Cotton Technological Research Laboratory

Indian Council of Agricultural Research

Annual Report
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Contents

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1. Introduction

This is the 55th Annual Report of the Cotton Technological Research Laboratory (CTRL) and covers the calendar year 1978.

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

The main functions of CTRL are :

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

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

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

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

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

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

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

Library

CTRL has an up-to-date library of books on cotton technology and allied subjects. With the addition of 190 books during the year, the total number of books by the end of 1978 was 3,514, in addition to 3,326 bound

volumes of journals. The library received regularly about 220 journals pertaining to textiles and related fields, of which 94 were subscribed and others received by way of exchange or as complimentary.

New Equipments Purchased

Many new items of equipment were acquired during the year as part of the programme for the modernisation and strengthening of research activities. A list of some of the new equipments added are given in Annexure I.

Distinguished Visitors

A team of six Members of Parliament, Sarvashri Ram Naresh Kushawaha, Hukam Deo Narain Yadav, Ram Sevak Hazari, Chandresh Prasad Varma, Raghubir Singh Machhand and P. A. Prasadrao, who were also members of the Consultative Committee for the Ministry of Agriculture, visited the Laboratory in January, 1978. The visitors evinced keen interest during the discussions, particularly in the work pertaining to the development of new varieties of cotton. They were also very much impressed by the instruments developed in CTRL to aid quality assessment.

Dr. M. S. Swaminathan (Director General, ICAR), Dr. C. Kempanna (Asstt. Director General, ICAR), Shri P. V. Hariharasankaran (Director, Personnel, ICAR), Shri S. S. Dhanoa (Secretary, ICAR), Dr. N. Gopalkrishna (Vice Chancellor, Punjabrao Krishi Vidyapeeth, Akola), and Dr. V. G. Jhingran (Director, CIFRI, Barrackpore) visited the Laboratory on various occasions in connection with official work. A list of other distinguished visitors during 1978 is given in Annexure II.

Management Committee

The Management Committee of CTRL constituted under Rule 66 of ICAR, met twice during the year.

In the first meeting held on April 5, 1978, the various items discussed included Revised Budget Estimates for Non-Plan and Plan for the year 1977-78 and Budget Estimates for 1978-79, Sixth Five Year Plan Budget to be sent to ICAR, filling up of the new posts provided under Plan, actions taken on the recommendations of the Grievance Cell as well as the Institute Joint Council of CTRL, progress of research work, purchase of certain items of equipment and accessories, etc. Suitable recommendations also were made, wherever necessary. An appraisal was made during the meeting, of the progress of the proposed construction of the multi-storeyed Laboratory building.

In the second meeting held on August 19, 1978, as many as 15 subjects on the agenda were discussed. This included Annual Accounts (Non Plan) 1977-78, Annual Accounts (Plan) Budget 1978-79 and Budget allocation for 1978-79, justifications for the various Sixth Plan Proposals, purchase of certain items against single quotation, honorarium for consultancy services in the light of the decision taken at the conference of the Directors of ICAR Institutes, appointment of private medical practitioners as authorised medical attendants, redelegation of powers to heads of the divisions/sections, progress of research work and enhancement of the limit of imprest amount. In addition, notes submitted on the actions taken on the recommendations of the Management Committee at its previous meeting as well as of the Grievance Cell and Institute Joint Council, and also the report of the work done on the project financed by Messrs. Sundatta Foods & Fibres Ltd., were recorded. As the term of the Management Committee was due to expire shortly, the Chairman, in his concluding remarks, thanked all the members of the Management Committee for their active participation in the lively discussions and the valuable suggestions made by them all through the meetings.

According to ICAR Memorandum No. 29(4)/75-Cdn.(1), dated October 25, 1975, the term of the Management Committee expired on September 22, 1978. Proposals for reconstituting the Management Committee have been submitted to the Council and the orders of the Council are awaited. Hence, no further meeting of the Management Committee could be held during 1978.

Staff Research Council

A meeting of the Staff Research Council was convened on April 5 and 6, 1978, mainly to discuss and finalise the programme of research work for the year 1979, as also to appraise of the progress of research made during the year. In the meeting, where members of the Management Committee were also present, the Chairman explained the stringent financial position to be borne in mind with respect to new project proposals and also the important points raised by Director General, ICAR, in a letter in March, 1978. He also emphasised the need for suggesting some economically viable technical know-how from CTRL for the farming community, as also to take up really important scientific works that can be released during the Golden Jubilee Year of ICAR. The deliberations of the meeting included lengthy discussions on running projects, project proposals and extension proposals. Sixteen projects on which work had been completed, were deleted, while extensions of period were granted to three projects taking into consideration the work already done and the difficulties experienced due to the circumstances beyond the control of the investigators. Twenty-one new projects, of which one was proposed to be taken up in collaboration with Punjabrao Krishi Vidyapeeth (PKV), Akola, were considered and approved.

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

Inter-Institutional Projects

The following four inter-institutional projects were operating at the Laboratory during the year :

1. Studies on deburring of raw wool using mechanical device.
2. Electron Microscopical investigation of dye diffusion and dye aggregation in unmodified and modified cotton fibre.
3. Blending cotton with wool, jute and other natural fibres.
4. Studies on the utilisation of Chitin and other allied products from prawn shell waste.

Steady progress was made only in the latter three projects. In the case of first one, progress was impeded by the defective machine parts of the deburring device which was to be set right before experiments were carried out.

As far as the project on utilisation of Chitosan and other allied products from prawn shell waste is concerned, the project has been terminated with effect from March 31, 1978, because one of the major programmes of work on finishing of fabrics, which was proposed to be carried out in collaboration with Prof. E. H. Daruwalla, Research Advisor, Bombay Textile Research Association, Bombay, was completed even before the project was actually activated at CTRL. However, the project has been modified to explore the possibilities of utilising Chitin in the place of Chitosan, for controlling the soil-borne fungal phytopathogens. It was also proposed to study the biological effects of Chitin on the physical and the chemical properties of soil, at the same time, in collaboration with the Regional Station of CICR, Coimbatore.

Two new research projects: (*i*) Enrichment of cattle feed by microbiological methods; and (*ii*) Studies on the biosynthesis of cellulose by microorganisms and higher plants, have been started during the year in collaboration with PKV, Akola, and Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri, respectively.

Integrated Cotton Development Project

Under this World Bank sponsored project launched by ICAR for a period of five years from November 30, 1976, CTRL was to establish a Ginning Training Centre at CICR Campus, Nagpur, with a total finan-

cial outlay of Rs. 32.32 lakhs. During the year, the Superintending Surveyor of Works (Food), CPWD, New Delhi, was requested to frame the estimate for the proposed building of Spinning/Testing House and Lecture Hall as the first stage of construction work. In view of the sanction for foreign exchange release received from the Ministry of Finance, an order was placed through DGS & D, Bombay, for the import of 90-12″—Plantation Type Saw Gin Plant with single box pressure unit, from M/s. Murray Pirantinga Corporation, USA. Arrangements were made for paying the first instalment of 25 % of the total cost in connection with the construction of Kapas Godown, for which administrative sanction was given on August 31, 1978. Approval of ICAR was also received for the proposed construction of building and shed for ginning machinery for a total cost, not exceeding Rs. 10,87,220. As part of the training programme envisaged, 13 roller gin fitters and mechanics were trained in the ginneries at Chandur Bazar and Achalpur in Maharashtra.

Consultancy on Development of Cottonseed Meal Product

The fermentation industry requires an inexpensive source of complex organic nitrogen. Cottonseed meal is one such source available in abundance in India. However, for its use in a fermentation medium, it should be of high quality pharmaceutical grade. Presently, India is importing such high quality cottonseed meal for its fermentation industry. In view of this, an one-year consultancy project (September 1977 to August 1978) sponsored by M/s. Sundatta Foods & Fibres Ltd., Hubli, was taken up for the development of high quality cottonseed meal product. This work involved systematic analysis of meal with respect to protein, oil, ash, gossypol, pH, bacterial count incidence of *Escherichia coli* and *Salmonella*, etc. Finally, a typical Sundatta cottonseed meal was used in a variety of fermentations such as antibiotics (penicillin and tetracycline, etc.), Vitamin B_{12} and enzymes (cellulase and amylase).

Dr. V. Sundaram (Director), Dr. S. M. Betrabet (Principal Consultant) and Dr. V. G. Khandeparkar (Microbiologist) had also visited M/s Sundatta Foods and Fibres Limited, Hubli, and their Protein Research Centre at Chitradurg.

On the basis of the observations made during the factory visits as well as the experimental data obtained, specific recommendations were made to improve the cottonseed meal product. The sponsors of the project have highly appreciated the work and suggestions made by CTRL scientists.

