four hours, after which the samples were washed with water steeped in 0.25% acetic acid and again washed with distilled water. Kiering loss was determined separately on a 5 g sample.

Kiered samples were then given a two step bleaching treatment. Each step was of two hours duration, keeping the material to liquor ratio at 1:20 and available chlorine 1 g/l. The pH value of the liquor was 8.7 in the first step, and it was adjusted to 7.0 in the second step.

Bleached samples were then washed with distilled water, and antichlor treatments was given by steeping for half an hour in 1% sodium metabisulphite solution; after which the samples were again washed thoroughly with distilled water and air dried.

Reflectance of the linter samples (kiered as well as kiered and bleached) was determined on Shimadzu spectrophotometer model UV-240 at a wavelength of 550 nm using barium sulphate powder as standard (100% reflectance).

The degree of polymerisation (DP) of kiered and bleached samples was determined in cuprammonium solvent. Kiered and bleached samples had a low D.P. probably due to some degradation under the experimental bleaching conditions.

Some New Approaches for Improving Particle Boards Prepared from Cotton Plant Stalks

(A) *Large Scale Trial of Particle Board Preparation* : The large scale trials for preparation of particle boards from cotton plant stalks was undertaken at M/s. Padmavathi Panel Boards, Tumkur, a factory situated about 50 kms. from Bangalore.

About one tonne of cotton stalk was processed at the factory using urea formaldehyde and phenol formaldehyde resins. Nearly 30-35 particle boards of medium density (6′ × 3′ size), having thicknesses varying from 10 mm to 18 mm, with different surface finishes like plain, veneer and bamboo mat faced were prepared.

The boards prepared were of good quality and were tested for various physico-mechanical properties. The test results were quite satisfactory and in conformity with Bureau of Indian Standard specifications.

On the basis of the large scale trial, the economic feasibility and viability of the process has been worked out. The preliminary cost estimates for a particle board preparation plant using cotton stalks and having a capacity of 3 tonnes and 5 tonnes per day has been prepared.

(B) *Demonstration of Technology*: The process of preparation of particle boards from cotton stalk was demonstrated to the extension and technical personnel from Directorate of Industries Jaipur, District Industries Centre, Sriganganagar, Maharashtra Co-operative Cotton Growers' Marketing Federation, etc.

(C) *Fabrication of a Device for Strength Measurement* : A device for measurement of (i) screw and nail withdrawal strength, and (ii) internal bond strength (Tensile strength perpendicular to the surfaces of the particle board) was got fabricated at CIRCOT workshop as per Bureau of Indian Standards specifications.

Different types of boards made earlier were evaluated for nail and screw withdrawal strength on a Universal Testing Machine.

Efforts are underway for prelamination of particle boards from cotton stalks.

Feasibility and Standardisation Studies of Cotton Plant Stalks for Preparation of Pulp and Various Grades of Paper

(A) *Preparation of Soda-Sulphate Pulp* : Trials were conducted to prepare soda-sulphate pulps by digesting cotton stalk chips in a rotary digester with 12%, 14% and 16% chemicals (NaOH + Na_2SO_4) on oven dry weight of raw material, at 20% sulphidity, at a temp. of 165°C for 75 min. The material to liquor ratio was maintained at 1:3. The cooked materials were washed thoroughly to remove the black liquor and unreacted chemicals and then beaten in a valley beater to get the pulps of desired freeness. All the pulps were well cooked and appeared light in colour. Paper sheets of 60 ± 1 g/m² were prepared from all the above pulps and evaluated for various properties. The quality of the paper sheets produced was satisfactory and could be used as liner grade paper in corrugated box manufacturing. Bleaching trials on the above pulps are being carried out.

(B) *Preparation of Chemi-mechanical Pulp*: Preliminary trials were undertaken to prepare chemi-mechanical pulps from cotton stalks by digesting the chips with 5%, 6% and 7% of alkali on oven dry weight of the raw material in a rotary digester at 160°C for 30 min. The material-to-liquor ratio was 1:4. The cooked materials were washed and then refined in a disc refiner in three passes at 25, 15 and 10 thou clearance. The material was beaten in a valley beater to get the pulps of desired freeness. i.e. 250 CSF. The pulps were then screened to remove uncooked material as rejects. Paper sheets of 60 ± 1 g/m^2 were prepared and then tested for various properties under standard conditions using TAPPI standard test methods.

All the pulps recorded higher yield percentage. However, the quantity of rejects was more in the first pulp compared to others. The quality of the paper sheets was good and the paper can be used for wraping and packaging purposes.

Efforts are continued to complete the scaling up trial for preparation of kraft pulp from cotton plant stalks.

Scale up Trials on the Preparation of Pulp and Paper from Cotton Stalks and other Cellulosic Materials via Anaerobic Digestion

During the period under report, the properties of the paper made from biodegraded cotton stalks were evaluated at the Hand Made Paper Institute, Pune. The data are given in Table. 15 and 16 The results indicated that cotton stalks treated with 4% alkali and subjected to anaerobic treatment for two weeks produced good quality pulp as evidenced by the properties of the paper. The burst factor, tear factor and breaking length ercorded were *onpar* with those of bleached paper made by kraft process. However, the number of double fold was significantly higher in the case of anaerobically digested sample. The probable reasons for the observed results could be that, by treatment with alkali, the cellulose in the wet state imparts an increase of strength as evidenced by the data on the enzyme hydrolysis of never-dried fibres, undertaken at this Institute earlier.

Scale up Trials of Oyster Mushroom Crop on Cotton Stalks

The trials on raising mushrooms, *Pleurotus sajor-caju* on cotton stalks during all the seasons have been completed. Spawn run was done in different quantities of cotton stalks, starting from 1 kg to 5 kg as per the conventional polythene bag technique. The results indicated that as much as 500 g of fleshy fruiting bodies were obtained per kg of cotton stalks. One kg cotton stalks material during spawn run period was found to be the optimum.

In all the above studies, grain spawn was used during spawn run. In another study, cotton stalk spawn was used to inoculate the fresh material. One of the drawbacks of grain spawn is that it has to be used within 15-20 days as otherwise the quality is affected and even the subsequent mushroom yield also will turn out to be poor. An attempt was therefore, made to replace the grain spawn with stalk spawn. The cotton stalk spawn can be used even after 1 month and upto 3 months without affecting the quality and quantity of mushrooms.

TABLE 15 : PROPERTIES OF PAPER MADE FROM BIODEGRADED PULP OF COTTON STALKS

(Freeness 250 CSF, Grammage 60±1)

Alkali Conc. (%)	Duration (Weeks)	Burst Factor	Tear Factor	Breaking Length (m)	Double Folds (in number)
1	Control	5.8	56	1323	2
1	1	6.9	79	1422	2
1	2	7.8	102	2170	19
1	3	9.3	107	2002	30
1	4	12.1	110	2323	20
2	Control	6.2	96	2068	10
2	1	14.1	98	2309	10
2	2	14.8	123	2389	41
2	3	15.6	128	2537	35
2	4	19.5	155	2634	63
3	Control	8.2	83	2259	14
3	1	14.6	87	2523	29
3	2	16.5	133	2642	37
3	3	18.2	133	2779	69
3	4	12.9	109	2481	8
4	Control	7.5	87	2645	24
4	1	28.2	102	3335	373
4	2	31.8	127	4346	951
4	3	26.5	123	3234	208
4	4	20.1	127	2463	34

TABLE 16 : PROPERTIES OF PAPER MADE FROM KRAFT PULP OF COTTON STALKS

(Freeness 250 CSF, Grammage 60±1)

Properties	Cotton
Freeness of pulp (CSF)	250
Basis Weight (g/m²)	60±1
Burst Factor	31.82
Tear Factor	154.8
Breaking Length (m)	4346
Double Folds (no.)	37

Improving the Efficiency of Biogas Production from Willow Dust and other Solid Cellulosic Wastes

In earlier studies, it was established that by inoculating the mixed cultures of photosynthetic bacteria during charging of willow-dust into the anaerobic digester, the percentage of methane goes up to 80%-85% after 15 days of charging as against 55%-60% without inoculation. The same bench scale trials were extended to pilot plant trials.

The existing one tonne capacity plant meant to process willow-dust for bio-gas production by dry fermentation was used with modifications on the lid. The lid was

cut and four 12″ × 12″ windows were provided with 2 mm transluscent fibreglass sheets that allow sunlight to enter inside the digester so as to facilitate the growth of photosynthetic bacteria.

Studies were undertaken on this plant, by inoculating the mixed cultures of photosynthetic bacteria by dry fermentation. The results indicated that methane percentage goes upto 85% after 15 days of biogas production and comes down to 70% after 30 days and continues in the same range during the subsequent 30 days. The percentage never came down below 70% even at the last phase of gas production.

Subsequently, an experimental plant to process 50 kg of willow-dust by dry fermentation was also fabricated from fibre glass sheets of 2 mm thickness. Studies undertaken on this plant with photosynthetic bacteria did not show any increase in the methane percentage beyond 60. This indicated that the thickness of the fibre glass (6 mm) sheet must have disallowed the sunlight to pass through for the growth of the photosynthetic bacteria.

Therefore, the gas holder was provided with two windows of fibre glass material of 2 mm thickness and the plant was charged again with willow-dust and photosynthetic bacteria.

THRUST AREA VI : ORIGIN OF COTTON DUST AND ITS CONTROL

A knowledge of the origin of cotton dust and its composition is essential to effectively combat the problem of Mill fever caused by hazardous respirable dusts present in the processing areas and also to enhance the life of the installed machinery in mills, which become unfunctional gradually, if timely attention is not given to solve the dust problem. Similarly, elemental composition of different parts of cotton plants, can generate sufficient information on the nutrient transport and related aspects of plant physiology. Therefore, the following investigation has been taken up, the progress of which is summarised below :

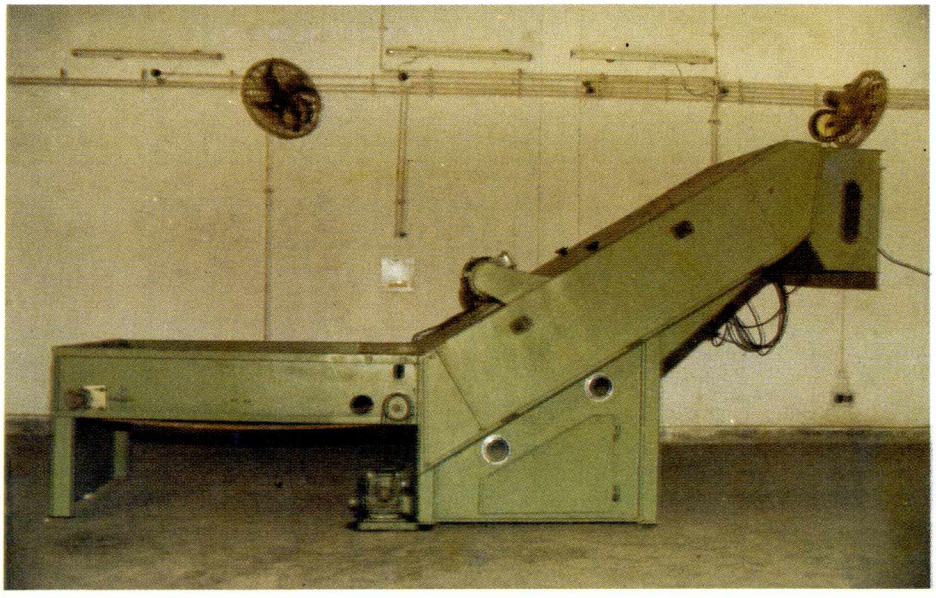
Studies on Cotton Plant Material and Cotton Dust Using X-Ray Fluorescence Spectrometry (XRFS)

Analysis of wastes collected from different stages of processing showed that maximum occupational hazard from inorganic elements was found to exist at the blow room processing stage. A significant reduction of about 80% in elemental concentration was achieved by blow room processing, the reduction being similar for different elements. From the carding stage to the ring frame, little further reduction in concentrations was noticed. However, the level of Si was observed to be reduced by about 36% due to card room processing. Although precleaning treatments given prior to ginning were indicated to be possibly of some effect in decreasing elemental levels in blow room, it appeared that such treatments might not be very useful in reducing the concentrations in processing dusts, as a general rule.

