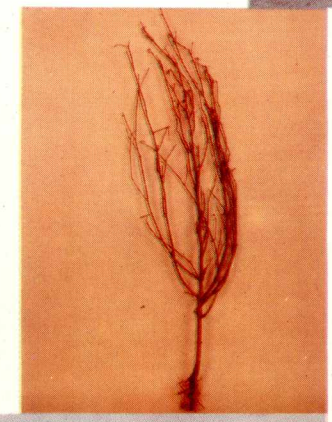

CIRCOT

ANNUAL REPORT 1990-91

भाकृअनुप
ICAR

CENTRAL INSTITUTE FOR RESEARC
ON COTTON TECHNOLOGY

BOMBAY

With effect from 1st April 1991,

the name Cotton Technological

Research Laboratory has been changed as

Central Institute for Research on Cotton Technology

(CIRCOT)

N. B. PATIL
Director

Cotton Technological Research Laboratory

Indian Council of Agricultural Research

भाकृअनुप
ICAR

Annual Report
1990 - 91

BOMBAY

Cover Theme : ... about new ways and new ideas with which we can change our horizons. We shall still see the old; this is our heritage. But we shall also see the new; this is our future.

— Pandit Jawaharlal Nehru

Published by : **Dr. N. B. Patil**, M.Sc., Ph.D.
Director, CTRL, Bombay.

Edited and compiled by : **Shri T. K. M. Das** and
Shri M. Mohan

Cover Design and Layout : **Shri T. K. M. Das**

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I

Introduction

This sixty-seventh Annual Report of Cotton Technological Research Laboratory (CTRL), covers the period, January 1,1990 to March 31, 1991.

This Institute was established by the Indian Central Cotton Committee (ICCC) in the year 1924 under the name of *Technological Laboratory*. 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 Laboratory 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. Since then, the research activities were reoriented 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 in terms of providing gainful employment and self-employment avenues among the rural massess.

The important *functions* of CTRL 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, cotton seeds, etc.

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

6. To issue authoratative reports on the samples received for tests from Government 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 Laboratory, 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 and Accounts Officer looks after matters concerning accounts and audit of the Laboratory.

Library : An up-to-date library of books on cotton, cotton technology and allied subjects are maintained at CTRL. During the reporting period, the total number of books was 4507 with the addition of 295 books during 1990-91. Similarly, the number of bound volumes added to the library was 150 making the total number to 5475. Out of the 200 journals being received on textiles and allied subjects, 90 journals were through subscription (54 foreign and 36 Indian) and the remaining received as complimentary or on exchange basis. The total expenditure for the library for 1990-91 was Rs. 2,77,196/-. 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 also exist for other libraries in Bombay.

New Equipments : Major equipments acquired from April 1, 1990 to March 31, 1991 are given in Annexure II.

Distinguished Visitors : Various officials from ICAR Headquarters and other organisations visited the Laboratory on various occasions.

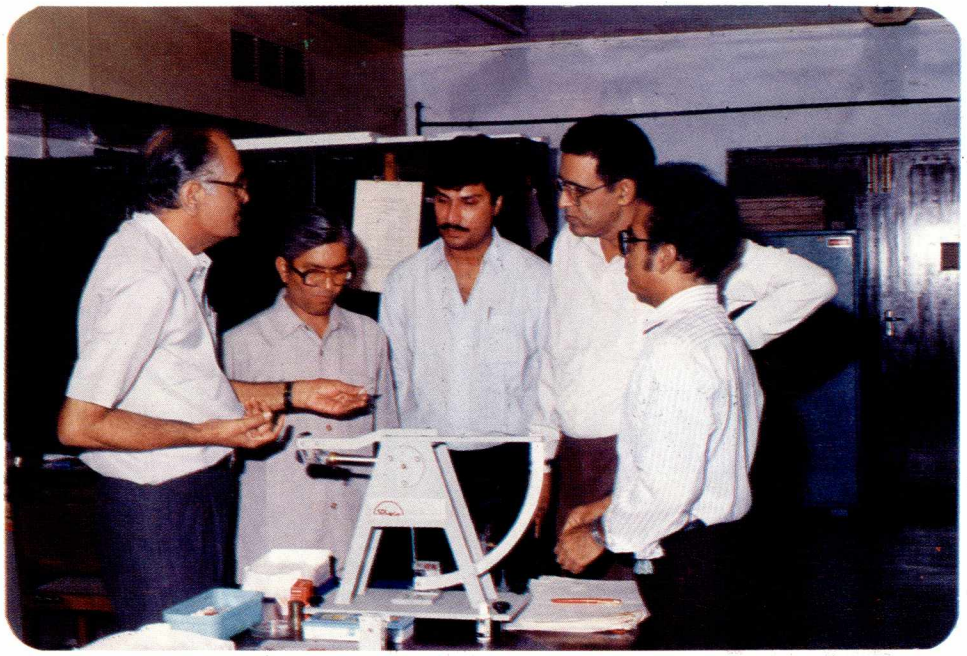
Management Committee : The reconstituted Management Committee of CTRL met on October 29, 1990. Apart from regular items such as confirmation of the minutes of the previous meeting, action taken on the recommendations of the Committee, progress of expenditure, progress of works, action taken on the recommendations of the Institute Joint Council and Grievance Committee, etc. on-going projects and research highlights, proposal for writing off the Matador vehicle, appointment of some AMAs for CTRL staff, major maintenance work on the laboratory buildings as well as staff quarters, conducting consultancy services etc. were also considered and recommendations made.

Women in Agriculture Day : The 'Women in Agriculture Day' was celebrated on December 4, 1990, with a lecture by Dr. Rajani Ashar, Professor, SNDT Univerrity on 'Progress of Programmes for Farm Women.'

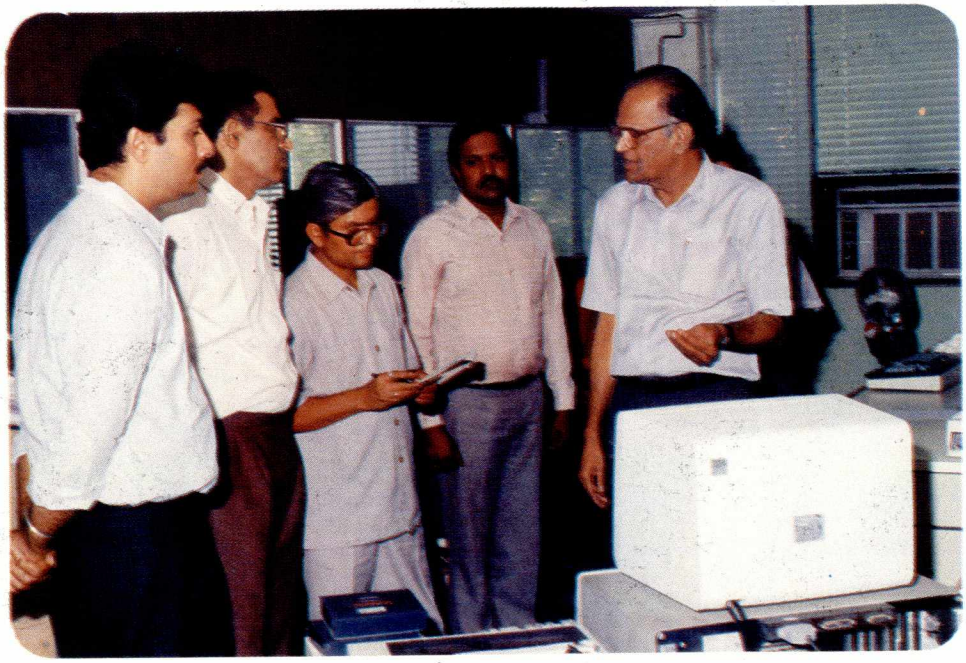
National Science Day Celebration: National Science day which falls on 28th February every year, was celebrated with a talk by Prof. V. A. Shenai of University Department of Chemical Technology on the *Recent Developments in Synthetic Fibres* on February 28, 1991. The function jointly sponsored by CTRL and the ARS scientists Forum was attended by scientists and technical staff of this Institute.

Award : In the thirty-first Annual Conference of the Association of Microbiologists of India held at the Tamil Nadu Agricultural University, Coimbatore, the following two poster papers from CTRL bagged the best poster paper presentation award.

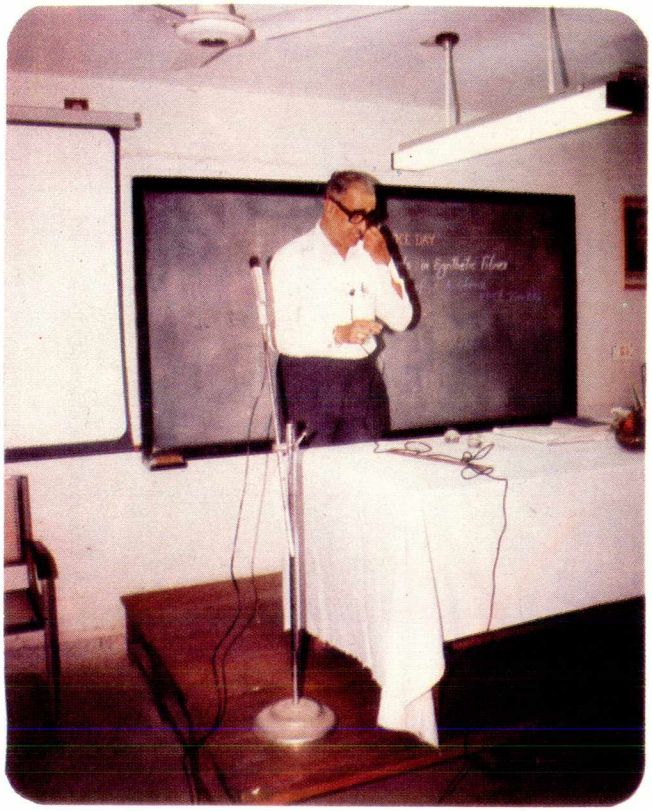
1. Anaerobic digestion of linseed stalk for the preparation of pulp and paper — by



Non-Official Members at the Physics Division. (From L to R) Dr. N. B. Patil, Director, CTRL, Dr. A. Alam, Assistant Director General (Engg.), ICAR, Shri Sukhdev Godara, Non-Official Member, Management Committee, Ch. Jeet Ram, Non-Official Member, Management Committee, and Dr. K. R. Krishna Iyer, Principal Scientist and Head, Physics Division.



Dr. N. B Patil, Director demonstrates the functioning of High Volume Instrument at the Quality Evaluation Division.



Dr. V. A. Shenai, Professor, Bombay University Department of Chemical Technology (BUDCT) delivering a lecture on 'Recent Developments in Synthetic Fibre'

A Section of the Audience

A. J. Shaikh, Y. D. Pai, R. H. Balasubramanya and V. G. Khandeparkar

2. Amylase fermentation by *Bacillus subtilis*-159 and application of enzyme in textiles — by S. G. Gayal and V. G. Khandeparkar.

An expert group of microbiologists from different parts of India were members comprising the Award Panel.

Internal Seminars : During April 1, 1990 to March 31, 1991 the following internal seminars were held :

Sr. No.	*Topic*	*Date*	*Name of the Speaker*
1.	Structure-Property Relations in Wool Fibres	20-6-1990	Dr. D. Rama Rao
2.	Textile Washing and Detergents	28-7-1990	Kum. C. R. Raje
3.	Use of Hollow Polyester Staple Fibres for Apparels	1-9-1990	Shri S. K. Chattopadhyay
4.	Biopesticides	22-9-1990	Dr. V. G. Khandeparkar
5.	Structure and Properties of Chemically Treated Cellulosic Fibres	6-12-1990	Dr. (Mrs.) P. Bhama Iyer
6.	Inverse Relaxation in Polymers	6-12-1990	Shri R. P. Nachane
7.	Effect of Softners on Soiling and Soil Removal from Modified Cross linked Cotton and Cotton: Polyester Blended Fabric.	30-1-1991	Kum. C. R. Raje

Staff Research Council : Two Staff Research Council Meetings were held during the period. The first meeting (eighty-nineth meeting) which was held on January 25, March 13, 14 and 15, 1990 had discussions on progress of research work during January 1, 1989 to September 30, 1989.

The second meeting (ninetyeth meeting) was held on May 29 and June 5 and 6, 1990. Progress of research work during the period April 1, 1990 to March 31, 1991 and new project proposals for the same period were discussed and a programme of work for 1990-91 was finalised. The Joint session with the Management Committee could not be conducted as the term of the Committee was over and the new Committee had not been constituted.

Research Projects:

In all, there were 43 on-going research projects grouped under five Thrust Areas, the details of which were as follows :

	Thrust Area	*No. of Research Projects*
1.	Technological Research for Cotton Quality Evaluation and Improvement.	11
2.	Post-Harvest Technology of Cotton.	5
3.	Structure, Property and Their Inter-Relationships in Textile Materials.	10
4.	Chemical Processing and Finishing Treatments.	5
5.	Utilisation of By-Products of Cotton and Processing Wastes	12

Implementation of Official language (Hindi) : With the passing of qualifying examinations in Hindi by 41 staff members in the Scientific, technical and administrative categories (17 for Pragya and 24 in Pravin), the overall level in Hindi proficiency of staff members has reached 80%. The official Language Implementation Committee had 4 meetings during the year to appraise of the progress of implemtation of various programmes at CTRL and also to chalk out fresh programmes to be taken up for the future. A few staff members from the administration wing attended the Hindi Typing and Shorthand training courses being conducted by the Hindi Teaching Scheme of the Department of Official Language, Bombay. Smt. Vrishali Janaskar and Shri Jayawant Mangale, passed Hindi Typing test with more than 90% marks and became eligible for special prize.

Hindi Day : Hindi Day was celebrated with different programmes during the period from September 1 to 15, 1990 both in the headquarters and at 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 Drs. A. P. Singh and A. P. Panday of Jhunjhunwala College, Ghatkopar as Chief guests. Dr. Sheraj of Central Institute of Cotton Research and Dr. Laxmikant Hirekarur of National Bureau of Soil Survey and land use planning were the chief guests at GTC, Nagpur. Prizes were distributed by the Chief Guests to winners of various competitions.

Post Graduate Training : The recognition granted to CTRL by the University of Bombay as a Post Graduate Institution was continued during the period. Eleven students were being guided for M.Sc. (2 for

Physical Chemistry, 2 for Organic Chemistry, 5 for Physics (Textiles), 2 for Microbiology) and 7 for Ph.D.

Dr. V. G. Khandeparkar has been recognised as a teacher by the Bombay University for guiding students for Ph.D. degree in Microbiology.

Membership to other Organisation:

The Director, CTRL 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. Cotton Development Council (Government of India) and Member of the Sub-Committees on :
   (i) Research and Development
   (ii) Trade, Pricing and Exports.
6. Member of the Textile Commissioner's Cotton Certification Committee.
7. Member of the ICAR Scientific Panel for Post-Harvest Technology.

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

Institute Joint Council (IJC): Three meetings on June 26, August 29 and December 10, 1990 were held during the period to discuss various matters of general interest to the staff.

Grievance Committee : Four meetings of the Grievance Committee were held on April 6, May 14, July 13, 1990 and March 22, 1991.

Finance : A statement showing sanctioned budget grant of CTRL and the actual expenditure for the financial year 1990-91 has been furnished in Annexure III. As could be seen from the statement the actual expenditure under non-plan was Rs. 1,48,80,778 as against sanctioned grant of Rs. 1,50,00,000 for 1990-91. Further, an expenditure of Rs. 31,61,524 was incurred under the Plan budget as against sanctioned grant of Rs. 36,30,000 for 1990-91. During the year 1990-91, an expenditure of Rs. 39,738 was also incurred for the Summer Institute on *Recent Developments in Instrumental Techniques for Cotton Quality Evaluation* from May 7 to 26, 1990.

Significant findings : Studies on the measurement of Ribbon Width of Cotton Fibre for Desi Hybrids with 108 samples from eight parents and 28 crosses in three replications indicated that the ribbon width and C.V. percentages for parents ranged from 17.9 μ to 23.2 μ and 15.5 to 20.3, respectively, while it was 17.9 μ to 21.5 μ and 14.7 to 19.2 for the hybrids. The maximum ribbon width observed was 23.2 μ for LD.210, whereas, it was lowest at 17.6 μ for NA.39.

The Inclined Type Cotton Cleaner designed and developed at the Ginning Training Centre of CTRL at Nagpur is

found to effectively preclean Fair and Kawadi types of *Kapas* and is capable of feeding 20 DR gins.

The main findings of the Survey of Ginning factories in Karnataka and the recommendations for the improvements made therein, included necessity for installation of precleaner, provision of adequate covered space for storage of *Kapas* and imparting training to gin fitters at the Ginning Training Centre at Nagpur.

Studies on the Incidence of Seed Coat Fragments in Ginned Cotton indicated that :

(i) a lower over-lap setting led to more number of cut-seed resulting in abnormally large incidence of seed coat fragments.

(ii) immature seeds which got cut during ginning give rise to seed coat fragments and.

(iii) the number of seed-coat fragments vary from variety to variety and ranged from as low a value of 10 per gm of lint for SRT.1 to as high as 33 per gm for Hybrid 6 at the optimum over-lap, even after the removal of immature seeds from the samples.

In an investigation into the anatomy of yarn faults, their sources of occurrence and mechanism of formation, it was observed that the presence of A and B category of faults in yarn as measured by the uster classimat were mainly due to contamination of trash, short-fibre-bunch and fibre fly.

A test method for determining the yarn bundle strength in the place of lea test has been developed and standardised. Because of the high reproducibility of the test results coupled with low variability, the new method requires only five tests to be done, as against about 60 tests by the conventional lea test.

Good quality singles yarn were spun from linseed fibres in flyer spining system from 1/3rd of the original length of the scutched fibre. Three-ply industrial twines also were prepared from these singles yarn. Kraft paper suitable for writing, wrapping and printing had also been produced from the stalk of the dual purpose linseed variety.

The following were the findings on thermal stability studies on cotton seed oil : (1) an increase in the kinematic viscosity of cotton seed, coconut, groundnut, til, soybean, corn and mustard oils occured with increase in heating time at 180°C, with no apparent change in the specific gravity. (2) the UV spectra of the oil samples did not have any shift in the absorption peak at 206 nm, but the peak at 232 nm increased in intensity with heating time while the peak at 267 nm decreased in intensity. (3) no change in the infra-red spectra of the oil samples was noted as compared to the untreated oil samples.

Qualitative analysis and ranking of major inorganic elements in cotton plant materials have been completed using XRFS.

Bagasse dust, has been used in the preparation of particle boards and the boards are made water repellent by the addition of 1% wax emulsion in the glue mix. Lignin from black liquor, which is an affluent of the paper industry, has been tried as a cheap

binder in the preparation of particle boards from cotton stalks.

Hard board samples of different densities have been prepared from cotton stalk and these boards are having all the desirable properties as specified by BIS for various end uses. The properties of these boards are well in conformity with the conventionally prepared hard boards from raw materials like eucalyptus, hard wood etc.

Pilot plant trials for the manufacture of writing and printing grade paper from cotton plant stalk conducted at M/s Ellora Paper Mills Ltd., Nagpur indicated that the process is economically viable for adoption by the small scale paper industry.

2

Progress of Research

A brief account of the progress of research work during 1990-91 at CTRL 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, viz. (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 1990-91 for different tests has been given in Table 1(a). The total number of samples tested at various Regional Quality Evaluation Units of CTRL 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 samples tested (state-wise) for fibre characters and reports issued on them have been given in Table 2.

AICCIP : The Indian Council of Agricultural Research launched the AICCIP in April, 1967 with a view to achieving closer collaboration between the scientists of

TABLE 1(a) : NUMBER OF COTTON SAMPLES RECEIVED FROM AGRICULTURAL TRIALS FOR DIFFERENT TESTS AT THE HEADQUARTERS OF CTRL

Type of Test	Average for the quin-quennium 1983-87	1988	1989	1990
Fibre and Full Spinning	114	205	235	319
Fibre and Microspinning	1828	1851	1886	1900
Microspinning alone	54	—	10	—
Fibre Tests alone	316	83	668	484
Mill Tests	9	17	4	14
Standard Cottons	13	13	16	20
Trade Varieties				
— Lint	40	18	22	33
— Kapas	43	25	16	12
Technological Research	81	45	4	12
Miscellaneous	20	5	6	21
Total	2627	2262	2867	2815

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

Regional Quality Evaluation Unit	Quality Parameters				
	Fibre length	Fibre fineness	Fibre strength	Fibre maturity	Micro spinning tests
Akola	450	450	450	450	—
Coimbatore	1583	1583	1583	1583	529
Dharwad	1484	1484	1484	1484	—
Guntur	612*	612	612	612	—
Hissar	493	493	493	493	—
Indore	605	563	563	563	—
Ludhiana	1412	935	853	935	—
Nagpur (GP 1466 included)	2048	2020	2048	1770	—
Nanded	852	852	852	852	—
Rahuri	1203	1203	1203	1153	—
Sirsa	362*	362	362	362**	—
Sriganganagar	753	1278	1278	761	—
Surat	8384	3991	3966	4116	37

* Baer Sorter

** Caustic soda method

TABLE 2: NUMBER OF SAMPLES TESTED AND REPORTS SENT DURING 1990-91

State	Fibre and Full spinning	Fibre and Micro-spinning	Fibre Tests alone	Total
Punjab	45 (9)	61 (9)	25 (2)	131 (20)
Haryana	30 (7)	29 (5)	45 (4)	104 (16)
Rajasthan	7 (1)	15 (2)	—	22 (3)
New Delhi (IARI)	20 (2)	106 (8)	141 (3)	267 (13)
Madhya Pradesh	6 (4)	72 (8)	10 (1)	88 (13)
Gujarat	38 (6)	117 (13)	34 (3)	189 (22)
Maharashtra	75 (9)	336 (57)	49 (4)	460 (70)
Andhra Pradesh	19 (5)	60 (6)	—	79 (11)
Karnataka	—	403 (27)	—	403 (27)
Tamil Nadu	16 (7)	221 (17)	—	237 (24)
Total	256 (50)	1420 (152)	304 (17)	1980 (219)

Note: Figures in brackets indicate the number of reports sent.

various disciplines as well as bringing together Agricultural Universities, Central Institutes and the State Departments of Agriculture. The main object 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 materiial is subjected to further screening. Maintenance of 'Germ Plasm' and Initial Evaluation Trial 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 and the South Zone covers the states of Andhra Pradesh, Karnataka and Tamil Nadu.

This is the twenty-fourth year of the AICCIP and as many as 1980 samples were screened for fibre properties and spinning potential during the year, and the test data on various trials were presented at the panel meetings of the respective zones held at New Delhi for North Zone, Surat for Central

Zone and Guntur for South Zone. The work done under this Project during the year is summarized below.

North Zone :

As most of the area in this zone is under irrigation, the yield levels are considerably higher as compared to other zones. This zone is mainly known for its medium staple American *G. hirsutum* and short staple *G. arboreum* types of cottons. The main object of trials is to identify strains superior to the existing varieties. Emphasis is also given to evolve strains of early maturing, short duration (i.e. about 150 days between sowing and harvesting) types with a view to making the fields available for the second crop of food grains. Trials are also conducted for short duration, high yielding hybrid cottons. Trials of North Zone were also conducted at Padegaon which is in the Deccan Canal region of Maharashtra where cotton is grown under irrigation and the crop is sown in April without waiting for the onset of monsoon.

G. hirsutum Trials : The Co-ordinated Varietal Trials (CVT) for Normal Plant Type as well as Short Duration Compact Plant Type were conducted at Faridkot, Hisar, Ludhiana, Muktsar, Sirsa and Sriganganagar. Table 3 shows the ranges of 2.5% span length, Micronaire fineness and bundle tenacity alongwith assessment of maturity and spinning potential for the samples tried in both the trials.

The strains which recorded encouraging spinning performance at 20s, 30s, 40s and 50s counts at different locations under these two trials are given below.

Location	*Count*	*Promising strains*
Faridkot	30s	F.1122, CNN.141, CNN.142, LH.900 and B.N.
	40s	F.846, F.1054 and LH.1134
	50s	LRK.516
Hisar	30s	LH.1031, LH.1446, H.1028, LH.1082, LH.1445, H.1101, LH.900 and H.777
	40s	H.1098
Ludhiana	30s	LH.1134, LH.1031, F.806, LH.1050, LH.1054 and B.N.
	50s	LH.1445
Muktsar	30s	LH.1134, LH.1120, F.806, LH.886, LH.1050, CNN.142, LH.900 and B.N.
	40s	HS(CP).69
	50s	LH.1446
Sirsa	20s	LH.1082, RS.716, RST.9, and RST.19
	30s	F.806 and H.777
Sriganganagar	20s	RST.19 and RST.9
	30s	LH.1050, H.1066, G.Ageti and B.N.