Lab to Land Programme

Under the Lab to Land Programme envisaged in connection with the

Golden Jubilee of ICAR, CTRL has suggested the following three items for inclusion :

1. Indian Cottons Suited for Easy-care Fabrics.
2. Utilisation of Jute Waste in Blends with Cotton.
3. Boards from Cotton Plant Stalks.

Action has also been taken to prepare live exhibits to demonstrate the process and utility of the above items.

Patent

An application for patenting the process of particle board preparation from cotton plant stalks, which is an agricultural waste material, was made in November 1977 under No. 145886 (327/BOM/77) and the patent is being sealed with the Controller of Patents, Calcutta.

Regional Committee

The third meeting of the ICAR Regional Committee No. 7 for the Semi-Arid Plateaus of Maharashtra, Western and Central Madhya Pradesh and Union Territory of Goa, Daman and Diu, was held at the Meeting Hall of the Cotton Development Council on September 30, 1978. As the Director, CTRL, is the nominated Member-Secretary of this Committee, the entire responsibility of organising the meeting was on CTRL. The meeting was inaugurated by Shri Ganpatrao Deshmukh, Hon'ble Minister for Agriculture, Government of Maharashtra. Among the dignitaries who attended the meeting were : Shri S. P. Chanpuria, Hon'ble Minister for Agriculture, Government of Madhya Pradesh, who presided over the latter sessions, Shri Yeshwant Borale, MP, and Member, Governing Body, ICAR, Shri Vijay Kumar Patil, MP, and Dr. V. S. Khuspe and Dr. P. V. Salvi, Vice-Chancellors of Marathwada and Konkan Agricultural Universities in Maharashtra.

The subjects discussed in the meeting covered various topics such as Agriculture, Animal Husbandry, Fisheries, Forestry and Tribal Development, The main recommendations included constitution of separate task forces for preparing Operational Research Projects for flat black soils, intensification of research on pulses and oil seeds under National Agricultural Research Projects, speedy implementation of research on minor millets, taking up new research projects to solve problems encountered in the cultivation of 'pan' (betel leaf), development of techniques for animal nutrition for small farmers and preservation of the Badavari breed of buffaloes and promoting more intensive work on leguminous shrubs and trees, which can provide fuel, fodder and feed, in addition to fixing nitrogen in the soil. Improving

the practical competence of Farm Graduates and transfer of technology under the programme for the Golden Jubilee of ICAR also figured prominently in the deliberations. There was also some discussion on the report of the review committee headed by Shri M. S. Randhawa, on agricultural universities.

Post Graduate Training

The recognition granted to the 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, Testing Technology), Shri M. S. Parthasarathy (Senior Scientist, Mechanical Processing), Dr. S. N. Pandey (Scientist, Chemical Studies), Kum. I. G. Bhatt (Scientist, Chemical Studies) and Dr. K. R. Krishna Iyer (Scientist, Physics), continued as research guides for various degrees recognised by the University of Bombay.

During the year, 11 members of the staff were being guided for M.Sc. and three for Ph.D. degrees in Physics (Textiles), three for M.Sc. degree in Physical Chemistry, one for Ph.D. degree in Bio-Physics, and one student for M.Text. degree in Spinning Technology, while one student, who was not a staff member, was being guided for M.Text. degree in Spinning Technology.

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

1. Shri S. R. Ganatra .. M.Sc. degree in Physics (Textiles).
2. Shri K. M. Paralikar .. Ph.D. degree in Bio-Physics.

Agricultural Research Service Examination

The third examination for selection of candidates for direct appointment in the S-1 grade of the Agricultural Research Service (ARS) was conducted from February 1 to 4, 1978, by the Agricultural Scientists' Recruitment Board (ASRB), in Bombay also. The Director and staff of CTRL were entrusted with the task of making arrangements to hold the examination in Bombay.

Training Course

A Training Course on Administrative Procedures and Financial Rules organised by ICAR for the ministerial staff of ICAR Institutes/Stations/Centres situated in Bombay and other places around, was conducted at

CTRL from September 25 to October 9, 1978. In all, 34 persons from different ICAR Institutes participated in the course. The training was inaugurated by Shri P. V. Hariharasankaran, Director (Personnel), ICAR. Three senior officers each of ICAR and the office of the Accountant General, Maharashtra, and the Assistant Administrative Officer and Accounts Officer of CTRL gave lectures on various topics. Shri S. S. Dhanoa, Secretary, ICAR delivered the valedictory address on October 9, 1978, and presented the Certificates to all participants of the course.

Membership on Other Organisations

The Director and Scientific Officers of CTRL continued to represent CTRL and ICAR on various committees and Institutions, as in the past.

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

(*i*) Indian Cotton Development Council;
(*ii*) Research and Development Sub-Committee of the Indian Cotton Development Council;
(*iii*) Sub-Committee for Preparation of Cotton Production Manual for Maharashtra;
(*iv*) Research Advisory Committee of Plant Breeding and Genetics of CICR, Nagpur;
(*v*) Management Committee of CICR;
(*vi*) Cotton Germplasm Advisory Committee of CICR;
(*vii*) Visiting Team for, (*a*) "Premhari Research Foundation", and (*b*) "Bhailal Amin Foundation"—in connection with their recognition for tax exemption under Section 35(1) (*ii*): of the Income Tax Act, 1961; and
(*viii*) Member, Board of Directors of National Textile Corporation (MP).

Dr. S. M. Betrabet, Senior Scientist, continued to be a member of the "Panel of Experts in Physics Oriented Studies" of ATIRA and Advisory Council of Electron Microscope Society of India (EMSI) and Editorial Board of EMSI Bulletin.

Hindi Implementation Scheme

The Official Language Implementation Committee of CTRL met a number of times in order to consider the progress made in the implementation of Hindi in official work and to chalk out fresh, programmes. Copies of "Karyalaya Sahayika", Hindi-English Dictionary and a consolidated glos-

sary of technical terms (science) in Hindi have been procured and distributed to various sections in the office. A note on the functions and achievements of the Laboratory was prepared in Hindi for use of visitors to the Laboratory

Staff Amenities

In the existing quarters of Type I, Type II-A and Type II-B, only 16 employees in Grade D and 22 in Grades C and B can be provided with accommodation. Recently one building of 10 tenements of the High Income Group (HIG) which could provide accommodation for 10 employees in Grade A has been purchased outright from the Maharashtra Housing Board (MHB) at a total cost of Rs. 6,15,000. Further, one building of 20 tenements of the Middle Income Group (MIG) has been booked with MHB at a cost of Rs. 10,00000. The possession is expected by the middle of next year.

Departmental Canteen

A long standing desire of the staff of CTRL for a departmental canteen was fulfilled on April 1, 1978, when Dr. V. Sundaram, Director, formally inaugurated a departmental canteen under the management of a five-member committee consisting of the following staff members :

Shri T. N. Ramamurthy	..	Chairman
Shri V. N. Wadhwani, Kum. I. G. Bhatt	..	Nominated by Director
Shri S. R. Ganatra, Shri A. V. Ukidve	..	Representatives of the Institute Joint Council

Shri S. R. Ganatra was later on elected as Hon. Secretary and Shri F. C. Fernandes has been entrusted with the work of maintaining the accounts of the canteen.

Expansion and Modernisation under Sixth Plan

As part of the expansion and modernisation programme of the Laboratory, an allocation to the tune of Rs. 48.00 lakhs was made for construction of a multistoreyed building, etc. The CPWD, who was approached to take up the work during the fifth plan period had submitted a detailed plan of construction for the additional accommodation in two stages, viz. (*i*) construction of multistoreyed Laboratory building and (*ii*) construction of Seminar Hall, Visiting Scientists' Hostel, etc. The detailed estimates amounting to Rs. 46.60 lakhs received from CPWD for the first phase of

construction was submitted to ICAR in August 1977 and the approval of the Council and the Ministry of Finance was received in March 1978. Accordingly, a sum of Rs. 11.65 lakhs being the 25% of the cost of construction was deposited with CPWD. Provision for the balance amount of Rs. 34.35 lakhs as well as Rs. 6.00 lakhs towards cost of power wiring has been made in the Sixth Plan Proposal. A sum of Rs. 15.00 lakhs also was budgeted in the Sixth Plan proposal for the Hostel for Visiting Scientists. In addition, a provision of Rs. 70.76 lakhs has been made for purchase of new equipment in the Sixth Plan proposals submitted to ICAR.