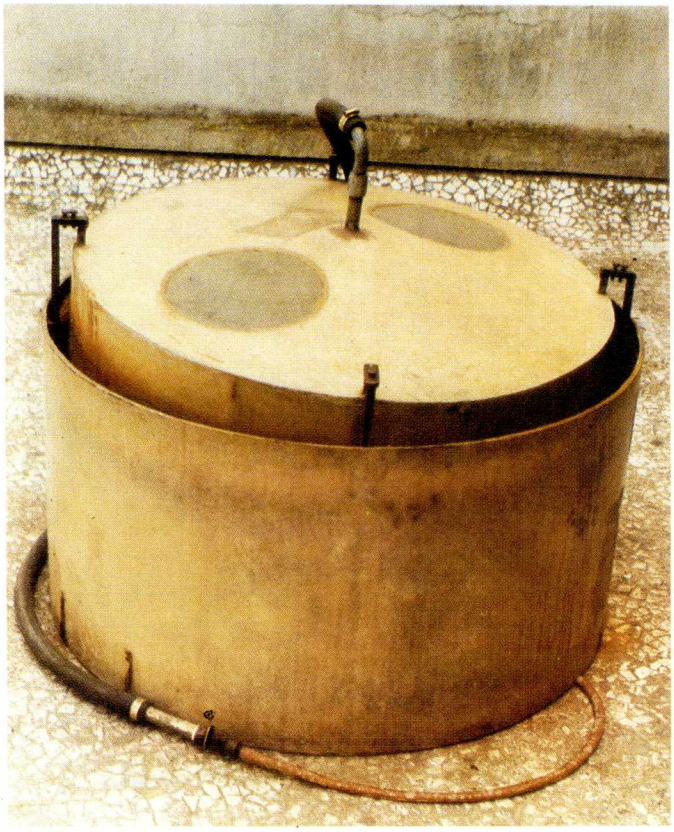
The origin of the various elements in the processing wastes was traced to cotton plant parts, among which leaf, bract and seed coat fragments were implicated.

A significant observation was that elemental concentrations were markedly higher in

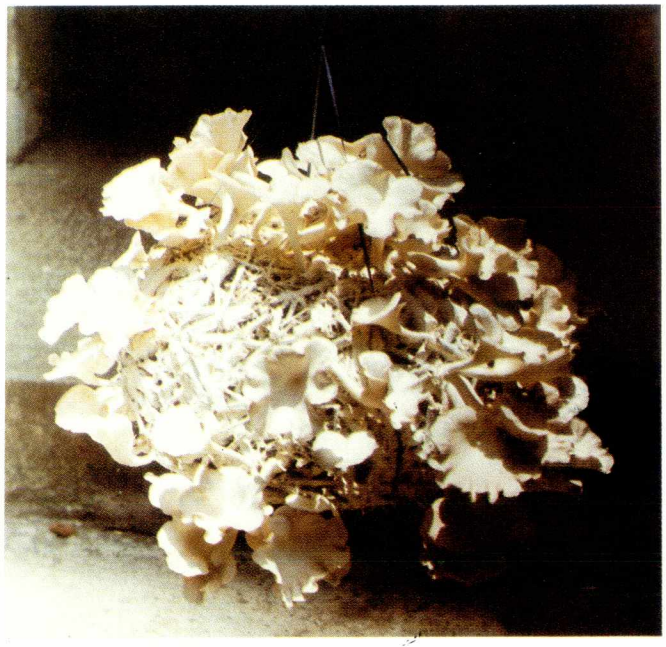
Particle Board of Size 6' x 3' x 12 mm Prepared from Cotton Plant Stalk



Seed Cotton Pre-Cleaning Machine Designed and ***Developed at*** *CIRCOT*



Modified Biogas Plant for More Gas with Higher Methane



Mushroom Crop on Cotton Plant Stalk

respirable dust fractions of particle size less than 25 microns as compared to non-respirable fractions containing larger particles.

S, P and Ca were determined to be elements universally present in all processing wastes with concentrations above 0.05% or 500 ppm. The blow room wastes contained Na and Fe also at such concentration levels. These elements could create health problems by acting as nuisance particulate dusts, if the exposures were very heavy.

Si, Co and Zr, with concentration levels of the order of 0.005% or 50 ppm and higher, as well as Mn detected at such levels in blow room wastes are known to be toxic at these moderate concentration levels, and merit investigation in the context of *byssinosis* and probable dermatological problems.

The most hazardous elements, known to be toxic even at levels lower than 0.0001% or 1 ppm found in the processing wastes were Ni, Br, Cd and Ba.

3

Publications

A. Annual Report

Annual Report of the Central Institute for Research on Cotton Technology for the calendar year 1990-91.

B. Technological Circular

Technological Circulars on Trade and Standard Varieties of Indian Cottons for the season 1989-90.

C. Research Publications (CIRCOT Publications — New Series)

470 S. Sreenivasan, R. P. Nachane, G. S. Patel, P. K. Chidambareswaran and N. B. Patil — *Parameters Related to Clothing Comfort — Diffusive Moisture Transport Evaluation* (Reprinted from IJFTR, Vol. 16, p. 189, September 1991).

471 G. S. Patel and K. R. Krishna Iyer — *Morphological Deformities in Cotton* (Reprinted from Journal of Applied Polymer Science, Vol. 143, p. 915, September 1991).

472 Y. Subrahmanyam, P. G. Patel, N. P. Mehta, K. R. V. Raja, M. C. Bhalod and V. G. Munshi — *Quality of Cotton Lint in Different Cultivable Species* (Reprinted from Indian Society for Cotton Improvement, Vol. 16, No. 2, p. 150, September 1991).

473 P. V. Varadarajan, Nayana D. Nachane and M. S. Sitaram — *Cross-linking Decrystallised and Partially Acetylated Cotton Yarn with Dimethylol-Dihydroxy Ethylene-Urea* (Reprinted from Journal of Applied Polymer Science, Vol. 43, p. 2051, December 1991).

474 Shaila P. Bhatawadekar, S. Sreenivasan, R. H. Balasubramanya and V. Sundaram — *Enhanced Enzymolysis of Never-Dried Cotton Fibres belonging to Different Species* (Reprinted from Journal of Applied Polymer Science, Vol. 44, p. 243, January 1992).

475 D. V. Mhadgut, G. R. Anap and M. S. Parthasarathy — *Survey of Ginning Factories in Karnataka.*

476 D. Rama Rao and V. B. Gupta — *Molecular Mobility in Wool Fibres as Determined from Nuclear Magnetic Resonance Studies* (Reprinted from Journal of Applied Polymer Science, Vol. 144, p. 623, February 1992).

477 S. K. Chattopadhyay, B. Srinathan and M. S. Parthasarathy — *Influence of Spinning Draft on Generation of Short-*

Thick Yarn Faults Estimated by Uster Classimat (Reprinted from Journal of Institute of Engineers, Textile Engineering Division, Vol. 71, p. 1, June 1991).

478 Munshi Singh, V. P. Singh and N. B. Patil — *Selection for Greater Fibre Strength in Medium and Superior Staple Upland Cotton (Gossypium hirsutum)* (Reprinted fom Indian Journal of Agricultural Sciences, Vol. 62, No. 5, p. 325, May 1992).

479 V. B. Gupta and D. Rama Rao — *Stress Relaxation Studies on Wool Fibres* (Reprinted from Journal of Applied Polymer Science, Vol. 45, p. 253, May 1992).

480 R. H. Balasubramanaya, K. M. Paralikar, P. K. Chidambarerswaran, N. B. Patil and V. Sundaram — *A Note on the New Wilt of Cotton* (Reprinted from Indian Society for Cotton Improvement, Vol. 17, No. 1, p. 74, March 1992).

481 Munshi Singh, V. P. Singh and N. B. Patil — *Pusa* 2-95 : *A High Strength Medium Long Staple Strain of Upland Cotton (G. hirsutum L.)* (Reprinted from Indian Society for Cotton Improvement, Vol. 17, No. 1, p. 13, March 1992).

482 Y. Subrahmanyam, R. G. Vashi, N. P. Mehta, G. G. Mistry and V. G. Munshi-*Effect of Applied and Native Phosphorus on the Yield and Quality of Hybrid* 6 *Cotton* (Reprinted from Indian Society for Cotton Improvement, Vol. 17, No. 1, p. 57, March 1992).

D. Other Publications

1. A. J. Shaikh — *Hand Made Paper from Green Cotton Plant Stalks* (Reprinted from Indian Farming Vol. 40, No. 11, P. 9, February 1991).

2. I. K. P. Iyer, V. G. Munshi and Muntazir Ahmed — *Application of HVI Technology for Indian Cottons* (Reprinted from JTA Vol. 52, No. 2, P. 45, July, 1991).

3. S. Arvindnath, P. Bhama Iyer and S. Sreenivasan — *Layer Morphology and Its Relation to Swelling and Structure Part I : Cotton Fibres Treated in Alkali* (Reprinted from JAPS Vol. 46, No. 12, P. 2239, December 1992).

4. S. Arvindnath, P. Bhama Iyer and S. Sreenivasan — *Layer Morphology and Its Relation to Swelling and Structure Part II : Cotton Fibres Treated with Ethylenediamine and Zinc Chloride* (Reprinted from JAPS Vol. 46, No. 12, P. 2245, December 1992).

E. Papers presented at Seminars/ Conferences/Symposia/Workshops

1. S. K. Chattopadhyay, B. Srinathan and M. S. Parthasarathy — *Influence of Spinning Draft on the Generation of Short-Range Thick Yarn Faults Estimated by Uster Classimat* (Presented at the Annual Paper Meet of Textile Engineering Division concurrently with the 6th National Convention held at Bangalore on April 11 and 12, 1991).

2. I. K. P. Iyer, V. G. Munshi and K. B. Rajagopal — *Importance of Calibration Procedure in HVI Measurements*

(Presented at the 32nd Joint Technological Conference held at SITRA, Coimbatore on June 23 and 24, 1991).

