Cotton Technological Research Laboratory

Indian Council of Agricultural Research

Annual Report
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Contents

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1. INTRODUCTION

This is the 56th Annual Report of the Cotton Technological Research Laboratory (CTRL) and covers the calendar year 1979.

CTRL was founded in the year 1924 by the erstwhile Indian Central Cotton Committee (ICCC) to collaborate actively with the Department of Agriculture in different parts of the country for the development of improved varieties by carrying out scientific evaluation of quality of the new varieties of cotton evolved from time to time. Consequent upon the abolition of Commodity Committees including ICCC in 1966, the administrative control of the Laboratory came under the Indian Council of Agricultural Research (ICAR) and the research activities were reoriented and intensified. Since then, concerted efforts were continued to help the breeders and agricultural scientists to produce more and better quality cotton in addition to enhance the utilisation of cotton lint and cotton plant by-products which ultimately improve the economy of the country.

The main functions of CTRL are:

(*i*) to participate actively in the programme for improvement in production and quality of cotton in India, by evaluating the quality of new strains evolved by the agricultural scientists and giving them necessary technical guidance;

(*ii*) to carry out research on the physical, structural and chemical properties of cotton in relation to quality and spinning performance;

(*iii*) to carry out research investigations on the ginning problems of cotton;

(*iv*) to investigate the greater and better utilization of cotton, cotton waste, linters, cottonseed, etc.;

(*v*) to help the trade and industry by providing reliable and accurate data on quality of representative Trade Varieties of Indian Cottons;

(*vi*) to issue authoritative reports on the samples received for tests from other government departments, the trade and other bodies; and

(*vii*) to collect and disseminate technical information on cotton.

Library

CTRL has an up-to-date library of books on cotton, cotton technology and related subjects. With the 70 books added during the year, the total

number of books by the end of 1979 was 3,684, apart from 3,426 bound volumes of journals. The library received regularly about 223 journals covering a wide spectrum of subjects in the textile and allied fields, of which 102 were subscribed for and the remaining received by way of exchange or complimentary.

New Equipments Purchased

Several new equipments were acquired during the year, some of which are listed in Annexure I.

Distinguished Visitors

A list of distinguished persons who visited CTRL during the year is given in Annexure II.

Management Committee

As the order for reconstitution of the Management Committee was received only in May 1979, the Management Committee of CTRL met only once during the year.

The meeting held on August 10, 1979, which started by introduction of the three new members in the reconstituted Management Committee, viz. Shri T. H. Nirmal, Assistant Director General, ICAR, Shri V. Sethuraman, Joint Director of Agriculture (Research), Tamil Nadu, and Shri S. R. Patel, Executive Director, Gujarat State Co-operative Marketing Federation Ltd., had nearly 17 items for consideration. These included details of the Sixth Plan Proposal of CTRL, Annual Accounts (Non-Plan) for 1978-79 and budget allocation for 1979-80, progress of construction of buildings for the Laboratory in Bombay and Nagpur, proposal for installation of inter-communication telephone system, revision of rules and regulations and schedule of test fees of Testing House, revision of fees for training course, proposal for purchase of some items against single quotation, transfer of scientists from one station to another within the same Institute, actions taken on the recommendations of the Institute Joint Council and the Grievance Cell of CTRL, Annual Report of the Laboratory for the year 1978, approval of programme of work for the year 1979 and formation of Research Advisory Committee.

In his concluding remarks, the Chairman thanked the members of the Management Committee for their active participation in the discussions and for the valuable suggestions given by them on various matters.

Staff Research Council

A meeting of the Staff Research Council was held on March 16 and 17, 1979, to discuss the progress of research work during 1978 and to finalise the programme of research work for 1979. In his introductory remarks, the

Director brought to fore some of the recommendations of the Task Force constituted by ICAR to go in depth into the decentralisation of administration, assignment of research responsibility, assessment of ARS scientists, placement of ARS personnel, etc. Discussions took place at length regarding progress made on various on-going research projects as well as new projects taken up last year and several recommendations/suggestions were offered. While three projects were deleted from the programme of work, as the work on them was completed, extension was granted to three projects taking into consideration the work already done and the difficulties experienced due to circumstances beyond the control of the investigators. Twelve new research project proposals were received for the year 1979 for consideration, of which ten proposals were approved.

Further, appropriate items for the appraisal of progress of research were included in the agenda of the Management Committee meeting held during the year, in which one session was held jointly with the Staff Research Council for discussion.

Inter-Institutional Projects

Work on the following six Inter-Institutional Projects, which were operating at CTRL, were continued during the year:

1. Studies on de-burring of raw wool using mechanical device.
2. Electron microscopical investigation of dye-diffusion and dye-aggregation in unmodified and modified cotton fibres.
3. Blending of cotton with wool, jute and other natural fibres.
4. Studies on the utilisation of chitin and other allied products from prawn shell waste.
5. Enrichment of cattle feed by microbiological methods.
6. Studies on the biosynthesis of cellulose by micro-organisms and higher plants.

While steady progress was made in the latter five projects, much progress could not be made in the first project as suitable scoured wool samples for assessing the efficiency of the new device were not received in time.

Indo-UK Collaborative Programme

Under the Indo-UK Collaborative Programme in Natural Resources Research, Dr. V. Sundaram, Director, along with Dr. S. M. Betrabet and Shri M. S. Parthasarathy, both Senior Scientists of CTRL, visited various textile research institutes and industrial organisations in the UK during May 5 to June 3, 1979. Thereafter, the above team visited various research organisations in Belgium and France from June 5 to 12, 1979. The impressions of the team have been compiled into a report and submitted to ICAR, together with proposals for five collaborative research projects.

Integrated Cotton Development Project (ICDP)

Under the Integrated Cotton Development Project which was sanctioned for a period of five years with effect from November 30, 1976, CTRL has been entrusted with the responsibility of organising a Ginning Training Centre at Nagpur with a total financial outlay of Rs. 32.32 lakhs. During 1979, it was proposed that the training programme at Nagpur should be initiated with the assistance of Punjabrao Krishi Vidyapeeth (PKV), Akola. Accordingly, action has been taken to purchase a double roller gin manufactured by M/s. Bajaj Industries, Nagpur. The PKV had kindly agreed to provide facilities for accommodating the gin. However, it was not possible to obtain permission from the concerned authorities for installing the gin in the PKV campus as it is situated in the heart of the Nagpur City and as Maharashtra was in the grip of a severe power shortage. Hence, it was decided to organise the training course at mofussil centres as in the previous years and a programme for training was chalked out accordingly for the Punjab area and 23 saw gin fitters and 35 roller gin fitters at various factories in Faridkot district were trained for the operation and maintenance of gins.

Post Graduate Training

The recognition granted to this Laboratory by the University of Bombay as a Post Graduate Institution was continued during the year for guiding students for M.Sc. and Ph.D. degrees in Physics (Textiles), M.Sc. degree in Physical and Organic Chemistry, M.Text. degree in Spinning Technology and Ph.D. degree in Bio-physics.

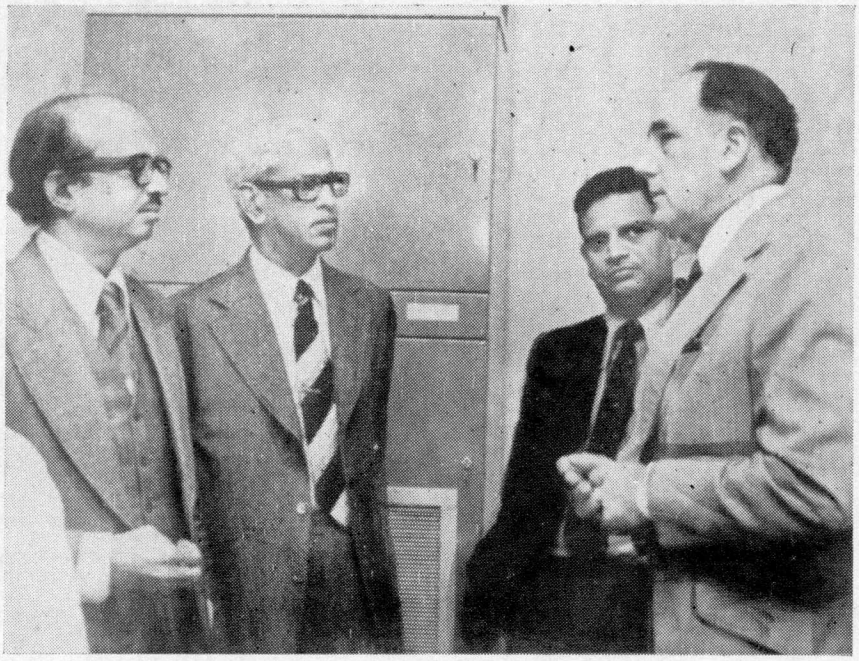
Dr. V. Sundaram (Director), Dr. S. M. Betrabet (Sr. Scientist, Microscopy), Dr. N. B. Patil (Sr. Scientist, Physics), Dr. V. G. Munshi (Sr. Scientist, Quality Evaluation), Shri M. S. Parthasarathy (Sr. Scientist, Mechanical Processing), Dr. S. N. Pandey (Scientist, Chemical Studies), Kum. I. G. Bhatt (Scientist, Chemical Studies) and Dr. K. R. Krishna Iyer (Scientist, Physics), continued as research guides for various degrees recognised by the University of Bombay.

During the year, 13 members of the staff were being guided for M.Sc. and three for Ph.D. degrees in Physics (Textiles), two for M.Sc. degree in Physical Chemistry, one for Ph.D. degree in Bio-Physics and one for M.Text. degree in Spinning Technology, while one student, who was not a staff member, was being guided for M.Text. degree in Spinning Technology.

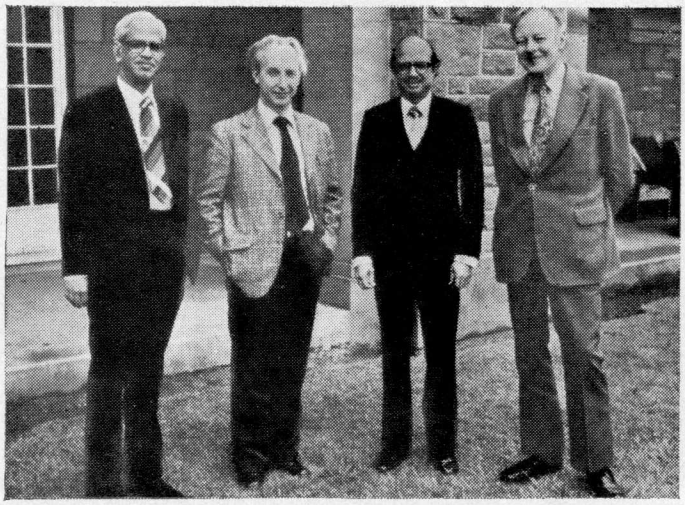
The following two students from the Laboratory have been awarded degrees as indicated:

Smt. J. K. S. Warrier	—	M.Sc. degree in Physics (Textiles)
Shri M. S. Anjane	—	M.Text. degree in Spinning Technology

VISIT TO UK



(L to R) Dr. S. M. Betrabet, Dr. V. Sundaram and Shri M. S. Parthasarathy of CTRL with Mr. F. H. Burkitt, Director, Technical Research, International Institute for Cotton, Manchester



With Dr. T. M. Wood and Dr. J. S. D. Bacon (Head, Carbohydrate Biochemistry) at the Rowett Research Institute, Aberdeen

VISIT TO BELGIUM AND FRANCE

Dr. R. Marechal showing a wild variety of cotton in the green house at The Faculty of Agricultural Science, Gembloux, to Dr. V. Sundaram and Shri M. S. Parthasarathy

Dr. R. Hagege, Shri M. S. Parthasarathy, Dr. M. Sotton and Dr. S. M. Betrabet at Institute Textil de France, Paris

FAO Consultancy

Dr. V. Sundaram, Director, CTRL, was deputed to Burma for one month from November 27 to December 26, 1979, as FAO Consultant in Cotton Technology. The terms of reference comprised reviewing the current facilities in Burma for ginning and quality evaluation of cotton, specifying equipments and instruments required for setting up a Cotton Technological Laboratory in view of the raw cotton requirements of the national textile industry, formulating interim guidelines for testing, pending installation of the new equipments and recommending other measures, where necessary, on the above aspects.

Consultancy Service

For the last 60 years, the East India Cotton Association Ltd. (EICA), Bombay, has been regulating transactions in cotton on an all-India basis. It has been the customary practice of EICA to get cottons graded by hand and eye tests by cotton graders. Although the cotton graders may possess considerable expertise and experience in this line, it is becoming increasingly clear of late, that visual grading has certain limitations and instrumental methods of grading are becoming more popular. In keeping with this trend, EICA has decided to set up a Cotton Testing Laboratory at Sewree Market in Bombay. CTRL, which has modern quality evaluation units and considerable experience in setting up testing laboratories in India as well as abroad, is helping EICA in their venture. A project report, specifying various details, such as staff and instrument requirements as well as cost estimates, has been prepared by CTRL and submitted to EICA to facilitate proper planning and speedy execution of the project.

ICAR Golden Jubilee

ICAR, which completed 50 years of fruitful existence in 1979, celebrated the Golden Jubilee Year in a befitting manner by organising an International Symposium on Agricultural Research and Educational Systems for Development. The Symposium held during the first week of September in New Delhi was attended by Director and Senior Scientists from CTRL. In the exhibition which was arranged as a part of the celebrations, items from projects undertaken by CTRL under the Golden Jubilee Lab-to-Land Programme were also displayed.

Membership on Other Organisations

The Director and other Scientists of CTRL continued to represent CTRL and ICAR on various committees and institutions, as in the past.

Further, the Director was nominated or continued as a member of the following committees/bodies during the year :

(*i*) Indian Cotton Development Council;
(*ii*) Research and Development Sub-Committee of the Indian Cotton Development Council;
(*iii*) Research Advisory Committee of Plant Breeding and Genetics of Central Institute for Cotton Research, Nagpur;
(*iv*) Cotton Germplasm Advisory Committee;
(*v*) Board of Directors of National Textile Corporation, M.P.;
(*vi*) Board of Directors of Cotton Corporation of India, Bombay;
(*vii*) Executive Council, MPKV, Rahuri;
(*viii*) Management Committee, Krishi Vigyan Kendra, Kosbad;
(*ix*) Board of Management of VJTI, Bombay;
(*x*) Governing Council and Research Advisory Committee of BTRA, Bombay; and
(*xi*) Research Advisory Committee of SITRA, Coimbatore.

Dr. S. M. Betrabet, Senior Scientist, continued to be a member of the 'Panel of Experts in Physics Oriented Studies' of ATIRA and Advisory Council of Electron Microscope Society of India (EMSI) and Editorial Board of EMSI Bulletin. He was also Chairman of Physics Group of Research Advisory Committee of ATIRA, Ahmedabad.

Conferences

Textile Institute Annual Conference : The sixty-third Annual Conference of the Textile Institute (Manchester) was held, for the first time in India, at New Delhi from January 19 to 23, 1979. At this Conference which was organised in collaboration with the Textile Association (India), twenty-two papers were presented, of which the paper 'A Survey of Research on Cotton Production in India during the Last Decade in Relation to Quality and Specific End-uses' authored by S. M. Betrabet, M. S. Parthasarathy and V. Sundaram of CTRL was well received by the audience as judged by the stimulating discussions it evoked after it was presented by Dr. S. M. Betrabet and by the reviews which have been published subsequently. The Director, CTRL, presided over a session in which the paper, 'Nigerian Cotton: Its, Production, Characteristics and Utilisation' was presented. Many senior scientists from CTRL also participated in the Conference and took an active interest in the proceedings and discussions.

Bombay International Conference—'Textiles in the Modern World': This Conference organised by the Bombay Unit of the Textile Association (India), Bombay section, in conjunction with the Textile Institute, in Bombay on January 29 and 30, 1979, was attended by many scientists from CTRL. Director, CTRL, Chaired one session, in which a paper was presented by Dr. N. B. Patil, Senior Scientist, on behalf of the author of the paper, who was unable to attend the session in person.

Technical Cell

A Technical Cell consisting of the following members has been constituted in order to supply factual and reliable information to various queries of technical nature received from outside parties and to prepare notes on technical matters, whenever necessary :

1. Dr. K. R. Krishna Iyer
2. Shri T. N. Ramamurthy
3. Shri A. V. Ukidve
4. Smt. Vatsala Iter
5. Shri S. G. Nayar
6. Shri T. K. M. Das (Co-ordinator).

Expansion and Modernisation

As part of the expansion and modernisation programme under Sixth Plan, CTRL was to construct a multistoreyed building, a seminar hall, visiting scientists' hostel, etc., in two stages. For the first phase of construction of the building, detailed estimates including departmental charges have been received from CPWD amounting to Rs. 46 lakhs. An amount of Rs. 6 lakhs also was provided in the Sixth Plan for power wiring, even though the estimate for the same was not received.

The construction work had started after a *Bhoomi Pooja* on October 22, 1979. The digging work for the basement as well as the concreting work has been in full swing. As per schedule of CPWD, the work of construction of the building is expected to be completed in September 1981.

Further, an automatic telephone exchange consisting of 50 lines is proposed to be installed in the new building. In this regard, quotations have already been received from Indian Telephone Industries and they have been requested to send details of different types of telephone exchange (Solid State) units. For this purpose, necessary provision has also been made in the budget during the financial year 1979-80.

Staff Amenities

In the existing staff quarters of Type I, Type II-A and TypeII-B, accommodation has been provided for 16 employees in Grade D and 22 in Grades C and B. Accommodation has been provided for 10 employees in Grade A by purchasing a building of 10 tenements for High Income Group (HIG) from the Maharashtra Housing Board (MHB). Even though 20 tenements for the Middle Income Group (MIG) have been booked with MHB by paying half of the total cost of Rs. 10 lakhs, possession of the building has not been received so far.

International Year of the Child

CTRL initiated prompt action on the instructions received from ICAR to celebrate the International Year of the Child. With a view to carrying out the various programmes to be organised from time to time in connection with the celebration, a broad based committee consisting of members of staff of different categories was formed, with the Director as Chairman. The various programmes chalked out and executed were as follows :

1. A baby show, fancy-dress competition (children up to 12 years) and sports and games for children of the age group of 3 to 12 years, were arranged in the month of April 1979.
2. Lecture demonstrations on the preparation of nutritious food were arranged on several occasions for the benefit of the housewives of the staff members through the courtesy of the Department of Food and Nutrition, Government of India.
3. Children's day was celebrated in a befitting manner by arranging a picnic to Victoria Gardens for children of the members of the staff and organising a drawing competition for them at the garden premises.
4. In order to educate and entertain children, a library of books for children was started on a small scale at the Laboratory.
5. Two film shows for the children were also arranged during the year.

CSIR-NSF Exchange Programme

Dr. B. C. Goswami, Associate Professor of Textiles and Clothing, University of Tennessee, Knoxville, Tennessee, USA, visited the Laboratory in December 1979 during his tour for a period of 17 days aimed at visiting various research organisations/institutions in India under the CSIR-NSF Exchange Programme. During his stay for two days on December 14 and 15, 1979 at Bombay, the feasibility for undertaking an Indo-US Collaborative Project pertaining to the structural factors of cotton fibres was discussed. A talk by Dr. Goswami was also arranged at the VJTI Auditorium under the joint auspices of CTRL, VJTI and BTRA.

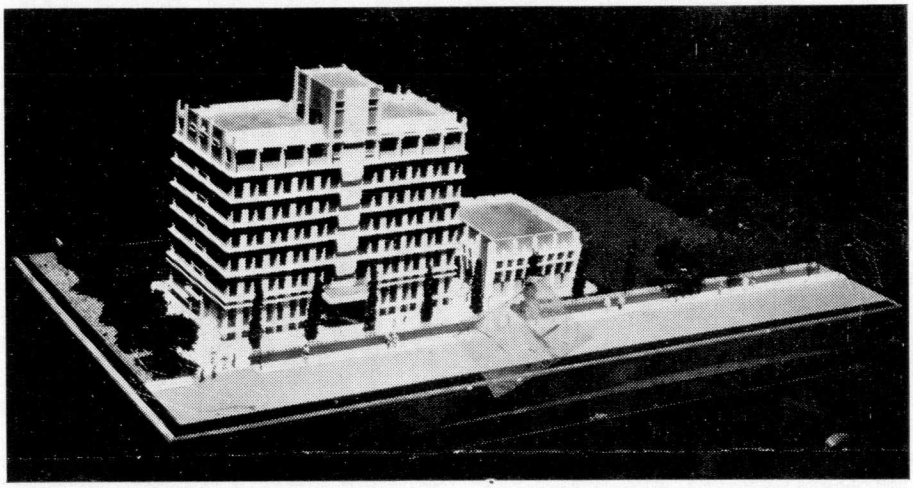
Finance

A statement showing the sanctioned budget grant of CTRL and the actual expenditure for the financial year 1978-79 is furnished in Appendix I. It will be seen from the statement that the actual expenditure was Rs. 31.66 lakhs as against sanctioned grant of Rs. 31.75 lakhs. An expenditure of Rs. 51.06 lakhs was incurred under the Fifth Plan Scheme for modernisation and strengthening of CTRL for intensive research on cotton against the sanctioned grant of Rs. 52.38 lakhs. Further, (*i*) a sum of Rs. 0.70 lakh was incurred on the scheme for 'Investigation of the effects of high energy radia-

Dr. V. Sundaram, Director, CTRL and Chairman of a session, with Dr. P. Adegbile and Dr. S. C. O. Ugboue

Dr. J. H. S. Green, Chairman of the session, with Dr. V. Sundaram, Shri M. S. Parthasarathy and Dr. S. M. Betrabet, authors of the paper from CTRL

NEW MULTISTOREYED BUILDING



A Model of the Building

Bhoomi Pooja Ceremony

tion on the induction and half-life of excited, free and/or ionised radicals in cotton cellulose to obtain basic information needed for the development of potentially new useful cotton products' against the sanctioned grant of Rs. 0.87 lakh, (*ii*) a sum of Rs. 1.97 lakhs was incurred on scheme for 'Optimal blending of standard varieties of Indian cotton' as against sanctioned amount of Rs. 3.46 lakhs, (*iii*) a sum of Rs. 0.06 lakh was incurred on Regional Committee against the sanctioned grant of Rs. 0.19 lakh, and (*iv*) Rs. 0.06 lakh was spent on the project entitled 'Studies on the production and utilisation of chitosan and allied products from prawn shell waste' against the sanctioned grant of Rs. 0.23 lakh. In addition, a sum of Rs. 0.40 lakh was spent on the scheme 'Response of Indian cotton to crosslinking treatments with a view to evolve cotton varieties most suitable for chemical finishing treatments' as against the sanctioned grant of Rs. 0.78 lakh. The savings during the year, in all the cases, were mainly due to non-filling of the posts and also non-materialisation of certain purchases, etc.

Significant Findings

The panel meetings of the Breeding and Technology Group of Central Zone and South Zone under the All India Co-ordinated Cotton Improvement Project recommended the following improved strains/hybrids for pre-release seed multiplications.

Strain/hybrid	*Special features*
	CENTRAL ZONE
G.Cot.11 (1449) ..	An early maturing (5 to 6 weeks earlier than Digvijay) *herbaceum* strain having more yield than the existing varieties Digvijay (62% more under irrigated conditions and 41.4% more under rainfed conditions) and Sujay (40% more under irrigated conditions and 44.5 % more under rainfed conditions). The ginning outturn is 39.2% and 37.4% under irrigated and rainfed conditions, respectively. Average reaction to pests and diseases. Spinning potential around 30s.
GHH.3 ..	A *hirsutum* × *hirsutum* hybrid, recording 29% higher yield than Hybrid 4; matures 3 weeks earlier with ginning outturn 33.6% and mean length 1 mm shorter than Hybrid 4. Spinning potential 70s to 80s count. More tolerant to sucking pests, blackarm and alternaria.

Strain/hybrid	*Special features*
	SOUTH ZONE
DCH.32 (Interspecific hybrid) ..	Earlier in maturity by 10 days than the existing hybrid, Varalaxmi; more synchronous in flowering and fruiting; high ginning outturn, high *kapas* yield potential. Spinning potential 70s to 80s count. This hybrid is meant for replacing Varalaxmi.
DS.56 ..	Matures in about 150 days; compact plant type with less foliage; more synchronous in flowering and fruiting; larger boll size; higher ginning outturn. Spinning capacity 40s.
DS.59 ..	Matures in about 165 days; good plant type with predominant vegetative branches; larger boll size, superior fibre characteristics and spinning potential. Higher *kapas* yield. It is meant to replace Hampi.
SRG.26 ..	Tall with medium internodes; large bolls and less leaf canopy; higher yield than 170-Co.2.
DB.3-12 ..	Dwarf compact plant type; maturing in about 165 to 170 days; roundish and slightly larger bolls; higher lint index and ginning percentage. It is meant to replace Jayadhar.

A study of the relationship between the various X-ray angles and tensile properties revealed that 20% X-ray angle could be the best parameter for considering the aspects of tenacity, while 75% X-ray angle might be most suited to describe elongation behaviour of cottons.

A comparative study was made between conventional and High Speed Drawing Frame using a long staple cotton, Hybrid 4. Yarn test results indicated that the use of wider settings of 38 mm and 42 mm for the back and front zones, respectively, could produce yarns with better strength and regularity of count and strength. For closer settings, while higher break draft of 1.7 at the first passage of draw frame is essential, differences were not marked at the wider settings. Throughout, the high speed draw frame exhibited better yarn quality than conventional draw frame.

A prediction formula has been worked out to estimate yarn strength and extensibility at 65% rh from the corresponding values determined in the wet state.

Fabrics subjected to chemical finishing treatments for crease resistant characteristics by radiation technique showed higher retention of strength. Flame proofing properties with higher retention of strength also can be imparted to fabrics by phosphorylation treatment using radiation technique. A new method for preparing propargyl cellulose of higher degree of substitution has been developed.

A simplified function involving fibre length, length uniformity, fineness and maturity determined solely from tests on Fibrograph has been developed to serve as a Fibre Quality Index, which can effectively substitute the conventional measures of Quality Indices based on multiple fibre tests on different instruments. The efficiency of new index has been demonstrated by working out its association with spinning performance of the respective cottons as compared to that shown by the established fibre quality functions.

A comparative study of the three Crease Recovery Testers, viz. Monsanto, Metrimpex and Shirley, showed that whenever accurate evaluation of Crease Recovery Angle is required, Metrimpex CR Tester is preferable. However, for comparative evaluation, Monsanto CR Tester can be safely used.

Of the three finishing treatments given to the yarn samples, viz. (*i*) conventional crosslinking (CCL), (*ii*) mercerised-stretched-washed and crosslinked in wet state (MWCL), and (*iii*) mercerised as in (*ii*) and crosslinked after drying (MDCL), MWCL consistently exhibited higher retention of tenacity and toughness in all the varieties of cotton tested.

Cotton-polynosic blended fabrics were given resin finishing treatment using mixtures of resins (DMDHEU and MMM) by poly-set process and it was observed that the poly-set process (single step) showed higher strength retention and abrasion resistance as compared to those treated by conventional process.

Acrylonitrile (AN) and mixtures of AN and styrene grafted on to cotton revealed that styrene in a mixture of styrene and AN could be grafted on to cotton at 65°C without the nitrogen atmosphere, while it was not possible to graft styrene alone on to the cotton at 65°C without nitrogen.

The results of water holding capacity and sinking time of a number of cotton varieties revealed that the cotton varieties, Lohit, LD.133 and Digvijay, are better suited for the manufacture of surgical cotton.

In order to explain the disagreement observed on the structure of cellophane as determined by Electron Diffraction (ED) and X-ray Diffraction (XRD) techniques, investigations were undertaken on wood pulp, alkali cellulose and NaOH treated cellophane and the results revealed that minute crystallites of cellulose I, in wood pulp, found to persist even in alkali cellulose, grow during further processing and eventually give ED pattern of cellulose I. But the crystallites of cellulose I in cellophane are too small in quantity and size to be detected by XRD. The ED pattern of alkali

cellulose was typical of cellulose II. However, the cellulose II crystallites in cellophane are smaller and unstable compared to alkali cellulose and give poor ED patterns.

The study undertaken to enrich cattle feed by microbiological methods revealed that semi-solid fermentation of paddy straw and wheat straw with *Penicillium funiculosum* and *Candida utilis* enhanced the crude protein three-fold and two-fold, respectively, besides bringing about a two-fold increase in crude fat and 20% to 30% increase in digestibility.

2. PROGRESS OF RESEARCH

In addition to assisting agricultural scientists in improving the yield and quality of cotton by authoritative evaluation of samples received from various cotton breeding, agronomy and other trials, considerable progress has been made in various research and related activities at CTRL, a resumé of which is given below :

Evaluation of the Quality of Cotton Samples Received from Agricultural Trials

The number of samples received for various tests from trials conducted by the Agricultural Universities, State Departments of Agriculture, etc., during the years 1977, 1978 and 1979 together with the corresponding average figures for the quinquennium 1971-75, are given in Table 1(a).

Table 1 (b) summarises the number of samples tested at the regional quality evaluation units of CTRL during 1979.

The samples received from agricultural trials are tested in the order of their receipt and test reports are issued as soon as possible.* The results of tests on samples of Trade Varieties and Standard Indian Cottons are reported as Technological Circulars as and when tests are completed and later on compiled for the whole season and published as two separate Technological Reports — one for Trade Varieties of Indian Cottons and the other for Standard Indian Cottons.

Test reports are not issued generally on the technological research samples used exclusively for various research project purposes, as the test results will appear in relevant research publications.

Apart from these, some samples are received for miscellaneous tests, such as determination of quality of ginning, neppiness, oil content in cotton-seed, etc.

The state-wise figures for the number of samples which were tested for fibre characteristics and spinning performance have been given in Table 2 under two heads, viz. (*i*) All India Coordinated Cotton Improvement Project (AICCIP) and (*ii*) Other State Schemes.