Finance

A statement showing the sanctioned budget grant of CTRL and actual expenditure for the financial year 1977-78 is furnished in Appendix I. It will be seen from the statement that actual expenditure was Rs. 29.05 lakhs as against the sanctioned grant of 28.89 lakhs. The increase in the expenditure was mainly due to increased cost of materials. An expenditure of Rs. 33.76 lakhs was incurred under the Fifth Plan Scheme for modernisation and strengthening of CTRL for intensive research on cotton against the sanctioned grant of Rs. 34 lakhs. The saving was mainly due to the non-materialisation of certain purchases. Further, (*i*) a sum of Rs. 0.25 lakh was incurred on the scheme "Response of Indian cottons to cross linking treatments with a view to evolve cotton varieties most suitable for chemical finishing treatments" against the sanctioned grant of Rs. 0.83 lakh, (*ii*) a sum of Rs. 0.12 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. 0.12 lakh, (*iii*) a sum of Rs. 0.05 lakh was incurred on the scheme "Studies on deburring of raw wool using mechanical device" carried out in collaboration with CSWRI, Avikanagar, against the sanctioned grant of Rs. 0.08 lakh, (*iv*) a sum of Rs. 0.42 lakh was incurred on the scheme "Investigation of the effect of high energy radiation on the induction and half-life of excited, free and/or ionised radicals in cotton to obtain basic information needed for the development of potentially new useful cotton products" against the sanctioned grant of Rs. 0.90 lakh, (*v*) a sum of Rs. 0.39 lakh was incurred on the scheme for "Optimal blending of standard varieties of Indian cottons" against the sanctioned grant of Rs. 5.92 lakhs, and (*vi*) a sum of Rs. 0.17 lakh was incurred on the scheme for "Studies on the production and utilisation of Chitosan from prawn shell waste" as against the sanctioned grant of Rs. 0.21 lakh. The savings during the year in all the six schemes were due to non-materialisation of purchase of equipments, etc. In addition, a sum of Rs. 0.07 lakh was incurred on the Regional Committee No. 7 as against the sanctioned grant of Rs. 0.20 lakh.

Significant Findings

The All India Workshop of AICCIP recommended the release of the following new varieties for general cultivation at the tracts indicated against them :

Variety released	*Variety replaced*	*Tract*
H.655C H.777	H.14 B.N. and H.14	Haryana
Godavari (NHH.1)	Hybrid 4	Marathwada tract of Maharashtra.
Savitri (RHR.253)	Varalaxmi	Irrigated areas of Deccan Canal tract of Maharashtra.
Suguna (CPH.2)	—	Southern and Central Districts of Tamil Nadu and Parts of Andhra Pradesh.

Again, at the meeting, the respective State Governments announced the release of the following varieties :

Variety released	*Variety replaced*	*Tract*
Amravathi (AV.1661)	MCU.5	Rainfed tract of Nagarjunasagar project area of Andhra Pradesh.
Mahanandi (355-E.6)	Nandicum	Northerns tract of Andhra Pradesh.
Sangam (V.14)	Krishna	Rice fallows area of Andhra Pradesh.
Saraswathi (12009)	Gaorani 6	Gaorani tract of Andhra Pradesh.
Srisailam (1512)	Mungari	Mungari tract of Andhra Pradesh.
SRT.1 (G.Cot.10)	—	Rainfed tracts of Maharashtra.

A *desi* variety HD.11 was recommended for pre-release seed multiplication to replace G.27 in Haryana.

A quick method for fairly accurate estimation of linear density of cotton fibres utilising the operational principles of Digital Fibrograph has been

developed. It has been found that the gravimetric values of fineness are closer to the estimates obtained with the new method, than with the micronaire values.

An optical index based on the intensity of light transmitted by a parallel array of cotton fibres has been evolved for measurement of fibre maturity.

A study of the physical and mechanical properties of cotton fibres decrystallised by partial cyanoethylation and acetylation revealed that: (*i*) cyanoethylation produced better decrystallisation than acetylation, for a given preswelling treatment and for very low degree of substitution, (*ii*) decrystallised and crosslinked fibres have better strength retention property and higher strength uniformity over the merely swollen and crosslinked control.

Based on the electron diffraction technique (ED) developed at CTRL, it was observed that there was no need of a 'super lattice' as proposed by some previous workers for explaning cotton fibre structure. The presence of odd order in the ED pattern of cellulose I showed that the cotton cellulose does not fall into $\underline{P}2_1$ space group.

Specific Indian varieties among *desi*, *hirsutum* and *barbadense* species, which are suitable for easy-care finishing treatments were identified. Special mention may be made of the *desi* varieties like Sanjay and Digvijay with circular cross sectional shape, which have shown high toughness retention and high crease recovery angle after crosslinking treatment. Pre-swelling followed by crosslinking has shown considerable improvement in the retention of mechanical properties of weak *hirsutum* cottons.

The cellulase dissolution technique developed at the laboratory using cellulase enzyme, besides serving as an effective analytical tool for the study of chemically modified cotton, has also an added advantage to aid as a quick method to evaluate cotton modified for mildew and rot resistance.

Cotton fabrics were treated with mixtures of DMDHEU and MMM resins under polyset two-step process as well as polyset I and II combined in single step and it was found that the single step process was as efficient as the two step polyset process in imparting DP properties.

Flame proofing characteristic with better strength retention can be effectively imparted to the fabric by phosphorylation using radiation technique.

Of the various fodder samples tested for their suitability for growing cellulolytic cultures as part of the nutritional studies, paddy and wheat straws were found to be promising and when the few fungal cultures were tried on these straws, the protein addition was maximum with *Penicillium funiculosum* in Paddy straw, while *Candida utilis* performed well in both the straws.

Leonard jar and pot culture studies have shown that amending soil with chitin controls the *Verticillium* wilt in MCU.5 cotton.

2. Progress of Research

A resumé of the progress of research and allied activities at CTRL during the year under report is given below:

Evaluation of the Quality of Cotton Samples

CTRL is imparting technological assistance to the Agricultral Scientists in improving the yield and quality of cotton by authoritative evaluation of samples received from several cotton breeding, agronomy and similar trials, in addition to carrying out research on physical, chemical, structural and technological aspects of textile materials. Moreover, CTRL is the coordinating centre for the quality evaluation of all new strains under trial in different parts of the country under AICCIP. Hence, a large number of samples are being received every year for various tests, which include samples from trials conducted by Agricultural Universities and State Departments of Agriculture and samples being obtained for different on-going research investigations.

Table 1(a) summarises the number of samples received during the years 1976, 1977 and 1978 as well as the average number of samples for the quinquennium 1971 to 1975.

Table 1(b) gives the number of samples tested at different regional units during 1978.

The samples received from agricultural trials are tested in the order of receipt and test reports are issued as soon as possible. The test results on Trade Varieties and Standard Indian Cotton samples are reported as Technological Circulars as and when the tests are over and later on, compiled for the whole season and published as two Technological Reports—one for Trade Varieties and the other for Standard Indian Cottons. Besides these, test reports are also issued on samples received for certain miscellaneous tests such as determination of quality of ginning, neppiness, oil content in cottonseed, etc.

The statewise figures for the number of samples tested for fibre characteristics and spinning performance have been given in Table 2 under the two heads, viz. (i) AICCIP and (ii) Other State Schemes.

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

Type of test	Average for the quinquennium 1971-75	1976	1977	1978
1	2	3	4	5
Fibre and Full spinning	403	193	138	120
Fibre and Microspinning	2,562	2,341	2,228	1,922
Microspinning alone	—	—	3	—
Fibre tests alone	86	28	132	435
Mill tests	12	6	17	16
Standard Cottons	21	23	28	22
Trade Varieties—lint	24	27	21	35
Trade Varieties—Kapas	49	45	44	41
Technological Research	81	19	154	170
Miscellaneous	—	—	3	16
Total	3,238	2,682	2,768	2,777

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

Unit	Total number of samples tested			
	Fibre length	Fibre fineness	Fibre strength	Fibre maturity
1	2	3	4	5
Coimbatore	1,088	1,071	1,359	1,080
Dharwar	1,924	1,023	1,023	1,041
Hissar	310	970	426	1,068
Indore	679	679	679	679
Ludhiana	296	296	296	264
Nanded	919	919	914	919
Guntur	348	361	201	174
Sriganganagar	638	456	317	468
Surat	8,667*	7,742	7,524†	7,769

*1,176 samples were evaluated on the basis of only one pair of combs on Digital Fibrograph.
†500 samples tested with two breaks.

