Cotton Technological Research Laboratory

Indian Council of Agricultural Research

Annual Report
1976

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Contents

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I. Introduction

This is the 53rd Annual Report of the Cotton Technological Research Laboratory (CTRL) and covers the calendar year 1976.

This Laboratory was founded in the year 1924, by the Indian Central Cotton Committee (ICCC) with a view to collaborate actively with the Departments of Agriculture in different parts of the country for an authoritative and scientific evaluation of the inherent quality of the new varieties of cotton evolved from time to time. Consequent upon the abolition of the Commodity Committees including ICCC, CTRL came under the administrative control of the Indian Council of Agricultural Research (ICAR), from the 1st April, 1966. Since then, the research activities have been reoriented and intensified. More sophisticated instruments, like electron microscope, spectrophotometer, gas chromatograph, x-ray diffraction unit, etc., have been added, so as to facilitate carrying out intensive basic studies on cotton fibre. The research efforts of the Scientists of CTRL will be continued, as in the past, to help the grower in producing more and better quality cottons, as also in enhancing the utilisation of cotton lint and cotton plant by-products, to improve the economy of the country, especially by saving valuable foreign exchange. 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;

(*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 utilisation of cotton, cotton waste, linters, cottonseed, etc.;

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

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

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

Library

CTRL maintains a good up-to-date library of books on cotton technology and allied subjects. During the year, 117 books were added and the total number of books by the end of 1976 was 3,196 in addition to 3,070 bound volumes of journals. About 195 journals dealing with textiles and related subjects were being received regularly in the library, of which 81 were subscribed and others received by way of exchange or as complimentary.

New Equipments Purchased

Important new equipments acquired during the year are given in Annexure I.

Distinguished Visitors

Dr. M. S. Swaminathan (Director General), Dr. Sukhdev Singh (Deputy Director General), Shri C. S. Sridharan (Assistant Director General), Dr. C. Kempanna (Assistant Director General) and Shri A. S. Bhatnagar (Legal Adviser), of ICAR, as well as Dr. K. V. Srinivasan, Project Coordinator (Cotton), visited CTRL on various occasions in connection with official work. A list of other distinguished visitors to the Laboratory during 1976 is given in Annexure II.

Awards

ICAR has recently instituted a biennial "Award for Team Research" to honour groups of research workers who working as a team have jointly made significant contribution to agricultural research. It is a matter of pride that the first ICAR Award for Team Research for the biennium 1975-76 has been given to nine Scientists of the All India Coordinated Cotton Improvement Project who through close interdisciplinary team work have made significant contribution to cotton improvement. The team includes, Dr. V. Sundaram, Director, and Shri P. G. Oka, Junior Physicist, at CTRL. The members of the team received the awards from the hands of Shri Jagjivan Ram, Minister for Agriculture and Irrigation, Government of India.

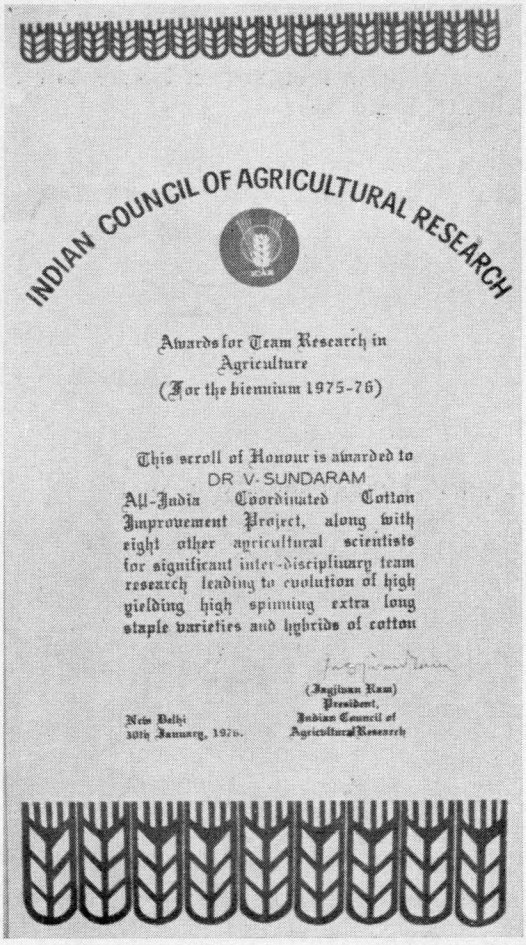
The above team also received the Indian Merchants Chamber Award for outstanding contribution in the field of Agriculture. The Awards were handed over by Shri L. K. Jha, Governor of Jammu and Kashmir (Plates I and II).

Management Committee

The Management Committee of CTRL constituted under Rule 66 of ICAR, mainly to insure and exercise to the fullest possible extent of the administrative and financial powers in addition to efficient implementation of the approved research programmes both in terms of physical targets and time

PLATE I

Dr. V. Sundaram, Director, receiving the Award from the hands of Shri Jagjivan Ram, Union Minister of Agriculture and Irrigation.



INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Awards for Team Research in Agriculture
(For the biennium 1975-76)

This scroll of Honour is awarded to
DR V. SUNDARAM
All-India Coordinated Cotton Improvement Project, along with eight other agricultural scientists for significant inter-disciplinary team research leading to evolution of high yielding high spinning extra long staple varieties and hybrids of cotton

(Jagjivan Ram)
President,
Indian Council of Agricultural Research

New Delhi
30th January, 1976.

Facsimile of the above Award for Team Research in Agriculture—1975-76

ICAR AWARD FOR TEAM RESEARCH

PLATE II

Dr. V. Sundaram, Director, receiving the Award from Shri L. K. Jha, Governor of Jammu and Kashmir.
Dr. K. V. Srinivasan, Project Co-ordinator, AICCIP, is also seen.

A photograph of the above Award.

schedule, met three times during the year. Some of the important actions taken are given below :

In the first meeting held on the 21st and the 22nd April, 1976, the Committee considered the Fifth Five Year Plan and Non-Plan Budgets of CTRL for 1976-77, purchase of machinery, action taken on recommendations of the Grievance Cell and Institute Joint Council of CTRL, etc. In a joint session along with CTRL Staff Research Council the progress of research during 1975 was reviewed and the programme of research work for 1976 finalised.

In the second meeting convened on the 6th September, 1976, the Committee recommended that the Ginning Section of CTRL should be strengthened by appointing a Junior Engineer in that Section. The Committee also considered the Revised Budget Estimates under the 'Fifth Plan' and 'Non-Plan' and noted the progress made in research work during the half year ended June 1976. In view of the difficulties experienced in getting comparative quotations for certain equipments and the delay involved in getting some equipments through the Director General of Supplies and Disposals (DGS&D), the Committee desired that such cases should be brought before the Committee for authorising suitable action and expediting work. Regarding the construction of new Laboratory Building, in view of the delay in action being taken by the Central Public Works Department (CPWD), the Committee desired that the matter might be referred to CECON of CSIR and to BARC to ascertain whether they would be prepared to take up the work.

During the third meeting held on the 21st December, 1976, the Committee noted the enhanced powers delegated to the Director, some of which have to be exercised in consultation with the Management Committee. The revised qualifications proposed for technical posts were recommended for adoption while filling up future vacancies in CTRL. Approval also was granted for the creation of one post of Junior Scientist (Ginning), in the grade of Rs. 700-1300 and a post of Superintendent (Accounts) in the grade of Rs. 550-900. With regard to the proposal for introducing a suitable Group Insurance Scheme for the Staff of CTRL, the Committee felt that the Group Insurance Scheme for accident only would be more desirable and hence the same was recommended for consideration of ICAR. The Committee reviewed the progress of research during the year and noted the action taken on the recommendations of the Joint Council and the Grievance Cell of CTRL. It recommended that CTRL might become a corporate member of the Indian Society for Cotton Improvement (ISCI), on payment of a single subscription of Rs. 5,000, according to the rules of the Society.

Staff Research Council

During the year, three meetings of the Staff Reserach Council were convened. The first meeting held on the 10th and the 23rd February, 1976, was mainly intended for drawing up the programme of research work for the

year 1976. In the meeting, a few projects on which work had already been completed, were deleted and extensions were granted to four projects taking into consideration the work already done and the difficulties experienced due to circumstances beyond the control of investigators. Seven new projects were also considered. The important suggestions made during the meeting were: (*i*) the fabrication of an additional unit of 'Interferometric Stapler' for independent evaluation of its performance and to carry out tests for correlating the values obtained using random tufts on the Interferometric Stapler with the span length values determined by Digital Fibrograph; and (*ii*) the emphasis needed to be given for indicating the approximate cost involved, while preparing new project proposals. The programme of work for the year was approved in the second meeting which was held jointly with that of the Management Committee on the 21st and the 22nd April, 1976.

The third meeting was held on the 21st December, 1976, chiefly to appraise the progress made in the research projects approved for the year. The concerned scientists gave brief account of the progress of research work done by them during the year.

Inter-Institutional Projects

Steady progress was made during the year in the following three Inter-Institutional Projects operating at the Laboraotry in collaboration with Jute Technological Research Laboratory (JTRL), the Central Sheep and Wool Research Institute (CSWRI) and the Victoria Jubilee Technical Institute (VJTI) :

(*i*) Studies on spinning from blends of cotton with wool, jute and ramie on cotton system.
(*ii*) Studies on de-burring of raw wool using mechanical device.
(*iii*) Performance of different flat tops in processing of immature cotton.

The work on another Inter-Institutional three-year Project on "Studies on the production and utilization of chitosan and allied products from prawn shell waste", to be carried out in collaboration with the Central Institute of Fisheries Technology (CIFT) and the Bombay Textile Research Association (BTRA), has been started on the 29th November, 1976.

Integrated Cotton Development Project

Under the sponsorship of the World Bank, an Integrated Cotton Development Project has been launched by ICAR and the Government of India in the States of Maharashtra, Punjab and Haryana, for improving cotton production in the country. Under this Project, CTRL is to set up a "Ginning Training and Advisory Centre" at Nagpur for providing training

to gin fitters and rendering assistance to ginning factories. The Project is for a five-year period from the 30th November, 1976 to the 29th November, 1981. A sum of Rs. 32.52 lakhs has been provided under the Project for CTRL Ginning Centre. It is proposed to construct buildings for housing the ginning machinery, training classes, etc., on a plot of land provided by the Punjabrao Krishi Vidyapeeth (PKV) on the Bombay-Amravati-Nagpur highway. As the sanction has been received only towards the end of the year, much progress could not be made. Further action to activate the Project will be taken up next year.

Regional Committee

ICAR has constituted eight Regional Committees to consider in depth the major gaps in agricultural research and education in different regions of the country which have been divided into regions based on soil and the agro-climatic conditions. Regional Committee No. 7 covers the States of Maharashtra, Western and Central Madhya Pradesh and the Union Territory of Goa, Daman and Diu. The Director, CTRL, has been nominated as the Member-Secretary of this Committee. The first meeting of the Regional Committee was held at Nagpur on the 6th April, 1976, under the Chairmanship of Dr. M. S. Swaminathan, Director General, ICAR. The meeting was inaugurated by Shri Sharadchandra G. Pawar, Minister for Agriculture, Maharashtra State.

Among the major subjects discussed at the meeting were the pilot project for training personnel for the cadre of self-employed soil health workers, consideration of the general recommendations of the Indian Science Congress held at Waltair, the Finance Minister's paper on Integrated Rural Development and consideration of a note on long-term plans for research in fisheries. The meeting was well attended by representatives from various State Governments, Agricultural Universities and other prominent persons in the region.

On the 7th April, the delegates were taken to the Operational Research Project of ICAR in progress at Wardha District of Maharashtra State and also for a meeting with Shri Vinobha Bave, at his Paunar Ashram.

Central Institute for Cotton Research

As mentioned in the last Annual Report, ICAR has established the Central Institute for Cotton Research (CICR) at Nagpur to carry out fundamental and basic path-breaking research to meet the long-term objectives of stepping up cotton production, quantitatively and qualitatively. The results which will flow from the programme of fundamental research at CICR will form the basis for applied research under the All India Coordinated Cotton Improvement Project (AICCIP). Initially, the Punjabrao Krishi

Vidyapeeth (PKV), Akola, had given 25 acres of land in their Nagpur Campus while the Government of Maharashtra had handed over the 100-acre Panjari-Parsodi Taluka Seed Farm for setting up the Institute. CICR was formally inaugurated by Shri Sharadchandra G. Pawar, Minister for Agriculture, Maharashtra State, on the 6th April, 1976. The former Regional Station at Coimbatore of the Indian Agricultural Research Institute (IARI) had been integrated with CICR with effect from the 1st April, 1976, and is now functioning as CICR Regional Station. A few trials under AICCIP were laid out in the Panjari-Prasodi Farm this year. Further, PKV has given additional land at its Telenkhedi Lake Complex. A plot of 10 hectares adjoining the Bombay-Amravati-Nagpur National Highway has been handed over for construction of the main laboratory building of CICR as well as of the National Bureau of Soil Survey and Land Use Planning and the Ginning Training Centre of CTRL proposd under the World Bank Project for Integrated Cotton Development. In addition, another plot of 20 hectares in the Lake Valley, with assured water for irrigation, has been handed over by PKV for use as a research farm by CICR.

Dr. V. Sundaram, Director, CTRL, continued to function as Dirctor, CICR, during the year, pending appointment of a new Director for CICR.

Deputation Abroad

Dr. V. Sundaram, Director, was deputed to London to participate in the meeting of the United Nation's Development Project (UNDP) Working Group on Cotton Production Research and Coordination held on the 26th and the 27th July, 1967. The Group discussed proposals for setting up International Centres for Research on Improvement of Cotton Production.

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 for 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), and Kum. I. G. Bhatt (Junior Scientist, Chemical Studies) continued as research guides for various degrees recognised by the University of Bombay.

Further, Dr. K. R. Krishna Iyer (Scientist) has been recognised by the University of Bombay as Teacher for Guiding students for M.Sc. degree in Physics (Textiles).

During the year, 10 members of the staff were being guided for M.Sc. and two 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 during the year.

Agricultural Research Service Examination

The first examination for selection of candidates for direct appointment in the S-1 grade of Agricultural Research Service (ARS) was condcted by the Agricultural Scientists Recruitment Board (ASRB) from the 24th March to the 27th March, 1976. Bombay was one of the venues for the examination and the Director and Staff of CTRL were entursted with the task of making arrangements for holding the examination in Bombay.

Membership on Other Organisations

The Director and Scientific Officers of CTRL continued to represent ICAR and CTRL on various committees and institutions, such as the various Sub-Committees of the Indian Standards Institution (ISI), etc., as in the past.

Further, the Director continued as a member of the following bodies during the year :

(*i*) Executive Council of Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri.

(*ii*) Cotton Research Advisory Sub-Committee of the Indian Cotton Mills' Federation (ICMF) Cotton Development and Research Association.

(*iii*) Governing Council of Bombay Textile Research Association.

(*iv*) Board of Management of Victoria Jubilee Technical Institute.

(*v*) Indian Cotton Development Council (ICDC) as well as Sub-Committee of ICDC on Research and Development, Directorate of Cotton Development, Bombay.

(*vi*) Member, General Advisory Committee for Research and Liaison as well as Sub-Committee for Research and Liaison (Physics, Physical Testing and Electronics) of BTRA.

(*vii*) Expert Committee for classification of Indian cottons, constituted by the Cotton Advisory Board of the Textile Commissioner.

(*viii*) Expert Committee to consider feasibility of correlating *kapas*/cotton prices with those of yarn and cotton, constituted by the Directorate of Cotton Development, Bombay.

In addition, the Director was also nominated as a member of the following bodies/committees during the year.

(*i*) The Scientific Panel on Post Harvest Technology, ICAR.
(*ii*) Committee constituted by the Ministry of Commerce to go into the nexus between the price of *kapas* and the mill-gate price of cotton and the present relationship between the price of *kapas* paid to the growers, the mill-gate price of lint and the prices fixed for yarn and cloth.

The Expert Committee for classification of cotton submitted its final report during the year. The report was based mainly on the work carried out at CTRL and the help rendered by the Director and staff of CTRL has been acknowledged therein. The report is under consideration of the Textile Commissioner, Government of India.

The Expert Committee, constituted by the Directorate of Cotton Development, to consider the feasibility of correlating *kapas*/cotton prices with those of yarn and cloth also completed its work and reported that it would be possible to correlate the price of *kapas* with that of yarn/cloth.

The Committee constituted by the Ministry of Commerce to study the nexus between the price of *kapas* and the prices of cotton lint, yarn and fabric, met on several occasions and held detailed discussions. In additon to the Director, Shri M. S. Parthasarathy (Senior Scientist, Mechanical Processing) was invited to attend the Meeting as a technical expert to help in working out the cost of conversion of fibre into yarn, etc. The work of the Committee is in progress.

Expansion and Modernisation under Fifth Plan

As part of the Expansion and Modernisation Programme of the Laboratory during the Fifth Plan period, a sum of Rs. 48 lakhs has been provided for construction of a new multistoreyed building and for certain essential fittings. No progress could be made in the previous years due to the ban on construction of buildings by the Government of India. With the lifting of the ban, CPWD was approached in the beginning of the year to take up this work on a priority basis. The Chief Engineer, Senior Architect and other officers of CPWD visited the Laboratory on the 30th January, 1976, to inspect the site and have discussions with the officers of CTRL. However, no progress has been made subsequently in spite of repeated reminders tc CPWD and even the preliminary drawings have not been prepared by them. This delay on the part of CPWD is hampering the progress of research at the Laboratory.

Staff Amenities

The existing CTRL Staff Quarters of Type I, Type II A and Type II B can provide residential accommodation for only 16 employees in Grade D

and 32 in other categories (Grades C and B). The work of constructing a new building consisting of eight Type IV quarters for providing residential accommodation to senior members of the staff is being pursued. The final lay-out plan and estimate of the proposed building are awaited from CPWD.

Finance

A statement showing the sanctioned budget grant of CTRL and the actual expenditure during the financial year 1975-76 is furnished in Appendix I. It will be seen that actual expenditure is Rs. 24.18 lakhs as against the sanctioned grant of Rs. 22.90 lakhs. The increase is mainly due to higher expenditure on account of enhanced dearness allowance amounting to Rs. 57,000, and other allowances, etc. An expenditure of Rs. 6.67 lakhs was incurred under the Fifth Plan scheme for modernisation and strengthening of CTRL for intensive research on cotton against the sanctioned grant ofRs. 8.00 lakhs, leaving an amount of Rs. 1.33 lakhs unutilised. The savings are due to non-materialisation of purchase of certain equipments. Further, a sum of Rs. 0.68 lakh was incurred on the scheme "Response of Indian cottons to crosslinking treatment with a view to evolve cotton varieties most suitable for chemical finishing treatment" against the sanctioned grant of Rs. 0.47 lakh. The excess expenditure is due to early materialisation of purchase of equipment, during the year. A sum of Rs. 0.23 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. 0.45 lakh. A sum of Rs. 0.13 lakh was incurred on the scheme "Studies on the de-burring of raw wool using mechanical devices" carried out in collaboration with CSWRI, Avikanagar, against the sanctioned grant of Rs. 0.25 lakh. A sum of Rs. 0.90 lakh was incurred on the scheme "Investigation of the effects 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" at CTRL against a sanctioned grant of Rs. 1.10 lakhs. A sum of Rs. 0.12 lakh was incurred on the "Scheme for optimal blending of standard varieties of Indian cotton" against a sanctioned grant of Rs. 1.5 lakh. The savings in the above four schemes were due to non-filling up o certain posts and also due to non-materialisation of purchases of equipments during the year.

Significant Findings

The All India Coordinated Cotton Improvement Project (AICCIP) in its panel meetings held at Hissar, Pune and Bangalore, recommended the following varieties for release for general cultivation.

Variety	Place	Yield kg/ha	Ginning percentage	Mean length (mm)	Spinning potential
LD.133	Ludhiana	1,300	38.0	16.5	Coarse counts
F.414	Faridkot	1,400	33.2	22.1	30s
JK.97	Dharwar	1,400	36.8	23.6	34s
CP.15-2 (Suman)	Coimbatore	1,600	40.0	24.6	40s

In addition to the above, a medium staple hybrid JKHy.1 released by the Jawaharlal Nehru Krishi Viswa Vidyalaya, Indore, for cultivation in Madhya Pradesh was reported to have recorded an average yield of 1,700 kg/ha as against 1,350 kg/ha of Hybrid 4 in comparative trials and was suitable for spinning 40s count of yarn.

Other strains identified as promising are:

Strain	*Station*
H.665C	Hissar
CPH.2	Coimbatore
RHR.253	Rahuri

A simple and quick method to assess crease recovery angle (CRA) of resin finished fabric from yarn pad has been standardised.

Cotton has been blended with jute caddies and jute staple and processed using cotton spinning machinery. A plain coarse fabric woven from the yarn of the blends revealed the feasibility of producing such fabrics for specific end-uses utilising waste jute products as caddies. An x-ray method has been standardised for determination of blend composition of cotton jute/blended yarns.

The Laboratory Kapas Extractor, designed and fabricated at CTRL for processing *kapas* samples having various amounts of trash content, was put to commercial exploitation.

The cotton plant stalk, which is an agricultural waste material, available in abundance, was converted into chippings and particles of different mesh size and boards of different types were prepared using appropriate formulations of resin and other conditions of treatment.

Infrared methods have been standardised for the determination of blend composition in polyester/cotton and wool/cotton blended materials.

The infrared absorption band at 342 cm^{-1} in the spectrum of cellulose has been found suitable for the estimation of crystallinity of cotton, and this band has the following definite advantages over the bands at 893 cm^{-1} and 1372 cm^{-1} proposed by earlier workers, viz.: (*i*) near horizantal base line which

leads to the derivation of unambiguous absorbance values and (*ii*) high sensitiveness at the levels of crystallinity generally encountered in cotton fibres.

Accelerating potential of 75 KV combined with very low beam current and exposure time of five seconds seemed to be ideal for recording electron diffraction pattern of cooled specimen of cellulose microfibril. This new technique to record electron diffraction pattern of cellulose to determine the crystallinity and crystallite size is now being used on normal cellulose and treated substrates like cotton, bagasse, wheat straw pulp and saw dust.

A new procedure has been developed to estimate the rate of fall in yarn strength from the lea test results obtained from the same sample of cotton spun to different counts. Since the procedure was found to be more scientific, this was accepted by ISI and recommended for adoption by ISO.

A new equation, viz. CSP = 8 (counts + 200) has been proposed based on the data on lea strength of different varieties of cotton spun using conventional and SKF drafting systems. Accordingly, the existing CTRL norms for lea strength also was raised by about 14 per cent.

Personal visits undertaken in connection with the survey of ginning factories in the states of Punjab, Haryana and Rajasthan, revealed that many of the ginning factories did not work to their full capacity due to the reduction in the production of cotton in those areas, and that the working conditions in most of the factories need improvement.

II. Progress of Research

During the year under report, considerable progress has been made in various research and allied activities at CTRL. In addition to 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, much headway has been made in the research on physical, chemical, structural and technological aspects of cotton, a brief resumé of which 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 1974, 1975 and 1976, 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 1976.

The samples received from agricultural trials are tested in the order of their receipt and test results 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. Test reports are not generally issued on the technological research samples being used exclusively in connection with various research projecs 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 number of samples which were tested for fibre characteristics and spinning performance have been given in Table II, grouped under two categories, viz. (*i*) AICCIP and (*ii*) other State Schemes.

TABLE 1 (*a*) : NUMBER OF COTTON SAMPLES RECEIVED FROM THE STATE DEPARTMENTS OF AGRICULTURE AND TESTED AT CTRL

Type of test	Average for the quinquennium 1971-75	1974*	1975*	1976*
Fibre and full spinning	403	309	233	193
Fibre and microspinning Microspinning alone	2,562	1,842	2,357	2,341
Fibre tests alone	86	58	39	28
Mill tests	12	14	—	6
Standard Cottons	21	24	24	23
Trade Varieties—lint	24	9	41	27
Trade Varieties—*kapas*	49	47	38	45
Technological Research	81	107	48	19
Miscellaneous	—	—	1	—
Total	3,238	2,410	2,781	2,682

*A large number of samples could not be accepted for test due to renovation work in the Mechanical Processing Division.