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

Location	No. of sample	Ranges of Fibre Properties				Spinning Performance			Control Variety
		2.5% span length (mm)	Micronaire value	Mature Fibres (%)	Bundle Tenacity (g/t)	Count	A	B	
1	2	3	4	5	6	7	8	9	10
				Normal Plant Type — Br 04 (a)					
Faridkot	7 F	23.6 — 27.1 (25.5)	4.0 — 5.2 (4.6)	73 — 86 (77)	46.6 — 50.4 (48.0)	30s	3	5	LH.886
Hissar	9 F	23.1 — 26.8 (24.7)	4.1 — 5.2 (4.5)	68 — 84 (76)	43.4 — 49.8 (46.9)	30s	5	3	H.777
Ludhiana	7 F	23.7 — 26.6 (25.6)	4.0 — 5.0 (4.3)	71 — 80 (74)	45.0 — 47.7 (46.5)	30s	4	4	LH.886
Muktsar	7 F	24.6 — 27.5 (26.2)	4.5 — 5.2 (4.7)	74 — 86 (80)	46.6 — 49.8 (47.7)	30s	5	4	LH.886
Sirsa	6 F	23.2 — 25.6 (24.1)	4.0 — 5.2 (4.9)	75 — 84 (79)	45.6 — 49.8 (47.4)	30s	2	—	H.777
Sriganganagar	7 F	23.4 — 26.6 (25.0)	4.0 — 5.1 (4.6)	71 — 76 (74)	45.6 — 49.2 (47.4)	30s	2	1	G.Ageti

1	2	3	4	5	6	7	8	9	10
			Compact Plant and Early Maturing Type — Br 04 (b)						
Faridkot	6 F	22.3 — 28.1 (25.6)	3.9 — 4.6 (4.4)	73 — 86 (79)	44.0 — 46.6 (45.4)	30s	6	4	LH.900
Hisar	5 F	24.7 — 27.8 (25.8)	3.6 — 5.1 (4.2)	67 — 79 (72)	46.1 — 49.3 (48.4)	30s	4	—	LH.900
Ludhiana	6 F	23.3 — 28.2 (24.9)	3.6 — 5.3 (4.5)	65 — 82 (76)	43.4 — 50.4 (47.9)	30s	2	3	LH.900
Muktsar	6 F	23.2 — 28.2 (26.2)	3.9 — 4.9 (4.5)	69 — 85 (75)	46.1 — 50.4 (48.5)	30s	5	4	LH.900
Sriganganagar	7 M	23.9 — 26.5 (25.3)	3.8 — 5.4 (4.3)	65 — 75 (69)	45.0 — 48.8 (47.5)	30s	3	2	G.Ageti

A — Samples spinnable to the count selected

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

F — Full spinning

M — Microspinning

Note — Values in bracket indicate averages.

Samples pertaining to Preliminary Varietal Trial (PVT) were received from Faridkot, Hisar, Ludhiana, Muktsar and Sriganganagar. The following strains fared well in spinning performance at 30s and 40s counts at the locations indicated below.

Location	*Count*	*Promising strains*
Faridkot	40s	F.1086 and LH.1126
Hisar	30s	F.1086
Ludhiana	30s	LH.1097, F.1086 and B.N.
Muktsar	30s	LH.1175, F.975 and B.N.
Sirsa	30s	F.965 and F.1084

The initial Evaluation Trial was conducted at Faridkot, Hisar, Ludhiana, Muktsar and Sirsa. The following strains recorded satisfactory yarn strength at the counts indicated.

Location	*Count*	*Promising strains*
Faridkot	40s	LH.1257
Hisar	30s	H.1136
Ludhiana	30s	LH.1263, LH.1257, F.1183 and B.N.
Muktsar	30s	LH.1267, LH.1248 and B.N.
Sirsa	30s	F.1184 and RS.795

G. arboreum Trials : Samples pertaining to Co-ordinated Varietal Trial were received from Hisar and Ludhiana for fibre test only. The object of this trial was to identify high yielding coarse and short staple varieties in place of the existing variety, G.27. The 2.5% span length of the strains tested under this trial ranged between 16.9 mm and 22.3 mm. The Micronaire values of the following strains were higher than 7.0 at the locations indicated below.

Location	*Promising strains*
Hisar	HD.107, DS.5, LD.327, HD.115, CSA.9-10 and G.27
Ludhiana	LD.417, LD.451, LD.486, HD.107 and LD.327

Samples pertaining to Preliminary Varietal Trial under this programme were received from Hisar, Ludhiana and Sirsa for fibre tests only. The 2.5% span length ranged between 17.3 mm and 23.6 mm. The Micronaire values higher than 7.0 were recorded by the following strains.

Location	*Promising strains*
Hisar	LD.327, LD.484, DS.5, DS.1, HD.120, HD.125, HD.107 and G.27
Ludhiana	LD.484, LD.470, HD.120, HD.125, DS.21 and LD.327
Sirsa	LD.447, LD.448, LD.484, DS.29, DS.51, LD.417, LD.451, HD.115, CSA.9-8 and DS.5

Hybrid Cotton Trials : *Intra-hirsutum* hybrids involving *hirsutum* × *hirsutum* crosses were tried at Hisar and Ludhiana. The range of 2.5% span length was between 25.0 mm and 27.8 mm. Micronaire value ranged between 3.7 and 5.1. Maturity was average to good. Bundle tenacity values were good, varying from 45.0 g/t to 49.3 g/t. The following hybrids fared well in spinning performance at the counts and the locations given below :

Location	*Count*	*Promising strains*
Hisar	40s	HHH.11 and HHH.81
	30s	HHH.21
Ludhiana	30s	PCHH.13, PCHH.21 and PCHH.31

Miscellaneous Hybrid Cotton Trials : It was noted that in the Interspecific Hybrid Trial conducted under the agro-climatic conditions of this zone at New Delhi, four hybrids, viz. Pusa Hybrid 22, Pusa Hybrid 24, Pusa Hybrid 28 and Pusa Hybrid 46 recorded satisfactory spinning performance at 60s count, while three hybrids, viz. Pusa Hybrid 12, Pusa Hybrid 19 and Pusa Hybrid 21 recorded desired yarn strength at 80s count.

Miscellaneous Trials : During the period, a good number of trials having different objectives continued to be conducted at IARI, New Delhi. Under the trials for further selections and propagation, a large number of Pusa selections and cultures of *G. hirsutum* belonging to superior medium staple category of cotton recorded extremely high bundle tenacity (as high as 61.6 g/t) and were spinnable to 60s count. In the case of *G. barbadense* and interspecific hybrids, the samples were spinnable to 80s count. The details of the trials and the test results were as given below :

A set of twenty-two lint samples of Pusa cultures of *G. hirsutum* was received with a view to screening the material for high fibre

strength. It was observed that five cultures, viz. Pusa 2-95, Pusa 2-98, Pusa 2-103, Pusa 2-116 and Pusa 2-123 recorded a bundle tenacity value greater than 55.0 g/t, and eight cultures, viz. Pusa 2-27, Pusa 2-54, Pusa 2-95, Pusa 2-98, Pusa 2-103, Pusa 2-123, and Pusa 57-2 recorded CSP values of more than 2400 at 40s count.

Further, five out of these eight cultures, viz. Pusa 2-54, Pusa 2-95, Pusa 2-98, Pusa 2-103 and Pusa 2-116 fared well when subjected to the microspinning test at a higher count of 60s.

Twenty samples of Pusa cultures having high seed oil content were analysed for fibre bundle tenacity. It was observed that all, except one, recorded high bundle tenacity of 50.9 g/t and above.

Eight samples of Pusa culture with 2.5% span length lying in the range of 24.5 mm to 27.2 mm (medium staple) and with average Micronaire value, good maturity and bundle tenacity were subjected to spinning test. Out of these, 5 samples, viz. Pusa 188-4-11, Pusa 188-8-8-1-4, Pusa 188-8-8-1-32, Pusa 188-26-7, and Pusa 45-2-3-18 fared well at 40s count.

A large number of single plant selections of Pusa cultures (126) were tested for fibre strength. Out of these, 30 plant selections exhibited very high bundle tenacity of 56.3 g/t or more.

A set of nineteen lint samples from single plant selections of culture, Pusa 501 were tested for fibre properties. The samples possessed 2.5% span length ranging between 22.5 mm and 28.3 mm with coarse to average Micronaire value and good bundle tenacity (46.6 g/t to 51.5 g/t).

The spinning potential of 7 different *hirsutum* cultures of Pusa was analysed. The spinning potential (given in brackets) as observed for different cultures was Pusa 45-3-6-99 (60s), Pusa 4-11(50s), Pusa 88(40s), Pusa 45-2-2K (40s), Pusa 734-1 (40s), Pusa 54-3-1-40(30s) and Pusa 45-2-2 B(30s).

Samples belonging to medium staple, short duration American *hirsutum* cottons harvested in May-June were analysed for fibre properties to assess the effects, if any, of the high temperature and dry climatic conditions prevailing during boll development period. It was observed that fibre length, Micronaire value and bundle tenacity varied within a narrow range.

Two sets of lint samples of twenty-five and nine each belonging to *G. barbadense* trial were received for assessment of spinning potential. It was observed that as many as fourteen cultures from one set, viz. Pusa 16-13-4 (P4), Pusa 16-14-6, Pusa 18-2-3, Pusa 18-5-1-23 (self), Pusa 19-8-5-1-7 (P56), Pusa 19-8-5-1-24, Pusa 19-8-5-1-28 (self), Pusa 19-8-5-1-32 (P 64), Pusa 19-8-5-1-33 (self), Pusa 19-8-5-1-34 (P 68), Pusa 19-8-5-1-37, Pusa 19-8-5-1 (P 28), Pusa 23-5 and Pusa 24 (P1) fared well in spinning performance at 60s count, while from the other set, only one culture, viz. Pusa 24 recorded encouraging CSP values at 80s count.

In a miscellaneous state Co-ordinated Trial of *G. hirsutum*, thirteen lint samples in two sets of six and seven samples each were received from Faridkot. In all, seven strains, viz. F.846, F.806, LH.1134, F.1054,

LH.1050 and LH.1318 including the control, LH.900 were found to give good spinning performance at 30s count.

A set of two *G. hirsutum* cottons, H.999 and H.984 raised under F.Y.T. trial was received from Hisar for assessment of spinning potential. It was observed that both the cottons recorded CSP values on par at 20s count, while H.999 recorded better CSP values at 30s count than that of H.984. However, both the cottons, H.999 and H.984 were found suitable for spinning at 30s count.

A released variety, H.974 was received from Hisar for the assessment of spinning performance. H.974 belonged to superior medium staple category in fibre length with good length uniformity, average Micronaire fineness, good maturity and bundle strength at both the gauge lengths. It recorded encouraging spinning performance at 30s count.

In another miscellaneous trial of I.E.T. of *G.hirsutum* under irrigated conditions, a set of five lint samples was received from Hisar. Only two strains, viz. H.1125 and H.1152 fared well in spinning performance at 30s count.

A miscellaneous trial of *G. arboreum* was conducted under irrigated conditions at Hisar. It was observed that only three out of fourteen strains, viz. HD.178, HD.184 and HD.193 had 2.5% span length 19.4 mm and below and Micronaire value more than 7.0.

In a miscellaneous trial of Compact Plant Type of Short Duration, two promising strains, LH.1445 and LH.1446 alongwith the control, LH.900 were received from Ludhiana. It was observed that the strains, LH.1445 and LH.1446 were significantly better in fibre length and Micronaire fineness than the control, LH.900. The strains, LH.1446 was significantly better in bundle tenacities at both the gauge lengths than the control LH.900, while the strain LH.1445 was on par. In the case of spinning performance, the strain, LH.1445 alongwith the control, LH.900 recorded encouraging CSP values at 20s count, while the strain, LH.1446 was found suitable for spinning at 50s count.

In another miscellaneous trial of Normal Plant Type, a set of four samples were received from Sirsa for screening the material for spinning potential. It was observed that all the medium staple strains were coarse to good in Micronaire value, average to good in maturity and good in bundle tenacity at zero gauge length. The strain, HS.6 gave encouraging spinning performance at 20s count, while the strain, HS.90-80 recorded good CSP value at 40s count.

Central Zone :

The States of Madhya Pradesh, Gujarat and Maharashtra constitute 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 number of cottons from *G. arboreum* species are also cultivated in the zone as most of the area is under rainfed cultivation. For the last many years, hybrids such as Hybrid 4, Hybrid 6, JKHy.1, Godavari, etc. are being commercially cultivated in this zone. Attempts are being made to identify early maturing hybrids without sacrificing the yield. Considering the in-

creasing demand for the medium and superior medium cottons, attempts are also directed to identify *desi* hybrids. Further, trials are also conducted for improvement in *G. herbaceum* species which are traditionally grown in the same areas in Gujarat.

G. hirsutum Trials : In the Co-ordinated Varietal Trials (CVT) samples were received under irrigated conditions from Akola, Badnawar, Bharuch, Indore, Khandwa, Nanded and Somnathpur (Udgir) under rainfed conditions and from Padegaon under rice fallows conditions.

Summary of the test results in respect of 2.5% span length, Micronaire value, maturity and bundle tenacity along with spinning potential has been compiled and has been given in Table 4. The following strains recorded desired CSP values at the locations and the counts given below :

Location	*Count*	*Promising hybrids*
		Irrigated
Padegaon	40s	G.4808, G.4812, G.5249, Suman Supriya, G.Cot.10, KOP.498 and LRA.5166
Surat	30s	G.84109, G.4814 and G.3945, G.4812, G(T).538,
	40s	G.Cot.10 and G.Cot.11
Talod	40s	G.3945, G.(T).895, G.4812, G(T).538, Supriya, G.Cot.10 and G.Cot.14
		Rainfed
Badnawar	40s	G.2443, 79.BH.5/3, KH.81-1911 and Vikram
Bharuch	40s	PH.93, 79.BH.5/3, KH.81-1911, G.Cot.10 and G.Cot.14
Khandwa	40s	G.2443, 79.BH.5/3 and KH.81-1911
Khandwa (1988-89)	40s	G.Cot.10
Somnatpur (Udgir)	30s	79.BH.5/3, G.4406 and Purnima
		Rice Fallows
Padegaon	40s	TADH.8658, JK.441-37 and MCU.7

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

Location	No. of Samples	Ranges of Fibre Properties				Spinning Performance			Control Variety
		2.5% span length (mm)	Micronaire value	Mature Fibres (%)	Bundle Tenacity (g/t)	Count	A	B	
1	2	3	4	5	6	7	8	9	10
				Irrigated Trial Br 04 (a)					
Padegaon	14 M	25.7 — 30.7 (27.9)	3.2 — 3.8 (3.5)	59 — 76 (68)	38.1 — 46.1 (42.3)	40s	7	2	KOP.498
Rahuri	16 FT	21.9 — 29.7 (24.8)	2.4 — 3.6 (3.2)	54 — 78 (62)	40.7 — 47.2 (43.8)	—	—	—	KOP.498
Surat	7 F	22.9 — 27.6 (25.8)	3.4 — 4.8 (4.3)	66 — 81 (75)	41.8 — 47.2 (45.2)	40s	4	2	G.Cot.14
Talod	7 M	24.5 — 27.8 (26.1)	3.7 — 4.7 (4.2)	68 — 81 (76)	44.0 — 50.9 (47.8)	40s	7	2	G.Cot.14
				Rainfed Trial — Br 04 (b)					
Akola	6 M	24.8 — 28.8 (26.2)	3.4 — 4.0 (3.7)	73 — 79 (76)	42.9 — 46.6 (45.0)	40s	—	3	G.Cot.10
Badnawar	10 M	23.5 — 33.4 (26.4)	2.8 — 3.8 (3.4)	57 — 70 (65)	42.9 — 49.3 (46.3)	40s	4	—	Vikram
Bharuch	7 M	25.9 — 32.0 (28.3)	3.2 — 4.6 (3.8)	65 — 75 (70)	44.5 — 50.4 (48.0)	40s	5	1	G.Cot.14

— Contd.

		3	4	5	6	7	8	9	10
Indore	10 FT	23.0 — 28.1 (25.0)	3.0 — 3.7 (3.4)	50 — 79 (64)	42.9 — 50.4 (46.4)	—	—	—	Vikram
Khandwa	10 M	22.4 — 29.2 (25.0)	3.3 — 4.6 (3.9)	66 — 85 (76)	42.9 — 50.4 (46.6)	40s	3	3	Khandwa 3
Khandwa (1988-89)	5 M	24.1 — 26.5 (25.4)	3.4 — 4.8 (4.1)	66 — 79 (74)	42.9 — 45.6 (44.3)	40s	1	—	G.Cot.10
Nanded	4 M	24.4 — 26.2 (25.4)	3.6 — 4.4 (4.0)	60 — 75 (71)	44.5 — 46.1 (45.2)	40s	—	2	G.Cot.10
Somnathpur	6 M	25.3 — 30.2 (27.1)	3.5 — 4.4 (4.0)	74 — 83 (78)	43.4 — 47.2 (45.7)	30s	3	1	Purnima
Padegaon	9 M	24.4 — 27.3 (25.8)	3.3 — 4.7 (4.0)	62 — 78 (70)	38.2 — 45.0 (42.3)	40s	3	2	MCU.7

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

Note — Values in bracket indicate averages.

Samples pertaining to Preliminary Varietal Trial were received from Padegaon, Rahuri, Surat and Talod under irrigated conditions and from Akola, Amreli, Badnapur, Junagadh and Nanded under rainfed conditions.

Promising strains which have recorded desired yarn strength at the counts and the locations are given below :

Location	*Count*	*Promising strains*
		Irrigated
Padegaon	40s	G(T).538
Surat	30s	G(B).2007, CNH.36 and DCI.121
		Rainfed
Akola	30s	KH.100-22-37, G(T).1093 and DHY.286
Amreli	40s	G(T).1093, G.2984, G.3932, JLH.168, B.82-BH-1, KH.101-2238, KH.98-2105 and G.Cot.10
Badnapur	20s	KH.100-2237, JLH.168, KH.98-2105, B.82-BH-1 and G.Cot.10
Nanded	40s	G.Cot.10

G. arboreum Trials : The Co-ordinated Varietal Trial was conducted at Akola, Amreli, Somnathpur (Udgir) and Ujjain. The promising strains at the locations and the counts were as listed below :

Location	*Count*	*Promising strains*
Akola	30s	AKH.4
Amreli	30s	KWA.3, AKH.4 and Sanjay
Somnathpur (Udgir)	20s	PA.141, KWA.3, AKH.4, Sarvottam and Rohini
Ujjain	20s	AKA.8621, Sarvottam, KW(HR).1, KWA.3, AKH.4, JLA.129, UA.1 and Maljari

G. herbaceum Trials : Samples pertaining to the Co-ordinated Varietal Trial were received from Bharuch and Surat under irrigated conditions. Six strains, viz. BHV.46, 378.BK, BHV.41, GH.490, G.Cot.11 and Digvijay at Bharuch and nine strains, viz. GH.149/85, GH.458/1165, G.450/58/81, GH.BHV.46, GH.378 BK, GH.490, GH.1474

BK/82, G.Cot.11 and Digvijay at Surat recorded satisfactory yarn strength at 20s count.

Hybrid Cotton Trials : The object of this trial was to identify hybrids superior in yield and quality to the existing local hybrids, viz. Hybrid 4, JKHy.1, G.Cot.Hy.6, Godavari, etc. in Gujarat, Madhya Pradesh and Maharashtra, either under irrigated or rainfed conditions.

Intra-hirsutum Hybrid Trials : Samples pertaining to this trial involving *G. hirsutum* × *G. hirsutum* crosses were received from Aurangabad, Jalna, Junagadh, Nanded, Rahuri, Surat and Talod under irrigated conditions and from Akola, Aurangabad, Bharuch, Jalna, Khandwa, Nanded and Parbhani under rainfed conditions.

The promising hybrids from the spinning point of view at different locations and counts are as indicated below :

Location	*Count*	*Promising hybrids*
		Irrigated
Aurangabad	30s	NHH.44, NMSH.5, G(I).HH.30, CNHH.468 and G(T).HH.41
	40s	WHH.53, NMSH.3, GHH.1003, NHH.302, PHH.134, HCH.102, G(T).HH.15, CICR.11, GHH.662, MECH.13, HCH.101, MECH.25, WHH.15 and Hybrid 4
	50s	WHH.37, DHH.129 and MECH.19
	60s	NFHH.104
Jalna	40s	MECH.19, PHH.134, MECH.13, WHH.37 and Hybrid 4
Nanded	40s	MECH.19, GHH.662 and Hybrid 4
Surat	40s	GHH.662, NHH.302, PHH.134, NMSH.3 and Hybrid 8
Talod	50s	G(T)HH.15, GHH.662, G.Cot.Hy.6 and Hybrid 4
		Rainfed
Aurangabad	30s	NFHH.3
	40s	GHH.756, WHH.90, WHH.204, GHH.662, PKV.Hy.2, PHH.256, MLC.9, NHH.302, PHH.231, NFHH.5, CNHH.468, MECH.15

— Contd.

Location	*Count*	*Promising hybrids*
	50s	MECH.94, MECH.98 and JKHy.2
Bharuch	40s	JKHy.2, PKV.Hy.2, MLC.9, NFHH.3, Hybrid 4, Hybrid 6 and Hybrid 8
Jalna	30s	WHH.90 and PHH.231
	40s	MECH.15, MECH.98 and MECH.138
Khandwa	40s	JKHy.2
Nanded	40s	JKHy.2, KHH.756, WHH.10, PHH.231 and Hybrid 4
Parbhani	50s	GHH.756 and GHH.662

Inter-specific Hybrid Trial : The Inter-specific Hybrid Trial involving *G. hirsutum* × *G. barbadense* crosses was conducted at Badnawar, Parbhani and Surat under irrigated conditions. Promising hybrids which recorded encouraging spinning performance at different locations are as indicated below :

Location	*Count*	*Promising hybrids*
Badnawar	80s	GHB.418, GHB.429, WHB.12, MECH.111, MECH.112, MECH.14, DHB.100, DHB.115 and DCH.32
Parbhani	80s	GHB.429 and NHB.12
Surat	40s	Hybrid 8
	60s	PHB.55 and MECH.111
	80s	NHB.12 and DCH.32

Efforts were also made to evolve *desi* hybrids involving *G. arboreum* × *G. herbaceum* crosses for cultivation under rainfed conditions, for higher yields. During the season, samples of *desi* hybrid were received from Aurangabad, Bharuch, Indore, Jalna, Surat and Ujjain. The following hybrids fared well in spinning performance at the locations and the counts as shown below :

Location	*Count*	*Promising hybrids*
Aurangabad	16s	MDH.106
	20s	MDCH.207
	30s	GDH.160, MDCH.201 and G.Cot.DH.9
	40s	DDH.2
Bharuch	30s	NFDH.105
	40s	G.Cot.DH.9
Jalna	20s	PA.32 and DDH.2
	30s	MDCH.201 and G.Cot.DH.9
Surat	30s	NFDH.105, HDH.106 and G.Cot.DH.7
	40s	GDH.160
	50s	G.Cot.DH.9
Ujjain	20s	GDH.160, MDCH.201, MDCH.207 and G.Cot.DH.9

Miscellaneous Hybrid Cotton Trial : A promising *intra-hirsutum* hybrid, NHH.302 along with the control, NHH.44 raised under rainfed conditions was received from Nanded for assessment of spinning potential. It was observed that the new hybrid, NHH.302 was superior to the control, NHH.44 in spinning performance at counts 30s and 40s and NHH.302 recorded good CSP value at 40s count.

In another *intra-hirsutum* hybrid trial conducted at Nanded, four sets comprising twenty-one samples were received from Nanded. In spinning performance, as many as six hybrids, viz. NHH.302, PHH.134, PHH.186, PHH.298, SRT.1×JPRI.12 and SRT.1×41-10 recorded desired CSP values at 50s count.

Yet another *intra-hirsutum* trial was conducted for the Cytoplasmic Male Sterile Hybrids with NHH.44 as the control at Nanded. It was observed that only two out of six hybrids, viz. CMHH.2 and CMHB.4 fared well in spinning performance at 50s count.

In an *intra-hirsutum* hybrid trial, two sets of five samples each were received from Parbhani. Only three hybrids, viz. PHH.253, PHH.256 and NHH.302 recorded satisfactory spinning performance at 50s count.

At Parbhani an inter-specific hybrid trial was conducted. The hybrid NHB.42 along with the control, DCH.32 recorded satisfactory yarn strength at 80s count.

Evaluation of Dwarf and Compact Material: Dwarf type plants have certain advantages in respect of yield over the normal type plants. In order to study the yield and tech-

nological aspects of such plants, trials were conducted at Akola, Bharuch, Nagpur, Nanded and Surat. The following strains recorded encouraging spinning performance at the counts and the locations indicated below :

Location	*Count*	*Promising strains*
Bharuch	30s	LRK.516, NISD.5, AKH.8433, G.Cot.10 and G.Cot.14
Nanded	40s	LRK.516, G.Cot.10 and Purnima
Surat	20s	G(T).996, AKH.8932, WH 216-2, LRK.516, G.Cot.10, and G.Cot.14.

Miscellaneous Trials : A few miscellaneous trials having different objectives were conducted at Badnapur, Badnawar, Jalgaon, Khandwa, Nagpur, Nanded, Padegaon, Parbhani, Somnathpur and Talod. The details of the trials and the test results are as given below :

Two sets consisting of twelve samples of *G. hirsutum* raised under rainfed conditions were received from Badnapur. As many as ten strains, viz. NH.387, PH.99, NH.380, NH.392, NH.428, NH.426, NH.422 including three controls, viz., LRA.5166, PH.93 and Purnima recorded encouraging spinning performance at 20s count.