3. S. S. Doke and K. R. Krishna Iyer — *Effect of Aqueous Swelling and Stretching on the Tensile Properties of Cotton Fibres* (Presented at the 32nd Joint Technological Conference held at SITRA, Coimbatore on June 23 and 24, 1991).

4. M. S. Parthasarathy, G. R. Anap and S. K. Chattopadhyay — *Influence of Precleaning and Ginning Treatments on Fibre and Yarn Quality of Indian Cottons* (Presented at the 32nd Joint Technological Conference held at SITRA, Coimbatore on June 23 and 24, 1991).

5. R. P. Nachane, G. F. S. Hussain and K. R. Krishna Iyer — *Yarn Bundle Strength — A New Test Method* (Presented at the All India Textile Conference held at A.C. College of Technology, Anna University, Madras on July 27 and 28, 1991).

6. N. B. Patil and P. K. Chidambareswaran — *Physico-chemical Properties of Cellulose* (Presented at the 7th Carbohydrate Conference held at Forest Research Institute, Dehra Dun on November 11 and 12, 1991).

7. M. S. Parthasarathy and N. B. Patil — *Indian Cotton Export — Potential and Prospects* (Presented at the 47th All India Textile Conference held at Indore on November 15 and 16, 1991).

8. S. Sreenivasan, P. Bhama Iyer and G. S. Patel — *Potassium hydroxide A Better Mercerising Agent as Revealed by Physico-Mechanical and Structural Properties* (Presented at the Poster Session of 'Cellulose 91', Cellucon Conferences, New Orleans, Lousiana, USA, held on December 2 to 6, 1991).

9. M. S. Parthasarathy — *ITMA 1991 — Review of Yarn Forming Machinery* (Presented at the One Day Seminar of Highlights of ITMA-1991 organised by Textile Association, Bombay on December 27, 1991).

10. S. G. Gayal and V. G. Khandeparkar — *Production of Cellulase by Penicillium funiculosum* (Presented at the 32nd Annual Conference of the Association of Microbiologists' of India held at Madurai Kamaraj University, Madurai, from January 10-12, 1992).

11. R. H. Balasubramanya, A. J. Shaikh, Y. D. Pai and V. G. Khandeparkar — *Biological Softening of Cotton Plant Stalks for the Preparation of Pulp and Paper* (Presented at the 32nd Annual Conference of the Association of Microbiologists of India held at Madurai Kamaraj University, Madurai, from January 10-12, 1992).

13. V. G. Munshi — *Quality System for Bale Management in a Cotton Spinning Mill* (Presented at the Seminar on 'ISO 9000, Challenges to the Textile Industry' Organised by the Textiles Committee at Bombay, on March 28 and 29, 1992).

F. Technological Circulars on Trade Varieties of Indian Cottons

T.C. No.	Variety	Place
2475	L.D.327	Ludhiana
2476	Bikaneri Narma	Sriganganagar
2477	Ganganagar Ageti	Sriganganagar
2478	RG.8	Sriganganagar
2479	DCH.32	Hubli
2480	Deviraj	Surendranagar
2481	G.12	Surendranagar
2482	Hybrid 6	Samalya
2483	LH.1134	Abohar
2484	AK.235	Bellary
2485	170 CO2	Gokak
2486	SRT.1	Botad
2487	Jayadhar	Hubli
2488	LH.900	Abohar
2489	LH.886	Abohar
2490	CJ.73	Botad
2491	Suyodhar	Bagalkot
2492	Ganganagar Ageti	Sriganganagar
2493	Bikaneri Narma	Sriganganagar
2494	Gujarat 11	Bharuch
2495	Digvijay	Kapadwanj
2496	Gujarat 13	Dhanduka
2497	Hybrid 4	Surat

G. Technological Circulars on Standard Cottons

S.C. No.	Variety	Place
379	Deviraj	Junagadh
380	170 CO2	Arabhavi
381	AKH.4	Akola
382	AKA.8401	Akola
383	Hybrid 4	Surat
384	CJ.73 (Sanjay)	Amreli
385	G.Cot.15	Amreli
386	G.Cot.11	Surat
387	Hybrid 4	Surat
388	G.Cot.Hy.8	Surat
389	J.K.119	Siruguppa
390	V.797	Chharodi
391	Digvijay	Bharuch
392	G.Cot.10	Bharuch
393	G.Cot.11	Bharuch
394	G.Cot.13	Chharodi
395	G.Cot.Hy.6	Surat
396	Laxmi	Raichur
397	Raichur 51	Raichur
398	DB-3-12	Raichur

4

Extension

CIRCOT has no agricultural farm attached to it at the headquarters. However, its Regional Units located in different cotton growing tracts of the country within the agricultural university premises maintain close collaboration with the cotton scientists of these universities and of the state agricultural department through various collaborative projects pertaining to problems faced by the farming community. Indirect assistance is also rendered to the farming community by way of development of useful equipments for field experiments and also through discussions/suggestions, advices, etc. on the technological aspects of cotton at different stages of crop development and post-harvest technology operations.

The Director and many of the Principal Scientists are members of several committees constituted by the Bureau of Indian Standards, for cotton and textiles and they actually participate in the preparation of specifications for various cotton products using their knowledge and expertise. Similarly, Director and few Principal Scientists are active members in many advisory panels of other textile research institutions like BTRA, ATIRA, etc. Being experts in the technology side of cotton, some of the scientists are invited from time to time to deliver lectures and to participate in research programmes of institutions such as VJTI, BUDCT, DKTE Institute, etc. The scientists and technical officers participate in conferences and symposia, and present papers so as to transfer the research results to different user groups.

Periodical publications of original articles based on research findings in national and international journals also form part of the extension work.

CIRCOT conducts full time training courses in cotton technology mainly on cotton quality evaluation of fibres, yarns and fabrics as well as elementary statistical methods applicable to quality parameters.

It has been established over the years that the ginning industry in India is one of the most neglected industrial activity with the result the cotton lint quality is considerably impaired mainly due to improper ginning, lack of adequate and sustained maintenance of the machinery and absence of proper training to the workers in ginning factories. CIRCOT has, therefore, established a Ginning Training Centre (GTC) at Nagpur and initiated training of fitters, supervisors and officers sponsored by the factory owners from all over the country. The GTC is equipped with different types of precleaners, gins and a modern bale press so that proper instructions and practical training could be

given to the trainees on aspects specially suited to their needs. The GTC has also a fairly well equipped fibre testing laboratory and a miniature spinning unit for micro-spinning of samples. A hostel capable of accommodating about 20 trainees is also provided with the centre. Research problems in precleaning and ginning as well as design and development of allied machinery to suit the country's needs form a major part of the activity of GTC.

The nature of extension activities, at CIRCOT by and large, is mainly confined to supply of reliable and accurate data on the quality aspects of cotton, yarns and fabrics, consultancy services and publication of research results for the benefit of user groups.

Technical Queries :

Several queries of technical nature received from private organisations, individuals, government and semi-government organisations on testing methods, instruments, fabrication, new products and processes, by-products/and waste utilisation, etc. were replied. Replies were also sent for queries from visitors to the Institute on matters relating to cottons and cotton technology.

Paid Tests :

CIRCOT has been receiving a fairly large number of samples of fibres, yarns, fabrics for paid tests from Textile Mills, Government and Semi-Government organisations, as well as from the cotton trade and industry on payment of prescribed tests fees. Different types of fabrics from the Controller of Stores, Municipal Corporation of Greater Bombay, are received regularly by this Institute. The demand for tests on High Volume Instrument (HVI) has considerably increased in recent years and our clientele includes the Cotton Corporation of India, State Co-Op. Cotton Marketing Federation, leading Textile Mills, and Private Organisations.

The number of samples received for tests during the period 1991-92 together with the samples tested for the year 1989 to 1991 and for the quinquennium 1986-90 are given below.

Type of tests	Average for the quinquennium 1986-1990	1989-90	1990-91	1991-92
Spinning	95	250	38	45
Fibre	1481	3685	1469	2059
Yarn	159	89	290	377
Fabrics	106	93	306	271
Moisture	14	0	—	—
Miscellaneous	20	23	25	17
Total	1875	4140	2128	2769

The total fees collected during the calendar year 1991-92 from paid tests was Rs. 2,76,171.00.

Besides routine tests, the following special tests were also carried out on samples received from various organisations.

1. Two samples of cotton linter received from Swan Mills Bombay, were tested for (1) ash content, (2) α-cellulose content (3) β and γ cellulose content and (4) Lignin content.

2. Five jute/cotton samples received from Ahmedabad Textile Industry's Research Association, Ahmedabad, were subjected to blend analysis by using x-ray diffraction method developed at the Institute.

3. One fabric sample received from Bhanwarilal Ashok Kumar & Co. Bombay, was subjected to tests to asses whether this fabric was suitable for raising purpose.

4. Two samples (blend of Recron and cotton) received from Reliance Industries Ltd., Bombay, were spun to 40s, 45s, 50s, and 60s counts and tested for lea strength, single yarn strength and Uster evenness test.

5. One sample of glass fibre adhesive tape received from Crompton Greaves, Bombay was tested for strength and elongation on Instron.

6. One cotton plant stalk sample received from Neoluxe India Ltd., Bombay, was subjected to chopping and pulverising for particle board preparation.

7. One polyester fibre sample of 5 kg received from J.K. Synthetics Bombay, was subjected to spinning into 8s count single yarn (100% PSF) on O.E. Machine and the yarn was supplied to the party.

8. Four samples of fibre received from Ruby Mills, Bombay were tested for the presence of mildew.

Training :

(a) *Integrated Training Course on Cotton Testing Methods and Evaluation.*

Five full time short duration courses of two weeks each were conducted from 24-6-1991 to 28-9-1991, mainly for persons working in cotton trade and industry. In all 60 officials from the Cotton Corporation of India (CCI), National Textile Corporation (NTC) and Maharashtra State Cotton Growers' Marketing Federation Ltd. underwent the training courses.

(b) *Integrated Training* :

Thirty-six personnel from different mills were imparted six weeks' training in three batches.

(c) *Special Training* :

Special training was given to ten sponsored personnel in three batches from the Orissa Co-operative Spinning Mills and NCDC for five days.

Apart from this, two students from Government Engineering College, Nanded were trained during 15-7-1991 to 14-8-1991.

(d) *In-service Training of CIRCOT Staff* :

The Regional Quality Evaluation Units of CIRCOT are equipped with all the important fibre testing instruments which are operated by trained staff for assessing the fibre quality parameters of the experimental strains. Considering the nature of tests and the likelihood of subjectivity creeping in, CIRCOT conducts refresher course on fibre testing at the headquarters in Bombay, as and when required for the staff working in Regional Units. During the year, nine technical staff working in the Regional Quality Evaluation Units were trained for five days.

(e) *Ginning Training* :

During this period, 252 sponsored personnel from the Maharashtra State Co-operative Cotton Growers' Marketing Federation Ltd., Nagpur and two persons from Central Institute for Cotton Research (CICR), Nagpur were trained in 16 batches.

5

Conference and Symposia

Director, Scientists and Technical Personnel of CIRCOT participated in the following scientific and technological conference besides meetings connected with the work of this Institute.