* It may be mentioned that a number of samples could not be tested due to restrictions on the use of electric power imposed by the Government of Maharashtra.

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

Type of test	Average for the quinquenium 1971-75	1977	1978	1979
Fibre and Full Spinning	403	138	120	247
Fibre and Microspinning	2562	2228	1922	1933
Microspinning alone	—	3	—	—
Fibre tests alone	86	132	435	193
Mill tests	12	17	16	6
Standard Cottons	21	28	22	24
Trade Varieties—lint	24	21	35	19
Trade Varieties—*kapas*	49	44	41	42
Technological Research	81	154	170	77
Miscellaneous	—	3	16	40
Total	3238	2768	2777	2581

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

Unit	Total number of cotton samples tested			
	Length	Fineness	Strength	Maturity
Akola	189	—	189	—
Coimbatore	808	845	810	918
Dharwad	1,184	955	955	955
Guntur	372	360	527	368
Hissar	242	530	242	510
Indore	479	472	477	472
Ludhiana	270	674	235	687
Nagpur	54	55	40	47
Nanded	971	1,029	1,029	1,047
Sriganganagar	750	452	36	12
Surat	10,337†	7,819	6,864	7,851

† On Fibrograph, 10,299 samples were evaluated on the basis of one pair of combs only.

Note:- At the Quality Evaluation Unit in Surat, 239 samples were spun on the Shirley Miniature Spinning Plant and 55 samples tested for trash content on the Shirley Analyser.

TABLE 2 : NUMBER OF SAMPLES TESTED AND REPORTED IN 1979

State	Fibre and Full Spinning	Fibre and Micro-spinning	Micro-spinning	Fibre tests	Total
		(*i*) AICCIP			
Punjab	21 (4)	42 (7)	—	22 (2)	85 (13)
Haryana	17 (4)	39 (8)	—	—	56 (12)
Rajasthan	2 (1)	20 (1)	—	—	22 (2)
Madhya Pradesh	— —	143 (9)	—	—	143 (9)
Gujarat	33 (5)	46 (2)	—	—	79 (7)
Maharashtra	5 (1)	276 (31)	—	7 (2)	288 (34)
Andhra Pradesh	9 (3)	20 (4)	—	—	29 (7)
Karnataka	29 (10)	130 (8)	—	—	159 (18)
Tamil Nadu	— —	105 (9)	—	—	105 (9)
Total	116 (28)	821 (79)	—	29 (4)	966 (111)
		(*ii*) Other State Schemes			
Punjab	—	—	—	72 (1)	72 (1)
Haryana	20 (5)	17 (4)	—	—	37 (9)
Rajasthan	9 (7)	—	—	—	9 (7)
Madhya Pradesh	5 (5)	72 (5)	—	—	77 (10)
Gujarat	18 (12)	12 (1)	—	—	30 (13)
Maharashtra	27 (16)	145 (16)	18 (3)	202 (8)	392 (43)
Andhra Pradesh	11 (8)	66 (4)	—	—	77 (12)
Karnataka	8 (8)	22 (2)	—	—	30 (10)
Tamil Nadu	15 (11)	13 (3)	—	—	28 (14)
Total	113 (72)	347 (35)	18 (3)	274 (9)	752 (119)
Grand Total					1718 (230)

Note : Figures in brackets indicate the No. of reports issued

ALL INDIA COORDINATED COTTON IMPROVEMENT PROJECT

In order to intensify the research programme on cotton, the Indian Council of Agricultural Research sponsored the All India Coordinated Cotton Improvement Project (AICCIP) with effect from 1967. The work on this project is carried out on an all India basis with the active collaboration of the Central Institutes, Agricultural Universities and the State Departments of Agriculture. In this project, a number of progenies or crosses under test are screened through various trials, viz. Initial Evaluation Trial, Preliminary Varietal Trial, Co-ordinated Varietal Trial, Pilot Project Demonstration Trial, etc. Yield is the prime factor in the initial evaluation trial, while quality together with yield are the criteria considered for further selections in the subsequent trials.

As the cotton sowing and harvesting seasons differ widely from state to state, the breeding trials are conducted zone-wise. Thus, three zones are demarcated according to the agro-climatic conditions. The North zone comprises the States of Punjab, Haryana, Rajasthan and Uttar Pradesh, and the Central zone includes the States of Madhya Pradesh, Gujarat and Maharashtra, while the South zone comprises the States of Andhra Pradesh, Karnataka and Tamil Nadu. The work done under this project during the year is summarised below.

North Zone

This zone is mainly known for American *hirsutum* and *desi arboreum* types of cotton. The main object of the trials here is to indentify strains superior to the current varieties. Emphasis is also given to evolve strain of early maturing or short duration types.

G. hirsutum Trials

The Coordinated Varietal Trial was conducted at Faridkot, Hissar, Ludhiana, Muktsar and Sirsa, and the Preliminary Varietal Trial at Faridkot, Hissar, Ludhiana and Muktsar. Ranges for the main fibre properties and the spinning potential of the samples from the above trials have been given in Table 3. It may be seen that the values of 2.5% span length of the strains included in these trials ranged between 21.3 mm and 28.7 mm indicating that some of the strains can be considered for further selection. Maturity, in general, was average to good and the bundle strength was also satisfactory for most of the strains. It can also be seen that a few strains have recorded spinning potential better than or on par with their respective controls.

The following strains recorded satisfactory spinning performance at the counts indicated against them:

Location	*Count*	*Promising strains*
Faridkot	30s	FP.277, RS.485, FP.123, B.N. and F.414 (Control)
Hissar	40s	RS.481, RS.488, B.N. and H.777 (Control)
	30s	FP.277, LH.299, H.808 and RS.89-166
Ludhiana	40s	B.N., LH.318, F.414, RS.485, FP, 277, LH.357 and F.414 (Control)
	30s	RS. 489, J.310, F.518, J.313, H.808 and LH.299
Muktsar	30s	RS.89-166, RS.488, H.689-1, SH.274, F.414, SH.2374, LH.299, RS.485, H.808, H.844, J.313 and RS.490
Sirsa	30s	RS.488, H.777, FP.277, SH.2374, LH.299, 05, H.849 and 320F (Control)

In the case of other *hirsutum* trials, the following strains fared well at the counts and locations indicated below:

Location	*Count*	*Promising strains*
Hissar	40s	H.689, H.812 and H.777 (Control)
	30s	H.850, H.847 and H.842
Ludhiana	40s	F.414
	30s	LH.357
Sirsa	40s	CPD.8-1, SH.274 and B.N.
	30s	FP.132, 4-1-1, 320 × Frago
Sriganganagar ..	40s	B.N.
	30s	RA.Hy.5, RA.Hy.6, RA.Hy.7, RA.Hy.8, RA.Hy.9, RA.Hy.10, RA.Hy.11, RA.Hy.15, RA.Hy.18 and Ganganagar Ageti (Control)
Udaipur	40s	PST.9, B.N. and SRT.1
	30s	C. Indore 1 (Control)

G. arboreum Trials

The object of the trial is to identify higher yielding coarse and shorter varieties, suitable for export to replace the existing variety, G.27. Samples pertaining to Coordinated Varietal Trial and Preliminary Varietal Trial were received from Jullundur, Ludhiana and Sirsa. Range of 2.5% span length was from 15.7 mm to 25.1 mm. Micronaire value ranged between 4.7 and 7.8. As many as eight samples recorded staple length below 18 mm and Micronaire value above 7.0 indicating scope for further selection.

TABLE 3: SUMMARY OF TEST RESULTS OF THE STRAINS TRIED IN COORDINATED VARIETAL TRIAL (CVT) AND PRELIMINARY VARIEATAL TRIAL (PVT) OF *G. hirsutum* IN NORTH ZONE

Location	No. of samples	Range of 2·5% span length (mm)	Range of Micronaire value (μg/in.)	Range of maturity	Range of bundle strength (g/t)	Count	Spinning performance		Control
							A	B	
Normal Plant Type, Br04(a) CVT									
Faridkot	6 M	24·1—26·7 (25·4)	4·1—4·6 (4·4)	Average to good	41·8—49·3 (45·8)	30s	1	1	F.414
Hissar	5 F	22·6—25·9 (23·8)	3·6—4·4 (4·2)	Average to good	47·2—50·9 (49·0)	40s	4	2	H·777
Ludhiana	5 F	22·6—25·9 (23·8)	4·6—5·1 (4·8)	Good	48·8—50·9 (49·8)	40s	4	3	F·414
Muktsar	6 F	21·8—28·7 (24·8)	3·8—4·5 (4·1)	Average to good	47·2—50·4 (48·9)	30s	5	3	F·414
Sirsa	3 M	21·8—22·6 (22·3)	4·0—4·2 (4·1)	Average to good	48·8—49·3 (49·1)	30s	2	2	H·777
Short Duration Type, Br04 (c) CVT									
Faridkot	6 M	22·3—24·4 (23·6)	3·9—4·9 (4·2)	Good	42·9—49·3 (46·2)	30s	2	2	F·414
Hissar	5 M	22·6—25·1 (23·7)	4·2—5·2 (4·6)	Average to good	45·6—50·4 (48·9)	30s	3	2	H·777
Ludhiana	5	23·9—25·4 (24·4)	4·1—5·1 (4·6)	Average to good	47·2—49·8 (48·8)	40s	3	1	F·414
Muktsar	6 M	22·4—26·9 (23·6)	3·9—5·0 (4·3)	Low to average	44·0—49·3 (46·6)	30s	4	3	F·414
Sirsa	4 M	22·9—24·9 (23·8)	3·9—4·0 (4·0)	Low to average	48·2—51·5 (50·0)	30s	3	2	H·777

TABLE 3 : SUMMARY OF TEST RESULTS OF THE STRAINS TRIED IN COORDINATED VARIETAL TRIAL (CVT) AND PRELIMINARY VARIETAL TRIAL (PVT) OF *G. hirsutum* IN NORTH ZONE (*contd.*)

Location	No. of samples	Range of 2·5% span length (mm)	Range of micronaire value (μg/in.)	Range of Maturity	Range of bundle strength (g/t)	Count	Spinning performance		Control
							A	B	
Sirsa (IARI)	7 M	22·1—27·7 (24·5)	3·7—4·5 (4·2)	Low to average	42·3—52·0 (47·5)	30s	7	6	320F
				PVT Br03 1					
Faridkot	6 M	23·5—24·8 (24·0)	4·2—4·7 (4·4)	Average to good	44·5—49·3 (46·6)	30s	2	1	F·414
Hissar	5 M	23·4—27·7 (25·0)	3·9—4·6 (4·3)	Average to good	43·4—49·8 (46·7)	30s	3	1	H·777
Ludhiana	6 M	24·1—27·4 (25·4)	4·1—4·6 (4·4)	Average to good	44·5—49·8 (47·6)	30s	6	—	F·414
Muktsar	6 M	21·3—26·7 (23·8)	3·8—4·6 (4·3)	Average	44·5—49·8 (47·2)	30s	5	4	F·414

Values in brackets indicate averages.

A—No. of samples spinnable to the count selected.

B—No. of samples better than or on par with the control.

M—Microspinning.

F—Full spinning.

CENTRAL ZONE

Although a large percentage of cottons from this zone belong to either *G. hirsutum* or *G. arboreum* species, greater attention is being given during recent years to evolve hybrids. Cottons belonging to *G. herbaceum* species are also grown in the rainfed tracts of Gujarat and Saurashtra. As more and more irrigation facilities become available in some of the tracts of this zone, trials both under irrigated and rainfed conditions would be carried out.

G. hirsutum Trials

The Coordinated and Preliminary Varietal Trials were conducted at Achalpur, Badnapur, Badnawar, Jalgaon, Khandwa, Nagpur, Nanded, Padegaon, Rahuri, Surat and Udgir. Ranges of the main fibre properties such as 2.5% span length, Micronaire value and bundle strength along with spinning potential have been compiled in Table 4. It may be seen from this table that range of 2.5% span length for the strains included in these trials was from 21.8 mm to 32.3 mm. It was observed that a few strains recorded 2.5% span length over 30 mm even under rainfed conditions. The maturity in most of the cases was average to good, and bundle strength values were satisfactory. It may be pointed out that many strains have responded satisfactorily when spun to 30s and 40s counts. Further, many strains at Khandwa, Nagpur and Jalgaon have recorded higher spinning potential than their respective controls.

The *G. hirsutum* strains promising from the spinning point of view, are listed below:

Location	*Count*	*Promising strains*
Achalpur	40s	B.N., G.Cot.10, CP.1998F, 68KH.33/1146, KDM.42, CPD.8-1, 76IH.22, 73IH.3, 72IH.2, BA.26, DS.4, NH.183, 76IH.20 and L.147 (Control)
Amravati	40s	0732, G.Cot.10 and DHy.286
Badnapur	30s	KDM.42, 68KH.33/1146, NH.124 and NH.54
Badnawar	40s	ACH.101, BA.26, CPD.8-1, IAN.3151, 73IH.3, IAN.11/1, 76IH.20 and B.72-2888
	30s	KDM.42, NH.124, 68KH.33/1146, B.N., JLH.19, JLH.41, CP.1998F, G.Cot.10, 76IH.20, B.72-2888 and Badnawar 1(Control)

Location	*Count*	*Promising strains*
Jalgaon	30s	KDM.42, ACH.108, NH.102, NH.124, SH.175, 68KH.33/1146, NH.54, JLH.19, JLH.41, CP.1998F, L.147, ACH.0150, ADB.0050-11-4, PCH.426, ACH.0151, PKV.065, H.655 and G. 1167
Khandwa	50s	76IH.20, ISTD.34, NH.116, BSTD.35, IC.1225 and NH.183
	40s	KDM.42, 1412, ACH.108, NH.102, G.949, B.N., ACH.344, NH.54, JLH.19, JLH.41, CP.1998F, G.Cot.10, B.72-2888, JK.Hy.1, ACH.101, BA.26, 76IH.22, CPD.8-1, IAN.3151, 73IH.3, IAN.11/1, B.72-2888 and Khandwa 2 (Control)
Nagpur	30s	1412, ACH.108, NH.102, NH.124, 68KH.33/1146, B.N., NH.54, JLH.19, JLH.41, CP.1998F, G.Cot.10, 71KH.82/1845, 76IH.20, ISTD.34, 0732, B.72-2888, 74IH.9, NH.116, AC.781, DS.59, DS.56, BSTD.35, S.1024, IC.1225, 76IH.23, NH.183, SH.175, 0011-7, 0012-4, RHR.393 and L.147 (Control)
Nanded	40s	JLH.19, 68 KH.33/1146, G.Cot.10, 0011-7, 71KH.82/1793, H.655C, H.777, NH.190 and 0732
Padegaon	40s	RS.481, LH.318, B.N., RS.478, RS.275, 0312 and Laxmi (Control)
Rahuri	40s	Ra.18H, 297-9, LH.114, H.689, H.642(C), SH.175, B.N., LH.299, DP.225, SVM and H.844
Surat	50s	BA.26 and S. 1051
	40s	KOP.210, 66BH.27-81, G.949 and IAN.3151
	30s	CPD.8-1 and KOP.203
Udgir	30s	NH.124, CP.1998F, JLH.19, 68KH.33/1146 and B.N.

G. barbadense Trials

Coordinated Varietal Trial was conducted at Padegaon and Surat under irrigated conditions. Range of 2.5% span length for the strains tried at

TABLE 4 : SUMMARY OF TEST RESULTS OF THE STRAINS TRIED IN COORDINATED VARIETAL TRIAL (CVT) AND PRELIMINARY VARIETAL TRIAL (PVT) OF *G. hirsutum* IN CENTRAL ZONE

Location	No. of samples	Range of 2·5% span length (mm)	Range of Micronaire value (μg/in.)	Range of maturity	Range of bundle strength (g/t)	Count	Spinning performance		Control
							A	B	
				CVT Br04 (a) Irrigated					
Rahuri	5	25·1—28·7 (27·4)	3·8—4·4 (4·1)	Low to average	35·4—45·0 (41·1)	40s	1	—	—
Surat	5	26·7—29·0 (27·7)	4·6—5·1 (4·8)	Good	38·1—45·0 (41·2)	40s	3	—	—
				(*b*) *Rainfed*					
Achalpur	7	24·1—29·5 (26·0)	3·8—4·5 (4·1)	Average to good	41·3—49·3 **(45·8)**	40s	6	2	L·147
Badnapur	5	23·8—29·6 (26·8)	3·2—5·0 (4·0)	Average to good	45·0—49·8 (47·5)	30s	4	—	—
Badnawar	16	23·4—29·2 (26·1)	3·2—4·3 (3·9)	Average to good	42·9—48·8 (45·1)	30s	12	1	Badnawar 1
Jalgaon	14	22·1—28·4 (25·5)	3·5—4·6 (4·1)	Average to good	40·7—49·3 **(45·4)**	30s	11	6	L·147
Khandwa	16	23·4—29·4 (26·1)	3·5—4·2 (3·9)	Average to good	44·0—50·9 (47·8)	40s	14	9	Khandwa 2
Nagpur	14	22·1—28·4 (25·5)	3·4—5·0 (4·2)	Low to good	38·1—52·0 (46·3)	30s	12	7	L·147
Nanded	4	26·0—30·5 (27·9)	2·6—3·3 (3·1)	Low to average	41·3—44·5 **(43·3)**	40s	3	—	
Udgir	5	24·4—31·6 (28·6)	3·6—4·5 (4·1)	Average to good	39·7—46·1 (43·4)	30s	5	—	
				(*c*) *High Ginning Type*					
Achalpur	6	23·9—27·7 (25·8)	3·8—4·3 (4·1)	Average to good	44·3—48·8 (46·8)	40s	6	2	L.147
Badnawar	14	22·1—29·7 (25·5)	3·6—4·4 (4·0)	Average to good	40·2—47·7 (44·4)	40s	9	3	Badnawar 1
Khandwa	14	23·9—31·0 (26·5)	3·7—4·4 (4·2)	Average to good	42·3—49·8 (46·8)	40s	12	11	Khandwa 2
Nanded	3	24·7—30·1 (27·2)	3·4—3·8 (3·5)	Low to average	39·7—44·0 (42·0)	40s	1	—	

TABLE 4 : SUMMARY OF TEST RESULTS OF THE STRAINS TRIED IN COORDINATED VARIETAL TRIAL (CVT) AND PRELIMINARY VARIETAL TRIAL (PVT) OF *G. hirsutum* IN CENTRAL ZONE (*contd.*)

Location	No. of samples	Range of 2·5% span length (mm)	Range of Micronaire value (μg/in.)	Range of maturity	Range of bundle strength (g/t)	Count	Spinning performance		Control
							A	B	
Surat	4	27·2—27·7 (27·4)	4·2—4·7 (4·5)	Average to good	40·7—47·7 (45·2)	40s	3	—	—
(d) North Zone Entries									
Padegaon	5	22·6—25·7 (24·2)	3·8—4·3 (4·1)	Average	37·5—46·6 (42·2)	40s	3	—	—
Rahuri	10	24·4—30·5 (26·8)	3·7—4·4 (4·0)	Average to good	35·9—43·4 (39·7)	40s	8	—	—
PVT Br03 (b) Rainfed									
Achalpur	5	22·4—28·2 (25·5)	3·5—4·2 (3·9)	Average	41·8—47·7 (46·0)	40s	4	—	—
Amravati	8	23·3—31·4 (26·6)	2·8—4·2 (3·6)	Low to good	37·5—47·2 (44·0)	40s	3	—	—
Jalgaon	25	22·8—31·0 (27·3)	3·2—4·8 (4·0)	Average to good	42·3—48·2 (45·6)	40s	24	—	—
Khandwa	26	22·8—31·6 (26·9)	3·3—4·4 (4·0)	Average to good	45·6—51·5 (48·7)	50s	7	—	—
Nagpur	26	21·8—31·0 (25·4)	3·3—4·8 (4·1)	Average to good	41·8—51·5 (46·1)	30s	21	11	L.147
Nanded	5	26·6—32·3 (28·6)	3·4—4·3 (3·8)	Low to average	42·3—47·2 (44·9)	40s	5	3	G.Cot.10
PVT Br03 North Zone Entries									
Padegaon	8	23·6—29·7 (26·5)	3·6—4·5 (4·0)	Average to good	33·8—44·5 (38·5)	40s	5	—	—
Rahuri	5	23·3—26·3 (25·0)	3·9—4·2 (4·1)	Average	35·4—46·1 (42·1)	40s	2	—	—

Values in brackets indicate averages.

A — No. of samples spinnable to the count selected.

B — No. of samples better than or on par with the control.

both the locations was 30.0 mm to 38.9 mm. Maturity was average to good and bundle strength satisfactory for all the strains. Two strains, viz. PDNV.135-78 and Suvin from Padegaon recorded satisfactory yarn strength at 100s count. The strains ERB.13758 and ERB.4600 raised at Surat recorded spinning potential over 90s.

G. arboreum Trials

Coordinated Varietal Trial was conducted at Badnapur, Jalgaon, Parbhani, Somnathpur (Udgir) and Washim. Promising strains identified at 20s count are listed below:

Location	*Promising strains*
Badnapur	AKH.487, AKH.605, JLA.7, NA.8 and AKH.607
Jalgaon	JLA.2, SC.97, NA.10, AKH.496, AKH.597, AKH.605, PBS.608, AKH.607, NA.8, AKH.487, NA.7 and AKH.4
Parbhani	NA.10, PBS.608, NA.9 and AKH.4
Somnathpur ..	AKH.496, AKH.605, AKH.607, NA.7 and NA.8
Washim	AKH.605, NA.10, AKH.4, NA.7 and AKH.597

G. herbaceum Trials

Coordinated Varietal Trial was conducted at Bharuch and Viramgam. The strains 6023, 1522 and 1449 at Viramgam recorded promising spinning performance at 30s count.

Hybrid Trials

Inter-hirsutum Hybrid Trial

The object of this trial was to identify hybrids which would replace Hybrid 4 that was under widespread cultivation in Madhya Pradesh, Gujarat and Maharashtra, both under irrigated and rainfed conditions. The performance of the following hybrids was promising at the counts and locations indicated below:

Location	*Count*	*Promising hybrids*
Achalpur	80s	IHH.468
	50s	GHH.19, JKHy.1, GHH.16, GHH.3, ACHH.4186, IHH.1, Hybrid 4 and ACH.Hy.1

Location	*Count*	*Promising hybrids*
Badnawar	40s	GHH.16, NHH.1, Hybrid 4, GHH.3, GHH.15 and JK.Hy.1 (Control)
Bharuch	60s	GHH.3 and Hybrid 4 (Control)
	50s	GHH.16 and JK.Hy.1

Interspecific Hybrids

Samples grown under irrigated conditions were received from Achalpur, Khandwa, Rahuri and Surat. The object of this trial was to identify a hybrid superior to existing *hirsutum-barbadense* hybrid, viz. Varalaxmi. The promising hybrids at various counts and locations are listed below:

Location	*Count*	*Promising hybrids*
Achalpur	80s	Varalaxmi (Control)
	60s	IBH.4208
Khandwa	80s	GHB.46, IBH.4208, RHR.253, GHB.5 and Varalaxmi (Control)
Rahuri	80s	RHR.277, RHR.279, RHR.282, MCH.1, DCH.32, DCH.37, and RHR.253 and Varalaxmi (Control)
Surat	100s	GHB.10 and Varalaxmi (Control)
	80s	GHB.14, GHB.5 and RHR.253

Demonstration Trials

These trials were conducted at various agricultural research stations to demonstrate the performance of new promising strains or hybrids.

Three Demonstration Trials—one each for *G. hirsutum*, *G. arboreum* and hybrids, were conducted at Akola. From the technological point of view, two *G. hirsutum* strains, viz. ACH.108 and AC.726, recorded more or less identical performance as compared to local controls, DHy.286 and L.147.

In the case of *G. arboreum* trials, the strains AKH.607 and AK.605 were found to be on par with the control variety, AKH.4.

Regarding Demonstration Trial of hybrid cottons, the interspecific hybrid, IBH.4208, recorded much superior technological performance over Hybrid 4 (spinning potential over 80s count). The intra-specific hybrid, IHH.468 showed spinning potential of 50s, that is on par with Hybrid 4.

The technological performance of a new *G. arboreum* strain, SC.97 was compared with that of the control variety Sanjay raised at Amreli. The new strain, however, was found to be inferior to control variety Sanjay in respect of staple length, fineness, bundle strength and spinning potential.

Trials involving varieties belonging to *G. hirsutum*, *G. barbadense* and *G. herbaceum* species and also *G. hirsutum-G. barbadense* hybrids and *desi* hybrids were conducted at Surat.

The following strains recorded best spinning performance in each of the above trials:

Species	*Variety*	*Spinning potential*
G. hirsutum	G.Cot.100	Over 50s
G. barbadense	Suvin	Over 120s
G. herbaceum	Sujay	Over 20s
G. hirsutum-G. barbadense hybrid	Hybrid 5	Over 100s
Desi hybrids ..	DH.70	Around 40s

It may be mentioned that the *desi* hybrid DH.70 recorded mean fibre length as high as 27.9 mm with 4.6 Micronaire value and 52.0 g/t tenacity. Its performance was quite comparable with that in the previous years.

SOUTH ZONE

Cottons form *G. hirsutum* species cover a large area in this zone. However, cottons form other species, viz. *G. arboreum*, *G. herbaceum* and *G. barbadense* are also grown in some tracts of this zone.

G. hirsutum Trials

The Coordinated and Preliminary Varietal Trials were conducted at Aduthurai, Arabhavi, Coimbatore, Dharwad, Nandyal, Siruguppa and Srivilliputtur. Ranges for the main fibre properties, such as 2.5% span length, Micronaire value and bundle strength along with the spinning potential have been compiled in Table 5.

It may be seen from Table 5 that the 2.5% span length ranged between 20.5 mm and 36.9 mm. Ranges for Micronaire and bundle strength values were from 2.6 to 5.2 and 32.7 g/t to 52.5 g/t, respectively. Many strains which have shown spinning potential in the range 40s, 50s and 60s exhibited superior spinning performance over their respective controls.

The following *G. hirsutum* strains recorded satisfactory spinning performance at the locations and counts indicated below:

Locations	*Count*	*Promising strains*
Aduthurai	50s	RF.13, SVPR.122, SVPR.124, SVPR.134, Cal.756, IC.1824, V.14 and MCU.7 (Control)
	40s	127-1-16, 127-8-12, 134-6-5, 244-8-1, 4828, 4992, 509, Krishna and MCU.7 (Control)

Location	*Count*	*Promising strains*
Arabhavi	40s	AV.2709, NLS.13, NLS.10, DS.59, UAS.70-480-2, MCU.5, ELS.271-A-1, ELS.391, IC.1245, MCU.5-WT, CP.2/1, CP.25/1, Bhagya, AHO.66-113, RARD.1163, ADB.10050, EL.575, AV.3374-4, DS.4, ELS.501, M.64, MCU.5, AHO.80, 187, DS.54-32, ELS.500, AHO.66-107-1-1, ELS.294-2-6, DS.48 and Mysore Vijaya (Control)
Coimbatore ..	40s	RARD.1163, LRA.5166, ADB.10050, AV.3364-4, ELS.524, ELS.525 and MCU.5 (Control)
Dharwad	60s	RRD.371
	50s	DS.56, DS.59, DP.1635, DP.197, DP.225, DS.44, DS.68 and Laxmi (Control)
	40s	CPD.17-B-12, CPD.8-1, CPD.7-B.2, CPD.35-41, SRT.1, CPM.25, NA.247, NA.332,C.50, DS.35, JK.78-162, NA.606, CPD.35-19, DS.67, DS.22, CPD.4-68-12, JK.78-299, JK.152-1, DS.14, CPD.103-2, DS.28, DS.40, DS.44 and Bhagya (Control)
Nandyal	50s	IC.1245, AV.2709, ELS.391, MCU.5, NLS.10, MCU.5-WT, DS.59, CP.25/1, JK.97-82 and NLS.13
Shimoga	50s	DS.44, CPD.17-B.12, CPD.7-B.2, CPD.35-41, CPD.34-B7, SRT.1, CPM.25, DS.35 and Bhagya (Control)
Siruguppa ..	60s	NLS.13, NLS.10, MCU.5, MCU.5-WT and CP.25/1
	50s	ADB.10050, ACB.71-230-2, EL.575, LRA.5166, AV.3373-4, RARD.1163, M.64, GL.14515, MCU.5, DS.56-16, AHO.61-38-2, AHO.80-187, ELS.501, DS.54-32, ELS.500, ELS.294-2-6, ELS.0631F, DS.48 and Hampi (Control)
Srivilliputtur ..	50s	RF.13, SVPR.122, SVPR.124, SVPR.134, Cul.756, IC.1824, NMF.62, V.14 and Krishna (Control)

TABLE 5: SUMMARY OF TEST RESULTS OF THE STRAINS TRIED IN COORDINATED VARIETAL TRIAL (CVT) and PRELIMINARY VARIETAL TRIAL (PVT) OF *G. hirsutum* IN SOUTH ZONE

Location	No. of samples	Range of 2·5% span length (mm)	Range of Micronaire value (μg/in.)	Range of maturity	Range of bundle strength (g/t)	Count	Spinning performance		Control
							A	B	
CVT Br04 (a) Irrigated									
Arabhavi	18	25·0—33·3 (29·9)	3·0—4·2 (3·6)	Low to good	37·0—49·8 (43·5)	40s	13	8	Bhagya
Nandyal	17	26·1—31·8 (29·5)	2·6—4·5 (3·4)	Low to average	39·7—47·7 (44·3)	50s	10	6	MCU·5
Siruguppa	20	27·7—35·6 (31·2)	3·0—4·2 (3·6)	Low to good	37·0—48·2 (42·5)	60s	6	18	Hampi
Srivilliputtur ..	20	26·7—34·0 (30·4)	3·0—4·0 (3·5)	Low to good	42·9—52·5 (47·1)	50s	18	5	MCU·8
(b) Rainfed									
Coimbatore	19	20·5—26·7 (23·6)	2·7—3·9 (3·4)	Low to good	41·8—50·4 (46·5)	—	—	—	—
Dharwad	20	23·6—27·2 (25·6)	3·1—4·5 (3·7)	Low to average	38·6—47·7 (44·3)	40s	13	—	Laxmi
Shimoga	20	25·6—31·5 (28·7)	3·4—5·2 (4·3)	Low to average	38·1—45·6 (42·6)	50s	10	8	Bhagya
(c) Rice Fallows									
Aduthurai	12	26·2—30·6 (28·4)	3·2—4·3 (3·8)	Average to good	39·7—50·4 (46·9)	50s	8	9	Krishna
Srivilliputtur ..	12	26·5—34·0 (30·2)	3·4—4·6 (4·1)	Average to good	44·0—47·7 (45·9)	50s	9	2	Krishna

TABLE 5: SUMMARY OF TEST RESULTS OF THE STRAINS TRIED IN COORDINATED VARIETAL TRIAL (CVT) and PRELIMINARY VARIETAL TRIAL (PVT) OF *G. hirsutum* IN SOUTH ZONE (*contd.*)

Location	No. of samples	Range of 2·5% span length (mm)	Range of Micronaire value (μg/in.)	Range of maturity	Range of bundle strength (g/t)	Count	Spinning performance		Control
							A	B	
				PVT Br03 (a)					
Arabhavi	27	26·3—33·8 (29·4)	3·0—4·4 (3·6)	Low to good	35·4—47·7 (40·8)	40s	18	6	Mysore Vijaya
Coimbatore	27	27·2—35·6 (30·6)	2·8—4·1 (3·3)	Low to good	32·7—42·3 (37·4)	40s	5	1	MCU·5
Siruguppa	27	28·1—36·9 (31·9)	3·0—4·5 (3·7)	Low to good	38·6—48·2 (42·3)	50s	22	13	Hampi
Srivilliputtur ..	21	27·2—34·5 (31·1)	3·4—4·5 (4·0)	Good	41·3—52·0 (47·1)	60s	10	6	MCU·8
				PVT Br03 (b)					
Dharwad	13	25·1—29·7 (26·8)	3·1—4·4 (3·5)	Low to average	40·2—46·1 (43·3)	40s	11	—	Laxmi
				PVT Br03 (c)					
Aduthurai	10	26·4—28·7 (27·4)	3·5—4·0 (3·8)	Average to good	45·6—49·8 (48·0)	40s	9	7	Krishna

Values in brackets indicate averages.