In another miscellaneous trial of *G. arboreum*, two sets comprising thirteen samples were received from Badnapur for spinning test. It was observed that as many as nine strains, viz. PA.202, NA.389, NA. 332, NA.260, NA.318, NA.326 including the three controls, viz. Eknath, PA.141 and Rohini fared well in spinning performance at 20s count.

A promising strain of *G. hirsutum*, viz. 79. BH.5-3 raised under rainfed conditions was received from Badnawar for the assessment of spinning performance. It was observed that this strain, belonged to long staple category of cotton with good length uniformity, Micronaire fineness, maturity and bundle tenacities at both the gauge lengths had recorded encouraging spinning performance at 50s count.

Another promising *G. hirsutum* strain, viz. JLH.168 along with the control variety, SRT.1 was received in two different lots from Jalgaon for the assessment of spinning potential. It was observed that the new strain, JLH.168 was superior to the control, SRT.1 in fibre length, fineness and almost *on par* in bundle tenacities at both the gauge lengths in their respective sets. However, in spinning performance, JLH.168 recorded encouraging yarn strength at 40s count, while SRT.1 was found to give good CSP value at 30s count in one lot. For the second lot, this trend was found to be reversed.

A set of four cottons, viz. Khandwa 2, Khandwa 3 and A.51-9 of *G. hirsutum* and Sarvottam of *G. arboreum*, was received from Khandwa. All the four cottons were of superior medium staple with good length uniformity and Micronaire fineness. In the

case of spinning performance, Khandwa 3 and A-51-9 recorded encouraging CSP values at 30s count, while, Khandwa 2 and Sarvottam indicated good spinning potential at 20s count.

Two *intra-hirsutum* hybrid cottons, viz. CICR.HH.2 and Hybrid 4 raised under irrigated conditions at Nagpur indicated that the control, Hybrid 4 was superior to the new hybrid, CICR.HH.2 in fibre properties as well as spinning performance and Hybrid 4 alone was found satisfactorily spinnable at 40s count.

The ranges of 2.5% span length, Micronaire value and bundle tenacity at zero gauge length were 27.0 mm to 29.1 mm, 4.0 μg/in to 4.6 μg/in and 40.2 g/t to 46.1 g/t, respectively for the set of six samples of *G. hirsutum* received from Nanded. From the other set of four samples, only NH.426 along with the control, LRA.5166 indicated good spinning performance at 40s count.

Two sets of six samples each from the miscellaneous trial of *G. arboreum* were received for fibre tests only. It was observed that 2.5% span length ranged between 24.2 mm and 29.0 mm with good length uniformity, average to good Micronaire fineness and good bundle tenacity at zero gauge length.

In another miscellaneous trial of *G. arboreum*, three sets of five samples each were received from Nanded. As many as nine strains, viz. PHA.22, PHA.44, PHA.46, PHA.91, NA.362, NA.403, NA.407, NA.416 along with the control, PA.141 fared well in spinning performance at 20s count.

Two multi-location trials, one for *G. hirsutum* and the other for *intra-hirsutum* hybrids, were conducted at Padegaon. None of the six strains of *G. hirsutum*, except the control, Laxmi was found suitable for spinning at 40s count, while only two hybrids of *intra-hirsutum*, viz. RHH.0987 and RHH.0288 fared well in spinning performance at 40s count.

A set of five samples raised under *intra-hirsutum* trial conducted for the Cytoplasmic Male Sterile Hybrids was received from Padegaon. As many as three hybrids, viz. MSRHH.8, MSRHH.13 and MSRHH.15 were found suitable for spinning at 30s count.

Five sets of five samples each from the *G. hirsutum* trials, were received from Parbhani. In spinning performance, as many as seven strains, viz. PH.93, NHH.302, NH.425, PH.99, NH.392 including the two controls, viz. LRA.5166 and Purnima recorded desired yarn strength at 40s count.

Another five sets of five samples each from different trials of *G. arboreum* were received from Parbhani. 2.5% span length ranged between 24.2 mm and 29.1 mm with good length uniformity, average to good Micronaire value and good bundle tenacity at zero gauge length. As many as thirteen strains, viz. NA.213, NA.260, PA.184, PA.186, PA.181, PA.190, PA.183, PHA.95, PHA.46, PHA.91 including the three controls, viz. PA.141, Eknath and Rohini fared well in spinning performance at 30s count.

Two sets comprising eleven samples of *G. arboreum* trial were received from Somnathpur (Udgir). It was observed that three strains, viz. PHA.44 PHA.91 and PHA.46 fared well in spinning performance at 30s count, while five strains, viz. PA.203,

PA.198, PA.199 including the two controls, Eknath and Rohini recorded good CSP values at 20s count.

Two strains, viz. G(T).538 and G(T).895 belonging to *G. hirsutum* raised under irrigated conditions were received from Talod. It was observed that G(T).538 was superior to G(T).895 in fibre length, maturity and bundle tenacities at both the gauge lengths. In the case of spinning performance, the strain, G(T).538 was found satisfactorily spinnable at 50s count, while the other strain, G(T).895 recorded good CSP value at 40s count.

South Zone :

This zone comprising the states of Karnataka, Andhra Pradesh and Tamil Nadu is known for its long and extra long staple category of cottons. Although cottons of *G. hirsutum* species occupy a large area under cultivation, cottons from *G. arboreum*, *G. herbaceum* and *G. barbadense* are also grown in some pockets of this zone, either in irrigated tracts or in rainfed tracts. *Intra-hirsutum* and interspecific hybrids are also cultivated on a large scale.

G. hirsutum Trials : Co-ordinated Varietal Trial was conducted at Coimbatore, Raichur and Siruguppa under irrigated conditions and at Adilabad, Annigeri, Dharwad, Kovilpatti, Raichur and Shimoga under rainfed conditions. The ranges of 2.5% span length, Micronaire value, maturity and bundle tenacity along with their spinning performance are given in Table 5.

The following strains recorded satisfactory spinning performance at the locations and at the counts indicated against them.

Location	*Count*	*Promising strains*
		Irrigated
Coimbatore	50s	NA.1290, NHYPS.152, HLS.56, LK.861, LRA.5166 and MCU.5
Raichur	40s	LK.861, 22-29.HS.54, JK.276-8-2, AH.33-5-1, HLS.56, TCH.1216, NHYPS.152, and MCU.5
Shimoga	50s	TKH.4-3, RKR.4145, HLS.321729, LK.861, NA.1290, JK.276-8-2, L.2, HLS.56, TCH.1216, NHYPS.152, LRA.5166 and MCU.5
Adilabad	40s	G.2443, 79.BH.5-3, KH.81-1911 and B.1007
Annigeri	50s	NA.1290, HLS.321729, JK.276-8-2, JKH.497 and LRA.5166
Dharwad	40s	NA.1290, RAMP.105 and LRA.5166
Kovilpatti	40s	CPD.404, TKH.497, S.1-44127, JK-226-8-2, NA.1269, NA.1290, SIMA.1, ICMF.6, HLS.321729, LRA.5166 and MCU.10
Shimoga	50s	CPD.404, HLB.321729, NA.1269, NA.1290, JK.276-8,2, TKH.497, CPD.402, ICMF.6 and LRA.5166

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

Location	No. of Samples	Ranges of Fibre Properties				Spinning Performance			Control Variety
		2.5% span length (mm)	Micronaire value	Mature Fibres (%)	Bundle Tenacity (g/t)	Count	A	B	
1	2	3	4	5	6	7	8	9	10
Irrigated Trial — Br. 04 (a)									
Coimbatore	19 M	24.1 — 32.5 (28.6)	3.7 — 4.9 (4.3)	—	—	50s	6	14	MCU.11
Raichur	22 M	23.2 — 35.2 (27.9)	2.4 — 4.0 (3.3)	54 — 78 (65)	38.6 — 46.6 (43.5)	40s	8	15	Sharada
Siruguppa	19 M	26.5 — 34.2 (30.6)	3.2 — 4.4 (3.9)	61 — 81 (70)	41.8 — 47.2 (44.7)	50s	13	12	JK.119
Rainfed Trial Br. 04 (b)									
Adilabad	10 M	25.3 — 29.4 (26.6)	2.4 — 3.4 (3.0)	46 — 64 (56)	41.8 — 47.7 (44.6)	40s	4	3	B.1007
Annegeri	14 M	22.8 — 30.0 (26.1)	3.6 — 4.9 (4.2)	74 — 86 (80)	42.9 — 48.2 (44.9)	50s	5	11	Sharada

1	2	3	4	5	6	7	8	9	10
Dharwad	14 M	24.1 — 29.6 (25.8)	3.4 — 4.2 (3.8)	65 — 87 (74)	38.6 — 47.2 (43.6)	40s	3	9	Sharada
Kovilpatti	14 M	24.1 — 31.0 (27.0)	3.6 — 4.6 (4.1)	—	—	40s	11	8	MCU.10
Raichur	16 M	22.2 — 27.2 (24.1)	2.8 — 3.6 (3.3)	54 — 69 (62)	39.7 — 45.0 (42.0)	40s	—	5	Laxmi
Shimoga	14 M	23.1 — 32.7 (26.5)	3.3 — 4.7 (3.8)	55 — 76 (69)	41.8 — 47.7 (45.8)	50s	9	9	Sharada

A — Samples spinnable to the count selected

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

M — Microspinning

Note — Values in bracket indicate averages.

Samples pertaining to Preliminary Varietal Trial were received from Arabhavi, Coimbatore, Guntur and Siruguppa under irrigated conditions and at Adilabad, Dharwad, Kovilpatti and Shimoga under rainfed conditions. The following strains recorded desired CPS values :

Location	*Count*	*Promising strains*
Arabhavi	40s	LRA.5166 and 170.CO2
	50s	TCH.948, TCH.1025-1-8, HLS.72, TCH.1024-3-3, HLS.79, HLS.88 and MCU.5
Coimbatore	40s	NA.1325, 8-13-1, TSH.179, LRA.5166 and MCU.11
	50s	HLS.88, HLS.72, TCH.1024-3-3, HLS.79, TCH.948, MCU.11 and MCU.5
Guntur	30s	TSH.179, NA.1325, NA.1363, JK.260-2, LPS.141 and LRA.5166
Siruguppa	50s	NA.1325 and LRA.5166
	60s	TCH.1024-3-3, HLS.72, HLS.79 and MCU.5
		Rainfed
Adilabad	30s	G.Cot.10, AKH.8263, JLH.168, AKH.8605, B.82-BH-1, JLH.158, KH.100-2237, AKH.8627, GT.1093, AKH.8650 and B.1007
Dharwad	40s	TAH.7, CNN.366, JK.260-2, CPD-89-15, ARC.260, TKH.650 and LRA.5166
Kovilpatti	40s	CPD.89-5,CPD.89-15, CPD.402, ICMF.8, ARC.260, JK.260-2, TAH.7, TKH.650, NA.1316, NA.1362, CNH.36 and LRA.5166
Shimoga	40s	TAH.7, CNH.382, CNH.126, JK.260-2, CP8.8-9-15, NDS.40, NA.1316, NA.1362, ARC.260, ICMF.1C, CPD.402, 2-182-8-7, TKH.650, LRA.5166 and Sharada

G. barbadense Trial : The Co-ordinated Varietal Trial was conducted at Coimbatore and Siruguppa only under irrigated conditions. At Coimbatore, many as five out of sixteen strains, viz. TCB.355, TCB.365, TCB.354, C.16 and C.17 fared well in spinning performance at 80s count, while at Siruguppa only three out of sixteen strains, viz. C.17, C.16 including the control, Suvin recorded good CSP values at 100s count.

G. herbaceum Trial : The Co-ordinated Varietal Trial was conducted at Dharwad and Raichur under rainfed conditions. As

many as four out of six strains, viz. SM.88, SM.150.B and RDS.164 including the control, Jayadhar recorded satisfactory yarn strength at 20s count.

Hybrid Cotton Trial

Intra-hirsutum Hybrid Trial : The Intra-hirsutum hybrid trial involving *G. hirsutum* × *G. hirsutum* crosses was conducted at Arabhavi, Raichur and Siruguppa under irrigated conditions and at Annigeri, Dharwad, Kovilpatti and Raichur under rainfed conditions. The following hybrids fared well in spinning performance at the counts and locations given below :

Location	*Count*	*Promising hybrids*
		Irrigated
Arabhavi	50s	T.13 x M.12, V.54 x M.12, NHH.39, TCHH.3642, NHH.198, NHH.176, CMSH.1, Savitha and JKHy.1
Raichur	40s	T.13 x M.12, V.54 x M.12, NHH.39, TCHH.3642, NHH.198, DHH.12, ARCH.204, ARCH.246, MLC.9, Savitha and JKHy.1
Siruguppa	50s	TCHH.23, DHH.10, DHH.11, DHH.13, NHH.39, TCHH.3642, NHH.198, NHH.176, ARCH.204, ACH.246 and JKHy.1
		Rainfed
Annigeri	50s	DHH.502, NHH.39, CNHH.104, CNHH.11, DHH.505, MLC.9, GHH.334, MEC.19, MECH.15 and JKHy.1
Dharwad	40s	DHH.502, DHH.503, CNHH.164, V.22 x M.29, ARCH.90, DHH.504, DHH.505, ICMF.14, MLC.9, GHH.334, MECH.19, MECH.15, JKHy.1 and Abadhita
Kovilpatti	40s	ARCH.53, ARCH.90, ARCH.237, CNHH.11, CNHH.103, CNHH.104, DHH.505, ICMF.14, V.22 x M.29, NHH.39, DHH.502, DHH.504, GHH.334, MECH.15, MECH.19, M.9 x T.1, MLC.9, LRA.5166, MCU.10 and JKHy.1
Raichur	40s	GHH.334 and MECH.15

Interspecific Hybrid Trial : The hybrids involving *G. hirsutum* × *G. barbadense* crosses were tried at Coimbatore, Raichur and Siruguppa under irrigated conditions and those of *desi* hybrids involving *G. arboreum* × *G. herbaceum* crosses at Dharwad and Raichur, under rainfed conditions. The following hybrids showed good spinning performance at the locations and the counts indicated against them.

Location	*Count*	*Promising hybrids*
		G. hirsutum × *G. barbadense*
Coimbatore	80s	TCHB.223, ICMF.HB.2, MECH.111 and MECH.113
Siruguppa	80s	DHB.115, MECH.111, ICMF.HB.2 and MECH.113
		G.arboreum × *G. herbaceum*
Dharwad	20s	DDH.2, GDH.149, NCA.23, MDSH.203, and Jayadhar
Raichur	20s	GDH.149, NCA.212 and NCA.230

Miscellaneous Hybrid Cotton Trial : Two sets comprising twenty-six samples of *intra-hirsutum* hybrids raised under irrigated conditions were received from Coimbatore. Only three hybrids, viz. EK.157-131, LCL× IC.384-62 and (LRK × D.1) × 7553 fared well in spinning performance at 50s count.

An *intra-hirsutum* trial was conducted for long staple hybrids at Coimbatore. The 2.5% span length for all the fourteen hybrids ranged between 28.7 mm and 33.9 mm, covering long staple category of cotton with average to good length uniformity. As many as seven hybrids, viz. M.37×V.14, M.37 × V.62, M.37 × LK.861, V.54 × DS.59, V.54 × M.33, V.54 × M.34 including the control, Savitha recorded good CSP values at 60s count.

A sample of interspecific hybrid, viz. HB. 224 received from Coimbatore along with the control, DCH.32, indicated that both the hybrids were almost *on par* in all the fiber properties. However, DCH.32 alone was found to be suitable for spinning to 80s count.

TCHB.213, an interspecific hybrid, along with control DCH.32, was received from Coimbatore for assessment of spinning potential. It was observed that TCHB.213 was significantly better in length and length uniformity and *on par* in Micronaire fineness, maturity and bundle tenacities at both the gauge lengths. In spinning performance, the CSP values of TCHB.213 were superior to those of the control, DCH.32 at 60s and 80s counts. However, none of the hybrids was found to be suitable for 80s count.

A set of nine cultures of interspecific hybrids along with the two controls, TCHB. 213 and DCH.32 raised under irrigated conditions was received from Coimbatore. As many as six hybrids, viz. HB.224, HB. 225, HB.226, HB.228, HB.426 and HB.524 recorded encouraging CSP values at 80s count.

Two sets of hybrids comprising twelve samples were received from Raichur. Only one hybrid, viz. JK.119 × DS.25-54 fared well in spinning performance at 40s count.

Miscellaneous Trials : A good number of trials having different objectives were conducted at Coimbatore, Kovilpatti, Mudhol, Nandyal, Paiyur, Raichur and Srivilliputhur.

The details of the trials and test results are given below :

Two samples of breeder seed trial of LRA. 5166 collected from the State Seed Farm at Pongalur and the ECC Farm at SBI, were received from Coimbatore. It is observed that LRA.5166 collected from the State Seed Farm at Pongalur was superior to that collected from the ECC Farm at SBI in fibre length, Micronaire fineness and bundle tenacities at both the gauge lengths. In the case of spinning performance, the LRA.5166 collected from the State Seed Farm at Pongalur was better than that collected from ECC Farm at SBI in CSP values at both the counts, viz. 50s and 60s. However, the LRA. 5166 collected from the State Seed Farm at Pongalur alone was found to record satisfactory spinning performance at 50s count.

A promising strain, SIMA 1 along with the control, Krishna raised under the rice fallow conditions, was received from Coimbatore. SIMA 1 was coarser than Krishna in Micronaire fineness. In the case of spinning performance both SIMA 1 and Krishna were *on par* at both carded counts, viz., 30s and 40s. Both the cottons were found satisfactorily spinnable at 40s count. The yarn from SIMA 1 was more neppy than that from Krishna at both the counts.

A trial of Advance Line of Selection of *G. hirsutum* was conducted at Coimbatore. From the first set, two out of four selections, viz. T.5-70 D and T.5-70 G and from the second set, four out of five selections viz. T.70-A, T.70-E, T.70-E, T.70-F and T.70-G fared well in spinning performance at 60s count.

A set of sixteen samples of *G. barbadense* cultures was received from Coimbatore. The 2.5% span length ranged between 24.8 mm and 34.9 mm with good Micronaire fineness, maturity and bundle tenacities at both the gauge lengths. Only one culture, viz. C.17 along with the control, Suvin was found to give satisfactory spinning performance at 100s count.

A new *G.hirsutum* strain, viz. TKH.650 along with two controls, MCU.10 and LRA.5166 tried under rainfed conditions was received from Kovilpatti. It was observed that the control, MCU.10 was significantly better in fibre length and Micronaire fineness as compared to the new strain, TKH. 650, while the other control was superior to TKH.650 in fibre length and bundle tenacity at 3.2 mm gauge length. In the case of spinning performance, the control, MCU.10 recorded better CSP values than TKH.650 at both the counts, viz. 30s and 40s. Although both the cottons were found to be suitable at 30s count, LRA.5166 recorded good CSP value at 50s count.

Cotton samples were received from Mudhol under the Improvement of Gaorani Cotton Scheme for evolving early maturity cotton varieties better than Gaorani in yield and fibre qualities and suitable for cultivation in the Gaorani tract under the rainfed conditions in Andhra Pradesh.

Under the Advanced Varietal Trial of *G. arboreum*, as many as six out of eight cultures, viz. 1867, 1874, 1876, SB.142 and SB.171 and the control, Saraswati recorded encouraging CSP values at 20s count. The cultures, 1867 and 1875 also showed good spinning potential at 20s count when these were tested for full spinning.

Under the Initial Evaluation Varietal Trial, as many as six out of eleven cultures,

viz. 2207, 2225, 2255, 2261, 2264 and 1867 fared well in spinning performance at 20s count, while under the Preliminary Varietal Trial, all the seven cultures included in the trial, viz. 2090, 2103, 2118, 2165, 2197, 2205 and MDL.32 recorded good CSP values at 20s count.

Under the scheme of evolving high yielding cotton varieties with tolerance to pest and diseases, two promising *G. hirsutum* strains, viz. NA.1280 and NA.1290 along with two controls, LRA.5166 and NA.920 raised under rainfed conditions were recieved from Nandyal. It was observed that both the new strains, NA.1280 and NA.1290 as well as the two controls, LRA.5166 and NA.920 were *on par* in fibre length and maturity. The strain, NA.1280 was found to be suitable for spinning at 20s count while the other new strain, NA.1290, recorded good CSP value at 60s count, the two controls, LRA.5166 and NA.920 faring well in spinning performance at 30s and 40s counts respectively.

With a view to developing a high yielding interspecific hybrid with fibre properties equivalent to or even better than DH.32 and with tolerance to pest and diseases, hybrid designated as NHB.116 has been evolved. This along with the control raised under irrigated conditions was received from Nandyal. It was observed that the new hybrid, NHB.116 was almost *on par* with the control, DCH.32 in fibre length, Micronaire fineness, and maturity. In the case of spinning performance, both the hybrids were *on par* in CSP values at 60s and 80s counts and recorded satisfactory yarn strength at 80s count.

A new strain, DPI.24181 along with controls, MCU.10 and LRA.5166 raised under the evaluation trial of high yielding winter rainfed *G. hirsutum* cotton suitable for the North Western Zone of Tamil Nadu, was received from Paiyur (TNAU). It was observed that the new strain, DP.24181 was *on par* with LRA.5166 in fibre length, Micronaire fineness, maturity and bundle tenacity at 3.2 mm gauge length, while it was significantly better than MCU.10 in respect of fibre length, maturity and bundle tenacity at 3.2 mm gauge length. In the case of spinning performance, both the controls, LRA.5166 and MCU.10 were found to be satisfactorily spinnable at 30s count, while DPI.24/81 recorded good CSP value at 40s count.

A medium staple, *G. hirsutum* culture, viz. TSH.164 along with the control, MCU.7 raised under the rice fallow conditions was received from Srivilliputhur. It was observed that the new strain, TSH.164 was significantly better in fibre length and bundle tenacity at zero gauge length as compared to the control, MCU.7. The spinning performance of TSH.164 was superior to that of MCU.7 at both the counts, 30s and 40s. TSH.164 recorded satisfactory spinning performance at 40s count while MCU.7 recorded good CSP value at 30s count.

Mill Test : A new strain which is promising in yield and technological performance after being subjected to full spinning test for two to three seasons successively, is tested under the mill conditions before it is released for large scale cultivation. CTRL arranges mill tests on new promising strains in cooperation with some of the textile mills in the country.

During the period, mill tests were arranged for samples received from Khandwa, Parbhani, Nandyal and Srivilliputhur, and the test results are incorporated in Table 6.

TABLE 6 : COMPARATIVE SPINNINGTEST RESULTS AT MILL AND AT CTRL FOR THE YEAR 1990

Location	Variety	Mill Test					Laboratory Test				
		Count (Ne)	Strength (lb)	CSP	TM	U%	Count (Ne)	Strength (lb)	CSP	TM	U%
Khandwa	JKHy.2	40s	54.1	2162	4.6	—	40s	52.9	2116	4.0	19.2
		50s	40.8	2039	4.6	—	50s	39.2	1960	4.0	20.4
	JKHy.1(C)	40s	53.4	2138	4.6	—	40s	55.5	2220	4.0	20.0
		50s	40.7	2034	4.6	—	50s	39.7	1984	4.0	20.2
	PH.93	30s	56.5	1696	4.5	—	30s	59.6	1788	4.0	17.7
	Purnima (C)	30s	53.4	1602	4.5	—	30s	64.6	1938	3.0	18.0
Nandyal	NHH.39	40s	56.8	2271	4.6	15.6	50s	46.8	2270	4.0	19.2
		50s	42.3	2115	4.6	17.5	60s	35.6	2124	4.0	20.2
	JKHy.1(C)	40s	56.7	2264	4.6	16.1	40s	56.0	2204	4.0	18.8
		50s	39.5	1998	4.6	16.2	50s	43.7	1925	4.0	19.2
Srivilliputhur	TSH.164	30s	74.4	2232	4.7	16.2	30s	71.2	2136	4.0	17.8
		40s	50.7	2027	4.7	18.2	40s	50.9	2036	4.0	18.6
	MCU.7(C)	30s	69.2	2075	4.7	17.0	30s	74.1	2223	4.0	17.3
		40s	50.6	2023	4.7	17.9	40s	50.9	2036	4.0	18.0

C — Control Variety

The new *intra-hirsutum* hybrid JKHy.2 and the control, hybrid JKHy.1 received from Khandwa, recorded encouraging CSP values at 40s count both at the mill and at the Institute. Both the hybrid cottons were almost *on par* in CSP values at 40s and 50s counts at the mill. At the Institute, JKHy.1 recorded CSP value higher than JKHy.2 at 40s count and both were *on par* at 50s count.

The improved strain PH.93 along with the control variety, Purnima received from Parbhani, were not found to be satisfactorily spinnable at 30s count, both at the mill and at the Institute. The spinning performance of PH.93 and Purnima at 30s count was better at the Institute than at the mill. It was also observed that the CSP value of PH.93 was better than that of Purnima at the mill, while the CSP value of Purnima at the same count was superior to that of PH.93 at the Institute due to the poorer fibre quality of PH.93 as compared to Purnima.

The promising *intra-hirsutum* hybrid, NHH.39 and the control hybrid JKHy.1 received from Nandyal were found to be satisfactorily spinnable at 50s count at the mill as well as at the Institute. The new hybrid, NHH.39 recorded better CSP values at 50s count as compared to JKHy.1 both at the mill and at the Institute. In the case of Uster value, imperfection parameters and yarn appearance, the yarn of 50s count of NHH.39 was superior at the mill conditions of processing to that at the Institute.