TABLE 2 : NUMBER OF SAMPLES TESTED IN 1978

State	Fibre and full spinning	Fibre and micro-spinning	Fibre tests	Total
1	2	3	4	5
(i) AICCIP				
Punjab	—	75 (11)	20 (2)	95 (13)
Haryana	10 (2)	64 (9)	14 (2)	88 (13)
Rajasthan	2 (1)	—	—	2 (1)
Madhya Pradesh	—	190 (17)	—	190 (17)
Gujarat	67 (9)	97 (7)	—	164 (16)
Maharashtra	—	384 (41)	65 (3)	449 (44)
Andhra Pradesh	2 (1)	62 (5)	—	64 (6)
Karnataka	19 (5)	361 (27)	—	380 (32)
Tamil Nadu	—	101 (8)	—	101 (8)
Total	100 (18)	1,334(125)	99 (7)	1,533(150)
(ii) Other State Schemes				
Punjab	4 (2)	—	—	4 (2)
Haryana	7 (3)	20 (3)	—	27 (6)
Rajasthan	5 (5)	—	—	5 (5)
IARI, New Delhi	—	3 (1)	—	3 (17)
Madhya Pradesh	21 (16)	16 (1)	—	37 (17)
Gujarat	18 (18)	53 (12)	—	71 (30)
Maharashtra	15 (11)	79 (14)	17 (2)	111 (27)
Andhra Pradesh	19 (8)	42 (4)	21 (1)	82 (13)
Karnataka	20 (20)	39 (4)	—	59 (24)
Tamil Nadu	11 (7)	—	—	11 (7)
Total	120 (90)	252 (39)	38 (3)	410 (132)

All India Coordinated Cotton Improvement Project

This is the eleventh year of the Project. Reports on the various samples grown under advanced trials, such as Coordinated Varietal Trial, Preliminary Varietal Trial, Hybrid Trial, etc., were presented at the panel meetings held at Hissar for the North Zone, at Junagadh for the Central Zone and at Coimbatore for the South Zone during the year. The reports for all the three zones were then presented at the All India Workshop held at Hyderabad. The project covered six locations in the North Zone comprising the States of Punjab, Haryana, Rajasthan and New Delhi, 15 locations in the Central Zone comprising the States of Madhya Pradesh, Gujarat and Maharashtra, and 12 locations in the South Zone comprising the States of Andhra Pradesh, Karnataka and Tamil Nadu.

North Zone

G. hirsutum Trials

The Coordinated Varietal Trial of *G. hirsutum* for Normal Plant Type and Early Maturing Type were conducted at Faridkot, Hissar, Ludhiana and Sirsa.

Table 3 gives the data on the ranges of mean fibre length, fineness, maturity and bundle strength for the samples pertaining to the above two trials.

It may be seen from the Table that mean fibre length for the samples pertaining to Normal Plant Type ranged between 19.8 mm and 27.7 mm. Range of fibre length for Early Maturing Type was between 20.1 mm and 25.9 mm. The ranges of fineness (Micronaire value) for the Normal Plant Type and for the Early Maturing Type were from 3.0 to 4.8 and 3.4 to 4.6, respectively. It may also be seen from Table 3 that the maturity was satisfactory for most of the strains. The range of bundle strength for the samples pertaining to Normal Plant Type was between 42.3 g/t and 52.5 g/t and that for Early Maturing type from 42.3 g/t to 52.0 g/t.

The following strains tried at the locations indicated gave encouraging spinning performance :

Location	*Count*	*Promising Strains*
Faridkot	30s	LH.357, F.605 and F.414
Hissar	40s	SH.175
	30s	LH.33, LH.114, H.538, LH.299, F.414, H.777, H.14 and B.N.
Sirsa	40s	LH.33, H.538, H.655C, B.N.,05, LH.299, H.777, 320F and LH.52

Samples pertaining to Preliminary Varietal Trial were received from Faridkot, Hissar, Ludhiana and Sirsa for microspinning test. The ranges of mean fibre length, Micronaire value, maturity and bundle strength have also been compiled in Table 3.

It may be seen from the Table that the range of mean fibre length was between 20.3 mm and 26.9 mm while the ranges for the Micronaire value and bundle strength were between 3.0 μg/in. and 5.0 μg/in. and 38.1 g/t and 50.4 g/t respectively. Maturity in the case of some of the samples from Ludhiana and Sirsa was low. The following strains fared well at the locations indicated :

Location	*Count*	*Promising Strains*
Faridkot	30s	J.310, 0312, RS.476 and FP.82
Hissar	30s	LH.127, J.313, RS.476, RS.481, LH.318, B.N. and H.14
Sirsa	40s	0312 and RS.481

In the Initial Evaluation Trial of *G. hirsutum*, the following strains fared well at the locations indicated:

Location	*Count*	*Promising Strains*
Faridkot	30s	FP.83, LH.315, F.414, LH.352, LH.289, FP.28 and FP.166
Hissar	30s	FP.235, 0356, H.808, DP.13, H.14 and B.N.
Sirsa	40s	H.808 and LH.315

G. arboreum Trials

Samples pertaining to *G. arboreum* trials were received from Hissar, Ludhiana, Jullundur and Sirsa for fibre tests only. The object of this trial was to identify a coarser and short staple variety for blending purposes. The existing variety, viz. G.27, will be replaced by new strains from the trial. Mean fibre length of the strains tried under this trial ranged from 14.5 mm to 24.9 mm with Micronaire values ranging between 4.9 μg/in. and 8.0 μg/in. The bundle strength values were also satisfactory.

Miscellaneous Trials

Under the miscellaneous trials conducted at Sirsa, H.689-1, B.N., H.809 and H.655C fared well at 40s count while H.777 and 320F fared well at 30s count.

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

Sr. No.	Location	No. of Samples	Range of mean fibre length (mm)	Range of Micronaire value (μg/in.)	Bundle strength (g/t)	Maturity	Count	Spinning performance		Control
								A	B	
1	2	3	4	5	6	7	8	9	10	11
				CVT Br04(a) — Normal Plant Type						
1.	Faridkot ..	8	19·8 to 23·9 (21·5)	4·1 to 4·8 (4·6)	45·0 to 50·4 (47·9)	Average to Good	30s	1	3	F·414
2.	Hissar ..	5(F)	22·1 to 26·9 (24·0)	3·8 to 4·1 (4·0)	46·6 to 47·7 (47·2)	Average to Good	30s	5	1	Bikaneri Narma
							40s	1	0	-do-
3.	Ludhiana ..	5	21·8 to 23·4 (22·8)	3·8 to 4·4 (4·1)	43·4 to 47·2 (45·7)	Average	40s	0	2	F·414
4.	Sirsa ..	7	22·4 to 27·7 (24·8)	3·0 to 4·1 (3·6)	42·3 to 52·5 (47·1)	Low to Average	40s	5	6	320F
				CVT Br04(c) — Early Maturing Type						
1.	Faridkot ..	7	20·1 to 22·1 (20·9)	4·3 to 4·5 (4·4)	43·4 to 49·8 (48·0)	Average to Good	30s	1	4	F·414
2.	Hissar ..	5(F)	21·1 to 24·6 (22·1)	3·8 to 4·6 (4·2)	46·6 to 52·0 (49·2)	Average to Good	205	—	—	Bikaneri Narma
							30s	4	—	-do-
							40s	—	—	-do-
3.	Ludhiana ..	5	22·6 to 25·9 (23·8)	4·2 to 4·6 (4·3)	43·4 to 48·8 (46·6)	Average to Good	40s	—	1	F·414
4.	Sirsa ..	7	21·8 to 23·1 (22·3)	3·6 to 4·0 (3·8)	42·9 to 49·3 (45·7)	Average to Good	40s	—	6	320F
5.	Sirsa ..	6	22·1 to 25·1 (22·8)	3·4 to 4·2 (3·8)	42·3 to 48·8 (47·2)	Average to Good	40s	5	3	320F

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

Sr. No.	Location	No. of samples	Range of mean fibre Length (mm)	Range of Micronaire value (μg/in.)	Bundle strength (g/t)	Maturity	Count	Spinning performance		Control
								A	B	
1	2	3	4	5	6	7	8	9	10	11
				PVT Br03						
1.	Faridkot	.. 9	21·3 to 24·4 (23·2)	4·0 to 5·0 (4·0)	39·7 to 48·8 (46·3)	Average to Good	30s	4	5	F·414
2.	Hissar	.. 10	21·3 ro 25·1 (23·3)	3·2 to 4·2 (3·8)	40·7 to 48·8 (45·7)	Average to Good	30s	7	4	H·14
3.	Ludhiana	.. 5	22·6 to 25·7 (24·3)	3·8 to 4·4 (4·2)	38·1 to 46·1 (44·1)	Low to Good	40s	—	2	F·414
4.	Sirsa	.. 7	20·3 to 26·9 (22·7)	3·0 to 4·4 (3·7)	44·5 to 50·4 (46·4)	Low to Good	40s	2	2	320F

A — No. of samples spinnable to count selected.
B — No. of samples better or on par with the control,
Values in brackets indicate averages,

A sample of the newly identified strain Ganganagar Ageti, along with the control sample Bikaneri Narma, was received from Sriganganagar for full spinning test. The strain Ganganagar Ageti was found to be superior in respect of mean fibre length and was on par with the control variety Bikaneri Narma in respect of fineness, maturity and bundle strength. However, uniformity of the staple was rather low for Ganganagar Ageti which might have caused its poor spinning performance at 30s count.