Sl. No.	Meetings/Conferences/ Seminar/Symposia, etc.	Place	Date	Name(s) of the Scientist(s) and Technical Personnel who attended the Conference/Meeting, etc.
1.	Annual Paper Meet (6th National Convention of Textile Engineers)	Bangalore	11-4-1991 and 12-4-1991	Shri S. K. Chattopadhyay
2.	First Asian Textile Conference	New Delhi	17-6-1991 to 19-6-1991	Dr. N. B. Patil Shri M. S. Parthasarathy
3.	All India Textile Conference	Madras	27-7-1991 and 28-7-1991	Dr. R. P. Nachane
4.	National Seminar on Technological Strategies for Textile Exports	Bombay	28-9-1991	Dr. V. Sundaram Shri B. Srinathan
5.	Seventh Carbohydrate Conference	Dehradun	11-11-1991 and 12-11-1991	Dr. N. B. Patil Dr. P. K. Chidambareswaran
6.	Forty-seventh All India Textile Conference	Indore	15-11-1991 and 16-11-1991	Shri M. S. Parthasarathy Dr. N. B. Patil
7.	International Workshop on Biodeterioration, Culture of Collection and Aspects of Applied Mycology	Mysore	18-11-1991 to 29-11-1991	Dr. V. G. Khandeparkar

Sl. No.	Meetings/Conferences/ Seminar/Symposia, etc.	Place	Date	Name(s) of the Scientist(s) and Technical Personnel who attended the Conference/Meeting, etc.
8.	Highlights of ITMA — 1991	Bombay	27-12-1991	Shri M. S. Parthasarathy Shri B. Srinathan
9.	Thirty-second Annual Conference of the Association of Microbiologists' of India	Madurai	10-1-1992 to 12-1-1992	Dr. R. H. Balasubramanya Dr. S. G. Gayal
10.	Thirty-third Joint Technological Conference	Bombay	14-2-1992 and 15-2-1992	Shri M. S. Parthasarathy Dr. V. G. Munshi Dr. K. R. Krishna Iyer Kum. C. R. Raje Shri Muntazir Ahmed Shri A. V. Ukidve Shri P. Bhaskar Shri S. K. Chattopadhyay Smt. S. D. Pai
11.	Seminar on "How to Get The Best Out of Carding"	Bombay	6-3-1992	Shri M. S. Parthasarathy Shri B. Srinathan
12.	Seminar on "ISO 9000"	Bombay	28-3-1992 and 29-3-1992	Dr. V. Sundaram Shri M. S. Parthasarathy Dr. V. G. Munshi Shri A. V. Ukidve Kum. I. K. P. Iyer

6

Summary of the Report

This Sixty-eighth Annual Report of the CIRCOT covers the period April 1, 1991 to March 31, 1992.

The CIRCOT, formerly CTRL, was established in the year 1924 under the name Technological Laboratory of the ICCC. With the abolition of commodity committees including ICCC in 1966, the administrative control of this Institute was passed on to ICAR and since then, the research activities were re-oriented and intensified. More than 2500 cotton samples were tested for fibre quality at the head quarters, while about 25,000 samples were tested at the Regional Quality Evaluation Units during the reporting period. The total number of books added to the library was 90 and of bound volumes 200. Nearly 200 journals pertaining to textiles and allied subjects were being regularly received at this Institute. CIRCOT continued to function as co-ordinating centre for technology of the AICCIP. The recognition granted to CIRCOT as a post-graduate institution was continued. The research activities during 1991-92 are summarised below :

At the panel meeting of the AICCIP, one variety CNH.36 has been recommended for release at Maharashtra, Gujarat and South Rajasthan.

About 650 germplasm samples belonging to *G. hirsutum* species collected from CICR, Nagpur were evaluated for fibre quality parameters. The overall range for 2.5% span length was from 18.1 to 31.3 mm, that for Micronaire fineness was from 2.5 to 5.0, and the range for strength at 3 mm gauge length was from 15.9 to 28.5 g/t. Most of the cultivars had low Micronaire and tenacity values.

The following regression equation was worked out for predicting count from HVI data :

Optimum Count =
0.638 FQI (Fibre Quality Index) — 12.07.

The equation was found suitable for predicting count ranging from 30s to 60s.

In a study on Inheritance of fibre length in *G. hirsutum* cottons using ten established varieties. it was observed that the variance due to parents, parents vs. crosses and lines vs. crosses were significant in both the generations. The magnitude of specific combining ability variance ($<$ sca) was larger than that of general combining ability variances ($<$ gca) for fibre length. This suggested the possibility of capitalising on non-additive gene effects for the fibre length. Majority of the hybrids lie in-between their parents

indicating positive heterosis. Out of the 24 hybrids, 16 hybrids showed positive heterosis. The genetic parameters are being evaluated.

In connection with an investigation on the Effect of Exposure to Weather Conditions on the Quality of Fibre in Matured Cotton Bolls, colour tests were done on samples from four pickings at intervals of one week duration upto fourth week. The colour values exhibited significant differences between pickings, when the cotton on the plant was exposed to sunlight. Effect of exposure of cotton to sunlight after picking also was studied using the same four varieties in three stages, viz. immediately after picking, after one month and after two months. It was observed that, by and large, the colour values were less in the later stages of long exposures, while the fibre quality parameters remained unaffected.

Effect on Fibre Qualities and Yield Levels of Cotton due to hormone-Biozyme Treatments have been studied at the QE Unit at Nanded using two cottons, Eknath (*G. arboreum* — diploid) and PH.93 (*G. hirsutum* — tetraploid) and two hybrids, NHB.12 and NHH.44. It was observed that :

1. The treatment of spraying hormone (growth regulator), defoliants and additional 'N' application with irrigation produced significantly high yield.
2. Sufficient moisture in the soil enhances the effectiveness of the sprayed hormone.
3. The interaction effects of varieties/hybrids × spraying hormone, defoliants and additional 'N' with irrigation were significant.
4. Eknath Cotton with all sprayings of hormone, defoliant and additional 'N' with irrigation produced significantly the highest seed cotton yield (1594 kg/ha) and *on par* technological performance.

In connection with the survey of ginning factories of Andhra Pradesh, questionnaires were got filled up from 77 ginning/pressing factories.

For a study on Strength of Attachment between Cotton Fibre and Seed, eighteen samples of seed cotton have been tested on the Shirley Attachment Strength Tester for estimating the ballistic work required to extract fibres from the seed surface. It has been found that the micropylar fibres are the most difficult ones to remove. The chalazal and side region fibres need much lower energy for extraction. The energy needed to extract 1 kg of lint showed a wide range from 1076 Joules for Suvin to 2777 for MCU.5 among the 18 varieties so far tested. It would appear that varieties belonging to *barbadense* and *herbaceum* need less energy for fibre extraction than do varieties of *hirsutum* and *arboreum* species.

A total of 25 cotton samples, in addition to the seven samples experimented earlier, were taken-up for the study of the Incidence of Seedcoat Fragments in Ginned Cotton. The number of seed coats and their weights were determined and a method to estimate the number of seed coats directly from the weight of the seed coats was attempted. There was good correlation between the two (r:0.96). Cotton varieties belonging to *G. hirsutum* species showed high incidence of seed coat fragments.

SUMMARY OF THE REPORT

Suitability of the hybrid cotton TCHB.213 for blending with 1.2D x 38 mm polyester in various proportions in comparison with similiar blends of another long staple cotton, Suvin was investigated at the Regional Unit of CIRCOT at Coimbatore. The 40:60 Suvin: Polyester blend recorded higher CSP than the corresponding hybrid : polyester blend.

Physical analysis of yarn faults according to their sources of occurence in 40s carded and combed export yarn was completed. Dimensional measurements of faults also were carried out. A limited study on the effect of fault reduction through noil extraction at comber on the quality of knitted fabric also was made. It was observed that the generation of fly as well as purely spinning faults need to be avoided to maintain high quality standard in export yarns. In the combing experiment, an improved relationship between the frequency of faults and the combined effect of uniformity ratio and trash content has been established. Appearance of grey knitted single jersey fabrics continues to improve with increase in noil extraction beyond the optimum level of 14% for the cotton under study at which different yarn properties optimise. This is largely due to reduction in A and B type yarn faults.

Tension measurements at the time of yarn formation during rotor spinning for polyester and suvin cotton were carried out and few samples were tested for dynamic modulus.

For a study on mechanical properties and wear comfort of apparel fabrics and their inter relationships, 48 fabric samples have been procured for the determination of physical properties, which included pure cotton fabrics as well as polyester-cotton and polyester-viscose blends. Out of the several tests planned, tests for fabric weight, drape and bending stiffness have been completed.

For an investigation on the physical, structural and biochemical studies on cotton fibres during boll development, physical, biochemical and structural investigations carried out on fibres collected each day after eighteenth day post-anthesis from flowers tagged on the same day. It was found that the cellulose deposited in an intermediate phase of about a week from 24th day post-anthesis, had a poorer molecular and crystallite organization as compared to those in the preceding and succeeding phases.

In connection with a study of morphological deformities in cotton fibres in relation to space constraint in the developing boll, experimental work on developing bolls of sixteen cotton varieties and hybrids has been completed. The volume of different components of bolls was measured using water displacement method and the mass was determined using a single pan balance. From the data collected so far, two indices C_1 and C_2 for space constraint has been worked out. These two indices are ranging from 0.459 to 0.883 and 0.358 to 0.813, respectively.

In connection with the investigation on measurement of frictional characteristics of cotton fibres, the influence of normal load on the coefficient of friction was investigated. It is found that Amonton's law, according to which coefficient of friction is a constant, independent of normal load, is not obeyed in the case of textile fibres. The coefficient of friction decreases as normal load increases.

In the case of textile fibres, with different values for static and dynamic friction both these coefficients experience reductions in their values, as applied load increased. But the reduction is more in the case of dynamic friction. A power law connecting frictional force (F) with normal load (N) (i.e. $F = a N^b$ where, a and b are constants) holds good in the case of textile fibres for static and dynamic frictions.

In connection with an investigation on Some Aspects of Electrical Properties of Cotton Fibres/Yarns, the measurement of I-V characteristics was made on different textile fibres in vacuum/without vacuum. It was observed that current values under vacuum were reduced by about 1000 times as compared to that in air. Conductivity studies on cotton fabrics are in progress.

For an investigation on the Structure and Properties of Natural Cellulosic Fibres Other than Cotton, evaluation of tensile, morphological and fine structural properties of a few varieties of pineapple and arecanut fibres have been completed in addition to a variety each of flax (dual purpose), jute and ramie. The tenacities of flax and jute at test lengths higher than that of ultimate units was very much dependent on the extent of retting. Birefringence measured on single cells and the tenacity of technical fibres showed good correlations (+ 0.8).

For an Analytical Study of Wax in Indian Cottons, fifty-four samples of Trade Varieties of Indian Cotton of crop season 1990-91 were quantitatively analysed for wax content. Species-wise variation and location-wise variation in wax content was observed. Solvent system for the separation of individual components of wax on TLC was perfected. Seven samples of cotton wax of different varieties were analysed on TLC Varietal variation in the percentage composition of the various components of wax was noted.

In connection with the development of a Durable Soil Release Finish for Cotton and cotton: polyester blended fabrics, fabrics samples were finished with conventional and modified antisoiling treatments using glyoxal and DMDHEU as crosslinking agents. The control and finished fabrics were evaluated for breaking strength, tearing strength and washfastness of the finish. Modified finishing treatments improved the strength as well as washfastness of the finished fabric.