The new strain, TSH.164 along with the control variety, MCU.7 received from Srivilliputhur recorded satisfactory spinning performance at 40s count both at the mill and at the Institute. Both the cottons, TSH.164 and MCU.7 were *on par* in CSP values at 40s count at the mill as well as at the Institute. It was also observed that there was practically no difference in the yarns of these two cottons in respect of irregularity and imperfections on Uster Evenness Tester and appearance by ASTM standards at 40s count, both 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	LH.1445, LH.1446, LH.1031, LD.451, LD.484, LH.486, PCHH.13, PCHH.21, PCHH.31
Haryana	H.974, HSCCP.69, HD.107, HD.115, HHH.111, HHH.81
I.A.R.I.	Pusa 2-54, Pusa 2-95, Pusa 2-98, Pusa 2-116,
New Delhi	Pusa Hybrid 12, Pusa Hybrid 19, Pussa Hybrid 21
Uttar Pradesh	CSA.9-10
Rajasthan	RST.19, RST.9, RS.716

Contd.

State	*Promising strains/hybrids*
Gujarat	G.4812, G(T) 538, G.2443, GHH.662, GHH.756, GHB.418, HDH.106, LRK.516
Maharashtra	LJH.168, PH.93, AK.8621, MECH.15, MECH.19, MECH.111, MECH.115, WHH.37, NFDH.105, NHH.302
Madhya Pradesh	79.BM.5-3, KW. 81-1911, KWA.3, KW(HR). 1, JKHy.2
Karnataka	NHYPS. 152, CPD.402, CPD.404
Andhra Pradesh	NA.1290, NHH.39, 1867, SB.142, SB 171
Tamil Nadu	TKH.4-3,, TKH.497, HLS.321729, LK.861, C.17 LK.861, C.17 a

(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 1990-91, 16 such circulars were issued. The results of samples of 1990-91 season were later consolidated and published as Technological Report on Standard Indian Cottons — 1990-91 Season.

(ii) Trade Varietie 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 procured 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 1990-91 on 15 Indian cottons is given in Chapter 3. In addition, booklets entitled "Major Fibre Properties of Some Trade Varieties of Indian Cottons", have been published incorporating test results of 324 such samples of 1989-90 season and of 467 samples of 1990-91 season.

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

Technological Evaluation of Germ Plasm Material

This project was taken up with the aim of registering and documenting the available genetic resources of cotton in India and abroad, which might serve as a donor during the improvement of the quality characters of the strains being developed by the cotton breeders and research workers.

During 1990-91, about 800 stocks of germ plasm (GP) were evaluated for their significant quality character. The samples of *G. hirsutum* and *G. herbaceum* were collected from CICR, Nagpur. A few of them were newly acquired from Punjab and Haryana. As many as 1460 samples of GP material were qualitatively evaluated at QE Unit of CTRL at Nagpur.

About 289 cultivars belonging to *G. hirsutum* species of medium staple category collected from Punjab had span length ranging from 18.8 mm to 28.6 mm. Fibre fineness in terms of Micronaire value varied from 2.3 to 4.7, tenacity at 1/8″ gauge from 13.4 g/t to 26.0 g/t and fibre maturity low to good. Another lot of 177 newly acquired GP samples from Hisar had 2.5% span length ranging from 15.4 mm to 30.2 mm, Micronaire value from 2.2 to 4.8, fibre tenacity at 1/8″ gauge from 15.5 g/t to 27.0 g/t and maturity between 0.54 and 0.72 evincing good scope for selection. From Nagpur, 38 cultivars belonging *G. hirsutum* and 27 samples of *G. herbaceum* were also tested for quality parameters. From Exotic group, 72 cultivars were qualitatively analysed. Two lost of 322 samples and 295 samples belonging to *G. hirsutum* received from Nagpur were tested for fibre properties and prominent quality characters of each cultivar noted.

Inheritance of Fibre Length G. Hirsutum Cottons

The following 10 established varieties were taken up for the study.

Long Staple	*Medium Staple*
1. Gujarat 67	5. FP.332
2. Deviraj	6. SA.540
3. G.Cot.100	7. A. 51-D
4. MCU.5	8. F. 414
	9. Sharada
	10. STC.2

During 1989, the above parents were sown and line × tester crossings were made. The resultant 24 crosses along with 10 parents were sown during June 1990. Again crossings were made for 10 parents during 1990.

Variations in Ribbon Width of Fibre for Desi Hybrids

Parents taken up for study were :

G. herbaceum	*G. arboreum*
1. 2272	5. G.27
2 3652	6. AKH.4
3. 785 IV/3	7. LD.210
4. 2340/53	8. NA.39

In all, 108 samples from eight parents and 28 crosses (partial diallel) in three replications were subjected to ribbon width measurements and the test results analysed. The ribbon width of the parents ranged

from 17.9 μm to 23.2 μm. The variety LD.210 had the maximum ribbon width of 23.2 μm whereas NA.39 had a width of 17.6 μm. The ribbon width of hybrids ranged from 17.9 μm to 21.5 μm. The C.V. percentages for parents were between 15.5 and 20.3 and for hybrids, the values ranged from 14.7 to 19.2.

The mean squares due to treatments, parents and hybrids were highly significant. This indicated the existence of genotypic variability. Thirteen crosses showed highly significant negative heterosis of desirable type. Eighteen hybrids showed highly significant desirable heterobeltiosis. Both general combining ability (gca) and specific combining ability (sca) were significant. However, gca variances were greater than sca variances indicating preponderance of additive type of gene action. The cross combinations involving strain nos. 4, 6 and 8 as one of the parents, manifested negative highly significant heterobeltiosis.

As the study was to be done on the current cultivable variaties, the two *desi* hybrids G.Cot.Hy.7 and G.Cot.Hy.9 were chosen. The ribbon widths of these hybrids and their parents were studied.

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

The following established strains which are under cultivation at present were chosen : (i) G.Cot. 10 (ii) G.Cot. 11 (iii) G.Cot.Hy.6, (iv) G.Cot.Hy.9. The four varieties are of different genotypes. About 350 just opened bolls were exposed to weather conditions on the plant. The seed cotton was collected in four pickings with an interval of one week. The lint was analysed for fibre properties.

		Ribbon width (mean value in μm)	Range (μm)	C.V. (%)
I.	G.Cot.Hy.7	26	13-38	24
	Sujay	20	11-30	21
	G.27	22	13-32	16
II.	G.Cot.Hy.9	22	13-32	17
	824	18	10-27	23
	4011	22	13-32	18

Varieties	*Pickings*
V1 : G.Cot.10	P1 : One week
V2 : G.Cot.11	P2 : Two weeks
V3 : G.Cot. Hy.6	P3 : Three weeks
V4 : G.Cot. Hy.9	F4 : Four weeks

The 2.5% span length, Micronaire value and strength at 3 mm gauge length were evaluated. The results are given in Table 7 were as follows :

About 1.5 kg seed cotton was collected from each variety from the field and exposed to direct sunlight every day. The lint was then tested at three stages with an interval of one month.

It can be seen that exposure to sunlight does not seen to alter fibre properties in any significant manner.

The test results are given in Table 8.

Variety	*Stages*
V1 : G.Cot.10	S 1 : immediately from the field
V2 : G.Cot.11	S 2 : after one month
V3 : G.Cot.Hy.6	S 3 : after two months
V4 : G.Cot.Hy.9	

TABLE 7 : IMPORTANT FIBRE PROPERTIES AT DIFFERENT PICKINGS

Treatment	Rep. I			Rep. II		
	2.5% SL (mm)	Micronaire value	Strength at 3 mm gauge length (g/tex)	2.5% SL (mm)	Micronaire value	Strength at 3 mm gauge length (g/tex)
V1P1	25.1	3.8	22.2	25.0	3.6	24.6
V1P2	26.2	3.7	21.7	26.0	3.8	25.1
V1P3	26.6	3.6	23.7	26.6	3.8	24.3
V1P4	25.3	3.5	21.4	26.0	3.9	25.3
V2P1	26.0	5.4	22.7	25.4	5.2	29.6
V2P2	25.3	5.8	29.6	25.2	5.2	25.1
V2P3	25.0	5.5	23.5	25.0	5.0	22.2
V2P4	25.4	4.7	25.8	23.8	4.7	22.4
V3P1	28.6	2.9	29.2	29.3	3.4	31.5
V3P2	29.2	3.5	30.9	28.9	3.5	29.2
V3P3	28.4	3.5	27.5	28.0	3.2	29.4
V3P4	28.2	3.5	28.6	28.1	3.6	31.2
V4P1	31.0	4.6	27.5	30.7	4.6	27.7
V4P2	31.7	4.7	26.6	31.6	4.6	28.5
V4P3	32.8	5.0	27.5	31.2	4.9	25.5
V4P4	30.4	4.8	27.5	31.2	4.8	26.3

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

In earlier work, the influence of HVI parameters on CSP was studied. From April to September 1990, work for correlating the fibre test data of 83 cottons with the respective lea strength of yarns ranging from 20s to 80s counts was attempted. This correlation was significant ($r = 0.7674$). Similarly, the correlation between FQI and lea strength was of the same order ($r = 0.7119$). Further, the product of fibre properties and nominal count as well as the product of FQI and nominal count showed correlation with lea strength, and the correlation coefficient was 0.9128 and 0.9182, respectively. The statistical analysis indicated that lea strength can be predicted better if the nominal count is included along with fibre properties.

In the second half of the year, the influence of different sets of calibration cottons on HVI data was studied.

The advantage of testing large number of samples in a short span of time on HVI system is marred by the differences observed

TABLE 8: IMPORTANT FIBRE PROPERTIES OF DIFFERENT STAGES OF EXPOSURE TO SUNLIGHT

	Rep. I			Rep. II			Rep. III		
Treatment	2.5% SL (mm)	Micronaire value	Strength at 3 mm gauge length (g/t)	2.5% SL (mm)	Micronaire value	Strength at 3 mm gauge length (g/t)	2.5% SL (mm)	Micronaire value	Strength at 3 mm gauge length (g/t)
V1S1	25.3	3.8	21.8	24.9	4.0	21.1	25.8	3.6	25.0
V1S2	24.4	3.8	20.9	26.2	3.9	22.0	25.8	3.6	24.6
V1S3	25.4	4.0	23.7	25.2	4.0	20.9	25.6	3.7	24.1
V2S1	25.6	5.7	22.3	26.0	5.6	18.6	26.1	5.7	19.7
V2S2	25.9	5.6	21.3	24.9	5.4	18.7	25.4	5.6	19.9
V2S3	25.6	5.7	21.3	26.0	5.4	18.4	24.6	5.8	17.4
V3S1	29.4	3.9	29.7	28.6	3.8	27.4	29.8	4.0	28.2
V3S2	29.4	4.1	31.4	30.8	3.8	27.2	31.0	4.1	27.2
V3S3	29.6	4.0	28.5	29.2	3.8	24.8	30.0	3.8	27.7
V4S1	31.6	5.0	30.6	30.8	4.9	27.0	32.7	5.1	27.2
V4S2	31.2	4.8	27.7	31.4	4.8	25.6	30.5	5.2	24.8
V4S3	31.4	4.8	28.9	31.6	4.8	25.0	30.0	5.0	23.3

in HVI test data within and between laboratories. It is likely that different calibration cottons and calibration routine influence the test results. To obtain reliable test data, apart from the machine calibration, the instrument has to be calibrated with standard cottons to eliminate the operator's bias.

Two sets of experiments were carried out to observe the influence of different sets of calibration cottons on HVI measures like, 2.5% SL, 50% SL, UR and strength.

Expt. i : The span length values of 10 cottons obtained by raw cotton and card-web calibration were in good agreement. In the case of bundle tenacity, the values obtained with raw cotton calibration were found to be within the tolerance limit, although values with raw cotton were more close to the standard values.

Expt. ii : The test data on 50 samples obtained with 2.5% SL (ICC) and UHML (HVI) calibrations were analysed and it was found that 2.5% SL and UHML were closely associated ($r = 0.98$). However, the 2.5% SL values obtained with UHML (HVI) calibrations were overestimated by about 0.8 mm. Similarly, the UHML

obtained with 2.5% SL (ICC) calibration were also overestimated by about 0.8 mm. Significant correlation ($r = 0.93$) was found to exist between tenacity values measured with different length level calibrations.

Miscellaneous Studies

The effect of micronutrients on the yield and quality of rainfed cotton

This study was conducted on AHH.468 in Akola Sprays of various micronutrients and their combinations along with major nutrients like nitrogen and phosphorous through urea and diammonium phosphate had little effect on *kapas* yield or fibre quality.

Also, the effect of Biozyme application on rainfed Hybrid AHH.468 was studied and it was found that there was little or no effect on the *kapas* yield or on the fibre quality as a result of Biozyme application.

Bio-efficacy of 13 newer insecticides against bollworm was taken up on MCH.5 cotton at Guntur Quality Evaluation Unit. Only fibre quality was found to be influenced by these treatments; however, by and large, there was no deterioration in the fibre quality due to insecticidal treatments.

Another study on the effect of growth regulators against *Heliothis* conducted at Guntur indicated no deterioration of fiber quality in MCU.5 due to treatments.

Multilocation trials of 10 common varieties at different locations in Andhra Pradesh indicated that the cotton grown at Jaglial and Madhire were better than those from other locations like Mudhol, Warangal and Lam.

In a study on the evaluation of new insecticides for the control of bollworm and their effect on the fibre quality, H.777 variety was given four sprays at an interval of 12-14 days at Hisar. In some treatments 2.5% span length and bundle strength were numerically higher, but the effect was non-significant for all quality parameters of length, fineness, maturity and strength of the fibres.

Mechanical picking of cotton in Punjab indicated that nature of picking-mechanical or handpicking, has no bearing on the quality of cotton. However, a higher level of trash was observed in machine picked cotton.

In a study conducted at Nanded on the influence of fibre quality and yield levels of H.4 cotton due to the application of insecticides against pink bollworm, most of the pyrethroid treatments improved the fibre tenacity and length with significant increase in *kapas* yield compared to control.

THRUST AREA II : POST HARVEST TECHNOLOGY OF COTTON

This thrust area encompasses preclaning and ginning of *Kapas* and further mechanical processing of the ginned lint into yarns. The importance of this thrust area lies in the fact that full realisation of the quality of the 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 farmer community. Several research investigations have, therefore, been taken up on the various aspects of this important thrust area.

Survey of Conditions of Ginning Factories in Madhya Pradesh, Karnataka and Andhra Pradesh

Last year, a report on the findings of the survey of ginning factories in Madhya Pradesh was published and also collection of filled up questionnaires and personal visits to ginning factories were completed in respect of Karnataka State. During 1990-91, apart from completing the survey work of Karnataka, the work for initiating survey of factories in Andhra Pradesh has been taken up.

(a) *Survey of Ginning Factories in Karnataka* : Tabulation of collected questionnaires has been completed. The Assistant Director of Agriculture (Cotton) at Dharwad was contacted and was requested to collect some more questionnaires; but he has expressed his inability to collect more number of completed questionnaires. Therefore, on the basis of the tabulated information and the information collected during personal visits to the factories, a final report on the conditions of ginning factories in Karnataka has been written up for publication.

The main findings of the survey were as follows :

(i) In Karnataka, all the ginning factories are equipped with Double Roller (DR) gins of old Platt make or new Bajaj make, apart from other similar types of machines; but their rate of production is very low.

(ii) There are too many small ginning factories having less than six gins; this should be discouraged.

(iii) *Kapas* should be cleaned before ginning so as to remove foreign matter which will improve the quality of ginned lint and fetch better price.

(iv) Wherever adequate labour is not available for manual precleaning, inclined type precleaning may be used.

(v) Ginning and pressing charges may be revised by dividing the entire area into two zones as Rural centres and Urban centres, keeping in view the differences in labour and other charges between them.

(vi) Most of the gin fitters employed at these factories are not properly trained. So, they may be sent to the Ginning Training Centre of CTRL at Nagpur for training.

(vii) Many factories do not get sufficient quantity of *Kapas* for ginning and are operating only in one shift; so no more licences may be issued for new factories.

(viii) Transport Act of cotton may be suitably modified, taking into consideration the difficulties faced by traders and farmers.

(b) *Survey of Ginning Factories in Andhra Pradesh* : The Survey of the ginning factories in Andhra Pradesh could not progress due to non-response from the local Government agencies, who could have helped in getting the questionnaires filled from the ginning factories.

Hence, this work will have to be taken up in the next cotton season by contacting

other private agencies like the Andhra Pradesh Cotton Association at Guntur.

Impact of Different Ginning Methods on Seed Quality

Seed samples of SRT.1, AKH.4, G.27 and PKV.081 were tested for fuzz percentage, germination percentage, shoot length, etc. With these tests, the project work is completed. Final report is under preparation.

Design and Development of an Inclined Type Cotton Cleaner

Rigorous precleaning trials of H.4 *Kapas* were carried out for five grades, viz. Super (5660 kg), FAQ (1315 kg), Fair (970 kg), × (815 kg) and *kawadi* (1270 kg). The capacity of precleaning machine varied from 2721 to 3156 kg/hr. The removal of trash was 0.26%, 0.30%, 0.81%, 1.53% and 2.34% respectively for the Super, FAQ, Fair, × and *kawadi* grades of H.4 *kapas*.

It was observed that after precleaning, there was an increase in ginning out-turn ranging from 2.29 to 19.95%. Table 9 gives results of testing different grades of *kapas* on the precleaner. The results of fibre test and spinning performance will be incorporated after finalisation.

Incidence of Seed Coat Fragments in Ginned Cotton

The laboratory model gin was installed and made operational for this work. About 10 samples of cotton produced from Surat Agricultural Farm have been hand opened and cleaned. The cleaning operation included removal of leafy trash and other extraneous substances in addition to freeing the sample from motes (undeveloped ovules), immature seeds and infected seeds. The immature seeds were easily identified by slightly pressing them between fingertips when they got crushed.

Seven samples were selected for the experiment. From each sample 40 gm of *kapas* was ginned after carefully setting the gin for the required overlap with the aid of appropriate gauges fabricated earlier for the purpose. The lint so obtained was once again thoroughly mixed and three 3 gm lots were taken for observation for the incidence of seed coat fragments. The samples studied by this procedure included SRT.1, Hy.4, Hy.6, DCH.32, LRA.5166, G.Cot.10 and Digvijay. The incidence of seed-coat fragments was highly variable among the samples. The fragments were separated by visual inspection (counting) in accordance with standard ASTM method. The fragments thus counted varied from about 30 to 100 in 3 gm lint lots and were found to be varied in size.

The overlap adjustment by lowering the fixed knife, seemed to contribute for higher incidence of seed-coat, especially when the overlap was around $\frac{1}{4}''$. This is inferred as due to cutting of the seeds when the knife-edge is below the horizontal plane of the axis of the roller. For overlaps higher than this value, however, there was no noticeable crushing of seeds. The presence of immature seeds was found to enhance the formation of fragments and it was necessary to remove such seeds from the *kapas* before ginning.

Presently, attempts are being made to adjust the overlaps to lower values by controlling the stroke angle of the moving knife instead. This is to see whether the cut seeds are primarily due to the lowering of the fixed knife.

TABLE 9 : RESULTS OF TESTS ON DIFFERENT GRADES OF KAPAS ON PRE-CLEANING MACHINE DESIGNED AT CTRL

Grades of H.4 kapas	Quantity of kapas processed (kg)	Processing time (min)	Out-put of pre-cleaner	Trash obtained (kg)	Trash %	Quantity of kapas ginned (kg)	No. of DR gins	Processing time (min)	Ginning out-turn (kg/hr)	% increase in out-put due to pre-cleaner (%)
Super										
Cleaned	5660	123	2760	14.7	0.26	5616	19	128	138.5	2.29%
Un-cleaned	Nil	—	—	N.A.	N.A.	5616	19	131	135.4	
FAQ										
Cleaned	1315	25	3156	3.8	0.30	1250	19	26	151.8	3.83%
Un-cleaned	Nil	—	—	N.A.	N.A.	1250	19	27	146.2	
Fair										
Cleaned	970	20	2910	7.9	0.81	955	19	24	125.7	8.68%
Un-cleaned	Nil	—	—	N.A.	N.A.	955	19	26	116.0	
X										
Cleaned	815	16	3056	12.5	1.53	800	19	25	101.0	19.95%
Un-cleaned	Nil	—	N.A.	N.A.	N.A.	800	19	30	84.20	
Kawadi										
Cleaned	1270	28	2721	29.8	2.34	1195	19	40	94.30	12.44%
Un-cleaned	Nil	—	N.A.	N.A.	N.A.	1195	19	45	83.90	

An Investigation into the Anatomy of Yarn Faults — Their Source of Occurrence and Mechanism of Formation

About 4000 yarn samples belonging to various categories of faults were collected and few of them were analysed, physically. In addition, four specimen faults belonging to A1, A2, A3, A4, B1, B2, B3 and B4 were scanned and photomicrographed using scanning electron microscope under two magnifications.

A detailed analysis of A and B categories of faults has shown that these faults occur mainly from three broad sources — (i) Trash (ii) Short Fibre-bunch and (iii) Fibre-fly.

A Study of Yarn Tension Behaviour in Rotor Spinning and its Relation to Yarn Characteristics

A priliminary study was undertaken on 20s yarn spun from J.34 cotton at various rotor speeds. The tension developed during the yarn formation at the junction of doffing tube and delivery roller was determined using Rothschild Tensiometer. The yarn tension was also calculated by theoretical methods. The results indicated that there exists a close relation between the calculated and measured tensions.

Further, a detailed study was undertaken to investigate the effect of frictional properties of fibres on yarn tension behaviour while spinning on OE-Rotor System. For this purpose, one bright polyester fibre of 1.2 D × 38 mm length, specially manufactured for OE-system and one long staple cotton, viz. Suvin were chosen.

Both polyester and Suvin cotton were processed through blow-room, card and draw-frame using identical processing parameters. Hand sliver of 0.17 hank produced from the finisher draw-frame was spun into 15s Ne yarn, in each case. Tension measurements were recorded for the yarns using Rothschild Yarn Tensiometer at various twist-multipliers and rotor speeds.

The actual values for yarn tension were read out from the recorded chart and the particulars like, average tension, maximum and minimum values of tension and C.V.% of tension were enumerated for some of the combinations during the period.

A Study of Comparison of Yarn Bundle Strength with Lea Strength

Fifteen cotton yarns of counts varying from 16s to 100s were selected for the study. Bundle strength tests on the Instron and on the Lea strength tester, with specially fabricated jaws to mount the bundles on Lea tester, were carried out. Five yarn bundles each consisting of 100 strands were tested per sample on each tester (Instron and Lea). These parallelised yarn bundles were prepared on a device specially fabricated for this purpose. A normal lea test was also caried out for the same samples. Fifty leas were tested per sample. Table 10 gives the tenacity values and C.V.% of yarn bundles tested on Instron and lea tester as well as of the normal lea tested on the latter.

It can be seen from the data in Table 10 that the C.V. % values for bundle tenacity on the Instron as well as the Lea Tester are less than half the C.V.% for tenacity observed in the normal lea test. This has been so, in spite of the fact that only five specimens were tested on the Instron and Lea tester, as compared to 50 specimens tested in the normal lea test.

The results, thus show that the yarn bundle strength test is better than the normal lea test for the following reasons :

i) Bundle test shows very low variability.

ii) Four or five bundle strength tests are enough as compared to 50 tests in the normal lea test.

iii) Sample consumed in testing is minimum.

iv) Single strand test data and bundle strength are theoretically related, while the lea test does not have any such relationship.

v) The bundle strength test can be carried out on the lea tester with a suitable jaw attachment.

vi) With proper mechanisation the testing can be made very fast.

Miscellaneous Studies

Standardisation of microspinning unit at the Coimbatore station by comparing the results with the microspinning unit at Headquarters. A set of two samples each was processed in the Shirley Miniature Spinning Plant for 40s, 50s, and 60s counts. One set of bobbins was sent to Headquarters for testing alongwith the lint samples of each variety for processing on the microspinning systems.