A — No. of samples spinnable to the count selected.

B — No. of samples better than or on par with the control.

G. barbadense Trials

Coordinated Varietal Trial and Preliminary Varietal Trial were conducted at Coimbatore and Shimoga. Range of 2.5% span length was between 31.5 mm and 40.3 mm. Micronaire values ranged between 3.2 and 4.7. Bundle strength values for all these strains were satisfactory. The following samples fared well at the location and counts indicated below :

Location	*Count*	*Promising strains*
Coimbatore ..	80s	CBS.34, TCB.15, TCB.7, IBSI.S3-S6.B, TCB.73, TCB.50, TCB.14, EB.7-2-6-4, EB.7-2-22-4, P.I./3-8-3, EB.7-2-12-1, P.III/WII/2, P.III/Y11/2, PSH, Sujata and Suvin (Control)
Shimoga ..	80s	PSH, CBS.202, Suvin, CBS.203, Giza 27-47, SBS (Y.F.) and S.I. Andrews (Control)

In a miscellaneous trial of *G. barbadense* conducted at Dharwad, the strain Suvin recorded 2.5% span length over 36 mm, with 3.8 Micronaire value and 52.5 g/t as bundle strength. This sample fared well at 80s count.

G. arboreum Trials

Coordinated and Preliminary Varietal Trials were conducted at Coimbatore. The following five strains fared well at 30s count :

355E.6, 0794-1, 12009, 824 and 861.

G. herbaceum Trials

In a Coordinated Varietal Trial of *G. herbaceum* conducted at Dharwad under rainfed conditions, the following seven strains fared well at 30s count :

SM.41, MDS.42, MD.56, R.51-238, SM.40, 1449 and Jayadhar (Control).

Hybrid Trials

Inter-Hirsutum Hybrid Trials

Trials involving *G. hirsutum-G.hirsutum* crosses were conducted at Coimbatore, Dharwad and Nandyal. The following hybrids fared well at the locations and counts indicated :

Location	*Count*	*Promising hybrids*
Coimbatore ..	50s	$T_1 \times M_7$, $T_6 \times M_7$, $M_2 \times T_6$, $V_1 \times M_7$, HH.3, and CPH.2, Hybrid 4 (Control)
Dharwad ..	40s	CPH.4, TNCHH.4, JK.Hy.1, DS.DCH.279, 2R, $T_6 \times M_7$ DS.DCH.295, TNCHH.57 and CPH.2
Nandyal ..	40s	NHH.21, NHH.26, NHH.37, NHH.39, NHH.52A, NHH.60, NHH.61, NHH.65, NHH.66, NHH.70, NHH.75 and Hybrid 4 (Control)

Interspecific (hirsutum-barbadense) Hybrid Trials

Trials involving *G. hirsutum G. barbadense* crosses were conducted at Coimbatore, Dharwad, Nandyal, Raichur and Siruguppa. The following hybrids recorded satisfactory yarn strength at the locations and counts indicated below :

Location	*Count*	*Promising hybrids*
Coimbatore ..	80s	H.134, JG.1 × P.4, PD.9364 × P.4, R(R × K) × P.4, DCH.32, DCH.37, HB.14 and KD.15-33 × P.4
Dharwad ..	80s	DCH.32, DCH.37, DCH.14 and Varalaxmi (Control)
Nandyal ..	80s	NHB.80 and Varalaxmi (Control)
Raichur ..	80s	DCH.32 and DCH.37
Siruguppa ..	80s	DCH.14, H.134, TNHB.55, DCH.37, TNHB.505, H.64, DCH.32, DCH.65 and Varalaxmi (Control)

In order to study the performance of the two new hybrids, viz. DCH.32 and DCH.37, adaptive field trials were conducted with Varalaxmi as control at various places in Malaprabha project area. It was observed that the technological performance of these new hybrids was on par with that of Varalaxmi. However, it may be stated that the yarns of these hybrids were neppy.

Pilot Project Demonstration Trials

These trials were conducted at Arabhavi, Coimbatore, Dharwad,

Shimoga, Siruguppa and Srivilliputtur. The following strains fared well at the locations and counts indicated below :

Location	*Count*	*Promising strains*
Arabhavi ..	40s	AV.2775-II, DS.70-480, Mysore Vijaya and 170-Co.2
Coimbatore (I) ..	40s	MCU.9
Coimbatore (R) ..	30s	CRH.71, C.50 and CPD.8-1
Dharwad ..	50s	CPD.8-1, Laxmi, DP.225, DP.197 and CP.1998F
	40s	JK.97
Shimoga ..	30s	DS.56, DS.59, DS.4, CPD.8-1, Laxmi and Mysore 14
Siruguppa ..	40s	CP.1998F, AV.277-II/1, DS.750-480, DS.59 and Hampi
Srivilliputtur ..	60s	ELS.481, MCU.5 and MCU.8

New Cotton Varieties Released

The panel meetings of the Breeding and Technology Group of Central Zone and South Zone under the AICCIP recommended the following improved strains/hybrids for pre-release seed multiplication :

Strain/hybrid	*Special features*
	CENTRAL ZONE
1449	An early maturing (5-6 weeks earlier than Digvijay) *herbaceum* strain having more yield than the existing varieties Digvijay (62% more under irrigated conditions and 41.4% more under rainfed conditions) and Sujay (40% more under irrigated conditions and 44.5% more under rainfed conditions). The ginning outturn is 39.2% and 37.4% under irrigated and rainfed conditions, respectively. Average reaction to pests and diseases. Spinning potential around 30s.
GHH.3 ..	A *hirsutum* × *hirsutum* hybrid recording 29% higher yield than Hybrid 4; matures 3 weeks earlier; ginning outturn 33.6% and mean length 1 mm less than Hybrid 4. More tolerant to sucking pest, blackarm and alternaria. Spinning potential 70s.

Strain/hybrid	*Special features*
SOUTH ZONE	
DCH.32 (Interspecific hybrid)	Earlier in maturity by 10 days than the existing hybrid, Varalaxmi; more synchronous in flowering and fruiting; high ginning outturn; high *kapas* yield potential. Spinning potential 70s to 80s count. This hybrid is meant for replacing Varalaxmi.
DS.56	Matures in about 150 days; compact plant type with less foliage; more synchronous in flowering and fruiting; larger boll size; higher ginning outturn. Spinning capacity 40s.
DS.59	Matures in about 165 days; good plant type with predominant vegetative branches; larger boll size, superior fibre characteristics and spinning potential. High *kapas* yield. It is meant to replace Hampi.
SRG.26	Tall with medium internodes, large bolls and less leaf canopy; higher in yield than 170-Co.2.
DB.3-12	Dwarf compact plant type; maturing in about 165 to 170 days; roundish and slightly larger bolls; higher lint index and ginning percentage. It is meant to replace Jayadhar.

EXTRA-LONG STAPLE (25 MM AND ABOVE) COTTONS

The results of the detailed tests carried out during 1979 on extra-long staple cotton samples received and tested at CTRL are shown in Table 6.

MILL TESTS

Taking into consideration the results of field trials and the tests for quality and spinning performance carried out at CTRL, selected improved varieties of cotton are being subjected to actual mill tests to assess their spinning performance under mill conditions. The recommendation for large scale propagation of these improved varieties will be generally made, only after its performance under mill conditions is confirmed. CTRL arranges mill tests on promising strains with the cooperation of a few textile mills in the country.

TABLE 6: RESULTS OF EXTRA-LONG STAPLE (27 mm AND ABOVE) COTTONS TESTED DURING 1979

Variety	Place	Mean fibre length		Fineness		Maturity coefficient	Bundle strength		
		mm	in.	Millitex	Micronaire value		Tenacity (zero gauge) g/t	P.S.I. (zero gauge) lb/mg	Tenacity (1/8" gauge) g/t
Andhra Pradesh									
MCU·5	Amravathi	27·6	1·09	130	3·2	0·69	45·6	8·5	27·1
Hybrid 4	Guntur	28·0	1·10	157	4·0	0·74	42·9	8·0	25·1
MCU·5	,,	29·2	1·15	146	3·7	0·69	46·1	8·6	26·6
Suvin	,,	37·2	1·46	146	3·7	0·69	57·9	10·8	39·0
Varalaxmi	,,	33·8	1·33	142	3·6	0·68	46·6	8·7	30·5
NHB·80	Nandyal	32·0	1·26	126	3·2	0·63	49·8	9·3	—
Gujarat									
Hybrid 4 ..	Bharuch	27·9	1·10	157	4·0	0·71	42·9	8·0	—
Hybrid 4 ..	Manavadar	29·5	1·16	177	4·5	0·73	40·2	7·5	23·6
Hybrid 4 ..	Palej	30·5	1·20	173	4·4	0·74	44·5	8·3	26·1
Hybrid 4 ..	Surat	27·6	1·09	154	4·5	0·81	45·0	8·4	25·8
ERB·13758	,,	28·2	1·11	165	4·2	0·87	49·3	9·2	31·3
ERB·13577	,,	30·0	1·18	157	4·0	0·89	49·3	9·2	31·1
Giza 7 ..	,,	30·0	1·18	157	4·0	0·81	47·2	8·8	30·2
ERB·4600	,,	29·2	1·15	185	4·7	0·85	52·0	9·7	35·6
GHB·14 ..	,,	32·5	1·28	142	3·6	0·68	47·7	8·9	—
RHR·253 ..	,,	31·8	1·25	130	3·3	0·64	46·6	8·7	—
GHB·5 ..	,,	32·0	1·26	142	3·6	0·67	47·7	8·9	—
GHB·10 ..	,,	32·5	1·28	134	3·4	0·66	49·8	9·3	—
HB·14 ..	,,	32·8	1·29	146	3·7	0·67	47·7	8·9	—
HB·5 ..	,,	32·8	1·29	142	3·6	0·64	47·2	8·8	—
H·5 ..	,,	35·3	1·39	118	3·0	0·60	48·8	9·1	—
Varalaxmi ..	,,	33·5	1·32	142	3·6	0·62	47·7	8·9	—
H·70 ..	,,	27·9	1·10	181	4·6	0·74	52·0	9·7	—
Suvin ..	,,	33·5	1·32	142	3·6	0·65	54·7	10·2	—
IBSI-LS·9 ..	,,	35·8	1·41	150	3·8	0·67	49·8	9·3	—
G.Cot.100		28·4	1·12	157	4·0	0·71	45·0	8·4	—
Gujarat 67	Talod	30·3	1·19	142	3·5	0·72	42·3	7·9	27·4
Haryana									
H·689 ..	Hissar	27·7	1·09	154	3·9	0·81	44·5	8·3	—
Karnataka									
S.I. Andrews	Anavati	30·7	1·21	154	3·9	0·71	43·4	8·1	26·7
DCH·32	Dharwad	33·3	1·31	126	3·2	0·63	46·1	8·6	—
DCH·37	,,	34·3	1·35	134	3·4	0·67	46·1	8·6	—
DCH·14	,,	31·5	1·24	126	3·2	0·63	46·1	8·6	—
Varalaxmi	,,	31·0	1·22	118	3·0	0·61	40·7	7·6	—
DS·59	,,	28·7	1·13	173	4·4	0·74	43·4	8·1	—
S.I. Andrews	Shimoga	28·2	1·11	138	3·9	0·77	43·4	8·1	27·0
Varalaxmi	Siruguppa	27·2	1·07	98	2·7	0·70	48·2	9·0	26·9

TABLE 6 : RESULTS OF EXTRA-LONG STAPLE (27 mm AND ABOVE) COTTONS TESTED DURING 1979 (*contd.*)

Variety	Place	Mean fibre length		Fineness		Maturity coefficient	Bundle strength		
		mm	in.	Millitex	Micronaire value		Tenacity (zero gauge) g/t	P.S.I. (zero gauge) lb/mg	Tenacity (1/8″ gauge) g/t
Maharashtra									
IBH·4208	Achalpur	30·7	1·21	126	3·2	0·64	46·1	8·6	—
IHH·468	,,	30·5	1·20	126	3·2	0·64	48·2	9·0	—
Varalaxmi	,,	31·8	1·25	142	3·6	0·69	45·6	8·5	—
IBH·4208	Akola	31·0	1·22	134	3·4	0·67	45·6	8·5	—
Hybrid 4	,,	27·9	1·10	161	4·1	0·72	39·7	7·4	—
Nimbkar	Baramati	27·9	1·10	189	4·8	0·73	36·4	6·8	19·5
Varalaxmi	,,	33·5	1·32	126	3·2	0·62	48·2	9·0	28·2
Hybrid 4	Kopargaon	28·4	1·12	165	4·2	0·71	35·9	6·7	20·2
Varalaxmi	Phalton	30·8	1·21	126	3·2	0·65	41·8	7·8	29·0
RHR·253	Rahuri	29·6	1·17	126	3·2	0·63	42·3	7·9	25·6
Varalaxmi	,,	30·0	1·18	122	3·1	0·62	40·2	7·5	25·8
Tamil Nadu									
ELS·481	Coimbatore	28·8	1·13	138	3·5	0·66	42·3	7·9	23·9
MCU·5	,,	27·9	1·10	126	3·2	0·62	44·5	8·3	22·6
MCU·5-WT	,,	31·2	1·23	118	3·0	0·62	46·6	8·7	—
PSH	,,	33·0	1·30	154	3·9	0·86	53·6	10·0	34·6
Giza 27-47	,,	30·5	1·20	154	3·9	0·83	46·1	8·6	27·8
SBS (Y.F.)	,,	31·5	1·24	165	4·2	0·85	46·6	8·7	28·5
Suvin	,,	35·1	1·38	134	3·4	0·74	53·6	10·0	35·8
Varalaxmi	,,	31·8	1·25	122	3·1	0·62	46·6	8·7	—
MCU·5 (Foundation)	Periakulam	29·0	1·14	114	3·0	0·75	46·6	8·7	26·0
MCU·5 (Nucleus)	,,	30·1	1·18	118	3·0	0·80	47·2	8·8	27·1
MCU·8 (Foundation)	,,	29·7	1·17	138	3·8	0·82	48·8	9·1	27·0
MCU·8 (Nucleus)	,,	30·2	1·19	134	3·5	0·83	46·1	8·6	25·3
MCU·9	,,	29·0	1·14	122	3·1	0·81	46·6	8·7	24·3
MCU·5	Theni	29·7	1·17	118	3·0	0·62	46·1	8·6	25·6

During the year, such mill tests were carried out on two improved strains pertaining to 1977-78 season along with their respective controls. Their comparative performances at CTRL and the mill are given in Table 7.

TABLE 7 : COMPARATIVE SPINNING TEST RESULTS AT MILL AND CTRL

Place	Variety	Laboratory Results				Mill Test Results			
		Waste (%)	Count	Strength (lb)	t.m.	Waste (%)	Count	Strength (lb)	t.m.
Maharashtra									
Rahuri	RHR·253	4·5	80s*	25·1	3·75	2·4	82s (combed)	23·3	4·1
	Varalaxmi	3·6	80s	25·1	3·75	2·8	82s (combed)	21·9	4·1
Tamil Nadu									
Coimbatore	ELS·481	1·0	60s	34·9	3·75	1·0	60s	34·3	4·0
	MCU·5	1·4	60s	36·7	3·75	1·6	60s	32·7	4·0

* Lakshmi-Rieter Drafting System.

Note : The spinning system and machinery used by the mills are in many respects different from those adopted at CTRL and hence the strength values are not strictly comparable.

It will be seen that RHR.253 from Rahuri gave almost the same yarn strength as Varalaxmi at the mill and the Laboratory.

ELS.481 from Coimbatore gave slightly better yarn strength than MCU.5 at the mill for 60s count. However, MCU.5 recorded better or equal yarn strength as compared to ELS.481 at both 40s and 50s counts at the mill as well as the Laboratory.

Evaluation of Quality of the Major Trade Varieties of Cottons Grown in Different Parts of the Country

Lint samples of fair average quality of the major Trade Varieties of Indian Cottons are being obtained for each season through the East India Cotton Association Ltd. (EICA), Bombay, and some regional Cotton Associations. Representative *kapas* samples of these varieties are also procured from the State Departments of Agriculture for determination of ginning percentage. The fibre and 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 of the cotton trade and

industry. Such circulars were issued during 1979, on 39 varieties covering most of the 1978-79 season samples. The test results on all the Trade Varieties of 1977-78 season were compiled together and published as "Technological Report on Trade Varieties of Indian Cottons, 1977-78 Season".

Evaluation of the Quality of Standard Indian Cotton Varieties

To assess the seasonal fluctuations in the characteristics of Indian cottons and to gauge the comparative superiority or otherwise of the newly evolved strains, a number of selected varieties of Indian cottons, called Standard Indian Cottons, are tested at CTRL every year. These varieties are grown in Government farms every year under identical conditions and departmental supervision. Extensive fibre and spinning tests are regularly being done on such samples and the test results are published as Technological Circulars for information of the Cotton Breeders and other research workers as early in the season as possible. During 1979, such circulars were issued on 17 varieties and thus most of the samples of Standard Indian Cottons of the 1978-79 season received and tested have been covered.

The results on all the samples pertaining to 1977-78 season were consolidated and published as "Technological Report on Standard Indian Cottons, 1977-78 Season".

Survey of the Conditions of the Ginning Factories in India

The ginning survey, which was started in 1976, to get detailed information on the working conditions of the existing gins and ginning factories in order to ensure the maintenance of quality ginning in the States of Punjab, Haryana and Rajasthan, has been successfully completed.

This survey has provided information on the actual working conditions of the ginning and processing factories. The extent to which the optimum settings necessary for good ginning actually in use as reported by the factories indicated that although the position was not unsatisfactory, there was scope for improvement. The awareness for production of good quality ginned lint is widely present, but its current short-comings are mostly due to factors such as: (*i*) lack of adequate trained gin fitters particularly in small factories, (*ii*) uneconomic turnover in many factories, (*iii*) lack of adequate incentives for good ginning, and (*iv*) too many legislative strictures and formalities enforced by various officials from different State Departments. Most of these can be remedied by the regional factory associations and the authorities in the States by adopting suitable measures within the existing State Acts.

Taking into consideration the factors mentioned above, the following suggestions are made :

1. While licensing factories for operation during each season, factories having good machinery and facilities may be encouraged in preference to those which are not well-equipped.
2. Wherever too many factories are located and are having poor turnover, some of them may be encouraged to shift to other regions.
3. The ginning and pressing charges may be revised periodically taking into consideration the quality of ginning and the materials used for baling.
4. In order that the quality of cotton exported is of the highest standard, ginning factories with roller gins and engaged in ginning Bengal Desi cotton may be encouraged to use 'Master Cleaner' or 'Super Unit' for cleaning the *kapas* before ginning. Good quality oil for gin lubrication should be used.
5. Adequate steps may be taken to make available to saw ginning factories saw discs of the requisite quality.
6. The regional factory associations may sponsor annually some gin fitters for training at the Cotton Technological Research Laboratory and at some progressive factories.
7. A forum of appropriate Government and non-Government officials may be created where representatives of factories or their associations can bring their problems to the attention of the concerned authorities.
8. Since the State Department of Agriculture is responsible for the production of good cotton, it is desirable that this department coordinates the administration of various Acts, such as the Cotton Ginning and Pressing Factories Act, Cotton Seed Control Order, etc. This would enable not only the proper implementation of the various Acts, but also ensure methodical collection of reliable statistics of cotton ginned and pressed in each State.

A Study of the Variability in Ginning Outturn and Fibre Characteristics of Extra-Long Staple Cottons Grown in Andhra Pradesh and Tamil Nadu

There is a general feeling amongst the users of extra-long staple cottons that the technological characteristics of extra-long staple cottons tend to decline in the later pickings of the same season. In order to ascertain whether there existed any variation in the fibre properties of samples picked at different intervals, samples of three varieties, viz. MCU.5, Varalaxmi and Suvin, from different pickings during the 1978 season were procured from Pollachi and Palani in Tamil Nadu and they were subjected to tests for fibre length, maturity, fineness and strength (zero gauge). The test results are given in Table 8.

TABLE 8 : RANGE OF FIBRE PROPERTIES OF THE SAMPLES PICKED AT DIFFERENT INTERVALS

Cotton	Location	No. of pick-ings	2·5% span length (mm)	Maturity (percentage of mature fibres)	Micro-naire value (μg/in.)	Strength at zero gauge length (g/t)
MCU·5 ..	Pollachi	5	1·26 to 1·29	65 to 72	3·5 to 3·6	46·1 to 48·8
Varalaxmi ..	,,	6	1·40 to 1·43	63 to 71	3·0 to 3·4	42·9 to 46·1
Suvin ..	,,	4	1·56 to 1·63	62 to 66	3·2 to 3·8	52·0 to 52·5
MCU·5 ..	Palani	5	1·32 to 1·34	57 to 65	2·8 to 3·4	43·4 to 45·0
Varalaxmi	,,	4	1·32 to 1·35	60 to 66	3·2 to 3·3	40·7 to 42·3
Suvin ..	,,	3	1·58 to 1·60	63 to 66	3·2 to 3·4	52·5 to 54·7

There were no noticeable differences in fibre properties amongst pickings. However, differences in fibre characters of samples grown at different locations were noticeable. Samples from Pollachi were comparatively better in fibre characters.

In addition, 54 samples of long staple varieties belonging to 1977 season were assessed for strength at zero gauge length. The results are given in Table 9.

TABLE 9: RANGE OF BUNDLE STRENGTH FOR SAMPLES PICKED AT DIFFERENT INTERVALS

Location	Cotton	No. of pickings	Strength at zero gauge length (g/t)
Chilakaluripeth	Suvin	2	50·4 to 54·7
	MCU·5	4	40·2 to 44·5
	Hybrid 4	4	42·3 to 45·6
	Varalaxmi	4	45·0 to 47·7
Parchuru	Suvin	2	52·0 to 53·1
	MCU·5	3	42·3 to 43·4
	Hybrid 4	1	38·6
Padanandipadu	MCU·5	4	39·7 to 45·0
Addanki	Hybrid 4	1	37·0
	Varalaxmi	4	44·5 to 46·6
	CBS·156	4	40·2 to 52·5

Significant difference in the bundle strength values between pickings was observed in the case of a few samples. However, there was no systematic trend in these values from the earlier pickings to the later ones.

Study of the Effects of Nitrogenous and Phospatic Fertilisers on theYield and Quality of the Cotton, Hybrid 4

The work was carried out on the same lines as during last year.

Lay-out	Split-plot design
Replications	3
Plot size	3.6 m ×3.0 m

Treatments : 12

(*i*) Main plots	4 Nitrogen levels
N_1	180 kg/ha
N_2	240 kg/ha
N_3	300 kg/ha
N_4	360 kg/ha
(*ii*) Sub-plots	3 Phosphorous levels
P_0	0 kg/ha
P_1	90 kg/ha
P_2	180 kg/ha

The produce was tested for yield and for fibre quality, viz. fibre length, fineness, maturity and strength. The following observations were made by the statistical analysis of the test results :

Yield : The yield differences were, as before, found to be significant for nitrogen levels and non-significant for phosphorous levels. The yield increases in the case of nitrogen levels were proportional to the doses of fertiliser applied, and the highest yield of 2380 kg/ha was from the application of 360 kg/ha of nitrogen. The yield of 2138 kg/ha at 300 kg/ha nitrogen level was found to be statistically on par with that at the 360 kg/ha nitrogen level The interaction NP was also significant. N_4P_0 gave the highest yield (2528 kg/ha) which is statistically on par with N_4P_2 (2369 kg/ha). These results, by and large confirm the trends noticed in last season.

Quality : The nitrogen and phosphorous levels and their interaction did not produce any significant effect on any of the chief fibre properties studied. Last season, some marginal effects were perceptible on some of the properties of the fibre.

A Study on Varietal Variability and Mode of Inheritance of Fibre Length

Data could be collected only in respect of three crosses belonging to *G. barbadense* species. The following indications are available from the data collected :

There has not been a happy choice of parents; the two parents do not show much variability among themselves. The F_1, F_2 and the backcrosses do not display heterotic effects. Additive gene effect is negligible. Dominant gene effect is present. The additive $\times$ additive effect is quite significant and is of much higher magnitude than additive $\times$ dominance effect. The magnitude of the epistatic parameters relative to the mean effects is very high. However, no valid conclusion is possible from this meagre data.

This work was being carried out in collaboration with the scientists at the Gujarat Agricultural University and Cotton Research Station at Surat. Due to transfer of two of the three investigators associated with the project at the Cotton Research Station, Surat, the work suffered heavily and no substitutes have so far been appointed; therefore, the project is being discontinued.

Studies on Trash Content in Cottons Grown in India

The study was undertaken to explore the causes for high trash content in Indian cottons. While careless picking is likely to be the prime cause for excessive trash content, the fact that cottons from the same location differ considerably in their trash content necessitates a probe into other factors such as leaf-hairiness, mode of boll opening, etc.

Accordingly, preliminary work on leaf hairiness was carried out on several varieties under trial at the JNKVV Campus at Indore with the help of the Senior Scientist (Cotton) there. Fresh green leaves of 20 varieties, including a few hybrids, were collected and examined under a low power microscope; depending on the extent of hairiness, the cotton varieties were grouped into five grades as detailed below :

Grade 1 (Almost non-hairy)	Grade 2	Grade 3	Grade 4	Grade 5 (Maximum hairiness)
Texas marker 1	Varalaxmi	Laxmi	Reba B.50	PLD.40
Am. Nectariless	Maljari	Bikaneri Narma	Khandwa 2	B.1007
SB.289E	Million Dollar	76IH.20	JK.Hy.1	Karunganni
Moco		Gujarat 67		
		Hybrid 4		
		JK.Hy.11		
		ERB.4492		

It is proposed to examine the nature of the trash in each variety especially in relation to the amount of leaf-bits present.

Optical Scanning Technique for Determination of Fibre Fineness and Maturity

During the period under report, experimental work was continued for determining the various fibre properties by testing 30 varieties of cotton samples, five each from the four botanical species and hybrids grown in India as well as five varieties of foreign cottons. From the Fibrograph test data, values of Optical Fineness Coefficient (OFC) and Optical Index of Maturity (IOM) were computed for each sample, employing the formula derived for these parameters. Statistical analysis was carried out to assess the extent of association of the actual gravimetric fineness (GF) values with the respective OFC measures and Micronaire values in respect of all the 60 cottons, including 30 cottons studied during last year.

The simple correlations between GF and OFC values for the species groups and for all cottons grouped together were highly significant. These correlations were consistently superior than the correlations obtained between GF and Micronaire values. It was also seen that while 90 per cent of the variations in GF values are explained by variations in OFC results, 84 per cent variations in GF results are accounted by variations in Micronaire values.

Statistical analysis was carried out to assess the extent of association between the Maturity Coefficient (Mc) determined by caustic soda method with respective IOM values obtained from Fibrograph test data, for the 60 varieties of cotton studied. Correlations were also worked out between Mc values from caustic soda tests and the difference in the Micronaire scale readings using the spacer techniques, which is one of the standard methods adopted for routine maturity tests. There was a highly significant correlation ($r = -0.7821$) in the former case, whereas the correlation in the latter case was poor ($r = +0.3512$). A regression equation to predict Mc from IOM has been worked out as, $Mc = -0.6355\ (IOM) + 1.2408$. By using this equation Mc values were "predicted" from the respective IOM values for all the 60 cottons. These were compared against corresponding Mc results obtained from Micronaire Spacer technique. It was observed that generally for all the cottons, the Mc values predicted from IOM were consistently better approximations of the actual Mc results obtained from caustic soda tests. On the other hand, there was a significant underestimation of values of Mc obtained using Micronaire spacer technique as compared to standard Mc values determined by caustic soda method. The variation is very much pronounced in the case of cottons with low Micronaire values. The work is intended to be extended by inclusion of more cottons for confirmation of the findings.