TABLE 1 (*b*) : NUMBER OF SAMPLES TESTED AT THE REGIONAL STATIONS

Station	Total number of samples tested			
	Fibre length	Fibre fineness	Fibre strength	Fibre maturity
Coimbatore	1,148	1,219	1,259	1,219
Dharwar	2,170	1,330	1,330	1,348
Hissar	340	1,204	340	1,204
Indore	503	503	503	536
Ludhiana	415	389	396	389
Nanded	885	885	876	885
Nandyal	440	440	500	475
Sriganganagar	492	492	492	492
Surat	10,689*	3,232	2,678†	3,287

*5,838 samples were evaluated on the basis of one pair of combs on Digital Fibrograph and the remaining samples on Balls Sorter/Baer Sorter.

†450 samples were tested with two breaks of tuft.

TABLE 2 : NUMBER OF SAMPLES TESTED IN 1976

State	Fibre and full spinning	Fibre and micro-spinning	Fibre tests	Total
	(*i*) *AICCIP*			
Punjab	15	105	16	136
Haryana	29	163	—	192
Rajasthan	4	36	—	40
IARI, New Delhi	—	16	—	16
Madhya Pradesh	13	109	—	122
Gujarat	100	39	—	139
Maharashtra	13	469	—	482
Andhra Pradesh	6	86	—	92
Karnataka	2	426	—	428
Tamil Nadu	3	43	—	46
Others	—	1	—	1
Total	185	1,493	16	1,694
	(*ii*) *Other State Schemes*			
Punjab	3	—	2	5
Haryana	3	46	—	49
Rajasthan	3	—	2	5
Madhya Pradesh	11	—	—	11
Gujarat	60	6	1	67
Maharashtra	17	83	35	135
Andhra Pradesh	11	111	—	122
Karnataka	22	—	—	22
Tamil Nadu	7	5	—	12
Total	137	251	40	428

ALL INDIA COORDINATED COTTON IMPROVEMENT PROJECT

This is the ninth year of the Project. Reports on various samples grown under advanced trials, such as Coordinated Varietal Trial, Preliminary Varietal Trial, Pilot Project Trial, Hybrid Trial, etc., were presented at the panel meetings held at Hissar for the North Zone, at Pune for the Central Zone, and at Bangalore for the South Zone.

The Project covered seven locations in the North Zone comprising the States of Punjab, Haryana and Rajasthan, and IARI, New Delhi, ten locations in Central Zone comprising the States of Madhya Pradesh, Gujarat and Maharashtra, and seven locations in South Zone comprising the States of Andhra Pradesh, Karnataka and Tamil Nadu.

NORTH ZONE

G. hirsutum Trials

The Coordinated Varietal Trial was conducted for : (*i*) Normal Plant Type at Faridkot, Hissar, Ludhiana, Sirsa and Sriganganagar; (*ii*) Short Branch Type at Hissar, Ludhiana and Sirsa; and (*iii*) Short Duration Type at Faridkot, Hissar, Ludhiana, New Delhi and Sriganganagar.

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

It may be seen from Table 3 that the mean fibre length for the Normal Plant Type samples ranged between 19.8 mm and 27.7 mm. The range of mean fibre length was between 19.0 mm and 26.4 mm for Short Branch Type samples and between 20.3 mm and 27.4 mm for Short Duration Types. The ranges of fineness (Micronaire value) for Normal Plant Type, Short Branch Type and Short Duration Type samples were from 2.4 to 4.3, 2.7 to 4.7, and 2.5 to 4.9, respectively.

It will also be seen from Table 3 that the maturity ranged from low to average for the samples pertaining to most of the trials. The range of bundle strength for the samples pertaining to Normal Plant Type was between 38.1 g/t and 48.8 g/t, for Short Branch Type between 42.9 g/t and 49.8 g/t, and for Short Duration Type between 35.9 g/t and 50.9 g/t.

The following strains grown at the locations indicated against them gave encouraging spinning performance at 40s count :

Location	*Strains*
Hissar	H.655(c).
Sirsa	LH.100, H.655(c), H.650, SH.269, 40-75D, 320F, J.207, J.260, RS.283, FSB.3, 1412, LH.299, F.414, H.642C, H.706, D.33 and Okra Leaf Mutant.
Sriganganagar	RS.89-57.

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

Location	Normal Plant Type					Short Branch Type					Short Duration Type				
	No. of samples	Mean length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)	No. of samples	Mean length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)	No. of samples	Mean length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)
Faridkot ..	8	21.6-23.9 (22.8)	3.3-4.1 (3.5)	Low to average	45.0-48.8 (47.2)	—	—	—	—	—	8	21.3-24.6 (22.8)	3.3-4.0 (3.8)	Low to average	42.9-50.9 (46.0)
Hissar	16	19.8-25.1 (22.4)	2.4-3.4 (2.6)	Low	43.4-48.8 (45.6)	7	21.1-26.4 (23.3)	3.7-4.7 (4.0)	Low to average	42.9-46.6 (44.4)	17	21.1-26.2 (23.1)	2.5-3.9 (3.1)	Low to average	35.9-47.7 (45.2)
Hissar	9	21.1-27.7 (24.8)	2.9-3.6 (3.2)	Low	41.3-48.8 (45.1)	—	—	—	—	—	—	—	—	—	—
Ludhiana ..	15	21.6-27.7 (24.7)	3.6-4.2 (3.8)	Low to average	40.7-46.6 (44.6)	6	19.0-24.6 (22.6)	3.5-4.3 (3.9)	Low to average	42.9-47.2 (45.9)	16	20.6-27.2 (23.4)	3.3-4.6 (3.8)	Low to average	39.7-48.8 (44.7)
New Delhi ..	—	—	—	—	—	—	—	—	—	—	16	21.1-27.4 (23.5)	3.3-4.9 (4.0)	Low to average	42.3-47.7 (45.0)
Sirsa	15	21.1-27.4 (23.7)	3.1-4.3 (3.6)	Low to average	45.0-48.2 (46.9)	21	20.3-26.2 (22.9)	2.7-3.9 (3.2)	Low	43.6-49.8 (46.5)	—	—	—	—	—
Sriganganagar	18	20.1-25.7 (23.4)	3.0-4.0 (3.4)	Low to average	38.1-48.8 (45.4)		—	—	—	—	18	20.3-26.2 (23.0)	2.9-4.3 (3.5)	Low to average	39.7-49.3 (45.1)

Note : 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 pertaining to the Preliminary Varietal Trial were received from Faridkot, Hissar and Ludhiana for microspinning test. Mean fibre length of 12 strains raised at Faridkot ranged between 21.8 mm and 24.9 mm. Maturity was average and bundle strength values were good. The range of mean fibre length for 34 samples received from Hissar was between 19.8 mm and 24.6 mm. They had average maturity and good bundle strength. In the case of 36 samples from Ludhiana, mean fibre length ranged between 21.6 mm and 27.4 mm. They recorded low to average maturity and average to good bundle strength. The strains RS.453, RS.458, RS.457, J.286 and Bikaneri Narma raised at Ludhiana recorded satisfactory spinning performance at 40s count.

A set of 16 samples raised under Initial Evaluation Trial at Hissar was received for microspinning test. The mean fibre length of these samples ranged between 20.8 mm and 25.7 mm. The maturity was low and bundle strength values were average to good. The strains F.475, O.462 and O.113 fared well at 30s count.

G. arboreum Trials

In the Coordinated Varietal Trial of *G. arboreum*, two sets each containing ten *G. arboreum* and six *G. hirsutum* strains were received from Hissar and Jullundur. Samples belonging to *G. hirsutum* were grown under sprayed and unsprayed conditions at both the places. The ranges of mean fibre length were from 16.5 mm to 18.5 mm and 16.5 mm to 18.8 mm for *G. arboreum* cottons received from Hissar and Jullundur, respectively. Bundle strength values were average to good. As regards *G. hirsutum* cottons also, there was no appreciable difference between the fibre properties of the samples grown under sprayed and unsprayed conditions.

Miscellaneous Trials

Under the Miscellaneous Trials conducted at Jullundur, 19 *G. hirsutum* strains were received for fibre and microspinning tests. Their mean fibre length ranged from 24.6 mm to 26.4 mm. Maturity was low to average and bundle strength values were good. All the samples under this trial showed good spinning performance at 40s count.

The technological performance of the high yielding variety RS.235-3 from Sriganganagar was compared with that of three controls, viz. RS.89, 320F and Bikaneri Narma. Although the strain showed comparatively better staple length than the rest, uniformity ratio and bundle strength values were low. The strain did not respond well at 30s count.

Three hybrids, namely CPH.2, CPH.4 and Hybrid 4, along with two controls, 320F and Bikaneri Narma, were received from Sirsa for microspinning tests. Of these, Hybrid 4 recorded the highest mean fibre length of 26.9 mm. Maturity was not satisfactory for all the three hybrids. Bundle strength values

TABLE 4 : SUMMARY OF FIBRE TEST RESULTS ON STRAINS TESTED IN COORDINATED VARIETAL TRIAL OF *G. hirsutum* BR 04 : CENTRAL ZONE

Location	Irrigated					Rainfed					High Ginning Type				
	No. of samples	Mean length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)	No. of samples	Mean length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)	No. of samples	Mean length (mm)	Fineness (Micronaire value)	Maturity	Bundle strength (g/t)
Akola	—	—	—	—	—	7	23.9 29.5 (26.7)	3.3- 4.3 (3.9)	Low to average	39.7- 45.0 (41.9)	7	22.4- 26.9 (25.3)	3.1- 3.8 (3.6)	Average	38.6- 46.6 (41.8)
Badnawar	—	—	—	—	—	16	21.1- 25.9 (23.5)	2.8- 3.8 (3.3)	Low to average	40.2- 46.1 (43.6)	8	22-1 25.4 (23.8)	3.1- 3.7 (3.3)	Low	39.7- 47.7 (42.0)
Khandwa	—	—	—	—	—	16	22.4- 27.7 (24.6)	3.3- 4.6 (4.1)	Average to good	37.5- 46.6 (43.8)	8	22.9- 27.4 (25.0)	3.4- 4.5 (4.0)	Low to average	39.7- 46.1 (42.1)
Parbhani	—	—	—	—	—	14	23.4 29.5 (26.4)	3.4- 4.4 (3.8)	Average	40.2- 44.5 (42.3)	—	—	—	—	—
Rahuri	6	21.1- 24.6 (23.1)	2.6- 3.3 (3.0)	Low	41.3- 46.1 (44.1)	—	—	—	—	—	7	20.8 - 25.7 (22.9)	2.7- 3.5 (3.0)	Low	38.6- 44.5 (41.8)
Surat	10	24.1- 27.9 (25.9)	3.5- 4.9 (4.1)	Average to good	38.6 47.2 (42.9)	—	—	—	—	—	—	—	—	—	—

Note : 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.

for the hybrids as well as for the controls were satisfactory. Hybrid 4 recorded promising yarn strength at 40s count, followed by hybrid CPH.2.

Under the Miscellaneous Trial of *desi* cottons conducted at Hissar, 14 strains were raised. Mean fibre length of these strains ranged between 16.3 mm and 20.6 mm, while bundle strength values were average.

CENTRAL ZONE

G. hirsutum Trials

In the Coordinated Varietal Trial, samples were received from Rahuri and Surat under irrigated conditions and from Akola, Badnawar, Khandwa and Parbhani under rainfed conditions. Samples specially identified for high ginning outturn were also received from Akola, Badnawar, Khandwa and Rahuri.

Table 4 gives a summary of the fibre test results of the samples pertaining to the Coordinated Varietal Trials in the Central Zone. It is seen from the Table that the mean fibre length for the strains raised under irrigated conditions ranged from 21.1 mm to 27.9 mm. Range of Micronaire value was from 2.6 to 4.9. Maturity was low in the case of samples from Rahuri; however, the same was satisfactory for samples from Surat. Bundle strength values ranged from 38.6 g/t to 47.2 g/t. As regards samples raised under rainfed conditions, mean fibre length ranged between 21.1 mm and 29.5 mm; Micronaire values ranged from 2.8 to 4.6; maturity was low to average and bundle strength values ranged from 37.5 g/t to 46.6 g/t. The ranges of mean fibre length, Micronaire values and bundle strength for the samples raised under High Ginning Type Trial were from 20.8 mm to 27.4 mm, 2.7 to 4.5 and 38.6 g/t to 47.7 g/t, respectively. Maturity was low for the samples raised at Badnawar and Rahuri. Samples from Akola and Khandwa recorded low to average maturity.

The following strains recorded promising spinning performance :

Location	*Count*	*Strains*
Surat	50s	J.1616, CP.25-1, MCU.5, and G.Cot.100.
	40s	IAN.4705, IAN.4757, IAN.6074 and 70IH.452.
Akola	40s	KOP.3, KOP.4, ACH.2, 70IH.452, MCU.5, DHY.286, ACH.105, AC.738, 70IH.3/512, and IAN.579-188.
Khandwa	40s	ACH.6, 71KH.33-1146, SRT.1, 70IH.452, Badnawar 1, 70IH.457, MCU.5, KOP.4, KOP.6, 73IH.3, Vishnu, and Khandwa 2.
Parbhani	40s	CP.15-2, 66BH.25-33, IAN.4757, B.68-2647, IAN.4912, AC.719, 66BH.591, AC.726, DHY.286, J.1616, KOP.3, CP.5-15, L.147, and MCU.5.

The samples from Badnawar and Rahuri could not be spun as the material contained fairly large amount of cut seeds, seed coat bits and other trash. This caused considerable difficulties while processing the material through the calender rollers of the carding machine.

In the irrigated tracts of Maharashtra, since sowing was done much early, the Coordinated Varietal Trial was carried out at Nanded, Padegaon and Rahuri under irrigated conditions with entries approved for North Zone. The test results are summarised in Table 5.

TABLE 5 : SUMMARY OF TEST RESULTS ON SAMPLES GROWN UNDER IRRIGATED CONDITIONS IN MAHARASHTRA

	Nanded	Padegaon	Rahuri
Normal Plant Type, Br. 04(a)			
Number of samples	—	8	10
Mean fibre length (mm)	—	24.6-28.4	21.1-27.2
Fineness (Micronaire value)	—	3.3- 3.9	2.8- 3.4
Maturity	—	Low	Low
Bundle strength (g/t)	—	36.4-41.3	37.0-45.6
Promising strains (40s count)	—	J.207, J.239 and J.260	nil
Short Branch Type, Br. 04(b)			
Number of samples	5	5	13
Mean fibre length (mm)	21.3-25.7	23.9-28.2	21.1-24.6
Fineness (Micronaire value)	3.4- 3.9	3.7- 4.0	2.6- 3.6
Maturity	Low	Low to average	Low
Bundle strength (g/t)	33.8-44.5	34.3-39.7	35.4-45.6
Promising strains (40s count)	nil	FSB.8	nil
Short Duration Type, Br. 04(c)			
Number of samples	7	6	14
Mean fibre length (mm)	22.4-27.9	23.4-29.5	21.1-25.9
Fineness (Micronaire value)	3.4- 4.4	3.3- 4.0	3.2- 4.0
Maturity	Low	Low	Low to average
Bundle strength (g/t)	38.1-42.3	39.1-42.3	38.6-48.2
Promising strains (40s count)	H.642C	RS.331, HSB.2 and PS.10R	nil

Samples pertaining to Preliminary Varietal Trial were received from Akola, Badnawar, Khandwa, Prabhani and Rahuri.

Samples from trials of : (*i*) Normal Plant Types and (*ii*) High Ginning Type were received from Akola. Mean fibre length of these samples ranged

between 22.9 mm and 31.0 mm. Micronaire values ranged between 3.2 and 4.6. Maturity and bundle strength values were satisfactory for all the strains. The samples which fared well at the counts indicated are given below :

Trial	*Counts*	*Promising Strains*
Normal Plant Type	50s	MCU.5, 70IH.457, ND.54, IAN.4912, and ACH.99.
High Ginning Type	40s	Indo American Amreli, SRT.1, DHY.286, Khandwa 2, and L.147.

The mean fibre length for 14 samples from Badnawar ranged from 19.8 mm to 24.6 mm. Micronaire values ranged between 2.4 and 3.4. Maturity was not satisfactory for most of the strains. The bundle strength values were average to good. These samples also could not be spun due to the reasons mentioned earlier.

The test results of 14 samples received from Khandwa indicated that their mean fibre length ranged from 20.3 mm to 26.7 mm. Maturity and bundle strength values were average to good. Of these, eight strains fared well at 40s count. The best spinning performance was shown by the strain Badnawar 1 followed by B.72-2888, MCU.5, KOP.8, Kh.2-12, IC.1036, B.72-2898, and 74IH.9.

Mean fibre length of 18 samples received from Parbhani ranged from 24.6 mm to 32.0 mm. Maturity was low to average and bundle strength values were average to good. All the samples recorded good yarn strength at 40s count. The best spinning performance was shown by the strain BS.49 (CSP—2566) followed by MCU.5 (CSP—2535) and ND.136 (CSP—2520).

Range of mean fibre length for the seven samples received from Rahuri was 22.4 mm to 25.7 mm. Maturity was low whereas bundle strength values were average to good. The samples could not be spun due to presence of cut seeds and other heavy trash.

Preliminary Varietal Trials with entries approved for North Zone were conducted at Padegaon and Rahuri. Under this trial, five samples were received from Padegaon for microspinning test. Mean fibre length for these samples ranged from 24.6 mm to 26.4 mm. Maturity was low to average and the bundle strength values were average to good. The best spinning performance was recorded by the strain H.473 followed by D.20 and LH.299.

Mean fibre length of 20 samples received from Rahuri ranged between 22.9 mm and 26.9 mm. Maturity was low to average and bundle strength values were average to good. None of the samples except Hybrid 4 fared well at 40s count.

Samples pertaining to Initial Evaluation Trial were received from Akola and Parbhani. Out of the seven samples from Akola only four showed good spinning performance at 40s count. As regards samples from Parbhani, all the 26 strains tried under Initial Evaluation Trial fared well at 40s count.

G. barbadense Trials

In the Coordinated Varietal Trial of *G. barbadense*, six samples were received from Padegoan for microspinning test. The test results indicated that their mean fibre length ranged between 27.2 mm and 33.8 mm with good to excellent uniformity in length. Maturity and bundle strength values were average to good. The best spinning performance at 80s count was shown by the strain Thanekar followed by Suvin and IBSI.57. The yarns spun from the three strains were fairly good in appearance.

G. arboreum Trials

The Coordinated Varietal Trials of *G. arboreum* were conducted at Akola and Parbhani. The mean fibre length for the *arboreums* ranged between 20.8 mm and 23.1 mm. Maturity and bundle strength values were satisfactory. Four strains, viz. AKH.4, AKH.177, JL.407 and JL.61, grown at Parbhani, fared well at 30s count. Technological performance of the *hirsutum* strain taken as control was superior to that of *arboreums*.

G. herbaceum Trials

The Coordinated Varietal Trials of *G. herbaceum* were conducted at Surat and Viramgam. The following samples fared well at 30s count.

Surat : 3031, 5495 and Digvijay.
Viramgam : 1522, 1464 and 1435.

Miscellaneous Trials

A large number of trials with different objectives were conducted at various locations in Madhya Pradesh, Gujarat and Maharashtra. A brief summary of the results is reported below.

MADHYA PRADESH

The test results of the three hybrids from Badnawar indicated that their mean fibre length ranged from 23.4 mm to 26.2 mm. The hybrid CPH.4 recorded low maturity while the hybrids JKHy.1 and Hybrid 4 recorded satisfactory maturity. Bundle strength values were average to good. The best spinning performance at 40s count was shown by the hybrid JKHy.1 followed by Hybrid 4.

Three samples, viz. JKHy.1, Hybrid 4 and CPH.4 under project DTCH 1(a), one sample JKHy.11 under project DTCH 1(b), and three other samples, viz. 68KH.33/1146, Khandwa 2 and F_2 population of JKHy.1, were received from Khandwa for full spinning tests. The hybrid JKHy.11 recorded highest mean fibre length of 29.2 mm, while Hybrid CPH.4 recorded

mean fibre length of 23.1 mm. Fibre maturity, in general, was not satisfactory. Bundle strength values were average to good. All the samples recorded encouraging CSP at 40s count. (The sample of JKHy.11 could not be processed in spinning due to excessive lapping at card and draw frame.) The sample drawn from F_2 population of JKHy.1 was found to be rather inferior to JKHy.1.

GUJARAT

An experiment was conducted at Surat to study the yield and economical characters of budded cotton plant.

Eight samples of YS (G.67 × Moco)F_1 generation grown under different climatic conditions and employing different cultural practices were received for the technological assessment. All the samples recorded mean fibre length of 29 mm and above. The uniformity in staple as well as the Micronaire values and maturity were poor. All the samples recorded good bundle strength ranging between 45.6 g/t and 48.2 g/t. A few of these samples had satisfactory yarn strength when spun to 80s count; however, the yarn appearance was much below the desired level.

MAHARASHTRA

Pilot Project Demonstration Trial of *G. arboreum* strains as well as *G. hirsutum* strains was carried out at Akola. The newly released *G. arboreum* strain AKH.4 recorded superior performance than the local control AK.235. In *G. hirsutum* Trial the strains DHY.286 and SRT.1 were found to be superior to B.1007.

In the Miscellaneous Trial conducted at Nanded, the performance of DHY.286 was found to be better than that of ACH.6.

In order to compare the technological performance of promising varieties, such as J.205 and Bikaneri Narma, with that of Laxmi, Nimbkar 1 and MCU.5, raised at Padegaon, fibre and microspinning tests were carried out. Of these, MCU.5 recorded mean fibre length as high as 32.8 mm. Bundle strength values were low for Laxmi and Nimbkar 1. The strains MCU.5, J.205 and Laxmi fared well at 40s count.

SOUTH ZONE

G. hirsutum Trials

Coordinated Varietal Trials were conducted under irrigated conditions at Amaravati, Arabhavi and Nandyal and under rainfed conditions at Nandyal and Shimoga.

Mean fibre length of 16 samples received from Amaravati ranged between 26.9 mm and 31.5 mm. Maturity was satisfactory except for a couple of strains. Bundle strength values were average to good ranging from 39.1 g/t to 45.0 g/t. As many as 12 samples fared well at 50s count. The best spin-

ning performance was shown by the strain CP. 25-1(CSP—2382) followed by Imp.A.179 (CSP—2272), 46-1(CSP—2266), MCU.5 (CSP—2243), EL.031 (CSP—2223) and ELS.191 (CSP—2202).

The range of mean fibre length of 22 samples received from Arabhavi was from 23.1 mm to 28.4 mm. Maturity was low to average and bundle strength values ranged between 39.7 g/t and 47.2 g/t . Almost all the strains recorded good yarn strength at 40s count, the best sample being CPD.105-3 (CSP—2218).

The test results of 12 samples from Nandyal indicated that their mean fibre length ranged from 23.9 mm to 29.7 mm. Maturity was satisfactory for all the strains except for Mahalaxmi and MCU.5. Bundle strength values were average to good ranging from 38.6 g/t to 43.9 g/t. The samples were spun to 50s count; the following six samples recorded satisfactory yarn strength: ELS.250 (CSP—2096), ELS.191 (CSP—2089), CP.25-1 (CSP—2085), IS.MCU.5-2 (CSP—2081), CP.15-2 (CSP—2045), and Mahalaxmi (CSP—2041).

Eleven samples raised under rainfed conditions were received from Nandyal. Their mean fibre length ranged between 22.9 mm and 26.7 mm. Fibre maturity was not satisfactory for many samples. However, the bundle strength values were average to good. The best spinning performance at 40s count was shown by the strain JK.97(CSP—2229), followed by JK.79(CSP—2211), JK.91(CSP—2152), CP.15-2(CSP—2133), CP.1998F(CSP—2129), CP.23-8(CSP—2095) and CO.050(CSP—2020).