TABLE 10 : TENACITY AND CV (% OF YARN SAMPLES TESTED ON INSTRON AND LEA TESTER

Sample	Count	Bundle on Instron		Bundle on Lea Tester		Normal Lea	
		Tenacity (g/tex)	C.V. %	Tenacity (g/tex)	C.V. %	Tenacity (g/tex)	C.V. %
36175	16	6.52	2.28	6.99	2.71	6.19	5.57
36177	16	10.24	2.02	10.85	0.69	9.86	4.54
36221	20	9.75	2.27	10.39	1.76	9.64	4.19
36246	20	9.31	2.32	10.68	1.39	9.85	3.91
36221	30	8.10	2.40	8.65	2.87	8.02	5.79
36226	30	11.56	1.87	11.67	1.15	10.43	3.70
36226	40	10.33	0.88	10.70	1.38	9.59	4.57
36242	40	10.02	1.85	9.25	1.97	9.38	4.10
36233	50	13.43	1.95	14.55	2.10	12.58	4.16
36240	50	10.07	1.13	9.59	1.79	9.71	4.14
36143	60	10.37	1.68	10.68	1.95	9.74	3.89
36260	60	14.71	2.58	16.04	2.14	12.85	4.06
36165	80	12.51	2.83	12.78	1.57	11.86	3.79
36186	80	12.38	2.51	10.90	2.82	11.35	8.72
36165	100	11.38	1.10	11.59	2.91	10.19	4.29

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

The morphological and fine structural parameters of the cotton fibre collectively determine the physical and mechanical properties of the fibre as well as of the yarn and fabric produced from the fibre. Again, the properties of yarns and fabrics are governed by the manufacturing processes and the resultant lay-out of fibres in the yarn and of yarns in the fabric. The advent of newer cotton varieties and modern processing techniques has brought to fore, a wide range of combinations of fibre quality, yarn geometry and fabric design. A true understanding of structure-property relationship is a pre-requisite for developing varieties suitable for various end-uses as also for determining the processing sequences for the manufacture of end-products having different applications. Several research investigations are underway, some of which are of fundamental nature, in different thrust areas. A brief outline of the progress of work on these investigations is discussed below :

Studies on Lattice Conversion Behaviour of Cotton Fibres

In an attempt to distinguish the roles played by genetic background and maturity on the lattice conversion of cotton fibres brought about by alkali solutions, varieties having the same levels of maturity but drawn from different species for each maturity level, as well as samples from specific varieties having different maturity levels for each variety were treated with 4.10 N and 4.80 N LiOH as well as 3.07 CsOH, which are identified earlier in the project as the most useful swelling probes for fine structure studies. Analysis of X-ray data is in progress.

A Study on Crystallisation in Cellulose

Measurements of crystallinity of the developing fibres were repeated with the same variety of cotton G.Cot.10 (as per discussions and suggestions by the Management Committee) sown in the 1990-91 season and also with another relatively long duration variety H.4. Analysis of the data obtained with G.Cot.10 confirmed the earlier observation. Measurement of moisture regain also gave values almost in line with those obtained with crystallinity.

However, H.4 cotton did not show a drop in crystallinity with increasing age particularly during the intermediate stage of secondary cell wall development, as noted earlier for G.Cot.10. In the case of H.4, the initial fast increase was followed by a region where the crystallinity increased very slowly with age followed by yet another interval where there was a faster increase with age, before reaching a near saturation value. Crystallite orientation in both the varieties, on the other hand, showed a gradual increase with age upto 30 days and, thereafter, registered a very slow rise.

Attempts were also made to monitor the gradual change in crystallisation during drying of the never-dried cotton fibres, after correcting for the water held by the fibres. Crystallisation Index vs. Water Content (% water held on the dry weight basis) showed certain definite peaks corresponding to evaporation of water held by different regions such as inter-fibre, lumen, pores and chemically bound. However, this result is to be confirmed with a fresh set of fully mature but unopened bolls, before we can predict the crystallisation behaviour.

As the project is also intended to study the recrystallisation behaviour of amorphous cellulose, some experiments were carried out in this direction, as well. It may be recalled that amorphous cellulose obtained by saponification of cellulose triacetate (CTA) showed a new peak at 1590 cm^{-1} in the infrared spectrum and was attributed to H-bonding by earlier workers. However, the peak at 1590 cm^{-1} did not appear during heating of amorphous cellulose obtained by ball-milling of hydrolysates of cellulose. Repeated measurement with the film and powder samples showed that the 1590 cm^{-1} peak appeared during heating only when the samples had some alkalinity (saponification is done with alkali which is not completely removed with repeated washings with ethanol). Hence, it appears that the peak is not due to any special hydrogen bonding occurring during heating as postulated by earlier workers, but due to binding of alkali ions to COO- (ionised carboxyl groups). The peak did appear even without heating, when the samples were washed with ethanol containing a drop of acetic acid. Further, it also appeared when the amorphous powder was given a treatment similar to saponification prior to heating.

The above observations suggest that there are no differences in the behaviour of the two types of amorphous celluloses during heating even at molecular levels, and that the peak at 1590 cm^{-1} appears not due to any special H-bonding taking place during heating of the amorphous cellulose.

Measurement of Frictional Characteristics of Cotton Fibres

It was reported earlier that a method has been standardised to measure the coefficient of friction between a fibre tuft and a reference surface. A brass plate had been chosen as the reference surface. Subsequent experiments proved that the brass plate could not be used as the reference surface, since the results were not quite reproducible. After considering some other materials as the reference surface, it was finally decided to measure the inter-fibre friction between two identical tufts of the sample under study as one tuft moves over the other. This method has since then been standardised.

Adopting the above technique, tests were carried out on mulberry silk, viscose, wool, polyester, ardil, orlon and cotton fibres and the coefficient of friction of each fibre determined. Amongst these materials mulberry silk, viscose, orlon and ardil, exhibit "stick-slip" effect which occurs due to the differences in the values of static and kinetic friction coefficients. The higher this difference, the more sharp and well defined but fewer are the peaks and of load-displacement graph. In the case of mulberry silk, the peaks are well defined and fewer in number as the difference between its coefficients of friction is high. The reverse is the case with orlon. Of the fibers tested so far, mulberry silk recorded the highest value for coefficient of friction and cotton, the lowest.

Strength of Attachment Between Cotton Fibre and Seed

This project programme had two components : (i) fabrication of an instrument for measuring strength of attachment, and (ii) study of strength of attachment in different cotton varieties. During the early part of 1989-90, fabrication work had been initiated and some progress had already been made in this work. Later, since it was known that a similar instrument was manufactured by a British firm, it was decided to purchase one

such instrument and abandon the fabrication work. On receiving the British instrument (Shirley Cotton Seed Attachment Tester-SCSAT) towards the end of the year, the second part of the project has been initiated.

The first task after installation of the SCSAT was to standardise the method of measurement. The designers of the instrument have measured the strength of attachment separately in the Micropylar (M), side(S) and Chalazal (C) regions of the seed and have found distinct differences in these values. The strength of attachment is highest in the micropylar region in all varieties. In most varieties, this was followed by side region fibres and the least strength of attachment was found in chalazal region. In some varieties, however, the C and S positions were reversed. They have also attempted to find association between strength of attachment and fibre tenacity for each region. Earlier researchers at CTRL too had made similar measurements and had calculated the energy required to pull out a single fibre from the three locations on the seed surfaces (M,S and C) in different varieties.

The approaches made by the two groups of workers have been such that they would not lead to an index representing the average energy required for the extraction of unit mass of lint. Calculation of the average energy requires information on the number of fibres in each of the three regions of the seed surface. In other words, the statistical weights for different regions is required to be known. However, since the regions have no specific boundaries, this approach cannot be expected to yield information relating to energy required in ginning. It was, therefore, decided to determine the energy required to detach all the fibres on a given seed and then arrive at the average energy to obtain unit mass of lint. A few samples of *kapas* have been tested in this manner, taking 12 seeds from which all fibres were separated on the Shirley machine.

The energy required to separate unit mass of fibres from the side region alone and the variation (CV%) found among 12 seeds were as follows :

Variety	Mean energy per unit weight of lint from side region (J/kg)	CV% among 12 seeds
Suvin	722	33
TNB.1	1385	40
Virnar	1684	29
Deviraj	1931	43

It could be noticed that the CV% is of the range of 29 to 43. The high CV% seems to result from the fact that the side region fibres selectively gathered from the seed surface might also include some from chalazal and micropylar regions which have different values of attachment strength. The data gathered are, thus, of poor reproducibility. More over, the data on attachments strength in different regions donot, as already pointed out, lend themselves to providing information on the energy required to extract unit mass of lint from the variety.

Table on page 51 gives data obtained by the method suggested for adoption in our future work.

Here, all the fibres on the given seed are pulled out in 50 or more bunches, and the

Variety	Mean energy per unit weight (J/kg)	CV% among 12 seeds
Suvin	1076	22
TNB.1	1520	25
Virnar	1985	16
Deviraj	2227	10

average energy per unit mass is calculated for each seed. The CV%, then, is found to reduce to very low values. It would appear, therefore, that useful and reliable information can be generated by this method of measurement.

SEM Studies on the Effect of Sodium Hydroxide Swelling Treatment on Morphological Deformities in Cotton Fibres

Individual fibres taken from two more cotton varieties, viz. Badnawar 1 and Suvin, were given NaOH swelling treatment with a stretching force of 1 gm using the same method as described last year. After swelling treatment, the fibres were carefully washed in 'still' water bath to remove alkali solution and then dried at room temperature under the same tension of 1 gm wt. Nearly twenty fibres from each of the two varieties were given swelling treatment. Treated fibres were mounted on SEM specimen stubs with the aid of an optical microscope and then, examined in SEM for morphological deformities. Selected micrographs were recorded at suitable magnifications.

Individual fibres were also tried for NaOH swelling treatment with a higher stretching force of 2 gm wt. applied during swelling. However, this was not successful as the majority of fibres broke either during the swelling or washing treatment. Therefore, swelling treatment at the higher stretching force was given up.

Fibres taken from all the four varieties used in the experiment, viz. AK.235, Jayadhar, Badnawar.1 and Suvin, were also given NaOH swelling treatment in slack condition, washed in water and dried at room temperature and were examined in SEM for morphological deformities. Micrographs representing the sample fibres were recorded.

Raw fibres from all the earlier mentioned four varieties of cotton were suitably mounted on specimen stubs and scanned in SEM. Selected micrographs were recorded for comparison with slack swollen and stretched swollen fibres.

Visual SEM examination and comparison of various micrographs show that although the fibres when swollen in NaOH in slack condition assume nearly circular cross-section, they retain almost all the morphological deformities present in the raw fibres. More over, a few fibres developed crack or will rupture near some of the deformities in weaker zones of the cell wall. On the other hand, fibres, when swollen under 1 gm stretching force in all the four varieties covering the four botanical species, were found to be free from all types of deformities and had acquired a circular rod-like structure similar to that of synthetic fibres.

Some Aspects of Electrical Properties of Cotton Fibres/Yarns

The set-up for measurement of electrical properties of cotton fibres/yarns/fabrics was completed and testing work was started during the reporting period. Three cotton varieties were selected for study. Current-

voltage (I-V) characteristics of single fibres and corresponding single yarns were measured at room temperature. Three sets of readings were taken for each variety. The diameter of fibre and yarn was measured. The electrical conductivities were calculated for fibres and yarns. The data so obtained were presented in a research paper submitted for publication.

With the help of the rotary pump, desired vacuum was obtained in the chamber of the cryostat. Henceforth, the testing could be done in vacuum. Also, an electric heater (AC as well as DC) was attached to the sample holder which gives heating upto 100°C.

The Structure and Properties of Natural Cellulosic Fibres other than Cotton

Study of fine structure, morphology and wet tensile properties has been completed on fibres from different varieties of (i) banana (ii) sisal and (iii) coconut. Light microscopic study of fibre cross-sections and torsional rigidity by torsional pendulam method have also been carried out.

X-ray orientation measurements on technical fibres showed wide variation for the same type of fibres originating from different varieties. Thus, in the case of banana, the angle varied from 8° to 22° among the four varieties tested. There was also variation in orientation along the length of the technical fibre. In sisal, the x-ray angle varied from 20° to 22° among the four varieties. For coir fibres, the azimuthal intensity distribution profiles showed a split pattern, indicating a large spiral angle of about 45°. Further, the spread of b-axis about the individual spiral direction measured as x-ray angle showed a variation from 20° to 30° among the varieties.

Tenacity and orientation showed a poor correlation when fibres from different regions of the same plant were considered. In such cases, it appears that the binding provided by the cementing material, which actually forms the matrix for embedding the single cells, influences the tenacity data more than the orientation. On the contrary when tenacity data for different varieties and types of fibres are compared with the respective orientation values, fibres with higher orientation generally showed higher tenacity.

Fine structural studies revealed that the presence of non-cellulosic matter influences the x-ray crystalline diagram and infrared crystallinity index.

In the case of banana and sisal, the wet tenacity showed a small decrease while wet extension showed a significant increase over the corresponding dry (65% rh) values. In coir, irrespective of variety, the wet tenacity either remained the same as that of the dry (conditioned) fibres or showed a marginal increase while the wet extension did not show any clear trend among the varieties.

Morphological studies of these fibres with light microscope showed that the technical fibres of sisal is least circular while, coir is the most circular with banana fibres falling in between. Under SEM, technical fibres of both sisal and banana revealed aggregates of single cells which were more clear in the latter. In the case of coir, aggregates became evident only after delignification. Unpurified technical fibre of coir showed a rough surface with uniform deposition of pitch along the length. On the contrary delignifi-

cation resulted in the formation of circular pits on the surface at regular intervals.

Single cells, under SEM, revealed fibrillar structure (as in cotton fibres) only in the case of sisal. The fibrillar structure was not evident in single cells of banana and coir although all the three fibres were treated alike to extract single cells. In order to see whether alkali treatment would reveal the fibrillar morphology better, especially in the cases where it is not otherwise evident, the fibres were treated with NaOH at 0°C and examined under SEM. The alkali treatment revealed the fibrillar structure quite vividly in the single cells of all the three fibres. The fibrillar inclination followed the order of coir > sisal > banana. Torsional rigidity showed increase with increase in the area of cross-section of the fibre. But the increase was the least for banana and the highest for coir. The average modulus for the technical fibre also had the highest value for coir and the least for banana with sisal falling in between.

THRUST AREA IV : CHEMICAL PROCESSING AND FINISHING TREATMENTS

Although mechanical processing converts cotton fibres into yarns and fabrics, these end-products have limited utility value unless they have been subjected to chemical processing and finishing treatments to impart desirable properties and aesthetic appeal. CTRL had undertaken several investigations on various aspects of this thrust area in the past. As the chemical processing technologies are vital to bestow useful properties to the end-product from cotton, there were many studies during 1990-91, a brief account of which is given below.

An Analytical Study of Wax in Indian Cottons

Some samples of important trade varieties of Indian cottons belonging to *G. arboreum, G. herbaceum* and *G. hirsutum* species were collected. Quantitative estimation of wax for 15 samples from the above species was completed.

After extraction of wax, several trials were carried out to separate the principal constituents from the wax to be used for quantitative estimation. As wax is a mixture of various components, their separation proved to be difficult. The usual method of saponification using alcoholic KOH was not very successful in separating out the saponified and unsaponified portions. On the other hand, direct preparation of methyl esters using methanolic HCI proved satisfactory. The components were further separated by preparative TLC after the preparation of methyl esters.

Antibacterial Finishing of Cotton Fabrics

In earlier trials, the treated fabric samples were subjected to thirty mild launderings. In order to test the durability of the finish to 50 launderings, some of the earlier treatments were repeated. The fabric samples were given antibacterial finish using zinc acetate (10%, 12% and 14%), acetic acid (12%), hydrogen peroxide (12%), softner (1%), and wetting agent (0.1%). The fabric samples were dried at 100°C for 7 min and cured at 140°C for 4 min. The treated samples along with the untreated control were subjected to 50 mild launderings in a laundrometer as per the BIS method.

All the treated, laundered and the untreated control samples were evaluated

for various physico-chemical properties as well as for antibacterial performance by the modified Quinn test method using *S. aureus* and *Escherichia coli* organisms. All the treated and laundered samples recorded 100% antibacterial property *vis-a-vis* better strength retention.

Further, to study the efficiency of the antibacterial treatment at lower concentration of chemicals, few treatments were carried out using low chemical concentrations. The treated samples recorded very low add-on values.

Development of Durable Soil-Release Finish

Untreated cotton poplin (control) was evaluated for fabric weight, count, ends and picks, breaking strength and tearing strength. Prior to finishing treatment, the fabric was desized by standard method. The desized fabric samples were padded with a solution containing glyoxal/DMDHEU as crosslinking agent, carboxymethyl cellulose as antisoiling agent and aluminium ammonium sulphate as catalyst. Zinc acetate, sodium hydroxide and a softner were the additives used to improve the washfastness of the finish. The padded samples were passed through rollers of a laboratory padding mangle to squeeze out the excess solution and then dried at 80°C for 5 min and cured at 160°C for 3 min and finally washed with soap solution and air dried.

The reflectance measurements and estimation of carboxylic group content of control and treated fabric samples were done at two stages (i) on unwashed samples (ii) on samples subjected to one wash.

It was observed that (i) the use of glyoxal along with zinc acetate increases the carboxyl group content of the treated fabric and (ii) glyoxal adversely affects the whiteness of the fabric.

Pre-Processing and Dyeing Behaviour of Rotor and Ring Spun Yarns

Several trials were undertaken with direct, vat and reactive dyes to study the differences in dyeing behaviour of open-end (OE) and ring spun (RS) yarns. Quantitative estimation of the percentage exhaustion and dye uptake of the dyes on OE and RS yarns was carried out by the measurement of differences in colour.

Small pieces of yarn samples were collectively and severally dyed to 1% shade in the same bath, with a control bath (without the material) run with all the samples. Percentage exhaustion was calculated from absorbance values of the exhausted dye baths and those of the blank dye baths after suitable dilution. Dye uptake of direct dyes was determined from absorbance values after extraction with aqueous dimethyl formamide. Vat and reactive dyes were dissolved in sulphuric acid (98% and 70%, respectively) before determining absorbance. Percentage exhaustion between OE and RS yarns did not show appreciable differences whether dyed separately or collectively in the same bath. Dye uptake values were always higher in the case of OE yarns, when dyed in the same bath.

Scoured and bleached OE and RS samples were tested for fluidity. The values of fluidity were found to be more or less the same in both the cases.

OE and RS yarns were mercerised under three different conditions :

(i) Mercerisation slack — wash slack

(ii) Mercerisation slack — restretch and wash under tension

(iii) Mercerisation and wash under tension

The samples were tested for moisture regain and barium activity number.

Effect of Laundering on Physical and Mechanical Properties of Apparel Fabrics

The effect of washing by detergents on apparel fabrics, 100% cotton (CO), 100% Polyester (P), 67% Polyester/33% Cotton (67 P/33 C) was studied last year. During the period, the same study was continued using a soap *Chawalchura* on the apparel fabrics. The three fabrics were soiled artificially by the IS 5785-1971 method and subsequently, all the fabrics were washed 30 times with *Chawalchura*. The Control (C), Control Washed (CW), Soiled (S) and Soil Washed (SW) samples were tested for mechanical properties and reflectance percentage (Table 11). As compared to C, CW showed reduction in tear strength for all samples and reduction in abrasion resistance for CO and P/C samples. S and SW fabric samples did not show definite trend in tear strength and abrasion resistance. For S samples, reflectance percentage was significantly reduced as compared to C. On washing, SW samples showed improvement in reflectance values.

In a separate experiment, the soiled fabric samples were hand washed 30 times by the detergent "Surfmatic" and tested for mechanical properties and reflectance percentage. There was an increase in abrasion resistance for soiled samples as compared to control. On washing of S samples, both soiled and control samples showed further increase in abrasion resistance. To find out the causes of this increase in abrasion resistance observed on soiling, the effect of each component of the soiling material on mechanical properties was studied. Certain components like graphite, lanolin, etc. appeared to be contributing to the increase in abrasion resistance.

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

This area assumes national importance in view of the impetus given to utilisation of by-products and waste recycling for useful purposes in the Agricultural and other sectors.

The work done in this area during 1990-91 is summarised below :

Fermentations Studies on the Production of Cellulase by Penicillium funiculosum

(a) *Effect of aeration and agitation on cellulase production* : *Penicillium funiculosum* was grown earlier in 5 litre fermenter containing 2 litres of *Trichoderma viride* medium (TVM) where, aeration rate and agitation speed were kept at 1 lit/min and 280 rpm, respectively. Under these conditions, the organism produced cellulase having filter paper activity equivalent to 800-1200 μg of reducing sugars per ml of enzyme filterate. Subsequent study was confined to the effect of various aeration rates and agitation speed on cellulase production. The results indicated

TABLE 11 : FABRIC PROPERTIES FOR CONTROL SOILED AND SOILED WASHED SAMPLES WASHED WITH 'CHAWALCHURA'

	Cotton (CO)				Polyester/Cotton (P/C)				Polyester (P)			
	C	CW	S	SW	C	CW	S	SW	C	CW	S	SW
Breaking Strength (lb)	87	82	82	82	135	130	135	132	130	130	132	130
Elongation (E%)	5.0	7.0	7.5	10.3	15.2	16.8	15.0	17.0	32.8	35.0	26.3	26.8
Abrasion (Number of rubs)	2332	1800	2451	2500	4305	3998	4410	5500	8194	7998	8005	8110
Reflectance (%)	85.9	84.2	59.2	77.4	73.5	74.9	49.4	64.2	85.5	85.0	52.2	51.2
Tear Strength (g)	1158.4	956.8	1152	1088	1290	980	1254.4	1369.6	3150	2560	3072	2470

C : Control
CW : Control Washed
S : Soiled Control
SW : Soiled-Washed

that there is no change in cellulase production at higher aeration rates and agitation speeds.

Since higher aeration rates did not produce more cellulase, the quantity of inoculum was increased from 2% to 10% and the organism was grown at the aeration rate of 3 lit/min and agitation speed of 400 rpm, approximately. The results showed that there was an increase in cellulase production. The filter paper activity and the carboxymethyl cellulase activity of the enzyme were equivalent to 1800-2000 μg and 670-750 μg of reducing sugars per ml of enzyme, respectively. Thus, the production of cellulase could be enhanced at higher aeration and agitation rates at higher inoculum.

(b) *Measurement of dissolved oxygen during fermentation* : The concentration of dissolved oxygen in the fermenter broth was measured at various time intervals in terms of per cent oxygen saturation by using oxygen electrode. Simultaneously, change in total solids in the broth, filter paper activity, carboxymethyl cellulase activity and protein, increased. The oxygen levels in the broth at 24 hr, 48 hr, 72 hr and 84 hr were 60-56%, 52-58%, 46-50% and 34-40%, respectively.

(c) *Effect of carbon sources on cellulase production*: All the studies on production of cellulase in 5 litre fermenter were carried out using pure wood cellulose powder as carbon source. Attempts were made to replace it with other carbon sources, like cotton stalk powder, cotton stalk pulp, cottonseed hulls and alkali boiled cotton stalk powder and pulp. However, it was observed that these carbon sources do not support cellulase production.

(d) *Measurement of pH and production of cellulase under controlled pH* : Work is in progress to monitor and control the pH during fermentation. After initial fall in pH, it was adjusted to 4.8 and was not allowed to drop below 3.0. The results showed an increase in cellulase production.

Thermal Stability of Cottonseed Oil

Fifty ml each of cottonseed, coconut, groundnut, til, corn, soyabean and mustard oils were taken in 100 ml glass beakers and heated at 180°C for varying periods from 1 to 8 hr. Viscosity, specific gravity, U.V. and I.R. Spectra of these samples were studied.

Kinamatic viscosity of all the oil samples increased with increase in heating time. Viscosity of cottonseed oil increased from 55.90 centistokes (control) to 71-99 centistrokes (8 hr). It increased from 49.57 centistokes (control) to 53.04 centistokes after 8 hours of heating in the case of coconut oil.

In til oil, the viscosity increased from 57.89 (control) to 67.78 (8 hr) centistokes and from 55.80 (control) to 63.63 (8 hr) centistokes in soyabean oil. In the case of mustard oil, the viscosity increased from 81.35 (control) to 101.14 (8 hr) centistokes, while in the case of corn oil, increase was the least, i.e. from 63.32 (control) to 65.92 (8 hr) centistokes. In the case of groundnut oil, kinamatic viscosity increased from 68.45 (control) to 78.08 (8 hr).

Specific gravity of the samples remained almost unchanged due to heating. In-

frared spectra of the oil samples (in 4% carbon tetrachloride solution) did not show any change due to heating at 180°C for various periods. U.V. Spectra of the oils were taken in iso-octane. While the absorption peaks at 206 mm remained unshifted in all the cases, the intensity of the new peak at 232 mm increased with the heating time. Intensity of the peaks at 267 mm decreased with increase in heating time.

Work on the preparation and characterisation of the polymers formed during heating will be carried out with the help of gel permeation chromatograph.

Aminoacid Analysis of Cottonseed Proteins and Cottonseed Meal Hydrolysates

Protein hydrolysates obtained from cottonseed meal were hydrolysed with alkali and acid, and the aminoacids were characterised qualitatively on aminoacid analyser. Quantitative estimations are underway.

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

(a) *Boards from other lignocellulosic agrowaste materials* : Boards were prepared from bagasse dust received from a paper mill at Pune. Trials were also conducted to prepare boards from groundnut husk, biodegraded cotton stalks, arecanut husk alone and in combination with cotton stalk chips, using ureaformaldehyde as binder. The percentage of the binder was varied from 3% to 12%. The boards from bagasse dust showed very good water resistant and mechanical properties.

(b) *Efficacy of different chemicals towards water repellency (WR)* : To reduce water absorption of the boards, different chemicals were used in glue mix or as coating.

Trials were conducted by giving a coat only on edges in the first set, one face in second set to study effect of polyurethene coating on water resistance of the boards. The samples were studied for the water resistant properties. It was observed that the water resistance property has been improved by 50%, as compared to control.

To study the effect of different water repellents viz. wax, polyurethene, Reba, etc. chips/particles were mixed with the glue and boards were prepared using 9% binder and 1.5% of the sizing material (water repellents) in the glue mix, keeping other parameters like pressure, temperature and time, as earlier. The boards so prepared were studied for water absorption strength and other physical properties. It was observed that there is marked improvement in the WR property as compared to control.