Fabrication of an Instrument for Evaluating Cotton Fibre Maturity

The influence of certain instrumental parameters on the test results obtained by the new optical method for fibre maturity was studied in detail.

The purpose of this study was to ensure that different combinations of these parameters give results with the same degree of accuracy and consistency.

The parameters studied were: (*i*) the quality of the light source, (*ii*) anode voltage of the photomultiplier, and (*iii*) the size of the microscope objective. The temperature of the light source was varied by changing the current through the lamp filament, thereby establishing marked changes in the intensity and spectral characteristics of the light. The anode voltage for the photomultipliers was also varied over a considerable range. Changes in these two parameters, however, were found to have no effect on the measurement of maturity by the new method. As for the 'size' of the objective, it was found that there is no detrimental effect on the results due to variation in this parameter also.

It was further confirmed that by abandoning the objective lens of the microscope altogether, the light from a larger area of the fibre array mounted on the test slide could be drawn into the photomultiplier. Subsequent tests were, therefore, carried out without the microscope objective.

Tests on 40 cotton samples, already reported last year, were once again repeated during the current year. The results were in agreement with those obtained earlier.

Determination of the Spiral Angle of Cotton

The solvent exchange procedure standardised in the Laboratory for obtaining uncollapsed/unconvoluted cotton fibres from unopened bolls has been used on seven more cottons belonging to the *barbadense* and *hirsutum* species. For each cotton, the solvent exchange was carried out on at least two different bolls. The number of convolutions per mm, convolution angle and X-ray angle were measured for the air-dried controls as well as for the solvent-dried samples. The efficacy of the solvent-drying was decided by the number of residual convolutions in the solvent exchanged fibres. The solvent-drying was taken to be effective when the convolutions were fewer than 1.5/mm, on an average. In the case of samples tested in the current year, the spread in the 50% X-ray angle for the air-dried fibres was found to be about 8°. This spread was reduced to about 3° when the fibres were solvent-dried. The reduced spread in the X-ray angle of solvent-dried fibres shows that a considerable amount of differences in spiral angle found among cotton varieties could be attributed to convolutions formed during air-drying. *G. herbaceum* and *G. arboreum* cottons could not be included in the study during the current year as fully mature bolls in the never-dried state were not available from these species. These cottons are known to have low X-ray angle even in the air-dried state and hence their study is essential to establish the consistency or otherwise of the spiral angle. The study on cottons belonging to these species will be undertaken as soon as mature, never-dried bolls of these species are obtained.

A Study of the Dimensional Changes of Cotton on Crosslinking and Subsequent Wetting

Kier-boiled and dewaxed lint from the variety Sujata was mercerised in the slack state, three times in succession. The thrice-mercerised fibres formed the control sample in the study. This sample was crosslinked using dimethylol dihydroxy ethylene urea (DMDHEU) by the conventional pad-dry-cure-method and formaldehyde (HCHO) by the Form W process. While N% was estimated by IR spectroscopy in the former case, the bound formaldehyde was determined by chemical method.

The cross-sections were prepared using a Hardy microtome after embedding the fibres in collodion. The sections were placed on microscope slide using liquid paraffin as immersion medium. For wet fibre cross-sections, the fibre bundle was kept soaked in water for a period of 1 hr after which the adhering water was carefully removed and the bundle embedded in collodion. The wet cross-sections placed on slide were irrigated with more water which also served as the immersion medium. Two hundred cross-sections were traced out from the projections for each sample. The cross-sectional data on the control and DMDHEU-treated samples are given in Table 10.

TABLE 10 : AREA AND PERIMETER VALUES OF CROSS-SECTION OF FIBRES COSSLINKED WITH DMDHEU

Property / Treatment	N%	Dry		Wet		Ratio (wet/dry)	
		Area (micron)^2	Perimeter (micron)	Area (micron)^2	Perimeter (micron)	Area	Perimeter
Control ..	—	160·29	48·42	274·91	63·06	1·72	1·30
Crosslinked with DMDHEU							
Treatment I ..	0·68	178·36	49·50	257·47	59·55	1·44	1·20
Treatment II ..	1·48	175·35	50·71	246·93	58·02	1·41	1·14
Treatment III ..	2·30	183·26	50·34	234·58	57·73	1·28	1·15
Treatment IV ..	2·84	198·68	52·43	234·36	56·04	1·18	1·07
Treatment V ..	3·12	207·57	54·70	237·09	58·18	1·14	1·06

It is clear from the above data that the cross-sectional area and perimeter increase with the degree of crosslinking. At the highest level of nitrogen content, the area showed an increase of 29% over that of the control, while the corresponding increase for the perimeter was 13%. The crosslinking treatment inhibits swelling of cotton fibre in water. With increase in the degree of crosslinking, there is a progressive fall in the ratio of wet and dry dimensions. Similar studies are in progress in the case of HCHO-treated samples also.

Relationship between X-ray Orientation and Tensile Properties of Cotton Fibres

The X-ray angles of the 40 samples taken up for the study were determined. In addition, values of Hermans, Orientation Factor, fx, were calculated for the 10 *G. barbadense* samples. The X-ray and tensile properties of 10 more *G. barbadense* samples were also determined and relationships between the various orientation parameters and tensile properties worked out for this species. The results are given in Table 11.

TABLE 11 : SIMPLE CORRELATION COEFFICIENTS OF TENACITY AND ELONGATION VALUES WITH CRYSTALLITE ORIENTATION PARAMETERS FOR *G. barbadense Species (20 samples)*

Strength parameters	Orientation parameters				
	X-ray angles				fx
	20%	40%	50%	75%	
Tenacity at zero gauge length	—0·8431***	—0·8335***	—0·8232***	—0·7788***	+0·8297***
,, ,, 3 mm ,, ,,	—0·4061***	—0·6882***	—0·6891***	—0·5839**	+0·6831***
Elongation ,, ,, ,,	+0·6499**	+0·7092***	+0·7049***	+0·7419***	—0·6423**

*** Significant at 0·1% level.
** Significant at 1% level.

It may be seen that 20%, 40%, 50%and 75%X-ray angles are correlated in the decreasing order of magnitude with tenacities at zero and 3 mm gauge lengths, though the correlations for the first three X-ray angles are quite close. Further, fx also is correlated as strongly as the 20%, 40% and 50% X-ray angles with these properties. Thus, even though the present results confirm the earlier findings, it would appear that the differential association of different X-ray angles with tenacity may not be so marked when *G. barbadense* species is considered alone. Nevertheless, the comparatively poorer correlation of the 75% X-ray angle with tenacity may be noted.

In the case of elongation also, the results confirmed the earlier findings that this property was best correlated with the 75% X-ray angle. While the correlation coefficients with the 50% and 40% X-ray angles were almost equal, they were slightly lower than the correlation coefficient with the 75% X-ray angle. The correlations with the 20% X-ray angle as well as fx are again of the same order, but lower than with other X-ray angles.

In general, therefore, the present results confirm that the 20% X-ray angle might be the best parameter for estimating fibre tenacity, while the 75% X-ray angle will be best suited for assessing elongation properties of *G. barbadense* cottons.

Work on determination of fx on other samples is in progress.

Studies on Inheritance of Strength and Structural Parameters in Cotton Fibres

Due to unfavourable climatic conditions, work could not be carried out as per the technical programme, and only one more step of purification of the parents was, therefore, attempted.

X-ray Diffraction Studies on Structural Parameters of Fibres and Yarns with a View to Utilising them for Textile Material Characterization

By considering the individual orientation profiles of cotton and viscose, and representing the profile of blends as linear combinations of the component profiles, the expected blend index values for different blend compositions were worked out. These values agreed well with the experimental values previously obtained, and showed that a linear calibration line drawn using the index values of the controls is quite appropriate for this blend system.

An index, defined as $\left\{ \frac{I_2O—2}{I_2O} \right\}$ where I_2O and $I_2O—2$ represent intensities at angles corresponding to the (002) peak and two degrees lower than this peak, was also found suitable for analysis of cotton-viscose blends. However, as this index was found to be different for different viscose samples, it would be advisable to initially establish the calibration line using the viscose used in a blend.

Preliminary studies showed that the orientation method is not well suited for cotton-polynosic blends. This aspect is being examined further.

Work on the suitability of the orientation method for cotton-polyester blends was initiated and is in progress. A new method using the breadths of (002) profiles was developed for cotton-jute blends. Analysis can be carried out with greater ease using this method than the techniques developed earlier.

Characterisation of Decrystallised Cottons Produced by New Methods and Assessment of Their Influence in Subsequent Crosslinking Treatments

Using the purified direct dye chlorazol sky blue FF, the dyeing behaviour of highly decrystallised cotton fibres obtained by partial acetylation (PA) and partial cyanoethylation (PC) of fibres swollen with caustic soda was studied.

It was found that the dye uptake increased with the concentration of NaOH used for preswelling in the case of controls as well as the decrystallised fibres. However, at any swelling concentration, the dye uptake for the decrystallised fibres was more than twice that for the corresponding swollen control for an acetyl content of not less about 5% for the PA samples and a N-content of not less than 1% for the PC samples. Between the PA and the PC samples, the latter always showed a higher dye uptake than the former

indicating higher decrystallisation. This is in line with the observations made on other physical and structural properties of these decrystallised fibres. This can also be expected as the cyanoethyl group is bulkier than the acetyl group and is thus capable of producing more severe distension of molecular bundles.

In order to see the effect of the degree of substitution (DS) on the dye uptake of the samples, decrystallised samples with different acetyl and N-contents were prepared and the dye uptake for these samples was measured. It was observed that with increase in DS, there was a steep increase in dye uptake initially though with further increase in DS, the dye uptake gradually tended to level off. The levelling-off stage was reached when the PA samples had an acetyl content of about 5% and PC samples had a N-content of about 1.5%. At all times, the dye uptake of the decrystallised material was more than twice that of the swollen controls.

On crosslinking the highly decrystallised fibres with DMDHEU, the dye uptake was reduced considerably, but still the trend in the results remained the same—the swollen decrystallised and crosslinked fibres showing a much higher dye uptake than the swollen and crosslinked controls. It appears that at least part of the difficulty in dyeing crosslinked fibres can be overcome if they are decrystallised prior to crosslinking.

The PA and the PC yarns (from Digvijay cotton spun to 30s count) were also pre-swollen with 21% NaOH both in slack state and with a small known extent of stretch. These were later crosslinked with DMDHEU along with the swollen controls. It was observed that while the stretched yarn showed better strength for the same crease recovery level, its work of rupture was considerably lower than that for the unstretched samples. The PA sample on crosslinking showed about 20% higher breaking strength and about 40% higher work of rupture than the similarly swollen and crosslinked controls. For the crosslinked PC samples too, the breaking strength and work of rupture were higher than those for the crosslinked controls, but lower than for the crosslinked PA samples. For the same level of N% (due to crosslinking only), the Crease Recovery Angle (CRA) was slightly lower for the decrystallised and crosslinked samples than that for the swollen and crosslinked controls.

Application of Electron Diffraction Technique in the Study of Normal and Chemically Modified Cotton Cellulose

Cotton Cellulose: The two modifications of cotton cellulose, viz. celluloses II and III, are comparatively less stable than cellulose I in the electron beam. A modified CTRL electron diffraction (ED) technique using a fast film, in place of an orthochromatic electron microscopic film used in the earlier studies has now been standardised to record a large number of reflections of celluloses II and III.

The samples of modified cotton were thoroughly fragmented in distilled water using a high speed homogeniser to obtain discrete microfibrillar bundles in slurry. A drop of diluted slurry was placed on uncoated 400 mesh copper grid and dried at room temperature. TEM was used at an accelerating potential of 75 kV and extremely low beam current. Liquid nitrogen was used throughout the experiment to cool the specimen. A grid supporting thin film of aluminium (Al) was inserted in the TEM and the microscope was set in diffraction mode and focussed to give a typical diffraction pattern of Al. The Al grid was then replaced with a grid supporting specimens of cellulose II or cellulose III, and a selected area diffraction pattern formed in the back focal plane of the objective lens magnified by appropriate lenses was recorded at an exposure time of 1 sec on a highly sensitive panchromatic film of 200 ASA speed. The film was developed, fixed, finally washed thoroughly, and air-dried.

The patterns of celluloses II and III thus recorded, revealed about 40 reflections per quadrant. The observed '*d*' spacings in both the cases were well in agreement with the calculated '*d*' spacings.

Silk: The lateral order factor of four Indian silks, viz. Mulberry, Tussar, Eri and Muga, were determined by the ED technique and compared with that determined by X-ray diffraction technique. The profiles of 002 and 201 planes in Mulberry were better resolved by the ED technique. This work was done in collaboration with Dr. N. V. Bhat of University Department of Chemical Technology, Bombay.

Application of Optical Anisotropy and Cellulase-Dissolution Technique as Analytical Tools for the Study of Chemically Modified Cottons

The following four modified cottons of different degrees of substitution (DS) were prepared: (*i*) *Acetylated cotton*: aliphatic ester (0.35, 0.45, 0.50, 0.55, 0.90, 1.16, 1.34, 1.45, 1.47 and 1.96 DS), (*ii*) *Cyanoethylated cotton:* aliphatic ether (0.30, 0.33, 0.68, 1.43, 1.54 and 1.69 DS); (*iii*) *Benzoylated cotton:* aromatic ester (0.29, 0.32, 0.70, 0.81, 1.09, 1.16 and 1.90 DS), (*iv*) *Benzylated cotton:* aromatic ether (0.33, 0.45, 0.54, 0.63, 0.70, 1.03 and 1.10 DS).

The refractive indices ($n_{\parallel}$ and $n_{\perp}$) for light polarised parallel and perpendicular to the fibre axis were determined at 28°C by the immersion technique. Identical behaviour was observed in the case of modified cotton substituted with aliphatic groups, viz. acetyl and cyanoethylated cottons. The values of $n_{\parallel}$, $n_{\perp}$, birefringence $\triangle n$ and average refractive index $[\frac{1}{3}(n_{\parallel}+2n_{\perp})]$ for these two substituted samples were found to decrease with increase in the DS. Considering the nature of the curves representing these variations, it appears that the curve of $n_{\parallel}$ vs DS could be used for estimating the DS of acetylated and cyanoethylated cottons prepared under the same conditions.

The behaviour of cotton modified with aromatic groups was, however, different from that of fibres substituted with aliphatic groups. With benzoylated cotton, there was a progressive increase in $n_{\perp}$ accompanied by relatively small fall in $n_{//}$ as the DS was increased. As a result, $\triangle n$ showed a steady fall. In the case of benzylated fibres, on the other hand, the rise in $n_{\perp}$ and the fall in $n_{//}$ were equally pronounced, though both the refractive indices reached steady values at higher levels of substitution. As a consequence, $\triangle n$ showed an initial fall but remained steady thereafter. When aromatic groups were attached to cellulose, the average refractive indices were higher than those of the controls in most cases.

Preparation and Standardisation of Calibration Cotton Samples

During the period under report, preliminary work was undertaken to study the extent of homogeneity of the blends of two samples by carrying out instrumental tests for fibre length and fineness on sub-samples of the blend. Two control samples of 3 kg each, one extra-long stapled fine variety, Varalaxmi, and the other a short stapled coarse variety, Sanjay, were initially processed through the blowroom according to the standard procedure adopted in the Laboratory. Blending of the samples was carried out at the last stage by doubling at the scutcher two times for good mixing. The scutcher lap was then processed on the MMC Flexible Card and the web was collected. Samples of the processed control cottons, Varalaxmi and Sanjay, and their blend in the proporation of 50:50 were taken up for tests. Twenty representative sub-samples were prepared from each of the three lots of processed samples and tested separately for fibre length and Micronaire values by two operators. The results indicated that the variations observed for individual test results between operators and within each operator were well within tolerance limits suggesting that the processed control samples and their blend were adequately homogeneous.

Studies on Lakshmi-Rieter Drawing and Speed Frames

During the period under report, a long staple cotton, Hybrid 4, having the following fibre properties was taken up for studies on both conventional and high speed drawing frame using different break drafts and different settings.

Fibre Properties of Hybrid 4 sample

2.5% span length	31.5 mm
Uniformity ratio	46%
Micronaire value	4.5
Maturity coefficient	0.73
Bundle tenacity :	
Zero gauge	41.3 g/t
3.2 mm gauge	23.1 g/t

The cotton was processed in the blowroom using Blending Hopper, Air Stream Cleaner and Kirschner Beater combination. The lap produced was then carded on a conventional card at the rate of 8 lb/hr. The carded sliver was given two passages on Lakshmi-Rieter Drawing Frame using four combinations of break draft and three settings. For comparison, a corresponding sample was also processed on T & S conventional drawing frame with 1.25 break draft with normal settings. The slivers of various combinations were then spun to 50s count on Lakshmi-Rieter Ring Frame after processing through can-fed intermediate stage. The uniformity of the material was determined at all intermediate stages. The yarns produced from the above combinations were tested for yarn characteristics (Tables 12 and 13).

TABLE 12 : INFLUENCE OF ROLLER SETTINGS ON SLIVER AND YARN QUALITY

Property	Settings in mm (1st and 2nd passage)			
	34-38*	36-40	38-42	T & S
Uster Unevenness (U%)				
Draw Frame I sliver	4·0	4·3	4·2	4·2
Draw Frame II sliver	5·4	5·4	4·0	4·2
Roving	10·7	8·0	7·4	7·4
Yarn	19·2	18·3	18·1	18·4
Yarn Properties				
Lea CSP	2022	2128	2236	1925
Tenacity (g/t)	14·4	14·6	15·2	14·8
CV. of @ strength (%)	16·4	11·4	12·4	13·6
Lea count CV (%)	3·7	3·8	3·0	4·7
Lea strength CV (%)	8·5	6·2	4·6	8·1

* Results averaged from only two spinnings using higher break draft of 1·7 in first passage.
@ CV % single thread strength.

TABLE 13 : INFLUENCE OF BREAK DRAFT COMBINATIONS

Property	Break draft (1st and 2nd passage)				T & S
	1·7-1·7	1·7-1·3	1·3-1·7	1·3-1·3*	1·25-1·25
Uster Unevenness (U%)					
Draw Frame I sliver	4·2	4·1	4·1	4·2	4·2
Draw Frame II sliver	3·9	6·3	4·3	4·5	4·2
Roving	7·2	9·7	7·9	8·3	7·4
Yarn	18·1	18·7	18·2	18·5	18·4
Yarn Properties					
Lea CSP	2162	2149	2141	2142	1925
Tenacity (g/t)	14·7	14·9	14·6	15·0	14·8
CV of @ strength(%)	12·8	13·4	13·0	11·2	13·0
Lea count CV (%)	3·3	3·3	4·1	3·6	4·7
Lea strength CV (%)	4·9	7·0	5·9	5·7	8·1

* Results averaged from only two spinnings using higher setting since lower setting of 34-38 did not work at draw frame.
@ CV % single thread strength.

It is proposed to take up a similar study next year, using another long staple cotton.

A Study of the Effect of Wetting on the Strength of Cotton Yarn

Three yarn samples from each of the counts 16s, 20s, 30s, 40s, 50s, 60s, 80s, 100s and 120s were chosen for the study. The counts selected were closest to the Highest Standard Counts for respective cottons and the values of twist multiplier ranged between 3.75 and 4.25 depending on the count. A sufficiently long length of yarn from the original bobbin was wound on a new bobbin with low tension and the same was immersed for 1 hr in water to which a wetting agent was added. After wetting, the yarn was fed into Uster Single Strand Strength Tester such that the yarn sample remained immersed in water. After 100 breaks, the broken strands were collected and their dry weight was determined on a specially recalibrated Brabender Moisture Meter maintained at 150°C. The yarn remaining on the original bobbin was used for the tests at 65% rh. The wet tenacity (TW) is expressed as the ratio of wet strength to the tex value in the conditioned state. This tex value was arrived at after adding a commercial regain of 7.5% to the dry weight of the yarn. The ratio of wet tenacity (TW) to the tenacity (TC) in the conditioned state was found to be 1.25 ± 0.06 indicating that yarn strength increased by about 25% on wetting. Similarly the breaking elongation increased on an average by about 13%. The spread in elongation ratio, EW/EC, was however, higher than in the case of tenacity ratio.

The coefficient of correlation between yarn properties in the wet and conditioned states were 0.98 and 0.76 for tenacity (T) and elongation (E), respectively. The regression equations for the properties in the two states were:

$$TC = 0.86\ TW - 1.11 \quad \ldots\ldots \quad (1)$$

$$EC = 0.43\ EW - 3.37 \quad \ldots\ldots \quad (2)$$

where C and W represent the conditioned and wet states, respectively.

Equation (1) can be used for estimating, with a fair degree of accuracy, the conditioned tenacity of normal twisted yarn from the results obtained in the wet state. In situations where quick results are required on samples of unknown moisture history, particularly those suspected to have been wet, or where facilities for conditioned atmosphere are not available, it is not expedient to carry out tests in the condition in which they are received, because moisture in the yarn may not correspond to the relative humidity of the testing room. On the basis of data published earlier, it can be said that possible uncertainty in the tenacity, if the samples are tested in the state in which they are received, can be as high as or be even higher than $\pm 10\%$. Wet test followed by interpolation using equation (1) would on the other hand involve less error and can, therefore, be carried out on such occasions in which quick results are required.

Study on the Relationship between Single Strand Strength, Lea Strength and Knotted Lea Strength

Preliminary experiments were carried out on 39 yarn samples (3 from each of a few chosen counts from 6s to 120s) which were tested for single strand strength as well as for lea strength with and without knotting. The number of strands actually breaking (up to the time the load reaches maximum) in the ordinary lea test (without knots) were counted in representative cases. This number was found to range between 5 and 35 with an average of 23 breaks highlighting at least qualitatively the poor participation of yarn segments in the lea test.

In view of the small number of strands breaking on the lea test, it was thought worthwhile to study the correlations of lea strength with the average strength of the weakest few strands. For this purpose, the lowest and the averages of the lowest 5, 10, 15, 20, 23 and 25 strength values in the single strand test results were calculated, besides the sub-mean and the mean. Using each of these averages, the lea strength was estimated as $160 \times \overline{S}$ where $\overline{S}$ is the value of the average. The correlation of lea strength and knotted lea strength with each of these nine values was worked out.

The following are the highlights of the analysis:

(i) Of the nine estimated values of lea strength, the one derived from the sub-mean gave the highest correlation with both the ordinary as well as the knotted lea strengths.

(ii) The correlations of the above estimated values of lea strength were consistently higher with the knotted lea strength than with the ordinary lea strength indicating that the knotted lea represents the yarn better than the ordinary lea for strength tests.

(iii) The knotted lea strength values were higher than the normal lea strength by about 7% signifying better strength realisation in the knotted lea.

Contribution of Fibre Length and Fibre Strength to Yarn Strength

Under this project, 37 samples of various varieties of cotton were tested for mean fibre length and fibre bundle strength using the revised procedures and the results analysed.

(*a*) *Fibre Length:* The mean fibre length (by number) was examined by using a sampling procedure to estimate the number of fibres in each length group in an array prepared from each sample. This value of mean length (by number) agreed closely with the Baer Sorter mean length (CTRL method) and was equal to about 0.9 times the 2.5% span length from the Fibrograph for all the cottons.

(*b*) *Fibre Strength:* Analysis of the fibre breaking load (L) and fibre weight (W) of the six specimens normally taken for fibre bundle tests showed that the breaking load increased exponentially with increase in the bundle

weight. This was true for the calibration cottons as well. After determining the rate of increase in breaking load with increase in bundle weight, the fibre strength for each sample was expressed as the load in kg required to break a tuft of standard weight. The standards chosen were 1 mg and 3 mg for tests at 0 and 3 mm gauge lengths, respectively. When the value of fibre strength derived in this manner were compared with those obtained by the conventional procedure it was observed that the latter values were different in all cases where the tuft specimens taken were off the above average weight. In order to improve the accuracy of the fibre bundle strength values the procedure needs to be standardised taking into account the variation caused in the breaking load due to weight of the specimens.

Formulation of Suitable Indices of Fibre and Yarn Quality for Assessing the Spinning Potential of Cotton

During the year under report, an attempt has been made to formulate a simplified index of fibre quality based on some recent innovations in testing technology involving certain parameters representing fibre fineness and maturity, in addition to length obtained from tests on Fibrograph. The new approach is to modify the basic formula given by Lord by replacing the conventional measures of fineness and maturity by optical indices obtained from Fibrograph tests. On the basis of recent work carried out at this Laboratory, the Optical Fineness Coefficient (OFC) is given by the expression $\left(\frac{W}{A \times L}\right)^2$. Optical Index of Maturity (IOM) developed by some Brazilian and French workers is given by the expression $\left(\frac{A^2}{W}\right)$. In these expressions, 'W' represents the weight of the fibre beard, 'A' the amount counter reading at 100% and 'L' the 2.5% span length. The values of OFC for the 50 cottons studied during the year had a highly significant correlation ($r = 0.95$) with actual gravimetric fineness values.

New CTRL Fibre Quality Index: On the original model laid down by Lord, the new Index of Fibre Quality (I), has been developed from the basic expression,

$$I = \frac{L\ U\ M\ S}{F} \quad \ldots\ldots (1)$$

where L represents 2.5% span length, U the uniformity ratio, M the maturity, S, the bundle strength at 3 mm gauge and F, the fineness. Substituting the optical parameters of fineness and maturity in the expression,

$$\text{CTRL Index, } I = \frac{L \times \frac{L_1}{L} \times S}{OFC \times IOM} \quad \ldots\ldots (2)$$

where L is 50% span length. Further substituting the expressions for OFC and IOM, the equation becomes

$$I_1 = \frac{L \times \frac{L_1}{L} \times S}{\frac{W^2}{A^2 \quad L^2} \times \frac{A^2}{W}} \quad \ldots\ldots(3)$$

$$\text{On simplifying } I_1 = \frac{L^2 \; L_1 \; S}{W} \quad \ldots\ldots(4)$$

If only factors of length, uniformity of length, fineness and maturity are taken into account, excluding strength, a simplified Index (I_2), obtained exclusively from Fibrograph test readings could be formulated as

$$I_2 = \frac{L^2 \; L_1}{W} \quad \ldots\ldots(5)$$

The relative efficiency of I_1 and I_2 as indicators of spinning potential has been examined. It was further studied whether the square roots of the values of I_1 and I_2 indicated by I_1^1 and I_2^1 had improved correlations with the prospective yarn CSP values for the two counts for which each cotton was spun. The analysis confirmed the SITRA study, that I_1^1 and I_2^1 had significantly higher correlations with yarn CSP, than I_1 and I_2. The 50 cottons representing the various species had been spun to a wide range of counts from 6s to 120s. To assess the comparative merits of the new CTRL Quality Indices, the FQI values according to the SITRA formula (Q') were also computed. On analysis, it was observed that for both the levels of CSP values, the parameter I_1^1 which includes the fibre strength factor also in addition to other fibre characteristics, gave slightly superior correlations than those obtained for the simplified Index I_2^1. However, both these correlations compare fairly well with those obtained for Q' (SITRA) values. The efficiency of the CTRL Quality Indices was examined further by working out multiple correlation coefficients to find out the combined effect of the association of individual fibre properties. It was observed that the values of the simple correlations for the CTRL Index I_1^1 were quite close to the corresponding multiple correlations to assess the spinnability of cottons. The corresponding correlation values for the simplified CTRL Index I_2^1 were slightly lower.

Optimal Blending of Standard Varieties of Indian Cottons

The testing of 50s and 60s yarn spun from MCU.5 during the last year was completed. With this the first phase of individual evaluation of the four long staple Maharashtra cottons, viz. Varalaxmi, MCU.5, Nimbkar and H.4 has been completed. The yarn properties of the four varieties are given in Table 14.

TABLE 14 : YARN PROPERTIES OF SUPERIOR MAHARASHTRA COTTONS

Property	Variety (FQI — SITRA Method)								
	Varalaxmi (98·8)		MCU·5 (82·5)		Nimbkar (73·4)		H·4 (68·7)		
Nominal count	80s	60s	60s	50s	50s	40s	60s	50s	40s
Corrected CSP	2300	2672	1987	2189	1912	2039	1822	1988	2174
Single yarn tenacity (g/t)	17·3	17·6	13·5	15·3	13·0	14·7	13·0	13·9	14·5
Breaking elongation (%)	7·2	7·3	6·0	7·1	7·8	8·1	6·0	7·1	7·3
U%	18·0	16·5	17·5	16·9	16·3	15·7	18·1	17·0	17·1
Neps/100 m	217	200	204	169	144	125	220	181	169
End breaks/100 spindle hours	7·55	10·10	12·45	9·30	5·21	3·68	15·0	10·30	7·73

A comparison of MCU.5, Nimbkar and H.4 which are placed in one group showed that, when spun to 60s count, MCU.5 was superior to H.4 in all properties except yarn elongation. At 50s count, while MCU.5 was stronger both in lea and single thread tests, Nimbkar was better in other yarn properties consistently. At 40s count, except for lea CSP, Nimbkar showed better performance than H.4. Thus, on the basis of their performance, the three cottons can be ranked as MCU.5 > Nimbkar > H.4.

Three blends of the above three cottons (each of 30 kg) as detailed below were taken up for processing:

Grade No.	Percentage composition		
	MCU.5	Nimbkar	H.4
AD3.L.9	20	50	30
,, L.10	30	20	50
,, L.11	50	30	20

Various fibre quality parameters of the blends also were determined (Table 15).

TABLE 15 : FIBRE QUALITY OF MIXINGS

Quality parameter	L.9	L.10	L.11
2·5% span length (mm)	30·2	29·7	30·0
Uniformity ratio	44	44	44
Maturity coefficient	0·64	0·74	0·69
Micronaire value	3·8	3·8	3·5
Bundle strength at 3mm gauge (g/t)	22·3	23·0	23·1
Fibre Quality Index (SITRA Method)	70·64	76·51	77·53

It could be seen from the Table that there was considerable similarity of fibre properties among the three blends.