The test results of 20 strains grown under rainfed conditions at Shimoga indicated that their mean fibre length ranged from 23.6 mm to 31.0 mm. The uniformity in staple was satisfactory for all the strains while maturity was low in the case of many samples. Bundle strength values were average except for the strain AHO.8-722-1. All the samples were spun to 40s count and as many as 10 samples fared well at this count. The best spinning performance was shown by the strain CP.15-2(CSP—2556) followed by CP.23-6 (CSP—2491).

Samples pertaining to Preliminary Varietal Trial under irrigated conditions were received from Amaravati, Arabhavi and Nandyal.

The test results of 12 samples received from Amaravati, indicated that their mean fibre length ranged between 26.9 mm and 29.7 mm. Fibre maturity was satisfactory and bundle strength values were average to good, ranging from 40.7 g/t to 46.1 g/t. All the samples fared well at 50s count. The best spinning performance was shown by the strain ELS.268(CSP—2307), followed by IC.1407(CSP—2285), ELS.177(CSP—2225), CP.13-20 (CSP—2197) and MCU.5 (CSP—2162).

Mean fibre length of 20 samples from Arabhavi ranged between 25.1 mm and 29.2 mm. Maturity was not satisfactory in the case of a few samples. The bundle strength values were average. Samples could not be spun due to sticking of fibres to the roller of the spinning machinery.

A set of five samples pertaining to Preliminary Varietal Trial under irrigated conditions was also received from Nandyal. The range of mean fibre length was from 24.4 mm to 29.7 mm. Maturity and bundle strength values were satisfactory. The strain ELS.177 recorded satisfactory yarn strength at 50s count.

Preliminary Varietal Trials under rainfed conditions were conducted at Dharwar, Nandyal and Shimoga.

Mean fibre length of 26 samples from Dharwar ranged between 22.6 mm and 27.2 mm. Maturity was low to average and bundle strength values were average. The best spinning performance at 40s count was shown by strains CPD.8-1, Bhagya, DS.58, CPD.19-3 and JK.97-11-73.

Two more sets of samples under this trial were received from Dharwar. Mean fibre length for 36 samples ranged from 22.1 mm to 25.7 mm. Maturity was low to average and bundle strength values were average to good. All the samples were spun to 40s count. As many as eight samples from one set and 18 samples from the other set recorded satisfactory yarn strength at 40s count, the best strain being CPD.34-9 followed by JK.78-300, CPD.34-34, CPD.7-8-26, DC.473, CPD.27-31, Laxmi, CPD.7-B.2, JK.44-47, CPD.19-B.2, CPD.35, and Bhagya.

Thirtytwo strains were raised under this trial at Shimoga. Mean fibre length of these samples ranged between 22.6 mm and 29.2 mm. Maturity was low to average and bundle strength values were average to good. As many as 14 strains recorded satisfactory yarn strength at 40s count. The best spinning performance was shown by the strain CPD.34-9 (CSP—2337) followed by CPD.34-23 (CSP—2321).

A set of eight samples of High Ginning Type pertaining to this trial was received from Nandyal. The test results of these samples indicated that their mean fibre length ranged between 20.8 mm and 25.1 mm. They had low to average maturity and average bundle strength. Only the strain CP.17-32 and the control strain Mahalaxmi fared well at 40s count.

Samples raised under Initial Evaluation Trial were received from Arabhavi and Shimoga.

Mean fibre length of 24 samples from Arabhavi ranged from 23.6 mm to 28.4 mm. Maturity was not satisfactory for all the strains. Bundle strength values were low to average. The following six samples recorded satisfactory yarn strength at 40s count : CPD.27-31, Mysore Vijaya, AHO.80-212-2, CPD.34-34, CPD.27-30 and AHO.80-187.

Mean fibre length of 43 samples received from Shimoga ranged from 21.6 mm to 27.4 mm. Maturity was low to average and bundle strength values were average to good. All the samples recorded good yarn strength at 40s count, the best being JK.78-29 (CSP—2280) followed by CPD.17-1, CPD.98-12, CPD-17-B.12, CPD.19-B.2 and CPD.19-1.

G. barbadense Trials

Coordinated Varietal Trial of *G. barbadense* was conducted at Arabhavi, Nandyal and Shimoga.

A set of 11 samples, including local control Mysore Vijaya and hybrid Varalaxmi, was received from Arabhavi. The range of mean fibre length of *G. barbadense* cotton was between 27.9 mm and 33.0 mm. All the strains except IBSI.33 recorded satisfactory maturity. Bundle strength values ranged from 42.3 g/t to 52.5 g/t. The best spinning performance at 80s count was recorded by Suvin 62-17 (CSP—2710), followed by IBSI.53 (CSP—2512) and Sujata (CSP—2484). Hybrid Varalaxmi recorded mean fibre length of 31.8 mm with good bundle strength. It has also fared well at 80s count (CSP—2520).

The test results of nine samples received from Nandyal indicated that their mean fibre length ranged between 28.4 mm and 34.8 mm. The strain CBS.34 recorded rather high Micronaire value of 4.5. Maturity was satisfactory except for the strains Menoufi and Suvin 62-17. The bundle strength values were also satisfactory ranging from 42.9 g/t to 50.4 g/t. The best spinning performance at 80s count was shown by Suvin 62-17 (CSP—3092) followed by Sujata (CSP—2848), N.28 (CSP—2779), IBSI.53 (CSP—2704) and CBS.25 (CSP—2671).

Twelve *G. barbadense* samples raised under this trial were received from Shimoga. Their mean fibre length ranged from 27.9 mm to 32.8 mm. All the strains except Sujata, Suvin 62-17, and CBS.25 recorded satisfactory maturity. The bundle strength values ranged between 40.2 g/t and 54.1 g/t. The best spinning performance was recorded by the strain Suvin 62-17 (CSP—2804) at 80s count. The other promising strains were CBS.25 (CSP—2583), Sujata (CSP—2503) and IBSI.53 (CSP—2464). The hybrid Varalaxmi recorded mean fibre length of 31.2 mm with satisfactory bundle strength. It fared well at 80s count.

Hybrid Trials

Hybrid Trials were conducted at Arabhavi, Coimbatore and Nandyal. It was observed that many of these hybrids were interspecific involving *hirsutum-barbadense* crosses. As a result, most of them have recorded excellent mean fibre length. However, maturity in the case of many hybrids was not up to the mark and, therefore, the bundle strength values were not impressive. Although many of them have recorded promising yarn strength at 80s count, the yarns were neppy. The lint also contained a large number of green motes.

The performance of seven new interspecific hybrids raised at Raichur, involving one of the *G. barbadense* varieties, such as SB.1085-6 or SB.289-E as a male parent, was compared with that of Varalaxmi, H.5 and CBS.156 taken as controls. The test results indicated that fibre characteristics of these hybrids were quite comparable with those of controls.

Miscellaneous Trials

Many trials having different objectives have been conducted in the States of Andhra Pradesh, Karnataka and Tamil Nadu. The following samples fared well at the locations indicated :

Location	*Count*	*Strains*
Amravati	50s	MCU.5, AV.1661, EL.031, DA.1188, AV. 2779-II/2, AV.2850-II/2, AV.2775-II/1, AV.2743-2, AV.2776-IV/2, and AV.2810-II/3.
Shimoga	50s	MS.19, MS.17, MS.20, MS.15, My.14, and Laxmi.
Coimbatore	40s	B.1007.

In the Pilot Project Demonstration Trial at Shimoga, six promising *G. barbadense* entries were tried along with Varalaxmi. Of these Sujata, IBSI.53, Sea Island Andrews, Giza 7 and Varalaxmi fared well at 80s count. However, none of these strains recorded better technological performance than Varalaxmi.

Non-Project Trials

With a view to develop a short duration high yielding Gaorani strain, a number of selections were screened at Hyderabad. Of these, nine selections were tested for technological properties. These selections have recorded mean fibre length around 25.6 mm and above with good bundle strength. However, maturity was not satisfactory. Five selections, viz., 1042, 1014, 875, 860 and 861, fared well at 40s count.

EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS

The results of the detailed tests carried out during 1976 on extra-long staple cotton samples received and tested at the Laboratory are shown in Table 6. This supplements the prominent strains described under AICCIP.

MILL TESTS

Selected improved varieties of cotton are being subjected to actual mill tests taking into consideration their promising potential and superiority over the current ones on the basis of Laboratory tests, to assess their spinning performance under mill conditions. Only after the superiority of the new varieties is confirmed by mill tests, atleast for two consecutive seasons, the varieties are recommended for large scale propagation. It is with the cooperation of a few mills, that the Laboratory arranges mill tests on promising strains.

TABLE 6 : RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1976

Variety	Place	Mean fibre length		Fineness		Maturity coefficient	Bundle strength	
		mm	in.	Millitex	Micronaire value		Tenacity (zero gauge) g/t	PSI (zero gauge) lb/mg
Andhra Pradesh								
MCU.5	Adilabad	29.5	1.16	114	2.9	0.59	44.0	8.2
AV.1661	Amaravati	27.9	1.10	138	3.5	0.66	44.0	8.2
EL.031	,,	27.7	1.09	146	3.7	0.67	44.5	8.3
DS.1188	,,	28.2	1.11	130	3.3	0.65	45.0	8.4
MCU.5	,,	28.2	1.11	130	3.3	0.65	45.6	8.5
NHY.12	Nandyal	36.6	1.44	102	2.6	0.56	47.7	8.9
Varalaxmi	,,	32.3	1.27	126	3.2	0.64	49.3	9.2
Gujarat								
Varalaxmi	Idar	31.3	1.23	126	3.2	0.62	45.0	8.4
Sankar 5	Kapadvanj	33.8	1.33	110	2.8	0.68	49.3	9.2
Hybrid 4	Karjan	28.9	1.14	154	3.9	0.69	40.7	7.6
IAN.579/188	Khedbrahma	27.2	1.07	161	4.1	0.74	39.7	7.4
Hybrid 4	Surat	29.2	1.15	138	3.8	0.75	41.8	7.8
Hybrid 4	Talod	28.0	1.10	161	4.1	0.72	43.4	8.1
70IH.452	Surat	27.4	1.08	193	4.9	0.91	44.5	8.3
MCU.5	,,	27.9	1.10	142	3.6	0.84	47.2	8.8
G. Cot.100	,,	26.9	1.06	142	3.6	0.77	45.0	8.4
YS+(G.67 × Moco)F_1 (5th Year)	,,	29.0	1.14	94	2.4	0.53	48.2	9.0
,, (6th Year)	,,	29.5	1.16	94	2.4	0.52	46.6	8.7
,, (5th Year)	,,	30.0	1.18	98	2.5	0.53	45.6	8.5
,, (5th Year-Control)	,,	29.2	1.15	98	2.5	0.55	47.2	8.8
,, (4th Year-Rainfed)	,,	29.0	1.14	94	2.4	0.52	46.6	8.7
,, (4th Year-10'×10')	,,	29.5	1.16	94	2.4	0.52	45.6	8.5
,, (4th Year-10'×8')	,,	30.2	1.19	106	2.7	0.58	48.2	9.0
,, (3rd Year)	,,	29.5	1.16	102	2.6	0.55	45.6	8.5
Karnataka								
S. I. Andrews	Shimoga	30.8	1.21	138	3.5	0.67	44.0	8.2
Madhya Pradesh								
Hybrid 4	Khargone	27.4	1.08	161	4.1	0.73	40.2	7.5
JK.Hy.11	Khandwa	29.2	1.15	106	2.7	0.56	45.0	8.4
Maharashtra								
Varalaxmi	Akola	30.0	1.18	114	2.9	0.56	45.6	8.5
Hybrid Godavari	Nanded	27.6	1.09	118	3.0	0.60	41.3	7.7
Haryana								
H.655C	Hissar	27.4	1.08	130	3.3	0.65	44.5	8.3
H.710	,,	27.7	1.09	122	3.1	0.62	47.2	8.8
Punjab								
H.650C	Ludhiana	27.7	1.09	150	3.8	0.80	43.4	8.1
H.654C	,,	27.0	1.06	142	3.6	0.83	44.5	8.3
H.655C	,,	27.7	1.09	146	3.7	0.89	46.1	8.6
SH.269	,,	27.0	1.06	142	3.6	0.83	45.0	8.4
Tamil Nadu								
ELS.380	Coimbatore	29.5	1.16	118	3.0	0.60	40.7	7.6
ELS.481	,,	29.0	1.14	134	3.4	0.67	43.4	8.1
MCU.5	,,	29.2	1.15	118	3.0	0.61	44.0	8.2
H·2	,,	34.5	1.36	110	2.8	0.78	48.8	9.1
H·3	,,	34.5	1.36	114	2.9	0.80	52.0	9.7
CBS.156	,,	33.8	1.33	114	2.9	0.75	50.4	9.4
Sujata	Tirupur	30.8	1.21	154	3.9	0.71	49.3	9.2

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

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

Place	Variety	Laboratory Test Results			Mill Test Results		
		Count	Strength	t.m.	Count	Strength	t.m.
Haryana							
IARI, Sirsa	SH.269	30s	60.2	4.0	30s	44.5	4.0
	SH.131	,,	49.0	,,	,,	32.7	,,
	320F	,,	43.2	,,	,,	30.9	,,
Maharashtra							
Nanded	Hybrid Godavari	50s	44.4*	4.0	50s	41.5	4.2
Tamil Nadu							
Coimbatore	CP.15-2	30s	63.7	4.0	30s	53.1	—
	CPH.2	,,	64.1	4.0	,,	57.0	—

*SKF Drafting Sysem.

Note : The Spinning System and machinery employed by the mills are in many respects different from those adopted at this Laboratory and hence the strength values are not strictly comparable.

It will be seen from the Table that SH.269 gave better yarn strength than the control 320F, while SH.131 had nearly the same yarn strength as 320F at the mill. At the Laboratory, SH.269 recorded better yarn strength than the other two, which were considered unsuitable for 30s count.

CPH.2 recorded better yarn strength than CP.15-2 for 30s count at the mill. But at the Laboratory both gave practically the same yarn strength. These results need confirmation by tests on samples of one or more seasons.

The sample of Hybrid Godavari had recorded lower strength at the mill than at the Laboratory, although the mill had spun the sample after combing and using better drafting system and higher twist. Yarns were neppy, probably due to low Micronaire value and low maturity.

Evaluation of the 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 determination of ginning percentage. The fibre and spinning test results, ginning percentage and other test results on each variety of cotton were 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 51 varieties during 1976. The test results on all the Trade Varieties of 1973-74 and 1974-75 seasons were compiled together and published as "Technological Report on Trade Varieties of Indian Cottons, 1973-74 and 1974-75 Seasons". Most of the 1975-76 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 judge 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 the Laboratory 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 carried out on such samples. The results obtained on the samples received are published as Technological Circulars for the information of the Cotton Breeders and other research workers as early in the season as possible. During 1976, such circulars were issued on 21 varieties. The results on all the samples pertaining to the 1973-74 and 1974-75 seasons were consolidated and published at the end of the season as "Technological Report on Standard Indian Cottons, 1973-74 and 1974-75 Seasons". Most of the samples of Standard Indian Cottons of the 1975-76 season have been received and tested.

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

It was mentioned in the previous report that Shirley Analyser, spinning and yarn tests on the CTRL Extractor cleaned and uncleaned samples were in progress. During the period under report all the above tests were completed and the results obtained were analysed from which the following conclusions were drawn :

(*i*) The CTRL Kapas Extractor is capable of removing finer as well as larger size impurities including immature locks present in the seed cotton.

(*ii*) Trash contents as determined by Shirley Analyser from the CTRL Extractor cleaned samples is less than that from the uncleaned samples. This shows that the CTRL Kapas Extractor processed samples are reasonably cleaner and reduce blowroom loss in the mills.

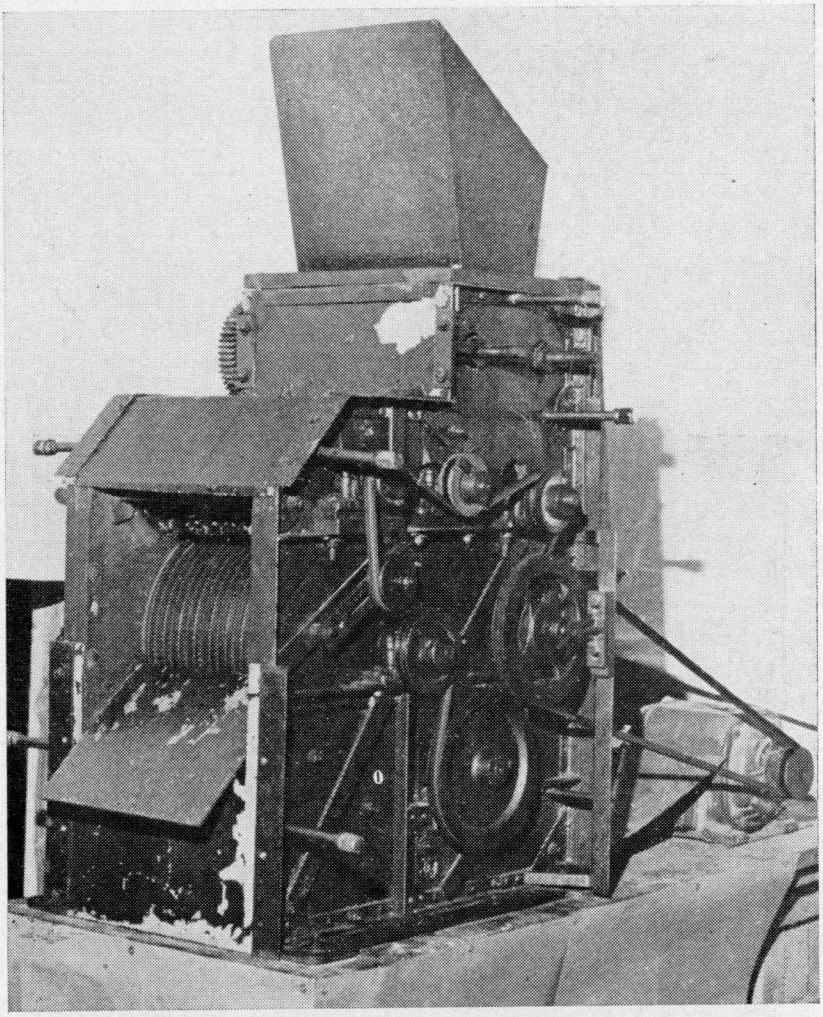
(*iii*) No appreciable difference was observed in the ginning percentages between the uncleaned and the CTRL Extractor cleaned samples.

(*iv*) There were no appreciable differences in fibre length, strength and fineness between the CTRL Extractor cleaned and uncleaned samples. This indicates that no harsh treatment is given to *kapas* samples while processing in the Extractor.

(*v*) The average cleaning capacity of the CTRL Kapas Extractor is such that it can feed two single-roller gins or one double-roller gin in continuous operation.

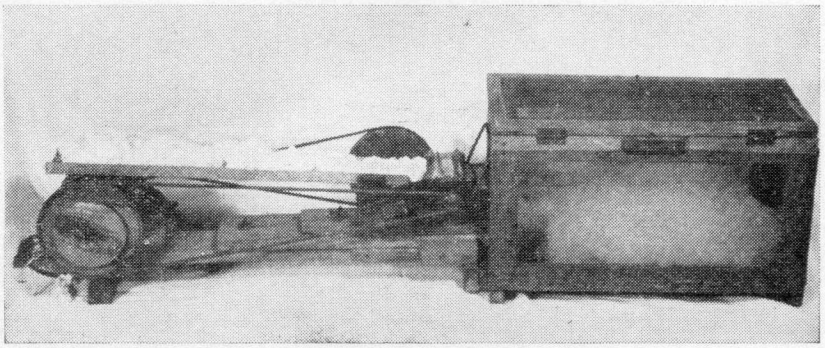
Publicity, including demonstration trials, was given to the CTRL Kapas Extractor, at the second NRDC get-together held in Bombay in December,

PLATE III



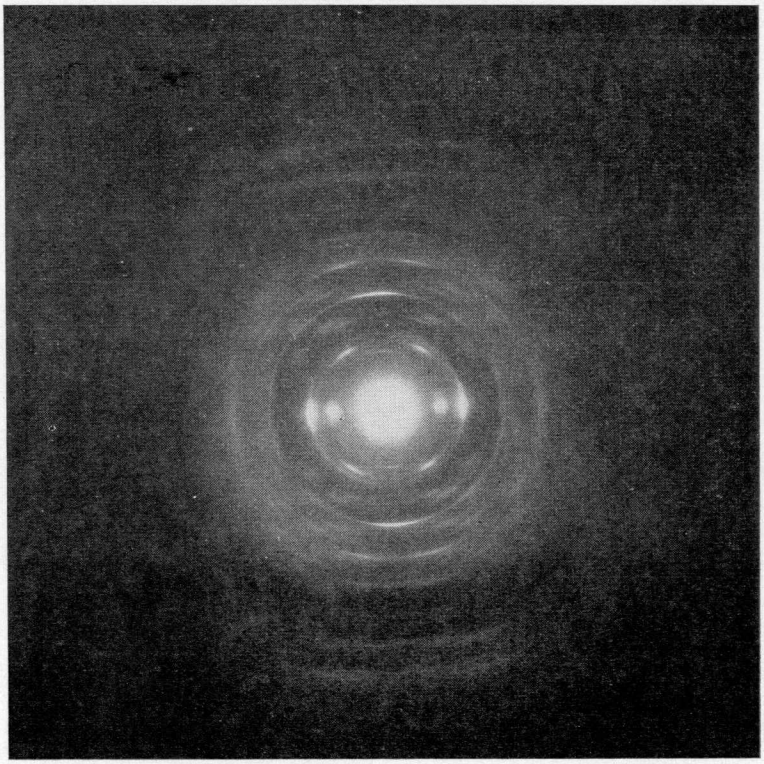
CTRL Kapas Extractor

PLATE IV



Lint Opener

PLATE V



Electron Diffraction Pattern of Cooled Cell Wall Fragment of Cotton Cellulose at 75kV. Note the Large Number of Reflections out to 10th Layer Line

1975, and one of the gin manufacturing firms has shown interest in undertaking the fabrication of the instrument for commercial exploitation (Plate III).

Survey of the Conditions of Cotton Ginning Factories in India

As a part of the study on the working conditions of the existing gins in India, a survey was planned in Punjab, Haryana and Rajasthan States by seeking cooperation from the Joint Director of Agriculture in Rajasthan, the Deputy Director of Agriculture in Punjab, the Marketing Officer in Haryana and the Secretary of the Punjab, Haryana and Rajasthan Factories' Association, Bhatinda, in addition to the personal contacts made with the factory owners. The position relating to questionnaire received so far, is given below :

State	*Number of factories to whom Questionnaires were sent*	*Number of factories from whom returns have been received*
Punjab	140	68
Haryana	41	37
Rajasthan	183	35
Total	364	140

A number of factories in Punjab and Haryana have been covered. The state officials were also requested to pursue the matter for collecting the replies from the remaining factories in Rajasthan. Most of the factories in Ganganagar division have been covered. For getting replies from the factories in Udaipur Division, the concerned officials were being contacted.

During personal visits undertaken in Punjab, Haryana and Rajasthan, it was observed that many of the factories did not work to the full capacity as cotton production in the respective areas had considerably reduced. It was also gathered that the working conditions in the factories could be improved to some extent by a thorough revision of all the legislations affecting the factory owners and workers and taking suitable remedial measures to minimise the hardships experienced by them.

Fabrication of Lint Opener

During the period under review, comparative tests for Micronaire and maturity values were carried out on 30 samples. Duplicate lots of samples were opened respectively by the Shirley Analyser and the Laboratory designed Lint Opener (Plate IV). Micronaire value and maturity were practically the same for the corresponding samples opened by both the instruments.

High correlation (0.99) was observed between Micronaire value of Shirley Analyser opened samples and that of the corresponding Lint Opener opened samples.

