Cotton Technological Research Laboratory

Indian Council of Agricultural Research

Annual Report
1977

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Contents

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1. Introduction

This is the 54th Annual Report of the Cotton Technological Research Laboratory (CTRL) and covers the calendar year 1977.

Founded in the year 1924 by the erstwhile Indian Central Cotton Committee with the basic objective of collaborating actively with the Departments of Agriculture in different parts of the country for scientific evaluation of the inherent quality of the new varieties of cotton evolved from time to time, CTRL came under the administrative control of the Indian Council of Agricultural Research (ICAR) from the 1st April, 1966. Since then, research activities were reoriented and intensified and the research efforts have been continued to help in producing more and better quality cottons, and in enhancing the utilisation of cotton lint and cotton plant by-products thereby improving the economy of the country.

The main functions of CTRL are :

(*i*) to participate actively in the programmes 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

This Laboratory maintains an up-to-date library of books on cotton technology and allied subjects. During the year 128 books were added and the total number of books was 3,324 by the end of 1977 in addition to 3,221

bound volumes of journals. About 200 journals dealing with textiles and related fields were being regularly received in the library, of which 90 were subscribed and others received either by way of exchange or as complimentary.

New Equipments purchased

Several new equipments were acquired during the year in order to facilitate carrying out intensive basic studies on cotton. A list of some of those important equipments added are given in Annexure I.

Distinguished Visitors

Sardar Surjit Singh Barnala, Union Minister for Agriculture and Irrigation visited CTRL on the 27th December, 1977, and evinced keen interest in its activities. He expressed his appreciation of the useful work being carried out at the Laboratory. Dr. M. S. Swaminathan (Director-General), Dr. N. K. Anant Rao, (Officer on Special Duty, Central Staff College, ICAR), Dr. C. Kempanna (Assistant Director-General), Shri C. S. Sridharan (Assistant Director-General), Dr. K. V. Srinivasan. (Director, CICR), Dr. R. Seetharaman (Project Coordinator, AICRIP, Hyderabad), and Dr. J. G. Bhatt (Project Coordinator, AICCIP), visited CTRL on various occasions in connection with official work. A list of other distinguished visitors during 1977 is given in Annexure II.

Awards

The excellent work carried out under the All-India Coordinated Cotton Improvement Project (AICCIP) for development of improved varieties of cotton received well-merited recognition from the Federation of Indian Chambers of Commerce and Industry (FICCI). A team of nine scientists working in AICCIP, including Dr. V. Sundaram, Director, and Shri P. G. Oka, Scientist S-1, received the FICCI Cash Award for 1976 for their outstanding contribution, at the hands of the Prime Minister of India, Shri Morarji Desai, on the occasion of the FICCI Golden Jubilee Meeting held at Delhi in Apirl, 1977.

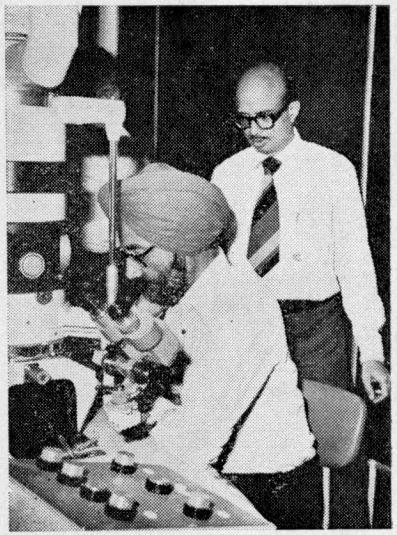
Management Committee

The Management Committee of CTRL constituted under Rule 66 of ICAR met three times during the year and some of the important subjects discussed are given below :

In the First Meeting held on the 5th and the 7th March, 1977, the Management Committee considered the non-plan expenditure up to the 28th February, 1977, in-service training to the scientific workers of CTRL, revision

UNION MINISTER FOR AGRICULTURE VISITS CTRL

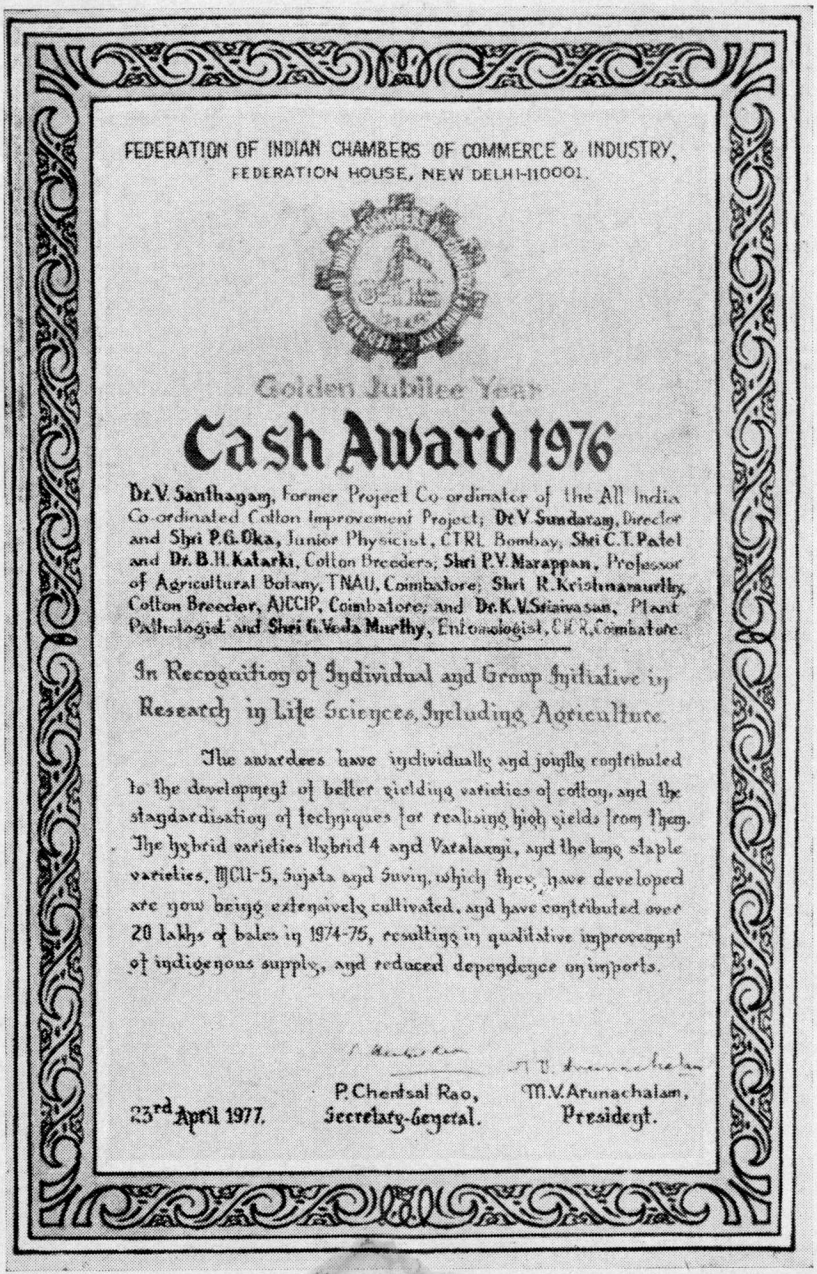
Shri S. S. Barnala in the Mechanical Processing Division of CTRL



Shri S. S. Barnala viewing through the Electron Microscope

FICCI AWARD

Dr. V. Sundaram, Director, CTRL, and Dr. K. V. Srinivasan, Director, CICR, Nagpur, receiving the FICCI Award from Shri Morarji Desai, Prime Minister



FEDERATION OF INDIAN CHAMBERS OF COMMERCE & INDUSTRY,
FEDERATION HOUSE, NEW DELHI-110001.

Golden Jubilee Year

Cash Award 1976

Dr. V. Santhanam, former Project Co-ordinator of the All India Co-ordinated Cotton Improvement Project; **Dr V. Sundaram**, Director and **Shri P.G. Oka**, Junior Physicist, CTRI, Bombay, **Shri C.T. Patel** and **Dr. B.H. Katarki**, Cotton Breeders; **Shri P.V. Marappan**, Professor of Agricultural Botany, TNAU, Coimbatore; **Shri R. Krishnamurthy**, Cotton Breeder, AICCIP, Coimbatore; and **Dr. K.V. Srinivasan**, Plant Pathologist and **Shri G. Veda Murthy**, Entomologist, CIR, Coimbatore.

In Recognition of Individual and Group Initiative in Research in Life Sciences, Including Agriculture.

The awardees have individually and jointly contributed to the development of better yielding varieties of cotton, and the standardisation of techniques for realising high yields from them. The hybrid varieties Hybrid 4 and Varalaxmi, and the long staple varieties, MCU-5, Sujata and Suvin, which they have developed are now being extensively cultivated, and have contributed over 20 lakhs of bales in 1974-75, resulting in qualitative improvement of indigenous supply, and reduced dependence on imports.

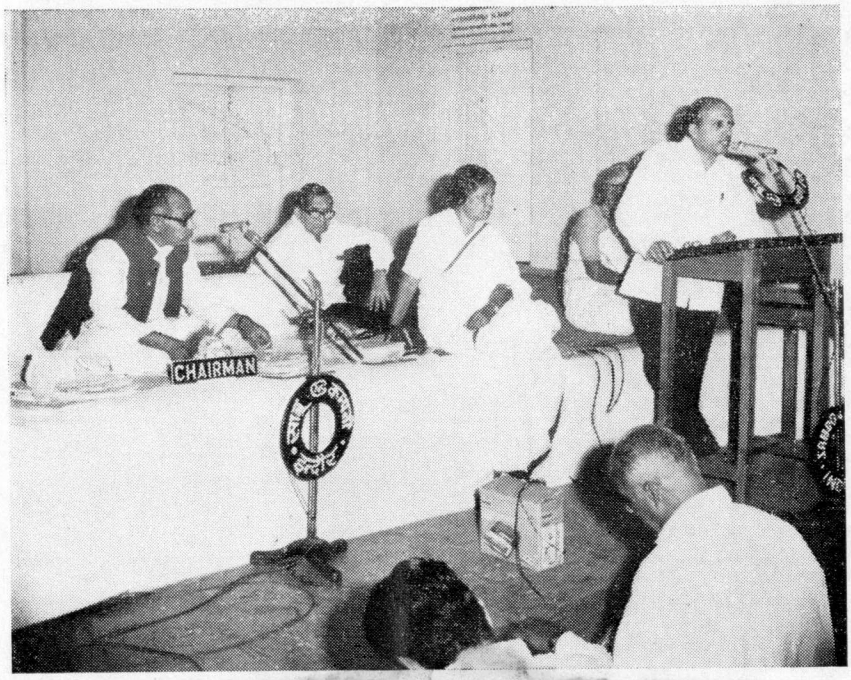
23rd April 1977.

P. Chentsal Rao,
Secretary-General.

M.V. Arunachalam,
President.

Facsimile of the Certificate presented by FICCI to individual members of the team of scientists working in the AICCIP

Citation Trophy presented by FICCI to the team of cotton scientists



Dr. M. S. Swaminathan addressing the second meeting of ICAR Regional Committee held at Kasturbagram. Seated on the dais are Shri Yeswantrao Meghawale, Minister for Agriculture, Madhya Pradesh and Smt. Lakshmi N. Menon, Chairman, Kasturba Gandhi Memorial Trust

of fees for training course, need for additional staff in the Quality Evaluation and Mechanical Processing Divisions and the strengthening of the Microscopy Division. The Committee also reviewed the progress of research during 1976 and finalised the programme of research work for the year 1977.

The Second Meeting was convened on June 20, 1977, chiefly to review the progress of research work during the first quarter of 1977 and to consider purchase of certain equipments, as well as the need for increasing the provision of Travelling Allowance in the Non-Plan Budget Estimates. The Committee also considered the action taken on the recommendations of the Institute Joint Council of CTRL regarding payment of pension through banks. provision of quarters to all CTRL staff and adequate coverage of the activities of the Joint Council in the CTRL Highlights.

In the Third Meeting held on December 23, 1977, the Committee mainly considered purchase of certain capital equipments in addition to Revised Budget Estimates for 1977-78 and Budget Estimates for 1978-79 in respect of 'Non-Plan' and 'Plan'. The Committee also considered preliminary proposal for Sixth Five Year Plan Budget for CTRL, and the proposal to take up a project on cottonseed meal, sponsored by M/s. Sundatta Foods and Fibres Limited, Bombay.

Staff Research Council

During the year, a meeting of the Staff Research Council was convened on the March 5 and 7, 1977, mainly to discuss and finalise the programme of research work for the year 1978. In the meeting, where members of the Management Committee were also present, 13 projects on which work had been completed were deleted, while extensions of period were granted to four projects taking into considerations the work already done and the difficulties experienced due to the circumstances beyond the control of the investigators. Thirteen new projects were considered and approved, while one project of the Mechanical Processing Division was recommended to be treated as a general continuing project in view of the fact that the project is pertaining to evaluation of optimum spinning of new varieties being released every year.

Further, as decided at the Meeting of Directors of ICAR Institutes, appropriate items for the appraisal of progress of research were included regularly in the agenda of the Management Committee meetings held during the year and at each meeting one session was held jointly with the Staff Research Council for discussing this item.

Inter-Institutional Projects

Steady progress was made during the year in the following three inter-institutional projects operating at CTRL in collaboration with Jute Techno-

logical Research Laboratory (JTRL), the Central Sheep and Wool Research Institute (CSWRI) and the Victoria Jubilee Technical Institute (VJTI) :

1. Studies on spinning from blends of cotton with wool, jute and ramie on cotton system.
2. Studies on deburring of raw wool using mechanical device.
3. Performance of different flat tops in processing immature cottons.

The Inter-Institutional Project "Studies on the production and utilisation of Chitosan and allied products from prawn shell waste" on which work was started in December last, in collaboration with the Central Institute of Fisheries Technology (CIFT) and the Bombay Textile Research Association (BTRA), was activated during the year.

Integrated Cotton Development Project

The Integrated Cotton Development Project (ICDP) launched by ICAR under the sponsorship of the World Bank for a period of five years from November 30, 1976, at a total estimated cost of Rs. 4,69,87,300 could be started only towards the end of 1976 as the sanction has been received late in the year. Under this project CTRL has to establish a Ginning Training Centre and the total financial outlay for the same is Rs. 32.52 lakhs. During 1977, Shri D. G. Shete, Technical Officer (Ginning), was deputed to give training to gin-fitters and mechanics at two ginning factories, one at Sirsa and the other at Fatehbad, both in Haryana State. During the training period, the gin-fitters and mechanics were properly trained for gin adjustments, precautions to be taken in the maintenance of ginning machinery, handling of cotton before, during and after ginning, etc. A talk also was given to them in Hindi regarding ginning, pre-cleaning, handling of *kapas*, lint, seed, etc.

A post of Assistant Administrative Officer (Stores) has been filled up. A Jeep with Trailor has been purchased. Action has been taken for the release of foreign exchange for the import of equipments and also for the early start of the first phase of construction work which constituted construction of building for housing the ginning machinery.

Regional Committee

The second meeting of the ICAR Regional Committee No. 7 for the Semi-Arid Lava Plateaus of Maharashtra, Western and Central Madhya Pradesh and Union Territory of Goa, Daman and Diu, was held at Kasturbagram, Indore, on the 28th September, 1977. As the Director, CTRL, is the nominated Member Secretary of this Committee, the entire responsibility of organising the meeting was on CTRL. The meeting, chaired by Dr. M. S. Swaminathan, Director-General, ICAR, was inaugurated by Hon'ble Shri Yeshwantrao Meghawale, Minister for Agriculture, Madhya Pradesh.

The Regional Committee considered and discussed broadly such major subjects as current agricultural situation in the States, problems of Agricultural Research and Development, Bundelkhand Development, Krishi Vigyan Kendras and Trainers' Training Centre for Advancement of Rural Women, agricultural implements for general use, etc., and brought to fore many recommendations in each of the subjects.

A 'Farm Journalists' Workshop' was also held on the 29th and 30th September, 1977. The Workshop inaugurated by Dr. M. S. Swaminathan discussed several subjects of rural interest. Visits were also arranged in this connection to the Indo-UK Dryland Project. The Dairy Development Corporation at Karnawad Dewas, Milk Collection Centre under the World Bank Project, College of Agriculture, Indore, College of Veterinary Science and Animal Husbandry and the Institute of Biological Research, Mhow.

Central Institute for Cotton Research

Consequent upon the appointment of the new Director for the Central Institute for Cotton Research (CICR), the Director CTRL, who functioned as the Director, CICR also, has handed over charge on February 7, 1977.

Post Graduate Training

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

Dr. V. Sundaram (Director), Dr. S. M. Betrabet (Senior Scientist, Microscopy), Dr. N. B. Patil (Senior Scientist, Physics), Dr. V. G. Munshi (Senior Scientist, Quality Evaluation), Shri M. S. Parthasarathy (Senior 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 vaiours degrees recognised by the University of Bombay.

During the year, 10 members of the staff were being guided for M.Sc., and three for Ph.D. degrees in Physics (Textiles), three for M.Sc. degree in Physical Chemistry, and one for Ph.D. degree in Bio-Physics, while one student, who was not a staff member, was being guided for M. Text. degree in Spinning Technology.

One staff member has registered for M. Text. degree in Spinning Technology during the period of report. One student has submitted his thesis to the University of Bombay for award of M.Sc. degree in Physics (Textiles), during the year.

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Agricultural Research Service Examination

The second examination for selection of candidates for direct appointment in the S-1 grade of the Agricultural Research Service (ARS) was conducted from February 14 to 17, 1977, by the Agricultural Scientists Recruitment Board (ASRB), in Bombay also. The Director and staff of CTRL were entrusted with the task of making arrangements and holding of the examinations in Bombay.

Membership on Other Organisations

The Director and Scientific Officers of CTRL continued to represent CTRL and ICAR on various committees and institutions, as in the past. The Committee constituted by the Ministry of Commerce to consider the relationship between the price of *kapas* and the mill-gate price of cotton and the nexus between the price of cotton and the price of yarn/fabric, held several meetings during the early part of the year and finalised the Report. In addition to the Director, CTRL, who was a Member of this Committee, Shri M. S. Parthasarathy, Senior Scientist (Mechanical Processing), was also associated with the work of the Committee as a technical expert.

Further, the Director was nominated as member of the following Committees/Bodies during the year :

1. Integrated Cotton Development Project Coordination Committee.
2. Ad-hoc Committee for Standards Quality Control and Research of the Textiles Committee.
3. Polymer and Fibre Research Committee of CSIR, New Delhi.
4. Research Advisory Committee of SITRA, Coimbatore.
5. Advisory Committee of National Council of Applied Economic Research, New Delhi.
6. Local Management Committee for Krishi Vigyan Kendra, Agricultural Institute, Kosbad.

Expansion and Modernisation under Fifth Plan

The total outlay on the Fifth Five Year Plan for CTRL was Rs. 86.84 lakhs, out of which Rs. 48.00 lakhs was earmarked for the construction of a multi-storeyed building for the Laboratory. But, due to the ban on construction in the early part of the Fifth Plan period, the work was not started. When the ban on construction of building was lifted, the Central Public Works Department (CPWD) was approached to speed up the construction work. However much headway has not been made owing to the inordinate delay at various stages. The detailed estimates amounting to about Rs. 46 lakhs received from CPWD for the first phase of construction,

viz., the multi-storeyed laboratory building was submitted to ICAR in August, 1977. The approval of the Council and Ministry of Finance are expected. A provision of Rs. 11.50 lakhs being 25% of the cost of construction had been made in the Plan Budget for 1977-78.

Staff Amenities

The existing staffquarters of Type I, Type II A and Type II B can provide accommodation for only 16 employees in Grade D and 32 in Grades C and B. Hence, ICAR was approached several times with the request for allocating sufficient funds for the purpose of purchasing buildings for residential accommodation of CTRL staff. Recently efforts have been made to purchase one building of 10 tenements of the High Income Group (HIG) and another of 20 tenements of the Middle Income Group (MIG) from the Maharashtra Housing Board at a total cost of Rs. 16 lakhs. The sanction of the Council is awaited.

Finance

A statement showing the sanctioned budget grant of CTRL and the actual expenditure for the financial year 1976-77 is furnished in Appendix I. It will be seen from the statement that actual expenditure was Rs. 26.10 lakhs as against the sanctioned grant of Rs. 25.35 lakhs. The increase in the expenditure was mainly due to increased cost of materials. An expenditure of Rs. 6.38 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. 6.25 lakhs. The increase was mainly due to the increased cost of materials. Further, (*i*) a sum of Rs. 0.41 lakh was incurred on the scheme "Response of Indian cottons to crosslinking treatments with a view to evolve cotton varieties most suitable for chemical finishing treatments" against the sanctioned grant of Rs. 0.54 lakh, (*ii*) a sum of Rs. 0.33 lakh was incurred on the scheme "Studies on spinning from blends of cotton with wool, jute and ramie on cotton system" carried out in collaboration with CSWRI, Avikanagar, and JTRL, Calcutta, against the sanctioned grant of Rs. 0.50 lakh, (*iii*) a sum of Rs. 0.09lakh was incurred on the scheme" Studies on deburring of raw wool using mechanical devices" carried out in collaboration with CSWRI, Avikanagar, against the sanctioned grant of Rs. 0.22 lakh, (*iv*) a sum of Rs. 0.22 lakh was incurred on the scheme "Investigation of the effect of high energy radiation on the induction and half life of excited, free and / or ionised radicals in cotton to obtain basic information needed for the development of potentially new useful cotton products" against the sanctioned grant of Rs. 0.42 lakh, (*v*) a sum of Rs. 1.01 lakhs was incurred on the scheme for "Optimal blending of standard varieties of Indian cotton"

against the sanctioned grant of Rs. 1.75 lakhs, and (*vi*) a sum of Rs. 5,000 was incurred on the scheme for "Studies on the production and utilisation of Chitosan from prawn shell wastes" as against the sanctioned grant of Rs. 8,000. A sum of Rs. 2,000 was incurred on the Regional Committee No. 7 as against the sanctioned grant of Rs. 3,000. The savings in all the six schemes were due to non-materialisation of purchase of equipments, etc., during the year.