Central Zone

G. hirsutum Trials

In the Coordinated Varietal Trial, samples were received from Nanded, Rahuri and Surat under irrigated conditions and from Achalpur, Badnapur, Badnawar, Indore, Jalgaon, Khandwa, Nagpur, Nanded and Udgir under rainfed conditions. Samples specially identified for high ginning out-turn were also received from Achalpur, Badnawar, Indore, Jalgaon, Khandwa and Surat. In the irrigated tracts of Madhya Pradesh and Maharashtra, where sowing was done prior to monsoon, trials having North Zone entries were conducted at Morena, Padegaon and Rahuri.

Table 4 gives a summary of the fibre and spinning test results of the samples pertaining to the above trials. It could be seen from the Table that mean fibre length of the strains raised under irrigated conditions ranged from 22.6 mm to 28.2 mm. Range of Micronaire value was from 3.3 µg/in. to 5.2 µg/in. Maturity was low in the case of many samples raised at Nanded and Rahuri. However, maturity was satisfactory for the strains from Surat. Bundle strength values ranged from 37.5 g/t to 48.8 g/t. Regarding samples raised under rainfed conditions, mean fibre length showed considerable variation ranging between 20.6 mm and 28.4 mm. Micronaire value ranged between 2.8 µg/in. and 4.7 µg/in. and bundle strength values between 40.2 g/t and 50.4 g/t. Maturity was low to average for most of the strains. The ranges of mean fibre length, Micronaire and bundle strength values for the strains raised under High Ginning Type trial were from 21.8 mm to 27.9 mm. 3.3 µg/in. to 4.8 µg/in. and 36.4 g/t to 49.3 g/t, respectively. Maturity was average for most of the strains. The ranges of length, Micronaire value and bundle strength for North Zone entries were between 20.8 mm and 30.0 mm, 3.1 µg/in. and 4.9 µg/in. and 36.4 g/t and 52.0 g/t, respectively. The following samples fared well at the locations and counts indicated:

Location	*Count*	*Promising Strains*
Achalpur	40s	B.N., Ach.101, G.Cot.10, 73IH.3, KH.33-1146, B.A.26 and H.655C.
Badnapur	40s	CP.1998F, H.655C, SH.175, L.147 and G.Cot.10

Location	*Count*	*Promising Strains*
Badnawar	40s	H.655C, NH.124, SH.175, NH.102, Khandwa 2, Badnawar 1, NH.54, BA.26, IAN.11-1 and 73IH.3.
Indore	40s	73IH.3, G.Cot.10, 70IH.20, 70IH.457 KDM.42, H.655C, NH.54, SH.175, Ach. 108, G.Cot.10, J1h.19 and Badnawar 1.
Jalgaon	40s	NH.124, J1h.19, Ach.108 and H.655C.
Khandwa	40s	70IH.457, H.655C, NH.124, KDM.42, J1h.19, Badnawar 1, Aeh.101, B.A.26, G.Cot.10 and 73IH.3
Morena	30s	IH.299 and H.777
Nagpur	40s	70IH.457, H.655C, B.N., NH.124, L.147, NH.54., J1h.41, SH.175, NH.102, J1h.19, Ach.108, KH.33-1146, CP.1998F and G.Cot.10
Nanded	40s	B.N., CP.1998F, KH.33-1146, G.Cot.10, PKV.065 and G.Cot.100
Padegaon	40s	H.654C, H.650, J.130, LH.33, SHB.2, H.665C, LH.115, LH.318, LH.114, J.260, F.605, SVM, N.1, H.645C, JK.78, H.392, FSB.8, LH.38, 064, F.414, F.457, H.777 and LH.299
Rahuri	40s	Laxmi, RS.456, G.Cot.100, H.777, SH.175, S.1051, B.N., 05, D.33, and IAN.4795
Surat	50s	IAN.4903, S.1051 and PKV.065
Udgir	30s	H.665C, B.N., KDM.42, NH.54, and CP.1998F.

Samples pertaining to Preliminary Varietal Trial (PVT) were received from Nanded, Rahuri and Surat under irrigated conditions and Achalpur, Badnawar, Indore, Khandwa, Nagpur and Nanded under rainfed conditions. Samples pertaining to PVT having North zone entries were also tried at Padegaon and Rahuri.

In Table 5, the fibre and spinning test results of the strains tried under the above trial are computed. It may be seen from the Table that the entire range of mean fibre length values was from 20.3 mm to 29.5 mm. The ranges for Micronaire and bundle strength values were from 2.9 μg/in. to 5.5 μg/in. and 35.9 g/t to 50.9 g/t, respectively. Maturity was satisfactory

TABLE 4 : SUMMARY OF TEST RESULTS OF STRAINS TRIED IN COORDINATED VARIETAL TRIAL UNDER IRRIGATED AND RAINFED CONDITIONS AND UNDER HIGH GINNING TYPE — CENTRAL ZONE

Sr. No.	Location	No. of samples	Range of mean fibre length (mm)	Range of Micronaire value (μg/in.)	Range of bundle strength (g/t)	Maturity	Count	Spinning performance		Control
								A	B	
1	2	3	4	5	6	7	8	9	10	11
				Br04 (a) — Irrigated						
1.	Nanded	.. 5	24·6 to 28·2 (26·3)	3·4 to 4·4 (3·9)	37·5 to 48·8 (41·4)	Low to Average	40s	2	@	L.147
2.	Rahuri	.. 5	23·9 to 28·2 (26·0)	3·3 to 3·8 (3·6)	38·1 to 43·4 (41·1)	Low to Average	40s	4	1	Laxmi
3.	Surat	.. 5F	22·6 to 27·7 (25·5)	3·5 to 5·2 (4·3)	41·3 to 47·7 (43·5)	Good	50s	3	@	G.Cot. 10
				Br04 (b) — Rainfed						
1.	Achalpur	.. 5	23·4 to 27·7 (25·2)	3·6 to 4·6 (4·2)	41·8 to 46·6 (44·6)	Good	40s	4	@	L.147
2.	Badnapur	.. 7	22·4 to 27·9 (25·9)	3·6 to 4·6 (4·2)	40·2 to 45·0 (42·5)	Good	40s	5	3	L.147
3.	Badnawar	18	22·6 to 28·4 (25·7)	3·6 to 4·7 (4·1)	40·2 to 47·2 (43·7)	Average to Good	40s	6	2	Badnawar 1
4.	Indore	.. 17	22·1 to 27·2 (24·3)	3·0 to 4·2 (3·7)	42·9 to 50·4 (46·2)	Average	40s	9	10	Khandwa 2
5.	Jalgaon	.. 15	20·6 to 26·7 (24·2)	2·8 to 4·6 (4·0)	40·7 to 45·6 (43·7)	Average to Good	40s	4	13	G.Cot.100
6.	Khandwa	.. 18	22·5 to 26·9 (24·8)	3·3 to 4·4 (3·9)	41·3 to 48·2 (46·1)	Low to Good	40s	6	15	Khandwa 2
7.	Nagpur	.. 16	22·4 to 27·9 (25·3)	3·3 to 4·6 (4·1)	41·3 to 49·8 (45·2)	Average to Good	40s	14	13	L.147
8.	Nanded	.. 5	21·1 to 26·9 (23·6)	3·6 to 4·4 (3·9)	41·3 to 47·2 (44·5)	Low to Average	40s	5	@	L.147
9.	Udgir	.. 5	22·1 to 26·9 (24·3)	3·8 to 4·4 (4·1)	40·7 to 44·5 (43·1)	Average to Good	30s	5	@	L.147

TABLE 4 : SUMMARY OF TEST RESULTS OF STRAINS TRIED IN COORDINATED VARIETAL TRIAL UNDER IRRIGATED AND RAINFED CONDITIONS AND UNDER HIGH GINNING TYPE — CENTRAL ZONE—(*Contd.*)