Adaptation of the Digital Fibrograph for Determination of Indian Grader's Length

During the period, 12 cottons were tested for effective length, 2.5% span length, halo length, 5.5% span length, mean length and grader's length. The results were in agreement with earlier findings. Halo length, 5.5% span length and mean length showed good agreement with grader's length, while effective length and 2.5% span length were much higher than grader's length. So far 22 varieties have been tested. Data are being statistically analysed.

A Study of the Influence of Fibre Taper on the Thickness Profile of an Aligned Tuft

The Interferometric Fibre Stapler (IFS) was used to determine length characteristics of cotton by measurement on randomly caught fibre tufts generally known as fibre beards. Fibre beards can be obtained by clamping a sliver at a place sufficiently far removed from its ends and then combing out fibres that are not gripped by the clamp. From the thickness variation of such a beard it is possible to derive various span lengths in much the same way as these length measures are obtained with the Digital Fibrograph. The use of the beard instead of an aligned tuft has the following advantages :

(*i*) Preparation of a beard is simpler than that of an aligned tuft.
(*ii*) End-error can arise while clamping the aligned tuft in the IFS. On the other hand to obtain a beard, the sliver can be clamped anywhere near the middle.
(*iii*) Normally the settings in spinning machinery are made on the basis of staple length or 2.5% span length and not the mean length.

Fifty samples were tasted on the IFS and the thickness variation of the beard was obtained in terms of shifting interference bands. Two tufts were tested for each sample.

The 2.5% and 50% span lengths (S2.5, S50) were calculated, respectively, as the distances from the clamp at which the tuft thickness reached 2.5% and 50% of its maximum value. The uniformity ratio (UR), viz. S50/S2.5 was also calculated. The results were compared with those obtained on the Digital Fibrograph and the following observations could he made :

(*i*) There exists a high correlation (r=0.98) between the 2.5% span length obtained by the IFS and the Digital Fibrograph.

(*ii*) The regression equation connecting 2.5% span length from the Digital Fibrograph ($S_{2.5}^{DF}$) and the IFS ($S_{2.5}^{IFS}$) is $S_{2.5}^{DF} = 1.06 \times S_{2.5}^{IFS}$.

(*iii*) The uniformity ratio (UR) values from IFS and the DF are very poorly correlated.

An attempt was also made to find out which span length from the IFS would be closest to the Balls Sorter mean length. It has been found that 4% span length from the IFS nearly coincides with the Balls Sorter mean length.

Studies on Linear Density and Its Influence on Fibre Tenacity

During the year, the observations on linear density and breaking load on individual fibres belonging to 12 different varieties covering all the four botanical species were completed. The breaking strength tests on about 200-300 fibres from selected varieties were conducted at 27°C under two conditions, viz. wet state and 65% r.h. Following the procedure adopted earlier, the fibres were grouped into different linear density groups and the plots of breaking tenacity versus fibre linear density made are shown in Figure 1 for four cottons, one each from the four botanical species.

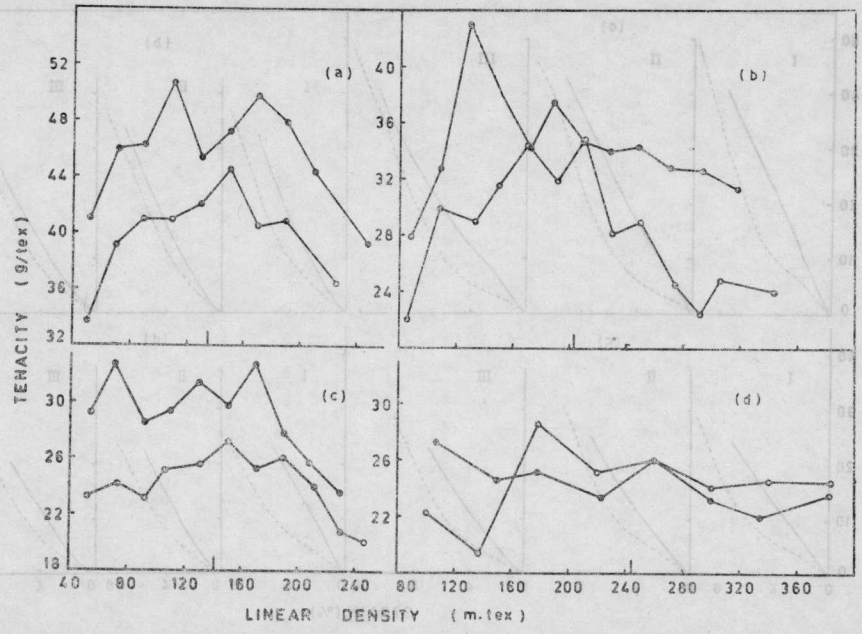


Fig. 1. Relation Between Fibre Breaking Tenacity and Linear Density under 27°C, 65% RH (o—o--o) *and Water at 27°C* (●—●—●); (*a*) *Suvin* (G. barbadense); (*b*) *Sanjay* (G. arboreum; (*c*) *Laxmi* (G. hirsutum) *and* (*d*) *V. 797* (G. herbaceum)

It was observed from the plots, that the increase in breaking tenacity under wet conditions was quite significant for fibres with lower and higher linear density compared to those having medium linear density values. For the latter group the increase was only marginal. The same trend was observed for cottons from all the species except *G. herbaceum*, where the fibres having considerably lower linear density alone showed an increase in wet breaking tenacity and the others having a higher linear density did not show any increase in wet fibre tenacity. This typical behaviour of cottons belonging to *G. herbaceum* was confirmed by carrying out tests on an additional cotton (Digvijay) and also after dewaxing and purifyng the cottons. Further, results of preliminary tests on fibre bundles under wet condition also tend to support the above observation.

Breaking Extension

The breaking elongation under wet condition (Fig. 2) did not show any dependence on linear density or the species to which the fibres belonged. It increased uniformly for fibres in all the linear density groups although the magnitude was slightly higher for those in lower linear density groups compared to others in higher linear density groups.

It is thus seen that the magnitude of additional mobility of structural elements brought about by soaking cotton fibres in water depends on fibre linear

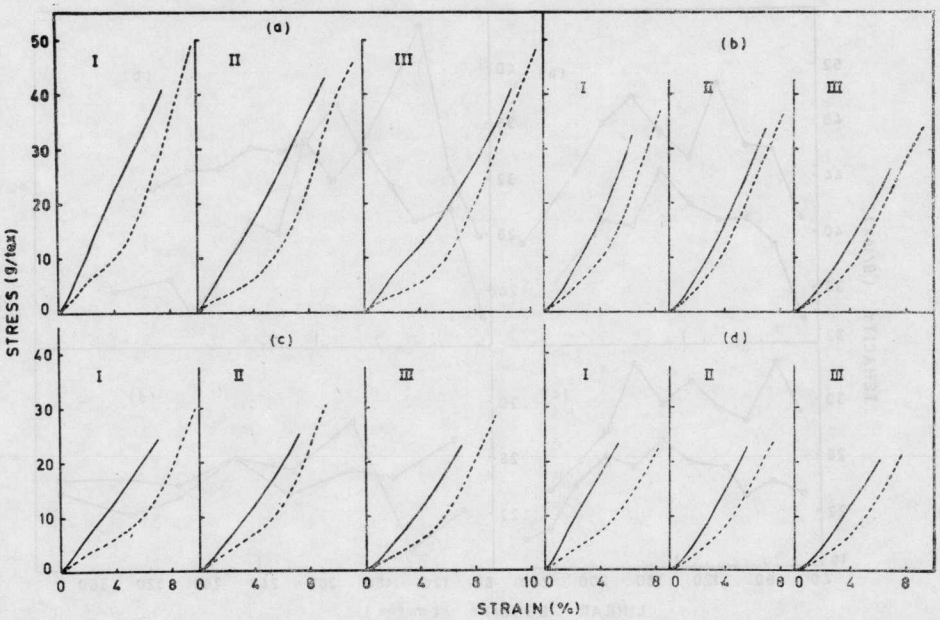


Fig. 2. Normalised Stress-Strain Curves of Fibres Belonging to I. Low, II. Average, and III. High Linear Density Groups, under 27°C, 65% RH (————), and Water at 27°C (— — — —), (a), (b) and (c) same as above (d) Jayadhar (G. herbaceum)

density and it influences the tensile and elastic properties of fibres in a complex way.

Studies on the Bundle Strength of Cotton in Non-conditioned Atmospheres

Experimental work of the project was proposed to be carried out at the CTRL Regional Station, Surat, where atmospheric conditions during certain seasons were found to be more favourable than at Bombay. A humidity box to preserve the samples at 65% r.h. was fabricated at CTRL Engineering Division. This box along with other necessary asscessories, samples of 10 varieties of cotton and samples of the corresponding calibration cottons have been taken to the Surat Regional Station. Further work is being taken up.

Studies on Fibre Elongation Characteristics of Different Varieties of Indian Cottons

During the period under review, 10 cottons each pertaining to *G. arboreum*, *G. herbaceum*, *G. hirsutum* and *G. barbadense* species were tested on the Stelometer for elongation at 1/8 in. (E1) and 1/4 in. (E2) gauge lengths. The average values for different species have been presented in Table 8 below :

TABLE 8 : AVERAGE STELOMETER ELONGATION VALUES AT DIFFERENT GAUGE LENGTHS FOR DIFFERENT SPECIES OF COTTON

Botanical species	Elongation at break (%)		Increase in elongation (%) from 1/8 in. gauge length to 1/4 in. gauge length
	1/8 in. gauge length	1/4 in. gauge length	
G. arboreum	4.3	7.6	3.3
G. herbaceum	4.2	7.4	3.2
G. hirsutum	5.1	9.3	4.2
G. barbadense	6.5	11.4	4.9

It was observed that as the gauge length increased from 1/8 in. to 1/4 in. the elongation at break (%) also increased by about 3 to 5 units, for all the cottons. Besides, the correlation between E1 and E2 was found to be highly significant.

A Study of the Bulk Resilience of Cotton

According to the original plan as outlined in the project proposal an instrument was to be fabricated for measurement of bulk compressibility. Even though a beginning had been made in 1973 for fabricating the instrument, it was later decided to give up the plan of fabricating the new instrument, but to use instead the Instron Tensile Tester with suitable attachments, consisting mainly of a cylinder and a piston. The components have since been fabricated and preliminary trials were also being conducted.

Since the Instron installed in CTRL did not have compression cells and hence could measure only tensile loads and extensions, the cylinder and piston had to be designed in such a way as to make the instrument suitable for compressive load measurement.

The cylinder is mounted on the movable part of the instrument, the 'crosshead'. The piston is suspended from the load cell and is designed to have a large weight (up to 5 kg), which can be reduced, if necessary, by removal of metallic weights attached to its long stem. The load cell will not be under tension, when the piston head rests fully on the cotton sample in the cylinder and the entire weight of the piston thus compresses the sample. If the crosshead is lowered, the load on the cotton sample will gradually diminish and increasing load will be sensed by the load cell. When the crosshead has gone far and the piston head is clearly above the sample, the entire weight of the piston will act on the load cell. The loads on the sample and the load cell thus change in opposite directions between zero and the total weight of the piston. By the above procedure the load-compression curve can be obtained on the chart as in tensile tests. The resilience is expected to be obtained in terms of the area enclosed by the load-compression curves resulting from the cyclic loading-unloading operation. Preliminary trials are now being carried out to arrive at optimum conditions for tests, such as sample size, extent of load-compression, number of loading-unloading cycles required, etc.

Studies on the Lateral Compressibility of Chemically Modified Cotton

Crosslinking treatment on mercerised cotton with DMDHEU and high concentrations of CH_2O was found to result in fibres of nonuniform thickness unsuitable for lateral compressibility measurement. Therefore, it became necessary to choose some other form of cellulose which could be crosslinked with CH_2O and DMDHEU so as to study the influence of lateral bonds on the compressibility of the material. Cellulose films which are known for their uniform physical characteristics were found to be suitable for lateral compressibility measurement. Further, with their high accessibility, crosslinking could be carried out to higher levels than would perhaps have been possible with cotton fibre.

Cellulose films used were of about 25 microns thickness and were confirmed to be made of pure cellulose from their Infrared spectra. For DMDHEU treatment, film strips immersed in solutions of 4%, 8%, 12%, 20% and 45% DMDHEU concentrations for 10 minutes were padded under a given load, dried at 100°C for 7 minutes and cured at 160°C for 3 minutes. The films were later soaked in detergent solution for 10 minutes, thoroughly washed and dried in air between filter papers. Crosslinking in CH_2O was carried out by Form W process at three different concentrations, viz. 5%, 15% and 22.8%, the last one being the highest concentration attainable with the commercially available reagent.

Tests were carried out on narrow strips of about 100 microns width cut from films. Stress-strain curves up to the rupture limit were obtained for these samples after cyclic loading and unloading between 0% and 2% extensions using the Instron Tensile Tester. Lateral compressibility was measured by the interferometric method developed at CTRL.

The results of tests indicating the breaking load, breaking extension, initial modulus and lateral compression modulus for the treated and untreated (control) cellulose films are given in Table 9.

TABLE 9 : DATA ON MECHANICAL PROPERTIES OF UNTREATED AND CROSSLINKED COTTON FIBRES

Property \ Treatment	Nil (control)	CH_2O			DMDHEU				
		5%	15%	22.8%	4%	8%	12%	20%	45%
Breaking load (g)	33.1	28.50	26.70	25.50	35.60	35.70	38.40	41.60	46.35
Breaking extension(%)	23.8	17.58	17.52	12.84	13.13	8.05	8.40	6.65	5.36
Longitudinal modulus ($\times 10^{10}$ dynes/cm^2)	3.69	3.83	3.60	3.77	3.49	4.38	4.44	5.89	5.29
Lateral compressional modulus ($\times 10^8$ dynes/cm^2)	15.36	16.48	17.16	19.89	16.88	18.33	21.34	21.25	22.56

It is evident from the data in the Table that while crosslinking in CH_2O brought about progressive decrease in breaking load and breaking extension with increase in concentration, DMDHEU treatment resulted in a considerable increase in strength and a corresponding decrease in breaking extension. Such changes were absent in the longitudinal modulus, though with DMDHEU treatment a small increase in the modulus was quite evident. Lateral compression modulus, on the other hand, showed a significant increase with both treatments, the increase being more pronounced at higher concentrations. It may be recalled that no such increase was noticed on the lateral compression modulus of cotton fibres as a result of crosslinking with 10% CH_2O which was found to be sufficient to bring about a considerable fall in the longitudinal extension modulus. Comparison of the results on cellulose films and cotton fibres thus lead to the inference that the morphology of cotton must be responsible for the absence of any change in the lateral modulus of this fibre.

Further Studies on the Cross-sectional Shape of Cotton Fibres

During the year under review, fibres from the cotton bolls of Suvin (*G. barbadense*), picked at the weekly intervals of 35, 42, 49 and 56 days were

obtained and dehydrated at room temperature. The circularity of the cotton fibres from these bolls was determined following the usual procedure. It was observed that circularity of the cotton fibre increased with the increasing age of cotton boll.

In order to determine the relation between cross-sectional shape and other fibre characters, one hundred cross-sections for each of five cottons belonging to *G. herbaceum* having 60 per cent mature fibres were prepared and the mean circularity and other fibre characters were determined. Further work is in progress.

Crystallite Orientation in Textile Fibres as Studied by Their Meridional (040) X-ray Diffraction Arcs

During the year under report, the effect of swelling and stretching treatments on the orientation parameters of cottons was studied. The swelling agents used were aqueous ethylenediamine (EDA) and sodium hydroxide (NaOH) solutions.

On slack swelling in either reagent, the DeLuca and Orr spiral angle (ϕ) and the Herman's Orientation factor (fx) appeared to indicate improved orientation with increasing concentration. The crystallite dispersion angle ($\propto$), however, was found to change irregularly.

The effect of stretching the swollen fibres, on the other hand, could be seen in changes in all the three parameters. These changes were more marked in samples swollen in NaOH. It was also noticed that (ϕ) reflected the effect of stretch more than ($\propto$). The orientation factors derived from the equatorial and meridional x-ray reflections were found to be almost identical in the highly stretched samples.

The tenacity at nominal zero gauge length of the samples taken up for study under the project were determined. Examination of relationships between strength and orientation is in progress.

A Study of the Crystallinity of Cotton by Infrared Methods

Infrared absorption band occuring at 342 cm^{-1} in the spectrum of cellulose has been found suitable for estimating degree of crystallinity in cotton. The advantages of this band over the bands at 893 cm^{-1} and 1372 cm^{-1} which were used by earlier workers for crystallinity assessment are : (*i*) near-horizontal base line which leads to the derivation of unambiguous absorbance values, and (*ii*) high sensitiveness at the levels of crystallinity generally encountered in cotton fibres. The new crystallinity index is defined by the ratio

$$I = \frac{a_{342}}{a_{2900}}$$

where a_{342} and a_{2900} are absorbance values at 342 cm^{-1} and 2900 cm^{-1}, respectively, the latter serving as an internal standard. The crystallinity percentage is obtained as the ratio

$$\frac{I_{obs} - I_{am}}{I_{cr} - I_{am}} \times 100$$

where I_{obs} is the value of the index for any sample of unknown crystallinity and I_{am} and I_{cr} are indices for 100% amorphous and 100% crystalline celluloses, respectively. The crystallinity of ball milled and chemically decrystallised cotton fibres obtained in the above manner were found to compare more closely with those obtained by x-ray diffraction than did the percentages derived from the 893 cm^{-1} and 1372 cm^{-1} bands.

Comparison of the new infrared index with the two earlier ones was also made in the case of 30 varieties of cotton drawn from all four species. When new index was used, only small differences in crystallinity were found between cottons of a given species as well as between different species. On the other hand with the infrared indices based on the bands at 893 cm^{-1} and 1372 cm^{-1} proposed by earlier workers, the crystallinities of different cottons showed a larger spread.

A Study of the Performance of the Modern Blowroom Line

Trials using all the four possible combinations in the blowroom were completed on two extra-long staple cottons, Suvin and Hybrid 5, which had the same length but differed considerably in maturity—the latter having a low Micronaire value of 2.8 against 3.6 for Suvin, and also being more trashy. The measurement of individual cleaning efficiencies for different blowroom combinations showed differences consistent with the earlier findings, viz. Shirley Opener combinations recorded higher cleaning efficiencies compared to the Airstream Cleaner.

However, it was noticed that use of both SRRL and Shirley Opener for Hybrid 5 resulted in lowering the yarn strength due to fibre rupture.

Trials have been started on an American cotton, Elpaso, and processing completed on two combinations.

Performance of Different Flat Tops in Processing Immature Cottons

This project work is being carried out in collaboration with Victoria Jubilee Technical Institute. The two varieties, MCU.5 and Gujarat 67, were processed in the blowroom and the laps carded on the conventional card using (*i*) flexible tops and (*ii*) semi-rigid tops. The latter reduced the

percentage of flat stips by nearly 50% for both the cottons. There was also a very significant reduction in the nep count of the carded sliver due to semi-rigid top.

The test results on yarns spun at CTRL (Table 10) showed that the use of either the flexible tops or the semi-rigid tops did not impair the quality of the yarn. There was a slight increase in the neps/100 m of yarn carded with semi-rigid tops.

TABLE 10 : PERFORMANCE OF DIFFERENT TOPS ON CARDS

Characteristic / Performace	MCU.5				Gujarat 67			
	Flexible top		Semi-rigid top		Flexible top		Semi-rigid top	
Nominal count	50s	60s	50s	60s	50s	60s	50s	60s
Actual count	48.4	59.6	50.9	59.3	50.2	61.0	51.3	60.0
Corrected CSP	2035	1829	2051	1879	2121	2007	2166	1992
Single yarn tenacity (g/t)	12.9	11.7	12.8	11.8	13.2	12.8	13.5	12.7
Breaking elongation (%)	6.9	6.4	5.7	5.3	6.8	6.6	6.4	6.3
Uster unevenness (%) ..	16.6	17.6	16.3	16.9	17.1	17.9	17.3	17.5
Number of neps/100 m ..	134	171	171	195	169	219	206	228
ASTM appearance grade	+D	+D	D	D	D	+D	D	D

The third type of tops, viz. rigid tops, could not be tried due to its non-availability at both the Institutes. Efforts are being made to procure the same from the industry.

Comparison of Different Systems for Processing Cotton Samples

During the period under report, 55 more samples in duplicate lots were taken up for microspinning. The details of the drafting systems for different counts are listed below :

Counts	SKF	OMS	A.500	Total samples
30s	2	1	—	3
40s	2	2	2	6
50s	18	17	4	39
60s	4	—	3	7
Total	26	20	9	55

Tests have been completed so far on 110 samples. The detailed analysis is in progress. It has been generally observed that lea strength values for micro spun samples were more variable compared to those for bulk spun samples. Further, the differences in CSP values between duplicate lots of micro spun samples were significant.

Fixation of Suitable Strength Standards for Estimation of Spinning Performance of Improved Varieties

Different cotton varieties were spun using both conventional and SKF drafting systems and the lea strength values of the yarns determined. On the basis of the data on corresponding samples, a new equation, viz. CSP = 8 (Counts + 200) has been proposed for fixing the standard strength for yarns spun on SKF system. The equation upgraded the existing CTRL norms by about 14% which agreed very closely with the level of improvement in strength shown for yarns spun on SKF top-arm drafting over those on A.500 system. In view of the revised norms, it has been proposed to spin all yarns beyond 20s on top-arm drafting in the case of Standard and Trade Varieties of Indian cottons from the ensuing year.

Estimation of Rate of Fall of CSP at Various Counts for Long and Extra-long Staple Improved Varieties of Cotton (above 25mm)

As already reported, the available data pertained to only two counts for each sample and these data were not adequate for examining the general relationship between the counts and CSP, particularly the rate of fall of CSP in different count ranges. Accordingly a new approach was thought of to determine the rate of fall in strength for different count ranges and these were examined with reference to the test results available for different bobbins spun for the same sample. This study revealed that the two assumptions made by earlier workers while undertaking this investigation, viz. (*i*) that the rate of fall of CSP follows a linear relationship with the count and (*ii*) that the rate of fall in CSP was practically same for all cottons, were not correct. Thus, on the basis of the findings by the new approach, it was observed that reliable estimates of this rate of fall in yarn strength could be obtained for any nominal count under consideration from the average strength values of the highest three and the lowest three values among the observed count values. Using this procedure, the CSP values at a nominal count can be calculated from the observed test results on a sample.

This procedure was verified by working out corrected average strength values for different nominal counts by making use of the test results available for various counts of yarn of 20s, 30s, 40s, 50s, 60s, 80s, 100s and 120s, and also in respect of yarns in the form of cones or hanks. This revised procedure

has been explained in an article entitled "A new procedure for determining the lea strength corrections for nominal counts" and sent for publication.

This procedure would be adopted for routine tests at CTRL from January, 1977. As this procedure was found to be more scientific and was superior to the existing procedures which derived the estimates of rates of fall in CSP on an arbitrary basis, the revised procedure was adopted by the Indian Standards Institution recently while considering revision of the Standard IS : 239-1951, 'Method for determination of yarn strength parameters of yarns spun on cotton system (First revision of IS : 1971-1960) (Amalgamating IS : 239-1951)'. The new procedure has also been recommended by ISI for adoption by the International Standards Organisation while considering the ISO fourth draft proposal 'Standard method of test for breaking load of yarn by the skein method [Doc : ISO/TC.38/SC.5 (USA Sec. 61) 96]'.

Study of Quality of Material at Different Stages of Processing

The main object of the project was to determine and compare the evenness and the appearance of the material at different stages of processing. The yarns spun on different ring frames, viz. 3-roller, A.500, SKF and GX2 were also to be assessed for strength, evenness and yarn appearance. The experimental work completed for the previous years was for the yarns of 20s, 30s, 40s and 50 counts. However, as a result of release of many new superior varieties or hybrids, during recent years, it was considered necessary to include cottons responding to counts of 60s and 80s in these studies.

During the period under report, samples of material at different stages of processing of MCU.5 and American Elpaso (both spun to 60s counts) and of Hybrid 5 and Egyptian Menoufi (both spun to 80s counts) were assessed. The selection of the above varieties also afforded an opportunity to compare the performance of cottons from Indian and foreign origin. The experimental work of the project is expected to be completed within the next few months.