Significant Findings

1. The plenary session of the South Zone Panel Meeting of AICCIP considered and approved the pre-release seed multiplication of the following varieties :

Variety	Area of adaptation	Advantages
ELS.481	Winter Irrigated Zones of Tamil Nadu	18% more yield than the existing MCU.5 variety. It has 3% more ginning outturn and 30% more lint yield
CP.1998F	Rainfed tract of Tamil Nadu	Higher yield than checks and a high ginning percentage
CPH.2 (Hybrid)	Southern and Central Districts of Tamil Nadu and parts of Andhra Pradesh	Good yield and ginning percentage

2. The Lint Opener fabricated at the Laboratory was found to cause little damage to fibres during their processing and could be safely employed for opening samples for test on Micronaire.

3. CTRL has successfully carried out an investigation exploring the possibility of utilising the working principle of the Digital Fibrograph (Model 230A) for determination of Optical Fineness Coefficient (OFC) from which fairly accurate estimates of gravimetric fineness of cotton sample could be made rapidly.

4. The circularity measurements done on fibres collected from bolls at different intervals (in days) showed that the circularity increased with increasing age of the boll and that the values of circularity of fibres of *G. arboreum* cotton were much higher than those of *G. barbadense* cotton from the initial stages of boll development.

5. Comparison of different systems for processing cotton samples have been made on bulk and microspinning techniques and it was observed that

there was no major difference between samples spun on bulk scale using SKF drafting and those spun using microspinning techniques either with SKF or with OMS drafting systems on ring frame.

6. A trial undertaken on blending carded medium staple SRT.1 cotton with both 1.2 d and 2.0 d polyester fibre revealed that use of coarser denier polyester seems more conducive for production of more regular yarn in this particular blend trial.

7. Blending of cotton separately with jute caddies, jute staple, wool noils and ramie on cotton system was carried out and it has been proved feasible to produce fabrics from blended yarns for various end-uses like curtains, furnishings, etc.

8. A new method for the quick evaluation of yarn hairiness using Digital Fibrograph has been developed with which comparative hairiness values of different yarns could be estimated fairly well.

9. A new procedure for determining lea strength corrections for nominal counts has been evolved and it has the definite advantage of being more scientific compared to earlier methods which were based on factors arbitrarily assumed.

10. Among the 34 varieties, belonging to different botanical species, screened so far in connection with the study of varietal response to crosslinking treatment, it was observed that the *G. hirsutum* strains 66BH.5-91, A.218, MCU.1, Gujarat 67, Hybrid 4, Bhagya, Deviraj and ELS.031, the *G. arboreum* strains Sanjay, Virnar, Gaorani 6 and Maljari, the *G. herbaceum* strains Jayadhar and Digvijay, and the *G. barbadense* varieties Sujata and Suvin are suited for easy-care finishing treatments.

11. A comparative study made of the desizing efficiency of amylase produced from *B. subtilis*-159 (BS) with three other commercially available amylases revealed that BS amylase was more efficient in desizing (78% size removal in 1 hr) and hence could be commercially exploited.

12. Cellulase of *Penicillium funiculosum* is highly active and has many applications. Attempts were made to enzymatically saccharify various agricultural waste materials to simpler sugars using this enzyme. The objective has been to grow yeast on the break-down products for their conversion to single cell protein. The cellulase was also found useful for clarification of lemon juice and desizing of fabrics sized with tamarind kernel powder (TKP).

13. The process for the preparation of particle boards using cotton plant stalk chippings has been standardised.

2. Progress of Research

During the year under report, considerable progress has been made in various research and allied activities at CTRL. In addition to carrying out research on physical, chemical, structural and technological aspects, the Laboratory is assisting the Agricultural Scientists in improving the yield and quality of cotton by authoritative evaluation of samples received from various cotton breeding, agronomy and other trials. Again, CTRL is the coordinating centre for the quality evaluation of all new strains under trial in different parts of the country under AICCIP. A brief summary of the progress made in the research activities during the year is given below :

Evaluation of the Quality of Cotton Samples Received from Agricultural Trials

The Laboratory receives a large number of samples every year for various tests from trials conducted by the Agricultural Universities and State Departments of Agriculture, etc., in addition to samples obtained in connection with various research investigations at CTRL. The number of samples received during the years 1975, 1976 and 1977, together with corresponding average figures for the quinquennium 1971-75, are given in Table I (*a*).

Table I (*b*) contains the number of samples tested at various regional stations during 1977.

The samples received from agricultural trials are tested in the order of their receipt and test reports are issued as quickly as possible. The results of tests on Trade Varieties and Standard Indian cotton samples are reported as Technological Circulars as soon as the tests are completed and later consolidated for the whole season and published as two Technological Reports—one on Trade Varieties and the other on Standard Indian cottons. No test reports are generally issued on the technological research samples being used exclusively in connection with various research projects at CTRL as the results are included in the relevant research publications. Besides these, some samples are received for miscellaneous tests, such as determination of quality of ginning, neppiness, oil content in cotton seed, etc., The statewise figures for the number of samples which were tested for fibre characteristics and spinning performance have been given in Table 2, grouped under two heads, viz. (*i*) AICCIP and (*ii*) Other State Schemes.

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

Type of test	Average for the quinquennium, 1971-75	1975	1976	1977
Fibre and full spinning	403	233	193	138
Fibre and microspinning	2,562	2,357	2,341	2,228
Microspinning alone				3
Fibre tests alone	86	39	28	132
Mill tests	12	—	6	17
Standard cottons	21	24	23	28
Trade Varieties—lint	24	41	27	21
Trade Varieties—*kapas*	49	38	45	44
Technological Research	81	48	19	154
Miscellaneous	—	1	—	3
Total	3,238	2,781	2,682	2,768

TABLE I (*b*) : NUMBER OF SAMPLES TESTED AT THE REGIONAL STATIONS

Station	Total number of samples tested			
	Fibre length	Fibre fineness	Fibre strength	Fibre maturity
Coimbatore	1,488	1,488	1,488	1,488
Dharwar	2,188	1,472	1,473	1,472
Hissar	365	760	551	792
Indore	515	515	515	548
Ludhiana	254	254	254	202
Nanded	868	868	853	858
Nandyal*	476	457	404	265
Sriganganagar	532	532	532	544
Surat **	10,391†	4,276	4,294	4,733

* This station was shifted to Guntur.

** At this station, 129 cottons were also spun on the Shirley Miniature Spinning Plant and the spun yarns evaluated for important yarn properties.

† 10,365 samples were tested on Digital Fibrograph and 26 on Baer Sorter.

TABLE 2 : NUMBER OF SAMPLES TESTED AND REPORTED IN 1977

State	Fibre and full spinning	Fibre and microspinning	Fibre tests	Total
	(*i*) *AICCIP*			
Punjab	12(2)	11(2)	18(1)	41(5)
Haryana	24(3)	131(11)	—	155(14)
Rajasthan	2(1)	70(3)	—	72(4)
Madhya Pradesh	—	114(9)	—	114(9)
Gujarat	14(1)	—	—	14(1)
Maharashtra	4(2)	157(22)	—	161(24)
Andhra Pradesh	2(1)	163(13)	26(1)	191(15)
Karnataka	11(2)	364(28)	—	375(30)
Tamil Nadu	3(1)	216(19)	—	219(20)
IARI, New Delhi	—	1(1)	—	1(1)
Total	72(13)	1,227(108)	44(2)	1,343(123)
	(*ii*) *Other State Schemes*			
Haryana	2(1)	—	—	2(1)
Rajasthan	6(4)	—	—	6(4)
Uttar Pradesh	—	—	20(2)	20(2)
Madhya Pradesh	9(7)	28(2)	—	37(9)
Gujarat	13(13)	—	—	13(13)
Maharashtra	23(18)	35(7)	14(3)	72(28)
Andhra Pradesh	18(10)	76(6)	—	91(16)
Karnataka	15(12)	—	—	15(12)
Tamil Nadu	14(6)	45(4)	—	59(10)
Total	100(71)	181(19)	34(5)	315(95)
		Grand Total		1,658(218)

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

ALL INDIA COORDINATED COTTON IMPROVEMENT PROJECT

This is the tenth year of the Project. Reports on various samples grown under advanced trials, such as Coordinated Varietal Trials, Preliminary Varietal Trials, Pilot Project Trials, Hybrid Trials, etc., were presented at the panel meetings held at Udaipur for the North Zone, at Pune for the Central Zone, and at Coimbatore for the South Zone. These panel meetings covered locations in the North Zone comprising the States of Punjab, Haryana and Rajasthan and IARI (New Delhi), locations in Central Zone comprising the States of Madhya Pradesh, Gujarat and Maharashtra, and locations in South Zone comprising the States of Andhra Pradesh, Karnataka and Tamil Nadu, respectively.

NORTH ZONE

G. hirsutum Trials

Coordinated Varietal Trials were conducted for (*i*) Normal Plant Type and (*ii*) Short Duration Type at Hissar, Ludhiana, Sirsa and Sriganganagar.

Table 3 gives the data on the range of mean fibre length, fineness, maturity and bundle strength values of samples pertaining to these two types.

It may be seen from the table that the mean fibre length of the strains from Normal Plant Type ranged between 19.6 mm and 27.9 mm and that for Short Duration Type ranged between 20.8 mm and 27.2 mm. The ranges of fineness (Micronaire value) for Normal Plant Type and Short Duration Type were from 3.3 to 4.7 and from 3.1 to 4.4, respectively.

It can also be seen from the table that while the maturity was average for the samples of both Normal Plant Type and Short Duration Type, bundle strength varied between 43.4 g/t and 50.9 g/t for Normal Plant Type and between 42.3 g/t and 50.4 g/t for Short Duration Type, respectively.

The following strains gave encouraging spinning performance at 40s count :

Location of growth	*Strains suitable for 40s count*
Hissar	LH.114, LH.115, H.655(C), H.654(C), H.642(C), H.538, SVM, H.700, HSB.2, H.640-1, LH.33, H.689-1, H.14 and B.N.
Ludhiana	LH.52, LH.249, J.286, J.290, J.205, B.N , LH.38, LH.299 and F.414.
Sirsa	J.290, H.655C, SH.2574, B.N., LH.299, H.777 and SH.174.
Sriganganagar	LH.114, LH.249, F.605, J.260, J.286, J.290, H.655C, H.654C, H.642C, H.700, RS.89-166, RS.456, 40-75D, SH.2574, 320F, B N., FSB.8 and SH.269.

TABLE 3 : SUMMARY OF TEST RESULTS ON STRAINS TRIED IN COORDINATED VARIETAL TRIAL OF *G. hirsutum*, BR. 04 : NORTH ZONE

Location	Normal Plant Type					Short Duration Type				
	No. of samples	Mean fibre length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)	No. of samples	Mean fibre length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)
Hissar	14	22·1-27·7	3·3-4·2	Average	44·5-48·8	9	21·3-24·9	3·1-4·0	Average	44·0-50·4
		(25·0)	(3·8)		(46·4)		(22·9)	(3·7)		(47·3)
Ludhiana	7	21·1-24·6	3·8-4·1	Average	46·1-50·4	5	21·1-23·6	3·7-4·0	Average	46·1-47·7
		(22·9)	(4·0)		(47·4)		(22·1)	(3·9)		(47·0)
Sirsa	7	19·6-27·7	3·4-4·7	Average	45·0-47·7	7	20·8-23·9	4·0-4·4	Average	45·6-48·2
		(23·2)	(4·0)		(46·1)		(21·9)	(4·1)		(46·9)
Sriganganagar ..	27	21·1-27·9	3·4-4·6	Average	43·4-50·9	16	22·1-27·2	3·3-4·4	Average	42·3-47·7
		(24·8)	(3·9)		(46·5)		(23·7)	(3·8)		(45·1)

Notes: Figures in brackets indicate averages.
Maturity coefficient; Low=below 0.70; Average=0·70 to 0·80; Good=above 0·80.
Bundle strength values are at nominal zero gauge.

Samples of Preliminary Varietal Trial (PVT), Normal Plant Type, were received from Hissar, Ludhiana, Sirsa and Sriganganagar. Mean fibre length of 22 strains raised at Hissar ranged between 22.1 mm and 27.7 mm. Maturity was average and bundle strength values were average to good. The range of mean fibre length of six strains tried at Ludhiana was between 21.8 mm and 24.1 mm. They recorded low to average maturity and good bundle strength. Mean fibre length of seven samples received from Sirsa ranged between 21.1 mm and 24.4 mm. Maturity was average and bundle strength values were good. The range of mean fibre length of 27 samples received from Sriganganagar was between 21.1 mm and 28.4 mm. They recorded low to average maturity and good bundle strength.

Ranges of mean fibre length for strains raised at Hissar, Ludhiana and Sirsa under PVT, Short Branch Type, were 22.4 mm to 26.7 mm, 20.8 mm to 24.6 mm, and 20.8 mm to 26.9 mm, respectively. They recorded satisfactory maturity and good bundle strength.

A set of 32 samples raised under Initial Evaluation Trial at Hissar was received for microspinning test. The mean fibre length of these samples ranged between 27.1 mm and 27.4 mm. Maturity was low to average and bundle strength values were average to good. Samples were spun to 30s count and most of the strains have shown good spinning performance at that count.

Other Trials

Eight strains were tried in Main Varietal Trial at Hissar and their mean fibre length ranged between 21.8 mm and 27.9 mm. Eventhough maturity was low, the bundle strength values were good. The following strains showed satisfactory yarn strength when spun to 40s count :

H.700, H.689-1, H.777, H.655C and B.N.

Two sets of samples under Miscellaneous Trial indicated as MAVT.1 and MAVT.2, were received from Hissar. Range of mean fibre length of these samples was between 22.1 mm and 25.9 mm. They recorded low maturity and good bundle strength. All the strains showed good spinning performance at 30s count.

The technological performance of a new selection of RS.89 designated as Ganganagar Ageti (RS.89-166), raised at Sriganganagar was evaluated against Bikaneri Narma. The test results indicated that although RS.89-166 recorded higher mean fibre length than Bikaneri Narma, the yarn strength at 20s and 30s counts for RS.89-166 was low probably due to the high percentage of short fibres.

G. arboreum Trials

Samples pertaining to Coordinated Varietal Trial were received from Hissar and Jullundur for fibre tests only. Mean fibre length of *G. arboreum*

strains raised at Hissar was between 16.5 mm and 20.1 mm. Uniformity ratio was excellent and bundle strength values were average to good.

Samples from Jullundur recorded variation in mean fibre length between 16.5 mm and 19.8 mm. All these strains were very coarse. The bundle strength values were average to good.

Desi strain HD.9 tried at Hissar recorded 19.8 mm mean fibre length, good uniformity ratio and bundle strength.

CENTRAL ZONE

G. hirsutum Trials

In Coordinated Varietal Trial, samples were received from Rahuri under irrigated conditions and from Parbhani under rainfed conditions.

The test results of seven strains received from Rahuri indicated that their mean fibre length ranged from 22.4 mm to 26.7 mm. The Micronaire values ranged from 3.2 to 4.4. Maturity was average and bundle strength values were average to good. However, only one strain, viz. G.Cot.100 (Vishnu), recorded satisfactory yarn strength when spun to 40s count.

In the case of five strains received from Parbhani, mean fibre length ranged between 24.4 mm and 29.2 mm. Maturity was average to good and bundle strength values were good. All the five strains, viz. MCU.5, JLH.19 KH.33-1146, Ach.108 and G.Cot.10, recorded impressive CSP at 40s count.

In the irrigated tracts of Central Zone, Coordinated Varietal Trial was carried out at Morena and Rahuri with entries approved for North Zone.

The test results are summarised in Table 4.

TABLE 4 : SUMMARY OF TEST RESULTS ON SAMPLES GROWN UNDER IRRIGATED CONDITIONS IN CENTRAL ZONE WITH NORTH ZONE ENTRIES

	Morena	Rahuri
Normal Plant Type Br.O4(a)		
Number of samples	—	7
Mean fibre length (mm)	—	21·2-23·4
Fineness (Micronaire value)	—	3·5- 3·9
Maturity	—	Average
Bundle strenth (g/t)	—	43·4-48·8
Promising strains (40s count)	—	B.N.
Short Duration Type Br.O4(c)		
Number of samples	18	7
Mean fibre length (mm)	20·8-25·4	21·1-24·4
Fineness (Micronaire value)	3·4- 4·6	3·8- 4·6
Maturity	Average	Average
Bundle strength (g/t)	45·0-51·5	41·3-46·6
Promising strains (40s count)	LH.299, F.414, FSB.8, H.777, SH.269, B.N., and C.59-228	Nil

Samples pertaining to Preliminary Varietal Trial were received from Rahuri under irrigated conditions and from Parbhani and Rahuri under rainfed conditions.

Mean fibre length of seven samples received from Rahuri under irrigated conditions ranged between 23.4 mm and 26.9 mm. Maturity and bundle strength values were average to good. The strains 064, 065 and IAN.2147 showed good spinning performance at 40s count.

Five strains were tried in Preliminary Varietal Trial at Parbhani under rainfed conditions. Their mean fibre length ranged between 22.6 mm and 24.4 mm. Maturity was average to good and bundle strength values were good. The strains ACH.270, 74IH.9 and JLH.40 recorded better spinning performance than the other strains.

Range of mean fibre length of seven strains tried in Preliminary Varietal Trial under rainfed conditions at Rahuri was between 25.9 mm and 28.7 mm. Maturity and bundle strength values were low to average. Four strains, viz. KOP.294, KOP.305 and SH.269 fared well at 40s count.

Preliminary Varietal Trials with entries approved for North Zone were conducted at Rahuri. Ranges of mean fibre length of seven strains of Normal Plant Type and seven strains of Short Branch Type were between 20.8 mm and 24.1 mm, and between 21.6 mm and 26.7 mm, respectively. Maturity was low for Normal Plant Type strains and low to average for Short Branch Types. Bundle strength values ranged from 43.4 g/t to 46.1 g/t, and from 35.4 g/t to 45.0 g/t for Normal Plant Type and Short Branch Type, respectively. Three strains, viz. Ra.18 × H.297-9, Laxmi and SH.175, fared well at 40s count.

Samples pertaining to Initial Evaluation Trial were received from Rahuri. Out of 15 samples received for microspinning test, eight Kopergaon selections, viz. KOP.390, KOP.453, KOP.574, KOP.540, KOP.607, KOP.654, KOP.661, and KOP.686 were found suitable for spinning to 40s count.

G. arboreum Trials

Samples pertaining to Coordinated Varietal Trial were received from Parbhani. Mean fibre length of five samples from this trial ranged between 21.1 mm and 22.1 mm. Maturity was average to good and bundle strength values were good. Only two strains, viz. AKH.605 and AKH.597 showed satisfactory spinning performance at 30s count.

G. herbaceum Trial

Mean fibre length of 13 *herbaceum* strains belonging to Coordinated Varietal Trial conducted at Dhandhuka ranged between 21.8 mm and 23.6 mm. Maturity was average and bundle strength values were good.

The following strains showed satisfactory spinning performance at the counts indicated :

Count	*Strains*
30s	22-7-1, 38-1, 53-3-1, 1501, 6023, 6053 and V.797.
40s	40-1-4-4, 1522, 1433, 1435, 6130 and 504.

Miscellaneous Trials

With a view to study the performance of hybrids, many trials were conducted at Rahuri under irrigated (I) and rainfed (R) conditions. The hybrids which exhibited good performance are listed below :

Trial	*Count*	*Hybrids*
Inter-hirsutum (I)	40s	HH.1 and HH.3
Interspecific (I)	80s	CBS.156
Rahuri hybrids (R)	50s	RHR.131
Rahuri hybrids (I)	60s	RHR.253
Rahuri hybrids (I)	80s	Varalaxmi

It was noted that although interspecific hybrids recorded much superior fibre length, the fibre maturity was not satisfactory which resulted in neppy yarns.

SOUTH ZONE

G. hirsutum Trials

Coordinated Varietal Trials were conducted at Amaravati, Arabhavi, Siruguppa and Srivilliputtur under irrigated conditions and at Dharwar and Raichur under rainfed conditions. Trials of early maturing varieties for rice fallows were also conducted at Aduthurai, Srivilliputtur and Tenali.

Table 5 gives a summary of the fibre test results of the samples pertaining to Coordinated Varietal Trials in the South Zone. It is seen from the table that mean fibre length of the strains tried under irrigated conditions ranged from 23.1 mm to 34.3 mm. Range of Micronaire value was from 3.0 to 4.8. Maturity was low to average and bundle strength values ranged between 37.5 g/t and 51.5 g/t.

As regards strains raised under rainfed conditions, their mean fibre length ranged between 22.4 mm and 29.0 mm. Maturity was average to good. Ranges of Micronaire values and bundle strength values were between 3.8 and 5.1 and between 40.2 g/t and 49.8 g/t, respectively.