The blended cottons were subsequently subjected to spinning test by spinning 50s and 40s counts out of the first two blends while the third one has been processed up to ring frame. Testing work of the first two blends has been completed and the results are given in Table 16. Further work is in progress.

TABLE 16 : YARN PROPERTIES OF BLENDS

Property	Blend composition			
	L.9	L.10	L.9	L.10
Nominal counts	50s	50s	40s	40s
Corrected CSP	1934	1973	2016	2044
Single yarn tenacity (g/t) ..	13·3	13·9	13·3	14·2
Breaking elongation (%)	6·8	6·9	7·1	6·9
U%	18·1	18·3	17·7	17·3
Neps/100 m	213	268	200	197
End breakings/100 spindle hours ..	7·33	7·15	4·81	5·44

Studies in Physical Characteristics of Cotton Blends

Three cottons, viz. Virnar, 320F and Deviraj, having Micronaire values 5.1, 4.3, and 3.8, respectively, were selected and blends of Virnar and 320F as well as Virnar and Deviraj in the proportion of 50: 50 were processed and spun to 30s count, using the same drafting system as that of control. The yarns produced were tested for different characteristics, such as lea strength, Uster single thread strength, Uster evenness and yarn appearance grade. Test results are given in Table 17. The project has since been completed.

Blending of Cotton with Wool, Jute and other Natural Fibres

As reported earlier, the yarns produced from the blended material of 75% V.797 and 25% jute caddies were converted into furnishing and curtain fabrics as detailed below, using different colour combinations.

Furnishing fabric	*Curtain fabric*
Count of warp : 6s	Count of warp : 6s
Count of weft : 6s	Count of weft : 6s
Reed : 26s (2 ply) ..	Reed : 26s (2 ply)
Picks : 20	Picks : 20 (2 ply)

Further, the yarns produced from admixture of Y.1 and Maljari cottons (75%) and wool noils (25%) were woven at All India Handloom Weavers Service Centre, Bombay.

TABLE 17 : YARN CHARACTERISTICS OF CONTROL AND BLENDS (50:50 PROPORTION)

Sr. No.	Nature of the sample	Lea Test				Uster Single Thread Test					Uster Evenness Test				Yarn appearance grade
		Actual count	Strength (lb)	Corrected strength (lb)	Corrected CSP	Breaking strength (g)	Tex	Tenacity (g/t)	E%	CV% of breaking strength	U%	Thin places (in 100 m)	Thick places (in 100 m)	Neps	
						Control									
1.	Virnar ..	32·1	43·6	57·2	1716	263·4	20·2	13·0	7·6	10·9	17·8	40	106	75	B
2.	320F ..	28·8	63·5	57·3	1717	247·2	20·2	12·2	6·7	10·2	16·5	28	88	56	+D
3.	Deviraj ..	30·5	64·7	67·4	2022	187·8	18·1	10·4	5·8	17·6	17·9	26	117	99	C
						Blends									
4.	Virnar+320F	31·2	51·7	57·7	1731	215·4	19·1	11·3	6·4	12·2	16·3	32	90	64	C
5.	Virnar+Deviraj	30·8	60·8	61·6	1848	225·6	18·4	12·2	6·8	10·4	16·9	22	105	106	C

Six types of furnishing fabrics as detailed below were produced using different combinations and weaves :

TABLE 18 : TYPES OF FURNISHING FABRICS WOVEN FROM COTTON-WOOL BLENDS

Sample No.	1	2	3	4	5	6
Count of warp	6s	6s (2 ply)	6s (2 ply)	6s	6s	6s
Count of weft	6s	6s (2 ply)	6s (2 ply)	6s	6s	6s
Reed	16s (2 ply) 4 in a dent	20s (2 ply)	20s (2 ply)	16s (2 ply) 4 in a dent	16s (2 ply) 4 in a dent	16s (2 ply)
Weft	32 (2 ply)	20 (2 ply)	16 (2 ply & 4 ply)	32 (2 ply)	32 (2 ply)	24 (2 ply)

Blending of Cotton Waste with Jute Caddies : A study was also undertaken utilising cotton waste, viz. flat strip of 30s mixing, instead of pure cotton, for blending with jute caddies. A sample of flat strips (16 kg) having mean fibre length 23.1 mm, Micronaire value 4.4 and bundle tenactiy 46.1 g/t at zero gauge length was processed through blowroom using Hopper Blender, SRRL and Shirley Opener and was blended with jute caddies (4 kg) by two passages through Kirschner Beater. The blended material was then given two passages at the scutcher using Kirschner Beater for intimate blending. The lap produced was then carded at 8 lb/hr, using MMC card, equipped with metallic wires on cylinder and doffer. The carded sliver was then processed on drawing and slubber to produce 0.45 hank and 6s count yarns were spun on SKF Spin Tester having P 211 E drafting system.

The yarn produced was tested for yarn characteristics on Lea Tester, Uster Single Thread Tester and Uster Evenness Tester.

Table 19 gives a comparison of card wastes produced from blends of pure cotton : jute caddies and cotton waste : jute caddies.

TABLE 19 : COMPARISION OF CARD WASTE OF BLENDED SAMPLES

Particulars	V·797 (Pure Cotton/ Jute Caddies)	Waste Cotton (Flat Strip/Jute Caddies)
Flat strips (%)	4·22	3·65
Licker-in-droppings (%)	9·85	5·20
Cylinder, Doffer fly (%)	0·39	0·78
Total	14·46	9·63

Table 20 gives a comparison of the yarns produced from pure cotton : jute caddies yarn and waste cotton : jute caddies yarn.

TABLE 20 : YARN CHARACTERISTICS OF BLENDED SAMPLES

Particulars	V·797 (pure cotton/ jute caddies)	Waste cotton (flat strip/jute caddies)
Count	6·8	6·3
Strength (lb)	168·8	186·8
CSP (corrected)	1096	1134
Uster Single Thread :		
Tenacity (g/t)	8·1	8·7
Elongation (%)	6·9	8·3
CV% (breaking strength)	14·2	16·3
U%	15·7	19·7
Thin places/100 m	15	47
Thick places/100 m	59	158
Neps/100 m	35	157
ASTM Appearance	B	D

Blending of Cotton with Man Made Fibres

The spinning of 80s count yarns from the blends of PSH cotton and high tenacity polyester in 75 : 25, 50 : 50 and 33 : 67 proportions along with controls was completed. The yarns produced from different blends were tested for yarn characteristics.

In order to compare the characteristics of PSH cotton/polyester blended yarns with that of Suvin/polyester blended yarns, Suvin cotton with 2.5% span length of 37 mm, Micronaire value of 3.6, bundle strength of 49.3 g/t at zero gauge and maturity of 68% was chosen for blending with 1.4 denier high tenacity polyester fibre. The corresponding fibre properties of PSH cotton were 2.5% span length of 38 mm, Micronaire value of 3.7, bundle strength at zero gauge of 52.5 g/t and maturity 67%.

Suvin cotton was combed to about 15% noil extraction and the combed sliver was blended with ployester in the proportions 75 : 25, 50 : 50 and 33 : 67 cotton : polyester and 80s count yarn was spun from the individual components as well as the blends. The yarns produced were tested for yarn characteristics. A summary of the yarn test results of PSH/polyester blends and Suvin/polyester blends are given in Tables 21 and 22.

TABLE 21 : YARN PROPERTIES OF PSH/POLYESTER BLENDS

Yarn property	Particulars of blend (PSH : Polyester)				
	100:0	75:25	50:50	33:67	0:100
Corrected lea CSP (80s) count	2832	2520	2240	2144	2664
Tenacity (g/t)	19·4	16·7	14·7	15·3	21·5
Elongation (%)	5·9	5·9	7·4	8·9	13·5
CV of breaking strength (%)	16·9	16·0	22·6	20·2	26·4
U%	16·4	16·2	16·5	17·3	18·5
Neps/100 m	52	56	51	46	25

TABLE 22 : YARN PROPERTIES OF SUVIN/POLYESTER BLENDS

Yarn property	Particulars of blend (Suvin : Polyester)				
	100:0	75:25	50:50	33:67	0:100
Corrected lea CSP (80s) count	2816	2512	2304	2328	2664
Tenacity (g/t)	19·1	16·9	16·2	17·4	21·5
Elongation (%)	5·6	5·9	7·5	8·9	13·5
CV of breaking strength (%)	14·2	13·8	15·8	17·6	26·4
U%	16·8	16·8	16·9	17·3	18·5
Neps	92	91	102	89	25

While neps are consistently lower in yarns from blends of PSH with polyester, no difference is observed in the strength of yarns spun from the individual cottons. However, Suvin has fared better than PSH in giving higher yarn strength at the blend levels of 50 : 50 and 33 : 67 cotton : polyester possibly due to differences in the stress-strain characteristics of the two cottons.

Studies on the Elastic Moduli and Elastic Recovery Properties of Cotton/Polyester Blended Yarns

During the year under report, the effect of mercerisation on static and dynamic moduli was studied. For this purpose, 100 leas of Digvijay cotton spun to 30s count with a TM of 4.0 were first dewaxed and then kier-boiled. These leas would constitute the control sample as well as sample for further treatments. Mercerisation was carried out with and without stretching. The stretch levels employed were: (*i*) stretched to 8% below the original length, (*ii*) stretched to the original length, (*iii*) stretched to 2% over the original length, and (*iv*) stretched to 4% over the original length. For slack mercerisation the leas

were kept immersed in 24% NaOH solution for 30 min. The mercerised samples were later washed in hot water scoured with acetic acid and finally washed with tap water. In the case of stretch-mercerisation, initially the leas were soaked slack in NaOH and before washing they were stretched to the levels required. Then they were washed, scoured and finally washed with tap water like slack mercerised samples.

These treated samples were stored in a desiccator containing saturated solution of sodium nitrite to maintain them at 65% rh before tests. The dynamic modulus of the treated as well as the control samples were measured using the Pulse Propagation meter. Maintaining the yarn under standard tension, the velocity (C) of the pulse was determined from the time taken for the pulse to traverse a distance of 50 cm along the yarn. By substituting the value of C in km/sec in the formula $E = 11.3 \times C^2$, the dynamic modulus value (E) in g/d was obtained for each sample. The Instron tensile tester was employed to determine the static modulus. From the average value of the slope of the initial portion of the stress-strain curves and the denier value of the corresponding sample, which was obtained by weighing a known length of the sample, the static modulus of each sample was calculated in g/d. One hundred tests were carried out for both static and dynamic moduli and the average values were arrived at. The results are summarised in Table 23.

TABLE 23 : DYNAMIC AND STATIC MODULUS VALUES FOR TREATED COTTON YARN

Treatment	Modulus (g/d)		Ratio with respect to control	
	Dynamic	Static	Dynamic	Static
Dewaxed and kier-boiled (Control)	87·8	36·0	—	—
Mercerised:				
(*i*) Slack	40·0	7·2	0·45	0·20
(*ii*) Stretched to 8% below original length	55·2	30·2	0·63	0·84
(*iii*) Stretched to original length ..	88·7	51·2	1·01	1·42
(*iv*) Stretched to 2% over original length	90·9	60·8	1·04	1·69
(*v*) Stretched to 4% over original length	101·0	69·1	1·15	1·92

From the above Table, it is evident that: (*i*) on slack mercerisation both the moduli suffered heavy reduction in their values, greater reduction being observed in the case of static modulus and (*ii*) with stretch these two moduli increased; at 4% stretch the dynamic modulus had registered an increase of about 15% over that of control, while the static modulus value was doubled. The impact of stretch was felt more in case of static modulus than the dynamic modulus.

Study of the Relationship Between CRA Obtained by Monsanto, Shirley and Metrimpex CR Testers

Four varieties of cotton fabrics, coarse (Drill), medium coarse (Sheeting), fine (Poplin) and superfine (Cambric) were treated with DMDHEU to impart durable press properties. The treated fabrics along with untreated control were evaluated for dry and wet Crease Recovery Angles (CRA) on both Monsanto and Metrimpex CR Testers. The samples were also assessed for their CRA on Shirley CR Tester at the Central Testing Laboratory (Textiles Committee).

In order to assess the effect of various physical factors, experiments were carried out varying the load, time of loading, time of relaxation, etc., on Monsanto, Metrimpex and Shirley CR Testers. As generally higher CRA values were observed in dry as well as in wet condition when the Mosanto CR Tester was used, the mode of creasing in each instrument was also studied. A plastic strip of 0.2 mm thickness, similar in thickness to that used in Monsanto was inserted while creating the fold in Metrimpex and Shirley Testers. In addition, the effect of gravity on folded samples was studied by preparing test specimen having varying amount of water retained and measuring their CRA on Monsanto Tester.

In the case of untreated control and treated cotton fabrics, irrespective of the type of the fabric, CRA was highest in Monsanto and lowest in Shirley CR Testers. Further, experiments on variation in load, time of loading, time of relaxation, etc., indicated that there was no appreciable effect of load, time of loading and time of relaxation on CRA. It was interesting to note that CRA values obtained by inserting plastic strip in Metrimpex and Shirley CR Testers were in close agreement with those obtained by Monsanto CR Tester.

Studies on Mechanical Properties of Cotton Fabrics

Effect of Fabric Assistance on the Abration Resistance

Preliminary studies were carried out on seven fabric samples. For each sample, 10 strips of one inch width each for warp and weft directions were taken as control samples and tested for flex-abrasion (Stoll method).

Similarly, another lot of 10 strips of the same width was taken each for the warp and weft directions and one inch of crossing threads were removed from both warp way as well as weft way and tested for flex abrasion resistance. It was observed that the abrasion values for the one inch ravelled strips were less than that of the control sample, by about 39% to 74% in the warp direction, and by about 44% to 89% in the weft direction. Further work is in progress.

Comparative Study of Tests for Tearing Strength

This study was undertaken to establish relationships between different types of instruments used for measuring the tearing strength of fabrics. During

the reporting period, preliminary work was carried out on five samples of grey fabric, varying in count and construction, procured from mills. After ascertaining the actual count, ends and picks, and thickness, these fabric samples were subjected to tearing strength tests by Elmendorf Tear Tester, Ballistic Tear Tester and Tongue Tear Tester using standard procedures. The test results are given in Table 24.

TABLE 24 : DATA ON CONSTRUCTIONAL AND TEARING STRENGTH PARAMETERS OF SELECTED COTTON FABRICS

Sample No.	Count		Ends per inch	Picks per inch	Thickness (mm)	Tearing strength (kg)					
						Elmendorf Tester		Ballistic Tester		Tongue Tester	
	Warp	Weft				Warp	Weft	Warp	Weft	Warp	Weft
1.	15·2	15·0	59	45	0·35	3·347	2·547	2·22	1·85	5·67	4·99
2.	15·9	17·5	51	51	0·29	3·622	3·098	2·33	2·02	6·12	4·94
3.	16·5	16·8	52	53	0·27	3·648	3·731	2·20	2·07	4·26	5·13
4.	21·8	29·3	55	45	0·17	1·810	1·110	1·42	0·88	3·18	1·81
5.	26·6	17·4	52	42	0·23	4·069	3·280	2·97	2·62	4·40	5·22

The values of correlation coefficients worked out between the tearing strength values obtained by the different instruments are given in Table 25.

TABLE 25 : CORRELATION COEFFICIENTS BETWEEN TEARING STRENGTH VALUES OBTAINED FROM DIFFERENT TEARING STRENGTH TESTERS

No.	Between instruments	Correlation coefficient (r)
1.	*Elmendorf Tear and Ballistic Tear*	
	Warp-way	0·938*
	Weft-way	0·887*
2.	*Elmendorf Tear and Tongue Tear*	
	Warp-way	0·577 NS
	Weft-way	0·923*
3.	*Ballistic Tear and Tongue Tear*	
	Warp-way	0·446 NS
	Weft-way	0·916*

* Significant at 5% level.
NS=Non-significant.

It can be observed from the above Table that the test values of Elmendorf Tear Tester and Ballistic Tear Tester exhibited significant correlation in both warp as well as weft direction samples, whereas significant correlations were observed only for the weft direction samples when results of tests with Tongue Tear Tester were compared with those obtained using Elmendorf or Ballistic Tear Tester.

Response of Cottons to Pre-swelling and Crosslinking Treatment and Influence of Ultra and Fine Structure on Mechanical Properties of Treated Cottons

Cotton yarns of Laxmi, L.147 and Sujay (all 2/30s) were given pre-swelling and crosslinking treatments under the following conditions : (*i*) conventional crosslinking treatment (CCL), (*ii*) mercerised, stretched, washed and crosslinked immediately in wet state (MWCL), and (*iii*) mercerised as in (*ii*) but crosslinked after drying the yarn (MDCL). The treated yarns were tested for tenacity and elongation using Uster single yarn strength tester. The results showed that MWCL treatment imparted consistently higher retention of tenacity as compared to CCL and MDCL treatments. Further, the MWCL yarns had higher retention of elongation as compared to MDCL yarns, indicating more open ultra structure in MWCL yarn than in MDCL yarn. This observation was later confirmed by electron micrograph, where a more honeycomb structure in MDCL fibres was noticed as against fuse structure in MDCL fibres. The MWCL treatment also imparted highest toughness retention.

Chemical Finishing Treatments on Blends of Viscose, Polynosic and Polyester Fibres with Suitable Cotton Varieties to Obtain Optimum Balance Between Wash and Wear and Mechanical Properties

Two polyester-cotton yarn blended samples, viz:(*i*) Normal Tenacity Polyester (67%) and Hybrid 4 (33%), and (*ii*) High Tenacity Polyester (67%) and PSH (33%) were purified and crosslinked with DMDHEU, the concentration of DMDHEU being kept at 4%. The treated samples were tested for breaking strength and percentage elongation.

The results showed that the tenacity retained by both the samples was 90%, whereas elongation increased to values as high as 157% of the original elongation in PSH blend and 107% in Hybrid 4 blend. Further work is in progress.

Study of Cotton and Cotton Blended Fabrics Treated with Mixtures of Resins

During the period under report, cotton-polynosic blended fabric was treated by poly-set process (single step) using mixtures of resins. The resins used for the poly-set process were dimethylol dihydroxy ethelene urea (DMDHEU) and methylol methyl melamine (MMM). The concentrations of

DMDHEU used for crosslinking treatments were 4%,6%,8%,10% ,12% and 15%, keeping the concentration of MMM constant at 10%. Zinc acetate (5%) and zinc nitrate (0.6%) were used as polymerisation catalyst and crosslinking catalyst, respectively. Vasrang PE(2%)was used as softener. The fabric was also given conventional treatment with DMDHEU using different concentrations of resin, viz. 4%, 8%, 12% and 15%. Zinc nitrate (2%) and Vasrang PE (1.3%) were used as catalyst and softener, respectively.

The fabrics treated by the poly-set and conventional processes were studied for various chemical and physical properties. It was observed that the fabric treated by the poly-set process showed higher strength retention and abrasion resistance as compared to the fabric treated by conventional process.

Study on Migration of Crosslinking Resin Finishes during Durable Press Finishing Treatments of Cotton and Cotton Blended Fabrics

In order to study the migration of resin and rate of drying, samples of cotton fabric were treated with 10% solution of HICOFOR TAE (Dimethylol alkyl tariazone)resin using the same conditions of crosslinking treatment as in the case of DMDHEU crosslinking, and with Vasrang PE as softener. The treated fabric samples were analysed for moisture content and nitrogen content.

It was observed that migration of triazone maintained the same trend as DMDHEU resin. In both the cases, migration of resin recorded a maximum value after 5 minutes and thereafter it decreased for some time and then levelled off. The rate of drying was observed to be a little higher for triazone treated fabric samples.

The migration of DMDHEU in polyester/cotton blended fabric was studied using 12% solution of DMDHEU and magnesium chloride as catalyst. Resin treated fabrics were dried at 70°C for periods varying from zero to 60 minutes. Curing was done at 130°C for 30 minutes. Moisture and nitrogen contents of treated samples were determined and per cent migration of resin and the rate of drying were worked out.

In order to assess the effect of different softeners on the migration of resin, the crosslinking treatment was carried out using Arkoline-SPW as softener, keeping rest of the treatment conditions as before. It was observed that in this case the rate of drying was much lower up to a drying period of 40 minutes. The migration of DMDHEU was higher in the case of Arkoline-SPW treated fabric samples as compared to the fabric samples treated with Vasrang PE as softener.

Studies on Grafting of Vinyl Monomers onto Cotton Fabrics

During the period under report, acrylonitrile (AN) was grafted onto cotton fabric using ceric ammonium nitrate as the initiator. Grafting was carried out varying the reaction time and initiator concentration to obtain

fabrics with 1 to 24 per cent graft. Per cent graft increased with initiator concentration up to 0.004M and remained constant thereafter. There was also an increase in per cent graft with reaction time. A reaction time of 30 to 45 minutes was found to be sufficient to get 10 to 15 per cent graft with the cotton: monomer ratio 1:1 and initiator concentration 0.004M.

Grafting of mixtures of monomers (styrene and AN) onto cotton fabric was also carried out, varying the initiator concentration, reaction time and the composition of the monomer mixture. The ratio 60:40 (styrene:AN) gave the highest per cent graft. A mixture of styrene and AN at 65°C without nitrogen atmosphere yielded up to 6 per cent grafts. Initiator concentration of 0.004M was found to impart maximum grafting. Further work is in progress.

An Investigation of the Effects of High Energy Radiation on the Induction and Half-Life of Excited, Free and/or Ionised Radicals in Cotton Cellulose to Obtain Basic Information Needed for the Development of Potentially New Useful Cotton Products.

Phosphorylation by Radiation Technique: Phosphorylation treatment by radiation technique recorded better retention of strength with improved flame proofing properties. With a view to introduce crease-resistant characteristics in addition to flame proofing properties in phosphorylated fabrics, various trials using DMDHEU and epichlorohydrin reagents were carried out. CRA and Oxygen Index Values of these samples are given in Table 26.

TABLE 26 : CRA AND OXYGEN INDEX VALUES OF VARIOUS TREATMENTS

Treatment	CRA	Oxygen Index Value
Untreated control	211	18·7
Phosphorylation followed by epichlorohydrin	250	21·6
Epichlorohydrin followed by phosphorylation	303	26·7
Phosphorylation followed by epichlorohydrin followed by padding with NaOH+NaCl	217	22·6
Phosphorylation using ethylene diamine instead of urea (N source) followed by epichlorohydrin	241	19·5
Phosphorylation followed by DMDHEU treatment	255	20·6
DMDHEU treatment followed by phosphorylation treatment ..	260	19·0
Ephichlorohydrin followed by phosphorylation using radiation technique	298	—
Conventional phosphorylation	217	33·5

Some selected treatments are being tried in bulk. Since urea-diammonium phosphate treatment imparts only non-durable flame proofing properties, a recent flame proofing agent, Pyrovatex, was tried for imparting durable flame-

proofing properties. Casement cloth treated with Pyrovatex (add-on 22%) was found to withstand severe washing conditions.

Flame-proofing treatment with Pyrovatex using radiation technique did not give any satisfactory result.

Other Chemical Treatments : Cotton cellulose was propargylated by three step process:

1. Allylation of cellulose with allyl bromide.
2. Bromination of allyl cellulose.
3. Dehydrobromination of brominated allyl cellulose with pottassium t-butoxide.

The degree of substitution of propargylation was determined by Silver method.

Post-Irradiation Activity : Post-irradiation activity of allyl cellulose was estimated by grafting the irradiated sample with acrylonitrile in 50% zinc chloride solution. The grafting percentage values are given below.

TABLE 27 : POST-IRRADIATION ACTIVITY OF ALLYL CELLULOSE

Dosage	Grafting % of allylated sample	Grafting % of raw Control sample (Grafted with AN in $ZnCl_2$-50%)
10^5 rads	29·16	2.84
1×10^6 rads	44·57	24·23
$2\cdot3\times10^6$ rads	67·66	26·51

Effect of Irradiation on other Fibres : Purified and bleached pineapple yarn was irradiated to three dosages, viz. $10,^5$ 10^6 and 10^7 rads of gamma ray radiation.

Tenacity retained by irradiated pineapple yarn showed a decreasing trend, even though there was a slight increase at the initial dosage of 10^5 rads. At a dosage of 10^7 rads, the yarn became too weak to be tested for strength.

To investigate the effect of lignin on radio-protection of bast fibres, pineapple, sisal and bhor-bhendi yarns were irradiated without purification as the purification treatment was found to reduce lignin content. Results are being analysed.

Studies on Absorbency of Indian Cottons

Sixteen varieties of Indian cottons were purified by dewaxing, kier-boiling and bleaching, and the purified varieties were tested for glycerine

retention value (GRV), sinking time and water holding capacity (WHC). The results of WHC and sinking time are presented in Table 28.

TABLE 28 : WATER HOLDING CAPACITY AND SINKING TIME OF SOME INDIAN COTTONS

Sr. No.	Variety	WHC (per g./)	Sinking time (sec.)
1.	Buri 147	15·9	2.3
2.	Deviraj	16·0	2·8
3.	Hybrid 4	16·6	2·5
4.	Hampi	17·2	2·1
5.	Varalaxmi	18·2	2.7
6.	G.67	18·8	2·4
7.	Wagad	20·8	2·8
8.	Jayadhar	20·8	3·1
9.	G.22	22.6	6·0
10.	G.6	23.0	4.5
11.	LD.133	23.1	7·8
12.	Digvijay	23.6	3.2
13.	LSS	24·2	6.5
14.	Westerns 1	24·4	8·2
15.	G.27	24.5	11.8
16.	Lohit	25.5	4·8

As absorbency is the most important criterion for utilising varieties in the manufacture of surgical cotton, the data collected were analysed keeping that in view. The results indicated that while certain varieties, such as G.6, LD.133, Digvijay, LSS, Westerns 1 and Lohit passed the tests for both sinking time and WHC, some varieties, viz. Buri 147, Deviraj, Hybrid 4, Hampi, Varalaxmi, G.67, Wagad and Jayadhar passed only the test for sinking time. Yet another variety, G.27, passed only for WHC and not for sinking time. The variety Lohit showed good WHC coupled with low sinking time.

Electron Microscopical Investigation of Dye Diffusion and Dye Aggregation in Unmodified and Modified Cotton Fibres

Two metallised dyes containing heavy metals, palladium and cerium, respectively, were synthesised for electron microscopic study of diffusion. Diffusion studies of these metallised dyes in cotton as well as in cellophane are in progress.

Structural study of cellophane using X-ray diffraction (XRD) and electron diffraction (ED) was completed. The ED pattern of fibrillated cellophane recorded by the CTRL technique was predominantly cellulose I and the intensity tracing of the pattern along the equator revealed the presence of very weak reflections corresponding to cellulose II. These observations were contradictory to the fact that XRD pattern of cellophane is typical of cellulose II. An attempt was made to seek the reasons for this

apparent anomaly with respect to the fine structure of cellophane by the two diffraction techniques. For this, ED patterns of wood cellulose (cellulose I), the starting material, and alkali cellulose (cellulose II), the intermediate product in the production of cellophane, were also examined. The conclusions are as follows:

Minute crystallites of cellulose I are likely to be present in wood pulp in the form of nuclei with a potential for growth under favourable conditions. These nuclei might be present in the material even after its conversion into alkali cellulose, its dissolution and eventual regeneration into cellophane. The process of regeneration and stretch could favour the growth of the "nuclei" of cellulose I crystallites which are quite stable in the electron beam and hence give rise to a clear ED pattern. The crystallites of cellulose II in cellophane, on the other hand, are relatively small and much less stable in the electron beam than those in alkali cellulose and get feebly recorded in the ED pattern. The cellulose I crystallites in cellophane, being small both in number and size, remain undetected in XRD.

Studies on the Biosynthesis of Cellulose by Microorganisms and Higher Plants

The biosynthesis of cellulose was studied (*i*) in developing cotton fibres and (*ii*) in the microorganism *Acetobacter xylinum.*

(*i*) *Developing Cotton Fibres:* Fresh cotton bolls of Laxmi and Suvin varieties grown in pots were collected after 10, 15, 20, 30, 40, 50 and 60 days post-anthesis. A portion of the bolls collected was kept for drying at 60°C. The bolls from the remaining portion were opened. The fibres were separated from seeds and were immediately assayed for the activity of enzyme involved in cellulose biosynthesis. In both the varieties, a peak of enzyme activity was observed at 15 days post-anthesis. This was followed by a drop in the activity at 20 days. The activity again increased, showing another peak at 30/40 days, and dropped at 50 days post-anthesis. The level of activity of the enzyme was higher in the fibres of Laxmi variety at all stages of development compared to that in the fibres of Suvin variety.

The fibres were separated from the seeds of dried bolls and were subjected to the estimation of cellulose and copper number. A gradual increase in cellulose content and decrease in copper number was observed with the development of cotton fibre in both the varieties.

To repeat the above experiments, seeds of these two varieties were again sown in pots on September 26, 1979. The plants are being raised in the same manner as in last year.

(*ii*) *Acetobacter xylinum :* Synthesis of cellulose by particulate fraction of *Acetobacter xylinum* was studied *in vitro.* The particulate fraction obtained by centrifugation between 1,000 and 27,000 $\times$g was used as source of enzyme. The product insoluble in 2% NaOH was isolated and hydrolysed with

cellulase enzyme. The enzyme activity obtained was of the order of 20 μg glucose per mg enzyme protein.

Formation of a polymer was observed when *A. xylinum* cells were grown on carbon sources other than glucose, viz. xylose, fructose, galactose, mannose and mannitol. The formation of the polymer was examined under electron microscope. It was observed that the synthesis of polymer starts within one minute of incubation with carbon source. The microfibrils project from the pole as well as from all sides of the bacterial cell. The *A. xylinum* cells were found to exist in different shapes ranging from round to elongated rods. Electron diffraction studies of the polymer showed two different patterns; one of the patterns resembled that of typical cellulose I, while the other was a spot pattern. The characterisation of the polymer is in progress.