Sr. No.	Location	No. of samples	Range of mean fibre length (mm)	Range of Micronaire value (μg/in.)	Range of bundle trength (g/t)	Maturity	Count	Spinning performance		Control
								A	B	
1	2	3	4	5	6	7	8	9	10	11
				Br04 (c) — High Ginning Type						
1.	Achalpur ..	5	23·9 to 25·1 (24·5)	4·0 to 4·4 (4·3)	45·0 to 49·3 (46·3)	Average to Good	40s	3	@	L.147
2.	Badnawar ..	10	23·4 to 27·9 (25·1)	3·9 to 4·5 (4·2)	38·1 to 45·0 (42·1)	Average	40s	4	1	Khandwa 2
3.	Indore ..	9	21·8 to 25·4 (23·9)	3·3 to 4·4 (3·9)	36·4 to 47·2 (44·5)	Low to Good	40s	3	3	Khandwa 2
4.	Jalgaon ..	10	22·1 to 24·1 (23·0)	3·7 to 4·8 (4·2)	40·2 to 48·2 (44·4)	Average to Good	40s	—	8	SRT·1
5.	Khandwa ..	10	23·4 to 26·9 (25·0)	3·4 to 4·3 (3·8)	38·6 to 48·2 (43·8)	Low to Good	40s	4	@	Khandwa 2
6.	Surat ..	5	23·4 to 25·9 (24·6)	3·5 to 4·7 (4·2)	40·7 to 42·9 (41·5)	Average	50s 40s	1 3		G. Cot. 10
				Br04 — North Zone Entries						
1.	Padegaon ..	15	24·4 to 29·2 (26·7)	3·1 to 4·4 (3·8)	36·4 to 46·1 (41·1)	Low to Average	40s	13	@	Laxmi
2.	Rahuri ..	5	22·6 to 25·7 (24·0)	3·4 to 3·9 (3·7)	40·7 to 46·6 (44·0)	Low to Good	40s	3		Laxmi
				Br04 — North Zone Entries (Early Maturing Type)						
1.	Morena ..	5	20·8 to 23·4 (21·5)	3·8 to 4·5 (4·2)	45·0 to 52·0 (49·7)	Average	30s	2	4	C·59·228
2.	Padegaon ..	11	23·6 to 30·0 (26·4)	3·2 to 4·9 (3·9)	41·3 to 47·2 (44·1)	Average to Good	40s	10	@	Laxmi
3.	Rahuri ..	4	22·9 to 26·9 (24·6)	3·8 to 4·0 (3·9)	38·6 to 46·6 (43·6)	Average to Good	40s	3	@	Laxmi

A — No. of samples spinnable to count selected
B — No. of samples better or on par with the control
@ — Sample of control variety not received for tests
Values in brackets indicate averages.

TABLE 5 : SUMMARY OF TEST RESULTS OF THE STRAINS TRIED IN PRELIMINARY VARIETAL TRIAL UNDER IRRIGATED AND RAINFED CONDITIONS : CENTRAL ZONE

Sr. No.	Location	No. of samples	Range of mean fibre length (mm)	Range of Micronaire value (μg/in.)	Range of bundle strength (g/t)	Maturity	Count	Spinning performance A	Spinning performance B	Control
1	2	3	4	5	6	7	8	9	10	11
				Br03 (a) — Irrigated						
1.	Nanded ..	3	20·8 to 27·9 (24·7)	3·4 to 4·4 (3·8)	42·9 to 48·8 (45·9)	Average	40s	2	@	L·147
2.	Rahuri ..	5	24·6 to 28·2 (26·6)	3·1 to 4·2 (3·6)	39·1 to 45·0 (41·7)	Average		3	@	Laxmi
3.	Surat ..	14	23·1 to 27·9 (25·1)	3·2 to 5·5 (4·1)	37·0 to 45·6 (42·1)	Good	40s	7	7	G. Cot. 10
				Br03 (b) — Rainfed						
1.	Achalpur ..	5	23·4 to 24·4 (23·8)	4·1 to 4·6 (4·3)	43·4 to 46·1 (45·0)	Average	40s	4	@	L·147
2.	Badnawar ..	22	23·4 to 29·5 (26·0)	3·1 to 4·7 (3·9)	36·4 to 48·2 (43·7)	Average to Good	40s	16	3	Badnawar 1
3.	Indore ..	18	21·1 to 26·2 (24·2)	2·9 to 4·3 (3·7)	40·7 to 47·7 (43·9)	Low to average	40s	5	@	Khandwa 2
4.	Khandwa ..	30	22·1 to 28·2 (24·9)	2·9 to 4·4 (3·7)	38·1 to 47·7 (44·8)	Average to Good	40s	9	8	Khandwa 2
5.	Nagpur ..	30	22·1 to 29·5 (25·7)	3·1 to 4·6 (4·0)	39·1to 50·9 (45·7)	Average to good	40s	16	15	L·147
6.	Nanded ..	6	20·3 to 23·4 (21·7)	3·1 to 4·2 (3·7)	39·7 to 45·6 (43·1)	Low to Average	40s	1	2	SRT·1
				Br03 — Irrigated — North Zone Entries						
1.	Padegaon ..	22	22·9 to 28·7 (26·4)	3·0 to 4·6 (3·9)	35·9 to 44·5 (39·5)	Low to Average	40s	22	2	Laxmi
2.	Rahuri ..	5	22·0 to 26·9 (24·6)	3·4 to 4·2 (3·8)	39·7 to 44·5 (43·3)	Average	40s	2	@	Laxmi

A — No. of samples spinnable to count selected.
B — No. of samples better or on par with the control.
@ — Control variety, not received for tests.
Values in brackets indicate averages.

at most of the locations. The following samples fared well at the locations and the counts indicated against them :

Location	*Count*	*Promising Strains*
Achalpur	40s	NA.332, B.72-2888, IC.1036 and J1h.72
Badnawar	40s	NH.137, Santher 13433, G.Cot.10, NH.110, J1h.60, B.N., 74IH.9, MCU.5, IC.1036, IAN.3166, NA.140 J1h.42, Ach.270, NA.332, Badnawar 1 and Khandwa 2
Indore	40s	Indo.B.4-4729, B.N., NA.247, MCU.5 and J1h.72
Khandwa	40s	NH.137, 71IH.83-1885, NH.110, MCU.5, B.72-2888, Ach.364, NH.140, J1h.42 and Khandwa 2.
Nagpur	40s	NH.137, Santher 13433, NH.110, J1h.72, MCU.5, IC.1036, BA.12, Ach.279, DS.4, B.72-2888, IAN.3166, 71IH.83-1882, NH.140, J1h.42, Ach.270 and L.147
Nanded	40s	S.1024, and Santher 13463
Padegaon	40s	Kop.355, Kop.372, CPD.81, Kop.203, Kop. 377, Kop.438, Kop.590, JK.77162, Kop.435, Kop.368, Kop.557, FP.82, Kop.343, LH.299, LH.127, Kop. 688, FP.26, B.N., 0312, Kop. 338, LH.289 and Laxmi
Rahuri	40s	S.1024, IAN.2979 and G.Cot.100
Surat	40s	(A.51-9 X G.Cot.10) F5, Santher 13463, Santher 13442, IAN.5063, IAN.2147 S.1024 and G.Cot.100.

In the Initial Evaluation Trial, the following strains fared well at the locations and the counts indicated against them :

Location	*Count*	*Promising Strains*
Achalpur	40s	G.Cot.10, ISTD.34, IC.1225, BSTD.35 and DHY.286
Badnawar	50s	IAN.9127, BSTD.35 and Badnawar 1.

G. barbadense Trials

Samples pertaining to the Coordinated Varietal Trial were received from Surat for full spinning test and from Padegaon and Rahuri for micro-spinning test. Most of the strains have shown mean fibre length 28 mm and above

with satisfactory maturity and bundle strength. At Surat, the following four strains recorded encouraging spinning performance at 80s count : Thanekar, ERB.13754, ERB.13650 and Marrad. However, only one strain, viz. Suvin, fared well at 100s count at Padegaon.

G. arboreum Trials

In the Coordinated Varietal Trial conducted at Jalgaon, Parbhani, Nagpur and Udgir, the strains AKH.4, Gao.853, AKH.605, AKH.597, AKH.171 fared well at 30s count only at Nagpur. The strain AKH.4 fared well at Parbhani also at 30s count.

G. herbaceum Trials

Five strains, viz. 6130, 1449, 4044, 1522 and 6053 received from Viramgam recorded satisfactory yarn strength at 30s count.

Hybrid Trials

Hybrid involving *hirsutum-hirsutum* crosses and *hisutum-barbadense* crosses were tried at Achalpur, Khandwa, Indore, Rahuri and Surat. The promising hybrids from the technological point of view are listed below, location-wise :

Location	*Count*	*Promising Hybrids*
Achalpur	40s	ACH.Hy.1, and ACH.Hy.2
Indore	50s	76IH.20 × G. Cot. 10
	40s	AHH.468, Hybrid 4, JK.Hy1., AHy,5 and CHH.19
Khandwa	60s	GHB.1, Varalaxmi, IBH.4028, GHB.10, GHB.14, GHB.7 and JK.Hy.11
Rahuri	60s	RHR.253, RHR.265, RHR.266, RHR.270, RHR.267, RHR./269, RHR.271 and NDH.1.
Surat	100s	Varalaxmi, IBH.4208, GHB.10, GHB.14, GHB.7 and JK.Hy.11
	60s	AHH.468, NHH.1, GHH.3 and Hybrid 4

In addition, hybrid trials involving *desi* strains was conducted at Indore. The hybrid Maljari × Million Dollar fared well at 20s count.