TABLE 5 : SUMMARY OF TEST RESULTS ON STRAINS TRIED IN COORDINATED VARIETAL TRIAL *G. hirsutum* BR.04 : SOUTH ZONE

Location	Irrigated, Br. 04(a)					Rainfed, Br. 04(b)					Rice fallows Br. 04 (c)				
	No. of samples	Mean fibre length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)	No. of samples	Mean fibre length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)	No. of samples	Mean fibre length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)
Aduthurai	—	—	—	—	—	—	—	—	—	—	14	22·1-26·9 (25·0)	3·4-4·7 (4·0)	Average to good	46·1-52·5 (49·0)
Amaravati	16	25·7-30·7 (28·5)	3·4-4·1 (3·8)	Average	38·6-46·1 (42·0)	—	—	—	—	—	—	—	—	—	—
	12	27·2-30·0 (28·1)	3·7-4·4 (4·0)	Average	40·2-45·0 (42·8)	—	—	—	—	—	—	—	—	—	—
Arabhavi	14	23·1-25·7 (24·2)	3·0-4·6 (3·6)	Low to average	38·1-45·0 (41·2)	—	—	—	—	—	—	—	—	—	—
Dharwar	—	—	—	—	—	21	22·4-29·0 (26·0)	3·8-5·1 (4·4)	Average to good	40·2-49·8 (44·0)	—	—	—	—	—
Raichur	—	—	—	—	—	1	23·4	4·4	Average	43·4	—	—	—	—	—
Siruguppa	15	27·2-34·3 (30·7)	3·0-4·4 (3·6)	Low to average	37·5-45·0 (40·9)	—	—	—	—	—	—	—	—	—	—
	15	26·4-32·5 (29·4)	3·1-4·1 (3·6)	Low to average	37·5-45·0 (41·0)	—	—	—	—	—	—	—	—	—	—
Srivilliputhur	23	23·4-30·0 (27·4)	3·6-4·8 (3·9)	Average to good	44·0-51.5 (48·5)	—	—	—	—	—	14	23·9-29·0 (26·8)	3·1-4·9 (3·8)	Low to average	42·3-49·8 (47·1)
Tenali	—	—	—	—	—	—	—	—	—	—	12	24·4-26·9 (25·3)	3·3-4·8 (4·2)	Average	40·7-49·8 (46·9)
	—	—	—	—	—	—	—	—	—	—	14	20·8-27·4 (24·7)	3·6-4·9 (4·4)	Average to good	45·6-52·5 (48·6)

Note : Please see note below Table 3.

Range of mean fibre length of the early maturing varieties from rice fallows was between 20.8 mm and 29.0 mm. Maturity was average to good. Micronaire values ranged between 3.1 and 4.9 and bundle strength values between 40.7 g/t and 52.5 g/t.

Following strains gave encouraging spinning performance at the counts indicated :

Location	*Count*	*Strains*
Aduthurai	50s	SVPR.75, 338, 450, 4418 and Krishna.
Amaravati	60s	ELS.139, MCU.5, SRG.11, AHO.66-114, CPD.17-13-12 and ELS.481.
Arabhavi	50s	ELS.268.
Dharwar	50s	CPD.19-B.2, CPD.7-B.2, DS.38, CP.1998F, DS.8, CPD.17-B.12, C.50, AHO. 80-222-1, DS.35, SRT.1, NA.247, CPD. 8-1 and Laxmi.
Siruguppa	60s	CP.1998F, ELS.191, ELS.380, ELS.481, ELS.271-4-1, ELS.365, ELS.46, DS.54, ELS.112-1, CP.25-1, MCU.5, AHO.80-224, CP.13-20, AS.27-13, ELS.268, IC.1245, CPD.105-3, AHO.80-222-1, DS.6-128 and SRG.26.
Srivilliputhur	60s	AV.1661, ELS.481, AHO.66-114, EL.031, ELS.250, IS.MCU.5-2, MCU.5, ELS.380, ELS.191, AS.31, ELS.103, ELS.139, CPD.106-3, AV.2775/II/I, AHO.80-220, MCU.8, CPD.17-B-12 and CP.25-1.
	50s	SVPR.61, SVPR.75, SVPR.154, 338, 450, 756, CRH.043, 17-56, 4418, CRH.049-3, JK.44, MCU.7 and Krishna.
Tenali	50s	338, 450, 756, 3400, PS.9, IC.1824, CRHO.43, MCU.7, V.14, Krishna, SVPR.60, SVPR.61, SVPR.69, SVPR.73, SVPR.77, SVPR.154, LH.299, 17-56, 4418 and Khandwa 2.

Samples pertaining to Preliminary Varietal Trial under irrigated conditions were received from Amaravati, Siruguppa and Srivilliputtur and those under rainfed conditions were received from Dharwar and Raichur. Preliminary Varietal Trials of early maturing strains were also conducted at Aduthurai, Srivilliputtur and Tenali.

The following strains fared well at the counts indicated against them :

Location	*Count*	*Promising strains*
Aduthurai	60s	SVPR.122, SVPR.124, SVPR.147, K.58 and Krishna.
Amaravati	60s	CP.13-20, GS.23-1009, ELS.39, AV.2709, ELS.268, MCU.5 and AHO.61-64.
Dharwar	50s	CRH.65, CPD.19-1, CPD.11-3-8, CPD.32-13, CPD.34-25, CPD.6-B-18, CPD.35-41, CPD.34-B-7, CPD.6-B-10 and Laxmi.
Raichur	40s	SRG.26, DS.4, DS.68, DS.44 and DS.32.
Siruguppa	60s	CPD.1-B-3, AHO.80-185, AHO.80-196-1, AHO.80-2-2-2, EL.0575, ELS.381, NMF. 167, ELS.177, Hampi, AV.2775-21-1-18 and MCU.5.
Srivilliputtur	60s	ELS.177, ELS.381, GS.23-1009, AV.2709, CP.13-20, IC.1842, ELS.268, AS.38, IC.1407, CP.2-1, AHO.75-234, AS.27-13, MCU.5 and MCU.8.
	50s	SVPR.122, SVPR.124, SVPR.134, SVPR. 147, K.5-8, MCU.7 and Krishna.
Tenali	50s	457-3, 752-1-5, 3400 III/I, 3438, 3703SP, 3763, SVPR.73, SVPR.122, SVPR.124, SVPR.134, MCU.7, V.14 and Krishna.

Samples raised in Initial Evaluation Trial were received from Amaravati and Siruguppa.

Mean fibre length for 28 samples raised at Amaravati ranged between 27.7 mm and 31.5 mm. Maturity was not satisfactory in the case of many samples, however bundle strength values were average to good. As many as 22 out of 26 strains fared well at 60s count. The strains which recorded very good performance were AV.3351-2 (CSP 2412), AV.3326-18 (CSP 2400), NMF.175 (CSP 2394), AV.3069-II/2-IV/2 (CSP 2376), AV.2775-II/1-48 (CSP 2346) and AV.3392-8-I/3 (CSP 2340).

In the case of 10 strains raised at Siruguppa, mean fibre length ranged between 23.6 mm and 29.5 mm. All the strains recorded excellent uniformity in staple length. They had low to average maturity and average to good bundle strength. None of the new strains fared well at 60s count.

In Pilot Project Demonstration Trial conducted at Siruguppa, three new strains, viz. AS.27-13, AHO.80-222-1 and CPD.105-3 along with Hampi (Control) were tested. All the three new strains showed encouraging spinning performance at 50s count.

Many hybrid trials involving *hirsutum* × *hirsutum* crosses or *hirsutum* × *barbadense* crosses were carried out at Arabhavi, Coimbatore, Dharwar, Nandyal, Raichur, Siruguppa and Srivilliputtur. By and large, the crosses

TABLE 6 : RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED DURING 1977

Variety	Place	Mean fibre length (mm)	Mean fibre length (in)	Fineness: Millitex	Fineness: Micronaire value	Maturity coefficient	Bundle strength: Tenacity (zero gauge) g/t	Bundle strength: PSI (zero gauge) lb/mg	Bundle strength: Tenacity (1/8″ gauge) g/t
Andhra Pradesh									
Krishna	Amaravati	27·3	1·07	150	3·9	0·82	45·0	8·4	26·6
MCU.5	,,	29·0	1·14	114	3·5	0·78	42·9	8·0	22·5
Hybrid 4	Chirala	27·4	1·08	157	4·0	0·69	41·3	7·7	22·4
MCU.5	,,	27·1	1·07	138	3·5	0·66	43·4	8·1	24·6
Gujarat									
Sankar 4	Bayad	28·0	1·10	134	3·4	0·63	39·1	7·3	22·1
Varalaxmi	Idar	31·3	1·23	118	3·0	0·61	47·2	8·8	29·1
Gujarat 67	Mandvi	27·0	1·06	134	3·4	0·67	41·3	7·7	22·3
Haryana									
H.655C	Hissar	27·7	1·09	150	3·8	0·83	45·6	8·5	25·9
H.689-1	,,	27·9	1·10	134	3·4	0·66	44·5	8·3	—
Karnataka									
SB.289E	Dharwar	30·5	1·20	165	4·2	0·69	45·6	8·5	—
S. I. Andrews	Shimoga	29·6	1·17	138	3·7	0·81	45·0	8·4	27·6
ELS.191	Siruguppa	27·2	1·07	126	3·2	0·76	43·4	8·1	23·1
MCU.5	,,	29·0	1·14	126	3·2	0·73	45·0	8·4	27·1
Varalaxmi	Dharwar	29·5	1·16	144	2·9	0·70	46·6	8·7	30·8
Maharashtra									
Varalaxmi	Jalna	31·4	1·24	114	2·9	0·61	50·4	9·4	32·1
MCU.5	Malkapur	27·6	1·09	126	3·2	0·62	47·2	8·8	25·4
Varalaxmi	Mehkar	31·8	1·25	118	3·0	0·60	48·8	9·1	29·5
NDHy.1 (Irrigated)	Nanded	28·6	1·13	130	3·3	0·66	43·4	8·1	25·6
Hybrid 4	Warora	27·4	1·08	165	4·2	0·71	38·6	7·2	22·6
RHR.253	Rahuri	30·5	1·20	110	2·8	0·58	44·5	8·3	—
RHR.253	Padegaon	32·3	1·27	122	3·1	0·65	39·7	7·4	—
RHR.253	Baramati	31·5	1·24	134	3·4	0·67	38·6	7·2	—

TABLE 6 : RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED DURING 1977—(*Concld.*)

Variety	Place	Mean fibre length (mm)	Mean fibre length (in)	Millitex	Micronaire value	Maturity coefficient	Blundle strength: Tenacity (zero gauge) g/t	Blundle strength: PSI (zero gauge) lb/mg	Blundle strength: Tenacity (1/8″ gauge) g/t
Madhya Pradesh									
Hybrid 4	Khandwa	28·0	1·10	150	3·8	0·72	45·0	8·4	25·6
Hybrid 4	Ratlam	27·4	1·08	173	4·4	0·72	42·3	7·9	22·3
Tamil Nadu									
ELS.271A.1	Coimbatore	27·9	1·10	146	3·7	0·69	42·3	7·9	—
ELS.294-2-6	,,	27·9	1·10	130	3·3	0·65	40·2	7·5	—
ELS.380	,,	27·7	1·09	126	3·2	0·63	42·9	8·0	—
ELS.481	,,	29·0	1·14	134	3·4	0·66	42·9	8·0	—
MCU.5	,,	28·4	1·12	122	3·1	0·61	42·9	8·0	—
112-1	,,	27·7	1·09	126	3·2	0·65	36·4	6·8	—
CP.25/1SB	,,	31·2	1·23	118	3·0	0·60	45·6	8·4	—
MCU.5 (Foundation)	Periakulam	28·6	1·13	118	2·8	0·77	50·4	9·4	25·9
MCU.5 (Nucleus)	,,	28·6	1·13	110	3·0	0·79	45·0	8·4	27·3
MCU.6	,,	28·0	1·10	138	4·0	0·85	48·2	9·0	24·3
MCU.8 (Foundation)	,,	29·0	1·14	126	3·6	0·83	49·3	9·2	25·8
MCU.8 (Nucleus)	,,	30·5	1·20	134	3·6	0·87	47·2	8·8	26·8
MCU.8	Srivilliputtur	27·9	1·10	110	2·8	0·57	47·7	8·9	—

of *hirsutum-barbadense* recorded encouraging staple length. However, uniformity in staple was not satisfactory in the case of many hybrids. The fibre maturity also needs to be improved as the yarns spun were very neppy. The following hybrids were found suitable for the counts shown against them :

Inter-hirsutum hybrids

Location	*Count*	*Promising hybrids*
Coimbatore	50s	$T_1 \times M_7$, $T_6 \times M_2$, $M_9 \times T_5$, JKHy.1 and Hybrid4.
Nandyal	50s	NHH.13, NHH.21, NHH.27, NHH.25, NHH.19 and Hybrid 4.
Srivilliputtur	50s	CPH.2, CPH.4, CPH.5 and TK×1.

Hirsutum-barbadense hybrids

Location	*Count*	*Promising hybrids*
Coimbatore	80s	H.61 and H.64.
Nandyal	80s	NHB.66, NHB.55, NHB.48, and NHY.12.
Raichur	80s	DCH.37.
Siruguppa	80s	DCH.32, DCH.37, DCH.40, TNH.2, DCH.18, Varalaxmi, DCH.39, TNH.3, DCH.36, CBS.156, DCH.57 and NHy.12.

EXTRA-LONG STAPLE (27MM AND ABOVE) COTTONS

The results of the detailed tests carried out during 1977 on extra-long staple cotton samples received at CTRL are shown in Table 6. This supplements the promising strains described under AICCIP.

MILL TESTS

Taking into consideration the results of yield 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. Only after the performance of the new varieties is confirmed by mill tests, atleast for two consecutive seasons, the varieties are generally recommended for large scale propagation. It is with the cooperation of a few mills, that the Laboratory arranges mill tests on promising strains.

During the year, mill tests were carried out on two strains pertaining to 1974-75 kharif season and two strains pertaining to 1976-77 season. The comparative test results at the mill and CTRL are given in Table 7.

It will be seen that the sample of V.14 from Guntur gave almost the same yarn strength as Krishna when spun to 40s count both at the mill and the Laboratory.

The sample, 12009 from Mudhol gave better yarn strength than Gaorani 6 both at the mill and the Laboratory.

TABLE 7 : COMPARATIVE MILL AND CTRL TESTS—SPINNING TEST RESULTS

Place	Variety	Laboratory Results				Mill Test Results			
		Waste (%)	Count	Strength (lb)	t.m.	Waste (%)	Count	Strength (lb)	t.m.
Andhra Pradesh									
Guntur .. (1976-77)	V.14	5·3	40s	57·9	4.0	5·6	40s	45·6	4·0
	Krishna (Control)	5·2	40s	58·0	4·0	6·8	40s	46·8	4·0
Mudhol .. (1974-75 Kharif)	12009	3·6	40s	49·7	4·0	4·0	40s	50·0	4·5
	Gaorani 6 (Control)	7·6	40s	45·6	4·0	6·0	40s	43·8	4·5

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.

NEW VARIETIES RECOMMENDED FOR RELEASE PRE-RELEASE SEED MULTIPLICATION

In the plenary session of the South Zone Panel Meeting of AICCIP held at Coimbatore on June 7 and 8, 1977, seed multiplication proposals of the following varieties were considered and approved for pre-release seed multiplication :

Variety	*Area of adaptation*	*Advantages*
ELS 481	Winter Irrigated Zones of Tamil Nadu	18% more yield than the existing MCU.5 variety, 3% more ginning outturn and 30% more lint yield. It can be spun to 60s count.
CP.1998F	Rainfed Tract of Tamil Nadu	Higher yield than Checks and 37% ginning outturn. It is suitable for spinning medium counts.
CPH.2	Southern and Central Districts of Tamil Nadu and parts of Andhra Pradesh	This Inter-*hirsutum* hybrid of medium staple involving Gregg male sterile line has good yield and ginning percentage under rainfed conditions.

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

Lint samples of fair average quality of the major Trade Varieties of Indian cottons are being obtained through the East India Cotton Association, Ltd. (EICA), Bombay, each season. Representative *kapas* samples of the varieties are procured from the State Departments of Agriculture for deter-

mination 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 the information of the cotton trade and industry. Such circulars were issued on 43 varieties during 1977. The test results on all the Trade Varieties of 1975-76 season were compiled together and published as "Technological Report on Trade Varieties of Indian Cottons, 1975-76 Season". Most of the 1976-77 season samples have been received and tested.

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 are grown under identical conditions from year to year on the government farms under departmental supervision. Extensive fibre and spinning tests are regularly being done on such samples and the test results are published as Technological Circulars for the information of the Cotton Breeders and other research workers as early in the season as possible. During 1977, such circulars were issued on 12 varieties and most of the samples of Standard Indian Cottons of the 1976-77 season received and tested have been covered.

The results on all the samples pertaining to the 1975-76 season were consolidated and published as "Technological Report on Standard Indian Cottons, 1975-76 Season".

Cleaning of Kapas by the Newly Fabricated Laboratory Extractor (CTRL Kapas Extractor)

In order to assess the cleaning efficiency of the newly fabricated Laboratory Extractor, the total trash present in the original uncleaned *kapas* sample of seven varieties selected for the study were determined by physically sorting out the trash from 1 kg *kapas* sample of each variety. The total trash present were analysed and the percentages of each type of trash were dertermined. This was then compared with the trash removed by the CTRL Kapas Extractor from each of the above seven varieties. The trash cleaning efficiency of the Extractor was found to be about 38% on an average.

Survey of the Conditions of Cotton Ginning Factories in India

It was mentioned in the last year's annual report that the concerned state officials were being contacted to expedite the replies to be sent for the questionnaire supplied. During the year, efforts were made to obtain comp-

leted questionnaires from the non-responding areas in the State of Rajasthan. Personal visits were also undertaken to some of the factories in Udaipur Division of Rajasthan to study the type and condition of the machinery installed, besides obtaining the particulars called for in the questionnaires. The information so far collected are being analysed.

Fabrication of a Lint Opener

During the year, the surface damage caused during processing of the five varieties, viz. MCU.5, Pramukh, L.147, Jayadhar and Bengal Desi, through the Lint Opener fabricated at CTRL and the Shirley Analyser was examined by the Congo Red Test. The percentage of damaged fibres was found to be 5% for the samples opened with CTRL Lint Opener and 4.5% for the samples opened on Shirley Analyser, as against 3% for the control samples, showing that very little damage was caused to fibres while passing through the Lint Opener.

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

In order to study the extent and the manner of variability in commercial cottons, samples of Suvin, MCU.5, Hybird 4, Varalaxmi and CBS.156, grown at different locations in Andhra Pradesh were procured and tested for seed index, lint index, ginning outturn, fibre length, fineness, maturity and bundle strength. As cottons are picked at different intervals, it was thought desirable to examine variations in the above characters picking-wise.

During the period under report, compilation of the test results in respect of seed index, lint index and 2.5% span length was completed. The values of 2.5% span length are reported location-wise and picking-wise in the Table below :

Cotton	Location	2·5% span length (mm)			
		I Picking	II Picking	III Picking	IV Picking
Suvin	Chilakaluripeth	41·0	38·4	—	—
,,	Parchuru	40·8	39·8	—	—
,,	Vijayawada	40·6	41·4	41·4	41·7
MCU.5	Chilakaluripeth	31·5	29·4	29·0	28·0
,,	Padanandipadu	33·8	32·8	33·6	32·5
,,	Parchuru	34·0	32·8	32·0	—
,,	Vijayawada	36·0	33·3	29·7	32·5
Hybrid 4	Chilakaluripeth	30·0	29·7	28·4	29·0
,,	Parchuru	32·6	—	—	—
,,	Addanki	31·5	—	—	—
,,	Vijayawada	30·4	31·8	31·5	32·2
Varalaxmi	Chilakaluripeth	33·6	33·4	33·8	34·3
,,	Addanki	36·0	38·4	38·8	38·6
CBS.156	Addanki	39·9	39·0	39·9	32·0

The main observations are as follows :

Seed Index : Hybrid CBS.156 and Suvin recorded higher seed index than other hybirds/varieties. No systematic trend of change was observed in seed index either location-wise or picking-wise.

Lint Index : Noticeable variation in lint index was observed location-wise as well as picking-wise. However, no specific trend was seen in lint index values.

Length : Length was determined with Digital Fibrograph. There appeared to be considerable reduction in length in the case of some varieties/hybrids with the later pickings. Variation for the variety MCU.5 appeared to be more than for other varieties.

Studies on Linear Density and its Influence on Fibre Tenacity

In order to confirm the results on single fibre tenacity under wet conditions reported earlier, bundle tenacity measurements were made under standard atmospheric and wet conditions for all the varieties selected for the study. Measurements were made at 3.2 mm and 5.0 mm gauge lengths using the Instron Tensile Tester. It was observed that all the varieties including those belonging to *G. herbaceum* showed an increase in tenacity under wet conditions. The extent of increase in tenacity was markedly low for *G. herbaceum* cottons. It was also observed that the increase in wet tenacity of fibre bundles was less appreciable when compared to the increase observed in the case of single fibres for which the range was 10-20%. It was therefore, concluded that the true behaviour of fibres was masked by some unknown factors when tested in bundle form.

The 50% x-ray angle, which was measured for the varieties selected for the study by recording the azimuthal profile of the strongest equatorial (002) angle, ranged from 21.3° to 33.3°.

Among the various other parameters, viz. (*i*) single fibre tenacity and (*ii*) elongation, measured under standard atmospheric conditions, as well as (*iii*) tenacity, and (*iv*) elongation, measured under wet condition, all determined using 1 cm gauge length, only the elongation values under wet condition correlated well with the 50% x-ray angle (r=0.83).

In the case of fibres representing increasing stages of growth, it was observed that the x-ray orientation also increased progressively. In general, the improvement in orientation also tended to follow the pattern observed in the tenacity.

A Study of the Bulk Resilience of Cotton

The method of measurement of bulk resilience using the Instron Tensile Tester has been standardised. In this method, a plug of cotton fibres is subjected to loading and unloading cycles whereby it is repeatedly compressed and allowed to retract. The sample is fed in a cylinder in which a piston

moves back and forth compressing and decompressing the fibre plug. The load on the piston and the thickness of the plug are continually recorded by the Instron on a strip chart.

Even though the bulk resilience, which is the ability of a mass of fibres to recover from imposed deformation, has been described by earlier workers in terms of several indices, in the present work the resilience has been calculated as : (*i*) work recovered during retraction to the work done during compression and (*ii*) the ratio of thickness of the plug during expansion to the thickness during compression, both taken at a particular load.

By using the method briefly described above, the bulk resilience determinations were carried out with many varieties of cotton covering a wide range of length and fineness. However, it was observed that neither the *energy ratio* nor the *thickness ratio* varied significantly between the cottons.

One variety of cotton was subjected to different degrees of crosslinking with formaldehyde and DMDHEU after pre-mercerisation for enchanced accessibility. While there was significant improvement in the resilience on mercerisation as revealed by a reduced *energy ratio* and an enchanced *thickness ratio*, there was no further change when the samples were crosslinked. The results thus lead to the conclusion that bulk resilience of cotton does not respond well to the changes in structure and that this characteristic cannot, therefore, be used as an index for assessing the efficiency of crosslinking treatments.