An attempt was made to isolate intermediate polymer of cellulose biosynthesis in *A. xylinum* by precipitation with 60% ethanol. The precipitate was dialysed and then lyophilised. It is being characterised further.

Fermentation Studies on Cellulase Production and Its Application

The Modular Fermenter received this year was commissioned and some preliminary studies on the estimation of dissolved oxygen by sulphite oxidation method were carried out.

Candida utilis showed higher growth on hydrolysates of cellulosic substrates. It indicated the presence of hemicellulases in the filtrate of *Penicillium funiculosum*. The presence of these enzymes was confirmed by studying xylanase, mannanase and arabanase activities. It was found that the filtrate contained potent xylanase and weak mannanase and arabanase.

The intracellular beta-glucosidase of *Candida utilis* was found to be affected when the organism was grown in glucose, xylose, cellobiose and alcohol. Xylose was a very strong inducer of the enzyme while ethanol and cellobiose were weak in inductions; glucose did not affect the enzyme production.

Electrophoresis of crude cellulase on 7.0% acrylamide gel in an ionic system gave two very prominent and four faint bands. The first protein band was rich in beta glucosidase and it had some CM-cellulase and FP activity. The second band had strong CM-cellulase and FP activity, but it was low in beta-glucosidase. Further studies on 6.0% gel showed that the first band was a mixture of two proteins.

Preliminary studies on mutation of *Penicillium funiculosum* by U.V. radiation were carried out.

Enrichment of Cattle Feed by Microbiological Methods

A number of post-harvest agricultural waste materials, viz. paddy straw wheat straw, rye straw, jowar stalks, cotton stalks, groundnut hulls and tur

stalks were assessed for their suitability for enrichment with microbial proteins. Based on the preliminary laboratory trials, paddy straw and wheat straw were selected for pilot scale studies. Pilot scale trials on enriching these two straws were undertaken at Punjabrao Krishi Vidyapeeth (PKV), Akola. Both the straws were hydrolysed with 0.5 N sulphuric acid and then ammoniated to a pH of 4.5 to 5.0 with 5.0 N ammonium hydroxide. Such ammoniated straws were inoculated with microbial cultures. Since the performance of *Penicillium funiculosum* was good on paddy straw and that of *Candida utilis* on wheat straw, the pilot scale trials were further restricted to enrich protein content of paddy straw with *P. funiculosum* and wheat straw with *C. utilis*. The trials were conducted in the Department of Plant Pathology, PKV, Akola, and all the analysis were carried out at CTRL, Bombay. Analysis included : total nitrogen, ammoniacal nitrogen, crude protein, cellulose, hemi-cellulose, total sugars, reducing sugars, lignin, fat, ash, moisture and pH. The triple acid hydrolysate was also analysed for presence of some elements like Ca, Mg, S, Na, K, and P. *In vitro* digestibility was also carried out on the above samples with rumen fluid collected from a fistulated local bull maintained on hay.

Penicillium funiculosum grown on paddy straw enhanced the crude protein by three-fold, whereas, *C. utilis* grown on wheat straw enhanced it by two-fold. There was about two-fold increase in crude fat and 20% to 30% increase in the digestibility. There was no change in the level of cellulose content after fermentation, though *P. funiculosum* has a potent cellulase system. The total sugars were almost exhausted at that stage with about 40% of ammoniacal nitrogen left behind. Non-utilization of excess ammoniacal nitrogen may be due to exhaustion of sugars at the end of 7 days incubation period. Analysis with respect to elements like Ca, Mg, P, etc., revealed that both the straws contain these in very low amounts of 0.1% or even less. Phosphorous could be one of the limiting nutrients. Since it is not advisable to incubate more than a week from the point of view of contamination, further experiments will be undertaken by supplementing sugars and some of the nutrients like phosphorus and sulphur to assess whether ammoniacal nitrogen level comes down or not.

Based on the acceptability trials on ruminants, feeding trials were undertaken by Dr. J. Honmode, Professor, Animal Nutrition Department, with the above enriched straws at PKV, Akola, after supplementing the materials with 5% and 10% molasses. The resuls indicated that the digestibility of enriched straws was 30% more than that of control.

Studies on the Utilisation of Chitin and Other Allied Products from Prawn Shell Waste

Considering the economics and nutrient reserve of prawn shell waste, both the pot culture experiments at CTRL and field trials at CICR,

Coimbatore, on the control of *Verticillium dahliae* were laid out by amending the soil with prawn shell waste instead of chitin. Analysis of prawn shell waste revealed that it contains 40% protein, 25% chitin, 30% ash and 5% fat.

Since pot culture trials at CTRL during 1978 indicated that application of chitin/prawn shell waste to the soil arrested the proliferation of *V. dahliae*, trials were extended during 1979 on the control of other two soil-borne pathogens, viz. *Fusarium oxysporum* and *Rhizoctonia solani* with their corresponding susceptible cotton varieties. MCU.5 variety was chosen for studying *V. dahliae* and *R. solani* infection and K.8 was chosen for studying *F. oxysporum* infection. There were six treatments and each treatment was replicated four times. Prawn shell waste was applied in two doses, viz. 2.0% and 4.0% level. To one set, a composite culture of chitinoclastic microorganisms comprising bacterial, actinomycete and fungal cultures was added. Appropriate controls were maintained. Chitosan coated seeds were sown in prawn shell waste amended soils, whereas untreated seeds were sown in controls. Appropriate plant protection measures were undertaken. Observations on the incidence of wilt are also being undertaken.

The same study was extended to field trials at Coimbatore. The experiment was laid out in a Randomized Complete Block Design with six treatments and four applications. Prawn shell waste was applied in two doses, 200 kg/acre and 400 kg/acre with and without chitinoclastic microorganisms. City compost at the rate of 50 tonnes/acre was applied to one treatment. Unamended soil served as control. Results are awaited.

Analysis and Grading of Cotton Linters

Three cotton varieties, viz. J.34, Cambodia and Badnawar, have been procured and delinted on the laboratory delinting machine. The linters were then subjected to Shirley cleaning, kier boiling and bleaching. Further tests are in progress.

Fatty Acid Composition of Cottonseed Oil of Different Varieties

During the period under report, oil was extracted from 18 cottonseed samples and methyl esters of the oil were prepared and run on a column of Free Fatty Acid Phase (FFAP) at 200°C using Flame Ionisation Detector. The individual fatty acids of cottonseed oil were in the following ranges:

Fatty Acid	*Percentage*
Myristic	0.42 to 1.05
Palmitic	20.57 to 26.77
Palmitolic	0.91 to 3.38
Stearic	2.23 to 4.25
Oleic	17.49 to 26.36
Linoleic	40.51 to 54.96
Arachdic	Traces

Evaluation of Cottonseed Oil, Vanaspati Containing Cottonseed Oil, Cottonseed Cake and Meal for Their Contents of Cyclopropenoid Fatty Acids

Samples of cottonseeds of different varieties were crushed and oil was extracted by solvent extraction method. The oil samples were converted into methyl esters which were subsequently subjected to alumina treatments before titration was carried out with HBr, keeping untreated samples as control. The contents of malvalic acid and sterculic acid were calculated and were found to vary from 0.59% to 1.29% and from 0.6% to 1.35%, respectively.

Utilisation of Cotton Stalks

The process of particle board preparation from cotton plant stalks developed earlier has been patented. Taking into consideration the various costs involved, the cost of preparation of particle board of size 45 cm × 45 cm × 8 mm on a laboratory scale was worked out to be about Rs. 1.08. Hence these boards would be cheaper as compared to similar type of boards available in the market.

As the process of board preparation would be a suitable item for commercial exploitation in rural areas where cotton is grown and stalks are available in abundance, the process was suggested for inclusion in the 'Lab to Land' programme envisaged in connection with the Golden Jubilee of the ICAR.

Demonstration of the board preparation was arranged during May-June 1979. It was attended by senior officials and engineers from M/s. Indian Plywood Manufacturing Co. (Dandeli), Gujarat State Cooperative Marketing Federation (Ahmedabad), Punjab State Industries Development Corporation (Chandigarh), Punjab Agricultural University (Ludhiana), Haryana Agricultural University (Hissar) and Agricultural Institute (Kosbad Hill, Maharashtra). Some of the institutions were persuaded to take up the process for large scale manufacture of boards.

Further work on preparation of particle boards from cotton plant stalks was continued using lignin as binding material and the boards thus prepared were tested for various physical and chemical properties. In addition, with a view to utilise other agricultural waste products as well, plant stalks of sunflower and chilli were collected and these were tried for preparation of particle boards.

Studies on Deburring of Raw Wool Using Mechanical Device

It was mentioned in the last year's report that the work of proper alignment of parts and running the device fabricated as a ginning machine, is in progress. As it is necessary to assess the efficiency of the mechanical device for deburring wool by carrying out trials with a few scoured wools differing in fibre parameters and vegetable matter content, CSWRI, Avikanagar, was contacted

for the selection of suitable samples as well as to draw up a detailed programme for further work which includes experimental comparison of the spinning performance on the woollen system, of scoured, carbonised and mechanically deburred wool samples of the same breed. Out of the three breeds selected, viz. Nali/Chokla (indigenous), half bred of Rambouillet/Merino (cross-bred) and Rambouillet Merino (exotic), scoured wools of the former two breeds have been received for mechanical deburring. In addition, action is being taken to procure from the Rajasthan State Cooperative Sheep and Wool Marketing Federation, Jaipur, wool samples with different cockle burr contents of 10%, 20% and 30%.

Research Work Done at Regional Quality Evaluation Unit

COIMBATORE

The data on the fibre properties of five varieties of cotton which include MCU.7 as control for three seasons (1976-1978) and two locations (Srivilliputhur and Aduthurai) were collected and analysed statistically. The varieties SVPR.122, SVPR.124 and SVPR.134 were found to be superior to the control in fibre length, fineness and GP but on par with the control in respect of yield. By and large, the bundle strength values recorded at Aduthurai were higher than those at Srivilliputhur. SVPR.122, SVPR.124, and SVPR.134 were considered suitable for cultivation in rice fallows with definite economic advantage over MCU.7.

A technological study on the use of spacer technique on Micronaire for the measurement of maturity was conducted at the Quality Evaluation Unit, Coimbatore. Forty samples belonging to different cultivated species were tested for maturity by the caustic soda method. These samples were tested for Micronaire value on Keisokki Micronaire. Using a spacer of 9 mm on the Keisokki Micronaire, a second set of readings was obtained for the above samples. The differences in the two sets of readings for each sample showed a correlation of 0.812 with the maturity values by the caustic soda method. A new spacer of 12 mm was fabricated and similar procedure for testing was employed. It was observed that this correlation improved to 0.837 on using the 12 mm spacer.

HISSAR

In an investigation, the efficacy of the new insecticides to control pink bollworm on the H.14 and H.655 cotton varieties was tested. Although all the insecticide treatments gave higher yield than the control, no significant effect was noticed on the fibre quality.

Another study was conducted at Sirsa on the effect of defoliants on two *hirsutum* strains, H.655 and 320F. Eight defoliating treatments were given

when 60% of bolls opened. The treatments had no significant effect on the yield or quality of the two varieties.

NANDED

An investigation to study the effect of gamma ray (10 kr) irradiation on the seeds of the three varieties, CJ.73, G.27, G.875, and eight hybrids was conducted and based on their performance, in respect of fibre properties, plants of the three varieties and hybrids were selected for growing M.2 generations. Further study is in progress.

3. PUBLICATIONS

During 1979, one Annual Report, two Technological Reports, 24 Research Publications, 62 Technological Circulars and two Miscellaneous Publications were issued in addition to 18 papers presented at various conferences.

A. Annual Report

Annual Report of the Cotton Technological Research Laboratory for the calendar year 1978.

B. Technological Reports

No. 23. Technological Report on Trade Varieties of Indian Cottons, 1977-78 Season.

No. 24. Technological Report on Standard Indian Cottons, 1977-78 Season.

C. Research Publications (CTRL Publication—New Series)

No. 119. Studies on Grafting of Styrene onto Cotton—by N. Thejappa and S. N. Pandey (Reprinted from Proceedings of the Nineteenth Technological Conference sponsored by ATIRA, BTRA and SITRA, held at ATIRA, Ahmedabad, in February 1978).

No. 120. Improved DP Cotton by Two-step Poly-set Process—Part I: Crosslinking of Cotton Cellulose with Dimethylol Ethylene Urea—by S. N. Pandey and Prema Nair (Reprinted from Proceedings of the Nineteenth Technological Conference sponsored by ATIRA, BTRA and SITRA, held at ATIRA, Ahmedabad, in February 1978).

No. 121. Studies on the Cross-sectional Shape of Cotton Fibres: The Relation of Cross-sectional Shape of Raw Cotton with Other Fibre Characteristics—by B. M. Petkar, P. G. Oka and V. Sundaram (Reprinted from Proceedings of the Nineteenth Technological Conference sponsored by ATIRA, BTRA and SITRA, held at ATIRA, Ahmedabad, in February 1978).

No. 122. Effect of Cycocel on the Yield and Fibre Quality of American Cotton (Gossypium *hirsutum* L)—by S. N. Nagwekar and

M. S. Kairon (Reprinted from *Haryana Agricultural University Journal*, September 1978).

No. 123. Studies on Fabric Assistance of Long Cloth Varieties—by S. R. Ganatra and V. G. Munshi (Reprinted from the *Indian Textile Journal*, December 1978).

No. 124. Determination of Bundle Tenacity of Wool Fibres Using the Stelometer—by J. K. S. Warrier and K. R. Krishna Iyer (Reprinted from *Journal of the Textile Association*, March 1979).

No. 125. A New Method for the Determination of Yarn Hairiness by Digital Fibrograph—by S. B. Pai and V. G. Munshi (Reprinted from *Textile Research Journal*, December 1978).

No. 126. Some Suggestions for Improving Cotton Ginning—by V. Sundaram (Reprinted from *Indian Cotton Mills' Federation Journal*, January 1979).

No. 127. Cotton Improvement Research in India During the Last Decade and the Role of CTRL—by V. Sundaram (Reprinted from *Journal of the Indian Society for Cotton Improvement*, September 1978).

No. 128. Know Your Cotton: (4) JKHy.1—by V. N. Shroff, R. Julka, and V. Sundaram (Reprinted from *Journal of the Indian Society for Cotton Improvement*, September 1978).

No. 129. Measurement of Imperfections and Norms for Uster Evenness (U%) and Neps for Yarn Spun at CTRL—by A. V. Ukidve and P. G. Oka (Reprinted from *Journal of the Indian Society for Cotton Improvement*, September 1978).

No. 130. The Association of Cross-Sectional Shape with Other Fibre Characters of Cotton of Species *Gossypium hirsutum*—by B. M. Petkar, P. G. Oka and V. Sundaram (Reprinted from *Journal of the Textile Association*, May 1979).

No. 131. The Design of Small Scale Lint Opener—by V. G. Munshi and H. V. Tamhankar (Reprinted from *Journal of the Textile Association*, July 1979).

No. 132. Quantitative X-ray Phase Analysis in Cottons Through Simple Indices—by P. K. Chidambareswaran, S. Srinivasan, N. B. Patil and V. Sundaram (Reprinted from *Textile Research Journal*, Vol. 49, No. 8, August 1979).

No. 133. Effect of Wetting on the Tenacity of Cotton Yarns — by K. R. Krishna Iyer, P. Bhaskar and A. V. Ukidve (Reprinted from *Journal of the Textile Association*, July 1979).

No. 134. Fine Structural Changes in Native and Mercerized Fibrous Cellulose Brought About by Ethylene-diamine and Methyl Alcohol — by P. K. Chidambareswaran, S. Srinivasan and N. B. Patil (Reprinted from *Journal of Applied Polymer Science*, Vol. 22, pp. 3089-3099, 1978).

No. 135. Effect of Crosslinking on the Torsional and Tensile Behaviour of Cotton Fibres — by K. R. Krishna Iyer, G. F. S. Hussain and P. K. Chidambareswaran (Reprinted from *Indian Journal of Textile Research*, Vol. 4, March 1979).

No. 136. Cellulase Dissolution : Electron Microscopic Technique for the Study of Chemically Modified Cotton—by S. Aravindanath, K. M. Paralikar and S. M. Betrabet (Reprinted from *Indian Journal of Textile Research*, Vol. 4, March 1979).

No. 137. The Crystal Structure of Cotton Cellulose Investigated by an Electron Diffraction Technique — by K. M. Paralikar and S. M. Betrabet (Reprinted from *Journal of Applied Crystallography*, Vol. 12, 1979).

No. 138. Agar-cup Method for Rapid Screening of Amylolytic Cultures — by S. G. Gayal and V. G. Khandeparkar (Reprinted from *Indian Journal of Microbiology*, Vol. 19, No. 2, April-June 1979).

No. 139. Determination of Approximate Cotton Fibre Fineness Using the Digital Fibrograph — by S. G. Nayar, V. G. Munshi and V. Sundaram (Reprinted from *Textile Research Journal*, Vol. 49, No. 9, September 1979).

No. 140. Know Your Cotton : (5) MCU.5—by S. Kamalanathan, V. Sundaram and K. V. Srinivasan (Reprinted from *Journal of the Indian Society for Cotton Improvement*, March 1979).

No. 141. Crystallite Orientation Parameters and Tensile Properties of Cotton Fibres—by J. K. S. Warrier, V. G. Munshi and P. K. Chidambareswaran (Reprinted from *Textile Research Journal*, Vol. 49, No. 10, October 1979).

No. 142. A Survey of Research on Cotton Production in India During the Last Decade in Relation to Quality and Specific End-Uses

by S. M. Betrabet, M. S. Parthasarathy and V. Sundaram (Reprinted from the 63rd Annual Conference of the Textile Institute, January 18-23, 1979, at IIT, New Delhi).

D. Papers Presented at Conferences/Seminars

1. Electron Diffraction Studies on Indian Silk—by N. V. Bhat, G. S. Nadigar, K. M Paralikar and S. M. Betrabet (Presented at the 11 Annual Conference of the Electron Microscope Society of India, held at Madras in January 1979).
2. A Survey of Research on Cotton Production in India During the Last Decade in Relation to Quality and Specific End-Uses — by S. M. Betrabet, M. S. Parthasarathy and V. Sundaram (Presented at the 63rd Annual Conference of the Textile Institute, Manchester, held at New Delhi in January 1979).
3. An Optical Scanning Method for Quick and Accurate Determination of Fibre Fineness — by S. G. Nayar, V. G. Munshi and V. Sundaram (Presented at the 20th Joint Technological Conference of ATIRA, BTRA and SITRA, held at Coimbatore in February 1979).
4. Comparative Performance of Conventional and High Speed Draw Frame—by M. S. Parthasarathy, B. Srinathan and K. S. Bhyrappa (Presented at the 20th Joint Technological Conference of ATIRA, BTRA and SITRA, held at Coimbatore in February 1979).
5. Radiation Induced Crosslinking of Cellulose with Formaldehyde and Dimethyloldihydroxy ethylene urea (DMDHEU)—I. G. Bhatt, V. Sundaram, S. M. Betrabet, V. Iyer and A. W. Shringarpure (Presented at the 20th Joint Technological Conference of ATIRA, BTRA and SITRA, held at Coimbatore in February 1979).
6. Effect of Gamma-ray Radiation of Raw and Chemically Treated Cotton Celluloses — by V. Sundaram, I. G. Bhatt and P. K. Chidambareswaran (Presented at the Department of Atomic Energy Conference at Anand, Gujarat, held in February 1979).
7. Study on Stability and Keeping Quality of Cottonseed Oil, Vanaspati and Other Edible Oils — by S. N. Pandey (Presented at the International Congress on Oil Seeds and 34th Annual Convention of Oil Technologists' Association of India, held at New Delhi in February 1979).
8. Semi-solid Fermentation of Paddy Straw and Wheat Straw — by R. H. Balasubramanya and S. P. Bhatawdekar (Presented at the 20th Annual Conference of the Association of Microbiologists of India, held at Hissar in November 1979).
9. Technological Aspects of Cotton Research — by P. G. Oak (Presented at the Cotton Seminar and Exhibition, held at Ichalkaranji in November 1979).

10. The Structure of Cotton Cellulose II and III by Electron Diffraction Technique — by K. M. Paralikar and S. M. Betrabet (Presented at the 12th Annual Conference of Electron Microscope Society of India held at Chandigarh in December 1979).
11. Electron Diffraction Study of Cellophane — by S. Aravindanath, K. M. Paralikar, S. M. Betrabet and N. K. Chaudhuri (Presented at the 12th Annual Conference of Electron Microscope Society of India held at Chandigarh in December 1979).
12. A Technical Survey of the Conditions of the Cotton Ginning and Pressing Factories in Punjab, Haryana and Rajasthan—by G. S. Rajaraman, D. G. Shete and D. V. Mhadgut (Presented at the National Seminar on Ginning held at Bhatinda in December 1979).
13. Contribution of Cotton Technological Research Laboratory to the Improvement of Cotton Ginning in India — by V. Sundaram (Presented at the National Seminar on Ginning held at Bhatinda in December 1979).
14. Studies on the Ginning Out-turn and Performance of Different Varieties of Cotton in North Zone — by M. S. Kairon and S. N. Nagwekar (Presented at the National Seminar on Ginning held at Bhatinda in December 1979).
15. Evaluation of Some Methods for Assessment of Spinnability of Cottons — by M. S. Anjane and M. S. Parthasarathy (Presented at the 36th Textile Association Conference held at Nagpur in December 1979).
16. A Technical Survey of the Conditions of the Cotton Ginning and Pressing Factories in India — by G. S. Rajaraman (Presented at the 36th Textile Association Conference, held at Nagpur in December 1979).
17. Measurement of CRA by Monsanto, Metrimpex and Shirley Testers—by M. S. Sitaram, A. W. Shringarpure, I. G. Bhatt, G. R. Phalgumani and B. R. Manjunatha (Presented at the 36th Textile Association Conference, held at Nagpur in December 1979).
18. A New Approach to the Formulation of Fibre Quality Index — by S. G. Nayar, V.G. Munshi and A. V. Ukidve (Presented at the 36th Textile Association Conference, held at Nagpur in December 1979).

E. Miscellaneous Publications

1. Hand book of Methods of Test for Cotton Fibres, yarns and Fabrics (Revised Edition).
2. Testing House Rules and Regulations and Schedule of Fees for Various Tests

F. Technological Circulars

Trade Varieties of Indian Cottons

T.C. No.	*Variety*	*T.C. No.*	*Variety*
1966	Gujarat 67 (Kutch)	1988	Hybrid 4 (Korjan Palej)
1967	Hybrid 4 (Junagadh)	1989	MCU.5 (Tamil Nadu)
1968	Laxmi	1990	Buri 1007 (Vidarbha)
1969	Nimbkar	1991	Varalaxmi (Andhra Pradesh)
1970	J.34 (Punjab)		
1971	Sanjay (Botad)	1992	MCU.5 (Andhra Pradesh)
1972	J.34 (Rajasthan)	1993	V.797
1973	Bengal Desi (Punjab)	1994	Digvijay (Palej)
1974	Y.1	1995	Suvin
1975	Virnar (Khandesh)	1996	Virnar (Madhya Pradesh)
1976	Varalaxmi (Maharashtra)	1997	My.14
1977	Hybrid 4 (Kopergaon—Irrigated)	1998	Laxmi
		1999	Hampi
1978	Deviraj (Karnataka)	2000	Hybrid 4 (Andhra Pradesh)
1979	Sea Island Andrews (Karnataka)	2001	Bhagya
		2002	Deviraj (Saurashtra)
1980	Bengal Desi (Rajasthan)	2003	Suyodhar
1981	C. Indore 1	2004	Jayadhar (Hubli)
1982	320F (Rajasthan)	2005	Maljari
1983	Comillas	2006	Khandwa 2
1984	Gaorani 6	2007	JKHy.1
1985	Narmada	2008	Hybrid 4 (Madhya Pradesh)
1986	Buri 147 (Vidarbha)	2009	Badnawar 1
1987	AK.235		

Standard Indian Cottons

T.C. No.	*Variety*	*T.C. No.*	*Variety*
175	V.797	184	Deviraj (Gujarat)
176	Gujarat 67	185	Hybrid 4 (Gujarat)
177	Sea Island Andrews (Karnataka)	186	Digvijay
		187	MCU.7
178	Krishna	188	V.797
179	Jayadhar	189	Hampi
180	AK.277	190	Gujarat 67
181	Sanjay (Amreli)	191	Badnawar 1
182	Buri 147	192	Jayadhar
183	MCU.5 (Tamil Nadu)		

4. EXTENSION

Cotton Technological Research Laboratory has no farm attached to it and, therefore, field work is carried out at various Central Institutes, Agricultural Universities and Regional Units in different cotton growing states of the country. Thus, the Laboratory does not directly deal with the farmer community. However, CTRL renders valuable assistance to cotton growers indirectly, by undertaking various tests for quality of cotton samples sent by them, by the trade and the industry, by the Government and civic organisations, etc., in addition to imparting training in cotton technology and supplying various testing instruments from time to time.

Testing Work

Apart from the research samples received from various agricultural stations, this Laboratory continued to receive a number of samples of fibre, yarn and cloth for tests from commercial firms and Government and semi-Government organisations. The number of such samples received and tested on payment of the prescribed fees during the year 1979 together with the corresponding figures for 1977, 1978 and for the quinquennium 1971-75 are given in Table 29.

TABLE 29 : NUMBER OF SAMPLES RECEIVED FOR PAID TESTS

Type of Test	Average for the quinquennium 1971-75	1977	1978	1979
Spinning	10	67	67	65
Fibre (EICA)*	16	189	163	116
Fibre (Others)	193	154	126	138
Yarn	37	61	20	51
Cloth	48	60	110	73
Moisture	73	1	—	—
Miscellaneous	8	25	26	22
Total	385	557	512	465

* The samples from the East India Cotton Association, Limited (EICA), Bombay, are tested free of charge as EICA reciprocates by supplying free of charge a number of samples (6 kg each) of the Trade Varieties and also the Grader's valuation reports on samples of improved cotton strains sent to them by this Laboratory.

The total test fees realised during 1979 for carrying out tests on these samples amounted to Rs. 24,349.20 against Rs. 30,134.10 during 1978.

Some special tests carried out, apart from the usual tests of routine nature, included the following:

1. A *kapas* sample received from a Public Sector Organisation was subjected to fibre tests in order to verify the admixture of varieties as well as mixing of different pickings. It was observed that the sample might have been from the last picking and that the sample which had large amounts of immature and insect-damaged locks and also light and heavy trash including soil, could be a mixture of at least two varieties.

2. One bast fibre sample received from a commercial firm at Jakarta in Indonesia was tested for various fibre characteristics.

3. One cotton sample received from a spinning mill in South India was subjected to Open-End Spinning for five counts with different TPI.

4. One sample of Vincel High Wet Modulus fibre was received from a Bombay firm for length and denier determination by the standard procedure.

5. A few polyester fibre samples from an indigenous producer were received for determining denier, tensile strength and elongation on Instron Tensile Tester.

6. Three yarn samples were received from two textile agencies in Bombay for identification of component fibres and their percentages.

7. An internationally reputed tooth brush manufacturing firm had sent five samples of Nylon 66 Monofilament for testing breaking strength and extension at a specified gauge length of 31.5 mm on Instron Tensile Tester.

8. Three tissue paper samples were received from a petroleum products' firm for identification of cellulose fibres and for preparation of photo-micrographs.

Training

The Laboratory is conducting two full time training courses lasting eight weeks each, one from July to September and the other from September to November for those deputed by cotton trading organisations in Bombay and mofussil centres. During the year, the following eight persons attended the training course which consisted of lecture and practical work on methods of

evaluation of cotton fibre quality and interpretation of the test results based on statistical analysis.

1. Shri Jogesh Kumar Dinanath Kapur,
   26, Khimji Maharaj Building,
   Mahatma Gandhi Road,
   Bombay-400 080.
2. Shri Satish R. Shah,
   C/o. M/s. Bhaidas Cursondas & Co.,
   16, Bombay Samachar Marg,
   Bombay-400 023.
3. Shri Prashant M. Marfatia,
   113, Bhuleshwar Road,
   Bombay-400 002.
4. Shri Hirendra Velji Shah,
   C/o. M/s. East India Co.,
   178, Sant Tukaram Road,
   Bombay-400 009.
5. Shri Jagdhish Ravjibhai Patel,
   Gujarat State Co-operative Cotton Marketing Federation Ltd.,
   Navarangpura,
   Ahmedabad-380 009.
6. Shri S. P. Asawa,
   453/454 West Mangalwar Peth,
   Solapur 2.
7. Shri R. B. Gawde,
   M/s. Rallis India Ltd.,
   Khandwa, M.P.
8. Shri Vadvai Deepak Mulji,
   M/s. Viram Ladha & Co.,
   62/66, Veer Vithaldas Chandan Street,
   Bombay-400 003.