(c) *Effect of wax emulsions on water absorption of the boards* : Wax emulsions in different concentrations from 0.5% to 2.5% were used while making glue mix for the preparation of the particle boards. The boards were pressed at 35-40 kg/cm^2 pressure at 160°C temperature for 4-4.5 min and were analysed for diffrent physico-mechanical properties. It was observed that the boards so prepared possess properties which are in conformity with the BIS specifications.

HINDI DAY CELEBRATION

Concluding Function of the Hindi Day Celebration. Sitting (From L to R) Dr. V. G. Munshi, Chairman, Hindi Day Celebration Committee, Dr. A. P. Singh, Chief Guest, Dr. N. B. Patil, Director, CIRL and Dr. A. P. Pandey, Guest Speaker.

A Section of the Audience

PARTICLE BOARD FROM COTTON PLANT STALK

Large Size Board (6' x 4')
Prepared from Cotton Stalk

Particle Boards of Different Finishes Prepared from Cotton Stalk

(d) *Preparation of fire-retardant boards*: Boards were prepared using chemicals such as borax, boric acid, urea and DAP, separately as well as in mixtures to study the effect of fire-retardants on different properties of the boards. The boards are being evaluated.

(e) *Use of phenol formaldehyde in board preparation* : Phenol formaldehyde binder was prepared by condensing phenol and formaldehyde in the mole ratio of 1:2 and 1:4 in alkaline medium (9.5 pH) at 90 to 100°C temperature for 45 min. The solid content of the resin was 70%. Particle boards were prepared using phenol formaldehyde as binder (1.3% to 8.8%). The boards were evaluated for different physical and mechanical properties. The boards gave excellent strength properties. Since the binder contributes to a greater extent to the cost of manufacture of the board, study on natural binders and on binders cheaper than the conventional ones was conducted.

Black liquor (a waste from paper industry) along with the phenol formaldehyde resin was used as binder for the preparation of particle boards. The boards were evaluated for different properties. The boards showed very good strength properties even by using 50% alkali-lignin slurry. In other words, black liquor can replace as much as 50% phenol. Preliminary trials were conducted to prepare the boards using chitosin as binder. The boards prepared gave encouraging results. Work on the preparation of resin from cashewnut shell liquid is being carried out.

(f) *Extension of the work on pilot plant scale*: A few boards of large size (16″×16″) having 12 mm thickness have been prepared with the facilities available in the Laboratory.

About one tonne cotton stalk chips are being pulverised on the minipulveriser and the particles of required size are being sieved at GTC, Nagpur for conducting trial on a larger scale at M/s. Padmavati Panel Boards, Bangalore to prepare about 30-40 boards of 6′ × 3′ size and 100 boards of 2′ × 2′ size with the facilities available in their factory.

Hard Boards from Cotton Plant Stalks

Trials were conducted earlier to standardise the pressure cycle for preparation of hard boards. These samples were evaluated for various properties. The test results indicated that the boards prepared by using the following pressure cycle give excellent results.

i) 200 kg/cm² for one min

ii) 50 kg/cm² for half min

iii) 100 kg/cm² for five min

(a) *Preparation of hard boards of different densities* : Trials were conducted to prepare hard board samples of different densities and thicknesses viz. 0.7, 0.9 and 1.1 g/cm³ and 5 mm, 8 mm, and 6 mm, respectively by slightly modifying the pressure cycle and by the use of metallic spacers of specific thicknesses. These board samples were evaluated for modulus of rupture, tensile strength and water absorption. The results were satisfactory and were in conformity with BIS specifications.

(b) *Preparation of oil tempered hard boards*: With a view to impart excellent water repel-

lency and strength, preliminary trials were conducted to prepare oil tempered hard boards using linseed oil. These boards are being evaluated for different properties.

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

(a) *Blending of rice straw pulp with pulp of cotton plant stalks* : The bleached rice straw pulp, (prepared by using 6.5% active alkali at 130°C for 3hr) received from M/s Ellora Paper Mills Ltd., Tumsar was blended in different proportions (25:75, 50:50, 75:25) with bleached kraft pulp of cotton stalk prepared during the pilot plant trial at Tumsar. Standard paper sheets of 60± 1 g/m² were prepared from the individual pulps as well as the paper prepared during the pilot plant trial were evaluated for various properties. The test results indicated that there was gradual improvement in the strength properties of rice straw pulp with increase in the addition of cotton stalk pulp.

(b) *collection of raw material for pilot plant trial* : With a view to conduct a large scale trial to prepare kraft paper from cotton plant stalks, about 8 tonnes of cotton stalk was collected from CICR, Nagpur. The stalk was cleaned properly and then mechanically cut into small chips of about 2 cm. The stalk is stored at GTC, Nagpur for undertaking the above trial.

(c) *Planning for large scale trial at Nagpur* : A large scale trial has been planned at M/s. Empress Paper Mills Ltd., Nagpur to prepare kraft paper from cotton plant stalks. As the mill does not have facilities to provide adequate pressure of 7.5 kg/cm,² it was decided to modify the cooking conditions by carrying out some laboratory scale trials at a lower pressure of 3.5 kg/cm² prior to the large scale trial.

Accordingly, trials were undertaken to prepare kraft pulp from cotton stalks using 16.0% and 16.5% kraft liquor at 130°C and 3.5 kg/cm² pressure for 3½ hr (which included 45 min required to raise the temperature to the cooking temperature of 130°C). The material to liquor ratio was 1:3. The cooked material was washed thoroughly and then defibrated in a valley beater to get the pulp of desired freeness, i.e. 250 CSF. Then the pulp was screened through a Somerville screen to remove the uncooked material. Standard paper sheets of 60 ± 1 g/m² were prepared from the above pulps and then tested for various properties using standard test methods.

The test results were satisfactory. Using these conditions, trials are proposed to be undertaken in the above paper mill.

(d) *Economic feasibility of the trial conducted at M/s. Ellora Paper Mills Ltd., Nagpur* : Last year a pilot plant trial was conducted to prepare writing grade paper from cotton stalks. Efforts were made to work out the feasibility of the above process. The actual cost of manufacture on comparing with the market price of similar quality writing paper indicated that the process is economically viable.

Preparation of Pulp for Various end Uses from Cotton Stalks and other Lignocellulosic Materials via. Anaerobic Digestion

The biologically digested linseed straws were converted into pulp and then

bleached with 1% sodium chlorite at 70°C for 120 min. (substrate-to-liquid ratio, 1:20). The bleached pulps were washed thoroughly and then beaten in a valley beater to get the desired freeness. Standard paper sheets of 60 ± 19 g per m^2 were prepared. The properties of paper tested at the Hand Made Paper Institute, Pune, are given in Table 12.

It is clear from the data that increasing concentration of alkali improved the strength of paper sheets. However, 4% alkali was found to be the limit since there was not much difference between 3% and 4% alkali to obtain paper sheets with desired properties. The results also indicated that biological treatments can be manipulated depending on the actual requirements. In other words, linseed straw treated with 4% alkali and subjected to anaerobic digestion just for one week imparts all the desirable properties to the paper.

TABLE 12: PROPERTIES OF PAPER SHEETS MADE FROM BIODEGRADED LINSEED STRAW

Treatments	Burst Factor	Breaking Length (Km)	Tear Factor	No. of Double Folds
I 1% NaOH Control	6.9	1435	127	1
,, 1 week	9.3	1679	127	5
,, 2 weeks	11.4	1967	205	20
,, 3 weeks	12.5	2274	131	26
,, 4 weeks	13.7	2515	105	40
II 2% NaOH Control	8.8	1668	128	6.0
,, 1 week	9.1	1734	80	11.0
,, 2 weeks	9.2	1967	80	11.0
,, 3 weeks	13.2	2582	129	40.0
,, 4 weeks	10.9	1976	99	17.0
III 3% NaOH Control	—	—	—	
,, 1 week	10.1	2001	121	9
,, 2 weeks	14.2	2422	144	36
,, 3 weeks	13.7	2001	139	25
,, 4 weeks	10.8	2101	119	9
IV 4% NaOH Control	10.7	2167	139	11
,, 1 week	26.6	3190	139	45
,, 2 weeks	20.4	2280	141	37
,, 3 weeks	13.5	1937	119	21
,, 4 weeks	11.2	1191	85	17

Utilisation of Linseed Stalk for Fibre Extraction and Pulping for Paper Making

Large scale retting trials involving about one tonne of dual purpose linseed stalk was carried out near Kanpur under the conditions optimised in laboratory trials. Fibres were extracted through hand scutching operations. The knowledge and experience gained in the first large scale trial was very useful for successfully carrying out further retting and extraction trials. During the same period, trials were undertaken to assess the spinning potential of the scutched fibres. The fibres were stapled to 10″ length and processed in a minature spinning system. Single yarns were spun in ring and flyer spinning frames. Threeply twine was also produced from the single yarns. The quality of the single yarn and the 3-ply twine was encouraging and indicated the possibility of utilising the fibres from linseed stalk for the production of 3-ply twines.

Pulping and paper making trials were also undertaken to assess the potential of the stalks of dual purpose variety of linseed as raw material for the paper industry. Kraft pulping was carried out with different concentrations of kraft liquor and standard paper sheets were made from the bleached as well as unbleached pulps. The pulping trial involving 20% kraft liquor yielded the best results and the paper produced was found suitable for wrapping, writing and printing purposes.

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 causing hazardous respirable dusts in the processing areas as also to enhance the life of the installed machinery which become unfunctional gradually, if timely attention is not levied on this problem. Similarly, elemental composition of different parts of cotton plants can give sufficient information of the nutrient transport and related aspects of plant physiology. Therefore, these studies have been taken up in a separate thrust area and the progress made during 1990-91 on various aspects of this thrust area was as follows.

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

The calibrations of the instrument for quantitative analysis of the 26 elements found in cotton plant materials were completed and the different plant parts were analysed for the estimation of elemental concentrations. The rankings of the major elements were found to be identical by qualitative and quantiative analysis.

Characterisation of Various Cotton Plant Parts for Microflora in Relation to Elemental Composition

In order to confirm the specific encouragement of Gram negative bacteria on the cotton plant parts, a systematic study was undertaken involving varieties from all the species of cotton, bacteria, fungi, actinomycetes, yeasts and nitrogen fixers were enumerated on specific media from leaves, bracts and boll rind. The results are given in Table 13. It is clear from the data that glandless varieties do not harbour gram negative bacteria and if so, the load is much less. In general, *desi* varieties harboured maximum microflora, viz. nitrogen fixers, gram negative bacteria, actinomycetes and yeasts.

TABLE 13 : PERCENTAGE OF GOSSYPOL AND MICROBIAL LOAD ON VARIOUS PARTS OF COTTON PLANT

Varieties	Gossypol (%)	Microorganisms expressed as no. per gram of sample					
		Nitrogen fixers	Gram -ve bacteria	Total bacteria	Actino-mycetes	Yeasts	Fungi
Sanjay :							
Leeaves	0.392	$130x10^7$	$26x10^4$	$13x10^4$	$13x10^7$	$18x10^8$	$40x10^3$
Bracts	0.713	$220x10^4$	—	20x10	$50x10^4$	$30x10^4$	$30x10^5$
Rind	0.321	—	$36x10^4$	$26x10^4$	$10x10^6$	$30x10^5$	$40x10^2$
G.Cot.11 :							
Leaves	0.260	$79x10^4$	$92x10^6$	$10x10^6$	$70x10^4$	$94x10^4$	$40x10^2$
Bracts	0.172	$31x10^7$	$32x10^7$	$35x10^7$	$29x10^7$	$88x10^7$	$70x10^2$
Rind	0.033	$23x10^3$	30x10	22x10	$11x10^4$	$61x10^3$	—
Suvin :							
Leaves	0.317	—	$14x10^3$	$30x10^3$	—	—	—
Bracts	0.140	$21x10^4$	$16x10^4$	$16x10^4$	$30x10^2$	$32x10^3$	$90x10^3$
Rind	0.245	—	—	—	—	—	—
Glandless G.P.							
Leaves	0.199	nil	nil	—	$56x10^4$	$10x10^3$	$20x10^3$
Bracts	0.064	nil	nil	$47x10^4$	—	$38x10^4$	$10x10^2$
Rind	0.020	nil	nil	$80x10^4$	—	—	—
Empire Glandless							
Leaves	0.412	$20x10^2$	nil	$45x10^4$	—	—	—
Bracts	0.084	nil	nil	—	$32x10^4$	$10x10^5$	—
Rind	0.209	$70x10^2$	$90x10^2$	$50x10^2$	$50x10^2$	$32x10^2$	10x10

3

Publications

A. Annual Report

Annual Report of the Cotton Technological Research Laboratory for the calendar year 1989-90.

B. Research Publications (CTRL Publications — New Series)

437 G. Viswanathan, V. G. Munshi, A. V. Ukidve and K. Chandran — A Critical Evaluation of the Relationship Between Fibre Quality Parameters and Hairiness of Cotton Yarns (Reprinted from Textile Research Journal, Vol. 59, No. 11, p. 707, November 1989).

438 D V. Mhadgut, G. R. Anap and M. S. Parthasarathy — Survey of Ginning Factories in India (Reprinted from The Indian Textile Journal, Vol. 100, No. 9, p. 20, June, 1990).

439 J. K. S. Warrier and P. K Chidambareswaran — Linter Content Estimation by X-ray Diffraction (Reprinted from The Indian Textile Journal, Vol. 100, No. 2, p. 98, November, 1989).

440 H. T. Lokhande, A. M. Thakare, N. B. Patil, P. K. Chidambareswaran and J. K. S. Warrier — Formation of Ethylenediamine-Cellulose Complexes by Vapor phase Treatment (Reprinted from Journal of Polymer Science : Part C : Polymer Letters, Vol. 28, No. 1, p. 21, January, 1990).

441 G. F. S. Hussain, R. P. Nachane, K. R. K. Iyer and B. Srinathan — Weak-Link Effect on Textile Properties of Cotton Yarns (Reprinted from Textile Research Journal, Vol. 60, No. 2, p. 69, February, 1990).

442 S. G. Gayal, V. G. Khandeparkar and D. V. Rege — Effect of Oilseed Meals and their Protein Fractions on Amylase Production by *Bacillus subtilis*-159 (Reprinted from Indian Journal of Microbiology, Vol. 30, No. 3, p. 331, September, 1990).

443 V. Iyer, P. V. Varadarajan, K. H. Sawakhande and N. D. Nachane — Preparation of Superabsorbents by Gamma-Ray Radiation (Reprinted from Journal of Applied Polymer Science, Vol. 39, No. 11 & 12, p. 2259, June, 1990).

444 J. K. S. Warrier and P. K. Chidambareswaran — Fine Structural Probes for the Evaluation of the Structure and Development of Cotton Fibers (Reprinted from Journal of Applied Polymer Science, Vol. 40, No. 5 & 6, p. 1059, September, 1990).

445 Ashok K. Dhawan, G. S. Simwat, A. S. Sidhu and V. K. Madan — Studies on the Effect of Various Insecticides on the Extent of Avoidable Losses Due to Bollworm in Cotton (Reprinted from Agricultural Science Digest, Vol. 9, No. 1, p. 53, 1989).

446 V. K. Madan, R. S. Jaglan, A. D. Taneja and A. P. Sharma — Effect of Synthetic Pyrethroids along with Conventional Insecticides on Pink Bollworm Incidence, Yield and Physico-Chemical Parameters of American Cotton H.777.

447 S. S. Doke and K. R. Krishna Iyer — Effect of Aqueous Swelling and Stretching on the Structure and Properties of Cotton (Reprinted from Journal of Applied Polymer Science, Vol. 39, No. 9, p. 1967, May, 1990).

448 J. K. S. Warrier and P. K. Chidambareswaran — Quick, Accurate and *in-situ* Linter Content Evaluation of Cotton-Seed (Reprinted from the Proceedings of 31st Joint Technological Conference, New Delhi, February, 16 & 17, 1990).

449 S. G. Vinzanekar and V. Sundaram — Rotor Spinning, Some Design and Operating Parameters (Reprinted from The Indian Textile Journal, Vol. 100, No. 9, p. 62, June, 1990).

450 R. P. Nachane — Yarn Tension as a Function of Extension : A New Approach — Application to an Ideal Twisted Multifilament Yarn (Reprinted from Textile Research Journal, Vol. 60, No. 3, p. 128, March, 1990).

451 A. D. Taneja, V. K. Madan, J. C. Sharma and D. K. Jain — Changes in Physical and Chemical Properties of Cotton Fibre During its Development (Reprinted from Indian Journal of Agricultural Research, Vol. 24, No. 1, p. 37, 1990).

452 R. H. Balasubramanya, K. M. Paralikar, N. B. Patil and V. Sundaram — A Compendium on Fibre Bases of Cotton Lint From Different Species of *Gossypium* (Reprinted from Indian Society for Cotton Improvement Journal, Vol. 15, No. 2, p. 119, September, 1990).

453 P. V. Varadarajan, V. Iyer and S. Saxena — Wax on Cotton Fibre : Its Nature and Distribution — A Review (Reprinted from Indian Society for Cotton Improvement Journal, Vol. 15, No. 2, p. 123, September, 1990).

454 N. Thejappa and I. G. Bhatt — Nutritional Aspects of Cotton Seed Oil (Reprinted from the News letter of All India Cotton Seed Crushers' Association Vol. 1, p. 11, January, 1989).

455 S. K. Chattopadhyay, B. Srinathan and M. S. Parthasarathy — Contribution of Polyester Fibre Denier to the Quality of Polyester-Viscose Blended Ring and Rotor-Spun Yarns (Reprinted from Journal of the Textile Association, Vol. 51, No. 3, p. 89, September, 1990).

456 S. Mukundan, K. V. Janardhanam, B. M. Reddy and A. S. Reddy — Effect of Nitrogen and Phosphorus on Fibre Quality of Cotton (Reprinted from Indian Society for Cotton Improvement Journal, Vol. 15, No. 1, p. 30, March, 1990).

457 R. H. Balasubramanya, A. J. Shaikh, K. M. Paralikar and V. Sundaram — Spoilage of Cotton Stalks During Storage and Suggestions for its Prevention (Reprinted from Indian Society for Cotton Improvement Journal, Vol. 15, No. 1, p. 34, March, 1990).

458 S. Sreenivasan, G. S. Patel, R. P. Nachane, P. K. Chidambareswaran and N. B. Patil — Parameters Related to Clothing Comfort – A New Approach for Measuring Moisture Transport Through Fabrics (Reprinted from Indian Journal of Fibre & Textile Research, Vol. 15, No. 3, p. 124, September 1990).

459 Munshi Singh, V. P. Singh and N. B. Patil — Development of High Strength Medium Staple Length Strains of Punjab American Cotton *(Gossypium hirsutum* L.) (Reprinted from Indian Society for Cotton Improvement Journal, Vol. 16, No. 1, p. 54, March, 1991).

460 P. Bhama Iyer, S. Sreenivasan, P. K. Chidambareswaran, N. B. Patil and V. Sundaram — Induced Crystallization of Cellulose in Never-Dried Cotton Fibers (Reprinted from Journal of Applied Polymer Science, Vol. 42, No. 6, p. 1751, March, 1991).

461 K. B. Rajagopal and K. R. Krishna Iyer — Flexural Stiffness and Liner Density of Palmyra Fibres (Reprinted from Indian Journal of Fibre & Textile Research, Vol. 16, No. 2, p. 178, June, 1991).

462 S. K. Chattopadhyay, B. Srinathan and M. S. Parthasarathy — Influence of Raw Material/Processing Factors on Yarn Faults (Reprinted from The Indian Textile Journal, Vol. 100, No. 4, p. 68, January, 1990).

463 A. J. Shaikh — Home-Made Paper and Board can be Made from Green Cotton Stalks (Reprinted from Indian Farming Vol. 40, No. 11, p. 9, February, 1991).

464 Munshi Singh, V. P. Singh, N. B. Patil and B. M. Petkar — Improvement of Yield and Fibre Strength in Medium and Superior-medium Staple Upland Cotton *(Gossypium hirsutum)* (Reprinted from Indian Journal of Agricultural Sciences, Vol. 61, No. 1, p. 11, January, 1991).

465 D. N. Makwana, V. B. Suryanarayanan and V. G. Munshi — Fineness and Maturity of Cotton Fibres by Fibrograph (Reprinted from The Indian Textile Journal, Vol. 101, No. 6, p. 144, March, 1991).

466 S. G. Gayal, V. G. Khandeparkar and D. V. Rege — Enhanced α-Amylase Production on Wheat Bran Medium by *Bacillus subtilis*-159 (Reprinted from Journal of Food Science and Technology, Vol. 28, No. 1, p. 44, January — February, 1991).

467 S. G. Gayal and V. G. Khandeparkar — Properties of Yarn Sized with Enzymatically Prepared Low Viscosity Starch (Reprinted from The Indian Textile Journal, Vol. 101, No. 3, p. 172, December, 1990).

468 S. K. Chattopadhyay, B. Srinathan and M. S. Parthasarathy — Use of Hollow Polyester Staple Fibre in Apparel (Reprinted from the Indian Textile Journal, Vol. 101, No. 4, p. 76, January, 1991).

469 P. Bhama Iyer, S. Sreenivasan, G. S. Patel, K. R. Krishna Iyer and N. B. Patil — Effect of Yarn Geometry and Fiber Properties on Tensile Behaviour of Cotton Yarns Swollen and Stretched in Aqueous Zinc chloride (Reprinted from Journal of Applied Polymer Science, Vol. 42, No. 11, p. 2915, June, 1991).

C. Other Publications

1. B. Srinathan, V. Iyer and K. H. Sawakhande — Pineapple Blend Fabric Processed on Cotton System (Reprinted from the Indian Textile Journal, Vol. 100, No. 5, p. 46, February, 1990).

2. I. K. P. Iyer, V. G. Munshi and B. Srinathan — All About Floating Fibres and Yarn Irregularity (Reprinted from the Indian Textile Journal, Vol. 100, No. 8, p. 86, May, 1990).

3. P. V. Varadarajan, K. H. Sawakhande, A. J. Shaikh and B. Srinathan — Processing of Flax from the Dual Purpose Linseed Crop (Reprinted from the Indian Textile Journal, Vol. 101, No. 2, p. 194, November, 1990).

4. G. S. Patel, P. Bhama Iyer, S. Sreenivasan and K. R. Krishna Iyer — Reversals in Cotton : A Study with Scanning Electron Microscope (Reprinted from Textile Research Journal, Vol. 60, No. 12, p. 771, December, 1990).

5. R. H. Balasubramanya, H. U. Gangar, V. G. Khandeparkar and V. Sundaram — Production of Biogas and Biomanure from Willow-dust, a Textile Mill Processing Residue Encyclopedia of Environmental Control Technology, Hazardous Waste Containment and Treatment (Ed) Paul N. Cheremisinoff, Vol. 4, p. 389, 1990).

6. N. B. Patil — Achievements in Production of Cotton and Future Requirements with Respect to Quality (Published by Daily Cotton Market Report in Cotton Annual, Bombay, 1990-91).

D. Papers presented at Seminars/ Conferences/Symposia/Workshop

1. N. B. Patil — Productivity and Prospects of Cotton in India (Presented at the All India Cotton Trade Association Meeting held in Bombay on 15th December, 1990).

2. P. Bhama Iyer — Structure and Properties of Chemically Treated Cellulose Fibres (Presented at "Polymers-91" held at National Chemicals Laboratory, Pune from 1st to 4th January, 1991).

3. R. P. Nachane — Inverse Relaxation in Polymers (Presented at "Polymers-91" held at National Chemical Laboratory, Pune from 1st to 4th January, 1991).

4. C. R. Raje and V. Iyer — The Effect of Different Softeners on Soil Resistant Property of the Fabric (Presented at the International Conference on Recent Advances in Chemistry and Technology of Processing of Cotton and Man-made Textiles held at BTRA, Bombay on 3rd to 6th February, 1991).

5. R. H. Balasubramanya, Y. D. Pai and V. G. Khandeparkar — Production of Biogas from Solid Cellulosic Wastes (Presented at the Poster Paper session of

the 31st Annual Conference of Association of Microbiologists of India held at the Tamil Nadu Agricultural University, Coimbatore from 23rd to 25th January 1991).

6. S. G. Gayal and V. G. Khandeparkar — Amylase Fermentation by *Bacillus subtilis*-159 and Application of the Enzyme in Textiles (Presented at the Poster Paper session of the 31st Annual Conference of the Association of Microbiologists of India held at the Tamil Nadu Agricultural University, Coimbatore, from 23rd to 25th January, 1991).

7. A. J. Shaikh, R. H. Balasubramanya and V. G. Khandeparkar — Anaerobic Digestion of Linseed Stalk for the Preparation of Pulp and Paper (Presented at the Poster Paper session of the 31st Annual Conference of the Association of Microbiologists of India held at the Tamil Nadu Agricultural University, Coimbatore from 23rd to 25th January, 1991).

E. Lectures Delivered

1. N. B. Patil delivered a lecture on 'Present Status and Future Requirements of Cotton with Respect of Quality' at the workshop *cum* Seminar on Cotton Production Technology held at CICR, Nagpur from 12th to 25th September, 1990.

2. M. S. Parthasarathy gave a lecture on 'Fibre Scene in India — Present and Future : Cotton' at the Refresher Course for Senior Spinning Executives organised by Textile Association, Bombay Unit and Textile Technology Department VJTI on 25th April 1990.