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 various trials is given below :

MADHYA PRADESH

In the District Varietal Trial of *G. hirsutum* conducted at Morena, three strains, viz. Bikaneri Narma, J.34 and J.207, were raised under irrigated conditions. They recorded mean length around 22 mm with low maturity and good bundle strength. Only Bikaneri Narma showed good spinning performance at 30s count.

In the 'Pure Line Programme' for the two hybrids, viz. JK.Hy.1 and JK.Hy.11, twenty-four selections of Khandwa 2 were received from Indore. Only two selections, viz. 3.3 Khandwa 2 (Model Bulk) and 4.4 Khandwa 2 (Model Bulk) fared well at 50s count.

In the miscellaneous trial at Indore, the strain 73IH.3 fared well at 40s count.

GUJARAT

In the Maximization Trial, three *hirsutum* strains, one *herbaceum* strain, two inter *hirsutum* hybrids, three *hirsutum-barbadense* hybrids and two *desi* hybrids were raised at Surat. As expected, their technological performance varied considerably. The following strains/hybrids fared well at the counts indicated against them :

Count	*Strain/Hybrid*
30s	*Desi* Hybrid DH.2 and *Desi* Strain 1449
60s	Hybrid 4, HH.70, G.Cot.10, IAN.4705 and G.Cot.100
100s	Varalaxmi, Hybrid 5 and HB.14

A sample of (YS+Guj.67 × Moco) F1 pertaining to 'Budded Trial' was received from Surat this year also for full spinning test. Although, it recorded satisfactory yarn strength at 80s count, the yarns were very neppy.

MAHARASHTRA

In the rainfed tract of Badnapur, the strains NH.172, G.Cot.10, NHB.1, NH.54, NH.116 and Hybrid 4 along with control L.147 performed well at 40s count.

South Zone

G. hirsutum Trials

Coordinated Varietal Trials were conducted at Arabhavi, Siruguppa and Srivilliputtur under irrigated conditions and at Dharwar under rainfed conditions. This trials having early maturing strains was carried out at Aduthurai and Srivilliputtur.

Table 6 contains the test results of the samples received under this trial. It may be seen from the Table that mean fibre length for the samples raised under irrigated conditions ranged from 25.9 mm to 33.5 mm. Micronaire values showed variation between 2.6 μg/in. and 4.6 μg/in. and the bundle strength values varied from 37.5 g/t to 50.9 g/t. Maturity, in general, was satisfactory for most of the strains.

Ranges of mean fibre length, Micronaire and bundle strength values for the strains raised at Dharwar under rainfed conditions were between 23.4 mm and 26.7 mm, 3.2 μg/in. and 4.6 μg/in. and 38.1 g/t and 45.6 g/t, respectively and those for the strains tried in the rice fallows at Aduthurai and Srivilliputtur were from 22.1 mm to 29.2 mm, 3.0 μg/in. to 4.9 μg/in. and 39.1 g/t to 52.0 g/t. Maturity was satisfactory in both the latter cases.

The following strains fared well at the locations indicated below :

Location	*Count*	*Promising Strains*
Arabhavi	40s	ELS481, ELS.391, ELS.380, DS.6-128, AS.27-13, CPD.105-3, AV.2775 II/1, CP.25-1, MCU.5WT and MCU.5
Aduthurai	60s	450
Dharwar	50s	C.50, DS.8, SRT.1, CPD.7-D-2, Bhagya, CPD. 17B.12, NA.332, Bikaneri Narma, CPD.11-3-8, DS.48, DS.81 and Laxmi
Siruguppa	50s	ELS.481, ELS.391, ELS.380, ELS.271-A-1, DS.59, DS.6-128, AS.27-13, UAS.70-480-2, CPD.105-3, AV.2775-II/I, AV.2709, CP.2-1, IC.1245, MCU.5WT, CP.13-20 and MCU.5
Srivilliputtur	60s	ELS.271-A-1, DS.54, ELS.380, CPS.25-1, MCU.5, CP.2-1, ELS.391, ELS.268, CPD.105-3, MCU.8, SVPR.122, SVPR.124, SVPR.134, SVPR.154, 450, 756 and JK. 97

Samples pertaining to Preliminary Varietal Trial were received from Arabhavi, Siruguppa and Srivilliputtur (under irrigated conditions) and also from Dharwar (under rainfed conditions) for microspinning test. A summary of the test results is compiled in Table 6.

Ranges of mean fibre length, Micronaire and bundle strength values for the strains raised under irrigated conditions were from 23.6 mm to 33.0 mm, 2.7 μg/in. to 4.6 μg/in. and 37.5 g/t to 47.7 g/t, respectively. Maturity was rather low for a few strains raised at Arabhavi and Srivilliputtur. Ranges of mean fibre length, Micronaire and bundle strength values for the strains raised under rainfed conditions were from 22.1 mm to 28.7 mm, 3.0 μg/in. to 4.9 μg/in. and 36.4 g/t to 46.6 g/t respectively. However, many samples were immature. In addition, Preliminary Varietal Trial having strains specially identified for high ginning out-turn, was conducted at Dharwar.

TABLE 6 : SUMMARY OF TEST RESULTS OF STRAINS TRIED IN COORDINATED VARIETAL TRIAL AND PRELIMINARY VARIETAL TRIAL : SOUTH ZONE

Sr. No.	Location	No. of samples	Range of mean fibre length (mm)	Range of Micronaire value (μg/in.)	Range of bundle strength (g/t)	Maturity	Count	Spinning performance		Control
								A	B	
1	2	3	4	5	6	7	8	9	10	11
					Br04 (a) — Irrigated					
1.	Arabhavi ..	22	26·2 to 30·5 (28·0)	3·0 to 4·6 (3·8)	39·1 to 46·1 (42·6)	Low to Good	40s	10	—	Mysore Vijaya
2.	Siruguppa ..	21	26·9 to 33·5 (30·0)	3·4 to 4·6 (4·0)	37·5 to 46·1 (41·8)	Average to Good	50s	13	18	Hampi
3.	Srivilliputtur I	15	27·2 to 29·7 (28·5)	2·8 to 3·9 (3·3)	42·3 to 46·6 (44·8)	Low to Good	60s	6	—	MCU·8/ MCU·5
4.	Srivilliputtur II	14	25·9 to 30·5 (27·6)	2·6 to 3·5 (3·0)	41·3 to 50·9 (45·3)	Low to Average	60s	8	—	MCU·8/ MCU·5
					Br04 (b) — Rainfed					
1.	Dharwar I	14	23·4 to 26·7 (25·0)	3·2 to 4·4 (3·7)	39·7 to 45·6 (42·2)	Average to Good	50s	6	—	Laxmi
2.	Dharwar II	16	23·4 to 26·7 (24·8)	3·3 to 4·6 (3·8)	38·1 to 45·6 (42·5)	Low to Average	50s	6	5	Laxmi
					Br04 (c) — Rice Fallows					
1.	Aduthurai ..	17	22·1 to 27·9 (25·7)	3·3 to 4·9 (4·2)	39·1 to 52·0 (48·3)	Average to Good	60s	1	—	MCU·7/ Krishna
2.	Srivilliputtur	17	22·4 to 29·2 (26·3)	3·0 to 4·5 (3·8)	41·8 to 48·8 (45·6)	Average to Good	60s	6	—	MCU·7/ Krishna

TABLE 6 : SUMMARY OF TEST RESULTS OF STRAINS TRIED IN COORDINATED VARIETAL TRIAL AND PRELIMINARY VARIETAL TRIAL : SOUTH ZONE—(*Contd.*)

Sr. No.	Location	No. of samples	Range of mean fibre length (mm)	Range of Micronaire value (μg/in.)	Range of bundle strength (g/t)	Maturity	Count	Spinning performance		Control
								A	B	
1	2	3	4	5	6	7	8	9	10	11
				Br03 (a) — Irrigated						
1.	Arabhavi ..	22	23·6 to 31·5 (28·1)	2·7 to 3·9 (3·4)	37·5 to 47·2 (40·9)	Low to Good	40s	10	—	Mysore Vijaya / 170Co. 2
2.	Siruguppa ..	21	24·6 to 33·0 (29·6)	3·0 to 4·6 (3·9)	37·5 to 45·6 (40·6)	Average to Good	50s	12	4	Hampi
3.	Srivilliputtur	21	24·4 to 29·5 (27·1)	2·7 to 4·0 (3·4)	39·1 to 47·7 (43·5)	Low to Average	50s	8	—	MCU·8 / MCU·5
				Br03 (b) — Rainfed						
1.	Dharwar I	18	24·4 to 27·9 (26·2)	3·2 to 4·7 (3·9)	37·5 to 46·6 (42·4)	Low to Average	50s	4	6	Laxmi
2.	Dharwar II	18	22·1 to 28·7 (25·9)	3·0 to 4·9 (3·9)	36·4 to 46·1 (41·8)	Low to Good	50s	5	5	Laxmi
				Br03 (c) — High Ginning Type						
1.	Dharwar ..	16	23·9 to 27·9 (25·4)	3·4 to 4·7 (4·1)	37·5 to 47·7 (41·6)	Low to Good	50s	6	1	Laxmi