5. CONFERENCES AND SYMPOSIA

Director and other Scientists of the Laboratory participated in the following Scientific and Technological Conferences and Meetings Connected with the work of this Laboratory:

Sr. No.	Meeting/Conference	Place	Date	Names of the officers who attended the meeting/conference
1.	Workshop Meeting on Rural Orientation of Agricultural Research Service and Golden Jubilee Programme organised by ICAR.	Hyderabad	4-1-1979 and 5-1-1979	Dr. N. B. Patil
2.	Eleventh Annual Conference of Electron Microscope Society of India held at Madras Medical College.	Madras	8-1-1979 to 10-1-1979	Dr. K. M. Paralikar
3.	Meeting of Task Force to go into the details of the Programme of Research Project Files.	New Delhi	18-1-1979	Dr. V. Sundaram
4.	Sixty-third Annual Conference of Textile Institute, Manchester.	New Delhi	19-1-1979 to 23-1-1979	Dr. V. Sundaram Dr. S. M. Betrabet Dr. N. B. Patil Shri M. S. Parthasarathy Dr. S. N. Pandey
5.	International Conference jointly sponsored by Bombay Sections of Textile Association of India and Textile Institute, Manchester, UK.	Bombay	29-1-1979 and 30-1-1979	Dr. V. Sundaram Dr. N. B. Patil Dr. K. R. Krishna Iyer Shri B. Srinathan Shri P. G. Oka Kum. I. G. Bhatt Shri T. N. Ramamurthy Shri P. K. Chidambareswaran
6.	Twentieth Joint Technological Conference of ATIRA, BTRA and SITRA held at SITRA, Coimbatore.	Coimbatore	9-2-1979 to 11-2-1979	Dr. V. G. Munshi Shri M. S. Parthasarathy Shri B. Srinathan Kum. I. G. Bhatt Smt. V. Iyer Shri A. W. Shringarpure Shri S. G. Nayar
7.	International Congress on Oilseeds and Oils.	New Delhi	9-2-1979 to 13-2-1979	Dr. S. N. Pandey
8.	SASMIRA Conference.	Bombay	9-2-1979	Dr. V. Sundaram Shri T. N. Ramamurthy

Sr. No.	Meeting/Conference	Place	Date	Names of the officers who attended the meeting/conference
9.	Symposium on "Industrial Polymers and Radiation", organised by the Department of Atomic Energy, held at Sardar Patel University, Vallabh Vidyanagar, Gujarat.	Anand	12-2-1979 to 14-2-1979	Dr. V. Sundaram Kum. I. G. Bhatt Shri P. K. Chidambareswaran
10.	Meeting of the Scientific Panel for Post-Harvest Technology of ICAR.	New Delhi	26-2-1979	Dr. V. Sundaram
11.	Conference of the Directors of ICAR.	Karnal	28-2-1979 to 3-3-1979	Dr. V. Sundaram
12.	Meeting of the Research Advisory Committee of SITRA.	Coimbatore	19-3-1979 and 20-3-1979	Dr. V. Sundaram
13.	Meeting of the Research and Advisory Committee of BTRA, Bombay.	Bombay	29-3-1979	Dr. V. Sundaram
14.	Twenty-third Annual Meeting of the Textile Divisional Council of Indian Standards Institution.	Bangalore	30-3-1979	Shri M. S. Parthasarathy
15.	North Zone Panel Meeting of AICCIP.	Ludhiana	3-4-1979 and 4-4-1979	Shri P. G. Oka
16.	Group Discussion on "Modernisation — Approach and Priority" arranged by Textile Association.	Bombay	6-4-1979	Shri M. S. Parthasarathy Shri T. N. Ramamurthy Shri Muntazir Ahmed Shri K. S. Bhyrappa
17.	Central Zone Panel Meeting of AICCIP.	Nagpur	9-5-1979 and 10-5-1979	Shri P. G. Oka
18.	Technical Seminar on Shuttleless Weaving organised by Textile Association, Bombay.	Bombay	29-5-1979	Shri T. N. Ramamurthy Shri Muntazir Ahmed Shri K. S. Bhyrappa
19.	South Zone Panel Meeting of AICCIP.	Dharwad	6-6-1979 and 7-6-1979	Shri P. G. Oka
20.	Sixth Meeting of the Research and Development Sub-committee of Cotton Development Council.	Bombay	11-7-1979	Dr. V. Sundaram
21.	ICAR Golden Jubilee symposium and IFARD Global Convention on Agricultural Research and Education Systems for Development.	New Delhi	3-9-1979 to 6-9-1979	Dr. V. Sundaram Dr. S. M. Betrabet Dr. N. B. Patil Shri M. S. Parthasarathy Dr. V. G. Munshi
22.	Seventeenth Meeting of the Indian Cotton Development Council.	Hissar	11-9-1979	Dr. V. Sundaram
23.	Seminar on "Value Added Fat Products" organised by Oil Technologists' Association of India, held at VJTI.	Bombay	7-10-1979	Dr. S. N. Pandey

Sr. No.	Meeting/Conference	Place	Date	Names of the officers who attended the meeting/conference
24.	National Seminar on Canary Colouration of Indian Wools organised by CSWRI.	Jaipur	13-10-1979 and 14-10-1979	Shri T. N. Ramamurthy
25.	Twentieth Annual Conference of the Association of Microbiologists of India.	Hissar	1-11-1979 to 3-11-1979	Dr. R. H. Balasubramanya
26.	Seminar on "Improvement of Cottons in India."	Ichalkaranji	26-11-1979	Shri P. G. Oka
27.	Pye-Unicam Analytical Symposium held at Hotel President.	Bombay	28-11-1979 and 29-11-1979	Dr. S. N. Pandey
28.	Symposium on ITMA organised by Textile Association of India, Bombay.	Bombay	30-11-1979	Shri M. S. Parthasarathy
29.	National Seminar on Cotton Ginning organised by the Textile Association of India.	Bhatinda	9-12-1979	Shri G. S. Rajaraman
30.	Twelfth Annual Conference of Electron Microscope Society of India held at Central Scientific Instruments Organisation, Chandigarh.	Chandigarh	17-12-1979 to 19-12-1979	Dr. S. M. Betrabet Dr. K. M. Paralikar Shri S. Aravindanath
31.	Thirty-sixth Conference of the Textile Association of India.	Nagpur	26-12-1979 and 27-12-1979	Shri M. S. Parthasarathy Dr. V. G. Munshi Shri G. S. Rajaraman Shri A. V. Ukidve Shri M. S. Sitaram Shri A. W. Shringarpure Shri S. G. Nayar

In additon to the above, Director and other Scientists of the Laboratory attended meetings of several sub-committees of the Indian Standards Institution, pertaining to the standardisation of textile materials and test methods.

The Director also attended various meetings of the Board of Directors of Cotton Corporation of India and National Textile Corporation (M.P.) Ltd., Management Committees of Central Institute for Cotton Research, Nagpur, and Krishi Vigyan Kendra, Kosbad, Governing Council of BTRA and the Board of Management of VJTI, Bombay.

6. SUMMARY OF THE REPORT

This is the 56th Annual Report of the Laboratory covering the calendar year 1979. The Laboratory continued to function as the co-ordinating centre on cotton technology under the AICCIP and collaborated actively with cotton breeders and agricultural scientists in their endeavour to evolve new strains of cotton by authoritative evaluation from time to time of the quality characteristics of improved cotton strains. Several samples of cotton, yarn and fabric received from trade and industry for paid tests were evaluated for desired quality characteristics. More than 50 research projects on agricultural aspects, fundamental studies in fibre physics, ginning and spinning technology, textile chemistry, microscopy and microbiology, were undertaken in addition to the regular testing and evaluation work and several papers based on these investigations have been sent for publication. Many new items of equipments were purchased and added during the year as part of the modernisation programme.

Research Activities

The progress made on various research investigations during 1979 is summarised below:

Under the AICCIP and various state schemes, 1718 samples were tested for fibre quality and spinning performance.

The panel meetings of the Breeding and Technology Group of Central Zone and South Zone under the AICCIP recommended for pre-release seed multiplication the following improved strains/hybrids:

Strains/hybrids	*Special features*
	CENTRAL ZONE
1449	A *herbaceum* strain, maturing 5 to 6 weeks earlier than Digvijay, having more yield than the existing varieties Digvijay and Sujay. Average reaction to pests and diseases. Spinning potential around 30s.

Strains/hybrids	*Special features*
CENTRAL ZONE	
GHH.3	A *hirsutum* × *hirsutum* hybrid recording 29% higher yield than Hybrid 4; matures 3 weeks earlier. More tolerant to sucking pest, blackarm and alternaria than Hybrid 4. Spinning potential: 70s.
SOUTH ZONE	
DCH.32 (Interspecific hybrid)	Earlier in maturity by 10 days than the existing hybrid, Varalaxmi; more synchronous in flowering and fruiting. Spinning potential 70s to 80s count.
DS.56	Matures in about 150 days; compact plant type with less foliage; more synchronous in flowering and fruiting; larger boll size. Spinning capacity 40s.
DS.59	Matures in about 165 days; superior fibre characteristics and spinning potential than Hampi.
SRG.26	Tall with medium internodes, large bolls and less leaf canopy; higher yield than 170-Co.2.
DB.3-12	Dwarf compact plant-type; maturing in about 165 to 170 days; higher lint index and ginning percentage than Jayadhar.

In order to study whether there exists any variation in the fibre properties of samples picked at different intervals, samples of three varieties, viz. MCU.5, Varalaxmi and Suvin, from different pickings procured from Pollachi and Palani in Tamil Nadu, were tested for fibre length, maturity, Micronaire Value and strength at zero gauge length. The test results indicated that there was no noticeable difference in fibre properties amongst pickings.

A study of the effect of nitrogenous and phosphatic fertilisers on the yield and quality of Hybrid 4 cotton revealed that the nitrogen levels produced significant impact on the yield of cotton and this was proportional to the dosage of the fertiliser applied, while the phosphorous levels failed to produce any

significant effect on the cotton yield. The fibre properties were not much affected by the application of fertilizers in the dosages employed.

The trash in the commercial cottons is mainly in the form of leaf-bits, bract pieces, etc., and since it is likely that hairy leaves may cling to cotton fibres more easily than the non-hairy leaves, it was considered desirable to study the leaf hairiness in different varieties. Accordingly, leaves of 20 varieties were examined under the microscope and based on the density of hair, five grades have been suggested.

The Optical Fineness Coefficient (OFC) and the Optical Index of Maturity (IOM) values computed from Digital Fibrograph test readings revealed that the correlations obtained between actual Gravimetric Fineness (GF) values and OFC measures were constantly superior to those obtained between GF and Micronaire values. In respect of maturity measurement, a comparative study was made between the existing Micronaire spacer technique and the new Fibrogaph method in their association with maturity by caustic soda test. The analysis of the test data showed that the values of maturity coefficient predicted from IOM were significantly better approximations of the actual results by caustic soda method than those determined by the spacer technique.

Changes in instrumental parameters, such as the colour characteristics of the light employed, the voltage applied to the photomultiplier, the magnification of the mircoscope objective, etc., were found to have no adverse effect on test results of maturity measurement by the new optical method. Since objective size was found to be immaterial, it was decided to dispense with the objective so that the size of the sample tested at a time is effectively increased. Results of fresh tests carried out without the objective on the same sample already tested last year showed good agreement with those obtained earlier confirming that the experimental set up for maturity measurement gives consistent results.

The X-ray orientation angle of unconvoluted cotton fibres obtained from seven varieties of cottons belonging to the *barbadense* and *hirsutum* species using the solvent exchange procedure standardised in this Laboratory were compared with those obtained for fibres which were dried in the natural way thereby allowing free formation of convolutions. While the spread in the 50% X-ray angle of the air-dried samples from these seven varieties was about 8°, it was narrowed down to about 3° in the solvent exchanged samples, signifying that a large part of the differences in spiral angle found among cotton varieties is attributable to convolutions.

The changes in cross-sectional parameters of cotton fibres brought about by crosslinking with DMDHEU and during subsequent wetting in water were studied. In the case of DMDHEU treated fibres, there was a progressive increase in mean area and perimeter as the degree of crosslinking was increased. Crosslinking with DMDHEU reduced the swelling in water and with increased degree of crosslinking there was further reduction of swelling in water.

SUMMARY OF THE REPORT

Analysis of data on various measures of X-ray angle in relation to tenacity on 20 samples of *G. barbadense* cottons revealed that the 20%, 40%, 50% and 75%X-ray angles correlated in the decreasing order of magnitude with tenacity at zero and 3mm gauge lengths, while for elongation at 3mm gauge length, a reverse trend was noticed. These results confirm the previous finding that 20%X-ray angle is more related to strength while the 75%X-ray angle is best suited for the prediction of elongation.

In connection with the study on inheritance of strength and structural parameters in cotton fibres, only one more step of purification of parents was attempted, as the samples could be harvested only towards the end of the year.

Two X-ray diffraction methods were developed which might be useful for blend analysis of cotton/viscose yarns. One of them may be useful for analysis of blended fabrics also. A new and easier method was developed for analysing cotton / jute blends and analysis of cotton / polynosic and cotton/polyester blends have been initiated.

A detailed study has been made of the dyeing behaviour of cotton fibres subjected to decrystallisation involving partial acetylation (PA) and partial cyanoethylation (PC) by procedures standardised at CTRL. The dye uptake increased with the degree of substitution (DS) in both cases over the control sample though it levelled off later on. The PC samples dyed better than the PA samples at any given DS indicating better decrystallisation in the former. The superiority of PA and PC samples over the control was evident even after crosslinking in DMDHEU though there was a general reduction in dye uptake after crosslinking.

The electron diffraction (ED) technique earlier used was modified by using more sensitive fast film to record larger number of reflections in the ED pattern of modifications of celluolse II and III. About 40 reflections per quadrant were observed in both the cases. The reflections were indexed assuming monoclinic unit cell and unit cell parameters were also determined.

The ED technique was used to determine the lateral order factor of four samples of Indian silks and compared with that obtained by X-ray diffraction technique. The profiles of 002 and 201 planes were better resolved by the ED technique.

The values of nll, $n_{\perp}$, $\triangle n$ and average refractive indices, determined at 28°C by the immersion technique, decreased with increase in degree of substitution (DS) for acetylated and cyanoethylated cotton (modified with aliphatic groups). For benzoylated cotton nll decreased slightly while $n_{\perp}$ increased. For benzylated cotton nll decreased and $n_{\perp}$ increased but both values remained steady after a certain DS. The $\triangle n$ values of both benzoylated and benzylated cottons decreased, but in the latter it remained constant after a certain DS. The average refractive indices were higher than that of control for cotton substituted with aromatic groups.

In connection with the preparation and standardisation of calibration cotton samples, the procedures for processing the cotton samples into well

opened, cleaned and thoroughly homogenous blends were standardised by preliminary work carried on two samples with wide ranging fibre length and fineness characteristics. Initially, 15 kg each of the varieties, Varalaxmi and G.6, were processed to prepare card lap samples. Twenty sub-samples of each lot were then tested on Fibrograph and Micronaire. The analysis of the test data indicated that the variations observed for individual test results between operators and within operators were well within tolerance limits. In the second stage of the work, a blend of the two varieties of cotton in the proportion of 50 : 50 is being processed.

A long staple cotton, Hybrid 4, was taken up for the studies on both conventional and high speed drawing frame using different combinations. The yarns produced were tested for yarn characteristics. The results indicated that the use of wider settings of 38 mm and 42 mm for the back and front zones, respectively, have produced yarns with better strength and regularity of count and strength. For closer settings, while higher break draft of 1.7 at the first passage of draw frame is essential, differences are not so marked as at the wider settings. Throughout, the high speed draw frame has given better yarn quality than conventional draw frame.

The strength and extensibility of optimally twisted cotton yarn is found to rise by about 25% and 13%, respectively, on wetting the sample. The tenacity (TC) and extension (EC) of the yarn in the conditioned state (65% rh) can be estimated with reasonable accuracy from the corresponding values (TW and EW) determined on wet yarn by using the following regression equations :

$$TC = 0.86\ TW - 1.11$$
$$EC = 0.43\ EW - 3.37$$

where tenacity values are expressed in grams per tex and extension values in percentage. Where quick results are required on yarn samples of unknown moisture history, tests in the wet state would be advantageous.

Single strand strength, lea strength and knotted lea strength were determined on 39 yarn samples for assessing the extent of strength realised in a lea. Out of the different averages worked out from single strand test data, viz. the lowest and the averages of the lowest 5, 10, 15, 20, 23, 25 strength values, sub-mean and the mean, the sub-mean gave the highest correlation with the lea strength as well as with the knotted lea strength. Further, the knotted lea strength was about 7% higher than the normal lea strength indicating that knotting leads to better strength realisation.

Mean fibre length (by number) estimated for 37 cottons, by using a sampling procedure to estimate the number of fibres in each of 8 length groups in an array prepared for each sample, agreed closely with the Baer Sorter mean length (CTRL) and was equal to 0.9 times the 2.5% span length determined with the Fibrograph for all the cottons. When the fibre strength values cal-

culated uniformly for all cottons, in terms of breaking load in kg per 1 mg of the sample for zero gauge and 3 mg of the sample for 1/8" gauge, using the rate of increase in fibre breaking load per unit weight of the sample derived from the test results, were compared with the strength values arrived at by the conventional method, the latter were divergent from the calculated values in those cases where the tuft specimens taken were wide off the prescribed average weight.

An attempt has been made to formulate a simplified Index of Fibre Quality by modifying the basic formula given by Lord by replacing the conventional measures of fineness and maturity by optical indices obtained from Fibrograph tests. The Optical Fineness Coefficient (OFC) is given by the formula $\left(\frac{W}{A \times L}\right)^2$ and the Optical Index of Maturity (IOM) by $\frac{A^2}{W}$, where W is the weight of the fibre beard, A the amount counter reading at 100% and L the 2.5% span length. The new Fibre Quality Index (I) is given by the formula, $I = \frac{L^2 L_1 S}{W}$, where L and L_1 represent the 2.5% and 50% span lengths, respectively, S the bundle strength at 3 mm gauge, W the weight of the test beard. A simplified Index (I_2) obtained exclusively from Fibrograph test readings is given by $I_2 = \frac{L^2 L_1}{W}$. The efficiency of both these indices for assessing spinnability has been examined by statistical analysis of the data.

In connection with the study on Optimal Blending of Standard Indian Cottons, individual fibre and spinning tests on four cottons from Maharashtra, viz. Varalaxmi, MCU.5, H.4 and Nimbkar, were completed. The latter three cottons were then blended in different proportions to produce three mixings which had similar fibre quality index values. Spinning tests on two of the blends were completed while spinning of the third is in progress.

Three cottons, viz. Virnar, 320F and Deviraj, having varying Micronaire values were selected for the study of physical characteristics of their blends. Virnar was first blended with 320F and then with Deviraj in the proportion of 50:50 and a common count of 30s was spun. The blended yarns were tested for the different yarn characteristics.

A study was undertaken utilising cotton waste, viz. flat strip of 30s mixing, in blend with jute caddies. Flat strip (75%) was processed through blowroom using Hopper blender, SRRL, Shirley Opener and was blended with 25% of jute caddies which was cleaned earlier using two passages through Kirschner Beater. The blended material was then given two passages at the Scutcher. The lap produced was then carded at 8 lb/hour using MMC metaltic card. The carded sliver was processed on drawing and slubber to produce 0.45 hk. 6s count yarn was spun from blends on SKF spin tester.

The yarn produced was tested for yarn characteristics. On comparison with similar trials using a pure variety, V.797, it was observed that total card waste is less by 4.83% in case of waste cotton/jute blend. The reduction is mainly due to less licker-in waste. Although the values of lea strength, single thread strength and elongation are higher in the case of cotton waste/jute blend, the yarns are, however, poorer as compared to pure cotton/jute blend with regard to yarn evenness and number of imperfections.

A new variety of cotton PSH was blended with 38 mm, 1.2 d, high tenacity polyester fibre in three different proportions of 75:25, 50:50 and 33:67 cotton: polyester and then spun to 80s. Comparison of the yarns produced from these blends with yarns from similar proportions of Suvin:polyester revealed a distinct reduction in neps for the PSH blended yarns though the Suvin blended yarns were stronger.

The effect of slack and stretch mercerisation on the dynamic and static moduli of cotton yarn was studied by using the Pulse Propagation Meter and the Instron Tensile Tester. It has been found that slack mercerisation brings about considerable reduction in both the dynamic and static moduli. On the other hand, if mercerisation is accompanied by stretch to levels beyond the initial length of the yarn, it leads to an enhancement of the modulus values above those of the unmercerised yarn. The ratio of dynamic modulus to the static modulus was found to be very high for the slack mercerised sample while for the stretch mercerised yarns, it was very much reduced. These changes could be explained in terms of the reduction in crystallinity on slack mercerisation, and the improvement in fibrillar orientation due to stretch.

Four varieties of cotton cloth, viz. Drill, Sheeting, Poplin and Cambric, were imparted durable press property by treating with DMDHEU and evaluated for dry and wet Crease Recovery Angle (CRA) on Monsanto and Metrimpex Crease Recovery (CR) Testers at CTRL and on Shirley CR Tester at Central Testing Laboratory of Textiles Committee. The results showed that Monsanto CR Tester generally showed higher CRA, while Shirley exhibited lower values. Further there was no appreciable effect of load, time of loading, and time of relaxation on CRA. However, when a plastic strip of 0.2 mm thickness was inserted for creating fold in the sample in the Metrimpex and Shirley CR Testers, CRA values were in close agreement with those on Monsanto CR Tester.

Preliminary work carried out on seven fabric samples which were subjected to flex-abrasion tests (Stoll Method) on the control sample as well as on the samples from which one-inch length of crossing threads were removed, revealed that the values for flex-abrasion for the one-inch ravelled fabric strips consisting of warp threads was less than the control sample by about 39 to 74%. Similarly, for strips consisting of weft threads it was less by about 44 to 89%.

Five grey fabrics varying in count and construction were subjected to tearing strength test by the three instruments, viz. Elmendorf, Ballistic and Tongue tear testers. It was observed that there was significant correlation (*i*) between test results with Elmendorf and Ballistic tear testers using both warp and weft direction samples, and (*ii*) between test results of both Elmendorf and Ballistic tear testers and those of Tongue tear tester in the case of weft direction samples only.

Preswelling and crosslinking studies were undertaken on doubled yarns of three varieties of cotton. The yarn samples were given treatments as follows:

(*i*) Conventional crosslinking (CCL).
(*ii*) Mercerised-Stretched-Washed and crosslinked in wet state (MWCL).
(*iii*) Mercerised as in (*ii*) and crosslinked after drying.

In general MWCL treatment consistently exhibited higher retention of tenacity and toughness in all the varieties.

Two cotton:polyester blended samples were given finishing treatments in order to obtain optimum balance between wash and wear and mechanical properties and the treated samples were tested for strength and percentage elongation.

Cotton:polynosic blended fabric was given resin finishing treatment using mixtures of resins (DMDHEU+MMM) by poly-set process. Treatment was also carried out using different concentrations of DMDHEU by conventional process. From the study it was observed that the fabric treated by poly-set process showed higher strength retention and abrasion resistance as compared to the fabric treated by conventional process.

In the study on the migration of resin in cotton fabric, it was observed that the rate of drying and the migration of both the resins, triazone and DMDHEU, showed the same trend. The work was also carried out on polyester: cotton blended fabrics in the presence of two different softeners, viz. Vasrang PE and Arkoline SPW using DMDHEU as crosslinking agent. Fabric samples treated with Vasrang PE as softener showed lower rate of drying compared to the later softener. The migration of DMDHEU was found to be higher in the case of Arkoline SPW treated samples compared to Vasrang PE treated samples.

Acrylonitrile (AN) and mixture of AN and styrene were grafted onto cotton fabric by ceric ion initiation method under different experimental conditions. Initiator concentration of 0.004M gave the maximum per cent graft. Monomer mixture having the composition of 60:40 (styrene:AN) gave higher per cent graft than the other mixtures.

Various trials were carried out on cotton fabrics to impart simultaneously two characteristics, viz. flame proofing by phosphorylation and crease

resistance by crosslinking. A new method to synthesise propargyl-cellulose from allyl cellulose by a three-step process was developed.

Post irradiation activity of allyl cellulose estimated by grafting with acrylonitrile in 50 % $ZnCl_2$ was found to be higher than that of raw control sample.

Pineapple yarn on irradiation with gamma-ray showed decrease in tenacity retention value.

In connection with the study on water absorbency of cotton, 18 varieties of cotton were tested for Glycerin Retention Value (GRV), Water Holding Capacity (WHC) and Sinking Time. The results indicated that certain varieties though passing the test for sinking time failed to pass the test for WHC. The varieties Lohit, LD.133 and Digvijay showed promising results.

The results of the ED and XRD studies of wood pulp (starting material), alkali cellulose (intermediate product) and NaoH-treated cellophane, revealed that the crystallites of cellulose I, a sort of 'nuclei' in wood pulp, seem to persist in alkali cellulose, grow during further processing of alkali cellulose which eventually give ED pattern of cellulose I. But the crystallites of cellulose I in cellophane are small both in quantity and size and hence X-rays fail to detect their presence in XRD. The ED pattern of alkali cellulose was typical cellulose II. However, the cellulose II crystallites in cellophane are smaller and unstable compared to alkali cellulose and get feebly recorded in ED pattern.

Studies on the activity of enzyme involved in cellulose biosynthesis in developing cotton fibres indicated two peaks of enzyme activity, one at 15 days and the other at 30 to 40 days post anthesis, respectively. A gradual increase in cellulose content and decrease in copper number was observed with the development of cotton fibre.

The enzyme activity during *in vitro* synthesis of cellulose by particulate enzyme system was of the order of 20 μg glucose per mg enzyme protein. The two electron diffraction patterns obtained of the polymer formed by *A. xylinum*, when grown on various carbon sources, resembled that of a typical cellulose I pattern and a spot pattern, respectively. An intermediate polymer of cellulose isolated is being characterised.

Preliminary studies on the estimation of dissolved oxygen were carried out on Modular Fermenter. The presence of hemi-cellulases in the filtrate of *Penicillium funiculosum* was confirmed by demonstrating xylanase, mannanase and arabanase activities in it. The intracellular beta-glucosidase of *Candida utilis* was strongly induced by xylose and to a lesser extent by ethanol and cellobiose. Electrophoresis of cellulase (*P. funiculosum*) on acrylamide showed 6 bands. Out of the two prominent bands the first and second bands were rich in beta-glucosidase and CM-cellulase, respectively. However, these bands were not pure proteins and had other enzyme activities.

SUMMARY OF THE REPORT

Acid hydrolysed and ammoniated paddy straw and wheat straw were enriched with microbial proteins. *Penicillium funiculosum* enhanced the crude protein of paddy straw three-fold, while *C. utilis* enhanced the crude protein of wheat straw two-fold. There was about two-fold increase in crude fat and 20% to 30% increase in the *in vitro* digestibility of the enriched straws. Feeding trials on ruminants indicated that the enriched straws increased the digestibility by 30% than the control.

Pot culture trials on control of *Verticillium* wilt were undertaken using prawn shell waste, a cheaper medium, instead of chitin, and the study was extended to the control of *Fusarium* wilt and *Rhizoctonia* root rot. A similar study was carried out in field trials at CICR, Coimbatore, on the control of only *Verticillium* wilt. The results on pot cultures indicated that the wilt pathogen could be effectively controlled by amending the soil with prawn shell waste. Results on field scale studies are awaited.

Analysis for fatty acid composition of cottonseed oil of 18 varieties was carried out on GLC using FID Detector. Palmitic acid was found to be in the range of 20.57% (Westerns 1) to 26.77% (Narmada) while oleic and linoleic acids were in the range of 17.49% (Sea Island) to 26.36 % (G.1) and 40.51% (G.1) to 54.96% (V.797), respectively.

The contents of cyclopropenoid fatty acids in cottonseeds of different varieties have been estimated using HBr method.

A statisfactory process for preparation of particle board from cotton plant stalk has been developed at the Laboratory. The process is economical, simple and well suited for rural areas in cotton growing tracts where stalks are available in abundance.

7. PERSONNEL

A. Appointments

(*a*) *Scientific Staff*

Smt. G. Revathi, Scientist S-1 (Bio-chemistry) was appointed on transfer from Central Mango Research Station, Lucknow, with effect from February 1, 1979.

(*b*) *Technical Staff*

1. Shri Ram Parkash, Senior Technical Assistant T-4 at Sriganganagar to the post of Quality Evaluation Officer T-6 at Akola with effect from February 1, 1979.

2. Sarvashri A. L. Muthu and J. K. Gohel to the post of Technical Assistant with effect from April 6, 1979 and May 2, 1979, respectively.

(*c*) *Administrative Staff*

1. Shri U. K. Iyer to the post of Administrative Officer (on transfer from IVRI, Bangalore) with effect from November 22, 1979.

2. Kum. Revathi K. Shetty to the post of Junior Stenographer (on transfer from Western Regional Station of NDRI, Bombay) with effect from July 21, 1979.

3. Shri Venu Thanikal to the post of Junior Stenographer with effect from August 1, 1979.

4. Shri Y. P. Belgaonkar to the post of Senior Clerk on deputation (without deputation allowance) from Western Regional Station of NDRI, Bombay, with effect from October 31, 1979.