Studies on the Lateral Compressibility of Chemically Modified Cotton

Work on cotton fibres and cellulose films carried out earlier under this project had indicated that the peculiar fibre morphology could be responsible for the absence of any change in the lateral compression modulus of cotton fibres despite crosslinking. Since lateral bonds between molecules and molecular aggregates could be expected to govern the torsional behaviour of the fibres in more or less the same way as they influence their response to compression, it was decided to carry out torsional tests to determine the torsional modulus of fibres before and after crosslinking.

Initial tests were made on slack mercerized cotton fibres, followed by tests on 5% stretch-mercerized fibres and finally on the latter after being crosslinked with DMDHEU of 4% concentration. From the data thus collected, it has been observed that stretch during mercerization has only a marginal effect on rigidity modulus wheras crosslinking of 5% stretch-mercerized fibres with DMDHEU of 4% concentration results in a considerably reduced modulus.

To study the effect of crosslinking on modulus, experimental work was carried out on slack mercerized Sujata fibres (control) and after crosslinking with formaldehyde (CH_2O) of 16% concentration for two different times of reaction, viz. 3 min and 40 min. Slack mercerised cotton (Control) was

also crosslinked with DMDHEU of two different concentrations, viz. 18% and 25%. Single fibres from those treated samples were subjected to torsional tests and the torsional modulus for each sample was calculated from the data thus obtained. Further, in order to ascertain the effect of wetting on the torsional modulus, torsional tests were also conducted on single fibres after wetting them in water. Such tests were carried out on the control samples as well. From these tests, values of wet torsional modulus and the ratio of wet modules to dry modulus were calculated. Results obtained are given in Table 8.

TABLE 8 : TORSIONAL MODULUS OF COTTON FIBRES UNDER DIFFERENT CONDITIONS OF TREATMENT

Treatment	Torsional modulus ($\times 10^{10}$ dynes/cm^2)		Ratio (Wet modulus)	Ratio (Wet crosslinked)
	Dry	Wet	(Dry modulus)	(Wet, Control)
1. Slack mercerised (*Control sample*)	2·47	1·24	0·50	1·00
2. Crosslinked in 16% CH_2O conc. for:				
(*a*) 3 min	2·26	0·45	0·20	0·36
(*b*) 40 min	2·01	0·47	0·23	0·38
3. Crosslinked with DMDHEU				
(*a*) 18%	2·10	—	—	—
(*b*) 25%	1·65	1·09	0·66	0·88

It is evident from the values in the table that modulus decreases with increase in severity of crosslinking reaction which could be expected to result in a similar increase in degree of crosslinking. Wetting softens the fibre as shown by the reduction in the modulus, especially in the case of crosslinked samples. The samples crosslinked with CH_2O recorded a considerable fall in modulus on wetting while this reduction has been low in the case of DMDHEU treated sample.

The above samples were also tested on the Instron Tensile Tester to study the effect of crosslinking on the tensile modulus. The fibres were first mechanically conditioned and then stressed to rupture. From the load-extension curve, the tensile modulus values were obtained for these samples. As in the case of torsional tests, here also the effect of wetting was studied.

A summary of the data thus obtained is given in Table 9.

TABLE 9 : TENSILE MODULUS OF COTTON FIBRES SUBJECTED TO DIFFERENT TREATMENTS

Treatment	Tensile modulus ($\times 10^{10}$ dynes/cm^2)		Ratio (Wet modulus)	Ratio (Wet cross-linked)
	Dry	Wet	(Dry modulus)	(Wet, Control)
1. Slack mercerised (*Control sample*)	7·39	2·68	0·36	1·00
2. Treated with CH_2O of 16% for :				
(*a*) 3 min	3·56	2·26	0·63	0·84
(*b*) 40 min	3·30	1·25	0·38	0·46
3. Treated with DMDHEU 18%	3·66	3·47	0·95	1·29

It is thus clear that the tensile modulus is reduced by crosslinking treatment. Wetting brings about further fall in the values. The fibres treated with DMDHEU suffer less reduction in modulus on wetting than those treated with CH_2O. The torsional modulus and tensile modulus respond in the same way to crosslinking treatments.

Further Studies on the Cross-Sectional Shape of Cotton Fibres

It was reported earlier that *desi* cottons had higher percentages of fibres having round cross-sectional shape than exotic cottons and that cottons belonging to *G. herbaceum* (*desi* variety) showed a tendency to have more circular shape of fibre cross-section from the very initial stages of boll development as compared to cottons of *G. hirsutum*. During the period under report, this study was extended for cottons pertaining to *G. arboreum* and *G. barbadense* species. The fibres collected from bolls at different intervals, viz. 28, 35, 42, 49 and 56 days were obtained and dehydrated at room temperature. The cross-sections obtained with Hardy Microtome were magnified to 1350 × under the microscope fitted with Euscope and ground glass screen. The circularity value (C) was determined from the formula, $C=4\pi A/P^2$, where A is the area of cross-section and P, the perimeter. It was observed that circularity of cotton fibre increased with increasing age of boll. It was further noted that the circularity values of cotton fibres of *G. arboerum* were much higher than those of *G. barbadense* from the initial stages of boll development.

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

The objectives of the project taken up in collaboration with the Cotton Specialist, Gujarat Agricultural University, Surat, were to study the breeding

and genetic aspects associated with the length uniformity as also to understand clearly the mode of inheritance of length characteristics. During the period, crosses have been effected amongst four *G. hirsutum* and three *G. barbadense* parents and F1s raised. Back-crosses too have been effected in the field. These along with the parents and F2s will be raised during next crop season 1978-79.

Studies on Inheritance of Strength and Structural Parameters in Cotton Fibres

Samples from 77 single plants raised from the earlier selections were tested for x-ray orientation and tenacity at 'nominal zero' gauge length. Although the selection did narrow the ranges of distribution, some overlap, particularly in tenacity, was observed between the high strength and low strength parents. It was hence decided to carry out further selection, and 37 plants were chosen for sowing.

As fibre maturity is one of the aspects to be studied, the efficiency and reliability of the conventional testing method of estimating maturity was evaluated by comparing the values obtained using the usual method with those found out by actual measurements of lumen-width and wall-thickness. About 400 fibres each from four selected cottons of different maturity levels were evaluated. It was tentatively concluded from the results that the accuracy of estimation was almost equal in both the methods.

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

A preliminary study was first made to find out the effect of count and twist on the orientation profiles of yarn samples. As the results were quite encouraging, the studies were extended to more samples. Sixteen cottons, chosen from the four major botanical species, were selected and spun into yarns. Each variety was spun to two different counts, each count being spun using two different twist multipliers. Fibre as well as yarn samples from the *desi* varieties, and fibre samples of others were analysed using orientation profiles obtained by x-ray diffraction.

The results on *desi* cottons indicated that it might be practically feasible to carry out blend analysis by orientation method.

A Study of Crystallinity of Cotton by Infrared Methods

The earlier observation that fibre maturity may influence the infrared (ir) crystallinity index III ($I = \frac{a_{342}}{a_{2900}}$, where a_{342} and a_{2900} are absorbance values at 342 cm^{-1} and 2900 cm^{-1} respectively, was taken up for further verification. Fibres from unopened bolls picked at different stages

of growth of a coarse and a fine variety were used for the investigation. For both the varieties index III showed a sharp rise with the stages of growth from the 27 day old fibre to the 48 day old fibre. Correlation of this index with x-ray crystallinity was good. However, the actual difference in absolute values of crystallinity estimated by the two methods could be attributed to the partial dependence of the intensity of 342 cm^{-1} band on some other factor which may change with fibre maturity.

In order to get some information regarding the origin of the 342 cm^{-1} band, measurements of relative intensity of the band were made on samples of fully and partially mercerized fibres as well as hydrolysates, prepared under different conditions of hydrolysis of native and partially and fully mercerised fibres.

It was found that on gradual conversion of cellulose I to cellulose II during swelling in NaOH solutions of increasing concentration up to mercerising strength, the index III showed a decrease which cannot be attributed to mere fall in crystallinity. Further, hydrolysis of fully mercerised fibres failed to produce any change in the relative intensity of this band, while hydrolysis of partially mercerised samples caused an increase in the intensity, the increase being dependant on the remaining cellulose I content. On ball-milling cellulose II, the band intensity became equal to that of amorphous cellulose. In samples of differently hydrolysed cellulose I, the intensity of the band showed only negligible variation.

It appears from the above observations that the band arises from a mode which is more sensitive to the type of intermolecular bonding. Two mutually opposing factors, viz. (*i*) apparent increase in crystallinity due to weight loss during hydrolysis and (*ii*) fall in degree of polymerisation, seem to influence the intensity of the concerned mode. When these two factors annul each other, there will not be any change in intensity. When factor (*i*) dominates over factor (*ii*), intensity increases and vice versa. Factor (*ii*) can dominate over factor (*i*) during very severe conditions of hydrolysis.

Characterisation of Decrystallised Cottons Produced by New Methods and Assessment of their Usefulness in Subsequent Crosslinking Treatments

In order to identify conditions of decrystallisation treatment under which fibres show extensive decrystallisation with minimal loss of important fibre properties, the first set of decrystallisation treatments involving the partial blocking of the OH groups of NaOH swollen cotton fibres by treating with acetic anhydride in benzene has been completed. The effect of different variables like pre-swelling NaOH concentration, time of treatment in acetic-anhydride, concentration of acetic anhydride in benzene, etc., on the physical and mechanical properties have been investigated.

It was found that the moisture regain of the acetylated sample is slightly higher than that of the NaOH treated control when the acetyl content is

low and the NaOH concentration used for swelling is lower than 18%. Though higher acetyl content led to extensive decrystallisation as observed from infrared measurements, it caused considerable decrease in bundle tenacity. To obtain good strength retention, it was found necessary to restrict the acetyl content to less than 10%. Acetyl content of the treated samples have been determined by infrared method after obtaining a calibration graph with samples of known acetyl content (determined chemically).

For measuring infrared crystallinity, only infrared index III, $I = \frac{a_{842}}{a_{2900}}$ could be used as acetylated samples also show absorption around 1370 cm^{-1} region on which is based the O'Connor index II. Even though index III cannot be used to get absolute values of crystallinity in cellulose II or when both cellulose I and II are present, it is still found suitable for comparing the decrystallised sample with its NaOH swollen counterpart. Index III showed a decrease on acetylation, partly due to increase in the intensity of CH band at 2900 cm^{-1} taken to be the internal standard.

Some preliminary studies on bundle tenacity at $\frac{1}{8}''$ gauge length were undertaken in this connection. Samples acetylated after pre-swelling with NaOH of concentration ranging from 12% to 15% had better strength retention property than those acetylated after being swollen with NaOH of mercerising strength. Double swollen and decrystallised sample was found to show marginally higher strength than its single swollen counterpart. For a detailed study of fibre properties including the effect of crosslinking, four samples swollen with 12%, 15%, 21% and 21% twice followed by 9%, respectively, and acetylated to nearly the same extent have been prepared. Infrared crystallinity, bundle tenacity and extension, single fibre strength and extension, and moisture regain have been measured.

For a comparative study of the fibre properties, samples decrystallised by partial cyanoethylation have also been prepared using the same preswelling conditions mentioned earlier. To limit the degree of cyanoethylation and also to ensure uniformity of treatment, benzene has been used as a diluent in the treatment. Physical and mechanical properties of the cyanoethylated samples are being investigated.

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

Electron diffraction (ED) technique standardised in this Laboratory is suited for determining the structure and line broadening analysis of cellulose. ED pattern of cotton cellulose obtained at 75 KV accelerating voltage combined with low beam current and higher exposure time was used to determine the structure of cellulose. The reciprocal net a^* vs. b^* and b^* vs. c^* were drawn to index the extra reflections obtained in the ED pattern of cellulose.

It was observed that all the reflections fit in Meyer and Misch unit cell. However, no systematic absence of odd-order 0k0 reflections was noted, indicating that cotton cellulose does not fall into the $P2_1$ space group.

ED patterns of 16 varieties of cotton have been recorded and analysis is in progress. ED patterns of mercerized cotton and liquid ammonia treated cotton were also recorded. Various structural parameters, viz. crystallinity and crystallite dimensions of the modified cottons, are being determined.

From ED studies on cellulase-treated bagasse pulp, wheat straw pulp and sawdust it was possible to establish that the enzyme preferentially attacked 101 and 002 planes of cellulose crystallite. It was also observed that enzymatic hydrolysis results in increase in crystallinity index of cellulosic substrates accompanied with reduction in crystallite width perpendicular to 002 plane and eventual disappearance of 101 plane in two cases which is unique.

A Study of the Performance of the Modern Blowroom Line

It was reported last year that trials for the study have been started on an American cotton. During the year, American Elpaso cotton was processed on the blowroom utilising two combinations, viz. (*i*) Blending Hoppers-SRRL Opener-Shirley Opener and Kirschner Beater, and (*ii*) Blending Hoppers-SRRL Opener-Airstream Cleaner and Kirschner Beater. As in the case of other cottons reported earlier, combination (*i*) using Shirley Opener gave higher cleaning efficiency of 54% than combination (*ii*) with cleaning efficiency of 38%. However, the overall cleaning efficiency of blowroom and card for both the combinations remained the same at 85%. The samples from both the combinations were spun to 60s and no marked difference in quality was noticeable, in general, between the yarns.

Performance of Different Flat Tops in Processing Immature Cottons

Under this project, which is being carried out in collaboration with Victoria Jubilee Technical Institute (VJTI), Bombay, five samples of cotton, MCU.5, Gujarat 67, Vishnu, American Elpaso and Sudan XG2VS, were processed on the card during the year, using rigid tops and Sudan XG2VS alone processed with flexible and semi-rigid tops on card. On comparison of the data obtained using flexible, semi-rigid and flat tops with conventional card clothing on cylinder and doffer, it was found that in all the cases, flat tops gave a substantial reduction in flat strips which ranged from about 60% to 75% compared to flexible tops and 21% to 66% compared to semi-rigid tops. Except in the case of Vishnu, the semi-rigid tops also gave a substantial reduction of 21% to 49% in flat strips compared to flexible tops. In general, while the neps in card sliver reduced by use of semi-rigid and flat tops, the presence of foreign matter was found to be on the increase.

Studies on Lakshmi Rieter High Speed Drawing and Speed Frames

The study was carried out in three parts :

1. Use of high speed drawframe for short staple cottons keeping the drafts, speeds, etc., constant for both passages of drawframes.
2. Influence of break draft combination in two passages of drawframe on sliver and yarn quality for short staple mixings.
3. Influence of break draft in drawing on sliver and yarn quality for medium count mixings.

In the first part of the study, five cottons, three of them belonging to the Gaorani variety, one Westerns and one Wagad, were processed through both Lakshmi Rieter high speed drawframe and T & S conventional drawframe and processed into 16s yarn. The slivers, rovings and yarns were tested for regularity and the yarns for strength and appearance. It was found that the quality of the material from the highspeed drawframe was throughout better than that from conventional drawframe as can be seen from Table 10.

TABLE 10 : COMPARATIVE PERFORMANCE OF HIGH SPEED (LR) AND CONVENTIONAL (T & S) DRAWFRAMES

Cotton	G. 1946		Wagad		G. 22		Westerns		G. 6	
Draw frame	L.R.	T & S	L.R.	T & S	L. R.	T & S	L.R.	T & S	L.R.	T &S
Lea CSP	2,007	1,908	1,576	1,490	2,042	1,998	1,781	1,816	2,042	2,067
Single thread tenacity (g/tex)	13·3	13·4	10·8	10·5	13·5	12·6	11·7	11·8	13·2	13·0
Uster (U%)	12·8	14·1	15·6	16·5	13·6	14·5	15·4	15·7	14·1	14·8
Neps 100 m	26	32	64	68	28	27	36	35	29	27
Drawframe sliver (U%)	2·9	3·6	3·4	3·9	2·6	3·5	3·6	3·9	3·0	3·9
Roving (U%)	4·4	4·8	5·0	6·5	4·9	5·4	4·9	6·0	4·9	5·7

In the second part of the study different combinations of break drafts of 1.7 and 1.3 were tried for the two drawframe passages on high speed drawing for a short staple mixing consisting of 60% of G.1 and 40% of J.34. The slivers and yarns are being compared for quality with those produced using conventional drawframes.

The study of the third part which deals similarly with a mixing of Digvijay cotton, is in progress.

Comparison of Different Systems for Processing Cotton Samples

During the period 23 samples of cotton were spun both on bulk and microspinning techniques using SKF drafting system. It was found that on an average the percentage difference between the bulk and microspun yarn CSP was negligible, being about 1.4%. Individual cottons, however, showed differences ranging from —8% to +8%.

Similarly 15 samples of cotton were spun using SKF drafting on ring frame for bulk spinning and OMS drafting for microspinning. The average difference between CSP of bulk and micro-spun yarns was found to be 3.6%, while individual values of differences ranged from —9.6% to +14%. CV of yarn strength (from 4.2% to 14.6%) was high for the micro-spun yarns using both the systems of drafting, as against the range of 4.4% to 9.0% observed for bulk spun samples. The above results show that there is no major difference in strength between samples spun on bulk scale using SKF drafting and those spun using microspinning technique either with SKF or OMS drafting systems on ring frame.

Study of Quality of Material at Different Stages of Processing with Different Systems of Processing

The main object of the project was to determine the evenness of the material at different stages of processing and the quality of yarns spun on different ring frames, viz. 3 roller, A.500, SKF and GX.2. It was reported earlier that the work had been completed for the yarns of 20s, 30s, 40s and 50s counts. However, with the release of superior varieties and hybrids during the recent years, it was considered necessary to extend the study to finer counts of 60s and 80s also. Accordingly samples of MCU.5, Hybrid 5 and Sujata were spun to 60s and 80s counts, respectively. In addition, American Elpaso and Egyptian Menoufi were spun to 60s and 80s counts, respectively. The selection of above varieties afforded an opportunity to compare the performance of Indian varieties with that of foreign varieties. During the period under report, the samples were tested for yarn characteristics. Results are being analysed.

A Study of the Characteristic Curve of the Yarn Strength in Relation to Count

The project has been completed by studying the data reported by earlier workers and available in the literature.

It has been observed that the yarn strength and the count bear a linear logarithmic relationship to each other and obey the differential equation

$\frac{dS}{dC} = \lambda \frac{S}{C}$ where S and C represent yarn strength and count respectively,

λ being a constant.

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

The work on the project was aimed at formulating a suitable Fibre Quality Index, which will be best related to the spinning value of cotton. In this context, a preliminary evaluation of the existing Fibre Quality

Indices, proposed by various research workers, was carried out on the data of fibre and spinning tests available for 20 Standard Indian cottons, tested at CTRL.

The fibre quality Indices evaluated are given by the following formulae :

$$Q_1 = \frac{EL\ (1/32\ in) \times S_1 \times MR}{F\ (10^{-8}\ g/cm)} \quad .. \quad (1)\ (Proposed\ by\ E.\ Lord)$$

$$Q_2 = \frac{1.25\,E.L.\ (mm) \times \sqrt{S_0.S_1} \times \sqrt{MR}}{F\ (10^{-8}\ g/cm)} \quad (2)\ (Proposed\ by\ ATIRA)$$

$$Q_3 = \frac{SL_{50\%}\ (mm) \times S_1 \times Mc}{f} \quad .. \quad (3)\ (Proposed\ by\ SITRA)$$

$$Q_4 = \frac{SL_{2.5\%} \times S_1 \times Su \times Mc}{f} \quad .. \quad (4)\ (Tenative—proposed\ in\ this\ project)$$

where Q_1, Q_2, Q_3 and Q_4 represent the various quality indices.

EL represents effective length by Baer Sorter.

SL represents span length by Digital Fibrograph.

S_0 & S_1 represent strength at zero and 1/8 in. gauges, respectively.

Su represents strength uniformity being ratio of S_1 to S_0.

MR & Mc maturity ratio and maturity coefficient, respectively.

F = fibre weight.

f = Micronaire value.

The HSCs for the 20 Standard cottons were correlated with the respective quality indices. The simple correlation coefficients obtained were :

$rQ_1\ C = +\ 0.7662^{**}$ $\qquad$ $rQ_3\ C = 0.8789^{**}$

$rQ_2\ C = +\ 0.7256^{**}$ $\qquad$ $rQ_4\ C = 0.8805^{**}$

** Highly significant.

The above results of the preliminary analysis have been kept in view during the proposed extensive investigation.

Further, experimental data for 50 cotton samples representing the various botanical species and ranging in spinning potential from 20s to 80s counts are being compiled for analysis.

Studies in Physical Characteristics of Cotton Blends

With a view to study the effect of blending of Indian cottons of different fineness range on the nep formation and its relationship with single yarn strength, evenness and other characteristics, four more varieties of cotton, viz. Maljari, LSS, Pramukh and Digvijay, differing in their Micronaire values, were selected. Individual Nepotometer grades of these samples

were first assessed. Maljari was then mixed separately with LSS, Pramukh and Digvijay in the proportion 50% : 50% with the help of cotton blender and their Nepotometer grades were ascertained. Maljari was again separately blended with Digvijay, LSS and Pramukh in the same proportion and the blends were spun to a common count of 30s.

Tests were carried out on the yarns spun from blends for lea strength, single thread strength, Uster evenness and yarn grading. The data are being analysed.

Optimal Blending of Standard Varieties of Indian Cottons

Preliminary blending trials on three cottons taken up during the previous year were completed. The blends tried out were the following :

Blend		G.22	AK.277	CJ.73
I	..	20%	50%	30%
II	..	30%	20%	50%
III	..	50%	30%	20%

The individual components and the blends were spun to 20s and 30s on OMS drafting system. It was found that at 20s count, Blend III having a lea CSP of 2,222 was the best when compared to Blends I and II with CSP 2,180 and 2,125, respectively. Similarly at 30s count, Blend III was having a lea CSP of 1,671 as against 1,607 and 1,522 for Blends I and II. While the actual CSP values of all the blends were better than the estimated weighted averages for 20s count, Blend III alone gave a higher CSP than estimated, for 30s count.