As part of an investigation on the Effect of Laundering on Physical and Mechanical Properties of Chemically Treated Apparel Fabrics, two aspects, viz. optimisation of washing temperature (4°, 60°, and 80°) for laundering and soap detergent combinations for washing different types of fabrics, were studied during the year. The washed/treated/control samples pertaining to various experiments were being tested for fabric properties.

Production of Cellulase by *Penicillium funiculosum* was studied in a 5-litre modular fermenter and flasks. To increase the cellulase production, concentration of two important ingredients, viz. cellulose and peptone, of T.V. medium was altered. Cellulase production was enhanced to a F.P. activity of 2500 μg of R.S. per ml of enzyme at 1.0% cellulose and 0.25% peptone. A further increase in F.P. activity upto 3000 μg/ml of R.S. could be obtained by increasing cellulose and peptone concentration to 2% and 0.6%, respectively.

SUMMARY OF THE REPORT

In connection with the study of Thermal Stability of Cotton Seed Oil, samples of cotton-seed, coconut, til, corn, groundnut and mustard oils were heated at 200°C for different periods upto 24 hours. Kinematic viscosity of those samples increased with increase in heating time. Gel permeation chromatography showed the formation of polymers in heated oils. Also the colour of oil samples darkened with increase in heating time.

In connection with the study on Amino Acid Analysis of the Cottonseed Proteins and Cotton Meal Hydrolysates, analysis has been completed for 35 samples and it was observed that the percentage of glutamic acid was maximum in all cases and the least was cystine.

For investigation on The Properties of Linters of Different Cotton Varieties, ginned cotton seeds of variety Laxmi, K-2, H-4 and C-Indore-1 were collected, delinted and the linter so obtained was cleaned on the Shirley Analyser. Linter %, trash % and cage loss % values for each variety were determined. Cleaned linter samples were then subjected to kiering and bleaching. Values for reflectance and degree of polymerisation (D.P.) of kiered as well as kiered and bleached samples were determined. Some degradation was observed in kiered and bleached samples as D.P. values were quite low.

Large scale trial was conducted at M/s. Padmavathy Panel Boards Ltd., Tumkur, to prepare particle boards of 6' x 3' from cotton stalks. One tonne cotton stalks has been processed to prepare 30-35 boards of various thicknesses with different surface finishes. The boards were found to be of good quality and they satisfied all BIS standards. From this trial, economics of plant of 3 tonne and 5 tonne per day capacity has been worked out. A unique device was also fabricated as per BIS to carry out various strength tests on the boards.

Trials were conducted to prepare sulphate pulps by digesting cotton stalk chips with various concentrations of chemicals, viz. 12%, 14% and 16% at 165°C for 75 min. at a material to liquor ratio of 1:3. The quality of the paper produced by the above process was comparatively better than the paper produced from kraft process under similar cooking conditions. The kraft paper so prepared can be used for preparing good quality corrugated boxes. Similarly, preliminary trials were conducted to prepare chemi-mechanical pulps by digesting cotton stalk chips with 5%, 6% and 7% NaOH at 160°C for 30 min. followed by refining in a disc refiner in 3 pass and then beating. The paper produced can be used for wraping as well as packaging purposes.

A noval method to produce pulp and paper from cotton stalks by anaerobic digestion has been tried out and the results indicated that cotton stalks treated with 4% alkali and subjected to anaerobic treatment for two weeks produced good quality pulp and paper.

Scale up Trials of Oyster Mushroom Crop on Cotton Stalks were undertaken and the results indicated that about 500 gms. of mushroom could be obtained using one kg. of cotton stalks. An attempt was made to replace grain spawn with stalk spawn and it was found that the cotton stalk spawn can be used even after one month and upto three months without any effect on quality

and quantity of mushrooms.

For improving the efficiency of biogas production from willow-dust, an experimental plant to process 50 kg. willow dust was fabricated and charged with willow-dust and photosynthetic bacteria. The observations regarding methane content of the gas were being made.

In connection with the studies on Cotton Plant Material and Cotton Dust using X-ray Fluorescence Spectrometry, analysis were made of wastes collected from different stages of processing. It was found that reducing toxic element concentration could be successfully effected at the blow-room stage and that the origin of toxic element found in cotton dust could be traced to leaf, bract, seedcoat and other plant parts. Ni, Br, Cd and Ba were identified as the most hazardous elements in cotton dust.

7

Personnel

Major events during 1991-92 under personnel function of CIRCOT are given below:

A. APPOINTMENTS

Sr. No.	Name	Grade	Effective date of appointment
		Technical Staff	
1.	Shri R. R. Chhagani	Technical Assistant T-II-3	5-8-1991
2.	Shri C. Sureshkumar	Technical Assistant T-II-3	29-8-1991
3.	Shri S. N. Hedav	Technical Assistant T-II-3	23-3-1992
4.	Shri Nehrulal Meena	Technical Assistant T-II-3	23-3-1992
5.	Shri A. K. Singh	Technical Assistant T-II-3	27-3-1992
6.	Shri M. B. Chandanshive	Technical Assistant T-I	7-9-1991
7.	Shri B. V. Shirsath	Technical Assistant T-I	10-9-1991
8.	Shri D. M. Correia	Technical Assistant T-I	19-9-1991
		Administrative Staff	
	Kum. B. G. Menon (on compassionate ground)	Jr. Clerk	6-1-1992
		Supporting Staff	
1.	Shri S. K. Parab	Supporting Staff Gr. I	9-3-1992
2.	Shri V. T. Tambade	Supporting Staff Gr. I	13-3-1992
3.	Shri A. F. Gudadur	Supporting Staff Gr. I	16-3-1992

B. ASSESSMENTS

Technical Staff

The five yearly assessment of eligible technical staff was made and Promotions/ Advance increments granted as given in the following tables.

Promotions

Sr. No.	Name	Grade to which promoted	Effective date of promotion
1.	Shri Ram Parkash	Technical Officer T-8	1-7-1991
2.	Shri E. S. Abraham	Technical Officer T-6	5-6-1991
3.	Shri S. Vancheswaran	Technical Officer T-5	1-1-1991
4.	Shri E. A. Pachpinde	Technical Officer T-5	1-1-1991
5.	Shri R. S. Pathare	Technical Officer T-5	1-1-1991
6.	Dr. V. K. Madan	Technical Officer T-5	1-1-1991
7.	Shri D. N. Moon	Sr. Technical Assistant T-4	1-1-1991
8.	Shri P. B. Gurjar	Sr. Technical Assistant T-4	1-1-1986
9.	Shri Bechan Nokhai	Technical Assistant T-I-3	1-1-1991

Advance Increments

Sr. No.	Name		No. of advance increments	Effective date of increment
1.	Smt. S. V. Sukhi	T-5	Two advance increments	1-7-1991
2.	Shri V. B. Suryanarayanan	T-5	Two advance increments	1-7-1991
3.	Shri R. M. Modi	T-5	Two advance increments	1-7-1991
4.	Shri P. K. Mandhyan	T-4	Two advance increments	1-7-1991
5.	Shri V. M. Kulmethe	T-4	Two advance increments	1-7-1991
6.	Shri C. P. Venugopalan	T-5	One more advance increment (Total 3)	1-1-1991
7.	Shri H. B. Tambe	T-I-3	Two advance increments	1-7-1991
8.	Smt. K. K. Kale	T-2	Two advance increments	1-7-1991
9.	Shri P. G. Kadam	T-1	One more advance increment (Total 3)	1-7-1991

C. PROMOTIONS

Administrative Staff

Smt. S. R. Shirsat to the post of Sr. Clerk w.e.f. 30-5-1991.

Auxiliary Staff

1. Shri G. G. Ambare to the post of Sr. Operative w.e.f. 21-9-1991.
2. Shri M. R. Nevrekar to the post of Sr. Operative w.e.f. 21-9-1991.

Supporting Staff

1. Shri T. H. Mhaske to the post of Supporting Staff Gr. III w.e.f. 8-10-1991.
2. Shri S. A. Waghela to the post of Supporting Staff Gr. III w.e.f. 9-10-1991.
3. Shri D. B. Temgire to the post of Supporting Staff Gr. II w.e.f. 16-10-1991.
4. Shri D. M. Raje to the post of Supporting Staff Gr. II w.e.f. 16-10-1991.

D. TRANSFER

Scientific Staff

Shri D. Rama Rao, Scientist S-2 from CIRCOT, Bombay to NAARM, Hyderabad, w.e.f. 5-4-1991.

Technical Staff

1. Shri H. S. Koli, Technical Assistant T-II-3 from CIRCOT, Bombay to Q.E. Unit, Sirsa, w.e.f. 13-12-1991 and back to CIRCOT, Bombay, w.e.f. 27-3-1992.
2. Shri R. G. Dhakate, Technical Assistant, T-II-3 from Q.E. Unit, Indore to Q.E. Unit, Nanded, w.e.f. 30-3-1992.

Administrative Staff

1. Shri P. K. Vasu, Jr. Clerk from CIRCOT. Bombay to CPCRI, Kasargod, w.e.f. 24-3-1991.
2. Shri A. K. Kunjipalu, Jr. Clerk from CPCRI, Kasargod to CIRCOT, Bombay, w.e.f. 3-9-1991.

Supporting Staff

1. Shri M. P. Tohokar, S.S. Gr. II from Q.E. Unit, Akola to GTC, Nagpur, w.e.f. 4-5-1991.

E. RESIGNATION/TERMINATION OF SERVICE

Technical Staff

1. Shri R. Srinivasan, Technical Assistant T-II-3 resigned from service w.e.f. 9-8-1991.
2. Shri Sita Ram, Technical Assistant T-II-3 resigned from service w.e.f. 30-11-1991.
3. Shri C. Sureshkumar, Technical Assistant T-II-3 resigned from service w.e.f. 13-12-1991.

Auxiliary Staff

Shri R. N. Kadam, Driver resigned from service w.e.f. 20-7-1991.

Administrative Staff

Shri T. S. Patil, Jr. Clerk resigned from service w.e.f. 16-12-1991.

F. RETIREMENT

1. Shri N. S. Sekaran, Finance & Accounts Officer, retired from service w.e.f. 31-5-1991.
2. Shri M. M. Rupawate, Sr. Operative retired from service w.e.f. 31-7-1991.
3. Shri Y. R. Sone, S. S. Gr. III retired voluntarily from service w.e.f. 1-2-1992 (FN).

G. DEPUTATION

1. Shri G. Sasidharan, Asstt. Administrative Officer deputed for one year to Power Engg. Training Society's Station at Neyveli, Tamil Nadu from 30-4-1991.
2. Shri P. Bhaskaran, Finance and Accounts Officer joined CIRCOT, Bombay on 24-10-1991 on deputation for one year from The Office of the Accountant General, Trivandrum.