(*d*) *Supporting Staff*

Sr. No.	*Name*	*Grade*	*Effective date of appointment*
1.	Shri V. Y. M. Suvarchala Rao	Grade I	1-1-1979
2.	,, M. B. Chandanshive	-,	2-1-1979
3.	,, P. S. Dalvi	,,	22-1-1979
4.	,, O. T. Thapa	,,	3-3-1979
5.	,, B. R. Sattam	,,	2-4-1979
6.	,, D. M. Chaugule	,,	3-4-1979
7.	,, D. B. More	,,	1-8-1979
8.	,, S. E. Temkar	,,	6-8-1979
9.	,, M. V. Bhowar	,,	6-8-1979
10.	,, S. Y. Deshmukh	,,	6-8-1979
11.	,, S. V. Naik	,,	6-8-1979

B. Assessment

(*a*) *Scientific Staff*

The Five Yearly Assessment of the eligible Scientific Personnel of CTRL for the period ending December 31, 1975, 1976 and 1977, was carried out by the ASRB in April-May, 1978. The details of promotions/advance increments granted to the scientific personnel are given below :

Promotions

Sr. No.	*Name*	*Grade to which promoted*	*Effective date of promotion*
1.	Dr. S. M. Betrabet	(Rs. 1800-2250)*	1-7-1976
2.	Dr. N. B. Patil	(Rs. 1800-2250)*	1-7-1977
3.	Shri P. G. Oka	S-2 (Rs. 1100-1600)	1-7-1976
4.	Dr. V. G. Khandeparkar	S-2 (Rs. 1100-1600)	1-7-1977
5.	Shri S. Aravindanath	S-1 (Rs. 700-1300)	1-7-1976
6.	Smt. S. P. Batawdekar	S-1 (Rs. 700-1300)	1-7-1976
7.	Shri G. F. S. Hussain	S-1 (Rs. 700-1300)	1-7-1976
8.	Dr. (Smt.) Bhama Iyer	S-1 (Rs. 700-1300)	1-7-1976
9.	Smt. Janaki K. Iyer	S-1 (Rs. 700-1300)	1-7-1976
10.	Smt. Vatsala Iyer	S-1 (Rs. 700-1300)	1-7-1976
11.	Dr. K. M. Paralikar	S-1 (Rs. 700-1300)	1-7-1976
12.	Kum. C. R. Raje	S-1 (Rs. 700-1300)	1-7-1976
13.	Shri A. J. Shaikh	S-1 (Rs. 700-1300)	1-7-1976
14.	,, S. Sreenivasan	S-1 (Rs. 700-1300)	1-7-1976
15.	,, P. V. Varadharajan	S-1 (Rs. 700-1300)	1-7-1976
16.	,, A. K. Gupta	S-1 (Rs. 700-1300)	1-7-1977
17.	,, B. M. Petkar	S-1 (Rs. 700-1300)	1-7-1977

* This scale of pay of 5-4 will be treated as personal

Advance Increments

Sr. No.	*Name*	*Number of advance increments*	*Effective date of increment*
1.	Shri A. K. Ahuja	Two	1-7-1976
2.	,, P. Bhaskar	Two	1-7-1976
3.	,, L. D. Deshmukh	Two	1-7-1976
4.	,, S. G. Gayal	Two	1-7-1976
5.	,, R. M. Gurjar	Two	1-7-1976
6.	,, S. B. Jadhav	Two	1-7-1976
7.	,, D. N. Makwana	Two	1-7-1976
8.	,, R. P. Nachane	Two	1-7-1976
9.	,, P. M. Patil	Two	1-7-1976
10.	,, K. H. Sawakhande	Two	1-7-1976
11.	Smt. K. L. Datar	Two	1-7-1977
12.	Shri Y. Subramanyam	Two	1-7-1977
13.	,, D. V. Mhadgut	One	1-7-1976

In the third Five Yearly Assessment of the eligible scientific personnel of CTRL made by ASRB in October-November, 1979, promotions/advance increments were granted as detailed below :

Promotions

Name	*Grade to which promoted*	*Effective date of promotion*
Kum. A. S. Dighe	S-1 (Rs. 700-1300)	1-7-1978

Advance Increments

Sr. No.	*Name*	*Number of advance increments*	*Effective date of increment*
1.	Shri M. S. Parthasarathy	Two	1-7-1978
2.	,, A. V. Ukidve	Three	1-7-1978

(*b*) *Technical Staff*

The Five Yearly Assessment of the eligible technical personnel of CTRL was made in July and November, 1979, and promotions/advance increments were granted as detailed below :

Promotions

Sr. No.	*Name*	*Grade to which promoted*	*Effective date of promotion*
1.	Shri S. K. Iyer	T-5 (Rs. 650-1200)	1-7-1976
2.	,, K. Venkateswaran	T-5 (Rs. 650-1200)	1-7-1976
3.	,, N. Thejappa	T-5 (Rs. 650-1200)	1-7-1978
4.	Kum. S. R. Jage	T-4 (Rs. 550-900)	1-7-1979
5.	Shri R. M. Modi	T-4 (Rs. 550-900)	1-7-1979
6.	,, V. B. Suryanarayanan	T-4 (Rs. 550-900)	1-7-1979

Advance increments

Sr. No.	*Name*	*Number of advance increments*	*Effective date of increment*
1.	Smt. P. A. Dabholkar	One	1-7-1979
2.	,, N. D. Nachane	One	1-7-1979
3.	Shri S. S. Patekar	One	1-7-1979

C. Promotion

Administrative Staff

Shri V. N. Wadhwani, Superintendent, was promoted to the post of Assistant Administrative Officer, with effect from August 9, 1979.

D. Transfers

(*a*) *Scientific Staff*

1. Dr. P. B. Lal Chourasia, Scientist S-1, to Central Arid Zone Research Institute, Jodhpur, with effect from February 9, 1979.
2. Shri P. V. Varadarajan, Scientist S-1, from CTRL Quality Evaluation Unit, Surat, to Headquarters at Bombay, with effect from May 1, 1979.
3. Shri Y. Subramanyam, Scientist S, CTRL Quality Evaluation Unit, Guntur, to Surat with effect from May 18, 1979.

4. Shri P. M. Patil, Scientist S, to Lac Research Institute, Ranchi, with effect from May 28, 1979.
5. Shri A. K. Ahuja, Scientist S, to Indian Institute of Horticultural Research, Bangalore, with effect from May 31, 1979.

(*b*) *Technical Staff*

1. Shri M. C. Bhalod, Senior Technical Assistant, from Quality Evaluation Unit, Surat, to Ludhiana with effect from May 24, 1979.

E. Retirements

(*a*) *Technical Staff*

1. Shri D. G. Shete, Technical Officer (Ginning) T-6, retired from service with effect from March 31, 1979.
2. Shri T. B. Dangle, Senior Fitter T-I-3, retired from service with effect from October 31, 1979.
3. Shri S. T. Patekar, Senior Operative T-I, retired voluntarily from service with effect from November 18, 1979.

(*b*) *Administrative Staff*

1. Shri P. V. Sreenivasan, Assistant Administrative Officer (Stores), retired from service with effect from March 31, 1979.
2. Shri V. R. G. Menon, Assistant, retired voluntarily from service with effect from April 14, 1979.

F. Resignations/Termination of Service

1. Sarvashri S. M. Mohile and A. K. Mehta, both Technical Assistants (T-II-3) resigned from service with effect from February 21, 1979 and February 26, 1979, respectively.
2. Kum. K. Radha, Junior Stenographer, resigned from service with effect from March 9, 1979.
3. Shri D. B. More, Supporting Staff Grade I, resigned with effect from November 8, 1979.
4. Shri S. E. Temkar, Supporting Staff Grade I, was removed from service with effect from August 31, 1979.

G. Deputations/Foreign Assignments

1. Dr. V. Sundaram, Director, along with Dr. S. M. Betrabet and Shri M. S. Parthasarathy, Senior Scientists, visited various textile research institutes as well as industrial organisations in the UK

INTERNATIONAL YEAR OF THE CHILD

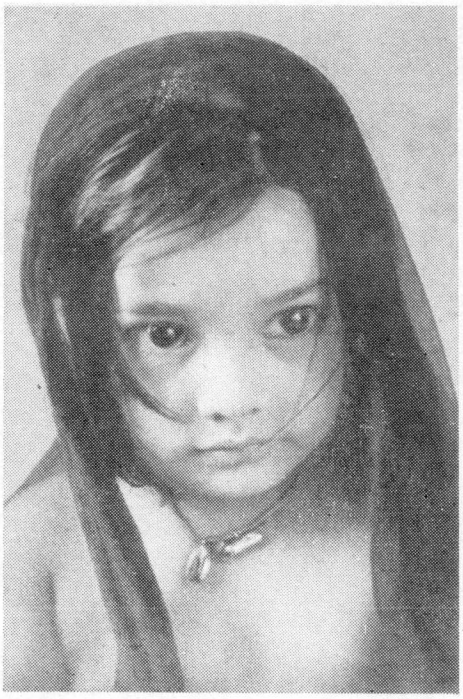
At Fancy Dress Competition

(L to R) Alankar K. Mohite, Bharati Gopalan, Prachi Ukidve, Aparna Pai, Sriniwas Bharadwaj, Phalguni Modi, Bharati T. Kadam, Aparna Bhat, Devyani Makwana, Sai Sankar Chandrasekar, Deepali Gupta, H. L. Ravindra, and Mahesh Ambare

ICAR INTER-INSTITUTIONAL SPORTS MEET

CTRL Contingent at Jodhpur with Director, Central Arid Zone Research Institute

MERIT



Portrait (by Shri R. M. Modi)

during May 5, 1979 to June 3, 1979, under the sponsorship of the Indo-UK Collaborative Programme in Natural Resource Research. They also visited a few centres of research on cotton and textile technology in Belgium and France from June 5 to June 12, 1979.

2. Dr. K. M. Paralikar, Scientist S-1, was deputed for training in the operation of Scanning Electron Microscope at M/s. Cambridge Scientific Instruments Co. Ltd., England, and University of Leeds from October 14, 1979 to January 20, 1980.
3. Dr. V. Sundaram, Director, was deputed on foreign assignment with FAO, to work as a consultant in Cotton Technology in Burma from November 27, 1979 to December 12, 1979.

H. Merit

Shri R. M. Modi of CTRL won the Certificate of Merit for his entry entitled "Portrait" at the Third International Exhibition of Photography, organised by the Women's Photographic Society of Sri Lanka in March 1979, to mark the International Year of the Child. Twenty countries from all over the world participated in the exhibition.

I. Badminton Titles

As part of the ICAR Golden Jubilee Celebrations, inter-institutional sports meets were introduced for the first time by the Council in 1979. The ICAR Institutes have been pooled into seven groups, CTRL being placed in Group B (West Zone). The first sports meet of this group was held from November 17 to 24, 1979, at Jodhpur. A fairly large contingent from CTRL participated in the event, and CTRL secured both singles and doubles badminton titles in straight games.

Shri A. K. Gupta of the Laboratory defeated Dr. A. K. Verma of CICR in the first round (quarter finals), Shri P. C. Pande of CAZRI in the second round and Shri Anil Kumar of IGFRI in the final round, and won the Men's (Singles) title for Badminton. Shri Gupta and Shri R. M. Gurjar sccured the title for Badminton (Doubles) event defeating the CSWRI team in the quarter finals, IGFRI team in the semi finals and CAZRI in the finals.

The CTRL players exhibited excellent control of shuttle and prowess in court-craft and elicited spontaneous appreciation of the spectators as well as opponents.

Staff members ot CTRL participated also in other games such as Kabaddi, Table Tennis and Volley Ball as well as in various sports events.

Considering the fact that the Kabaddi and Volley Ball teams were playing for the first time, the performance of the participants from CTRL was quite satisfactory.

8. APPENDICES

APPENDIX I

Financial Statement

EXPENDITURE AND RECEIPTS OF THE LABORATORY DURING 1978-79

	Sanctioned grants (Rs.)	Actual expenditure (Rs.)	Savings (—) Deficit (+) (Rs.)
A. EXPENDITURE			
I. Technological Research Laboratory including Regional Stations (Non-Plan) ..			
(*a*) Capital expenditure including expansion of Laboratory	4,89,200	4,89,103	(—) 97·00
(*b*) Working expenditure	26,85,800	26,77,031	(—) 8,769·00
	31,75,000	31,66,134	(—) 8,866·00
II. Scheme for modernisation and strengthening of CTRL for intensive research on cotton (Plan)	52,38,000	51,06,147	(—)1,31,853·00
III. Schemes financed from AP Cess funds :			
(*a*) Investigation of the effects of high energy radiation on the induction and half life of excited, free and/or ionised radicals in cotton cellulose to obtain basic information needed for the development of potentially new useful cotton products ..	86,800	70,196	(—) 16,604·00
(*b*) Optimal blending of Standard Varieties of Indian Cottons	3,46,250	1,96,535	(—)1,49,715·00
(*c*) Regional committee No. 7	19,000	6,290	(—) 12,710·00
(*d*) Studies on the production and utilisation of chitosan and allied products from prawn shell waste	23,080	6,068	(—) 17,012·00
(*e*) Response of Indian cottons to crosslinking treatments with a view to evolve cotton varieties most suitable for chemical finishing treatments.	78,500	40,456	(—) 38,044·00

APPENDIX 1—*(cont'd.)*

B. RECEIPTS

	Rs.
Sale of vehicles, machine-tools, plants, equipments, and other non-consumable stores	4,539
Analytical and testing fees	34,566
Rent	46,293
Fees for training, application fees, etc.	4,000
Receipts from services rendered by the Institute	1,200
Sale of Publications	1,947
Miscellaneous receipts (including sale of cotton waste, cotton, fruits, Interest on loans, etc.	49,264
	1,41,809

APPENDIX II

Scientific and Technical Staff Working at the Cotton Technological Research Laboratory as on 31-12-1979

(List does not include vacant posts)

A. AT CTRL, BOMBAY

Director : Dr. V. Sundaram, M.Sc., Ph.D., A.R.I.C., F.T.I.

Scientific Staff

Scientist	(Microscopy)	Grade S-3	Dr. S. M. Betrabet, M.Sc., Ph.D., F.T.I., F.R.M.S.
,,	(Physics)	,, ,,	Dr. N. B. Patil, M.Sc., Ph.D.
,,	(Spinning Technology)	,, ,,	Shri M. S. Parthasarathy, M.Text. (Bom.), M.Sc. Tech. (Manch.), A.M.C.S.T.
,,	(Testing Technology)	,, ,,	Dr. V. G. Munshi, M.Sc., Ph.D., F.T.A.
,,	(Chemistry)	Grade S-2	Kum. I. G. Bhatt, M.Sc.
,,	,,	,, ,,	Dr. S. N. Pandey, M.Sc., Ph.D.
,,	(Fibre Technology)	,, ,,	Shri T. N. Ramamurthy, B.Sc., B.Sc. (Tech.)
,,	(Microbiology)	,, ,,	Dr. V. G. Khandeparkar, M.Sc., Ph.D.
,,	(Physics)	,, ,,	Shri P. K. Chidambareswaran, M.Sc.
,,	,,	,, ,,	Dr. K. R. Krishna Iyer, M.Sc., Ph.D.
,,	,,	,, ,,	Shri P. G. Oka, M.Sc.
,,	(Statistics)	,, ,,	Shri G. S. Rajaraman, M.A.
,,	(Textile Manufacture)	,, ,,	Shri B. Srinathan, B.Sc. (Text.), M.Sc. (Text.)*
,,	(Biochemistry)	Grade S-1	Dr. R. N. Adsule, M.Sc., Ph.D.*
,,	,,	,, ,,	Smt. S. P. Bhatawdekar, M.Sc.
,,	,,	,, ,,	Smt. G. Revathi, M.Sc.
,,	(Biophysics)	,, ,,	Dr. K. M. Paralikar, M.Sc., Ph.D., F.R.M.S.
,,	(Chemical Studies)	,, ,,	Shri S. Aravindanath, M.Sc.
,,	,,	,, ,,	Smt. Vatsala Iyer, M.Sc.@
,,	,,	,, ,,	Smt. Prema Nair, M.Sc.
,,	,,	,, ,,	Kum. C. R. Raje, M.Sc.
,,	,,	,, ,,	Shri P. V. Varadarajan, M.Sc.
,,	(Electronics and Instrumentation)	,, ,,	Shri N. Ramesh Babu, B.E., M.Tech.
,,	(Farm Machinery and Power)	,, ,,	Shri U. N. Borker, B.Sc.(Agri.), B.Sc. (Agri. Engg.), M.Tech.
,,	,, ,,	,, ,,	Shri S. Ganesan, B.E. (Agri. Engg.)
,,	(Microbiology)	,, ,,	Dr. R. H. Balasubramanya, M.Sc., Ph.D.
,,	,,	,, ,,	Kum. A. S. Dighe, M.Sc.
,,	(Organic Chemistry)	,, ,,	Shri L. K. Suri, M.Sc.
,,	(Physics)	,, ,,	Shri G. F. S. Hussain, M.Sc.
,,	,,	,, ,,	Dr. (Smt.) P. Bhama Iyer, M.Sc., Ph.D.
,,	,,	,, ,,	Shri R. P. Nachane, M.Sc.*
,,	,,	,, ,,	Shri S. Sreenivasan, M.Sc.
,,	,,	,, ,,	Shri A. V. Ukidve, M.Sc.
,,	,,	,, ,,	Dr. N. C. Vizia, M.Sc., Ph.D.
,,	(Quality Evaluation)	,, ,,	Shri A. K. Gupta, M.Sc.
,,	,,	,, ,,	Shri B. M. Petkar, M.Sc.
,,	(Statistics)	,, ,,	Smt. Janaki K. Iyer, M.Sc.
,,	(Textile Manufacture)	,, ,,	Shri Muntazir Ahmed, B.Sc., B.Sc. (Text.) @@@
,,	(Biochemistry)	Grade S	Shri S. G. Gayal, M.Sc.*
,,	(Quality Evaluation)	,, ,,	Shri P. Bhaskar, M.Sc.
,,	,,	,, ,,	Smt. K. L. Datar, M.Sc.
,,	,,	,, ,,	Shri R. M. Gurjar, M.Sc.
,,	,,	,, ,,	Shri D. N. Makwana, M.Sc.*
,,	(Statistics)	,, ,,	Shri D. V. Mhadgut, M.Sc.

Technical Staff

Technical Officer (Electrical Engineering)	Grade T-7	Shri H. V. Tamhankar, L.M.E., L.E.E.
Quality Evaluation Officer	Grade T-6	Shri M. S. Sitaram, B.Sc.@@j
Jr. Quality Evaluation Officer ..	Grade T-5	Shri K. S. Bhyrappa, L.T.T., A.T.A.
,, ..	,, ,,	Shri S. R. Ganatra, M.Sc.
,, ..	,, ,,	Shri S. G. Nayar, B.Sc., L.L.B.
,, ..	,, ,,	Smt. S. B. Pai, B.Sc.
,, ..	,, ,,	Shri A. W. Shringarpure, B.Sc.@
,, ..	,, ,,	Shri N. Thejappa, M.Sc.
Sr. Technical Assistant (Information) ..	Grade T-4	Shri T. K. M. Das, B.Sc., D.B.M., Dip. J., D.P.R.
,, (Instrumentation) ..	,, ,,	Shri G. S. Patel, B.Sc.
,, (Library) ..	,, ,,	Kum. Rachel Verghese, B.Sc., B.Lib.*
,, (Photography) ..	,, ,,	Shri R. M. Modi, S.S.C. (Certificate in Photography)
,, (Quality Evaluation) ..	,, ,,	Shri K. V. Ananthakrishnan, B.Sc., D.B.M.
,, ,, ..	,, ,,	Smt. R. P. Bhat, B.Sc.
,, ,, ..	,, ,,	Shri B. S. Ganvir, B.Sc.
,, ,, ..	,, ,,	Kum. I. K. P. Iyer, B.Sc.
,, ,, ..	,, ,,	Shri C. R. Sthanu Subramony Iyer, B.Sc.
,, ,, ...	,, ,,	Kum. S. R. Jage, B.Sc.
,, ,, ...	,, ,,	Shri V. Jose Joseph, B.Sc.
,, ,, ...	,, ,,	Shri K. R. Kamath, B.Sc.
,, ,, ...	,, ,,	Smt. S. D. Pai, B.Sc.
,, ,, ...	,, ,,	Shri V. B. Suryanarayanan, B.Sc.
,, ,, ...	,, ,,	Shri G. Vishwanathan, B.Sc., A.T.A.
,, ,, ...	,, ,,	Smt. J. K. S. Warrier, M.Sc.
,, (Spinning)	,, ,,	Shri S. Chandrasekhar, L.T.M., A.T.A.
,, ,, ...	,, ,,	Shri H. R. Laxmivenkatesh, D.T.T.
,, (Statistics)	,, ,,	Shri K. Chandran, B.A.
Technical Assistant (Engineering)	Grade T-II-3	Shri A. L. Muthu, D.C.E.
,, (Library)	,, ,,	Smt. Rekha K. Shahani, B.Sc., B.Lib.
,, (Microbiology)	,, ,,	Kum. R. D. Mhatre, B.Sc.
,, (Quality Evaluation) ..	,, ,,	Smt. P. A. Dabholkar, B.Sc.
,, ,, ...	,, ,,	Shri S. J. Guhagarkar, B.Sc.
,, ,, ...	,, ,,	Shri I. H. Hunsikatti, B.Sc.
,, ,, ...	,, ,,	Shri S. N. Hussain, B.Sc., Grad. I.E.T.E.
,, ,, ...	,, ,,	Shri M. Karmakar, B.Sc.
,, ,, ...	,, ,,	Smt. N. D. Nachane, B.Sc.@@
,, ,, ...	,, ,,	Shri E. A. Pachpinde, B.Sc.
,, ,, ...	,, ,,	Shri R. S. Pathare, B.Sc.
,, ,, ...	,, ,,	Smt. Girija Radhakrishnan, B.Sc.*
,, ,, ...	,, ,,	Shri D. Radhakrishna Murthy, M.Sc.@@@
,, ,, ...	,, ,,	Shri K. B. Rajagopal, B.Sc.
,, ,, ...	,, ,,	Shri S. Sekhar, B.Sc.
,, ,, ...	,, ,,	Shri N. R. Tare, B.Sc.
,, ,, ...	,, ,,	Shri J. C. Toscano, M.Sc.
,, ,, ...	,, ,,	Shri S. Vancheswaran, B.Sc.*
Boiler Attendant	Grade T-I-3	Shri S. N. Salvi
Draughtsman	,, ,,	Shri P. B. Gurjar
Electrician	,, ,,	Shri R. B. Pawar
Fitter (Ginning)	,, ,,	Shri A. R. S. Abdulla*
Mechanic	,, ,,	Shri R. K. Landge
Operator (Refrigeration) ..	,, ,,	Shri S. G. Dalvi*
,, ,, ...	,, ,,	Shri V. V. Kshirsagar
,, (Workshop Machinery) ..	,, ,,	Shri D. L. Upadhye
Turner	,, ,,	Shri M. M. Shaikh
Electrician	Grade T-2	Shri M. T. Itnare
Fitter (Mechanical Processing) ..	,, ,,	Shri Purushottam Vira
Laboratory Assistant (Chemistry) ..	,, ,,	Shri N. O. Anthony

Technical Staff (cont'd.)

Carpenter	Grade	T-1	Shri G. D. Narkar
Driver	,,	,,	Shri B. B. Gaykar
,,	,,	,,	Shri S. S. Patekar
Driver-cum-Mechanic	,,	,,	Shri Premchand Rana
Fitter (Mechanical Processing)	,,	,,	Shri P. K. Gopalan
Laboratory Assistant	,,	,,	Shri S. B. Kamble
Plumber	,,	,,	Shri H. B. Tambe
Senior Operative (Mechanical Processing)	,,	,,	Shri P. J. Ahire
,, ,,	,,	,,	Shri R. A. Dalvi
,, ,,	,,	,,	Shri K. V. Nair
,, ,,	,,	,,	Shri Bechan Nokai
,, ,,	,,	,,	Shri H. K. Pawar
Telephone Operator	,,	,,	Kum. A. Y. Dhotre
Wireman	,,	,,	Shri K. R. Chawan

B Regional Quality Evaluation Units of CTRL

Station	Quality Evaluation Officer, Grade T-6	Jr. Quality Evaluation Officer, Grade T-5	Sr. Technical Assistant (QE), Grade T-4	Technical Assistant (QE), Grade T-II-3	Scientist, Grade S-1	Scientist, Grade S
Akola ..	Shri Ram Parkash, B.Sc	—	—	—	—	—
Coimbatore ..	—	Shri A. K. Antony, B.Sc.	Smt. Santa V. Nair, B.Sc. Shri C. P. Venugopalan, B.Sc.	—	—	—
Dharwad ..	—	Shri E. S. Abraham, B.Sc.	—	—	—	Shri K. H. Sawakhande, M.Sc.
Guntur ..	—	Shri R. Dwarkanath, B.Sc.	—	—	—	—
Hissar ..	—	Shri S. N. Nagwekar, B.Sc.	—	—	—	—
Indore ..	—	—	—	—	—	Shri S. B. Jadhav, M.Sc.
Ludhiana ..	—	—	Shri M. C. Bhalod, B.Sc.	—	—	—
Nanded ..	—	—	—	—	Shri A. J. Shaikh, M.Sc.	Shri L. D. Deshmukh, M.Sc.*
Sriganganagar	—	—	—	Shri Tula Ram, B.Sc.	—	—
Surat ..	Shri L. R. Jambunathan, B.Sc., A.M.I.C.T., L.T.I.	—	—	Shri R. S. Darade, B.Sc.	—	Shri Y. Subramanyam, M.Sc.

Explanations for symbols used :

* Under the Fifth Five Year Plan Scheme for expansion and strengthening of CTRL for intensive research on cotton.

@ Scheme for investigation of the effects of high energy radiation on the induction and half life of excited, free and/or ionised radicals in cotton cellulose to obtain basic information needed for the development of potentially new useful cotton products.

@@ Scheme for response of Indian cottons to crosslinking treatments with a view to evolve cotton varieties most suitable for chemical finishing treatments.

@@@ Scheme for optimal blending of Standard Varieties of Indian Cottons.

APPENDIX III

Statement Showing the Total Number of Employees and the Number of Scheduled Castes/Tribes Amongst Them as on December 31, 1979

Class	Permanent/ Temporary	Total No. of employees	No. of Scheduled Caste employees	Percentage of Scheduled Caste employees with reference to col. 3	No. of Scheduled Tribe employees	Percentage of Scheduled Tribe employees with reference to col. 3.	Remarks
1	2	3	4	5	6	7	8
Class I	Permanent	35	1	7	—	—	—
	Temporary	9	2		—	—	—
Class II	Permanent	28	2	6	—	—	—
	Temporary	22	1		—	—	—
Class III	Permanent	41	4	8	2	2	—
	Temporary	44	3		—	—	—
Class IV (excluding sweepers) ..	Permanent	33	7	20	1	3	—
	Temporary	30	5		1		—
Class IV (sweepers)	Permanent	2	2	100	—	—	—
	Temporary	4	4		—	—	—

Note : (1) This statement relates to persons and not to posts. Therefore, vacant posts, etc., have not been taken into account.
(2) As persons on deputation should be included in the establishment of the borrowing Ministry/Department/Office and not in the parent office, such cases also have been included.
(3) Persons permanent in one grade but officiating or holding temporary appointment in the higher grades have been shown in the figures relating to the class of service in which the higher grade concerned is shown.

APPENDIX IV

Statement Showing the Number of Reserved Vacancies Filled By Members of Scheduled Castes/Tribes During the Year 1979

Class of Post	Total No. of vacancies		Scheduled Castes					Scheduled Tribes					Remarks
			No. of vacancies reserved		No. of SC candidates appointed	No. of ST candidates appointed against reserved vacancies for SCs in the 3rd year of carry forward	No. of reservations lapsed after carrying forward for three years	No. of vacancies reserved		No. of ST candidates appointed	No. of SC candidates appointed against vacancies reserved for STs in the 3rd year of carry forward	No. of reservations lapsed after carrying forward for three years	
	Notified	Filled	Out of col. 2	Out of col. 3				Out of col. 2	Out of col. 3				
1	2	3	4	5	6	7	8	9	10	11	12	13	14
I—Posts filled by direct recruitment													
Class I	2	2	—	—	—	—	—	—	—	—	—	—	—
Class II	—	—	—	—	—	—	—	—	—	—	—	—	—
Class III	5	5	1	1	1	—	—	—	—	—	—	—	—
Class IV (excluding Sweepers) ..	10	10	—	—	—	—	—	—	—	—	—	—	—
Class IV (Sweepers)	1	1	1	1	1	—	—	—	—	—	—	—	—
II—Posts filled by promotion													
Class I	1	1	1	1	1	—	—	—	—	—	—	—	—
Class II	2	2	—	—	—	—	—	—	—	—	—	—	—
Class III	1	1	—	—	—	—	—	—	—	—	—	—	—
Class IV (excluding Sweepers)	—	—	—	—	—	—	—	—	—	—	—	—	—
Class IV (Sweepers)	—	—	—	—	—	—	—	—	—	—	—	—	—

9. ANNEXURES

ANNEXURE I

New Equipments Purchased During 1979

1. Open End Spintrainer
2. Kenmore Electric Washing Machine and Electric Tumble Dryer
3. Imperfection Indicator
4. Cambridge S-150 Scanning Electron Microscope with Accessories
5. Polaron P 050 M Vacuum Evaporator
6. Stelometer Model 154
7. Sartorius Balance Model 2355
8. Fibrograph Model 430
9. Wiley Mill (Fibre Cutter)
10. Projection Microscopes
11. Block Digester
12. Laboratory Stenter (Drying and Setting Machine)
13. Centrifuges
14. Muffle Furnace
15. Shirley Yarn Hairiness Meter
16. BOD Incubator

ANNEXURE II

Distinguished Visitors to CTRL During 1979

1. Dr. Edmond DeLanghe,
   Professor of Tropical Agriculture,
   Katholeike Universiteit,
   Leuven, Belgium.

2. Dr. Fritz Hadwich,
   Director,
   Faserinstitut and Bremen Cotton Exchange Laboratory,
   Bremen.

3. Dr. J. R. Twine,
   FAO Consultant,
   Indian Grassland and Fodder Research Institute,
   Jhansi.

4. Dr. Peter Brown,
   Associate Professor,
   University of Minnasota,
   USA.

5. Dr. Richard Petges,
   Economist,
   Foreign Agriculture Service, USDA,
   Washington D.C.,
   USA.

6. Mr. Charles M. Clendenen,
   Consulate General of USA,
   Bombay.

7. Mr. A. B. Jakanur,
   State Minister for Regulated Markets and Prisons,
   Government of Karnataka,
   Bangalore.

8. Mr. K. R. M. Anthony,
   Principal Agricultural Advisor (Research),
   Ministry of Overseas Development,
   London.

9. Mr. Alan C. Jackson,
   British High Commission,
   British Council Division,
   New Delhi.

10. Dr. John A. Richards,
Assistant Education Adviser,
British Council Division,
British High Commission,
Bombay.

11. Mr. Vijay Nesargi,
RDO, British Council Division,
Bombay.

12. Mr. N. G. Kulkarni,
Member, Indian Cotton Development Council,
Bombay.

13. Mr. J. C. Learke,
Consultant,
DANIDA.

14. Dr. V. Santhanam,
Project Manager,
UNDP/FAO,
Rangoon, Burma.

15. Dr. T. Radhakrishnan,
Director-Designate,
ATIRA,
Ahmedabad.

16. Mr. P. K. Kapur
Deputy Director of Industrial Training,
Government of Kenya,
Nairobi, Kenya.

17. Dr. B. C. Goswami,
University of Tennesse,
Knoxville,
USA.