Standardisation of Imperfection Indicator

It was reported earlier that 30 samples each of 20s, 30s, 80s, and 100s count yarns were tested for different yarn characteristics, viz. Uster evenness, Uster imperfections, Uster single thread strength, lea strength, and ASTM yarn appearance grade. During the period under report, data collected were analysed and the correlations were worked out between yarn appearance grade index and the other yarn characteristics. Further, to enable comparison between qualitative assessment and quantitative measurement of yarn unevenness, correlations were also worked out between Uster evenness values and imperfections.

In order to fix suitable norms for Uster value (U%) and neps per 100 m, the data collected for 50 samples of various counts, viz. 20s, 30s and 40s (A.500) and 40s, 50s, 60s and 80s (SKF), were analysed.

The values were grouped using class intervals of 0.5 for U% values. The first 10% of the samples, having the lowest range of U% values were classified as very good. The next 15% of the samples were treated as belonging to 'good' category and the corresponding range of U% values were fixed accordingly. The next 50% of the samples were treated as having average evenness and the limits of U% values were fixed accordingly. Thus, 75% of the samples would have evenness value better than the higher limit for average category. The next 15% of the samples were classified as 'below average' and the subsequent 10% as 'poor' and the ranges of U% values for these categories were fixed accordingly. These norms are given in Table 11 A.

For routine work, it may be sufficient to have only three categories, viz. good, average and below average and the norms for these are given in Table 11 B.

TABLE 11 : TENTATIVE NORMS FOR USTER U% VALUE FOR LABORATORY SPUN YARNS (CARDED)

A. DETAILED CLASSIFICATION

Counts	Very good	Good	Average	Below average	Poor	Range (mean)
20s ..	Below 17.2	17.3-18.0	18.1-19.2	19.3-20.5	20.6 and above	16.4-22.1 (18.7)
30s ..	Below 20.0	20.1-20.5	20.6-22.0	22.1-23.0	23.1 and above	19.3-24.6 (21.3)
40s (A.500) ..	Below 20.5	20.6-21.1	21.2-22.5	22.6-23.4	23.5 and above	17.9-24.6 (21.8)
40s (SKF) ..	Below 16.7	16.8-17.6	17.7-19.5	19.6-20.0	20.1 and above	15.6-21.7 (18.4)
50s ..	Below 17.5	17.5-18.0	18.0-19.8	19.8-21.0	21.1 and above	15.8-22.7 (19.0)
60s ..	Below 18.0	18.1-19.0	19.1-20.5	20.5-21.5	21.6 and above	16.6-23.7 (19.9)
80s ..	Below 18.5	18.5-20.0	20.1-22.0	22.1-22.8	22.9 and above	17.5-24.8 (21.0)

B. BROAD CLASSIFICATION

Counts	Good	Average	Below average
20s ..	18.0 and below	18.1-19.2	19.3 and above
30s ..	20.5 and below	20.6-22.0	22.1 and above
40s (A·500) ..	21.1 and below	21.2-22.5	22.6 and above
40s (SKF) ..	17.6 and below	17.7-19.5	19.6 and above
50s ..	18.0 and below	18.1-19.8	19.9 and above
60s ..	19.0 and below	19.1-20.5	20.5 and above
80s ..	20.0 and below	20.1-22.0	21.1 and above

A similar procedure was adopted for fixing up norms for neppiness by using appropriate class intervals for grouping the data on neps per 100 m. The norms worked out are given in Tables 12 A and B.

TABLE 12 : TENTATIVE NORMS FOR NEPS PER 100 m AT SENSITIVITY POSITION —3 FOR LABORATORY SPUN YARNS (CARDED)

A. DETAILED CLASSIFICATIGN

Counts	Very good	Good	Average	Below average	Poor	Range (mean)
20s ..	Below 30	31-50	51-100	101-150	151 and above	22-332 (88)
30s ..	Below 42	43-60	61-130	131-200	200 and above	34-246 (105)
40s (A·500) ..	Below 70	71-90	91-185	186-240	241 and above	44-331 (148)
40s (SKF) ..	Below 75	76-100	101-190	191-235	236 and above	43-297 (144)
50s ..	Below 85	86-115	116-225	226-250	251 and above	74-355 (160)
60s ..	Below 105	106-140	141-250	251-300	301 and above	93-380 (200)
80s ..	Below 110	111-170	171-300	301-350	351 and above	64-432 (235)

B. BROAD CLASSIFICATION

Counts	Good	Average	Poor
20s ..	50 and below	51-100	101 and above
30s ..	60 and below	61-130	131 and above
40s (A.500) ..	90 and below	91-185	186 and above
40s (SKF) ..	100 and below	101-190	191 and above
50s ..	115 and below	116-225	226 and above
60s ..	140 and below	141-250	251 and above
80s ..	170 and below	171-300	301 and above

Preparation of Nep Grades for Indian Cottons

It was reported earlier that cottons 320F, Hybrid 4 and Comillas had been selected for preparing nep grade photographs to represent very fine, average and very coarse groups. During the period under report, five fine cottons having Micronaire value between 3.0 and 3.5 and five coarse cottons having Micronaire value between 4.5 and 5.0 were selected and tested for maturity by the caustic soda method.

As the card clothing of the cylinders of the Nepotometer had worn-out, it had to be replaced. Further work will be continued after setting up the instrument and taking preliminary trials to check the performance of the new card clothing.

Evaluation of Techniques for Measurement of Neps

The test data collected so far were analysed to investigate the relationships between the following parameters :

— Nep content in raw cotton and Nepotometer Index.
— Neps in card sliver (Readex) and Nep count in card web (Shirley Template).
— Neps in card sliver and Nepotometer Index.
— Neps in card web and fibre properties.
— Uster evenness parameters at sensitivity levels of 50, 2, 2 and 50, 3, 3.
— Yarn Appearance Index and Uster Parameters.

In the case of yarns, the analysis were done countwise for 20s, 30s, 40s, 60s and 80s while in the case of cottons, sliver, etc., the analysis were done specieswise taking *G. arboreum* and *G. herbaceum* in one group and *G. barbadense* and *G. hirsutum* in another.

Among the various fibre properties, immaturity, 2.5% span length and Micronaire value had the highest influence on neps in card web for *G. arboreum* and *G. herbaceum* cottons, while 2.5% span length and Micronaire value had the greatest influence in the case of *G. barbadense* and *G. hirsutum*. In general, the relationship between card neps and fibre properties was poorer for *G. barbadense* and *G. hirsutum* cottons compared to the old world cottons. Yarn appearance was found to be significantly related to the nep count in yarn than with thick or thin places.

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

During the year, yarns of the following cottons were screened after giving the standard DMDHEU crosslinking treatment : Laxmi, Bhagya, Buri 147, Karunganni 7, Pramukh, Jayadhar, Virnar, Gaorani 6 and Gaorani 22. Of these, Bhagya among *hirsutums* and Jayadhar, Gaorani 6 and Virnar among *desi* cotton showed better retention of mechanical properties.

Eight samples received from Regional Station, Surat, were screened in fibre form. Of these, three promising strains, viz. ERB.13650, IBSI.53 and Sea Island, have been selected for further studies in yarn form.

Crease Recovery Angle (CRA) is an important property determined as a routine on crosslinked fabrics. However, it is not practicable to obtain fabrics made of pure varieties of cotton for giving easycare finishing treatment and determining their CRA. A rapid method has, therefore, been standardised to predict CRA of a crosslinked fabric from CRA value obtained on crosslinked yarn of the cotton under study. This technique was standardised by carrying out tests on seven varieties of cotton, viz., Deviraj, Gujarat 67, MCU.1, Hybrid 4, 66BH.5/91, Sanjay and Digvijay. Both

yarns and fabrics of these cottons were given DMDHEU crosslinking treatment. Metrimpex CR Tester was used to determine CRA of crosslinked fabrics and yarn-pads (size : 3 cm × 1.5 cm with 1 cm free arm). The correlation coefficient between CRA values of yarn-pad and CRA values of fabric was very high at 0.98 (Fig. 3). This technique can, therefore, be used to predict CRA of resin-treated fabric from CRA of yarn-pad prepared from resin-treated fabric.

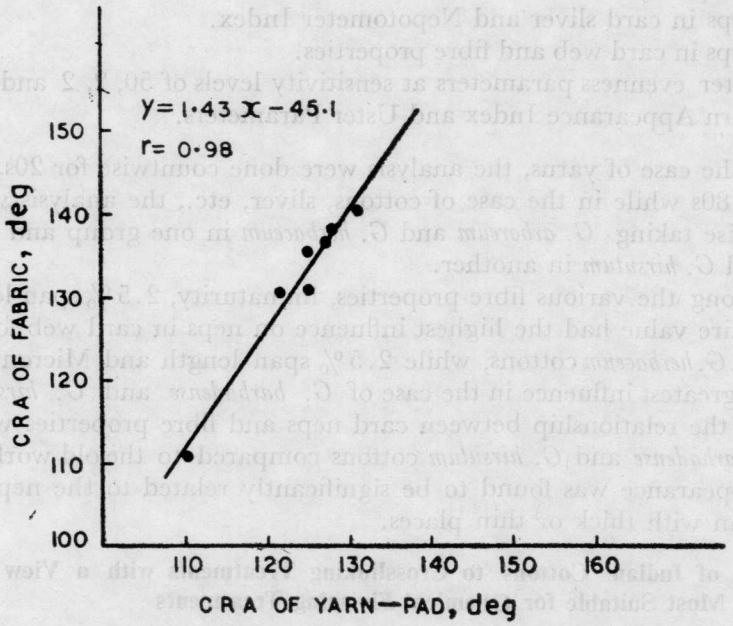


Fig. 3. Relationship Between CRA of Yarn-Pad and CRA of Fabric in Seven Varieties of DMDHEU-Treated Cottons

Pre-swelling under tension in alkali and subsequent crosslinking of yarn is one more approach to improve the retention of mechanical properties of crosslinked cotton fabric. A laboratory model mercerisation unit has been fabricated for this purpose during the year. Eight varieties of cotton, viz., Gujarat 67, MCU.1, Deviraj, Hybrid 4, A.218, 66BH.5/91, Digvijay and Sanjay, were screened by mercerising doubled yarn (2/30) followed by crosslinking treatment with DMDHEU. Tenacity and elongation properties of yarns are being determined.

Study of the Effect of Crosslinking Treatments on the Structure, Number and Distribution of Crosslinks

In continuation of the work reported last year, further work was continued on this project. Distention index (DI) of a few samples was checked.

Selected samples crosslinked with formaldehyde were also examined for crosslink distribution in network structure of cellulose by electron microscope technique. The results were analysed and a paper based on these data was submitted to the 18th Joint Technological Conference. The main conclusions drawn from the study are given below :

Marked differences in the values of DI and distribution of crosslinks are observed in cellulose samples crosslinked under different conditions of treatments. At the different levels of formaldehyde content of the cellulose, the order of apparent crosslink density in the gel is Form D < Form W. For the same series of samples, volume of swollen gel and DI decrease as the number of crosslinks per glucopyranosyl unit (GPU) increases. DI showed different levels of apparent crosslink density in network structure depending on the conditions of treatment at the time of crosslink development, different accessibilities and structure of formaldehyde units in crosslinks. These data provide quantitative information on distribution of crosslinkages and the techniques can be used with greater confidence. Electron microscopic observations also provide useful information regarding the distribution of crosslinkages in the network structure of the fibre.

Further, crosslinking treatments on fabric samples were carried out with different concentrations of "HICOFOR"—DMH and DMEU by two step polyset process. Two different catalysts, viz. zinc acetate and magnesium chloride, were used in the first step and zinc nitrate was used in the second step. The treated samples along with untreated control are being studied for various properties including number, distribution and length of crosslinks as well as fabric strength, elongation and wrinkle recovery angle.

Effects of High Energy Radiation on the Induction and Half-life of Excited, Free and/or Ionised Radicals in Cotton

Three different aspects were taken up for study as indicatd below :

Pre-irradiation Technique

Various experiments were carried out to investigate the feasibility of using pre-irradiation technique for imparting crosslinking treatments.

(*i*) Effect of pre-irradiation dosage

Digvijay yarn was pre-irradiated to eight dosages of gamma rays ranging from 0.325×10^5 to 10.300×10^5 rads and thereafter crosslinked with formaldehyde (Form W treatment).

(*ii*) Effect of the concentration of hydrochloric acid (HCl)

Degradation in Form W treatment is caused by HCl; hence the concentration of HCl in the crosslinking liquor was reduced. The various experimental conditions are given below :

(*a*) Lower pre-irradiation dosage, 1.3×10^5 rads and varying concentrations of HCl, viz. 0, 2, 4, 6, 8, 10 and 12 per cent in the crosslinking liquor.

(*b*) Higher pre-irradiation dosage, 10.3×10^5 rads and varying concentrations of HCl.

(*c*) Mercerisation, lower pre-irradiation dosage and varying concentrations of HCl.

(*iii*) EFFECT OF REACTION TIME

The pre-irradiated samples (lower dosage — 1.3×10^5 rads) were crosslinked (Form W) using various reaction times, viz. 5, 10, 15, 20, 25 and 30 minutes.

All the samples from the above experiments were tested for strength and formaldehyde uptake.

Pre-irradiation at lower dosage of 1.3×10^5 rads followed by Form W treatment showed better retention of tensile strength.

About six different varieties of cottons were subjected to crosslinking treatment (Form W) in yarn form by both the methods, viz. (*i*) usual chemical method and (*ii*) pre-irradiation method, to the same level of formaldehyde uptake. The results are presented in Table 13.

TABLE 13 : COMPARISON BETWEEN (*i*) PRE-IRRADIATION AND (*ii*) USUAL CHEMICAL METHODS OF CROSSLINKING WITH FORMALDEHYDE

Variety	Pre-irradiation		Chemical	
	Tenacity retained	HCHO uptake (%)	Tenacity retained	HCHO uptake (%)
Hybrid 4	65.40	0.43	62.16	0.45
MCU.1	56.70	0.45	53.88	0.43
Digvijay	59.20	0.42	40.05	0.45
Deviraj	64.88	0.45	62.96	0.42
A.218	75.78	0.43	72.80	0.42
Gujarat 67	67.81	0.46	62.80	0.46

The tenacity retained values of practically all the varieties crosslinked with formaldehyde by pre-irradiation technique showed slight improvement over the chemically crosslinked samples.

Chemical Treatment

Cellulose was modified to prepare 5, 6 celluloseen.

Digvijay yarn after activation was reacted with thionyl chloride in dimethylformamide (DMF) to get chlorodeoxy cellulose, which was then treated with : (*i*) alcoholic potassium hydroxide (KOH) and (*ii*) potassium tert-butoxide which yielded celluloseen with a high degree of substitution (DS).

The DS for celluloseen was calculated from the unsaturation measured by bromine number.

Post-irradiation Activity

The method to evaluate post-irradiation activity was standardised. Immediately after irradiation, the sample was reacted with 15 per cent acrylonitrile in 70 per cent zinc chloride solurion. The grafting percentage was estimated from nitrogen percentage.

Production and Characterisation of Cellulases

Enzymic method for desizing fabrics sized with tamarind kernel powder (TKP) and low viscosity TKP has been standardised using cellulase of *Penicillium funiculosum* (F4). This cellulase is thermostable, most active at 50°C, and readily acts on the beta-1-4-D glucosidic backbone of TKP polysaccharide. Desizing by cellulase is more efficient than the soda-boiling method currently used in the industry and has no adverse effect on the fabric strength. Optimum conditions for enzymic desizing were worked out with respect to pH, temperature, incubation period and enzyme concentration. Under standard conditions of treatment, 95-99 per cent size removal was achieved. A complete specification for a patent for the desizing process using cellulase was filed in May, 1976.

The cellulase enzyme has also been used for saccharification of cellulosic materials. About 90 per cent of bagasse pulp was hydrolysed within 24 hr, whereas wheat straw pulp was hydrolysed to the same extent after two enzymic treatments. Three different types of yeast cultures were grown on enzymically hydrolysed pulps of bagasse and wheat straw containing about 2 per cent reducing sugar (RS). Higher concentrations of the enzyme to yield 10 per cent RS could be obtained by concentrating enzyme using Amicon Ultrafiltration assembly and increasing incubation period around 72 hr at 50°C. The yield of single cell protein (SCP) was very encouraging amounting to over 50 per cent in the case of two yeast cultures. The experimental work is being intensified to obtain higher yields of SCP.

Experiments are presently underway to scale up the production of cellulase in a 100 litre capacity fermenter made available by courtesy of a reputed firm. Ultrafiltration and lyophilization techniques have been standardised to concentrate the enzyme 10-fold and eventually into a dry powder.

Study of the Mechanism of Enzyme Hydrolysis of Cellulose and Structural Factors Influencing Enzyme Production by Electron Microscope and X-ray Diffraction

The studies in a companion project have revealed that wheat straw pulp and bagasse are rather poor carbon sources for cellulase production in a medium, but they are very good for saccharification. On the other hand, alkali-treated linters are good source for cellulase production, but not for saccharification, whereas sawdust is effective in both the roles. Many factors could be responsible for this differential response to cellulase enzyme and the objective of this investigation is to get an insight into the biophysical

nature of enzymic degradation of cellulosic substrates. Standardisation of a new technique to record electron diffraction pattern of cellulose to determine crystallinity and crystallite size has proved very helpful in this regard.

Accelerating potential of 75 KV combined with very low beam current and exposure time of 5 sec seem ideal for recording electron diffraction pattern of cooled specimen of cellulose microfibril. Over 16 reflections could be seen distinctly. The structural parameters of ordered regions were : 89 per cent crystallinity index, 72 Å crystallite width and 209-230Å crystallite length. At higher exposure time, about 300 reflections, out to the 10th layer line could be recorded (Plate V).

The above technique is now being used for determining crystallinity and structural parameters of normal and cellulase treated substrates like cotton, bagasse, wheat straw pulp and sawdust.

Electron microscopic observations were also made on the cell wall fragments of above mentioned cellulosic substrates in native state and after enzymic hydrolysis for varying periods.

Production and Application of Desizing Enzymes Active at High Temperatures

Nutritional studies on *Bacillus subtilis*-159 were carried out by incorporating various carbon and nitrogen sources in TNS medium; the sources showing better amylase production were tested for their optimum concentrations. It was found that arabinose 0.2%, inulin 0.5%, maltose 0.2%, xylose 0.4%, sorbitol 1%, dextrin 0.2% and starch 0.5% were optimum levels for amylase synthesis. Some of these sources, viz. inulin, arabinose and xylose, produced some two-fold increase in amylase. Among the nitrogen sources studied, ammonium sulphate 0.2%, peptone 2% and tryptone 2% were found to be superior sources. An optimum C:N ratio in the medium was found to be 1:3, where starch 0.5% and tryptone 1.5% yielded maximum amylase.

Oilseed cakes studied as nitrogen source for the amylase production proved that they were excellent sources and produced more than four times amylase as compared to normal medium (Table 14).

TABLE 14 : EFFECT OF OILSEED CAKES ON AMYLASE PRODUCTION BY *B. subtilis*-195

Oilseed cake	Amylase units/ml
Sesame (black)	148.4
Soyabean	130.0
Sesame (white)	113.2
Sunflower	113.2
Mustard (black)	91.4
Pharmamedia	90.0
Castorseed	83.6
Groundnut	81.6
Cottonseed	80.0
Coconut	75.1
Mustard (red)	38.0
Control (TNS medium)	20.0

The amylase was studied for its stability in presence of starch. It was noticed that the enzyme was very active at 60°C and retained its activity up to 6 hr, a condition desirable for desizing in textile industry.

The starch hydrolysing capacity of *B. subtilis*-159 amylase and other three commercially available amylases which were studied together showed that the *B. subtilis* amylase could be well compared with these enzymes.

Studies in Physical Characteristics of Cotton Blends

During the period, seven varieties with different Micronaire values were selected for blending on the Nepotometer. These were divided into two sets and tested as indicated below :

(*i*) Set I consisted of Hybrid 4, Gujarat 67 and MCU.5 with Micronaire values of 4.0, 3.2 and 3.1, respectively. Hybrid 4 was separately blended with Gujarat 67 and MCU.5 in 50:50 proportion with the help of Cotton Blender and processed through Nepotometer. The Nepotometer grades of the two blends were found to be intermediary between those of Hybrid 4 and the cotton blended. For yarn tests, Hybrid 4, was blended in 50:50 proportion with Gujarat 67 and MCU.5 at blowroom stage and the material was spun to a common count of 60s. Tests for lea strength, single thread strength, yarn evenness and yarn appearance grade were carried out. From the test results, it was noted that there was no improvement in either the lea strength or single thread strength as compared to control, Hybrid 4. However, it was observed that as compared to control, there was a marked improvement in U% and neps per 100 metres of the blends. Yarn appearance grade of the blends showed no improvement.

(*ii*) Set II consisted of Maljari, Digvijay, Pramukh and LSS with Micronaire values of 5.2, 4.4, 3.9 and 3.4, respectively. Maljari was separately blended with Digvijay, Pramukh and LSS in 50:50 proportion with the help of Cotton Blender and processed through Nepotometer. The Nepotometer grades of the blends were found to be intermediary between those of the components. For yarn tests, it is proposed to spin to a common count of 30s. Further work is in progress.

Optimal Blending of Standard Varieties of Indian Cottons

Trials on blends of three varieties of Maharashtra cottons, viz. Gaorani 22, AK.277 and Sanjay (CJ.73), all having similar fibre properties, were taken up first. The following three blends have been spun to 20s and 30s counts on the OM Super High Draft Ring Frame :

Cottons	Blend 1	Blend 2	Blend 3
Gaorani 22	20%	30%	50%
AK.277	50%	20%	30%
Sanjay (CJ.73)	30%	50%	20%

The processing sequence prior to spinning for all the samples was blow-room, carding, two passages of high speed drawing and third passage on O.M. Drawing Frame.

Both 20s and 30s yarns of Blend 3 have been found to be the best in respect of lea CSP and yarn tenacity, followed by Blend 1 and Blend 2. The CSP for both the counts of Blend 3 were significantly high in comparison to Blend 2. The detailed results are given below :

Particulars	Blend 1		Blend 2		Blend 3	
Nominal count	20s	30s	20s	30s	20s	30s
Actual count	20.0	29.6	20.2	29.0	20.3	29.0
Corrected CSP	2180	1607	2125	1532	2222	1671
Single yarn tenacity (g/t)	13.4	11.5	13.3	11.2	13.6	12.1
Breaking elongation (%)	6.4	5.9	6.9	6.2	7.5	6.8
Uster unevenness (%)	17.1	19.9	17.1	20.8	18.3	20.5
Neps/100 m	54.6	73.1	49.9	98.3	36.1	50.0
ASTM Appearance Grade	+C	+C	B	B	B	B

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

During the reporting period, Shyamali cotton was blended with jute caddies in the proportion of 75 : 25. The sample was processed using micro-spinning technique and spun to 6s count using twist multiplier ranging from 4 to 8. The yarns were tested for tensile strength on Instron Tensile Tester. Analysis of the results indicated that the tenacity, elongation and work of rupture of yarn were optimum at twist multiplier 6 and 7. Further, the tenacity of the yarn was found to decrease if the proportion of jute caddies component formed more than 25 per cent in the blend.

Bulk spinning trials were completed on blends of Wagad cotton and jute caddies. The yarns produced from the blends were tested for yarn characteristics. Further, preliminary weaving trials were also conducted from the blended yarns and the fabrics produced were tested for tensile strength using Instron Tensile Tester.

Yarn tenacity and Uster irregularity results for the full scale spinning trials from the blends of Wagad and jute caddies indicated a drop in tenacity

as well as slight increase in irregularity for the blends compared to pure cotton but the differences were not high. Also no difference was noticed between 90 : 10 and 80 : 20 blends, the quality values being more or less identical.