H. OBITUARY

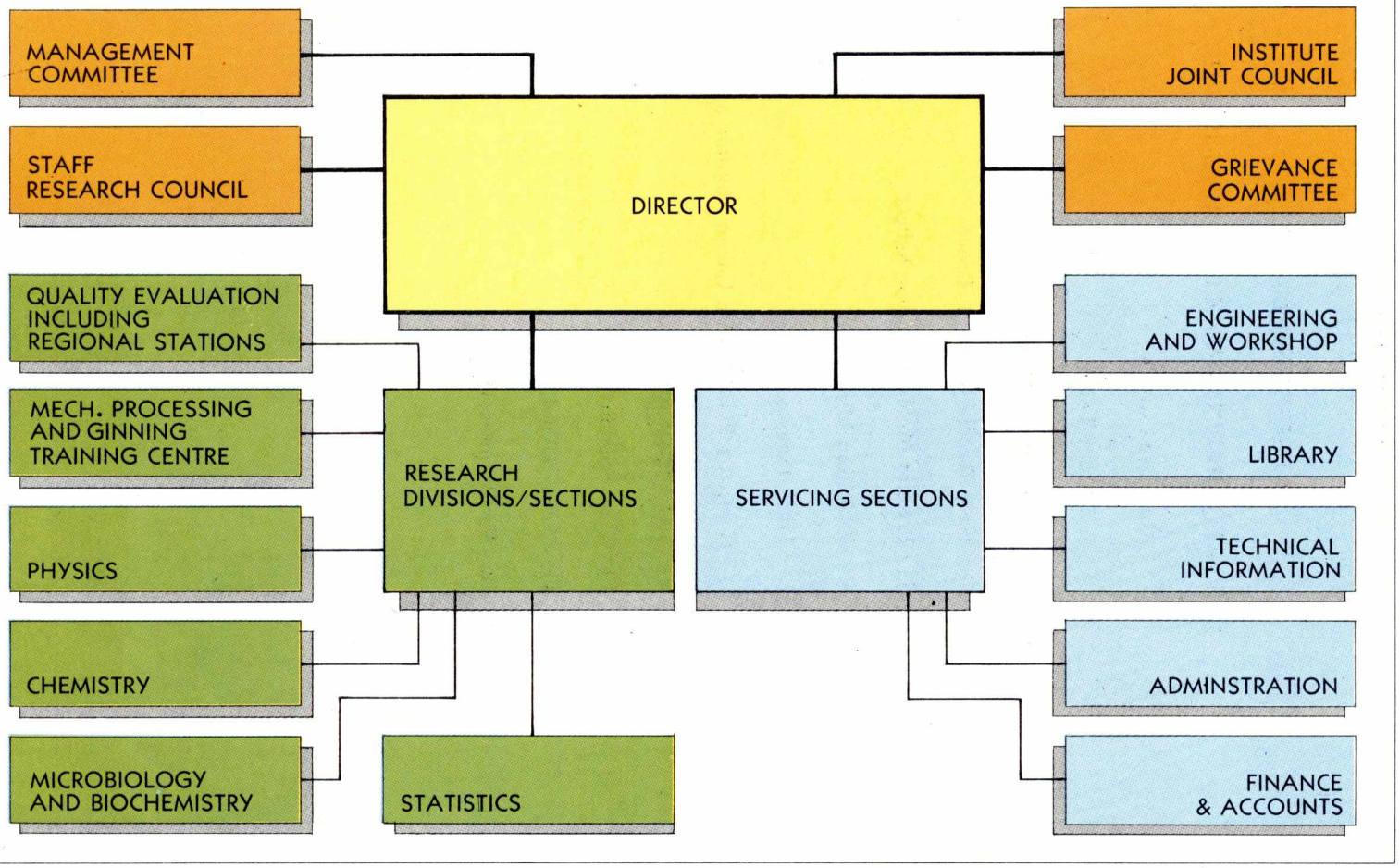
Shri P. K. Gopalan, T-1-3 expired on 21-5-1991.

8. Annexures

ANNEXURE — I

CENTRAL INSTITUTE FOR RESEARCH ON COTTON TECHNOLOGY

ORGANISATION CHART



ANNEXURE — II

NEW EQUIPMENTS ADDED DURING 1991-92

1. Autoclave
2. Lea-Multi Tester
3. Fibre Cutting Machine
4. Fibre Bundle Strength Tester
5. Premier Mesdam Unibox Splicer
6. Projection Microscope
7. Fibre Fineness Tester
8. Computer PC/AT with Colour Monitor and Printer
9. Stor Digital Autospan
10. Yarn Friction Tester
11. Coarse Length Tester
12. Air Compressor

ANNEXURE — III

LIST OF DISTINGUISHED VISITORS

1. Dr. A. B. Joshi, Retd. Director General, ICAR, New Delhi and Former Vice Chancellor, MPKV, Rahuri.
2. Mr. Pham Duy Lam., Head of Textile Mission, Vietnam.
3. Mr. Ha Ba Ktwe, Commercial Counsellor, Embassy of S. R. Vietnam in India
4. Md. Ataur Rahman, Sr. Scientific Officer, Bangladesh Jute Research Institute, Bangladesh.
5. Md. Mohammad Ali, Principal Scientific Officer, Bangladesh Jute Research Institute, Bangladesh.
6. Mr. Siddiqur Rahman, Sr. Scientific Officer, Bangladesh Jute Research Institute, Bangladesh.
7. Mr. Rafique Quader, Sr. Scientific Officer, Bangladesh Agricultural Research Institute, Bangladesh.
8. Dr. Khem Singh Gill, Vice-Chancellor, Punjab Agricultural University, Ludhiana.
9. Mr. K. N. Ardhanareeswaran, Secretary, Govt. of India, Ministry of Textiles, New Delhi.
10. Shri K. Rajendran Nair, Textile Commissioner, Bombay.
11. Shri K. Sidhu, Chairman and Managing Director. NTC, Maharashtra (North) Bombay.
12. Mr. Cheng Yaobang, Vice Minister of Agriculture, P.R. of China.
13. Mr. Dong Qingbong, Dy. Director, Dept. International Co-operation, Ministry of Agriculture P.R. of China.
14. Mr. Hao Lingbhen, Dy. Director, Dept. of Agriculture, P.R. of China.
15. Mr. Liu Gunagning, Counsellor for Science and Technology, Embassy of China, New Delhi.
16. Mr. Li Zhengdong, Dy. Division Chief, Department of International Co-operation, Ministry of Agriculture, P.R. of China.
17. Mr. Ni Hongxing, Official of Dept. of International Co-operation, Ministry of Agriculture, P.R. of China.
18. Ms. Ke Kear, Official of Dept. of International Co-operation, Ministry of Agriculture, P.R. of China.
19. Dr. D.P.S. Chauhan Asstt. Commissioner of Fisheries, Ministry of Agriculture, Krishi Bhavan, New Delhi.

ANNEXURE — IV

FINANCIAL STATEMENT — A

EXPENDITURE AND RECEIPTS OF THE INSTITUTE DURING 1991-1992

		Sanctioned Grant	Actual Expenditure	Savings(—) Deficit(+)
		Rs.	Rs.	Rs.
	A. EXPENDITURE			
I.	CIRCOT including Q.E. Units (Non-Plan)			
	(a) Capital expenditure including expansion of the Institute	6,46,278	6,46,278	—
	(b) Working expenditure	1,43,53,722	1,43,45,202	(—) 8,520
		1,50,00,000	1,49,91,480	(—) 8,520
II.	(Plan)			
	(a) Capital expenditure including expansion of the institute	34,68,337	34,68,337	—
	(b) Working expenditure	5,31,663	7,43,562	(+) 2,11,899
		40,00,000	42,11,899	(+) 2,11,899
III.	Emeritus Scientist Scheme of ICAR	42,000	40,608	(—) 1,392

B. RECEIPTS

Sale proceeds of farm produce	59,553
Sale proceeds of vehicles, machines, tools, and plants and other non-consumable materials	35,190
Analytical and testing fees	2,89.987
Rent	88,899
Application fees from candidates in connection with recruitment and training	1,66,256
Sale of publications	1,469
Interest on loans and advances granted to Council's employees.	33,603
Leave Salary and pension contributions, etc.	—
Miscellaneous receipts	10,550
Summer Institute	—
Receipts for services rendered by the institute	3,000
	6,88,507

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Appendices

APPENDIX — I

STAFF WORKING AT THE CENTRAL INSTITUTE FOR RESEARCH ON COTTON TECHNOLOGY AS ON MARCH 31, 1992

(List does not include vacant posts)

LIST OF STAFF IN THE HEADQUARTERS

Scientific Personnel

Director

Dr. N. B. Patil, M.Sc., Ph.D.

Principal Scientist

1. Dr. P. K. Chidambareswaran, M.Sc., Ph.D.
2. Dr. V. G. Khandeparkar, M.Sc., Ph.D.
3. Dr. K. R. Krishna Iyer, M.Sc., Ph.D., F.T.A.
4. Dr. V. G. Munshi, M.Sc., Ph.D., F.T.A.
5. Shri M. S. Parthasarathy, M.Text (Bom.), M.Sc. Tech (Manch.), A.M.C.S.T., Rashtrabhasha Ratna
6. Shri B. Srinathan, B.Sc. (Text), M.Text.

Scientist (Selection Grade)

1. Shri Muntazir Ahmed, B.Sc., B.Text. (Text. Tech.)
2. Dr. R. H. Balasubramanya, M.Sc., (Agri). Ph.D.
3. Smt. S. P. Bhatawadekar, M.Sc.
4. Dr. S. G. Gayal, M.Sc., Ph.D.
5. Shri G. F. S. Hussain, M.Sc.
6. Dr. (Smt.) P. Bhama Iyer, M.Sc., Ph.D.
7. Smt. J. K. Iyer. M.Sc.
8. Smt. Vatsala Iyer, M.Sc., M. Phil.
9. Dr. R. P. Nachane, M.Sc., Ph.D.
10. Smt. Prema Nair, M.Sc. (Agri.).
11. Dr. K. M. Paralikar, M.Sc., Ph.D., F.R.M.S.
12. Shri B. M. Petkar, M.Sc., D.C.M.
13. Kum. C. R. Raje, M.Sc.
14. Shri A. J. Shaikh, M.Sc.
15. Dr. S. Sreenivasan, M.Sc., Ph.D.
16. Shri A. V. Ukidve, M.Sc., F.T.A.
17. Shri P. V. Varadarajan, M.Sc.
18. Dr. N. C. Vizia, M.Sc., Ph.D.

Scientist (Sr. Scale)

1. Shri R. M. Gurjar, M.Sc.
2. Shri N. Thejappa, M.Sc.
3. Smt. J. K. S. Warrier, M.Sc.

Scientist

1. Shri P. Bhaskar, M.Sc.
2. Shri S. K. Chattopadhyay, B.Sc. Tech. (Text.), M.Tech. (Text. Engg.)
3. Shri A. K. Gupta, M.Sc., L.L.B., W.P.M.M.T.
4. Shri S. B. Jadhav, M.Sc.
5. Dr. D. N. Makwana, M.Sc., Ph.D.
6. Shri D. V. Mhadgut, M.Sc.
7. Shri G. S. Patel, M.Sc.
8. Shri K. H. Sawakhande, M.Sc.
9. Dr. (Smt.) Sujata Saxena, M.Sc., Ph.D.