Further, the following nine varieties of Maharashtra cottons were procured for spinning trials — Varalaxmi, Hybrid 4, MCU.5, Nimbkar, Laxmi, B.1007, Virnar, L.147 and 197/3. Spinning trials were completed on Varalaxmi, Hybrid 4 and Nimbkar while processing of MCU.5 is under way. Testing of the yarns is in progress.

Studies on Spinning of Blends of Cotton with Wool, Jute and Ramie on Cotton System

(*i*) *Blending of Cotton with Jute Staple*

Suyodhar cotton having a mean length of 22 mm and Micronaire value of 5.5 μg was blended with jute stapled to 25 mm, in the proportions of 80 : 20 and 90 : 10 cotton-jute and spun to 12s count. The yarns, though inferior in strength to the pure cotton yarn, can be successfully used for producing plain fabrics on handlooms and also dyed in attractive colours.

(*ii*) *Cotton-Jute Caddies*

Maljari cotton with a mean length of 20 mm and a Micronaire value of 5.3 μg was blended with jute caddies to the same proportion as in the

case of jute staple and spun to 6s yarn. The yarns were woven at the Handloom Weaver's Service Centre to produce attractive curtain material.

It has thus been proved that it is feasible to blend up to about 20% jute caddies or jute staple with cotton on the cotton spinning system and the yarns produced are suitable for weaving fabrics mainly for end-uses like curtain material, furnishings, etc.

(iii) Cotton-Wool Noils

Maljari cotton was blended with wool noils from a crossbred wool in the proportion of 75 : 25, 67 : 33 and 50 : 50 cotton : wool and spun to 6s count on the microspinning system, using different twist multipliers. The strength deteriorated with increase in proportion of wool noils and a twist multiplier of about 5 seems optimum for the blends. Bulk spinning of 75% cotton with 25% wool noils was undertaken using a twist multiplier of 4.75 and the yarns have been woven into blankets.

(iv) Blending of Ramie with Polyester

Samples of stapled Ramie fibre, subjected to six types of degumming and softening treatments, were received from JTRL for blending with polyester fibre. These were spun to 30s count after blending with 67% of polyester fibre of 2.0 d and 38 mm fibre length, using microspinning technique. It was found that, among the six samples, the ramie sample degummed and treated with non-ionic softener proved the most suitable from the point of view of yarn regularity. This was hence blended on a bulk scale with polyester fibre and used for weaving a plain poplin type fabric on handloom.

Studies on Blends of Indian Cottons with Polyester Fibre

Earlier work on blending dealt only with blending of polyester with combed cottons. Since a substantial portion of cotton is still used in the carded state for medium count fabrics, a study was undertaken on blending carded medium staple cotton SRT.1 with both 1.2 d and 2.0 d polyester fibre in different proportions and spinning the blends to 30s count.

The results are presented in Table 11.

TABLE 11 : YARN PROPERTIES OF BLENDS OF POLYESTER WITH SRT.1 (30s Yarn)

Blend Proportion	1·2 denier polyester				2 denier polyester		
Cotton	100	67	33	0	67	33	0
Polyester	0	33	67	100	33	67	100
Lea CSP	2,106	2,103	2,739	4,233	1,761	2,154	3,390
Yarn Tenacity (g/t)	13·8	14·3	19·9	29·0	11·0	14·8	23·0
Elongation (%)	6·4	11·3	16·8	18·4	7·1	17·1	21·5
Uster (U%)	16·0	17·9	17·5	13·3	17·0	15·4	13·2
Neps/100 m	74	54	54	11	62	41	2
Appearance Grade	C+	B	B	A	C+	B+	A

The main conclusions are : (*i*) use of finer denier polyester, as expected, results in a stronger yarn; (*ii*) the strongest yarns are produced from blends of 67% polyester and 33% cotton; (*iii*) use of coarse denier polyester, surprisingly, seems more conducive for production of more regular yarn in the particular blend trial.

Response of Indian Cottons to Crosslinking Treatments with a View to Evolve Cotton Varieties Most Suitable for Chemical Finishing Treatments

The work of screening of different varieties of Indian cottons regarding their response to easy-care finishing treatment has almost been completed. In all, 34 varieties of Indian cottons subjected to DMDHEU treatment have been studied so far. From the toughness retention values of these cottons after crosslinking, it was observed that the varieties suited for easy-care finishing treatments were 66BH.5-91, A.218, MCU.1, Gujarat 67, Hybrid 4, Bhagya, Deviraj and ELS.031 among *G. hirsutum* strains, Sanjay, Virnar, Gaorani 6 and Maljari among *G. arboreum* strains, and Jayadhar and Digvijay among *G. herbaceum* strains. Earlier, it was also reported that Sujata and Suvin, both *G. barbadense* varieties, which have inherently high strength and high elongation are also better suited for easy-care finishing treatment.

During the year, 12 samples from breeders were screened for their response to crosslinking treatment; four of these samples, viz. ERB.13650, Sea Island, IBSI.53, and Digvijay × Sanjay were from Surat, and eight samples, viz. American Nectariless × SV.213, Buri 1007 × CL.20, Buri 1007 × Laxmi, SV.213, Reba B.50 × Buri 1007, K.2427 × MCU.5, Lankart × Laxmi, and CL.20 × SV.213 were from the Division of Genetics, IARI, New Delhi. The toughness retention after crosslinking was observed to be high in the case of three cottons, viz. American Nectariless × SV.213 (80%), Buri 1007 × CL.20 (85%), and Buri 1007 × Laxmi (76%).

To obtain high retention of tenacity and elongation characters along with high Crease Recovery Angle (CRA) in different cottons, some pre-swelling treatments in caustic soda followed by crosslinking were attempted. The objective was to re-set the cotton fibres by mercerising before crosslinking. Eight varieties of Indian cottons, viz. Gujarat 67, Hybrid 4, MCU.1, Deviraj, A.218, 66BH.5-91, Digvijay and Sanjay were spun to 2/30s count and mercerised in a laboratory model mercerising unit under 3% stretch. The mercerised samples were crosslinked under two conditions, viz. (*i*) mercerised washed and dried at room temperature, and crosslinked with 8% DMDHEU (MDCL) and (*ii*) mercerised, washed and immediately crosslinked in wet state (MWCL).

Analysis of tenacity and elongation data after crosslinking in the above treatments has revealed that, in general, high retention of tenacity was achieved in the case of MWCL samples as compared to the MDCL samples.

CRA values of MDCL samples were high ranging from 297° (66BH.5-91) to 279° (MCU.1) while CRA values of MWCL samples were little lower varying from 293° (Deviraj) to 229° (A.218). By crosslinking in wet state after mercerisation, i.e. MWCL, it was possible to obtain good combination of high retention of mechanical properties and high degree of CRA.

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

Radiation Technique for Crosslinking

Cotton cellulose was crosslinked with dimethyloldihydroxyethylene urea (DMDHEU) by both the pre-irradiation and the simultaneous irradiation methods.

To find out optimum conditions, trials were carried out to crosslink cotton cellulose with DMDHEU by pre-irradiation method and the results are tabulated in Table 12(*a*).

TABLE 12(*a*): CROSSLINKING BY RADIATION TECHNIQUE

(a) Effect of temperature				(b) Effect of different concentrations of DMDHEU			
	Curing Temp. °C	Tenacity retained %	Nitrogen content %		Concentration of DMDHEU	Tenacity retained %	Nitrogen content %
Conventional method	160	40·33	1·045	Conventional method	8%	40·33	1·045
Pre-irradiation method	120	62·39	—	Pre-irradiation method with curing temp. 140°C	2	73·92	—
	130	54·30	0·155				
	140	52·66	0·855		4	77·54	0·233
	150	43·95	0·980		6	62·50	1·479
	160	39·88	1·113		8	53·68	1·339
	170	35·29	0·760		10	48·98	0·666

The results of nitrogen content in the samples crosslinked by pre-irradiation method (Table 12-*a*) show that a curing temperature of 140°C with DMDHEU concentration of 6% brings about the same range of crosslinking as that obtained by conventional method wherein a curing temperature of 160°C and DMDHEU concentration of 8% is used. Thus, the tenacity

loss in pre-irradiation method is reduced and it is possible to step up the tenacity retained value considerably from 40.33% to 62.50%.

Mercerisation treatment increases chemical reactivity by opening the structure of cotton fibre. Trials were conducted to crosslink mercerised cellulose under different conditions (*i*) wet (MWCL) and (*ii*) dry (MDCL).

Tenacity retained and nitrogen content of the mercerised and crosslinked samples (using radiation technique) were lower. In the case of MDCL treatments, level of crosslinking as judged by nitrogen content was low whereas in MWCL treatment, with the same level of crosslinking as that obtained by conventional method, strength losses were higher. Trials are underway to suitably modify radiation technique so as to obtain improvement in tenacity retention and also level of crosslinking in mercerised samples.

In order to have a realistic assessment, the study was extended to fabric. The results are given in the Table 12(*b*).

TABLE 12 (*b*) : FABRIC TREATMENT

	Strength retained (%)		Crease recovery angle	N(%)
	Warp	Weft		
Control—untreated..	100	100	210	—
Conventional	39·71	43·89	304	0·88
Pre-irradiation at lower dosage ..	57·13	82·30	265	0·68
Simultaneous irradiation at lower dosage	67·06	53·98	269	0·81
Simultaneous irradiation at higher dosage	33·96	54·24	278	0·67

The fabric crosslinked by radiation techniques (either pre-irradiation or simultaneous irradiation) showed higher retention of tenacity. However, simultaneous irradiation at higher dosage caused adverse effect on tenacity retention. Values of nitrogen percentage and crease recovery angle (CRA) of fabrics crosslinked by radiation technique were in the same range as those obtained for fabric crosslinked by conventional method.

Chemical Treatment

5,6-celluloseen was irradiated to different dosages of gamma-ray radiation. During this modification treatment, the sample was degraded and it was not possible to carry out strength test. The irradiated 5,6-celluloseen samples were tested for copper number, bromine number and viscosity.

The oxidative breakdown (judged by copper number values) in celluloseen increased with dosage and was very high at a dosage of 5×10^7 rads. Bro-

mine number showed slight reduction at initial dosage of 1×10^5 rads after which there was no appreciable change. The hydrolytic breakdown (judged by viscosity values) increased with doasage.

Post-irradiation Activity

Post-irradiation activity, in the case of raw cotton cellulose and mercerised cotton cellulose was measured at increasing dosages of gamma-ray radiation. The activity was maximum at a dosage of 2.3×10^6 rads. Mercerised cotton cellulose sample recorded higher post-irradiation activity.

Attempt to estimate post-irradiation activity in the case of irradiated celluloseen sample failed, as the sample dissolved in zinc chloride solution.

Storage Studies

Storage studies on cotton cellulose for shorter and longer intervals of time after irradiation of 2.3×10^6 rads did not show any appreciable change in tenacity and viscosity values.

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

Literature survey was carried out on cotton-blended fabrics treated with binary and tertiary mixtures of different crosslinking resins. Accordingly, some of the resins to be used for this study were selected, preliminary treatments on fabrics were carried out and the techniques to be adopted were standardized.

Cotton fabrics treated earlier using N-methylol resins, DMEU and DMDHEU, by two step poly-set process were studied for resin add-on, nitrogen content, formaldehyde content and number of crossslinks per GPU. Treated fabrics along with untreated control were also studied for tensile strength and other mechanical properties. Data obtained from crosslinking treatment of DMEU were analysed. Use of zinc acetate as catalyst in the first step contributed to higher resin add-on than use of magnesium acetate as catalyst. The fabric treated by poly-set process showed improved DP characteristics with high strength and elongation retention over the conventional single-step process.

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

A diffusion cell has been fabricated and set up for the study of diffusion of dyes in cellophane films of 20 micron thickness in normal state and after acetylation or cyanoethylation to different degrees of substitution (DS). The objective was to study the effect of DS on diffusion coefficient. The

diffusion studies have been carried out using purified Chlorazol Skyblue F.F., a direct dye, at 80°C temperature in a water bath. Studies on diffusion of dyes in cotton fibre will be activated after synthesising the reactive metallized dyes. This investigation is being carried out in collaboration with Dr. N. K. Chaudhuri of University Department of Chemical Technology, Bombay.

Fermentation Studies on Cellulase Production and Its Applications

The cellulase production by *Penicillium funiculosum* was compared with some well known cellulolytic cultures, viz. *Myrothecium verrucaria*, *Trichoderma viride*-6A, *T. viride*-9123 and *T. viride*-9414. It was found that the *P. funiculosum* produces enzyme activity comparable to *T. viride*-9123 and it is also rich in beta-glucosidase activity.

Attempts made to find out the course of formation of intra- and extracellular beta-glucosidase by *P. funiculosum* revealed that the intracellular enzyme makes its appearance even in the early stages of growth, whereas the extracellular enzyme appears much later in the medium.

Studies on saccharification of wheat straw pulp (WSP) by cellulase revealed that, by and large, it is resistant to enzymatic hydrolysis. It was made soluble up to 90% using higher concentration of the enzyme at 50°C (pH 4.5) within 72 hr.

Thin layer chromatographic analysis of the end products of enzymatic hydrolysis of bagasse and WSP showed glucose, cellobiose, galactose, xylose, galacturonic acid, glucuronic acid along with inseparable higher oligosaccharides; WSP hydrolysate showed an additional spot of arabinose.

The yeast cultures *Candida tropicalis* and *Candida utilis* were selected for the production of single cell protein on bagasse and WSP hydrolysates. Although, the cultures were grown aerobically on a rotary shaker, they produced some alcohol which indicated that they require still higher aeration.

Modified tamarind kernel power (LTKP) sized fabric was desized with cellulase employing a method to simulate the padding process in industry. The fabric was soaked in a cellulase-buffer bath for 3 min squeezed through a padding mangle (tension 8.5 kg) and incubated at 50°C for 2 hr. It was found that 90% of the size was removed by the above treatment.

Clarification of fruit juice by cellulase was yet another application of this enzyme. The turbid lemon juice was treated with cellulase at various pH levels, temperatures and time intervals. It was found that 24 hr cellulase treatment at 40°C, pH 4.0, resulted in about 90% clarification of the juice.

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

Certain bi- and poly-functional reactive dyes are suspected to form cross-links in cotton cellulose on dyeing. But to-date the evidence available in

support of the above view was indirect, chiefly based on insolubility of dyed cotton in a suitable solvent. By employing CTRL cellulase-dissolution technique, it was possible to illustrate how certain reactive dyes do induce crosslinking and how the amount of dye in the fibre and conditions of application influence the crosslinking process. This investigation was done in collaboration with Prof. E. H. Daruwalla of the University Department of Chemical Technology, Bombay.

Ethers and esters of cotton cellulose at varying degrees of substitution (DS), viz. cyanoethylated (0.3 to 1.5 DS), allylated (0.1 to 1.2 DS), benzylated (0.3 to 1.2 DS), acetylated (0.88 to 2.4 DS) and benzoylated (0.3 to 3.0 DS) were also analysed in the electron microscope by the cellulase dissolution technique. Experimental work has been completed and a detailed report is being prepared.

Cyanoethylated, benzoylated and benzylated cottons of various DS and formaldehyde crosslinked cotton samples varying in formaldehyde contents were prepared. Determination of refractive indices has been completed with respect to cyanoethylated and crosslinked samples.

Further work is in progress.

Production and Application of Desizing Enzymes Active at High Temperatures

Bacillus subtilis—159 was grown for amylase production on raw and purified starches prepared from various cereals and tubers. It was found that all the starches yield similar amount of enzyme.

Studies carried out on the effect of the presence of certain metal ions in various concentrations in Tendler's non-synthetic medium indicated that Ag^{+}, Hg^{++} were inhibitory at 10^{5} M concentration and Co^{++} and Cu^{++} were toxic up to 10^{4} M concentration for the amylase production.

The enzyme filtrate was first concentrated ten-fold by ultrafiltration and then further concentrated either by isopropanol or ammonium sulphate precipitation. A six-fold concentration with solvent was achieved without any loss of enzyme activity and about 80% activity was recovered with ammonium sulphate precipitation at 70% saturation. Ultrafiltration studies showed that a membrane (PM.30) of molecular weight cut off to 30,000 is suitable for enzyme concentration.

The *B. subtilis*-159 (BS) amylase was compared with three other commercially available amylases for desizing. BS amylase removed 78% size in 1 hr, while other amylases could remove 65%-68% size. BS amylase was further compared with a commercial amylase (Bacteria-A) manufactured indigenously. The BS amylase could remove 88% and 94% size in 6 hr at 475 and 700 units strength, respectively, while Bacteria-A amylase could remove 82% size at 700 units level in the same time. *B. subtilis*-159 is, therefore, a potent amylase producer and its amylase could be exploited for effective desizing purposes.

Utilisation of Chitin and Chitosan

In all, 28 isolates were screened under this project for chitinoclastic activity using Skerman's medium containing colloidal chitin (0.25%) as the sole source of carbon and energy. A few isolates were further selected on the basis of zone of hydrolysis. Of these, two isolates *Streptomyces* sp. and *Bacillus* sp. seem promising for the production of chitinase. Eventually, the bacterium was found to be the best isolate from the point of view of glucosamine produced.

Nitrification studies indicated that *Bacillus* sp. liberated ammonium and then oxidised it further to nitrite whereas *Streptomyces* sp. did liberate ammonium but failed to oxidise it further. Liberation of ammonium was maximum with chitin and not with chitosan with regard to both the isolates. There was no change in pH with chitin, whereas the pH rose to 8.0 from an initial value of 7.0 with chitosan.

Ammonification and nitrification in soil was studied after adding chitin flakes and colloidal chitin. Nitrite was not detected in any of the treatments, whereas nitrate-nitrogen was found to accumulate in both the treatments. This indicated that ammonification and nitrification was complete in treated soil.

Observations are being made on the moisture holding capacity of chitin flakes amended soil. Studies are also in progress to see the survival of *Fusarium vasinfectum* and *Verticillium dahliae*, both soil borne wilt pathogens of cotton, in chitin amended soils.

Analysis and Grading of Indian Cotton Linters

The investigation has been taken up with two objectives, viz. (*i*) developing grade standards for the commercially available linters and (*ii*) improving the quality of linters produced in the country. Mill-run, First-cut and Second-cut linters of varieties L.147 and Hybird 4 were kier-boiled and bleached. Cellulose content of these samples was also determined by Shirley Analyser during the period. Further work is in progress.

Fatty Acid Composition of Cotton Seed Oil of Different Varieties

Gas chromatograph (GLC) was installed and estimation of fatty acids of cotton seed oil by GLC was standardised using known mixtures of fatty acid esters injected at different temperatures and flow rates; the optimum flow rate and temperature for column, injector port and the flame ionization detector were worked out.

Cotton seed samples of different varieties were collected and oil was extracted from these samples using petroleum ether in a soxhlet apparatus. A small quantity of the oil sample was saponified and fatty acids were

converted to methyl esters using borontrifluoride-methanol reagent according to AOCS method. Ultra-high purity nitrogen was used as the carrier gas and ultra-high pure hydrogen as the fuel gas for the flame ionization detector. Different fatty acids were identified and estimated with the help of known fatty acid esters. Fatty acid analysis of 20 samples has been carried out so far.

Evaluation of Protein Composition of Indian Cotton Seeds

A paper entitled "Amino acid composition of cotton seed protein" was presented at the 32nd Annual Convention-Symposium organised by the Oil Technologists' Association of India, Kanpur, on February 12 and 13, 1977, wherein it was reported that seed index, as well as linter, hull, kernel, oil, protein and gossypol contents showed marked differences among the varieties and that the amino acid content of different varieties were varying in the arginine, aspartic acid, glutamic acid and cystine contents. The variation was marked in the case of serine, glycine, methionine and phenylalanine.

Utilization of Cotton Stalks

The particle boards prepared from cotton plant stalk by making stalks into chips, coating with appropriate quantities of binding materials and pressing at suitable temperature and pressure, have been tested for density, tensile strength, modulus of rupture and water absorption and were found to conform with the ISI specifications. Large boards up to the size of 45 cm $\times$ 45 cm have been successfully prepared at CTRL. Detailed chemical analysis of the cotton plant stalk has also been taken up for finding out other applications of this material.

Studies on Deburring of Raw Wool Using Mechanical Device

It was mentioned in the last annual report that the installation of electric motor as well as preparation of slide rails and new double vee groove pulley for direct drive, etc., are in progress.

During the period under report, new double vee groove pulley for direct drive from motor to gin shaft has been fabricated. Special slide rails required for proper aligning of drive belt has also been made. The work of welding of slide rail parts and fixing of electric motor on foundation is in progress.

RESEARCH WORK DONE AT THE REGIONAL STATIONS

HISSAR

The influence of defoliants was studied on American cotton H.14 and *desi* G. 27. It was observed that the defoliants had no significant effect on the fibre properties.

INDORE

(*a*) Samples from the trial conducted during 1975-76 season to find out the effect of irrigation at different levels of depletion of soil moisture on the fibre properties of JKHy.1 cotton were tested. The treatments did not show any appreciable effect on the fibre quality.

(*b*) The variation in physical properties of the fibres obtained from the different positions of the bolls of JKHy.1 and Hybrid 4, was studied during the period and the treatments were three dates of sowing and three pickings. The fibres from the basal portion had high ginning percentage, and high seed weight and were coarser as compared to the fibres from the tip portion.

NANDED

In the experiment to study the effect of different levels of irrigation and nitrogen on the fibre properties of NDHy.1 cotton (1976-77 season), no significant difference was observed due to the treatments. However, the combination of 200 kg/ha nitrogen with irrigation (20% available moisture) was found to be beneficial for fibre length, fineness and strength.

SURAT

From the study on the genetical selections for fibre strength, 30 plants from each of 10 varieties were selected. One boll from each of these 30 plants was randomly gathered and the remaining bolls of the plants were collected for use as control for that variety. The randomly gathered bolls and the control samples of each variety were tested for tenacity. It was observed that four out of 10 varieties tested in this manner showed a significant difference in fibre tenacity as compared to the corresponding control samples.