F. Technological Circulars on Trade Varieties of Indian Cottons

T.C. No.	Variety	Place
2460	V.797	Dhandhuka
2461	Gujarat 13	Dhandhuka
2462	V.79	Dhandhuka
2463	Eknath (PA.32)	Parbhani
2464	Sanjay (CJ.73)	Parbhani
2465	Rohini (NA.48)	Parbhani
2466	Suvin	Salem
2467	Bengal Deshi	Goluwala
2468	Sankar 6	Botad
2469	MECH.1	Guntur
2470	J.34 (S.G.)	Sirsa
2471	Hybrid 4	Khargone
2472	DCH.32	Mudhol
2473	F.414 (S.G.)	Kotkapura
2474	Sankar 6	Manavadar

G. Technological Circulars on Standard Cottons

S.C. No.	Variety	Place
363	G.Cot.13	Chharodi
364	Bikaneri Narma	Sriganganagar
365	Ganganagar Ageti	Sriganganagar
366	RG.8	Sriganganagar
367	G.Cot.11	Surat
368	V.797	Chharodi
369	G.Cot.Hybrid 6	Surat
370	Sanjay	Amreli
371	G.Cot.Hybrid 4	Surat
372	Deviraj	Junagadh
373	G.Cot.10	Surat
374	G.Cot.12	Surat
375	AKA.8401	Akola
376	G.Cot.10	Bharuch
377	G.Cot.11	Bharuch
378	Digvijay	Bharuch

4

Extension

CTRL has no farm attached to it either at the headquarters or at its regional units and hence direct linkages are not existing with the farming community. However, indirect assistance to the farming community is rendered through developmental activity of useful equipments for field experiments and also by way of discussions/suggestions, advices on the technological aspects at every stage of crop development and post harvest technology practices. Close collaboration is maintained with all major cotton breeding centres under agricultural universities and institutes under ICAR. The scientists and technical officers, who are in-charge of the Regional Quality Evaluation Units of CTRL in different cotton growing tracts in the country function in close collaboration with cotton specialists and other cotton scientists in the agricultural universities and state departments of agriculture. They also associate themselves in the research projects taken-up by these cotton scientists to tackle problems being confronted by the farming community.

The Director and some of the principal scientists are members of several committees constituted by the Bureau of Indian Standards for cotton and textiles, preparation of specifications for various cotton products in which the knowledge and expertise available at CTRL are fully utilised. Similarly, Director and few principal scientists are active members in many advisory panels of other textile research institutions. 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, etc. thereby disseminating knowledge on the state-of-art of various facets of cotton technology. The scientists and technical officers participate in conferences and symposia, and presenting papers so as to transfer the expertise and information to the user group.

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

CTRL 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 ginning industry in India is one of the most neglected sector and the quality of cotton lint of Indian cottons gets severely damaged due to improper ginning, lack of adequate maintenance and carelessness on the part of workers in ginning factories. Keeping this

state of affairs in view, a ginning training centre was established by CTRL at Nagpur and this CTRL ginning Training Centre (GTC) imparts training in quality ginning to fitters, supervisors, who are sponsored by the factory owners, all over the country. The GTC is equipped with different types of precleaners, gins and a modern bale press so that proper instruction 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 microspinning of samples. A hostel capable of accommodating about 20 trainees also is provided with the Centre. Research problems in precleaning and ginning and design work 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, by and large, at CTRL is mainly confined to supply of reliable and accurate data on the quality aspects of cotton, yarn and fabrics, reply to queries of technical nature, consultancy services and publication of research results for the benefit of the user group.

Technical Queries : Several queries of technical nature received from government, semi-government and private organisations confined mainly on testing methods, instrument fabrications, new products and processes, by-products and waste utilisation, etc. were replied, apart from answering queries of those who are personally visiting the institute seeking information on various aspects of cotton and cotton technology.

Paid Tests : CTRL has been receiving fairly large number of samples of fibres, yarns and fabrics for paid tests from textile mills, government and semi-government organisations as well as from cotton trade and industry on payment of the prescribed test fees. With the installation of HVI a few years back, there has been a steady increase in the number of samples being tested for fibre properties using that instrument and the clientele included M/s. Cotton Corporation of India Ltd., Bombay, Maharashtra State Cotton Growers' Marketing Federation and various State Cooperative Cotton Marketing organisations, many well known textile mills, and other private organisations.

The number of samples received for tests during the period from April 1990 to March, 1991 together with samples tested for the year 1988 to 1990 and for the quinquennium ending 1985 are given below :

Type of Tests	Average for the quinquennium 1981-1985	1988	1989-90 (Jan. 89 to March 90)	1990-91 (April 90 to March 91)
Spinning	50	105	250	38
Fibre	201	1457	3685	1469
Yarn	145	93	89	290
Fabrics	60	40	93	306
Moisture	31	3	—	—
Miscellaneous	32	23	23	25
Total	519	1721	4140	2128

The total fees received during the period April 1990 to March 1991 for paid tests was Rs. 2,42,722/-.

Besides the routine tests, a number of special tests were also carried out on different types of samples received from various organisations. A few of these are listed below :

(i) One fabric sample received from a party from Bombay was tested for fluidity.

(ii) Two fabric samples from a reputed textile firm at Madurai were evaluated for resistance to microbial attack.

(iii) One tarpaulin sample received from an exporting firm was subjected to the study of degree of fungal growth.

(iv) Two fabric samples (green canvas) received from a textile mill at Bombay were tested for mildew growth (qualitative) over a 14 days incubation period.

(v) Four samples of Asbestos Yarn from a firm at Thane, Bombay were tested for ignition loss.

(vi) Three fibre samples from a local textile mill were subjected to honeydew test.

(vii) Calibration and standardisation were undertaken and completed on fifteen stelometer instruments submitted by a firm in Thane, Bombay.

(viii) Calibration and standardisation work was completed on one Digital Yarn Twist Tester received from an engineering firm in Bombay.

(ix) Eight samples of copper wire received from an engineering firm in Bombay were tested for breaking strength and elongation (K factor).

(x) A 100% polyester yarn sample received from a synthetic yarn manufacturing firm was evaluated for knitting performance.

Training :

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

Three full time courses of two months duration each, were conducted during the period 11-6-1990 to 15-12-1990. These courses were specially organised for the persons working in cotton trade and industry. In all 27 officials, 6 sales officers from the Maharashtra State Co-op. Cotton Growers' Marketing Federation Ltd., 2 Assistant Managers from Cotton Corporation of India Ltd., 7 trader members of the East India Cotton Association, 7 trader members of South India Cotton Association and the remaining from different mills, underwent the training course.

(b) *Short duration course* :

Two weeks' training courses in Cotton Evaluation and Testing Methods were conducted from 18-6-1990 to 24-11-1990. In all, 8 batches consisting of a total of 74 trainees, attended the training course. Though this course was exclusively meant for the graders from the Maharashtra State Co-operative Cotton Growers' Marketing Federation Ltd., staff members from Banahatti Co-operative Spinning Mills Ltd., Banahatti (6) Mala-

prabha Co-operative Spinning Mills Ltd., Saundatti (2) and Kowa Spinning Mills, Indore (2) also attended this course.

(c) *Special Training Course* :

A special two weeks' training course in Grading and Evaluation of Cotton was conducted for 16 staff members of the Girijan Co-operative Corporation Ltd., Hyderabad.

Similarly, another special course of two weeks' duration in spinning and methods of tests for cotton was conducted for 4 Technical Staff members sponsored by M/s. Laxmi Card Clothing Co. Ltd., Coimbatore.

A senior Technical Officer from M/s. Eastern Pacific Co., Bombay was given an appraisal course on latest technology in cotton testing and processing methods.

Two B. Text. students from Shri Guru Gobind Singh College of Engineering and Technology, Nanded completed their "*in-plant* training" for a month, mainly for fibre testing, yarn testing and spinning technology.

(d) *Ginning Training* :

During 1990-91, the GTC offered training to gin fitters and supervisors in eight batches. The trainees were sponsored by various ginning factories from Maharashtra, Karnataka, Madhya Pradesh and Uttar Pradesh.

(e) *Inservice Training of CTRL Staff* :

The Regional Quality Evaluation Units of CTRL are equipped with all the important fibre testing instruments which are operated by trained staff for assessing fibre quality parameters of the experimental strains. Considering the nature of tests and likelihood of subjectivity creeping in, CTRL conducts refresher courses on fibre testing at the headquarters in Bombay, as and when required for the staff working in Regional Units. During the year, a two weeks' refresher course was conducted for eight technical staff of CTRL Regional Quality Evaluation Units of Akola, Guntur, Hisar Indore Nagpur, Rahuri, Sirsa and Sriganganagar.

The total fees realised from the various training courses during the year was Rs. 64,782.

Women in Agriculture Day

The women in Agriculture Day was celebrated at CTRL on December 4, 1990.

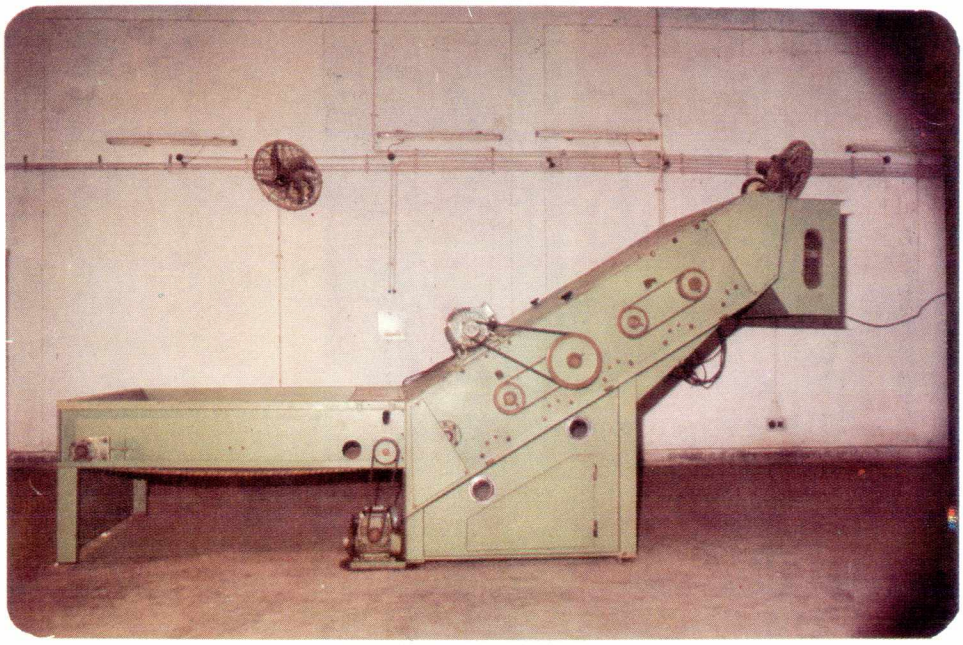
Dr. Rajani Ashar, Head, Education, Extension Department of SVT College of Home Science, SNDT University, Bombay, who was the chief guest, gave a lecture on *Progress of Programmes for farm women.* The lecture covered the various programmes initiated by Govt. of India under different five year plans.

Smt. Janaki Iyer Scientist of CTRL gave a comprehensive report on the *Participation of Women in Cotton Farm in India* based on data collected from various sources pertaining to the involvement of women in cotton farming.

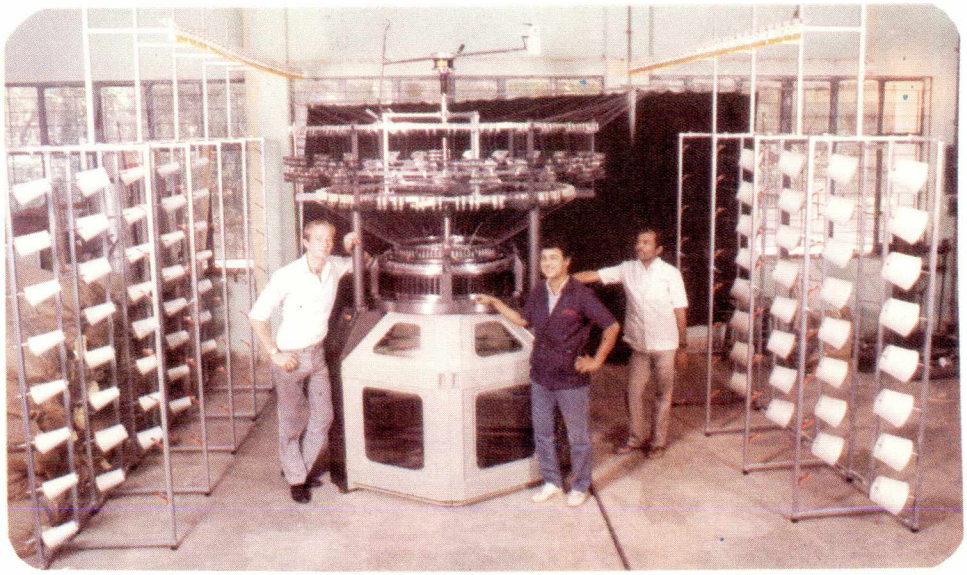
WOMEN IN AGRICULTURE DAY CELEBRATION

Dr. Rajani Ashar, Professor, SNDT University, addressing at the Special Function

A Section of the Engrossed Audience



Inclined Type Seed Cotton Cleaner Designed and Developed at the Ginning Training Centre of CTRL at Nagpur



Single Jersey Knitting Machine (Camber) Installed at CTRL

5

Conference and Symposia

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

Sl. No.	Meeting/Conference/ Seminar/Symposia, etc.	Place	Date	Name(s) of the Scientist(s) and Technical Personnel who attended the Conference/Meeting, etc.
1.	Refresher Course for Senior Spinning Executives	Bombay	24-4-90 to 26-4-90	Shri B. Srinathan Shri M. S. Parthasarathy
2.	Course on Technical Information Management, Research Communication and Project Maintenance in Agriculture	Hyderabad	31-7-90 to 10-8-90	Shri M. Mohan
3.	Course on Administration and Financial Management	Hyderabad	3-9-90 to 7-9-90	Dr. N. B. Patil
4.	Seminar on Speciality Chemicals for Textiles	Bombay	22-9-90	Smt. V. Iyer Kum. C. R. Raje Shri P. V. Varadarajan
5.	Polymers' 91	Pune	1-1-91 to 4-4-91	Dr. R. P. Nachane Dr. (Smt.) P. Bhama Iyer Shri G. F. S. Hussain Dr. S. Sreenivasan
6.	Seminar on Soybean and its Products	Bombay	13-1-91	Shri N. Thejappa
7.	First Asian Textile Conference	New Delhi	17-1-91 to 19-1-91	Dr. N. B. Patil Shri M. S. Parthasarathy

Sl. No.	Meeting/Conference/ Seminar/Symposia, etc.	Place	Date	Name(s) of the Scientist(s) and Technical Personnel who attended the Conference/Meeting, etc.
8.	31st Annual Conference of the Association of Microbiologists' of India	Coimbatore	23-1-91 to 25-1-91	Dr. V. G. Khandeparkar Dr. R. H. Balasubramanya Dr. S. G. Gayal
9.	Workshop of alternative feed stock for Biogas	New Delhi	20-2-91 & 21-2-91	Dr. V. G. Khandeparkar Dr. R. H. Balasubramanya
10.	International Conference on Recent Advances in Chemistry and Technology of Processing of Cotton and Man-Made Textiles	Bombay	3-2-91 to 6-2-91	Smt. V. Iyer Kum. C. R. Raje
11.	All India Cotton Trade Association Annual Meeting of EICA	Nagpur	17-3-91 & 18-3-91	Dr. N. B. Patil

6

Summary of the Report

This is the sixty-seventh Annual Report which covers the period April 1990 to March 1991.

The Cotton Technological Research Laboratory (CTRL) formerly known as the Technological Laboratory was established in 1924 by the earstwhile Indian Central Cotton Committee. With the abolition of commodity committees including ICCC, the administrative control of CTRL was passed on to the Indian Council of Agricultural Research (ICAR) with effect from April 1, 1966 and research activities were re-oriented and intensified since then, to meet the challenges in respect of production and quality of cotton grown in the country.

The major functions of CTRL are as follows :

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 investigation on the ginning problems of cotton.
4. To investigate the greater and better utilisation of cotton, cotton wastes, linters, cotton seeds, etc.
5. To help the trade and industry by providing reliable and accurate data on quality of representative trade varieties of Indian Cottons.
6. To issue authoratitive reports on the samples received for tests from Government, the trade and other bodies.
7. To collect and disseminate technical information on cotton.

As could be seen from the organisational chart given in Annexure I, Director is the head of the Institute ably assisted by a team of scientists, technical officers and other staff.

CTRL has 13 Regional Quality Evaluation Units at the chief cotton breeding centres in the country, viz. Akola, Coimbatore, Dharwad, Guntur, Hisar, Indore, Ludhiana, Nagpur, Nanded, Rahuri, Sirsa, Sriganganagar and Surat. Preliminary screening of experimental strains with respect of the chief fibre properties are being carried out in these Regional Units. In addition, CTRL's Ginning Training Centre at Nagpur carries out regular courses for training gin fitters and

supervisors. As in the previous years, CTRL continued to collaborate actively with agricultural universities in their endevour to evolve new improved cotton varieties in terms of quality and yield, and better utilisation of cotton plant by-products. CTRL continued to play a major role in cotton improvement research under the AICCIP by (i) laying down norms for fibre properties (ii) continuous monitoring of the fibre quality of the breeders' materials at various stages of breeding so as to enable them to undertake corrective measures whenever necessary (iii) technological evaluation of pre-release materials through detailed fibre tests, ginning and spinning trials, and (iv) final evaluation through mill trials. More than 2500 samples belonging to various trials were tested for fibre properties and spinning performance at the headquarters and at the Regional Units.

The total number of books in the library was 4507 with the addition of 295 books during 1990-91. Abstracts of articles were continuously supplied for TEXINCON of the National Information Centre for Textile and Allied subjects (NICTAS) functioning at ATIRA, Ahmedabad.

All the onging as well as new research projects taken up under various disciplines have been grouped under six thrust areas identified for the institute keeping in view the mission oriented approach envisaged for problems, within the frame work of the objectives laid down for CTRL in particular, and ICAR ,in general.

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

In connection with the technological evaluation of germplasm material, a total of 1460 samples was qualitatively evaluated at Nagpur. In addition 289 germplasm samples collected from Punjab and 177 from Hisar were also evaluated for their quality characters.

In connection with the study on variations in Ribbon width of Fibres of Desi Hybrids, 108 samples were evaluated for ribbon width. It was observed that the ribbon width of the hybrids ranged from 17.9 to 21.5 μ and their CV percentages were from 14.7 to 19.2. The existence of genotypic variability was indicated apart from showing highly significant negative heterosis of desirable type by thirteen crosses. Eighteen hybrids showed highly significant desirable heterobeltiosis. The general combing ability and specific combining ability data indicated preponderance to additive type of gene action.

For the assessment of fibre quality parameters from HVI and their influence on spinnability of cotton, work for correlating fibre test data with respective lea strength was undertaken. Analysis of the data revealed that lea strength can be predicted better, if the nominal count is included along with the fibre properties. The difference observed in the HVI test data within and between laboratories, was attributed to calibration procedures normally carried out with different calibration cottons.

THRUST AREA II : POST HARVEST TECHNOLOGY OF COTTON

On completion of the survey of ginning factories in Karnataka, a report based on the findings were prepared for publication. Such a survey for Andhra Pradesh has since been initiated with the assistance of private agen-

cies like Andhra Pradesh Cotton Association and East India Cotton Association, etc.

Pre-cleaning trial undertaken on the newly designed and fabricated inclined type pre-cleaner had shown that this cleaner is able to feed 20 DR gins and that the trash removal was to the extent of 0.26%, 0.30%, 0.81%, 1.53% and 2.34% for H.4 Super, FAQ, Fair, X and Kawadi type of *Kapas* of H.4 cotton. The pre-cleaning has increased the ginning out-turn from 2.29% to 19.95%.

The incidence of seed coat fragments during ginning was investigated using a laboratory model gin with 10 samples of cotton of different trash levels. The samples exhibited wide variation in their propensity to give out seed-coat fragments in ginned lint.

To probe into the anatomy of yarn faults, their source of occurrence and mechanism of formation, about 4000 samples were analysed and the 'A' and 'B' categories of faults were found to occur mainly through three sources (i) Trash (ii) Short-fibre bunch, and (iii) Fibre-fly.

A comparison of yarn bundle strength with lea strength was made using a specialiy fabricated jaw to mount the sample on lea-tester. It was observed that only five bundle tests using the jaw are enough to get sufficiently accurate results as compared to 50 tests required for the normal lea test.

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

In an attempt to distinguish the roles played by genetic background and maturity on the lattice conversion of cotton fibres brought about by LiOH and CsOH, varieties having the same levels of maturity, but drawn from different species for each maturity levels and samples from sepecific varieties having different maturity levels for each variety were treated with the above alkali solutions. The treated samples were subjected to X-ray diffraction.

Infra-red studies on crystallisation of amorphous samples produced by (i) ball-milling hydrolysate of cellulose and (b) saponification of cellulose triacetate (CTA) conclusively suggested that the peak that appear at $1590cm^{-1}$ during heating of saponified CTA is not due to hydrogen bonding and crystallisation, but it is the result of the linkage between alkali ions and COO^-(ionised carbonyl group) on account of the residual alkali remaining in the saponified form even after repeated washing in ethanol. The slowing down of crystallisation at intermediate growth levels of G.Cot.10 cotton fibre has also been reconfirmed.

In connection with a study on measurement of frictional characteristics of cotton fifbre, a method has been standarised in which measurement is made of the inter-fibre friction between two identical tufts of the sample, as one tuft moves over the other. Of the fibres subjected to tests, viz. mulberry silk, viscose, wool, polyester, ardil, orlon and cotton, mulberry silk recorded the highest value for coefficient of friction and cotton, the lowest.

For a study on strength of attachment between cotton fibre and seed, an instrument fabricated by the Shirley Developments Ltd., England was acquired, in which the ballistic

work required to separate a bunch of fibres from the cotton seed is measured. This method suggested by the instrument makers has been partially modified so that the data provided by the instrument become more useful in predicting the energy requirement in ginning. In the modified method all the fibres on a given seed will be included in the test and the average energy to extract unit mass of lint can be arrived at.

SEM studies on the effect of NaOH swelling treatment on morphological deformities in cotton fibres were continued by examining and comparing a number of recorded electron micrographs of cotton fibres swollen in slack as well as stretched states. It was observed that the fibres swollen in slack condition in NaOH retain almost all the morphological deformities, eventhough they assume nearly circular cross section. A few fibres developed cracks or even cell wall ruptured in 'weaker zones' near some of the deformities. The fibres of all the tested varieties when swollen at 1 gm stretching force, had rod-like structure with circular cross section as that of synthetic fibres and did not exhibit any deformities.

The current-voltage (I-V) characteristics of cotton fibres and yarns were measured on a specially fabricated set up and it was found that the I-V characteristics were linear for fibres as well as yarns, in the voltage range 0-150 V. The electrical conductivity was 10^{-9} ohm^{-1} cm^{-1} for yarn and 10^{-5} ohm^{-1} cm^{-1} for fibre.

In connection with the study on the structure and properties of natural cellulosic fibres other than cotton, analysis of fine structural and morphological aspects of the study for four varieties of banana, two varieties of sisal and three varieties of coir were completed. There appears to be a definite relation between fine structure and some of the physical properties like, tenacity and extension of these fibres.

THRUST AREA IV : CHEMICAL PROCESSING AND FINISHING TREATMENTS

Quantitative estimation of wax on some of the important trade varieties of Indian cotton samples were completed. After the extraction of wax, trials were undertaken to quantify the principal constituents. Initial trials using alcoholic KOH for saponification did not yield satisfactory results. Hence direct preparation of methyl ester of wax using methanolic HCl was resorted to, for better separation of the components on TLC.

To test the durability of the anti-bacterial finish developed at this institute to launderings, 50 mild launderings were given to treated samples as well as the untreated controls. Physio-chemical properties of these samples revealed that the treated samples possessed 100% antibacterial property even after 50 wash with better strength retention.

Anti-soil finish was given to few fabric samples using Glyoxal/DMDHEU along with carboxy methyl cellulose and other additives. Reflectance measurements and carboxyl group estimation had shown that the use of glyoxal as cross linking agent along with zinc acetate increases the carboxyl group content with no adverse effect on the whiteness of the fabric.

A series of dyeing experiments were undertaken to study the dyeing behaviour

of Open-End (OE) and Ring-spun(RS) yarns. Quantitative estimation of the percentage exhaustion and dye uptake was made and it was found that there was no significant difference in the percentage of exhaustion values, whether dyed separately or in the same bath. However, the dye uptake values of rotor spun yarns were consistently higher in most of the cases, when dyed in the same bath. Fluidity values of the scoured and bleached OE and RS yarns were found to be more or less the same in the both cases.

The effect of three washing methods, viz. (i) hand washing (ii) launderometer washing and (iii) washing with domestic washing machine, using two detergents and two soaps on three fabrics (cotton, polyester and polyester/cotton) were compared with respect to breaking strength, elongation (%), abrasion resistance, tear strength and reflectance. It was observed that by and large there was reduction in strength, abrasion resistance and tear strength for all the fabrics irrespective of the use of soap or detergent. Amongst the three washing methods domestic washing machine washing appears to be severe followed by hand washing and landerometer washing. Between detergents and soaps, performance of the former was better.