L.147 cotton was blended with jute staple in the proportion 100 : 0, 75 : 25, 67 : 33 and 50 : 50. The samples were processed using microspinning technique and spun to 16s at twist multipliers ranging from 4 to 8. The yarns spun were tested for tenacity and elongation using Instron Tensile Tester. In the case of L.147 cotton and jute staple blends, the pure cotton recorded significantly stronger yarns at all twists than even 75 : 25 cotton-jute staple blends, whereas for the blends with jute caddies, the tenacity values for Shyamali-jute caddies blends of 75 : 25 were similar to that of Shyamali especially at the optimum twist.

Based on the results of microspinning, further bulk trials of cotton and jute staple for three blend compositions, viz. 100 : 0, 90 : 10, and 80 : 20, were completed and the yarns produced from the blended material were tested for yarn characteristics. The test results for full scale spinning trials of L.147 and jute staple blends indicate that the blended yarn quality is inferior to the cotton yarn quality in terms of strength and regularity.

Under the collaborative project, four samples of ramie were received from JTRL for blending with cotton and polyester fibres. During the reporting period, the yarns were spun from the blended material and tested for yarn characteristics.

Studies on Blends of Indian Cottons with Polyester Fibre

Suvin was blended with 1.2 d polyester fibre and the results are summarised in Table 15. It can be seen that the trends for various yarn properties for the different blends were similar to those noticed in the earlier blending trials with other cottons.

TABLE 15 : TEST RESULTS ON BLENDS OF SUVIN WITH POLYESTER

Particulars	Suvin 100%	Suvin 75% polyester 25%	Suvin 50% polyester 50%	Suvin 33% polyester 67%	Polyester 100%
Lea CSP	3055	2686	2508	2688	2799
Single thread tenacity (g/t)	20.3	17.7	17.8	18.2	20.7
Breaking elongation (%) ..	6.7	6.6	7.4	7.9	10·7
Uster evenness (%)	15.5	16.0	16.7	16.4	16.8
Neps/100 m	41	42	42	39	15

Use of Suvin in blends with 1.2 d polyester fibre for 80s yarns was found to improve the strength of the blended yarns considerably in comparison with the yarns produced earlier from 1.5 d polyester and Giza 45 or Sujata cottons. The neps in yarn were also lower compared to the blends with Giza 45 though higher than for blends with Sujata.

Analysis of Blend Composition in Cotton-Polyester Blended Yarns and Fabrics by Infrared Absorption Studies

An infrared method has been standardised for the analysis of cotton-polyester blends. The method is based on the measurement of integrated intensity of the carbonyl (C = O) absorption peak at 1725 cm^{-1} in polyester.

For the determination of the blend composition of unknown blends, a calibration curve was obtained. For this, blends of known compositions were prepared by mixing cotton and polyester in a vibratory ball mill and grinding the mixture for a specified time. Infrared spectra of the mixtures were recorded in KBr matrix using a Perkin-Elmer Model 457 Infrared Sepctro-photometer.

A linear relationship has been found to exist between the product (Ad_ν) of absorbance (A) and bandwidth (d_ν). The latter is influenced by the particle size and it has been established that the degree of grinding attained by polyester in the mechanical blends used for preparing the calibration curve as well as in any unknown sample should be such that the bandwidth variation is not more than 8 cm^{-1}. Yarn samples of various nominal blend compositions were analysed and the results were found to agree well with those obtained by chemical analysis (Table 16).

TABLE 16: BLEND COMPOSITION DETERMINED BY INFRARED AND CHEMICAL METHODS

Sample	Absorbance (A) × Bandwidth (d_ν) (Ad_ν)	Polyester (%)		
		Nominal	By infrared method	By chemical method
SF_1	7.24	25.0	25.0	24.8
SF_2	14.16	50.0	51.0	49.7
SF_3	17.69	67.0	66.0	66.4
HF_1	6.93	25.0	24.5	25.0
HF_2	14.19	50.0	51.0	50.8
HF_3	17.35	67.0	63.5	68.7

S: Sudan cotton; H: Hybrid 4 cotton; F: Polyester.

Wool/Cotton Blends

The above method of blend analysis has been suitably modified for application to wool / cotton blends. Here, simultaneous use is made of the infrared bands of wool and cotton, occurring at 1520 cm^{-1} and 1160 cm^{-1}, respectively. Both these peaks are found to be sensitive to particle size. In the case of the former, even the product (Ad_ν) of the absorbance (A) and bandwidth (d_ν) showed an increase with reduction in particle size, while for the latter, the measurement of bandwidth itself was not possible due to interference from neighbouring bands. The blend composition estimated from the absorption band of either component was, therefore, likely to be in error because the particle size of that component in the unknown sample after ball-milling would in general differ from the particle size of the same component in the mechanical blend used in preparing the calibration curve. Thus, if the grinding has been say, too severe, the independent estimates for the percentage of one component, say wool, will turn out to be higher by the wool peak and lower by the cotton peak than the actual percentage of that component. However, it has been established that the average of the two values would agree closely (within $\pm$ 3 units) with the actual proportion of wool in the blend provided that the two estimates of wool percentage differ by less than 10 units. This has been subsequently verified by tests on yarn and fabric samples, employing chemical analysis (Table 17) as the standard method for comparison.

TABLE 17: COMPARISON OF THE BLEND COMPOSITION ON BLENDED YARNS OBTAINED BY INFRARED AND CHEMICAL METHODS

Sample	% Wool (by infrared method)			% Wool (by chemical analysis)
	From wool band (W)	From cotton band (W')	Average $\frac{(W + W')}{2}$	
Yarn I	58.58	59.75	59.17	59.63
Yarn II	43.83	37.83	40.83	39.46
Yarn III	27.08	24.83	25.95	25.37
Fabric (wool + cotton)	39.42	35.33	37.38	39.33

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

An x-ray diffraction (XRD) method was developed for quantitative analysis of cotton/jute blends. This method is based on the fact that there

is appreciable difference between the resolution of the (101) and (101) peaks in the XRD scans of cotton and jute fibres treated with 3.1 ± 0.05N aqueous NaOH solution.

The XRD method was compared with two other methods developed earlier by other workers elsewhere. Further, two more simple methods were devised and tried. All the methods were found to be equally accurate for analysing synthesised blends. For actual yarn samples, however, the results indicated that the XRD method might be superior to the rest.

Yarns spun from blends of jute caddies as well as jute staple with cotton were analysed by the XRD method (Table 18). The results indicated that there was a preferential loss of jute during processing, the loss being higher when caddies were used. Further, the loss of caddies appeared to increase with the proportion of caddies in the blend, at least in samples having jute in the range 25-50%.

TABLE 18: XRD RESULTS ON COTTON/JUTE BLENDED YARNS

Samples	Blend composition (cotton/jute)	
	Nominal	Experimental
Caddies + Shyamali (6s)	50/50	62/38
	67/33	75/25
	75/25	79/21
Caddies + Wagad (6s)	80/20	85.5/14.5
	90/10	95.5/ 4.5
Staple + L.147 (16s)	50/50	53/47
	67/33	66/34
	75/25	76/24

Preliminary studies indicated that crystallite orientation can be used for blend analysis. Further work in this connection is in progress.

Studies on Deburring of Raw Wool Using Mechanical Device

It was mentioned in the previous report that the installation of a commercial single-roller gin purchased for conducting large scale trials on raw wool samples was in progress.

The work was delayed due to certain manufacturing and machining defects of the parts which were rectified from time to time to suit the requirements.

During the period under report, the assembly of gin parts and the alignment of bearings, etc., has been completed. The gin was also installed. The installation of electric motor as well as preparation of special slide rails and new double Vee groove pulley for direct drive, etc., are in progress.

Evaluation of Protein Composition of Indian Cotton Seeds

During the period under report, 12 cottonseed meal samples were analysed for amino acid content. The results for a few varieties (Table 19) revealed the presence of 17 amino acids in some of the samples. There was marked variation in individual amino acid contents for different samples. Efforts were also made to get a few more samples analysed for amino acids on an Automatic Amino Acid Analyser at the Nuclear Research Laboratory, IARI, New Delhi.

Further, since amino acid analysis of protein on Automatic Amino Acid Analyser did not provide information about tryptophan, one of the essential amino acids which gets destroyed during acid hydrolysis, efforts were made to estimate tryptophan by other methods. After thorough survey of literature a suitable spectrophotometric method was standardised. Tryptophan content in 12 cottonseed protein samples was estimated by this method.

Utilization of Cotton Stalks

It had been mentioned in the last Annual Report that preliminary work had been carried out on the preparation of pressed boards from cotton stalks cut into small chips and treated with resins. During the year under report, several experiments were carried out to determine the optimum condition for gelation of resin when the treatments were given under acidic and alkaline conditions. Further, effects of using different sizes of stalk chips and different concentrations of resin as well as varying the moisture content of the material in the preparation of the boards were also examined. The boards are being tested for various properties such as tensile strength, modulus of rupture, density, extent of swelling in water, etc. Action is being taken to procure a press with temperature and pressure controls for carrying out further work.

RESEARCH WORK DONE AT THE REGIONAL STATIONS

DHARWAR

The effect of different concentrations of gibberallic acid (GA) on the quality of Laxmi cotton (1973-74 season) was studied. Flowers were treated at : (*i*) fertilization, (*ii*) 15 days after fertilization, and (*iii*) 25 days after fertilization. Application of GA 15 days after fertilization increased fibre maturity and strength.

SURAT

The data for five seasons (1971-75) pertaining to the investigation on genetical selection for fibre strength were analysed. Comparing the results

TABLE 19 : AMINO ACID COMPOSITION OF COTTONSEED PROTEIN

Variety	Digvijay	Gujarat 67	MCU. 5	Hybrid 4	BC. 68 × Acala 423/5215/ 8950	Sujata	Mean	Range
Amino acid—g/16 g of meal nitrogen								
Lysine	2.57	3.04	2.87	2.70	2.99	2.82	2.83	2.57- 3.04
Histidine	1.61	2.29	2.60	2.12	2.56	2.19	2.23	1.61- 2.60
Ammonia	1.66	1.19	1.14	1.06	1.27	1.80	1.35	1.06- 1.80
Arginine	9.80	13.35	12.42	12.48	14.45	10.99	12.25	9.80- 14.45
Aspartic acid	7.62	8.34	9.94	9 .86	8.66	8.19	8.77	7.62- 9.94
Threonine	1.67	1.90	2.01	2.16	1.94	2.27	1.99	1.67- 2.27
Serine	2.17	2.90	3.86	3.36	2.97	4.13	3.23	2.17- 3.86
Glutamic acid	21.08	20.53	25.09	26.70	27.32	28.46	24.86	20.53- 28.46
Proline	1.73	1.49	1.71	1.60	1.68	1.61	1.64	1.49- 1.73
Glycine	4.16	4.40	4.81	4.94	5.07	5.55	4.82	4.16- 5.55
Alanine	2.25	2.39	2.85	2.89	2.51	3.15	2.67	2.25- 3.15
Cystine	26.25	25.04	12.16	10.64	8.12	14.42	16.10	8.12- 26.25
Valine	—	—	—	0.81	—	—	—	—
Methionine	1.42	—	1.02	2.82	0.72	0.78	1.13	0.72- 2.82
Isoleucine	2.51	1.67	2.71	2.28	1.93	1.76	2.14	1.67- 2.71
Leucine	5.29	4.66	5.63	5.57	5.02	4.81	5.16	4.66- 5.63
Tyrosine	1.45	0.87	1.41	1.37	1.14	1.01	1.21	0.87- 1.45
Phenylalanine	2.41	2.22	3.28	3.34	2.77	2.16	2.70	2.16- 3.34
Tryptophan	0.98	1.41	1.52	1.20	0.97	1.77	1.31	0.97- 1.77

of 1975 with those of the base year 1971 (when selection was initiated), the varieties 500-1395, 2681, 2236 and IAN.4618 revealed upward trend in tenacity, while the remaining varieties showed no appreciable change in tenacity. It seems, therefore, that the varieties either differ in their nature of response to this mode of selection or are in different stages of stabilization. The plan of this experiment is being modified in the light of these observations.

Earlier work on the occurence of green fuzz in ginned lint had been carried out using the hand gin. During the period, confirmatory tests were done on the Laboratory Model Power Gin. The results obtained on the Laboratory Gin confirmed the previous findings.

HISSAR

The influence of defoliants was studied on *desi* cotton G.27 during 1973-75 seasons and it was found that defoliants had no influence on the fibre properties of G.27 cotton.

III. Publications

During 1976, one Annual Report, two Technological Reports, 17 Research Publications and 72 Technologial Circulars were issued, in addition to one Miscellaneous Publication and nine Articles/Papers published in various journals, conference proceedings, etc. Apart from this, eight articles were sent for publication.

A. Annual Report

Annual Report of the Cotton Technological Research Laboratory for the calendar year 1975.

B. Technological Reports

No. 17. Technological Report on Trade Varieties of Indian Cottons, 1973-74 and 1974-75 Seasons.

No. 18. Technological Report on Standard Indian Cottons, 1973-74 and 1974-75 Seasons.

C. Miscellaneous Publication

Seminar on Cotton Production and Technology — by V. Sundaram and S. M. Betrabet.

D. Research Publications (CTRL Publications—New Series)

No. 67. Technical Survey of Ginning Factories in Gujarat, Maharashtra and Tamil Nadu (A Joint Survey by CTRL, ATIRA, BTRA and SITRA)—by G. S. Rajaraman, D. G. Shete, V. Sundaram, J. M. Grover, N. Balasubramanian and K. P. R. Pillay.

No. 68. Varietal Response of Indian Cottons to Easy-Care Finishing—by S. M. Betrabet (reprinted from *Journal of the Indian Society for Cotton Improvement*, March, 1976 issue).

No. 69. Revision of Staple Length Classification of Indian Cottons— by V. Sundaram (reprinted from *Journal of the Indian Society for Cotton Improvement*, March, 1976 issue).

No. 70. Effect of Combing on Spinning Performance of Quality Cottons — by B. Srinathan, S. Ramanathan, V. Sundaram and M. S. Parthasarathy (Reprinted from the *Indian Textile Journal*, May, 1976 issue).

No. 71. Irradiation of Cellulose in Presence of Various Radio-sensitive and Radio-protective Chemicals — by (Kum.) I. G. Bhatt, V. Sundaram, Jai Prakash, (Smt.) V. Iyer and A. W. Shringarpure (Reprinted from *Colourage*, May, 1976 issue).

No. 72. An Infrared Technique for the Quick Analysis of Cotton-Polyester Blends — by (Smt.) P. Bhama Iyer, K. R. Krishna Iyer and N. B. Patil (reprinted from *Journal of Applied Polymer Science*, 20, 591-595, 1976).

No. 73. Infrared Bands and Cellulose Crystallinity : A New IR Ratio for Measuring Crystallinity of Native Cellulose—by (Smt). P. Bhama Iyer, K. R. Krishna Iyer and N. B. Patil (reprinted from the Proceedings of the Seventeenth Joint Technological Conference held at SITRA, February, 1976).

No. 74. Evaluation of Techniques for Measurement of Neps — by P. K. Jairam, M. S. Parthasarathy and V. Sundaram (reprinted from the Proceedings of the Seventeenth Joint Technological Conference held at SITRA, February, 1976).

No. 75. Cellulolysis of Cotton Fibre in Indian Environment and Cellulase Enzyme — by S. M. Betrabet (reprinted from the *Journal of Scientific and Industrial Research*, 35, No. 3, 152-162, March, 1976 issue).

No. 76. Cellulase Dissolution Technique for the Study of Chemically Modified and Crosslinked Cotton — by S. M. Betrabet and K. M. Paralikar (reprinted from *Journal of Applied Polymer Science*, 20, 1651-1660, 1976).

No. 77. Comparative Performance of Different Drafting Systems — by B. Srinathan, P. G. Oka, A. V. Ukidve and K. S. Bhyrappa (reprinted from the *Indian Textile Journal*, September, 1976 issue).

No. 78. Cotton Linters : Production, Analysis and Grading in India — by V. Sundaram and S. N. Panday (reprinted from *Journal of the Indian Society for Cotton Improvement*, September, 1976 issue).

No. 79. The Effect of Insecticidal Treatments on the Fibre Quality of Sujata Cotton — by V. G. Munshi, (Smt.) S. B. Pai and G. Vedamoorthy (reprinted from *Journal of the Indian Society for Cotton Improvement*, September, 1976 issue).

No. 80. Know Your Cotton : (1) Suvin —by K. Dharmarajulu, K. V. Srinivasan and V. Sundaram (reprinted from *Journal of the Indian Society for Cotton Improvement*, September, 1976 issue).

No. 81. Nomenclature of Cotton Strains and Varieties — V. Sundaram (reprinted from *Journal of the Indian Society for Cotton Improvement*, September, 1976 issue).

No. 82. Order in Cellulose Fibres — by P. K. Chidambareswaran, N. B. Patil and V. Sundaram (reprinted from the notes in *Journal of Applied Polymer Science*, 20, 1976).

No. 83. Enzymic Desizing of Fabrics Sized with Tamarind Kernel Powder — by S. M. Betrabet, V. G. Khandeparkar and (Smt.) S. P. Bhatawdekar (reprinted from the *Journal of the Textile Association*, December, 1976 issue).

E. Articles and Papers

(*a*) *Published*

1. "Microprojecta" — A. Project Out-fit for Optical Microscopes —by V. G. Munshi (*Journal of the IMDA Instruments India*, May, 1976).

2. Influence of Some Fibre Length Parameters on the Yarn Long-term Variations — Short Communication — by A. V. Ukidve, P. G. Oka and (Kum.) C. R. Raje (*Journal of the Textile Association*, June, 1976).

3. Recent Progress on Durable Press Cotton — by S. N. Pandey (*Textile Industry and Trade Journal*, Jan.-Feb., 1976).

4. Electron Diffraction Technique for the Determination of Cellulose Crystallinity — by K. M. Paralikar and S. M. Betrabet (*Journal of Applied Polymer Science*, August, 1976).

5. X-ray Diffraction Studies on Cotton-Jute Blends — by P. K. Chidambareswaran, S. Sreenivasan, N. B. Patil, V. Sundaram and B. Srinathan (*Journal of Applied Polymer Science*, December, 1976).

(*b*) *Presented at Conferences/Seminars*

1. Varietal Response of Indian Cottons to Easy-care Finishing — by S. M. Betrabet, (Course in Cotton Production and Technology, organised by the Agricultural University, Dharwar, January 26, 1976).

2. Utilisation of Cotton Plant Products other than Cotton Fibre — by V. Sundaram and S. N. Pandey (The Seminar on Prospects and Plans for Agro-Industrial Development in Vidarbha Region at Amravati in October, 1976).

3. Nutritional Requirements and Media for the Production of Cellulase by *Penicilium funiculosum* (F_4) — by V. G. Khandeparkar and S. M. Betrabet (17th Annual Conference of Association of Microbiologists of India at Manipal in December, 1976).

4. Some Electron Microscopical and Electron Diffraction Techniques Developed at CTRL for the Study of Normal and Chemically Modified Cotton Cellulose — by S. M. Betrabet (9th Annual Conference of Electron Microscope Society of India (EMSI) at Lucknow, December 1976).

(*c*) *Sent for Publication*

1. Utilisation of Cotton Seed and Its Products — by S. N. Pandey (*Journal of Cotton Development*).

2. CTRL Methods of Cotton Quality Evaluation — by V. G. Munshi (*CCI Bulletin—Cotton News*).

3. Sol-gel Studies of Chemically Modified Cellulose — by S. N. Pandey and (Smt.) Prema Nair (*Indian Journal of Textile Research*).

4. A Note on Elongation Properties of Indian Cotton — by V. G. Munshi, S. D. Pai and J. K. S. Warrier (*Indian Journal of Textile Research*).

5. Effect of Accelerating Potential on the Determination of Structural Parameters of Cellulose by Electron Diffraction Technique — by K. M. Paralikar and S. M. Betrabet (*Journal of Applied Polymer Science*).

6. The Cross-Sectional Shape of Different Textile Fibres — by B. M. Petkar and P. G. Oka (*Colourage*).

7. 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 (*Colourage*).
8. Critical Analysis of the Technological Performance of the Strains Tried in the Coordinated Varietal Trials in North Zone — by P. G. Oka, K. V. Ananthakrishnan and V. Sundaram (*Cotton Development Journal*).

F. Technological Circulars

1. On Trade Varieties of Indian Cottons—Nos. 1825 to 1834 for 1974-75 season and Nos. 1835 to 1875 for 1975-76 season.
2. On Standard Indian Cottons—Nos. 119 to 131 for 1974-75 season and Nos. 132-139 for 1975-76 season.

TRADE VARIETIES OF INDIAN COTTONS

T.C. No.	*Variety*	*T.C. No.*	*Variety*
1825	Digvijay (Kapadvanj)	1851	Khandwa 2
1826	Sujay (3943)	1852	Badnawar 1
1827	G.22 (Bidar)	1853	Hybrid 4 (Khargone)
1828	Virnar	1854	Hybrid 4 (Karjan)
1829	Deviraj (Gokak)	1855	Hybrid 4 (Navsari)
1830	Sujata	1856	Hampi (Raichur)
1831	Hampi (Raichur)	1857	S.I. Andrews (Shimoga)
1832	320F (Rajasthan)	1858	Varalaxmi (Ganapavaram)
1833	Suyodhar	1859	Varalaxmi (Idar)
1834	Hybrid 4 (Karjan)	1860	Laxmi (Raichur)
1835	Sanjay (Botad)	1861	Buri 147 (Vidarbha)
1836	Desi (Rajasthan)	1862	AK.235
1837	Laxmi (Baramati)	1863	Hybrid 4 (Parbhani)
1838	Desi (Punjab)	1864	SRT.1
1839	320F (Ganganagar)	1865	Digvijay (Palej)
1840	Maljari (Khargone)	1866	Digvijay (Dabhoi)
1841	J.34 (Ganganagar)	1867	Karunganni
1842	MCU.5 (Guntur)	1868	MCU.5 (Tiruppur)
1843	Deviraj (Manavdar)	1869	Sujata (Tiruppur)
1844	Deviraj (Gokak)	1870	Varalaxmi (Tiruppur)
1845	Buri 1007 (Vidarbha)	1871	Suvin (Tiruppur)
1846	Y.1	1872	Bhagya (Gadag)
1847	Nimbkar	1873	Wagad (Morvi)
1848	Hybrid 4 (Vadali)	1874	Laxmi (Gadag)
1849	Jayadhar (Raichur)	1875	V.797 (Bavla)
1850	Narmada (Khandwa)		

Standard Indian Cottons

S.C. No.	*Variety*	*S.C. No.*	*Variety*
119	K.8	130	Westerns
120	Laxmi (Gadag)	131	Hampi (Siruguppa)
121	Sujay (Surat)	132	Laxmi (Kopargaon)
122	Gaorani 46	133	Deviraj (Junagadh)
123	Laxmi (Kopargaon)	134	Hybrid 4 (Surat)
124	Virnar	135	Sujay (Surat)
125	Deviraj (Junagadh)	136	Buri 147
126	Deviraj (Arabhavi)	137	V.797 (Viramgam)
127	S.I. Andrews (Shimoga)	138	Virnar
128	Jayadhar	139	Hampi (Siruguppa)
129	Buri 147		

IV. Extension

Since the Laboratory has no farm attached to it, field work is carried out at various Central Institutes, Agricultural Universities and Agricultural Stations in different states and thus the Laboratory does not directly deal with the farmers. But the Laboratory renders indirectly valuable assistance to growers, the trade, the industry, government and civic organisations, etc., by issuing circulars on Trade Varieties of cotton, by undertaking tests on samples, by imparting training in Cotton Technology and by suppyling useful testing instruments.

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 to be carried out on payment of the prescribed test fees, from commercial firms and government and semi-government organisations. The number of samples received for various tests during the year, together with the corresponding figures for 1974 and 1975 and for the quinquennium 1971-75 are given in Table 20.