3. Publications

During the period, one Annual Report, two Technological Reports, 22 Research Publications and 43 Technological Circulars were issued, in addition to 10 papers presented at various Conferences, Seminars, etc.

A. Annual Report

Annual Report of the Cotton Technological Research Laboratory for the calendar year, 1976.

B. Technological Reports

No. 19. Technological Report on Trade Varieties of Indian Cottons, 1975-76 Season.

No. 20. Technological Report on Standard Indian Cottons, 1975-76 Season.

C. Research Publications (CTRL Publications—New Series)

No. 84. Effect of Gamma-Ray Radiation on the Physico-Chemical Properties of Allyl Cellulose—by (Kum.) I. G. Bhatt, V. Sundaram, Jai Prakash, (Smt.) V. Iyer and A. W. Shringarpure (reprinted from the *Proceedings of the 14th Joint Technological Conference sponsored by ATIRA, BTRA and SITRA*, January, 1973).

No. 85. Effect of Soil and Climatic Conditions on Yield and Fibre Properties of Improved Strains of Upland Cotton—by A. K. Anthony and E. Kesvankutty (reprinted from *Indian Journal of Agricultural Science*, May, 1975 issue).

No. 86. Comparative Evaluation of Fibre Length Variation Parameters—by V. Venugopalan, R. L. N. Iyengar and V. G. Munshi (reprinted from *Journal of the Textile Association*, March, 1977 issue).

No. 87. Chemical Analysis of Seeds of New Glandless Cotton Varieties—by S. N. Pandey and N. Thejappa (reprinted from *Indian Journal of Agricultural Science*, January, 1976 issue).

No. 88. Analysis of Cotton/Jute Blends—by S. Sreenivasan and P. K. Chidambareswaran (reprinted from the *Indian Textile Journal*, November, 1976 issue).

No. 89. The Cross-Sectional Shape of Different Textile Fibres—by B. M. Petkar and P. G. Oka (reprinted from *Colourage*, April, 1977 issue).

No. 90. Adaptation of Micronaire Instrument for the Determination of Fineness of very Coarse *desi* Cottons—by S. G. Nayar, C. A. S. Aiyar, A. Rajagopalan and P. K. Jairam (reprinted from *Journal of Indian Society for Cotton Improvement*, March, 1977 issue).

No. 91. Cross-Sectional Shape of Fibres of Different Group Lengths in a Sample of Cotton—by B. M. Petkar, P. G. Oka and V. Sundaram (reprinted from *Journal of Indian Society for Cotton Improvement*, March, 1977 issue).

No. 92. Know Your Cotton : (2) Varalaxmi—by V. Sundaram, K. V. Srinivasan and R. Krishnamourthy (reprinted from *Journal of Indian Society for Cotton Improvement*, March, 1977 issue).

No. 93. Method to Assess Crease Recovery Angle of Resin Finished Fabric from Yarn-Pad—by M. S. Sitaram, (Kum.) I. G. Bhatt and S. M. Betrabet (reprinted from *Colourage*, January 1977 issue).

No. 94. X-ray Diffraction Studies on Cotton/Jute Blends—by P. K. Chidambareswaran, S. Sreenivasan, N. B. Patil, V. Sundaram and B. Srinathan (reprinted from *Journal of Applied Polymer Science*, March, 1976 issue).

No. 95. CTRL Fibre Microtome—by H. V. Tamhankar (reprinted from *Instruments India*, October-December, 1976 issue).

No. 96. A New Procedure for Determining the Lea Strength Corrections for Nominal Counts—by G. S. Rajaraman (reprinted from *Journal of the Textile Association*, June, 1977 issue).

No. 97. Technological Performance of New Varieties of Cotton. Part IV : Critical Analysis of the Technological Performance of the Strains Tried in the Coordinated Varietal Trials in

North Zone—by P. G. Oka, K. V. Ananthkrishnan and V. Sundaram (reprinted from *Journal of Cotton Development*, January, 1977 issue).

No. 98. Ethylenediamine-Induced Conversion of Cellulose I to Cellulose II—by H. T. Lokhande, S. R. Shukla, P. K. Chidambareswaran and N. B. Patil (reprinted from *Journal of Polymer Science* : Polymer Letters Edition, December, 1976 issue).

No. 99. Ethylenediamine-Induced Conversion of Cellulose I to Cellulose III—by H. T. Lokhande, S. R. Shukla, P. K. Chidambareswaran and N. B. Patil (reprinted from *Journal of Polymer Science* : Polymer Letters Edition, February, 1977 issue).

No. 100. Electron Diffraction Technique for the Determination of Cellulose Crystallinity—by K. M. Paralikar and S. M. Betrabet (reprinted from *Journal of Applied Polymer Science*, April, 1976 issue).

No. 101. Strength-Elongation Characteristics of Indian Cottons—by V. G. Munshi, (Smt.) S. D. Pai and (Smt.) J. K. S. Warrier (reprinted from *Indian Journal of Textile Research*, March, 1977 issue).

No. 102. Application of N-Methylol Crosslinking Agent to Cotton from Emulsion System—by S. M. Betrabet, E. H. Daruwalla and S. M. Doshi (reprinted from the *Proceedings of the Eighteenth Joint Technological Conference sponsored by ATIRA, BTRA and SITRA*, held at BTRA, Bombay, in February, 1977).

No. 103. Studies on Cotton/Jute Blends : Part I. Spinning on the Cotton System—by B. Srinathan, A. S. Sathe, M. S. Parthasarathy and V. Sundaram, and Part II.Analysis of Blend Composition—by P. K. Chidambareswaran, S. Sreenivasan and N. B. Patil (reprinted from the *Proceedings of the Eighteenth Joint Technological Conference sponsored by ATIRA, BTRA and SITRA*, held at BTRA, Bombay, in February 1977).

No. 104. Sol Gel Studies on Chemically Modified Celluloses—by S. N. Pandey and (Smt.) Prema Nair (reprinted from *Indian Journal of Textile Research*, December, 1976).

No. 105. Effect of Relative Humidity on Skein Strength and Linear Density of Cotton Yarn—by V. Sundaram, S. Ramanathan

and K. R. Krishna Iyer (reprinted from *ISI-Bulletin* Vol. 29, September, 1977).

D. Papers Presented at Conferences/Seminars

1. Studies on the Cross-Sectional Shape of Cotton Fibre : Part I. The Cross-Sectional Shape of Cotton Fibre as a Varietal Characteristic—by B. M. Petkar, P. G. Oka, and V. Sundaram (*Eighteenth Joint Technological Conference of ATIRA, BTRA and SITRA* held at BTRA, Bombay, in February, 1977).
2. A Study on Distention Index and Distribution of Crosslinks in Formaldehyde Crosslinked Cotton—by S. N. Pandey and (Smt.) Prema Nair (*Eighteenth Joint Technological Conference of ATIRA, BTRA and SITRA*, held at BTRA, Bombay, in February, 1977).
3. Progress in Cotton Production Research in Relation to Quality and Specific End-uses—by V. Sundaram, M. S. Parthasarathy and S. M. Betrabet. (*National Seminar on Self Sufficiency in Cotton*, held at Directorate of Cotton Development, Bombay in February 1977).
4. Present Day Long Staple Indian Cottons and the Spinner—by M. S. Parthasarathy and V. Sundaram (*Seminar on Long Staple Cotton and the Indian Textile Industry*, organised by ICAR and Indian Society for Cotton Improvement, at Coimbatore in June 1977).
5. Comparative Performance of Conventional and High Speed Draw Frames for Short Staple Cottons—by M. S. Parthasarathy, B. Srinathan and K. S. Bhyrappa (*Seminar on High Speed Drawing of Short Staple Cottons* organised by the Textile Association (India), at New Delhi, in July 1977).
6. Advances in Fibre Technology—by V. Sundaram and V. G. Munshi (Seminar on Cotton Production and Its Processing and Marketing Technology organised for Senior Officers of the State Department of Agriculture, held in October 1977 at Punjab Agricultural University, Ludhiana).
7. Technological Performance of Varalaxmi Cotton—by M. S. Sitaram, M. S. Parthasarathy and V. Sundaram (*Cotton Seminar* at the Regional Station of University of Agricultural Sciences, Bangalore, in December, 1977).
8. Effect of Cellulase on the Morphology and Fine Structure of Cellulosic Substrates : Part I. Wheat Straw Pulp—by S. M. Betrabet

and K. M. Paralikar (*Electron Microscope Society Conference* held at Bombay in December 1977).

9. Cellulase Dissolution : Electron Microscopical Technique for the Study of Chemically Modified Cotton—by S. Arvindanath, K. M. Paralikar and S. M. Betrabet (*Electron Microscope Society Conference* held at Bombay in December 1977).

10. Production of Amylase by *Bacillus subtilis*-159—by S. G. Gayal and V. G. Khandeparkar (*Eighteenth Annual Conference of Association of Microbiologists' of India*, held at Madurai in December 1977).

11. Amino Acid Study of Cotton Seed Protein—by S. N. Pandey and N. Thejappa (32nd Annual convention—Symposium of Oil Technologists' Association of India held at Harcourt Butler Technological Institute, Kanpur, in February 1977).

12. Role of CTRL in Cotton Quality Testing—by V. G. Munshi and V. Sundaram (Seventeenth Indian Standards Convention held at Jaipur in November-December, 1977).

E. Technological Circulars

1. On trade Varieties of Indian Cottons—Nos. 1876 to 1880 for 1975-76 season and Nos. 1881 to 1918 for 1976-77 season.

2. On Standard Indian Cottons—Nos. 140 to 144 for 1975-76 season and Nos. 145 to 151 for 1976-77 season.

TRADE VARIETIES OF INDIAN COTTONS

T.C. No.	*Variety*	*T.C. No.*	*Variety*
1876	Sujay (Surat)	1886	Desi (Hissar)
1877	V.797 (Petlad)	1887	B.1007 (Yavatmal)
1878	G.22 (Bidar)	1888	320F (Sirsa)
1879	Gujarat 67 (Mandvi)	1889	J.34 (Ganganagar)
1880	Jayadhar (Hubli)	1890	Narmada (Khandwa)
1881	Sanjay (Botad)	1891	Khandwa 2 (,,)
1882	Laxmi (Phaltan)	1892	Hybrid 4 (,,)
1883	Nimbkar (,,)	1893	Y.1 (Jalgaon)
1884	Varalaxmi (Baramati)	1894	Virnar (Jamner)
1885	Desi (Ganganagar)	1895	Hybrid 4 (Yavatmal)

T.C. No.	*Variety*	*T.C. No.*	*Variety*
1896	G.6 (Bhainsa)	1908	Varalaxmi (Idar)
1897	G.22 (Bidar)	1909	Deviraj (Surendranagar)
1898	Deviraj (Gokak)	1910	Sujay (Surat)
1899	Gujarat 67 (Mandvi)	1911	Gaorani 46 (Parbhani)
1900	Badnawar 1 (Ratlam)	1912	Hybrid 4 (Sailu)
1901	320F (Ganganagar)	1913	Wagad (Morvi)
1902	AK.235 (Akola)	1914	V.797 (Viramgam)
1903	Buri 147 (Amravati)	1915	Digvijay (Palej)
1904	Virnar (Ratlam)	1916	J.34 (Fatehabad)
1905	C.Indore 1 (Bhilwara)	1917	Hampi (Yadgiri)
1906	Westerns 1 (Bellary)	1918	Hybrid 4 (Palej)
1907	Hybrid 4 (Bayad)		

STANDARD INDIAN COTTONS

S.C. No.	*Variety*	*S.C. No.*	*Variety*
140	Jayadhar (Dharwar)	146	Westerns 1 (Hagari)
141	Krishna (Vijayawada)	147	Gaorani 22 (Badnapur)
142	K.8 (Periakulam)	148	Sanjay (Parbhani)
143	AK.235 (Akola)	149	MCU.5 (Periakulam)
144	S. I. Andrews (Shimoga)	150	Deviraj (Junagadh)
145	Gaorani 46 (Nanded)	151	Sanjay (Amreli)

4. Extension

This Laboratory has no farm attached to it and hence field work is carried out at various Central Institutes, Agricultural Universities and Agricultural Stations in different States. Even though CTRL does not directly deal with the farmers, it renders valuable assistance indirectly to cotton growers, through the trade, the industry, the government and civic organisations, etc., by undertaking tests on samples sent by them, by imparting training in cotton technology, and by 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 special 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 1977 together with the corresponding figures for 1975, 1976, and for the quinquennium 1971-75 are given in Table 13.

TABLE 13 : NUMBER OF SAMPLES RECEIVED FOR PAID TESTS

Type of test	Average for the quinquennium, 1971-75	1975	1976	1977
Spinning	10	27	22	67
Fibre (EICA)*	16	248	250	189
Fibre (others)	193	247	77	154
Yarn	37	27	42	61
Cloth	48	67	61	60
Moisture	73	32	—	1
Miscellaneous	8	1	4	25
Total	385	649	456	557

* These 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 1977 for carrying out tests on these samples amounted to Rs. 27,344.20 against Rs. 18,114.20 during 1976.

Apart from the usual tests of routine nature, the following special tests were also carried out.

1. Two samples of 44s mixing Blender and 44s mixing Scutcher laps were received from a Bombay mill for ascertaining damage caused to the fibres during mechanical processing. Tests showed that the fibres had suffered mechanical damages to the extent of 6.5% and 11% respectively.

2. A reputed pharmaceutical firm desired to have six samples of inorganic complex 'Magaldrate' USP analysed at the Laboratory by x-ray diffraction technique. The analysis was carried out as a special case and report sent informing of the relative intensity of the various interferences.

3. A firm of international repute in Bombay wanted tests to be carried out on three silica samples for crystallinity and crystallite dimensions by x-ray diffraction technique. The Laboratory undertook the work as a special case and reported the findings.

4. Two samples of leather cloth sent by a leather manufacturing company in Bombay were tested for tensile strength and elongation.

5. Two HDPE mono-filament twines received for test from a twine and rope manufacturing firm were tested for breaking strength and elongation, in plain and in knotted, as well as in dry and in wet conditions.

6. Research and Development Group, BARC, had sent six samples of suture surgical threads for determination of knotted breaking strength and cross-sectional diameters. Tests were carried out and findings reported.

7. Tests for strength and elongation were carried out on one sample of rot proof synthetic fishing thread and one sample of rot proof nylon tape received from a Bombay firm.

8. Sir Padampat Research Centre, Kota, had sent a number of samples of nylon filament produced by mass colouration for examination in electron microscope to investigate into aggregation of Carbon particles.

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 1977, the following persons attended the training course which consisted of lectures and practical work on methods of evaluation of cotton fibre quality and interpretation of the test results, including statistical analysis.

1. Shri V. R. Phaphat,
   C/o. M/s. Bharat General and Textile Industries Ltd.,
   3/56, Cotton Exchange Building,
   Cotton Green, Bombay 400 033.

2. Shri P. K. Trivedi,
   C/o. The Finlay Group of Mills,
   Parel, Bombay 400 012.

3. Shri J. K. Parikh,
   C/o. M/s. Chetankumar Chemical and Company,
   262/270, Narsi Natha Street,
   Anant Niwas, Bombay 400 009.

4. Shri R. Balachandran,
   M/s. Sayaji Mills Ltd.,
   76, P. K. S. Street, Sivakasi 626 123.

5. Shri S. Sabapathy,
   Cotton Assistant,
   Loyal Textile Mills Ltd.,
   21/4, Mill Street,
   Kovilpatti 627 701.

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 CTRL.

S. No.	Meeting / Conference	Place	Date	Name of the Officer who attended the meeting/conference
1.	Seminar on "Products based on modified fats" organised by Oil Technologists' Association of India, Bombay.	Bombay	16-1-1977	Dr. S. N. Pandey
2.	Eighteenth Joint Technological Conference of ATIRA, BTRA and SITRA, held at BTRA, Bombay.	Bombay	3-2-1977 to 5-2-1977	Dr. V. Sundaram Dr. S. M. Betrabet Dr. N. B. Patil Shri M. S. Parthasarathy Shri B. Srinathan Dr. S. N. Pandey Dr. K. R. K. Iyer Shri P. G. Oka Shri P. K. Chidambareswaran Shri B. M. Petkar Smt. Prema Nair Shri A. S. Sathe Shri S. Sreenivasan
3.	Seminar on "Self-sufficiency in cotton —research imperatives, developmental efforts and other strategies to meet this goal" organised by the Directorate of Cotton Development, Bombay.	Bombay	9-2-1977 and 10-2-1977	Dr. V. Sundaram
4.	Thirty-second Annual Convention/ Symposium of Oil Technologists' Association of India, Bombay, held at Harcourt Butler Technological Institute, Kanpur.	Kanpur	12-2-1977 and 13-2-1977	Dr. S. N. Pandey
5.	Conference of Directors of ICAR Institutes.	New Delhi	9-3-1977 and 10-3-1977	Dr. V. Sundaram
6.	National Seminar on "Thermal Analysis and Reaction Kinetics" organised by Indian Chemical Society at UDCT, Bombay.	Bombay	25-3-1977	Dr. S. N. Pandey
7.	Thirteenth meeting of the Research Advisory Committee of SITRA, Coimbatore.	Coimbatore	22-3-1977 and 23-3-1977	Dr. V. Sundaram

S. No.	Meeting / Conference	Place	Date	Name of the Officer who attended the meeting/conference
8.	Seminar on "Cotton Research and Development in the North Zone with particular reference to Rajasthan Canal Area" organised under the AICCIP.	Udaipur	5-4-1977	Dr. V. Sundaram Shri P. G. Oka
9.	National Seminar on "Instrumentation in India—Present and Future".	Bombay	9-4-1977	Dr. N. B. Patil
10.	Sixty-first Meeting of the Executive Council of the Mahatma Phule Krishi Vidyapeeth, Rahuri.	Pune	18-4-1977	Dr. V. Sundaram
11.	Meeting of the Integrated Cotton Development Project, Sponsored by the World Bank.	New Delhi	22-4-1977	Dr. V. Sundaram Shri D. G. Shete
12.	Meeting to draft a programme for Operational Research as well as for training the cotton workers under the World Bank assisted Integrated Cotton Development Project, operating in Maharashtra.	Pune	4-5-1977	Dr. V. Sundaram
13.	Meeting of the Scientific Panel for Post-Harvest Technology.	New Delhi	9-5-1977 and 10-5-1977	Dr. V. Sundaram
14.	Seminar on "Tandem Carding" organised by Machinery Manufacturers' Corporation Limited, Bombay.	Bombay	12-5-1977	Shri M. S. Parthasarathy Shri B. Srinathan Shri T. N. Ramamurthy Shri K. S. Bhyrappa
15.	First BTRA-Colourage meeting on Textile wet-processing.	Bombay	28-5-1977	Dr. S. N. Pandey
16.	Seminar on "Present day Long Staple Indian Cottons and the Textile Industry".	Coimbatore	6-6-1977	Dr. V. Sundaram Shri M. S. Parthasarathy
17.	Seminar on "Application of Electron Microscopy to the Study of Textile Materials".	ATIRA, Ahmedabad	21-7-1977 and 22-7-1977	Dr. S. M. Betrabet Shri K. M. Paralikar
18.	Meeting of the Management Committee of CICR, Nagpur.	Coimbatore	27-7-1977 and 28-7-1977	Dr. V. Sundaram
19.	Seminar on "High Speed Drawing of Short Staple Cottons" of the Textile Association (India), New Delhi Branch.	IIT, New Delhi	29-7-1977	Shri M. S. Parthasarathy Shri K. S. Bhyrappa
20.	Conference of the Directors of ICAR Institutes at Indian Grassland and Fodder Research Institute, Jhansi.	Jhansi	12-9-1977 to 15-9-1977	Dr. V. Sundaram
21.	Meeting of the Regional Committee No. 7.	Indore	28-9-1977 to 30-9-1977	Dr. V. Sundaram

S. No.	Meeting/Conference	Place	Date	Name of the Officer who attended the meeting/conference
22.	Seminar (Staff Course) on "Cotton Production and its Procuring and Marketing Technology" organised for Senior Officers of the State Agricultural Departments, by the Directorate of Extension, New Delhi.	Punjab Agricultural University, Ludhiana	10-10-1977 to 14-10-1977	Dr. V. G. Munshi
23.	Fourteenth Meeting of the Indian Cotton Development Council, Bombay	Directorate of Cotton Development, Bombay	14-10-1977 and 15-10-1977	Dr. V. Sundaram
24.	Meeting to discuss the formulation of the Sixth Plan.	ICAR, New Delhi	22-10-1977 to 25-10-1977	Dr. V. Sundaram
25.	Seventeenth Indian Standards Convention.	Jaipur	27-11-1977 to 3-12-1977	Dr. V. G. Munshi
26.	Seminar on "Patent Documentation and Information Services" Organised by Documentation Research and Training Centre, Bangalore.	Bombay	1-12-1977 to 3-12-1977	Dr. V. G. Khandeparkar
27.	Seminar on "Fatty acids production and utilisation" organised by Oil Technologists' Association of India, Bombay.	Bombay	4-12-1977	Dr. S. N. Pandey
28.	Tenth Annual Conference of the Electron Microscope Society of India.	BARC, Bombay	19-12-1977 to 21-12-1977	Dr. S. M. Betrabet Shri K. M. Paralikar Shri S. Aravindanath
29.	Eighteenth Annual Conference of the Association of Microbiologists of India.	Madurai (Tamil Nadu)	21-12-1977 to 23-12-1977	Dr. V. G. Khandeparkar Shri S. G. Gayal
30.	Seminar on "Cotton" arranged by the University of Agricultural Sciences, Regional Research Station, Raichur.	Raichur (Karnataka)	28-12-1977	Shri M. S. Sitaram Shri E. S. Abraham

In addition to the above, the Director and various scientists of this Laboratory attended meetings of several sub-committees of the Indian Standards Institution pertaining to the standardisation of textile materials and test methods.