Technical Personnel

Technical Officer T-6

Engineering

1. Shri H. U. Gangar, B.E. (Elect.) Grad. I.E.T.E.

Quality Evaluation

1. Shri K. S. Bhyrappa, L.T.T., A.T.A.
2. Shri B. S. Ganvir, B.Sc.
3. Kum. I. K. P. Iyer, M.Sc.
4. Shri S. N. Nagwekar, B.Sc.

Technical Information

Shri T. K. M. Das, B.Sc., D.B.M., D.E.I.M., Dip. J., D.P.R., Cert. I.S.R.S.

Technical Officer T-5

Library

Smt. R. K. Shahani, B.Sc., B.Lib.

Photography

Shri R. M. Modi, S.S.C., Cert. in Photography

Quality Evaluation

1. Shri K. V. Ananthakrishnan, M.Sc., D.B.M.
2. Shri S. Chandrasekhar, L.T.M., A.T.A., Cert. S.Q.C.
3. Smt. P. A. Dabholkar, B.Sc.
4. Shri S. G. Dalvi, S.S.C., Cert. Wireman, Cert. Ref.&Air-Cond., Govt. Elect. Sup.
5. Shri S. J. Guhagarkar, M.Sc.
6. Shri I. H. Hunsikatti, B.Sc. A.T.A.

7. Shri C. R. Sthanu Subramony Iyer, B.Sc.
8. Smt. A. A. Kathe, B.Sc.
9. Shri H. R. Laxmivenkatesh, D.T.T., A.T.A., L.T.I.
10. Smt. N. D. Nachane, B.Sc.
11. Shri E. A. Pachpinde, M.Sc.
12. Smt. S. D. Pai, M.Sc.
13. Shri R. S. Pathare, B.Sc.
14. Shri D. Radhakrishnamurthy, M.Sc., M.Phil.
15. Shri K. B. Rajagopal, B.Sc.
16. Shri S. Sekar, B.Sc.
17. Smt. S. V. Sukhi, M.Sc., D.F.L. (German)
18. Shri V. B. Suryanarayanan, B.Sc., Dip. Ger.
19. Shri G. Viswanathan, M.Sc., A.T.A.
20. Shri S. Vancheswaran, B.Sc.

Senior Technical Assistant T-4

1. Shri N. O. Anthony, S.S.C.
2. Shri S. M. Gogate, B.Sc.
3. Shri P. B. Gurjar
4. Shri Jayaprakash Narayana, B.Tech. (Text.)
5. Smt. S. R. Kamath, B.Sc.
6. Shri P. K. Mandhyan, B.Sc., A.T.A.
7. Shri D. N. Moon, B.Sc.
8. Shri D. L. Upadhye, S.S.C. (Tech.), N.C.T.V.T., (I.T.I. & C.T.I.)
9. Shri T. Venugopal, B.E. (Civil)
10. Shri G. Vijayan Iyer, Dip. Mech. Engg., Dip. Prod. Mgt., A.M.I.E. (Mech.)

Technical Assistant T-II-3

1. Shri Amar Pal, B.Sc.
2. Smt. N. M. Ashtaputre, B.Sc.
3. Shri R. R. Chhagani, B.Sc.
4. Shri U. D. Devikar, B.Sc.
5. Shri Gopal B. Hadge, B.Sc.
6. Shri S. N. Hedau, B.Sc.
7. Shri V. D. Kalsekar, B.Sc.
8. Kum. S. S. Kamerkar, B.Sc., B.Lib.
9. Shri H. S. Koli, B.Sc.
10. Shri M. Mohan, M.Sc., Dip. J.
11. Shri V. V. Murudkar, L.T.M.
12. Shri R. D. Nagarkar, M.Sc.
13. Smt. Nirupama Panda, M.Sc.
14. Shri R. S. Prabhudesai, B.Sc.
15. Shri B. R. Pawar, B.Sc.
16. Shri P. N. Sahane, D.I.F.T.
17. Smt. Sheela Devi Raj, M.Sc.
18. Smt. Sugatha Padmanabhan, M.Sc.
19. Shri S. Kumar Subramaniam, B.Sc.
20. Shri M. V. Vivekanandan, B.Sc.

Technical Assistant T-I-3

Shri R. K. Landge

Technical Assistant T-2

1. Smt. K. K. Kale, B.A.
2. Shri S. B. Kamble
3. Shri D. V. Kambli

Technical Assistant T-1

1. Shri M. B. Chandanshive, (Machinist/Fitter)
2. Shri D. M. Correia (Mechanic)
3. Shri P. G. Kadam (Wireman)

Auxiliary Personnel

1. Shri V. V. Kshirsagar,* S.S.C., I.T.C., Cert. Elec. Super., Cert. F.&S., (Conditioning Plant Operator T-5)
2. Smt. K. R. Joshi, M.A. (Hindi Translator)
3. Shri P. J. Ahire* (Operator, T-I-3)
4. Shri G. D. Narkar* (Carpenter, T-I-3)
5. Shri S. S. Patekar*, (Driver, T-I-3)
6. Shri H. B. Tambe*, (Plumber, T-I-3)

Operator T-2

1. Shri D. B. Gadankush*
2. Shri B. Nokhai*
3. Shri H. K. Pawar*
4. Shri S. G. Shinde*

Driver

Shri B. B. Gaykar* T-2

Operator

1. Shri G. G. Ambare
2. Shri R. G. Chiplunkar
3. Shri G. S. Deorukhkar
4. Shri B. R. Jadhav
5. Shri T. R. Kadam
6. Shri K. K. Kasar
7. Shri R. R. Khurdekar
8. Shri K. D. Mohite
9. Shri M. R. Nevrekar
10. Shri S. V. Patil
11. Shri A. B. Sawant
12. Shri M. B. Thokrul
13. Shri V. Y. Unhalekar

Administrative Personnel

Administrative Officer

Shri M. K. Jain, B.Sc.

Finance and Accounts Officer

P. Bhaskaran, M.A., L.L.B.

Assistant Administrative Officer

1. Shri P. D. Sonawane, B.A., L.L.B.
2. Shri K. Sudhakaran (Ad-hoc)

Superintendent

1. Shri D. P. Naidu
2. Shri G. Moosad, B.Com.
3. Smt. S. S. Dongare (Ad-hoc), B.A.

* Holding Technical post as Personal.

APPENDICES

Assistant

1. Smt. Jayagouri Sivaramakrishnan
2. Shri M. Z. Bhagat
3. Smt. M. V. Kamerkar, B.A.
4. Shri K. W. Khamkar, B.A.
5. Shri S. N. Salve
6. Shri B. D. Sawant
7. Shri A. B. Dalvi
8. Shri D. G. Kulkarni
9. Shri B. S. Bhenwal
10. Smt. S. S. Shanbhag
11. Shri Niraj Kumar Dixit, M.A., Dip. J.
12. Smt. V. V. Desai
13. Smt. Sujata Koshy, B.Com.
14. Smt. S. D. Ambre (Ad-hoc)
15. Smt. S. M. Desai (Ad-hoc)

Senior Stenographer

Shri Venu Thanikal

Stenographer

1. Smt. S. D. Dudam, M.A.
2. Smt. T. T. Souz

Junior Stenographer

1. Smt. U. N. Bhandari
2. Kum. K. B. Patne

Senior Clerk

1. Shri A. P. Natu
2. Smt. J. J. Karanjavkar
3. Shri E. T. Gurav
4. Shri K. Parleshwar
5. Smt. S. R. Shirsat, B.A.
6. Shri N. V. Kambli (Ad-hoc)

Junior Clerk

1. Smt. V. V. Janaskar, B.Com.
2. Shri J. R. Mangale, B.Com.
3. Shri S. D. Ambolkar
4. Shri R. K. Pallewad, B.A.
5. Shri P. V. Jadhav
6. Kum. S. K. Gaonkar, B.A.
7. Kum. S. V. Pai (Tel. Operator)
8. Shri V. M. Sable
9. Smt. J. R. Chavkute
10. Shri A. K. Kunjipalu
11. Kum. B. G. Menon

Supporting Staff Gr. III

1. Shri Chatrapal Mhatri
2. Shri A. R. Bane
3. Shri T. S. Mhaske
4. Shri S. A. Waghela

Supporting Staff Gr. II

1. Shri T. B. Thapa
2. Shri S. L. Gawde
3. Shri B. K. Sawant
4. Shri N. J. Kharat
5. Shri M. Y. Chandanshive
6. Shri R. B. Jadhav
7. Shri S. M. Sawant
8. Shri M. B. Gurve
9. Shri A. R. Gujar
10. Shri O. T. Thapa
11. Shri B. R. Satam
12. Shri D. M. Chougule
13. Smt. T. V. Bhowar
14. Shri N. R. Kamble
15. Shri S. D. Gurav
16. Shri M. K. Ghadge
17. Shri M. Z. Rathi
18. Shri Narayan Singh
19. Shri D. B. Temgire
20. Shri D. M. Raje

Supporting Staff Gr. I

1. Shri Mohsin Ahmed
2. Shri C. S. Salvi
3. Smt. Birmo Ramkishan Balmiki
4. Shri C. P. Solanki
5. Shri M. J. Sumra
6. Shri K. T. Mahida
7. Shri R. R. Gosai
8. Shri R. S. Rane
9. Shri T. B. Khan
10. Shri H. B. Vaismiya
11. Shri P. G. Ghogale
12. Shri C. V. Shivgan
13. Shri S. S. Angane
14. Shri L. S. Takkar
15. Shri M. M. Katpara
16. Shri G. N. Mayawanshi
17. Shri S. K. Bobate
18. Shri P. P. Patil
19. Shri Ramnivas G. Tak
20. Shri R. P. Karkate
21. Shri S. B. Worlikar
22. Shri N. D. Walzade
23. Shri M. M. Kadam
24. Shri S. G. Phalke
25. Shri S. N. Bandre
26. Shri D. G. Gole
27. Shri S. K. Parab
28. Shri V. T. Tambde

APPENDICES

LIST OF STAFF AT THE QUALITY EVALUATION UNITS

1. AKOLA :

Senior Technical Assistant T-4

Shri N. V. Bansode, B.Sc.

Technical Assistant T-II-3

Shri Adil Zubair, B.Sc.

Supporting Staff Grade I

Shri S. R. Patode

2. COIMBATORE :

Technical Officer T-6
(Quality Evaluation)

Shri A. K. Antony, B.Sc.

Technical Officer T-5
(QualityEvaluation)

1. Smt. Santa V. Nayar, B.Sc.
2. Shri C. P. Venugopalan, B.Sc.

Senior Technical Assistant T-4

Shri S. Venkatakrishnan, M.Sc.

Auxiliary Staff

Operator T-2

Shri K. V. Nair

Supporting Staff Grade IV

Shri N. Arumugham

Supporting Staff Grade III

Shri V. M. Subramanyan

3. DHARWAD :

Technical Officer T-6
(Quality Evaluation)

Shri E. S. Abraham, B.Sc.

Technical Assistant T-II-3

1. Shri K. Narayanan, B.Sc.
2. Shri K. Venkanna, M.Sc., B.Ed.

Supporting Staff Grade I

1. Shri C. J. Bagalkoti
2. Shri A. F. Gudadur

4. GUNTUR :

Senior Technical Assistant T-4
Shri S. Mukundan, B.Sc.