TABLE 20: NUMBER OF SAMPLES RECEIVED FOR PAID TESTS

Type of test	Average for the quinquennium 1971-75	1974	1975	1976
Spinning	10	2	27	22
Fibre (EICA)*	16	66	248	250
Fibre (others)	193	92	247	77
Yarn	37	37	27	42
Cloth	48	26	67	61
Moisture	73	76	32	—
Miscellaneous	8	1	1	4
Total	385	300	649	456

* These samples from the East India Cotton Association (EICA), Limited, Bombay, are tested free of charge as EICA reciprocates by supplying free of charge, a numbrr 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 1976 for carrying out tests on these samples amounted to Rs. 18,114.20 against Rs. 22,014.00 during 1975.

In addition to the usual tests of routine nature the following special tests were carried out on some of the samples received for paid tests :

1. Two kapok samples were tested for trash content. It was observed that one sample had 1.8% trash content, while the other had trash content of 1.3%.

2. Two samples of polyester fibres marked A and B were received for determination of denier and breaking tenacity. The denier and breaking tenacity of sample A were 1.44 d and 5.2 g/d, respectively, while the corresponding values for samples B were 1.37 d and 4.7 g/d.

3. Two spun tow samples received from a firm were tested for assessing cross-sectional diameter and C.V. % of diameter. Photo micrographs of the cross-sections were also supplied.

4. Two samples of nylon yarn submitted by an indigenous manufacturer were tested for breaking tenacity, crystallite orientation, crystallinity index and denier. The photomicrographs for the two samples were also supplied.

5. Isomed Section, R & D group, BARC, sent 8 samples of Linen suture surgical thread for determination of knotted breaking strength and cross-sectional diameter.

6. Central Warehousing Corporation, Bombay, had sent two samples of HDPE bags for tensile strength test. In addition, tapes taken out from the bags were tested for denier and breaking strength.

7. One cloth sample sent by the Textile Committee was tested for mildew resistance test. It was observed that the fabric was not protected against mildew.

8. Two woven Roving fabrics were submitted by M/s. Fibreglass Pilkington Ltd., Thane, for tensile strength determination. It was observed that the breaking strength of the heavy-weight sample (610 g/m^2) was higher than that of the light-weight (360 g/m^2) sample by about 100 kg.

Training

The facilities available at CTRL were availed of for imparting training in the evaluation of cotton fibre quality to a scientist from the USSR deputed under the Indo-USSR Protocol for Scientific and Technical Co-operation

in the field of Agriculture. The Scientist, Dr. F. A. Verkhoturtsev, Chief of the Laboratory for Technology of Cotton Fibre, Central Cotton Seed Station, USSR Ministry of Agriculture, Tashkent, spent about 90 days, from the 20th September, 1976, to the 18th December, 1976, at CTRL, Bombay, and two of its regional stations, at Surat and Coimbatore, to study accelerated methods for evaluation of cotton quality in relation to cotton breeding research. He underwent a special course of lectures and practical work pertaining to methods for evaluation of fibre characters, microspining and full spinning tests, yarn quality evaluation, statistical analysis, etc.

Another foreign trainee, Mr. F. W. Igothi sponsored by Messrs Kisumu Cotton Mills Ltd., Kisumu, Kenya, was admitted to a special training course against the reserved quota for nominees of the Government of India. He spent a period of four months at CTRL, from the 12th July, 1976, to the 12th November, 1976, and underwent intensive training in : (*i*) ginning of seed cotton (*kapas*), (*ii*) fibre quality evaluation, (*iii*) microspinning and full spinning techniques, (*iv*) yarn quality evaluation, and (*v*) statistical analysis.

In addition to the above, the Laboratory conducted, as usual, two full-time training courses, one from July to September, and the other from September to November, for candidates deputed by cotton trading organisations in Bombay and mofussil centres. Each training course lasting for eight weeks consisted of lectures and practical work on methods for evaluation of cotton fibre quality and statistical analysis and interpretation of the test results. The following persons attended the training courses held during the year :

1. Shri P. M. Peer,
   C/o. M/s. D. Mulji & Co.,
   19/10, Azad Nagar, Wadala, Bombay 400 031.

2. Shri S. G. Nagda,
   C/o. M/s. Kanji Shivaji &Co.,
   116, Keshavji Naik Road,
   Bombay 400 009.

3. Shri V. A. Gangan,
   C/o. M/s. Patel Cotton Co. Ltd.,
   19, Graham Road, Bombay 400 038.

4. Shri S. J. Shah,
   C/o. Bhaidas Cursondas & Co.,
   16, Bombay Samachar Marg,
   Bombay 400 001.

5. Shri K. M. Mehta,
C/o. M/s. Devchand Panachand & Co.,
Indira Gandhi Marg, Morvi, Gujarat 363 641.

6. Shri Y. J. Sanghvi,
C/o. M/s. Kirchand Sunderji Sanghvi,
Morvi, Gujarat.

7. Shri R. N. Shah,
C/o. M/s. Ramakrishnawala Industries,
Limbdi, Gujarat 363 421.

8. Shri N. M. Morolia,
C/o. M/s. Morolia & Sons,
Balaji Plots, Khamgaon, Maharashtra.

V. Conferences and Symposia

The Director and other scientists of the Laboratory participated in the following scientific and technological conferences and meetings connected with the work of this labortory.

S. No.	Meeting/Conference	Place	Date	Names of the officers who attended the meeting/conference
1.	Fifth Meeting of Advisory Sub-Committee for Research and Liaison (Physics, Physical Testing & Electronics) of BTRA, Bombay.	Bombay	3-1-1976	Dr. V. Sundaram
2.	Second Meeting of the Sub-Committee on Trade, Pricing and Exports of Cotton Development Council, Bombay.	Bombay	24-1-1976	Dr. V. Sundaram
3.	Course in Cotton Production and Technology, University of Agricultural Sciences, Dharwar.	Dharwar	26-1-1976	Dr. S. M. Betrabet
4.	Symposium on 'The Physical Chemistry of Dyeing and Finishing Processes' of the Centre of Advanced Study, UDCT, Bombay.	Bombay	1-2-1976	Dr. S. M. Betrabet and Dr. S. N. Pandey
5.	Meeting of the Committee set up by the Ministry of Commerce to Examine the Question of Bringing up the Average Count of the Cotton Textile Industry to a Finer Level, held at the Office of the Textile Commissioner, Bombay.	Bombay	2-2-1976	Dr. V. Sundaram
6.	Meeting of the Standing Committee on Cotton of ICMF and Third Meeting of the Cotton Research Advisory Sub-Committee of ICMF, Bombay.	Bombay	12-2-1976	Dr. V. Sundaram
7.	17th Joint Technological Conference (ATIRA, BTRA and SITRA), held at SITRA, Coimbatore.	Coimbatore	14-2-1976 and 15-2-1976	Dr. V. Sundaram Dr. N. B. Patil Shri M. S. Parthasarathy Shri P. K. Jairam Dr. (Smt.) P. Bhama Iyer
8.	Conference of the Directors of the ICAR Institutes held at Krishi Bhavan, New Delhi	New Delhi	4-3-1976 to 10-3-1976	Dr. V. Sundaram

CONFERENCES AND SYMPOSIA

S. No.	Meeting/Conference	Place	Date	Names of the officers who attended the meeting/conference
9.	Third International Conference on Culture Collections Organised by the World Federation for Culture Collections (WFCC) held at University of Bombay.	Bombay	15-3-1976 to 19-3-1976	Dr. V. G. Khandeparkar
10.	Four Day Course-cum-Workshop on 'Gas Chromatography and Its Application', held at BARC, Bombay.	Bombay	5-4-1976 to 8-4-1976	Shri N. Thejappa
11.	Meeting of Polymers and Fibres Research Committee of CSIR held at SASMIRA, Bombay.	Bombay	23-4-1976	Dr. V. Sundaram
12.	Symposium on Management of Spinning Technology, Labour and Management Organised by the Textile Association, Bombay.	Bombay	23-4-1976 and 24-4-1976	Shri M. S. Parthasarathy
13.	Seminar on 'Production and Utilisation of Cotton Linters in India' Organised by All India Cotton Seed Crushers' Association.	Bombay	29-4-1976 and 30-4-1976	Dr. S. M. Betrabet Dr. S. N. Pandey Kum. I. G. Bhatt
14.	Meeting on 'Inspection for Mercerisation' arranged by Export Promotion Council, Bombay.	Bombay	4-6-1976	Kum. I. G. Bhatt
15.	Seminar on Cotton arranged by Andhra Pradesh Cotton Association, Guntur.	Guntur	14-6-1976 and 15-6-1976	Shri P. G. Oka
16.	Meeting of the Representatives of the State Governments Agricultural Univertities of Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Madhya Pradesh and Tamil Nadu held at College of Agriculture, Nagpur, to Discuss and Evolve a Coordinated Approach for Hybrid Seed Production Programme for Cotton in the Entire Country	Nagpur	23-8-1976	Dr. V. Sundaram
17.	Seminar on 'Performance of Pneumafils in Spinning Processes' arranged by BTRA, Bombay.	Bombay	26-8-1976	Shri M. S. Parthasarathy
18.	Fourth Meeting of the Cotton Research Advisory Sub-Commitee of ICMF, Bombay.	Bombay	14-9-1976	Dr. V. Sundaram
19.	Seminar on 'Access to Bibliographic Data Bases' arranged by BARC, DRTC and INSDOC.	Bombay	18-9-1976	Kum. Rachael Varghese
20.	Meeting of the Inter-Organizational Panel for Food and Agriculture of Indian Council of Agricultural Research, New Delhi.	New Delhi	21-9-1976	Dr. V. Sundaram

S. No.	Meeting/Conference	Place	Date	Names of the officers who attended the meeting/conference
21.	Agro-Industries Seminar Organised by the Development Corporation of Vidarbha Limited, Nagpur.	Amravati	9-10-1976 and 10-10-1976	Dr. S. N. Pandey
22.	Third Meeting of the Research and Development Sub-Committee of Indian Cotton Development Council.	Baroda	29-10-1976	Shri G. S. Rajaraman
23.	Group Discussion on Processing of Superior Indian Cottons, Arranged by the Textie Association (India), Bombay.	Bombay	13-11-1976	Shri M. S. Parthasarathy
24.	Symposium on World Instrumentation and International Exhibition of Scientific Instruments.	New Delhi	22-11-1976 to 26-11-1976	Dr. N. B. Patil
25.	Nineth Annual Conference of Electron Microscope Society.	Lucknow	6-12-1976 to 9-12-1976	Dr. S. M. Betrabet Shri K. M. Paralikar
26.	Workshop-Seminar on Applications of TEM and SEM.	Lucknow	9-12-1976 to 13-12-1976	Shri K. M. Paralikar
27.	17th Annual Conference of Association of Microbiologists of India.	Manipal	13-12-1976 to 15-12-1976	Dr. V. G. Khandeparkar

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

As a member of the Expert Committee on classification of Indian cottons, the Director attended meetings of this Committeee and also participated in the drafting of the Final Report of the Committe which was submitted to the Textile Commissioner, Ministry of Commerce, Government of India, in February, 1976.

The Director was nominated as representative of Indian Council of Agricultural Research on the Committee appointed by the Ministry of Commerce to go into the nexus between the price of *kapas* and mill gate price of cotton and the present relationship between the price of *kapas*, mill gate prices of cotton and the prices of yarn/cloth. In addition to the Director, Shri M. S. Parthasarathy, Senior Scientist (Mechanical Processing), also actively participated in various meetings of this Committee.

The Director also attended various meetings of the Governing Council of Bombay Textile Research Associaton as well as of the Board of Management of Victoria Jubilee Technical Institute, Bombay.

VI. Summary of the Report

This is the 53rd Annual Report of CTRL for the year 1976. As in the past, this year also the research activities progressed very satisfactorily. The Laboratory continued to function as the coordinating centre on cotton technology under the AICCIP as also to collaborate actively in the research for evolving new strains of cotton by evaluating the quality characteristics of the improved cotton strains. In addition, several samples of cotton, yarn and fabric received from trade and industry for paid tests were evaluated for different quality characteristics. Various research projects on fundamental studies in fibre physics, ginning and spinning technology, textile chemistry, microscopy and microbiology were undertaken, apart from the regular testing and evaluation work and several papers based on these investigations were sent for publication. Many new items of equipment and books were purchased and added during the year.

The financial year 1975-76 showed an increased expenditure of Rs. 24.18 lakhs as against the sanctioned grant of Rs. 22.90 lakhs. Again, an expenditure of Rs. 6.67 lakhs was incurred under the Fifth Plan Scheme for modernisation and strengthening of CTRL for intensive research against the sanctioned grant of Rs. 8 lakhs leaving a sum of Rs. 1.33 lakhs unutilised. The savings were due to non-materialisation of purchase of equipments. As far as the five Ad-hoc schemes and Inter-institutional projects are concerned, there was a total saving of Rs. 1.70 lakhs, the reason being non-filling up of certain posts and non-materialisation of purchases of equipments during the year.

Research Activities

The progress made on various research investigations during 1976 is summarised below :

Under the AICCIP and various schemes sponsored by Agricultural Universities, State Governments, etc., for evolving new varieties of cotton and for improving cotton production in the country, 1694 samples were tested for fibre quality and spinning performance.

At the panel meetings held at Hissar, Pune and Bangalore, the following four new varieties have been recommended for release for general cultivation :

Variety	*Area*
LD.133	Desi tracts of Punjab.
F.414	Punjab.
JK.97	Dharwar, Bellary, Shimoga and Hassan districts of Karnataka and also the irrigated tracts of Bijapur and Raichur of Karnataka.
CP.15-2 (Suman) ..	Tamil Nadu.

A Hybrid JKHy.1 was released by Jawaharlal Nehru Krishi Vishwa Vidyalaya, Indore, for cultivation in Madhya Pradesh.

In addition, the following strains exhibited promising potentials :

Strain	*Station*
H.655C	Hissar
CPH.2	Coimbatore
RHR.253	Rahuri

Gossypium barbadense variety Suvin continued to give excellent performance. A sample received from Guntur recorded mean fibre length of 36 mm (1.42 in.) with a spinning potential of 120s.

The pilot model of the CTRL Kapas Extractor, designed and fabricated at the Laboratory was tested for cleaning efficiency and it was observed that most of the heavy trash was removed from *kapas* by the Extractor and that the Extractor could feed two single roller gins or one double roller gin in continuous operation. It was also observed that processing of *kapas* through the Extractor did not affect the ginning outturn nor did it cause any fibre damage. Arrangement for the fabrication of the Extractor for commercial exploitation is being negotiated through NRDC.

During personal visits undertaken by the officers of CTRL in the States of Punjab, Haryana and Rajasthan in connection with the technical survey of ginning factories, it was observed that many of the factories did not work to the full capacity. Further, the working conditions in these factories could be improved to some extent by revising suitably the legislations affecting the factory owners and workers.

Cotton lint samples, opened both by the Lint Opener fabricated at the Laboratory and the Shirley Analyser, were subjected to Micronaire and maturity tests. It was observed that the Micronaire and maturity values were practically the same for the samples opened by both the instruments.

Indian grader's length closely agreed with the values of halo length, 5.5% span length and mean length, while it was much lower than the values of effective length and 2.5% span length.

Using the Interferometric Fibre Stapler (IFS) and the Digital Fibrograph (DF), the 2.5% and 50% span lengths were obtained for 50 samples

as the distances from the clamp at which the tuft thickness reached 2.5% and 50% of its maximum value and the Uniformity Ratio (UR) was calculated as the ratio of the 50% span length to 2.5% span length. A high correlation was found between the 2.5% span lengths obtained by IFS and DF, while URs from IFS and DF were poorly correlated. Further, 4% span length from IFS nearly coincided with the Balls Sorter mean length.

The observations made on linear density and breaking load of individual fibres belonging to 12 different varieties of cotton covering all the four botanical species revealed that except in the case of cottons belonging to *G. herbaceum* the increase in tenacity under wet conditions was quite significant for fibres with lower and higher linear density compared to those having medium linear density values. In the case of *G. herbaceum* cottons, fibres having considerably lower linear density than the mean alone showed an increase in wet breaking tenacity. The breaking elongation under wet conditions, on the other hand, did not show any dependence on linear density.

Ten cottons belonging to the four botanical species were tested to study the fibre elongation characteristics on stelometer at 1/8 in. (E1) and 1/4 in. (E2) gauge lengths. It was observed that as the gauge length increased, the elongation at break also increased by about 3 to 5 units for all the cottons. A highly significant correlation was observed between E1 and E2.

To study the bulk resilience of cotton, some preliminary trials are underway to standardise the conditions for carrying out the tests on the Instron Tensile Tester.

It was observed that breaking load and breaking extension of CH_2O crosslinked cellulose films progressively decreased with increase in concentration, whereas in the case of DMDHEU treated films, there was an increase in strength and a decrease in breaking extension. Even though the longitudinal modulus did not show any significant change, the lateral compression modulus was found to increase with both the treatments. Comparison of the present results on cellulose films with the results on cotton fibres reported earlier leads to the inference that the morphology of cotton must be responsible for the absence of change in the lateral modulus of the cotton fibre.

Determination of circularity of fibres from cotton boll of the *G. barbadense* species, Suvin, picked at the intervals of 35, 42, 49 and 56 days showed that circularity of fibre cross-section increased with increase in the age of the boll.

The slack swelling of cotton with aqueous ethylenediamine (EDA) and Sodium Hydroxide (NaOH) solution was found to improve orientation with increasing concentration, even though the crystallite dispersion angle (α) was changed irregularly. The orientation factors derived from the equatorial and meridional x-ray reflections were observed to be almost identical in the highly stretched samples.

The Infrared absorption band occuring at 342 cm^{-1} in the spectrum of cellulose was found more suitable to estimate the degree of crystallinity in

cotton than the bands at 893 cm^{-1} and 1372 cm^{-1} used by earlier workers, the advantages being (*i*) near horizontal base line which leads to the derivation of unambiguous absorbance values and (*ii*) high sensitiveness at the levels of crystallinity generally found in cotton fibres. The new crystallinity Index $\frac{a_{342}}{a_{2900}}$ when compared with the earlier ones, has shown only small differences in crystallinity between cottons of a given species as also between different species.

Two extra-long staple cottons, viz. Suvin and Hybrid 5, which had the same length, but differed in maturity values, were processed using different machine combinations in the blowroom. The measurement of individual cleaning efficiencies exhibited differences consistent with the earlier findings, viz. combinations using Shirley Opener recorded higher cleaning efficiency. Processing of Hybrid 5 through SRRL and Shirley Opener, however, lowered the yarn strength due to fibre rupture.

The blowroom laps of the two varieties MCU.5 and Gujarat 67 were processed on conventional card using : (*i*) flexible tops and (*ii*) semi-rigid tops. There was considerable reduction in the percentage of flat strips and the nep count of the carded sliver, when semi-rigid tops were used. Comparative tests on yarn spun from flexible and semi-rigid tops showed that the use of either flexible or semi-rigid tops did not affect yarn quality even though a slight increase in the neps/100 m was noticeable for yarn spun using semi-rigid tops.

Comparative study of the three different systems of processing, viz. SKF, OMS and Casa A.500, has been continued by spinning 55 more samples using microspinning technique. Wide variation was observed between the lea strength values of micro spun samples and bulk spun samples. The differences in CSP values between duplicate lots of micro spun samples also were significant.

A new equation, namely, CSP = 8 (count + 200), upgrading the existing CTRL norms by about 14% has been proposed for fixation of yarn strength standards based on the data of different cotton varieties spun using both conventional and SKF drafting systems.

A new procedure has been developed to estimate the rate of fall in yarn strength from the lea test results of the yarn tested. This enables an accurate determination of the appropriate yarn strength for the particular count. As this procedure was found to be more scientific than the existing methods which derived the rates of fall on an arbitrary basis from other samples, this procedure has been accepted by the Indian Standards Institution as the standard procedure.

Data relating to Uster evenness, Uster imperfections, Uster single thread strength, lea strength and ASTM yarn appearance grade, collected on 30 samples of different counts, were analysed and correlations were worked out between yarn appearance grade index and other yarn properties and also

between Uster evenness values and imperfections. Based on the data collected for 50 samples of various counts ranging from 20s to 80s, tentative norms for Uster value (U%) and neps per 100 m have been proposed.

For evaluation of techniques for measurement of neps, the data collected were analysed, countwise, for 20s, 30s, 40s, 60s and 80s yarns and species-wise for cottons, sliver, etc. It was observed that among the various fibre properties, immaturity, 2.5% span length, and Micronaire value had the highest influence on neps in card web for *G. arboreum* and *G. hirsutum* cottons, while 2.5% span length and Micronaire value had greatest influence in the case of *G. barbadense* and *G. hirsutum* cottons. It was also found that *G. barbadense* and *G. hirsutum* cottons showed poorer relationship between card neps and fibre properties compared to *desi* cottons and that the yarn appearance showed more significant association with the nep count in yarn than with the number of thick or thin places.

Of the nine cotton varieties, viz. Laxmi, Bhagya, Buri 147, Karunganni 7, Pramukh, Jayadhar, Virnar, Gaorani 6 and Gaorani 22, screened after giving standard DMDHEU treatment, the varieties Bhagya among *hirsutums*, and Jayadhar, Gaorani 6 and Virnar among *desi* showed better retention of mechanical properties. A rapid method was also standardised to predict Crease Recovery Angle (CRA) of a crosslinked fabric from CRA value obtained on crosslinked yarn of the cottons under study. A Laboratory model mercerization unit was fabricated for pre-swelling the yarn under tension before crosslinking treatment to improve the retention of mechanical properties.

Studies on Distention Index (DI) and distribution of crosslinks in the network structure of cellulose samples crosslinked with formaldehyde indicated that at different levels of formaldehyde content of cellulose, increasing order of crosslink density in the gel was form D < form W and that the volume of swollen gel and DI decreased as the number of crosslinks per glucopyranosyl unit (GPU) increased.

Comparative study on six cotton varieties crosslinked using pre-irradiation technique and chemical method to the same level of formaldehyde uptake showed that tenacity retention was better in the case of the samples crosslinked using pre-irradiation technique. A method to evaluate the post-irradiation activity was also standardised.

An enzymic method for desizing fabrics sized with Tamarind Kernel Powder (TKP) and low viscosity TKP (LTKP) has been standardised using cellulase enzyme of *Penicillium funiculosum* (F4). A complete specification for a patent for the desizing process has been filed. This enzyme has also been used for the saccharification of various cellulosic materials, such as wheat straw pulp, bagasse, cotton linters, etc. Experiments are also underway to enhance the production of cellulase in a 100 litre fermenter. Further, ultrafiltration and lyophilisation techniques have been standardised to concentrate the enzyme 10-fold and eventually into a powder.

To get an insight into the biophysical nature of enzymic degradation of cellulosic substrates, electron diffraction pattern of cooled specimen of cellulose microfibril at an accelerating potential of 75 kV combined with very low beam current and exposure time of 5 sec was found to be ideal. This technique is now being used for the determination of crystallinity and structural parameters of normal and cellulase enzyme treated substrates.

Nutritional studies on *Bacillus subtillis*-159 were carried out by incorporating various carbon and nitrogen sources in TNS medium and the sources showing better amylase production were tested for their optimum concentrations. The enzyme was active at 60°C for about 6 hr. and the starch hydrolysin capacity of the enzyme was well comparable with the three commercially available amylases studied.

Seven cotton varieties having different maturity values were selected for blending and were divided into two sets. In the first set Hybrid 4 was separately blended with Gujarat 67 and MCU.5 in 50 : 50 proportion and processed through Nepotometer. The same blend proportion was used for spinning of yarns to a common count of 60s also. While the Nepotometer grades of the two blends were intermediary between those of Hybrid 4 and the cottons blended, the lea strength, single thread strength and yarn apprearance grade had shown no improvement as compared to those for Hybrid 4. However, U% and neps/100 m of the blends exhibited considerable improvement. In the second set, Maljari cotton separately blended with Digvijay, Pramukh and LSS in 50 : 50 proportions and processed through Nepotometer had revealed that the nep grades of these blends were also intermediary.

In connection with the study of the optimal blending of standard varieties of Indian cottons, three cottons from Maharashtra, viz. Gaorani 22, AK.277, and Sanjay (CJ.73), were blended in three different percentage levels and spun to 20s and 30s counts on Super High Draft Ring Frame. The blend containing 50% of Gaorani 22, 30% of AK.277 and 20% of Sanjay was found to be best in respect of lea CSP and tenacity.