The Director, as a nominated representative of the ICAR on Committee appointed by the Ministry of Commerce to go into the relationship between the price of *kapas* and the millgate price of cotton and the nexus between the price of cotton and the price of yarn/fabric, attended several of its meetings to finalise its report. Shri M. S. Parthasarathy, Senior Scientist (Mechanical Processing), also attended some meetings as a technical expert.

The Director also attended various meetings of the Governing Council of BTRA and the Board of Management of VJTI.

Dr. S. M. Betrabet, who is a member of the 'Panel of experts in Physics Oriented Studies' of ATIRA, attended its Annual Meeting held on 20th January, 1977, to review the work of the Group for Physics at ATIRA. Dr. Betrabet continued to be Member of the Advisory Council of Electron Microscope Society of India (EMSI) and member of the Editorial Board of EMSI Bulletin.

Shri M. S. Parthasarathy was nominated as a member of the Technical Panel constituted by the Cotton Corporation of India for screening of foreign cottons offered for import into India. He attended a number of meetings at the Cotton Corporation of India for this purpose.

6. Summary of the Report

This is the 54th Annual Report of CTRL covering the calendar year 1977. The Laboratory continued to collaborate actively in the research programmes for evolving new strains of cotton by evaluating the quality characteristics of the improved cotton strains. Fundamental studies in fibre physics, ginning and spinning technology, textile chemistry, microscopy and microbiology were continued through various research projects, and several papers based on the research findings were published. Many new items of equipment and books were purchased and added.

Research Activities

A brief account of the progress made on various research investigations during 1977 is given below :

Under AICCIP and various schemes sponsored by Agricultural Universities, etc. for evolving new varieties of cotton and for improving cotton production in the country, 1,658 samples were tested for various fibre characteristics and spinning performance.

The plenary session of the South Zone Panel Meeting of AICCIP considered and approved the pre-release seed multiplication proposals of the following varieties :

Variety	*Area of adaptation*
ELS.481	Winter Irrigated Zones of Tamil Nadu.
CP.1998F	Rainfed tract of Tamil Nadu.
CPH.2	Southern and Central Districts of Tamil Nadu and Andhra Pradesh.

During 1977, Technological Circulars were issued on 43 Trade Varieties and 12 Standard Cotton samples and mill tests were arranged on four samples pertaining to 1974-75 and 1976-77 seasons.

Tests carried out on seven varieties of cotton with the CTRL Kapas Extractor revealed that the CTRL Kapas Extractor was comparatively more efficient as the trash cleaning efficiency of the Extractor, on an average, was found to be about 38%.

The survey of the conditions of cotton Ginning Factories in the States of Punjab, Haryana and Rajasthan was continued and the information collected were being analysed.

The extent of surface damage caused to cotton fibres during processing through the newly fabricated Lint Opener has been ascertained during the year and it was found that practically no damage is caused to the fibres by Lint Opener.

A study was conducted to assess the extent and the manner of variability of different characteristics of samples of Suvin, MCU.5, Hybrid 4, Varalaxmi and CBS.156 grown at different locations in Andhra Pradesh during the year. While Seed Index and Lint Index did not exhibit any systematic trend, either locationwise or pickingwise, the length values showed progressive reduction for the later pickings in the case of some varieties.

Bundle tenacity measurements made both in wet and in standard atmospheric conditions showed that the tenacity increased by about 3% to 9% on wetting. The rise was considerably less than the increase of 10% to 20% observed in the case of single fibres.

A method for the measurement of bulk resilience using the Instron Tensile Tester has been standardised. It was observed that the bulk resilience was the same for different varieties and the value did not change even after crosslinking cotton to different degrees. It was concluded that the bulk resilence of cotton does not respond well to the changes in structure and hence cannot be used for assessing crosslinking efficiency.

Torsional tests on crosslinked fibres have shown that the torsional rigidity increases on crosslinking with DMDHEU while such a change does not accompany the HCHO crosslinking. The torsional modulus, on the other hand, showed an apparent decrease due to increase in fibre diameter after crosslinking treatments.

Circularity measurements on cotton fibres of *G. arboreum* and *G. barbadense* species showed that circularity values increased with increasing age of boll and that the circularity values of cotton fibres of *G. arboreum* were much higher than those of *G. barbadense* even from the initial stages of boll development.

Analysis of fibre and yarn samples of *desi* cottons using orientation profiles obtained by x-ray diffraction has indicated the feasibility of carrying out blend analysis by orientation methods.

In order to confirm the observation that fibre maturity influences crystallinity, fibres from unopened bolls picked at different stages of growth were tested. It was observed that Index III ($I = \frac{a_{342}}{a_{2900}}$, where a_{342} and a_{2900} are absorbance values at 342 cm^{-1} and 2900 cm^{-1} respectively) showed sharp rise with stages of growth and this index had high correlation with x-ray crystallinity. The origin of 342 cm^{-1} band was traced at a mode which is more sensitive to the type of intermolecular bonding during conversion of cellulose I to II. Two mutually opposing factors, (*i*) apparent increase in crystallinity during hydrolysis and (*ii*) fall in the degree of polymeri-

sation, appear to influence the intensity of the concerned mode.

Studies were undertaken to identify the optimum conditions by infrared methods for decrystallisation treatment; cotton fibres having acetyl content up to 10% had good strength retention. Some preliminary studies were done on bundle tenacity to find out the influence of various conditions of treatment such as preswelling with NaOH at different concentrations, double swelling, etc., before acetylation and the results were compared with those of cyanoethylated samples prepared under the same conditions.

Electron Diffraction (ED) patterns of 16 varieties of raw cotton, a few mercerised and liquid ammonia treated cottons were recorded. From the ED studies on cellulase-treated bagasse pulp, wheat straw pulp and sawdust, it was noted that the cellulase enzyme preferentially attacked 101 and 002 planes of cellulose crystallite and enzymatic hydrolysis results in increase in crystallinity index of celulosic substrates accompanied by reduction in crystallite width perpendicular to 002 plane.

Performance of the modern blowroom was assessed by processing American Elpaso cotton with two combinations in blowroom, viz. (*i*) Blending Hoppers-SRRL Opener-Shirley Opener and Kirschner Beater and (*ii*) Blending Hoppers-SRRL Opener-Airstream Cleaner and Kirschner Beater. Even though the cleaning efficiency varied individually for the two combinations, the overall cleaning efficiency of blowroom and card for both the combinations remained at 85%. No marked difference in yarn quality also was noticed.

Tests on five cottons processed with different types of flat tops on card showed that use of rigid tops results in a reduction of flat strips to the tune of 60% to 75% compared to flexible tops and 21% to 66% compared to semi-rigid tops.

The studies on Lakshmi Rieter High Speed Drawing and Speed Frames with five short staple cottons have shown that the quality of the material from the high speed draw frame was better than that from conventional draw frame.

A comparative study of bulk spinning and microspinning using SKF drafting system revealed that there was no major difference in yarn strength between samples spun on bulk scale spinning using SKF drafting and those spun using microspinning technique either with SKF or OMS drafting systems.

In order to determine the evenness of the material at different stages of processing and the quality of yarn from 3 roller, A.500 and GX.2 drafting systems, three Indian cottons, viz., MCU.5, Hybrid 5 and Sujata and two foreign cottons, viz. American Elpaso and Egyptian Menoufi, were spun to 60s and 80s counts; yarn characteristics were being examined.

Yarn strength and count was found to bear a linear logarithmic relationship to each other and obey the differential equation $\frac{dS}{dC} = \lambda \frac{S}{C}$,

where S and C represent yarn strength and count, respectively.

As part of the studies undertaken on the effect of blending on nep formation and its relationship with single yarn strength, evenness and other characteristics, four cottons were subjected to Nepotometer grade estimation and the yarns spun from blends of these were tested for various characteristics.

Preliminary blending trials with Gaorani 22, AK.277 and CJ.73 revealed that out of the three blends studied, a blend containing 50% of Gaorani 22, 30% of AK.277 and 20% of CJ.73 gave the best lea CSP values which were higher than the estimated weighted averages for both 20s and 30s counts. Nine more varieties from Maharashtra State have been procured for further trials.

Blending of cotton with jute staple or jute caddies revealed that it is feasible to blend up to about 20% jute with cotton and the yarns thus produced are found to be suitable for weaving fabrics mainly for curtain materials, furnishings, etc.

Test on blends of Maljari cotton with wool noils in different proportions spun to 6s count on microspinning system using various twist multipliers indicated that the yarn strength deteriorated with increase in the proportion of wool noils and a twist multiplier of about 5 seemed optimum for the blends. Yarns from bulk spinning of 75% cotton with 25% wool noils have been woven into blankets.

Ramie samples subjected to six types of degumming and softening treatments on blending with 67% polyester showed that the sample degummed and treated with nonionic softener proved the best, from the point of view of yarn regularity.

While spinning blends of carded medium staple cotton SRT.1 with 1.2 d and 2.0 d polyester fibre in various proportions to 30s count, it was observed that a blend of 67% polyester with 33% cotton produced the strongest yarns. While finer denier polyester resulted in stronger yarn, coarse denier polyester gave more regular yarn.

66BH.5-91, A.218, MCU.1, Gujarat 67, Hybrid 4, Bhagya, Deviraj and ELS.031 among *hirsutums*, Sanjay, Virnar, Gaorani 6 and Maljari among *arboreums*, Jayadhar and Digvijay among *herbaceums* and Sujata and Suvin among *barbadenses* were found suitable for easy-care finishing treatment with DMDHEU. Further, out of the 12 breeder's samples screened for their response to crosslinking treatment, American Nectariless × SV.213, Buri 1007 × CL.20 and Buri 1007 × Laxmi showed high toughness retention after crosslinking.

Analysis of data on tenacity-elongation and crease recovery angle (CRA) on crosslinking of eight cottons, mercerised, washed and dried at room temperature, and crosslinked with 8% DMDHEU (MDCL) and mercerised, washed, and crosslinked in wet state (MWCL) indicated that generally MWCL samples had good combination of high retention of mechanical properties and high degree of CRA.

Higher retention of tenacity was noticed when cotton cellulose was crosslinked with DMDHEU using pre-irradiation or simultaneous irradiation technique compared to crosslinking at the same level by conventional method.

Celluloseen was prepared and irradiated to various dosage of gamma-ray radiation. The oxidative as well as hydrolytic break down increased with dosage.

It was found that post-irradiation activity was higher in mercerised cotton than in the case of raw cotton and the activity was maximum at a dosage of 2.3×10^6 rads. Storage studies in cotton cellulose for various intervals of time after irradiation to 2.3×10^6 rads revealed no appreciable effect on tenacity and viscosity values.

Studies are underway on cotton fabrics treated by two-step polyset process for resin add-on, nitrogen content, formaldehyde content and number of crosslinks per GPU and it was observed that zinc acetate as catalyst in the first step contributed to higher resin add-on than magnesium acetate. Besides, improved DP characteristics with high strength and elongation retention was noticed in polyset process-treated fabrics compared to conventional single-step process.

An investigation to study the effect of degree of substitution on dye diffusion is underway for which a diffusion cell has been fabricated and various studies have been carried out using the direct dye Chlorazol Skyblue F.F. at a temperature of 80°C in a water bath.

Some of the applications of the cellulase of *Penicillium funiculosum* were successfully tried. Wheat straw pulp (WSP) was hydrolysed to 90% solubility by employing high concentrations of cellulase. Thin layer chromatographic analysis of WSP and bagasse hydrolysates revealed the presence of glucose, cellobiose, galactose, xylose, galacturonic acid, glucuronic acid and higher oligosaccharides. Food yeast cultures, viz. *Candida tropicalis* and *C. utilis*, grew well on these hydrolystates. Studies on desizing of modified tamarind kernel powder (LTKP) sized fabrics by cellulase, simulating the padding process in industry, showed that in this process 90% size could be removed. The cellulase was also found useful in clarifying the turbid lemon juice, thereby improving its visual appeal, yet retaining its flavour.

Bacillus subtilis (BS) was grown on many inexpensive starches for amylase production. The presence of metal ions like Ag^+, Hg^{++}, Co^{++} and Cu^{++} in the medium above 10^{-4} M were inhibitory for the amylase synthesis. A comparisen of the BS amylase and three other commercially available amylases tried for desizing fabrics showed that the BS amylase was more potent among all these amylases.

Amongst several isolates screened for chitinoclastic activity, *Bacillus* sp. and *Streptomyces* sp. were found to be the best, in view of glucosamine produced. Culture studies with either chitin and chitosan revealed that *Bacillus* sp. was found to possess heterotrophic nitrification ability in oxidising the released amino group up to nitrite level, whereas *Streptomyces* sp. did release

the amino group but failed to oxidise it. In chitin amended soil also, ammonification and nitrification were complete. Studies are underway to find out the biological effects of chitin in soil on the survival of soil-borne phytopathogenic wilt fungus of cotton, *Verticillium dahliae.*

In the investigation for improving the quality of linters and developing grade standards for commercially available linters, different types of linters were kier-boiled and bleached and their cellulose content was determined by Shirley Analyser.

Gas liquid chromatograph (GLC) was installed and using known mixture of fatty acid esters injected at various temperatures and flow rates, estimation of fatty acids of cotton seed oil was standardised. Fatty acid analysis of 20 samples of cotton seed oil have been carried out so far with the help of known fatty acid esters.

The study on the evaluation of protein composition of Indian cotton seeds revealed that seed index, linter, hull, kernel, oil, protein and gossypol contents showed marked variation among varieties and amino acid content varied in arginine, aspartic acid, glutamic acid and cystine contents. The variation was marked in certain cases.

The particle boards made from cotton plant stalk when tested for density, tensile strength, modulus of rupture and water absorption were found to conform to ISI specifications.

For studies on deburring of raw wool using mechanical device, a new double vee groove pulley for direct drive from motor to gin shaft and special slide rails for proper alignment of drive belt have been fabricated.

Research work at Hissar indicated that the defoliants had no significant effect on fibre properties.

Tests conducted at Indore showed that fibres from basal portion of bolls of JKHy.1 and Hybrid 4 were coarser and were having higher ginning percentage and seed weight compared to tip-end fibres.

Experiments conducted at Nanded to study the effect of different levels of irrigation and nitrogen on fibre properties of NDHy.1 showed no significant different due to treatments, though application of 200 kg/ha of nitrogen with irrigation was found to be beneficial for fibre length, fineness and strength.

In the study undertaken at Surat on genetical selections for fibre strength, four out of 10 varieties indicated a significant increase in fibre tenacity over control.

7. Personnel

The Committee constituted by ASRB for screening the bio-data of the scientific staff of CTRL, while recommending the initial induction of 41 scientists to the appropriate grades of the Agricultural Research Service with effect from the 1st October, 1975, had also approved Dr. V. G. Munshi, Senior Testing Technologist, and Shri M. S. Parthasarathy, Senior Spinning Technologist, for induction subject to the posts being classified as scientific. The posts were eventually classified as scientific and the above two scientists were also inducted to the grade S-3 of ARS with retrospective effect from the 1st October, 1975, by redesignating them as Senior Scientist (Testing Technology) and Senior Scientist (Spinning Technology), respectively.

Sarvashri B. M. Petkar and A. K. Gupta, both Senior Research Assistants, who qualified for induction into ARS after the initial induction have also since been inducted into Grade 'S' of ARS.

The case of Shri T. N. Ramamurthy, Scientist (Fibre Technology), is still not decided pending finalisation of his permanent absorption under ICAR.

The posting at this Laboratory of five scientists selected for appointment to Grade S-1 of ARS on the basis of the results of the all-India competitive examination held in 1976, was reported in the last Annual Report. Of these, one was subsequently transferred to IARI and the remaining four were deputed in May 1977, for training for three months in the Central Staff College for Agriculture, Hyderabad, from April to July 1977.

Twelve scientists of CTRL inducted into Grades S, S-1, S-2 and S-3 of the Agricultural Research Service, due for the five-yearly assessment for promotion or advance increments, appeared before the Assessment Committee constituted by ASRB, New Delhi, for personal discussion. As a result of the assessment, merit promotions and advance increments were granted to the following scientists :

S. No.	Name	Merit promotion		No. of advance increments
		from grade	to grade	
1.	Kum. I. G. Bhatt	S-1	S-2	—
2.	Shri P. K. Chidambareswaran	S-1	S-2	—
3.	Smt. Prema Nair	S	S-1	—

S. No.	Name	Merit promotion		No. of advance increments
		from grade	to grade	
4.	Dr. S. M. Betrabet (Scientist S-3)	—	—	Two
5.	Smt. S. P. Bhatawdekar (Scientist 'S')	—	—	Three
6.	Kum. C. R. Raje (Scientist 'S')	—	—	Three
7.	Shri G. F. S. Hussain (Scientist 'S')	—	—	One

The promotions and advance increments take effect from the 1st July, 1976.

A comprehensive list of all the Scientific, Technical, Administrative and Supporting Staff as on the 31st December, 1977 is given in Appendix II.

Training

Smt. Prema Nair who was promoted to the Grade S-1 was deputed to participate in the fifth training programme at the Central Staff College for Agriculture, Hyderabad, which commenced in November 1977.

Appointments

Kum. R. D. Mhatre, Sarvashri I. H. Hunsikatti, A. K. Mehta, S. Vancheswaran, S. N. Hussain, K. B. Rajagopal, S. M. Mohile, R. S. Darade, S. Sekar, M. Karmakar, J. C. Toscano, S. J. Guhagarkar, R. S. Pathare, E. A. Pachpinde, N. R. Tare and D. Radhakrishna Murthy, were appointed to the posts of Technical Assistant.

Retirements and Resignations

Shri K. Venkateswaran, Senior Technical Assistant (Statistics), retired from service with effect from the 30th April, 1977.

Shri A. S. Sathe, Scientist Grade 'S', resigned and was relieved on the 14th July, 1977.

Transfers

Sarvashri R. S. Darade and S. M. Mohile, Technical Assistants, were transferred to the Quality Evaluation Units of the Laboratory at Surat and Nanded on the 28th November, 1977, and the 26th December, 1977, respectively.

Training on Computer Programming

Shri D. V. Mhadgut, Scientist 'S', was deputed for training under the Fourteenth Training Course in Computer Programming for Agricultural Reserach conducted from the 10th October to the 2nd November, 1977, at the Indian Agricultural Statistics Research Institute, New Delhi.

Appreciation Course for Administrative Officers

Shri P. V. Sreenivasan, Assistant Administrative Officer (Stores), was deputed to participate in the First Appreciation Course on Improvement of Administrative Efficiency for the Administrative Officers of ICAR Institutes in New Delhi, from the 13th June to the 2nd July, 1977.

Summer Institute

Dr. K. R. Krishna Iyer, Scientist Grade S-2, attended the Summer Institute on 'Methodology of Effective Communication for Presentation of Scientific Papers' held at IARI, New Delhi, from the 30th August to the 17th September, 1977.

Refresher Course

Dr. K. R. Krishna Iyer, Scientist Grade S-2, participated as a faculty member in the 'Refresher Course in Spinning' jointly organised by the Textile Institute (Manchester) and the Victoria Jubilee Technical Institute (Bombay), between the 24th and the 28th October, 1977, in Bombay.

8. Appendices

APPENDIX I

FINANCIAL STATEMENTS

Expenditure and Receipts of the Laboratory During 1976-77

	Sanctioned Grant (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	3,83,300	3,83,294	(—) 6
(*b*) Working expenses	21,51,700	22,26,975	(+) 75,275
Total ..	25,35,000	26,10,269	(+) 75,269
II. Scheme for Modernisation and Strengthening of CTRL for Intensive Research on Cotton (Plan)	6,25,000	6,37,510	(+) 12,510
III. Schemes Financed from A.P. Cess Funds :			
(*a*) Response of Indian cottons to crosslinking treatments with a view to evolve cotton varieties most suitable for chemical finishing treatments	53,900	41,026	(—) 12,874
(*b*) Studies on spinning from blends of cotton with wool, jute and ramie on cotton system (in collaboration with CSWRI and JTRL)	49,500	33,495	(—) 16,005
(*c*) Studies on deburring of raw wool using mechnical devices (in collaboration with CSWRI)	21,600	8,613	(—) 12,987
(*d*) 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 ..	41,600	21,653	(—) 19,947
(*e*) Optimal blending of Standard Varieties of Indian Cottons	1,75,000	1,00,711	(—) 74,289
(*f*) Studies on the production and utilisation of chitosan and allied products from prawn shell waste	8,020	4,935	(—) 3,085
(*g*) Regional Committee No. 7	3,000	2,080	(—) 920

B. RECEIPTS

	(Rs.)
Analytic and testing fees	18,568
Rent	33,003
Fees for training, application fees, etc. ..	3,408
Sale of publication	8,299
Interest on loans and advances granted to employees	46
Leave salary and pension contribution, etc. ..	611
Miscellaneous receipts (including sale of waste cotton)	37,611
Total ..	1,01,546

APPENDIX II

Scientific, Technical, Administrative and Supporting Staff Working at the Cotton Technological Research Laboratory as on 31st December, 1977

(List does not include Vacant Posts)

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

Scientific Staff

Senior Scientist	(Microscopy)	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. (Manchester), A.M.C.S.T.
,,	(Testing Technology)	,,	Dr. V. G. Munshi, M.Sc., Ph.D., F.T.A.
Scientist	(Chemical Studies))	S-2	Dr. S. N. Pandey, M.Sc., Ph.D.
,,	(Fibre Technology)	,,	Shri T. N. Ramamurthy, B.Sc., B.Sc. (Tech.)
,,	(Physics)	,,	Shri P. K. Chidambareswaran, M.Sc., A.
,,	,,	,,	Dr. K. R. Krishna Iyer, M.Sc., Ph.D.
,,	(Statistics)	,,	Shri G. S. Rajaraman, M.A.
,,	(Textile Chemistry)	,,	Kum. I. G. Bhatt, M.Sc., 1, A
,,	(Textile Manufacture)	,,	Shri B. Srinathan, B.Sc. (Text)., M.Sc. (Text.)*
,,	(Bio-Chemistry)	S-1	Dr. R. N. Adsule, M.Sc., Ph.D.*
,,	(Chemical Studies)	,,	Smt. Prema Nair, M.Sc. A
,,	(Microbiology)	,,	Shri R. H. Balasubramanya, M.Sc. 3
,,	,,	,,	Dr. V. G. Khandeparkar, M.Sc., Ph.D.
Scientist	(Organic Chemistry)	S-1	Shri L. K. Suri, M.Sc.
,,	(Physics)	,,	Shri P. G. Oka, M.Sc. t
,,	,,	,,	Shri A. V. Ukidve, M.Sc.
,,	(Textile Manufacture)	,,	Shri Muntazir Ahmed, B.Sc., B.Sc. (Text.) 4.
,,	(Bio-chemistry)	'S'	Smt. S. P. Bhatawdekar, M.Sc.
,,	,,	,,	Shri S. G. Gayal, M.Sc.*
,,	(Bio-physics)	,,	Shri K. M. Paralikar, M.Sc.
,,	(Chemical studies)	,,	Shri S. Aravindanath, M.Sc.
,,	,,	,,	Smt. Vatsala Iyer, M.Sc. 1
,,	(Microbiology)	,,	Kum. A. S. Dighe, M.Sc.
,,	(Physics)	,,	Dr. (Smt.) Bhama Iyer, M.Sc., Ph.D.
,,	,,	,,	Shri G. F. S. Hussain, M.Sc.
,,	,,	,,	Shri R. P. Nachane, M.Sc.*
,,	,,	,,	Shri S. Sreenivasan, M.Sc.
,,	(Quality Evaluation)	,,	Shri P. Bhaskar, M.Sc.
,,	,,	,,	Smt. K. L. Datar, M.Sc.
,,	,,	,,	Shri A. K. Gupta, M.Sc.
,,	,,	,,	Shri R. M. Gurjar, M.Sc.
,,	,,	,,	Shri D. N. Makwana, M.Sc.*
,,	,,	,,	Shri B. M. Petkar, M.Sc.
,,	,,	,,	Kum. C. R. Raje, M.Sc.*
,,	,,	,,	Smt. A. P. Sindkar, M.Sc.
,,	(Statistics)	,,	Smt. Janaki K. Iyer, M.Sc. t
,,	,,	,,	Shri D. V. Mhadgut, M.Sc.