Technical Assistant Grade T-II-3
Shri K. Thiagarajan B.Sc.

Supporting Staff Grade IV
Shri Ch. Thimmanna

Supporting Staff Grade II
Shri V. Y. M. Suvarchala Rao

5. HISAR :

Technical Officer T- 5
Dr. V. K. Madan, M.Sc., Ph.D.

Technical Assistant T-II-3
Shri Jal Singh, M.Sc.

Supporting Staff Grade IV
Shri Gian Singh

6. INDORE :

Technical Assistant T-II-3
1. Shri S. Banerjee, B.Sc.
2. Shri Nehrulal Meena, B.Sc.

Supporting Staff Grade IV
Shri John Robert

Supporting Staff Grade III
Shri H. S. Bhabar

7. LUDHIANA :

Technical Officer T-8
(Quality Evaluation)
Shri Ram Parkash, B.Sc., L.L.B.

Technical Assistant T-II-3
Shri Hamid Hasan, M.Sc.

Supporting Staff Gradt III
Shri Kammikkar Singh

Supporting Staff Grade I
Shri Satyanarayanan Gope

8. NAGPUR :

Scientist (Selection Grade)
Dr. G. R. Anap, M.Tech., Ph.D.

Senior Technical Assistant T-4
Shri V. M. Kulmethe, B.Sc.

Technical Assistant T-II-3

1. Shri S. L. Bhanuse, B.Sc.
2. Shri R. C. Yadav, Dip. Mech, Engg.
3. Shri M. Bhaskar, Dip. in Ref. & Air-cond.

Technical Assistant Gr. T-1

1. Shri P. N. Raut, Electrician
2. Shri B. V. Shirsath, I.T.I., B.A.

Junior Clerk

1. Shri B. D. Dhengale
2. Smt. G. G. Palorkar, B.A.
3. Shri S. A. Telpande, M.Com.

Driver (Auxiliary)

Shri R. A. Suddawar

Supporting Staff Grade II

Shri B. H. Umredkar

Supporting Staff Grade I

1. Shri A. R. Chutale
2. Shri J. P. Patel
3. Shri C. L. Mundale
4. Shri R. B. Kautkar
5. Shri P. S. Panchbudhe, M.A.
6. Shri I. P. Tomaskar
7. Shri M. P. Tohokar

9. NANDED

Scientist

Shri L. D. Deshmukh, M.Sc.

Technical Assistant T-II-3

1. R. G. Dhakate, B.Sc.
2. Shri R. K. Jadhav, B.Sc.

Supporting Staff Grade III

Shri L. R. Indurkar

Supporting Staff Grade I

Shri S. N. Umare

10. RAHURI :

Technical Offictr T-5
Shri R. S. Darade, B.Sc.

Technical Assistant T-II-3
Shri C. M. More, B.Sc.

Supporting Staff Grade I
Shri D. G. Kamble

11. SIRSA :

Senior Technical Assistant T-4
Shri M. T. Danolli, B.Sc.

Technical Assistant T-II-3
Shri A. K. Singh, B.Sc.

Supporting Staff Grade I
Shri Mahabir Singh

12. SRIGANGANAGAR :

Technical Assistant T-II-3
1. Shri Matish Chandra, M.Sc.
2. Shri Udai Vir Singh, B.Sc., B.Ed.

Supporting Staff Grade IV
Shri Vijendra Singh

Supporting Staff Grade III
Shri Sanwarlal Saini

13. SURAT :

Scientist
Shri Y. Subramanyam, M.Sc.

Technical Officer T-5
Shri M. C. Bhalod, B.Sc.

Senior Technical Assistant T-4
Shri G. G. Mistry, B.Sc.

Technical Assistant T-II-3
1. Shri M. B. Patel, B.Sc.
2. Shri V. L. Rangari, B.Sc.

Junior Clerk
Shri J. I. Parmar, B.Com.

Operator (Auxiliary)
Shri J. B. Dhodia

Supporting Staff Grade III
Shri K. M. Rathod

APPENDIX — II

Statement showing the total number of Government Servants and the num ber of Scheduled Castes and Scheduled Tribes amongst them as on March 31, 1992

Group/Class	Permanent / Temporary	Total No. of employees	Scheduled Castes	Scheduled Tribes	Remarks
Gr. A. (Class I)					
Permanent					
(i) Other than lowest rung of Cl. I		30	1	—	—
(ii) Lowest rung of Cl. I		21	—	—	—
Total		51	1		
Temporary					
(i) Other than lowest rung of Cl. I		—	—	—	—
(ii) Lowest rung of Cl. I		1*	—	—	* on deputation
Total		1	—		
Gr. B. (Cl. II)	Permanent	48	5	1	
	Temporary	2	—	1	
Gr. C. (Cl. III)	Permanent	100	24	4	
	Temporary	16	2	3	
Gr. D. (Cl. IV) (Excluding Safaiwala)	Permanent	53	11	3	
	Temporary	10	1	1	
Gr. D. (Cl. IV) Safaiwala	Permanent	8	8	—	
	Temporary	1	1	—	

APPENDIX — III

Part I: Posts filled by direct recruitment

Statement showing the number of reserved vacancies filled by members of Scheduled Castes and Scheduled Tribes during the year 1991-92

SCHEDULED CASTES

Name of post	Total No. of Vacancies Notified Filled		No. of vacancies reserved		No. of SC candidates appointed	Short fall	No. of ST candidates appointed against vacancies reserved for SCs in the year	No. of SC vacancies carried forward to the next year	No. of reservations lapsed after carrying forward for 3 years	No. of reservations lapsed from 1980 till the end of the year previous to the year of review	Progressive total of reservation lapsed (Col. 10+1)
			Out of Col. 2	Out of Col. 3							
1	2	3	4	5	6	7	8	9	10	11	12
Group A Other than Lowest rung of Group A	—	—	—	—	—	—	—	—	—	—	—
Lowest rung of Group A	—	—	—	—	—	—	—	—	—	—	—
Group B	—	—	—	—	—	—	—	—	—	—	—
Group C	5	5	1	—	1	—	—	—	—	—	—
Group D (Exc. Sweepers)	—	—	—	—	—	—	—	—	—	—	—
Group D (Sweepers)	—	—	—	—	—	—	—	—	—	—	—

SCHEDULED TRIBES

	No. of vacancies reserved Out of Col. 2	Out of Col. 3	No. of ST candidates appointed	Short fall	No. of SC candidates appointed against vacancies reserved for STs in the 3rd year of carry forward	No. of STs vacancies carried forward to the next year	No. of reservations lapsed after carrying forward for 3 years	No. of reservation lapsed from 1980 till the end of the year previous to the year of review	Progressive total of reservation lapsed (Col. 19+20)
	13	14	15	16	17	18	19	20	21
Group A Other than Lowest rung of Group A	—	—	—	—	—	—	—	—	—
Lowest rung of Group A	—	—	—	—	—	—	—	—	—
Group B	—	—	—	—	—	—	—	—	—
Group C	—	—	—	—	—	—	—	—	—
Group D (Encl. Sweepers)	—	—	—	—	—	—	—	—	—
Group D (Sweepers)	—	—	—	—	—	—	—	—	—

Part-II Posts filled by Promotion (on seniority-cum-fitness)

SCHEDULED CASTES

Name of post	Total No. of Vacancies Notified	Filled	No. of vacancies reserved		No. of SC candidates appointed	Short fall	No. of ST candidates appointed against vacancies reserved for SCs in the year	No. of SC vacancies carried forward to the next year	No. of reservations lapsed after carrying forward for 3 years	No. of reservations lapsed from 1980 till the end of the year previous to the year of review	Progressive total of reservation lapsed (Col. 10+1)
			Out of Col. 2	Out of Col. 3							
1	2	3	4	5	6	7	8	9	10	11	12
Group A Other than Lowest rung of Group A	—	—	—	—	—	—	—	—	—	—	—
Lowest rung of Group A	—	—	—	—	—	—	—	—	—	—	—
Group B	—	—	—	—	—	—	—	—	—	—	—
Group C	5	5	1	—	1	—	—	—	—	—	—
Group D (Exc. Sweepers)	—	—	—	—	—	—	—	—	—	—	—
Group D (Sweepers)	—	—	—	—	—	—	—	—	—	—	—

SCHEDULED TRIBES

	No. of vacancies reserved Out of Col. 2	No. of ST candidates appointed Out of Col. 3	Short fall	No. of SC candidates appointed against vacancies reserved for STs in the 3rd year of carry forward	No. of STs vacancies carried forward to the next year	No. of reservations lapsed after carrying forward for 3 years	No. of reservation lapsed from 1980 till the end of the year previous to the year of review	Progressive total of reservation lapsed (Col. 19+20)
	13	14	15	16	17	18	19	20	21
Group A Other than Lowest rung of Group A	—	—	—	—	—	—	—	—	—
Lowest rung of Group A	—	—	—	—	—	—	—	—	—
Group B	—	—	—	—	—	—	—	—	—
Group C	—	—	—	—	—	—	—	—	—
Group D (Encl. Sweepers)	—	—	—	—	—	—	—	—	—
Group D (Sweepers)	—	—	—	—	—	—	—	—	—

Part-III Posts filled by promotion (by selection)

SCHEDULED CASTES

Name of post	Total No. of Vacancies Notified Filled		No. of vacancies reserved		No. of SC candidates appointed	Short fall	No. of ST candidates appointed against vacancies reserved for SCs in the year	No. of SC vacancies carried forward to the next year	No. of reservations lapsed after carrying forward for 3 years	No. of reservations lapsed from 1980 till the end of the year previous to the year of review	Progressive total of reservation lapsed (Col. 10+1)
			Out of Col. 2	Out of Col. 3							
1	2	3	4	5	6	7	8	9	10	11	12
Group A Other than Lowest rung of Group A	—	—	—	—	—	—	—	—	—	—	—
Lowest rung of Group A	—	—	—	—	—	—	—	—	—	—	—
Group B	—	—	—	—	—	—	—	—	—	—	—
Group C	—	—	—	—	1	—	—	—	—	—	—
Group D (Exc. Sweepers)	—	—	—	—	—	—	—	—	—	—	—
Group D (Sweepers)	—	—	—	—	—	—	—	—	—	—	—

SCHEDULED TRIBES

	No. of vacancies reserved Out of Col. 2	Out of Col. 3	No. of ST candidates appointed	Short fall	No. of SC candidates appointed against vacancies reserved for STs in the 3rd year of carry forward	No. of STs vacancies carried forward to the next year	No. of reservations lapsed after carrying forward for 3 years	No. of reservation lapsed from 1980 till the end of the year previous to the year of review	Progressive total of reservation lapsed (Col. 19+20)
	13	14	15	16	17	18	19	20	21
Group A Other than Lowest rung of Group A	—	—	—	—	—	—	—	—	—
Lowest rung of Group A	—	—	—	—	—	—	—	—	—
Group B	—	—	—	—	—	—	—	—	—
Group C	—	—	—	—	—	—	—	—	—
Group D (Encl. Sweepers)	—	—	—	—	—	—	—	—	—
Group D (Sweepers)	—	—	—	—	—	—	—	—	—