Shyamali cotton was blended with jute caddies in the proportion 75 : 25 and processed using microspinning technique, the twist multiplier (TM) used being in the range from 4 to 8. The tensile test carried out on yarn indicated that the tenacity, elongation and work of rupture were optimum at the TM 6 and 7 and that the tenacity of yarn decreased as the proportion of jute caddies component formed more than 25% in the blends. Further, the yarns of blends of Wagad cotton and jute caddies under bulk spinning trial exhibited a slight drop in tenacity and an increase in irregularity compared to pure cotton. Again, microspinning of the blends of L.147 and jute staple using TM from 4 to 8 produced yarns having lesser strength for all twists as compared to pure cotton. The full spinning trial also had shown a similar trend.

SUMMARY OF THE REPORT

Suvin cotton on blending with 1.2 d polyester fibre for 80s yarns improved the yarn strength considerably as compared to the yarns produced from 1.5 d polyester and Giza 45 or Sujata cottons. Neps/100 m were lower in the Suvin-polyester blended yarns than in the yarns of blends of polyester with Giza 45, while being higher than in blends of polyester with Sujata.

An infrared method based on the measurement of integrated intensity of the carbonyl absorption peak at 1725 cm^{-1} in polyester has been standardised for the analysis of polyester-cotton blends. To analyse wool-cotton blends, the method was modified by employing simultaneous use of the infrared bands of wool and cotton occuring at 1520 cm^{-1} and 1160 cm^{-1}. Although the independent estimates of composition from the two peaks gave slightly different values, the average of these two estimates was found to agree closely with the proportion determined by chemical analysis.

For the quantitative analysis of cotton-jute blends, an x-ray diffraction (XRD) method was developed based on the fact that there is appreciable difference between the resolution of the (101) and ($10\bar{1}$) peaks in the XRD scans of cotton and jute fibres treated with 3.1 ± 0.05 N aqueous solution of NaOH. The method was found to be superior to other methods.

The results of the analysis of 12 cottonseed meal samples revealed the presence of 17 amino acids in some of the cotton seed samples. There was marked variation in individual amino acid content also.

The study on the utilisation of cotton stalks has been continued by testing for tensile strength, modulus of rupture, etc., of various types of boards prepared using different sizes of stalk chips, different concentrations of resin, etc.

VII. Personnel

It had been mentioned in the last Annual Report that ICAR had constituted a new Agricultural Research Service (ARS) with effect from the 1st October, 1975, and that action had been initiated to screen the existing scientists in various Institutes for induction into the service. On the basis of the recommendations of the Committee constituted for screening the bio-data of the members of staff of CTRL, the following persons have been approved for induction into appropriate grades (S-3, S-2, S-1 or S) of the Agricultural Research Service with retrospective effect from 1st October, 1975 :

Scientist, Grade S-3

Dr. S. M. Betrabet
Dr. N. B. Patil

Scientist, Grade S-2

Dr. K. R. Krishna Iyer
Dr. S. N. Pandey
Shri G. S. Rajaraman
Shri B. Srinathan

Scientist, Grade S-1

Kum. I. G. Bhatt
Shri P. K. Chidambareswaran
Dr. V. G. Khandeparkar
Shri P. G. Oka
Shri A. V. Ukidve

Scientist, Grade S

Shri A. K. Ahuja
Shri S. Aravindanath
Dr. (Smt.) P. Bhama Iyer
Shri P. Bhaskar
Smt. S. P. Bhatawdekar
Smt. K. L. Datar
Shri L. D. Deshmukh
Kum. A. K. Deshpande
Kum. A. S. Dighe
Shri N. S. Gangakhedkar
Shri S. G. Gayal
Shri R. M. Gurjar
Shri G. F. S. Hussain
Smt. Janaki K. Iyer
Smt. Vatsala Iyer
Shri S. B. Jadhav
Shri D. N. Makwana
Shri D. V. Mhadgut
Shri R. P. Nachane
Smt. Prema Nair
Shri K. M. Paralikar
Shri P. M. Patil
Kum. C. R. Raje
Shri A. S. Sathe
Shri R. H. Sawakhande
Shri A. J. Shaikh
Shri C. V. Simon
Shri S. Sreenivasan
Shri Y. Subramanyam
Shri P. V. Varadarajan

Dr. V. G. Munshi, Senior Testing Technologist, and Shri M. S. Parthasarathy, Senior Spinning Technologist, have also been approved for induction subject to their posts being classified as scientific. The Council's decision on the classification is awaited.

The cases of Shri T. N. Ramamurthy, Scientist (Fibre Technology), who is on deputation from U.P. Government, as well as those of Shri B. M. Petkar and Shri A. K. Gupta, both Senior Research Assistants, who qualified subsequently for induction, are under consideration.

The following scientists selected for appointment to the Agricultural Research Service on the basis of the results of the All-India Competitive examination held in March, 1976, were posted by ICAR against vacancies in this Laboratory.

	Name	*Post*	*Date of appointment*
1.	Dr. R. N. Adsule	Scientist Grade S-1 (Biochemistry)	14-9-1976
2.	Kum. Usha Kiran Loomba	-do- (Physics)	23-9-1976
3.	Shri L. K. Suri	-do- (Organic Chemistry)	23-11-1976
4.	Shri R. H. Balasubramanya	-do- (Microbiology)	29-11-1976
5.	Shri Muntazir Ahmed	-do- (Textile Manufacture)	29-12-1976

Kum. Usha Kiran Loomba was subsequently posted to IARI, New Delhi, and was relieved from this Laboratory on 31-12-1976.

In order to tide over man-power shortage in Grades S and S-1 of the Agricultural Research Service, ICAR sanctioned the creation of 15 fellowships for this Laboratory for a period of two years. However, the appointment of the Research Fellows was initially to be made for one year. Against the sanctioned number, the following four Research Fellows were appointed in this Laboratory from the dates shown against their names :

	Name	*Date of appointment*
1.	Shri A. K. Mehta	1-6-1976
2.	Shri B. Guru Prasad	2-6-1976
3.	Shri D. Balasubramanyam	26-7-1976
4.	Shri D. Radhakrishna Murthy	26-7-1976

Shri Balasubramanyam resigned and was relieved on the 1-11-1976.

The following persons holding technical posts in the scale of pay of Rs. 425-700 were promoted to Senior Posts in the technical cadre in the grade of Rs. 550-900 with effect from the 16-12-1976 :

	Name	*Post to which promoted*
1.	Smt. J. K. S. Warrier	Senior Technical Assistant
2.	Shri T. K. M. Das	-do-
3.	Shri V. Jose Joseph	-do-
4.	Shri C. P. Venugopalan	-do-
5.	Shri B. S. Ganvir	-do-
6.	Kum. Rachael Varghese	Senior Technical Assistant (Library)

Retirements, Resignations, Transfers and Discontinuation of Services

The undermentioned staff retired or resigned their posts and were relieved from duty on the dates indicated against them :

	Name	*Post*	*Date of relief*
1.	Shri P. K. Jairam	Senior Research Assistant (Resigned)	30-4-1976
2.	Shri S. K. Iyer	-do- (Retired)	30-11-1976
3.	Dr. M. S. Gangakhedkar	Senior Assistant (Information) (Resigned)	25-12-1976
4.	Smt. P. J. Patankar	Research Assistant (Services Terminated)	24-8-1976

VIII. Appendices

APPENDIX I

FINANCIAL STATEMENT

Expenditure and Receipts of the Laboratory During 1975-76

	Sanctioned Grant (Rs.)	Actual Expenditure (Rs)	Savings (—) Deficit (+) (Rs.)
A. EXPENDITURE			
I. Technological Reserarch Laboratory including Regional Stations (non-Plan)			
(*a*) Capital expenditure including expansion of Laboratory	2,23,000.00	2,22,943.00	(—) 57.00
(*b*) Working expenses	20,67,000.00	21,95,413.00	(+) 1,28,413.00
	22,90,000.00	24,18,356.00	(+) 1,28,356·00
II. Scheme for Modernisation and Strengthening of CTRL for Intensive Research on Cotton (Plan)	8,00,000.00	6,67,308.00	(—) 1,32,692.00
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.. ..	46,900.00	68,177.00	(+) 21,277.00
(*b*) Studies on spinning from blends of cotton with wool, jute and ramie on cotton system (in collaboration with CSWRI & JTRL)	44,700.00	23,427.00	(—) 21,273.00
(*c*) Studies on de-burring of raw wool using mechanical devices (in collaboration with CSWRI)	25,100.00	13,040.00	(—) 12,060.00
(*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	1,10,000.00	89,750.00	(—) 20,250.00
(*e*) Optimal blending of Standard Varieties of Indian cottons	1,50,000.00	12,420.00	(—) 1,37,580.00
(*f*) Evaluation of cotton seed oil, *vanaspati* containing cotton seed oil, cotton seed cake and meal for their contents of cyclopropenoid fatty acids and study of the keeping quality of cotton seed oil ..	4,800.00	4,555.00	(—) 245.00

B. RECEIPTS

	(Rs.)
Sale proceeds of fruits, vegetables, plants, etc.	120.00
Vehicles, machine tools, plants equipments and other non-consumable materials ..	20,300.00
Analytic and testing fees	20,358.00
Rent	30,011.00
Fees for training, application fees, etc. ..	2,936.00
Sale of publications, etc.	1,202.00
Interest on loans and advances granted to employees	82.00
Miscellaneous receipts (including sale of waste cotton)	58,760.00
	1,33,769.00

APPENDIX II

Scientific and Technical Staff Working at the Cotton Technological Research Laboratory as on the 31st December, 1976

Director

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

Scientific Staff

Senior Scientist	(*Microscopy*)	Grade S-3	Dr. S. M. Betrabet, M.Sc., Ph.D., F.T.I., F.R.M.S.
,,	(*Physics*)	,,	Dr. N. B. Patil, M.Sc., Ph.D.
,,	(*Testing Technology*)	,,	Dr. V. G. Munshi, M.Sc., Ph.D., F.T.A.
Senior Spinning Technologist	(*Mechanical Processing*)		Shri M. S. Parthasarathy, M.Text. (Bom.), M.Sc. Tech. (Manchester), A.M.C.S.T.
Scientist	(*Chemical Studies*)	Grade S-2	Dr. S. N. Pandey, M.Sc., Ph.D.
,,	(*Fibre Technology*)	,,	Shri T. N. Ramamurthy, B.Sc., B.Sc. (Tech.)
,,	(*Instrumentation Technology*)	,,	(Vacant)
,,	(*Physics*)	,,	Dr. K. R. Krishna Iyer, M.Sc., Ph.D.
,,	(*Spinning Technology*)	,,	Shri B. Srinathan, B.Sc.(Text.), M.Sc. (Text.)[1]
,,	(*Statistics*)	,,	Shri G. S. Rajaraman, M.A.
,,	(*Bio-Chemistry*)	Grade S-1	Dr. R. N. Adsule, M.Sc., Ph.D.*
,,	(*Chemical Studies*)	,,	Kum. I. G. Bhatt, M.Sc.[2]
,,	,,	,,	Shri L. K. Suri, M.Sc.
,,	,,	,,	(Vacant)[3]
,,	(*Microbiology*	,,	Shri R. H. Balasubramanya, M.Sc.[4]
,,	,,	,,	Dr. V. G. Khandeparkar, M.Sc., Ph.D.
,,	(*Microscopy*)	,,	(Vacant)*
,,	(*Physics*)	,,	Shri P. K. Chidambareswaran, M.Sc.
,,	(*Quality Evaluation*)	,,	Shri P. G. Oka, M.Sc.
,,	,,	,,	Shri A. V. Ukidve, M.Sc.
,,	,,	,,	(Vacant)*
,,	(*Textile Technology*)	,,	Shri Muntazir Ahmed, B.Sc., B.Sc. (Text.)[5]
,,	(*Technical Information*)	,,	(Vacant)*
,,	(*Different disciplines*)	,,	(3 posts vacant)
,,	(*Bio-Chemistry*)	Grade 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.
,,	,,	,,	Smt. Prema Nair, M.Sc.
,,	(*Microbiology*)	,,	Kum. A. S. Dighe, M.Sc.
,,	(*Physics*)	,,	Shri G. F. S. Hussain, M.Sc.
,,	,,	,,	Dr. (Smt.) P. Bhama Iyer, M.Sc., Ph.D.
,,	,,	,,	Shri R. P. Nachane, M.Sc.
,,	,,	,,	Shri S. Sreenivasan, M.Sc.
,,	(*Quality Evaluation*)	,,	Shri P. Bhaskar, M.Sc.
,,	,,	,,	Smt. K. L. Datar, M.Sc.
,,	,,	,,	Kum. A. K. Deshpande, 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.
,,	(*Statistics*)	,,	Smt. Janaki K. Iyer, M.Sc.
,,	,,	,,	Shri D. V. Mhadgut, M.Sc.
,,	(*Spinning*)	,,	Shri A. S. Sathe, B.Text.[1]

Technical Staff

Technical Officer	(*Electrical Engineering*)	Grade 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*)	Grade T-4	Shri A. W. Shringarpure, B.Sc.
,,	,,	,,	Shri M. S. Sitaram, B.Sc.[3]
,,	,,	,,	Shri N. Thejappa, B.Sc.
,,	(*Electrical Engineering*)	,,	Shri M. K. K. Menon, D.E.E.
,,	(*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.
,,	,,	,,	Shri K. R. Kamath, B.Sc.
,,	,,	,,	Shri S. G. Nayar, B.Sc., LL.B.
,,	,,	,,	Smt. S. B. Pai, B.Sc.
,,	,,	,,	Smt. S. D. Pai, B.Sc.
,,	,,	,,	Smt. J. K. S. Warrier, B.Sc.
,,	,,	,,	(5 posts vacant)
,,	(*Statistics*)	,,	Shri K. Chandran, B.A.
,,	,,	,,	Shri K. Venkateswaran, B.A.+
,,	(*Spinning*)	,,	Shri K. S. Bhyrappa, L.T.T., A.T.A.
,,	,,	,,	Shri S. Chandrasekhar, L.T.M., A.T.A.
,,	,,	,,	Shri H. R. Laxmi Venkatesh, D.T.T.
,,	(*Technical Information*)	,,	Shri T. K. M. Das, B.Sc., D.B.M.
Senior Library Assistant	,,	,,	Kum. Rachael Varghese, B.Sc., B.Lib.
Technical Assistant	(*Civil Engineering*)	Grade T II-3	(Vacant)*
,,	(*Ginning*)	,,	(Vacant)
,,	(*Quality Evaluation*)	,,	Kum. P. V. Adelkar, B.Sc.
,,	,,	,,	Shri K. V. Anathakrishnan, B.Sc.
,,	,,	,,	Smt. R. P. Bhat, B.Sc.
,,	,,	,,	Shri C. R. Sthanusubramoni Iyer, B.Sc.
,,	,,	,,	Kum. S. R. Jage, B.Sc.
,,	,,	,,	Shri E. Kesavan Kutty, B.Sc.
,,	,,	,,	Smt. Girija Radhakrishnan, B.Sc.+
,,	,,	,,	Shri R. Srinivasan, B.Sc.
,,	,,	,,	Shri V. B. Suryanarayanan, B.Sc.
,,	,,	,,	Shri G. Viswanathan, B.Sc.
,,	,,	,,	(17 posts vacant).

Regional Stations

Station	Technical Officer (Quality Evaluation) Grade T-6	Senior Technical Assistant (Quality Evaluation) Grade T-4	Scientist (Quality Evaluation) Grade S	Technical Assistant (Quality Evaluation) Grade T II-3
Coimbatore	(One post vacant)	Shri A. K. Anthony, B.Sc. Smt. Santa V. Nair, B.Sc.* Shri C. P. Venugopalan, B.Sc.†	—	—
Dharwar	(One post vacant)	Shri E. S. Abraham, B.Sc.	Shri A. J. Shaik, B.Sc. Shri C. V. Simon, M.Sc.	—
Hissar	—	Shri S. N. Nagwekar, B.Sc.†	—	—
Indore	—	Shri W. R. Sharma, B.Sc.†	Shri S. B. Jadhav, M.Sc.	—
Ludhiana	—	—	Shri A. K. Ahuja, M.Sc.†	—
Nanded	—	—	Shri K. H. Sawakhande, M.Sc. Shri L. D. Deshmukh, M.Sc.†	(One post vacant)
Nandyal	—	Shri R. Dwarakanath, B.Sc.	Shri Y. Subrahmaniam, M.Sc.†	—
Sriganganagar	—	Shri Ram Prakash, B.Sc.†	—	Shri Tula Ram, B.Sc.(Hons.)
Surat	Shri L. R. Jambunathan, B.Sc., A.M.I.E.T., L.T.I.	Shri M. C. Bhalod, B.Sc.†	Shri P. V. Varadarajan, M.Sc. Shri P. M. Patil, M.Sc.†	

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

† Under the All India Coordinated Cotton Improvement Project.

1. Scheme for studies on spinning from blends of cotton with jute, wool and ramie on cotton system.
2. Scheme for investigation of the effects of high energy radiation on the induction and half-life of excited, free and/or ionised radicals in cotton cellulose to obtain basic information needed for the development of potentially new useful cotton products.
3. Scheme for response of Indian cottons in crosslinking treatments with a view to evolve cotton varieties most suitable for chemical finishing treatment.
4. Scheme for studies on the production and utilisation of chitosan and allied products from prawn shell waste.
5. Scheme for optimal blending of Standard Varieties of Indian cottons.

APPENDIX III

Statement Showing Total Number of Employees and the Number of Scheduled Castes and Scheduled Tribes Amongst Them as on the 31st December, 1976

Class	Permanent/ Temporary	Total number of employees	No. of Scheduled Caste employees	Percentage of Scheduled Caste employees with reference to col. 3	No. of Scheduled Tribe employees	Percentage of Scheduled Tribe employees with reference to col. 3	Remarks
1	2	3	4	5	6	7	8
Class I ..	.. Permanent 9	23	—	—	—	—	—
	Temporary 14		1	5	—	—	—
Class II (Gazetted rank)	.. Permanent —	2	—	—	—	—	—
	Temporary 2		—	—	—	—	—
Class II (Non-Gazetted)	.. Permanent 24	64	—	—	—	—	—
	Temporary 40		4	6	—	—	—
Class III . .	Permanent 50	74	5	7	—	—	—
	Temporary 24		—	—	—	—	—
Class IV (including Sweepers)	Permanent 47	71	14	20	3	4	—
	Temporary 24		—	—	—	—	—

Note: (1) The statement is prepared with reference to persons and not 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 1976

Class of post	Total No. of vacancies		Scheduled Castes					Scheduled Tribes					Remarks
	Notified	Filled	No. of vacancies reserved		No. of SC candidates appointed	No. of ST candidates appointed against vacancies reserved for SC's in the 3rd year of carry forward	No. of reservation lapsed after carrying forward for three years	No. of vacancies reserved		No. of ST candidates appointed	No. of SC candidates appointed against vacancies reserved for ST's in the 3rd year of carry forward	No. of reservation lapsed after carrying forward for three years	
			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 (Cazetted rank)	—	—	—	—	—	—	—	—	—	—	—	—	—
Class II (Non-Gazetted rank)	—	—	—	—	—	—	—	—	—	—	—	—	—
Class III	12(B)	11	—	1	1	—	—	1	—	(B)	—	—	—
Class IV	6(C)	6	—	1	1	—	—	—	1	1	—	—	—
II. Posts filled by promotion													
Class I	—	(A)	—	—	—	—	—	—	—	—	—	—	—
Class II (Gazetted rank) ..	—	1	—	—	—	—	—	—	—	—	—	—	—
Class II (Non-Gazetted rank)	—	8	—	1	1	—	—	—	—	—	—	—	—
Class III	—	3(D)	—	—	—	—	—	—	—	—	—	—	—
Class IV	—	5(D)	—	—	—	—	—	—	—	—	—	—	—

(A) Since the posts are filled by ICAR Headquarters they are not shown in this 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. One post of L.D.C. was filled up by appointment of a Class IV employee.
(C) Two posts were filled by ex-servicemen.
(D) The posts have been filled up on the basis of seniority-cum-suitability.

IX. Annexures

ANNEXURE I

New Equipments Purchased During 1976

1. Digital Fibrograph—Model 430
2. 'Sartorius' Semi-micro Balance
3. 'Omniscribe' Chart Recorder
4. 'Keisokki' Micronaire
5. Stelometer—Model 154
6. Scintillation Detector Probe
7. Cobalt 60 Gamma Chamber — 900 Unit
8. Gas Chromatograph — CIC-AIMIL Dual column
9. 'Riken Denshi' Recorder (Japan make)
10. 'Planner' Heavy Duty Wood Cutting Machine
11. Circular Saw Machine — Model 'BMT' (Heavy Duty)
12. Twist Tester — KMT (Motorised)
13. Lea Strength Tester — KMT (Wall Model)
14. Mercerising Machine (Table Model)
15. 'Lakshmi - Rieter' Can Fed Speed Frame with accessories
16. 'Lakshmi - Rieter' Ring Frame with accessories.

ANNEXURE II

Distinguished Visitors to CTRL During 1976

1. Shri Vithalbhai C. Patel,
   Chairman,
   Indian Cotton Development Council, Bombay.
2. Dr. Hussein Idris,
   Minister of State for Agriculture,
   Khartoum, Sudan.
3. Dr. William Reed,
   Cotton Research Advisor,
   IARI Regional Station, Coimbatore.
4. Prof. R. H. Peters,
   University of Manchester Institute of Science & Technology,
   Manchester, U.K.
5. Mr. Ing. Floresen Nicolae,
   Textile Research Institute,
   Bucharest, Rumania.
6. Shri K. Ramanujam,
   Joint Secretary, Ministry of Commerce,
   Government of India, New Delhi.
7. Dr. J. J. Sparrow,
   UNDP Expert,
   C/o. ATIRA, Ahmedabad.
8. Dr. R. M. Acharya,
   Director,
   Central Sheep and Wool Research Institute,
   Avikanagar.
9. Dr. P. P. Sorokin,
   Assistant Agricultural Councillor,
   Embassy of USSR, New Delhi.
10. Dr. H. S. Mann,
    Director,
    Central Arid Zone Research Institute, Jodhpur.
11. Shri N. Ganga Prasad Rao,
    Project Co-ordinator (Sorghum),
    IARI Regional Research Station,
    Hyderabad.
12. Shri K. N. Sundaram,
    Industrial Advisor,
    Somaiya House, Bombay.
13. Shri J. L. Desai,
    Principal,
    K. J. Somaiya College of Science, Bombay.

ANNEXURE II

Distinguished Visitors to CTRI, During 1976

1. Shri Vithalbhai C. Patel,
   Chairman,
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2. Dr. Hussein Idris,
   Minister of State for Agriculture,
   Khartoum, Sudan.
3. Dr. William Reed,
   Cotton Research Advisor,
   IARI Regional Station, Coimbatore.
4. Prof. K. H. Peters,
   University of Manchester Institute of Science & Technology,
   Manchester, U.K.
5. Mr. Ing. Florean Nicolae,
   Textile Research Institute,
   Bucharest, Rumania.
6. Shri K. Ramamujam,
   Joint Secretary, Ministry of Commerce,
   Government of India, New Delhi.
7. Dr. J. J. Sparrow,
   UNDP Expert,
   C/o. ATIRA, Ahmedabad.
8. Dr. R. M. Acharya,
   Director,
   Central Sheep and Wool Research Institute,
   Avikanagar.
9. Dr. P. P. Sorokin,
   Assistant Agricultural Counsellor,
   Embassy of USSR, New Delhi.
10. Dr. H. S. Mann,
    Director,
    Central Arid Zone Research Institute, Jodhpur.
11. Shri N. Ganga Prasad Rao,
    Project Co-ordinator (Sorghum),
    IARI Regional Research Station,
    Hyderabad.
12. Shri K. N. Sundaram,
    Industrial Advisor,
    Somaiya Hotels, Bombay.
13. Shri J. L. Desai,
    Principal,
    K. J. Somaiya College of Science, Bombay.