THRUST AREA V : UTILISATION OF BY-PRODUCTS OF COTTON AND PROCESSING WASTES

Production of cellulase by *Penicillium funiculosum* was studied in a 5 litre modular fermenter at various rates of aeration and agitation. A 10% inoculum at higher rates of aeration and agitation increased cellulase production. Effect of various sources on cellulase production was also attempted. The concentration of dissolved oxygen in the broth during fermentation was measured along with changes in total solids of the broth, proteins and cellulase activity. The pH of the broth in 1 litre fermenter was also monitored during cellulase production; it was observed that after an initial fall in pH, (that is, from 4.8 to 3.00) there was increase in the cellulase production.

In connection with the thermal stability study of cotton seed oil, samples of cotton seed, coconut, til, corn, groundnut, mustard and soyabean oils were heated at 180°C for various periods upto 8 hrs. Kinamatic viscosity of these samples were found to increase with increase in heating time. Practically, there was no change in the specific gravity of these samples. Infrared spectra of these heated oil samples did not show any change, when compared with that of unheated oil samples (control). However, U.V. spectra of the heated oils showed a new peak at 232 nm.

Particle boards were prepared using Bagasse dust with *Aerolite* as binder; a 9% binder concentration imparted good strength and water absorption properties to the boards. Trials were successfully undertaken to prepare particle boards with other agrowastes like bio-degraded cotton stalks, fibre extracted linseed stalks, groundnut husk and arecanut husk, using urea formaldehyde as binder. Different water repelling agents like Polyurethene, Wax, Reba and Wax emulsions were used for imparting water repellency to particle boards in the form of coating or in glue preparation and it was observed that water repellency could be achieved to the extent of about 50% by appropriate use of these water repellency

agents or by the use of 1% to 1.5% wax emulsion in the glue preparation.

Hard board samples of different density and thicknesses were prepared from cotton plant stalks and evaluated. Preliminary trials were also conducted to prepare oil tempered hard board samples.

Trials were undertaken to modify the cooking conditions of the kraft process standardised earlier for preparation of pulp and paper, by carrying out pulping at a lower pressure of 3.5 kg/cm² to suit the requirement of the paper mill where a large scale trial has been planned. The quality of the paper produced was satisfactory. The pilot plant trial conducted at the Ellora Paper Mills Ltd., Tumsar evinced economic viability of the process as a commercial proposition. Trials were also completed to improve the properties of the rice straw pulp by blending with kraft pulp of cotton stalk for paper preparation.

Anaerobic digestion of linseed straw reduces the requirement of alkali to a great extent in extracting the pulp. Pretreatments of the substrate with either 4% or 3% sodium hydroxide followed by anaerobic digestion for 7 days or 14 days respectively, imparted all the desirable properties to the papers made from this pulp.

Large scale retting trial involving about 1 tonne of double purpose linseed stalk was successfully carried out and the fibres extracted were spun on a miniature spinning system. Good quality singles as well as 3-ply industrial twines were produced. The pulping trial of the whole linseed stalk showed that kraft paper suitable for writing wrapping and printing could be produced from this agrowaste.

THRUST AREA VI : ORIGIN OF COTTON DUSTS AND ITS CONTROL

Different plant parts were analysed using XRFS for elemental composition.

Bacteria, fungi, actinomycetes and yeasts were enumerated on specific media from different parts of cotton plants, viz. leaves, bracts and boll rind. The results indicated that the population of gram negative bacteria from glandless/varieties are significantly less.

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Personnel

Major events during 1990-91 under personnel function at CTRL are given below :

A. APPOINTMENTS

Sr. No.	Name	Grade	Effective date of appointment
		Technical Staff	
1.	Shri K. Venkanna	Technical Assistant T-II-3	12-4-1990
2.	Shri R. Srinivasan	Technical Assistant T-II-3	29-6-1990
3.	Shri B. R. Pawar	Technical Assistant T-II-3	10-7-1990
4.	Shri M. Bhaskar	Technical Assistant T-II-3	21-9-1990
		Administrative Staff	
1.	Kum. K. B. Patne	Junior Stenographer	16-4-1990
		Supporting Staff	
1.	Shri Mahabir Singh	Supporting Staff Grade I	12-1-1990
2.	Shri M. M. Kadam	Supporting Staff Grade I	5-4-1990
3.	Shri S. G. Phalke	Supporting Staff Grade I	5-4-1990
4.	Shri S. N. Bandre	Supporting Staff Grade I	17-7-1990
5.	Shri D. G. Gole	Supporting Staff Grade I	19-7-1990

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 K. B. Rajagopal	T-5	1-1-1990
2.	Shri R. S. Darade	T-5	1-1-1990
3.	Shri S. Sekar	T-5	1-1-1990
4.	Shri S. J. Guhagarkar	T-5	1-1-1990
5.	Shri D. Radhakrishnamurthy	T-5	1-1-1990
6.	Shri I. H. Hunsikatti	T-5	1-1-1990
7.	Shri S. G. Dalvi	T-5	1-1-1990
8.	Smt. A. A. Kathe	T-5	1-1-1990
9.	Smt. R. K. Shahani	T-5	1-1-1990
10.	Shri N. O. Antony	T-4	1-1-1989
11.	Shri P. K. Gopalan	T-I-3	1-1-1990
12.	Shri K. V. Nair	T-I-3	1-1-1990
13.	Shri H. K. Pawar	T-I-3	1-1-1990
14.	Shri D. V. Kambli	T-2	1-1-1990

Advance Increments

Sr. No.	Name	Grade	No. of advance increments	Effective date of increment
1.	Shri Ram Parpash	T-7	Two advance increments	1-7-1990
2.	Shri G. Viswanathan	T-5	Three advance increments	1-7-1990
3.	Shri S. Vancheswaran	T-4	Two advance increments	1-1-1990
4.	Shri R. S. Pathare	T-4	Two advance increments	1-1-1990
5.	Shri E. A. Pachpinde	T-4	Two advance increments	1-1-1990
6.	Shri D. N. Moon	T-II-3	Two advance increments	1-1-1990
7.	Shri C. R. S. Moni Iyer	T-5	One more advance increment (Total 3)	1-7-1990
8.	Shri K. V. Ananthakrishnan	T-5	One more advance increment (Total 3)	1-1-1990
9.	Shri C. P. Venugopalan	T-5	One more advance increment (Total 2)	1-1-1990
10.	Shri M. M. Shaikh	T-4	Two advance increments	1-7-1988

Re-assessment was made of the following technical personnel and advance increments granted as follows :

Sr. No.	Name	Grade	No. of advance increments	Effective date of increment
1.	Shri M. M. Shaikh	T-4	1 (Total 3)	1-7-1989
2.	Shri P. B. Gurjar	T-II-3	1 (Total 3)	1-1-1983
3.	Shri P. G. Kadam	T-1	2	1-7-1990
4.	Shri N. O. Antony	T-II-3	2	1-1-1988
5.	Shri Bechan Nokhai	T-2	1 (Total 3)	1-1-1990

C. PROMOTIONS

Administrative Staff

1. Kum. Sujata Nayar to the post of Assistant w.e.f. 15-5-1990.
2. Shri K. Parleshwar to the post of Senior Clerk w.e.f. 15-5-1990.

Supporting Staff

1. Shri N. R. Kamble to the post of Supporting Staff Gr. II w.e.f. 24-5-1990.
2. Shri S. D. Gurav to the post of Supporting Staff Gr. II w.e.f. 18-5-1990.
3. Shri M. K. Ghadge to the post of Supporting Staff Gr. II w.e.f. 15-5-1990.
4. Shri M. Z. Rathi to the post of Supporting Staff Gr. II w.e.f. 16-5-1990.
5. Shri Narayan Singh to the post of Supporting Staff Gr. II w.e.f. 16-5-1990.
6. Shri K. M. Rathod to the post of Supporting Staff Gr. III w.e.f. 19-5-1990.
7. Shri A. R. Bane to the post of Supporting Staff Gr. III w.e.f. 28-5-1990.

D. TRANSFERS

Technical Staff

1. Shri K. Thiagarajan, Technical Assistant T-II-3 from Q.E. Unit, Coimbatore to Q.E. Unit, Guntur, w.e.f. 14-5-1990.
2. Shri M. T. Danolli, Sr. Technical Assistant T-4 from Q.E. Unit, Dharwad to Q.E. Unit, Sirsa w.e.f. 21-5-1990.
3. Shri S. Venkatakrishnan, Sr. Technical Assistant T-4 from CTRL, Bombay to Q.E. Unit, Coimbatore w.e.f. 16-5-1990.
4. Shri R. S. Prabhudesai, Technical Assistant, T-II-3 from Q.E. Unit, Nanded to CTRL Headquarters w.e.f. 3-9-1990.

Administrative Staff

1. Shri L. R. Gopalkrishnan, Assistant (on deputation to G.T.C., Nagpur) went back to his parent organisation w.e.f. 30-4-1990 (FN).

Supporting Staff

1. Shri H. C. Thapa, S. S. Gr. I from GTC, Nagpur to NBSS & LUP, Nagpur from 2-5-1990.

2. Shri Gian Singh, S. S. Gr. IV from Q.E. Unit Hisar to Q.E. Unit Ludhiana w.e.f. 5-7-90 and Q.E. Unit, Ludhiana to Q.E. Unit, Hisar, w.e.f. 3-9-1990.

3. Shri Satyanarayan Gope, S. S. Gr. I from CTRL Headquarters to Q.E. Unit Ludhiana w.e.f. 9-11-1990.

4. Shri M. P. Tohokar, S.S. Gr. I from GTC, Nagpur to Q.E. Unit of CTRL, Akola w.e.f. 21-3-1990.

E. RESIGNATION/TERMINATION OF SERVICE

1. Shri S. N. Wani, Technical Assistant Gr. T-II-3 resigned from service w.e.f. 11-5-1990.

F. RETIREMENTS

1. Dr. (Kum) I. G. Bhatt, Principal Scientist retired from service w.e.f. 31-5-1990.

2. Shri A. W. Shringarpure, Technical Officer T-6 retired from service w.e.f. 31-3-1991.

3. Shri R. Dwarakanath, Technical Officer T-5 retired from service w.e.f. 31-3-1990.

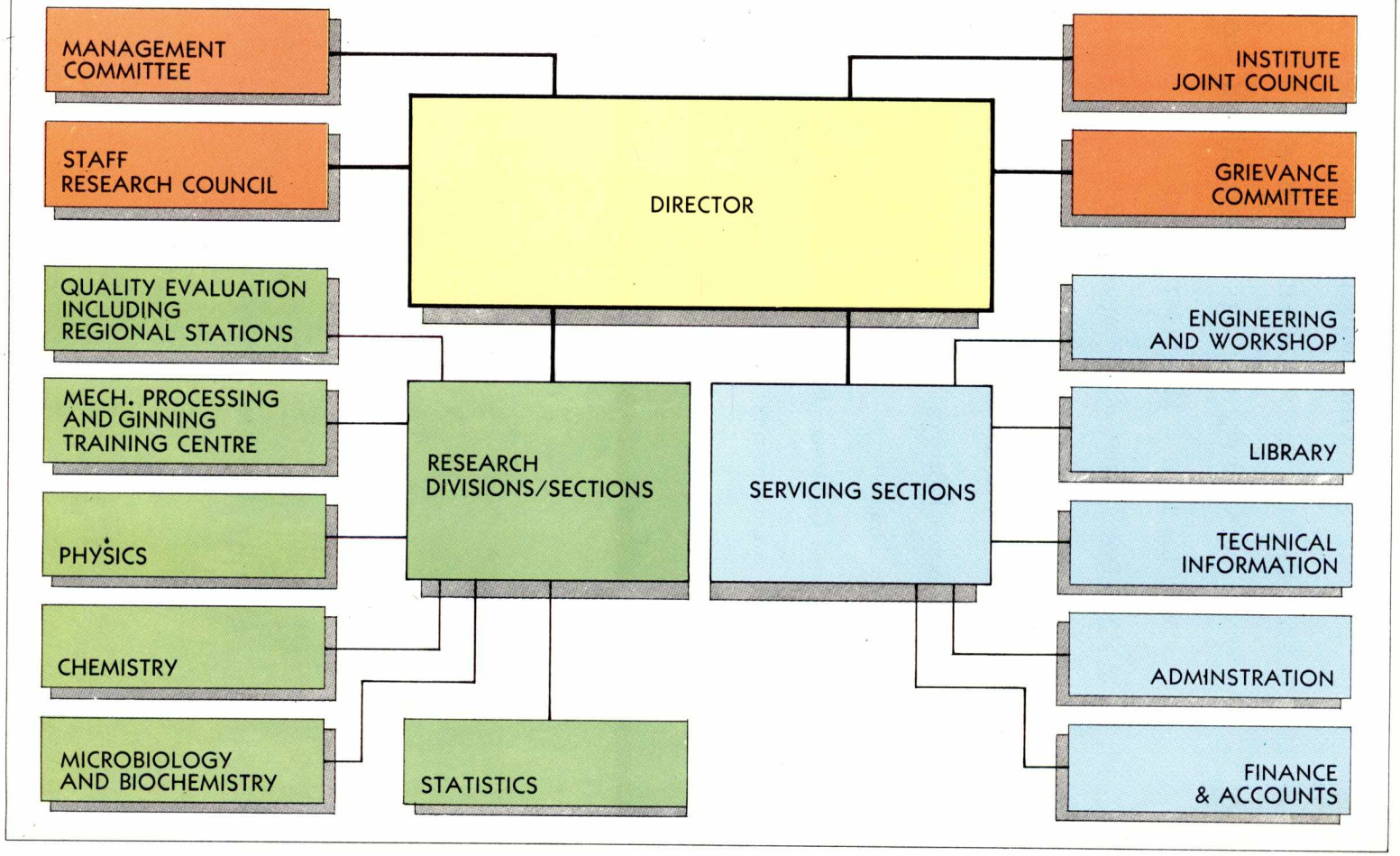
4. Shri R. B. Pawar, T-I-3, retired from service w.e.f. 31-3-1990.

8. Annexures

ANNEXURE — I

COTTON TECHNOLOGICAL RESEARCH LABORATORY

ORGANISATION CHART



ANNEXURE — II

NEW EQUIPMENTS ADDED DURING 1990-91

1. Multi Lea Tester — Model LMT 9910001
2. Star Digital Autospan with Autosampler
3. Gas Chromatograph
4. Cotton Seed Attachment Force Tester — SDL - 2 LDM
5. Proportional Detector for X-ray Diffractometer
6. Freeze Drier
7. Personal Computer (PC-AT) with accessories
8. Data Acquisition and Analysis Software, Series IX, Version 4.0

ANNEXURE — III

FINANCIAL STATEMENT

EXPENDITURE AND RECEIPTS OF THE INSTITUTE DURING 1990-91

	Sanctioned Grant	Actual Expenditure	Savings(—) Deficit(+)
	Rs.	Rs.	Rs.
A. EXPENDITURE			
I. CTRL including Q.E. Units (Non-Plan)			
(a) Capital expenditure including expansion of the Institute	7,74,436	7,74,436	—
(b) Working Expenditure	1,42,25,564	1,41,06,342	(—) 1,19,222
	1,50,00,000	1,48,80,778	(—) 1,19,222
II. (Plan)			
(a) Capital expenditure including expansion of the Institute	25,63,167	25,63,167	—
(b) Working Expenditure	10,66,833	5,98,357	(—) 4,68,476
	36,30,000	31,61,524	(—) 4,68,476
III. Summer Institute	45,000	39,738	(—) 5,262

B. RECEIPTS

Sale proceeds of fruits, vegetables, Plants, etc.		8,785
Sale proceeds of vehicles, tools, plants and other non-consumable stores		74,893
Analytical and testing fees		2,53,977
Rent		79,275
Fees for training, application fees, etc.		64,782
Sale of publications		2,335
Interest on loans and advances granted to Council's employees	(—)	47,979
L.S. and Pension contributions		951
Miscellaneous receipts		1,536
Summer Institute		125
		4,38,680

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Appendices

APPENDIX — I

STAFF WORKING AT THE COTTON TECHNOLOGICAL RESEARCH LABORATORY AS ON MARCH 31, 1991

(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., 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. Shri R. P. Nachane, M.Sc.
10. Smt. Prema Nair, M.Sc.
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 D. Rama Rao, M.Sc.
15. Shri A. J. Shaikh, M.Sc.
16. Dr. S. Sreenivasan, M.Sc., Ph.D.
17. Shri A. V. Ukidve, M.Sc., F.T.A.
18. Shri P. V. Varadarajan, M.Sc.
19. 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 A. K. Gupta, M.Sc., L.L.B., W.P.M.M.T.
2. Shri P. Bhaskar, M.Sc.
3. S. K. Chattopadhyay, B.Sc. Tech. (Text.), M.Tech. (Text. Engg.)
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. Smt. Sujata Saxena, M.Sc.

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.
5. Shri A. W. Shringarpure, 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. in 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. Smt. S. D. Pai, M.Sc.
12. Shri D. Radhakrishnamurthy, M.Sc., M.Phil.
13. Shri K. B. Rajagopal, B.Sc.
14. Shri S. Sekar, B.Sc.
15. Smt. S. V. Sukhi, M.Sc., D.F.L. (German)
16. Shri V. B. Suryanarayanan, B.Sc.
17. Shri G. Viswanathan, M.Sc., A.T.A.

Senior Technical Assistant T-4

1. Shri N. O. Anthony, S.S.C.
2. Shri S. M. Gogate, B.Sc.
3. Shri Jayaprakash Narayana, B.Tech. (Text.)
5. Shri P. K. Mandhyan, B.Sc., A.T.A.
6. Shri E. A. Pachpinde, B.Sc.
7. Shri R. S. Pathare, B.Sc.
8. Shri D. L. Upadhye, S.S.C. (Tech.), N.C.T.V.T., (I.T.I. & C.T.I.)
9. Shri S. Vancheswaran, BSc.
10. Shri T. Venugopal, B.E. (Civil)
11. 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. Shri U. D. Devikar, B.Sc.
3. Shri P. B. Gurjar
4. Shri Gopal B. Hadge, B.Sc.
5. Shri V. D. Kalsekar, B.Sc.
6. Kum. S. S. Kamerkar, B.Sc., B. Lib.
7. Shri H. S. Koli, B.Sc.
8. Shri M. Mohan, M.Sc.
9. Shri D. N. Moon, B.Sc.
10. Shri V. V. Murudkar, L.T.M.
11. Shri R. D. Nagarkar, M.Sc.
12. Smt. Nirupama Panda, M.Sc.
13. Shri B. R. Pawar, B.Sc.
14. Kum. Y. D. Pai, B.Sc.
15. Shri R. S. Prabhudesai, B.Sc.
16. Shri P. N. Sahane, D.I.F.T.
17. Kum. M. G. Sheela Devi, M.Sc.
18. Kum. Sugatha Kumari, 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

Shri P. G. Kadam

APPENDICES

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 H. B. Tambe*, Plumber, T-I-3
4. Shri G. D. Narkar*, Carpenter, T-I-3
5. Shri S. S. Patekar*, Driver, T-I-3
6. Shri P. J. Ahire*, Operator, T-I-3

Operator T-2

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

Driver

1. Shri B. B. Gaykar* T-2
2. Shri R. N. Kadam

Operator

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

Administrative Personnel

Administrative Officer

Shri M. K. Jain, B.Sc.

Finance and Accounts Officer

Shri N. S. Sekaran

Assistant Administrative Officer

Shri P. D. Sonawane, B.A., L.L.B.

Superintendent

1. Shri K. Sudhakaran
2. Shri D. P. Naidu
3. Shri G. Moosad, B.Com.

* Holding Technical post as Personal.

Assistant

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

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. Smt. S. D. Ambre
2. Smt. S. M. Desai
3. Shri A. P. Natu
4. Smt. J. J. Karanjavkar
5. Shri E. T. Gurav
6. Shri K. Parleshwar

Junior Clerk

1. Smt. S. R. Shirsat, B.A.
2. Shri N. V. Kambli
3. Smt. V. V. Janaskar, B.Com.
4. Shri J. R. Mangale
5. Shri S. D. Ambolkar
6. Shri R. K. Pallewad, B.A.
7. Shri P. V. Jadhav
8. Shri T. S. Patil
9. Kum. S. K. Gaonkar, B.A.
10. Shri V. M. Sable
11. Smt. J. R. Chavkute
12. Shri P. K. Vasu

APPENDICES

Telephone Operator

Kum. S. V. Pai

Supporting Staff Gr. III

1. Shri Chatrapal Mhatri
2. Shri G. G. Ambare
3. Shri M. R. Nevrekar
4. Shri A. R. Bane

Supporting Staff Gr. II

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

Supporting Staff Gr. I

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

LIST OF STAFF AT THE QUALITY EVALUATION UNITS

1. AKOLA : *Senior Technical Assistant T-4*
Shri N. Y. Bansode, B.Sc.

Technical Assistant T-II-3
Shri Adil Zubair, B.Sc.

Supporting Staff Grade I
1. Shri S. R. Patode
2. Shri M. P. Tohokar

2. COIMBATORE : *Technical Officer T-6*
(Quality Evaluation)
Shri A. K. Antony, B.Sc.

Technical Officer T-5
(Quality Evaluation)
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-5*
(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 III
Shri Y. R. Sone

Supporting Staff Grade I
Shri C. J. Bagalkoti

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 : *Senior Technical Assistant T-4*
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 R. G. Dhakate, B.Sc.

Supporting Staff Grade IV
Shri John Robert

Supporting Staff Grade III
Shri H. S. Bhabar

7. LUDHIANA : *Technical Officer T-7*
(Quality Evaluation)
Shri Ram Parkash, B.Sc., L.L.B.

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

Supporting Staff Grade 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.

Electrician Grade T-1

Shri P. N. Raut

Operator (Auxiliary)

Shri B. V. Shirsath, I.T.I., B.A.

Assistant Administrative Officer

Shri G. Sasidharan, B.A., L.L.B.

Junior Clerk

1. Shri B. D. Dhengale
2. Smt. G. G. Palorkar, B.A.
3. Shri S. A. Telpande, B.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
6. Shri I. P. Tomaskar

9. NANDED : *Scientist*

Shri L. D. Deshmukh, M.Sc.

Technical Assistant T-II-3

1. Shri R. K. Jadhav, B.Sc.
2. Shri R. Srinivasan, M.Sc.

Supporting Staff Grade III

Shri L. R. Indurkar
Shri S. N. Umare

10. RAHURI : *Technical Officer 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 Sita Ram, M.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 IIII
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 number of Scheduled Casts and Scheduled Tribes amongst them as on March 31, 1991

Group/Class	Permanent / Temporary	Total No. of employees	Scheduled Castes	Percentage to total employees	Scheduled Tribes	Percentage to total employees	Remarks
Gr. A. (Class I)							
Permanent							
(i) Other than lowest rung of Cl. I		27	1	6%	—	—	—
(ii) Lowest rung of Cl. I		21	2				
Total		48	3				
(i) Other than lowest rung of Cl. I		1		25%	—	—	—
(ii) Lowest rung of Cl. I		3	1				
Total		4	1				
Gr. B. (Cl. II)	Permanent	45	5	10%	1	4%	—
	Temporary	4	—		1		
Gr. C. (Cl. III)	Permanent	91	9	26%	—	7%	—
	Temporary	24	20		8		
Gr. D. (Cl. IV) (Excluding Sweepers)	Permanent	42	9	19%	2	6%	—
	Temporary	25	4		2		
Gr. D. (Cl. IV) (Sweepers)	Permanent	1	1	100%	—	—	—
	Temporary	8	8		—	—	—

APPENDIX — III

Statement showing the number of Reserved Vacancies filled by Members of Scheduled Castes and Scheduled Tribes as on 31st March, 1991.

Class of post	Total No. of vacancies		No. of vacancies reserved		Scheduled Castes					Scheduled Tribes				
	Notified	Filled	Out of Col. 2	Out of Col. 3	No. of SCs candidates appointed	No. of SCs vacancies carried forward from the previous year	No. of STs candidates appointed against vacancies reserved for SCs in the 3rd year of carry forward	No. of reservations lapsed after carrying forward for 3 years	No. of vacancies reserved: Out of Col. 2	No. of vacancies reserved: Out of Col. 3	No. of STs candidates appointed	No. of STs vacancies carried forward from the previous year	No. of SCs candidates appointed against vacancies reserved for STs in the 3rd year of carry forward	No. of reservations lapsed after carrying forward for 3 year
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I — Posts filled up by direct recruitment														
Other than lowest rung of Class 1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Lowest rung of Class I	1	—	1	—	—	—	—	—	1	—	—	—	—	—
Class II	1	—	1	—	—	—	—	—	—	—	—	—	—	—
Class III	8	6	1	—	1	—	—	—	—	—	—	—	—	—
Class IV (Excluding Sweepers)	9	9	2	—	2	—	—	—	1	1	—	—	—	7
Class IV (Sweepers)	—	—	—	—	—	—	—	—	—	—	—	—	—	—

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					II — Posts filled up by promotions									
Other than Lowest rung of Class I	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Lowest rung of Class I	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Class II	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Class III	—	—	—	—	3	—	—	—	—	—	—	—	—	—
Class IV (Excluding Sweepers)	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Class IV (Sweepers)	—	—	—	—	—	—	—	—	—	—	—	—	—	—