Technical Staff

Technical Officer	(Electrical Engineering)	T-6	Shri H. V. Tamhankar, L.M.E., L.E.E.
,,	(Ginning)	,,	Shri D. G. Shete, L.M.E.
Senior Technical Assistant	(Chemical Studies)	T-4	Shri A. W. Shringarpure, B.Sc.
,,	,,	,,	Shri M. S. Sitaram, B.Sc. 2
,,	,,	,,	Shri N. Thejappa, B.Sc. t
,,	(Quality Evaluation)	,,	Shri S. R. Ganatra, B.Sc.
,,	,,	,,	Shri B. S. Ganvir, B.Sc.
,,	,,	,,	Kum. I. K. P. Iyer, B.Sc.
,,	,,	,,	Shri V. Jose Joseph, B.Sc.

Technical Staff—(Contd.)

Senior Technical Assistant	(Quality Evaluation)	T-4	Shri K. R. Kamath, B.Sc.
,,	,,	,,	Shri S. G. Nayar, B.Sc., L.L.B.
,,	,,	,,	Smt. S. B. Pai, B.Sc.
,,	,,	,,	Smt. S. D. Pai, BSc.
,,	,,	,,	Smt. J. K. S. Warrier, B.Sc.
,,	(Instrumentation)	,,	Shri G. S. Patel, B.Sc.
,,	(Spinning)	,,	Shri K. S. Bhyrappa, L.T.T., A.T.A.
,,		,,	Shri S. Chandrasekar L.T.M., A.TA.
,,	,,	,,	Shri H. R. Laxmivenkatesh, D.T.T.
,,	(Statistics)	,,	Shri K. Chandaran, B.A.
,,	(Information)	,,	Shri T. K. M. Das, B.Sc., D.B.M.
,,	(Library)	,,	Kum. Rachel Varghese, B.Sc., B. Lib.*
,,	(Electrical)	,,	Shri M. K. K. Menon, D.E.E.
Technical Assistant	(Quality Evaluation)	T-II-3	Kum. P. V. Adelkar, B.Sc.
,,	,,	,,	Shri K. V. Ananthakrishnan, B.Sc.., D.B.M.
,,	,,	,,	Smt. R. P. Bhat, B.Sc.
,,	,,	,,	Smt. Girija Radhakrishnan, B.Sc.
,,	,,	,,	Shri S. J. Guhagarkar, B.Sc. t
,,	,,	,,	Shri I. H. Hunsikatti, B.Sc.
,,	,,	,,	Shri S. N. Hussain B.Sc. t
,,	,,	,,	Kum. S. R. Jage, B.Sc.
,,	,,	,,	Shri C. R. Sthanusubramoni Iyer, B.Sc.
,,	,,	,,	Shri M. Karmakar B.Sc. t
,,	,,	,,	Shri A. K. Mehta M.Sc.
,,	,,	,,	Shri E. A. Pachpinde B.Sc.
,,	,,	,,	Shri R. S. Pathare, B.Sc.
,,	,,	,,	Shri D. Radhakrishna Murthy, M.Sc. 4
,,	,,	,,	Shri K. B. Rajagopal, B.Sc. t
,,	,,	,,	Shri S. Sekar B.Sc. t
,,	,,	,,	Shri V. B. Suryanarayanan, B.Sc.
,,	,,	,,	Shri N. R. Tare, B.Sc.
,,	,,	,,	Kum. N. S. Tipnis, B.Sc. 2
,,	,,	,,	Shri J. C. Toscano, B.Sc.
,,	,,	,,	Shri S. Vancheswaran B.Sc.*
,,	,,	,,	Shri G. Vishwanathan, B.Sc., A.T.A.
,,	(Microbiology)	,,	Kum. R. D. Mhatre, B.Sc. 5
,,	(Photography)	,,	Shri R. M. Modi, S.S.C. (Certificate in Photography—1 year)
Senior Library Assistant, Gr. II		,,	Smt. Rekha K. Shahani, B.Sc., B.Lib.
Senior Fitter	(Mechanical Processing)	T-I-3	Shri Thama Bhiwaji Dangle
,,	(Ginning)	,,	Shri A. R. S. Abdulla *
Operator	(Refrigeration)	,,	Shri S. G. Dalvi *
,,	,,	,,	Shri V. V. Kshirsagar
,,	(Workshop Machinery)	,,	Shri D. L. Upadhye
Draughtsman	,,	T-2	Shri P. B. Gurjar
Boiler Attendant	,,	,,	Shri S. N. Salvi
Turner	,,	,,	Shri M. M. Shaikh
Mechanic	,,	,,	Shri R. K. Landge
Electrician	,,	,,	Shri M. T. Itnare
,,	,,	,,	Shri R. B. Pawar
Fitter	(Mechanical Processing)	T-1	Shri P. K. Gopalan
,,	,,	,,	Shri Purshottam Vira
Senior Operative	(Mechanical Processing)	,,	Shri P. J. Ahire
,,	,,	,,	Shri R. A. Dalvi
,,	,,	,,	Shri Bechan Nokai 4
,,	,,	,,	Shri S. T. Patekar
,,	,,	,,	Shri H. K. Pawar 4
,,	,,	,,	Shri K. Vasudevan Nair 4
Driver-cum-Mechanic	,,	,,	Shri P. B. Chouke
Plumber	,,	,,	Shri H. B. Tambe
Wireman	,,	,,	Shri K. R. Chawan
Carpenter	,,	,,	Shri G. D. Narkar
Laboratory Assistant	(Chemistry)	,,	Shri N. O. Anthony

Driver	T-1	Shri K. S. S. Panicker
,,	,,	Shri S. S. Patekar
Telephone Operator	,,	Kum. A. Y. Dhotre

Administrative Staff

Senior Administrative Officer (Post sanctioned up to 31-1-1978).	Shri C. D. Kulkarni, B.A. (Hons.)
Assistant Administrative Officer (Stores)	Shri P. V. Sreenivasan 7
Assistant Administrative Officer	Shri K. S. Ram Narayan, B.A., D.Com. (IMC) (*on adhoc basis*)
Accounts Officer	Shri T. Govindarajulu, B.Sc., S.A.S.
Superintendent (Accounts)	Shri V. J. Antony, B.Com., F.S.A.A. (India)
Superintendent (R & P)	Shri F. X. Meyers
,, (GAD)	,, V. N. Wadhwani
P. A. to Director	Shri T. P. Parameswaran*
Assistant	Shri K. S. Deshpande
,,	,, F. C. Fernandes
,,	Smt. V. V. Gore, B.A.
,,	Shri M. P. Juwale
,,	,, D. L. Kalsekar
,,	,, V. R. G. Menon
,,	,, J. P. Mishra, B.A.
,,	,, D. P. Naidu
,,	,, D. J. Raut
Stenographer Gr. I	Smt. I. A. Fernandes
Junior Stenographer	Kum. A. K. Annamma*
,,	Smt. Chellamma Damodaran t
,,	Kum. Radha Krishnamurthy
,,	Shri J. D. Lewis, G.C.D.*
Senior Clerk	Shri M. Z. Bhagat
,,	Smt. S. S. Dongare, B.A.
,,	Kum. P. P. Gujar, B.A.
,,	Smt. Veena Kotwani, B.A.
,,	Smt. Jayagouri Sivaramakrishnan
,,	Shri P. D. Sonawane
Cashier	Shri V. M. Kasabe
Junior Clerk	Kum. R. B. Dalal* at Surat
,,	Shri A. B. Dalvi
,,	Kum. S. F. Harrison 1
,,	Shri K. N. Iyer
,,	,, K. W. Khamkar
,,	,, H. G. Kini
,,	,, D. G. Kulkarni
,,	,, G. N. More
,,	Kum. B. R. Rane 6
,,	,, V. E. Sagwekar @
,,	Shri S. N. Salve
,,	Kum. M. M. Salvi@
,,	Shri B. D. Sawant
,,	Kum. G. N. Shanbhag@
,,	Shri K. M. Shejwal

Supporting Staff

Operative	Gr. III	Shri D. B. Gadankush
,,		,, G. M. Kadam
,,		,, K. K. Kasar
,,		,, K. D. Mohite
,,		,, Mubarak Raju

(@ Appointed against posts created in lieu of certain other administrative posts held in abeyance).

Operative	Gr. III	Shri M. M. Rupawate
,,	,,	,, S. G. Shinde
,,	,,	,, M. B. Thokrul
Laboratory Attendant	,,	Shri R. G. Chiplunkar
,,	,,	,, K. K. Dalvi
,,	,,	,, P. G. Kadam
,,	,,	,, S. B. Kamble
Workshop Attendant	,,	,, D. V. Kambli *
Sliver Maker	Gr. II	Shri T. R. Kadam
Junior Operative	,,	Shri Babu Aba Babar
,,	,,	,, R. R. Khurdekar
Naik	,,	,, H. N. Gawde
Head Watchman	,,	,, Obilal Parsuram *
Watchman	Gr. I	,, M. T. Aldar
,,	,,	,, Ratansingh Gussain
,,	,,	,, G. M. Shedge
Pump Attendant cum Watchman	,,	,, R. B. Jadhav
,,		,, T. B. Thapa
Hamal	,,	,, T. S. Mhaske
Hamal cum Safaiwala	,,	,, Butnislal Balmiki*
,,	,,	,, Chatrapal Mathri
Mali	,,	,, N. J. Kharat
,,	,,	,, R. S. Pawar
Safaiwala	,,	,, Kartarsingh Sivdayalsingh
,,	,,	,, Ramkishan Taleram
,,	,,	,, Shamji Waghela
Lab. Boy/Peon/Farash	,,	Shri G. G. Ambare
,,	,,	,, T. A. Asaldekar
,,	,,	,, A. R. Bane
,,	,,	,, V. S. Bhowar
,,	,,	,, M. T. Desai
,,	,,	,, G. S. Devrukhkar
,,	,,	Shri G. D. Gawand
,,	,,	,, S. L. Gawde
,,	,,	,, B. B. Gaykar
,,	,,	,, A. C. Kadam
,,	,,	,, P. S. Lad
,,	,,	,, M. R. Nevrekar
,,	,,	,, S. V. Patil
,,	,,	,, M. P. Salunke
,,	,,	,, A. B. Sawant
,,	,,	,, B. K. Sawant
,,	,,	,, A. G. Shirke
,,	,,	,, V. Y. Unhalekar

QUALITY EVALUATION UNITS AT OUTSTATIONS

Station	Technical Officer (Quality Evaluation) Grade T-6	Senior Technical Assistant (Quality Evaluation) Grade T-4	Scientist Grade 'S'	Technical Assistant (Quality Evaluation) Grade T-II-3	Supporting Staff Grade II (Silver Maker)	Supporting Staff Grade I (Lab. Boy)
1	2	3	4	5	6	7
Coimbatore		Shri A. K. Antony, B.Sc. Smt. Santa V. Nair, B.Sc. Shri C. P. Venugopalan, B.Sc.			Shri N. Arumugham t	Shri V.M. Subramaniam
Dharwar		Shri E. S. Abraham, B.Sc.	Shri A. J. Shaikh, M.Sc. Shri C. V. Simon, M.Sc.		Shri R. P. Belamaddi t	Shri Y. R. Sone
Hissar	—	Shri S. N. Nagwekar, B.Sc. t.	—		Shri Gian Singh t	
Indore	—	Shri W. R. Sharma, B.Sc.	Shri S. B. Jadhav, M.Sc.		Shri John Robert t	Shri Harisingh Babar
Ludhiana			Shri A. K. Ahuja, M.Sc. t		Shri Kamikkar Singh t	
Nanded			Shri K. H. Sawakhande, M.Sc. Shri L. D. Deshmukh, M.Sc. *	Shri S. M. Mohile, B.Sc. t	Shri L. R. Indurkar t	
Guntur		Shri R. Dwarkanath, B.Sc.	Shri Y. Subrahmanyam, M.Sc. t		Shri Ch. Thimmanna t	Post vacant

QUALITY EVALUATION UNITS AT OUTSTATIONS—(*Contd.*)

Station	Technical Officer (Quality Evaluation) Grade T-6	Senior Technical Assistant (Quality Evaluation) Grade T-4	Scientist Grade 'S'	Technical Assistant (Quality Evaluation) Grade T-II-3	Supporting Staff Grade II (Silver Maker)	Supporting Staff Grade I (Lab. Boy)
1	2	3	4	5	6	7
Srigananagar		Shri Ram Parkash, B.Sc. t		Shri Tula Ram, B.Sc.	Shri Vijendra Singh t	Shri SanwarMal Saini
Surat	Shri L. R. Jambunathan, B.Sc., A.M.I. C.T., L.T.I.	Shri M. C. Bhalod, B.Sc.	Shri P. V. Varadarajan M.Sc.	Shri R. S. Darade B.Sc. t	Shri J. B. Dhodia t	Shri K. M. Rathod
			Shri P. M. Patil,* M.Sc.			

(*Explanations for symbols used*)

* Under the Fifth Five Year Plan Scheme for expansion and strengthening of the Cotton Technological Research Laboratory for intensive research on Cotton.

t Under the All India Coordinated Cotton Improvement Project.

1 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 basis information needed for the development of potentially new useful cotton products.

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

3 Scheme for studies on the production and utilisation of Chitosan and allied products from prawn shell waste.

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

5 Scheme for cotton seed meal as a complex nitrogen source for the production of fermentation products.

6 Regional Committee No. 7 of I.C.A.R. for the semi Arid Lava Plateaus of Maharashtra, Western and Central Madhya Pradesh and Union Territory of Goa, Daman and Diu.

7 Integrated Cotton Development Project.

A By assessment with effect from the 1st July, 1976.

APPENDIX III

STATEMENT SHOWING THE TOTAL NUMBER OF EMPLOYEES AND THE NUMBER OF SCHEDULED CASTES AND SCHEDULED TRIBES AMONGST THEM AS ON 31ST DECEMBER, 1977

Class	Permanent / Temporary	Total number of employees	Scheduled castes	Percentage of total employees	Scheduled Tribes	Percentage of total employees	Remarks
Class I	Permanent	10	—	—	—	—	—
	Temporary	13	1	8	—	—	—
Class II (Gazetted rank)	Permanent	1	—	—	—	—	—
	Temporary	3	—	—	—	—	—
Class II (Non Gazetted)	Permanent	23	—	—	—	—	—
	Temporary	39	4	10	—	—	—
Class III	Permanent	43	4	9	—	—	—
	Temporary	44	5	11	2	5	—
Class IV (excluding Safaiwala) ..	Permanent	44	8	18	2	5	—
	Temporary	20	4	20	—	—	—
Class IV (Safaiwala)	Permanent	1	1	100	—	—	—
	Temporary	2	2	100	—	—	—

Note : (1) The statement is prepared with reference to persons and with reference to posts', Vacant posts have not been taken into account.
(2) Persons on deputation have been included in the above statement.
(3) Persons permanent in one grade but officiating or holding temporary appointment in the higher grades, have been shown in the figure relating to such higher grade.

APPENDIX IV

STATEMENT SHOWING THE NUMBER OF RESERVED VACANCIES FILLED BY MEMBERS OF SCHEDULED CASTES AND SCHEDULED TRIBES DURING THE YEAR 1977

Class of post	Total No. of vacancies		Scheduled Castes					Scheduled Tribes					Remarks
			No. of vacancies reserved		No. of SCs. candidates appointed	No. of STs. candidates appointed against vacancies reserved for SCs. in the 3rd year of carry forward	No. of reservations lapsed after carrying forward for three years	No. of vacancies reserved		No. of STs. candidates appointed	No. of SCs. candidates 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 ..	—	(A)	—	—	—	—	—	—	—	—	—	—	—
Class II (Gazetted)	—	(A)	—	—	—	—	—	—	—	—	—	—	—
Class II (Non-gazetted) ..	—	—	—	—	—	—	—	—	—	—	—	—	—
Class III ..	28	28(C)	—	5	5	—	—	—	3(B)	2	—	—	—
Class IV (excluding Safaiwala)	2	2(D)	—	—	—	—	—	—	—	—	—	—	—
Class IV (Safaiwala)	—	—	—	—	—	—	—	—	—	—	—	—	

APPENDIX IV—(*Contd.*)

II. *Posts filled by promotion*

Class I ..	1	1(E)	—	—	—	—	—	—	—	—	—	—	—
Class II (Gazetted)	1	1(E)	—	—	—	—	—	—	—	—	—	—	—
Class II (Non-gazetted) ..	3	3(E)	—	—	—	—	—	—	—	—	—	—	—
Class III ..	4	4(E)	—	—	—	—	—	—	—	—	—	—	—
Class IV (excluding Safaiwala) ..	—	—	—	—	—	—	—	—	—	—	—	—	—
Class IV (Safaiwala)	—	—	—	—	—	—	—	—	—	—	—	—	—

(A) Since the posts are filled up by ICAR Headquarters, they are not shown in the statement.
(B) One post of Machine Operator (Class III) is reserved for Scheduled Tribes. Action has been taken to fill up the post as per reservation orders.
(C) One post of L.D.C. was filled up by appointment of a Class IV employee.
(D) One post was filled up with an ex-serviceman.
(E) The posts have been filled up on the basis of seniority-cum-suitability.

9. Annexures

ANNEXURES I

New Equipments Purchased During 1977

1. Dynamic Modulus Tester
2. Fibrosampler—Model 192
3. Quartz Prism Monochromator
4. Gradient Mixer
5. Knife Maker—KLB make (for Ultra Microtome)
6. Hardy Microtome
7. Air Compressor—'Kartik', Model 301
8. Laboratory Oven (Thermolab)
9. Semi-Self Indicating Scale—Super Deluxe—Model 'Forward'
10. Photophone Overhead Projector with Accessories
11. Advanced Scientific Calculator
12. Autoclave (for a maximum pressure of 15 psi.)
13. Autoclave (for a maximum pressure of 25 psi.)
14. Micro Computer — DCM Microsystem 1121
15. X-ray Counting Unit with Accessories

ANNEXURE II

Distinguished Visitors to CTRL During 1977

1. Dr. Zoltan Barabas,
   Cereal Research Institute,
   St. Eger, Hungary.
2. Dr. Ivan Orbanyi,
   Ministry of Food and Agriculture,
   Budapest, Hungary.
3. Dr. Hodossi Sandor,
   Vegetable Research Institute,
   6000 Kecskemet, Hungary.
4. Mr. Carl V. Feaster,
   Research Agronomist,
   ARS, USDA (Pima Improvement, University of Arizona),
   Phoenix, Arizona, U.S.A.
5. Mr. O. Kelley,
   3317, Valley Hi,
   Colo Springs,
   Colo 80910, U.S.A.
6. Dr. M. H. Arnold,
   Plant Breeding Institute,
   Cambridge, United Kingdom.
7. Dr. S. Cretenet,
   Institut de Recherches du Cotton
   et des Textiles Exotiques,
   34, Rue de Renaudes, Paris.
8. Mr. Francisco Pacheco—Mendivil
   Instituto Nacional Investigaciones Agricoles,
   Mexico.

(1–8) UNDP Cotton Production Research Mission

9. Shri Rustom S. Tirandaz,
   Municipal Councillor,
   780, Karani Mansion,
   Jamet Jamshed Road,
   Dadar, Bombay 400 014.
10. Dr. G. S. Kalkat,
    Agricultural Commissioner,
    Government of India,
    New Delhi.
11. Mr. Joji Kimura,
    Technical Service Manager,
    International Institute for Cotton,
    Kyoto, Japan.

12. Smt. Lakshmi N. Menon,
Chairman,
Kasturba Gandhi National Memorial Trust,
Kasturbagram, Indore,
Madhya Pradesh.
13. Dr. K. R. M. Anthony,
Agricultural Advisor,
Ministry of Overseas Development,
Government of United Kingdom, London.
14. Dr. H. Petersen,
BASV Aktiengesellschaft,
Ludwigshafen, West Germany.