A — No. of samples spinnable to count selected.
B — No. of samples better or on par with the control,
Values in brackets indicate averages,

Their mean fibre length ranged from 23.9 mm to 27.9 mm. Micronaire value varied from 3.4 μg/in. to 4.7 μg/in., while bundle strength values ranged between 37.5 g/t and 47.7 g/t. Most of the strains recorded satisfactory maturity. The following strains fared well at the counts and locations indicated against them :

Location	*Count*	*Promising Strains*
Arabhavi (Irrigated)	40s	ELS.501, ELS.294-2-6, ELS.381, GS.23-1009, AHO.80-185, NLS 10, NLS.13 and MCU.5.
Dharwar (High Ginning)	50s	CPD.34-9, NA.548, IC.1912-1, Bhagya and Laxmi (Control).
Dharwar (Rainfed)	50s	CPD.27-B-14, CRH.65, 4-34-4, CPD.6, B10, BS.22, DS. 32, DS.61, NA.585 and NA. 608.
Siruguppa (Irrigated)	50s	ELS.503, ELS 501, ELS. 500, ELS. 575, ELS.381, ELS.294-2-6, AHO.80-187, GS.23-1009, NLS.13 ADB.10050, and MCU.5.
Srivilliputtur (Irrigated)	50s	ELS.381, DS.56, MCU.5WT, AV.2775-II/1-48, GS.23-1009, ELS.177, MCU 5 and MCU.8.

A set of 28 samples pertaining to Initial Evaluation Trial was received from Siruguppa. Their mean fibre length ranged between 23.6 mm and 31.2 mm. Maturity was low to average. As many as 22 strains showed good spinning performance at 40s count, the first five being DS.59-15 (CSP. 2180), DS.54-12 (CSP.2176), AHO.61-38 (CSP.2172), Hampi (CSP.2132) and AHO.66-114 (CSP.2100).

G. barbadense Trials

A set of ten samples pertaining to Coordinated Varietal Trial of *G. barbadense* was received from Shimoga. Their mean fibre length ranged between 26.4 mm and 32.5 mm. They had low to average maturity and good bundle strength. The strain Suvin recorded CSP as high as 2868 at 60s count, followed by CBS.203 (CSP.2520) and CBS.202 (CSP.2166). The hybrid Varalaxmi taken as control also recorded satisfactory yarn strength (CSP.2298) at 60s count.

Another set of 26 samples pertaining to a trial indicated as Initial Evaluation Trial of *G. barbadense* was received from Shimoga. Mean fibre length for these strains ranged between 25.4 mm to 32.0 mm. Maturity was average and bundle strength values were good. The following nine strains recorded encouraging spinning performance at 60s count : SIVRB, SIV. 135-18, IBSI, Giza 146-hy, 90784, K.4831-56015-B, 82-2-R, BAHKSA and Varalaxmi (Control).

G. herbaceum Trials

Eleven strains belonging to coordinated Varietal Trial were received from Dharwar. They have recorded mean fibre length ranging between 20.3 mm and 23.1 mm. maturity and bundle strength values were good. Six strains, viz. SM.88, DB.3-12, MDS.42, MDS.56, SM.46 and SM.40 recorded better spinning performance than Jayadhar the control variety.

Hybrid Trials

Hybrid trials were conducted at Arabhavi, Dharwar, Nandyal, Siruguppa and Srivilliputtur. Since many of the hybrids were from the crosses of *hirsutum* and *barbadense* species, they have recorded excellent mean fibre length. However, most of these hybrids suffered from low maturity and hence low bundle strength. The following hybrids have shown encouraging spinning performance at the counts indicated :

Location	*Count*	*Promising hybrids*
Arabhavi	80s	TNH 3, DCH.14, DCH.37, Varalaxmi, and CBS. 156.
Dharwar	80s	DCH.32 and Varalaxmi
Dharwar	50s	2P, TINCH 4 and JK.Hy.1
Nandyal	80s	Varalaxmi, NHB.55, NHB.80 and NHB.73.
Siruguppa	80s	TNH.3, NHy.12, DCH.14, DCH.32, DCH.37 RHR.253, Varalaxmi and CBS.156.
Srivilliputtur	80s	DCH.70, DCH.14, DCH.15, DCH.18, Varalaxmi, RHR.253, CBS.156, THH.3 and TNH.2

Pilot Project Demonstration Trial

Pilot Project Demonstration Trials were conducted at Arabhavi, Dharwar, Shimoga and Siruguppa with *hirsutum* entries. These trials with *barbadense* entries were conducted at Shimoga. The following strains showed encouraging spinning performance at the counts indicated :

Location	*Count*	*Promising Strains*
		G. hirsutum
Arabhavi	40s	ELO.AV.2773-II/1, AS.27-13, Mysore Vijaya, 170-Co2 and MCU.5
Dharwar	50s	CP. 1998F. and Laxmi

Location	*Count*	*Promising Strains*
Siruguppa	60s	ELS.481 and MCU.5
	50s	DS. 70-480 and DS.59
Shimoga	40s	Bhagya
		G. barbadense
Shimoga	80s	Suvin 62-17
	60s	Varalaxmi, Menoufi, S.I. Andrews and Marrad.

Miscellaneous Trials

Various trials with different objectives have been conducted at different places such as Rajendranagar in Andhra Pradesh, Davangere and Siruguppa in Karnataka and Coimbatore in Tamil Nadu.

In the development of short duration, high yielding Gaorani cottons, samples from 23 selections were received from Rajendranagar (Hyderabad). These selections recorded mean fibre length ranging between 26.9 mm and 29.5 mm. They have recorded average maturity and good bundle strength. The selections 853, 1030, 1042 and 1089, recorded promising spinning performance at 40s count.

In order to study the variation in the fibre properties of the hybrid Varalaxmi raised under rainfed conditions, samples were received from Davangere (Karnataka) for fibre test and spinning performance. All the samples recorded mean fibre length around 30 mm, in the range 29.5 mm to 31.0 mm. They had low to average maturity. The bundle strength values also did not show much variation, the range being between 42.9 g/t and 46.1 g/t. Most of the samples fared well at 80s count.

Two new strains, DS. 59 and DS.56, were identified at Dharwar as promising strains during the last year. These strains were tried during the year in the cultivators field at Siruguppa. The strain DS. 59 recorded mean fibre length over 28.0 mm with average maturity and average to good bundle strength. This strain may be suitable for 40s count. The strain DS.56 recorded mean fibre length of about 25.4 mm with average maturity and bundle strength. Its technological performance was rather inferior to that of DS. 59.

In the Multilocation Trial at Coimbatore, the selection MCU.5WT recorded mean fibre length over 28 mm with low maturity and good bundle strength. It fared well at 50s count.

New Varieties Released

At the All India Workshop held at Hyderabad for evaluating the work carried out under AICCIP during the last five seasons, the release of the

following varieties were recommended :

Variety Released	*Variety Replaced*	*Tract*
H.655C	H.14	Haryana
H.777	B.N. and H.41	
Godavari (NHH.1)	Hybrid 4	Marathwada tract of Maharasthra
Savitri (RHR 253)	Varalaxmi	Irrigated areas of Deccan Canal tract of Maharashtra
Suguna (CPH.2)	—	Southern and Central Districts of Tamil Nadu and parts of Andhra Pradesh

In addition, the release of the following varieties was announced by the respective State Governments during the meeting :

Variety Released	*Variety Replaced*	*Tract*
Amaravathi (AV.1661)	MCU.5	Rainfed tract of Nagarjunasagar Project area of Andhra Pradesh
Mahanandi (355-E.6)	Nandicum	Northerns tract of Andhra Pradesh
Sangam (V.14)	Krishna	Rice Fallows area of Andhra Pradesh
Saraswathi (12009)	Gaorani 6	Gaorani tract of Andhra Pradesh
Srisailam (1512)	Mungari	Mungari tract of Andhra Pradesh
SRT.1 (G.Cot.10)	—	Rainfed tracts of Maharashtra

A *desi* variety, HD. 11, was recommended by the Panel for pre-release seed multiplication to replace G. 27 in Haryana.

Extra-long Staple (27mm and above) Cottons

The results of the detailed tests carried out during 1978 on extra-long staple cotton samples received and tested at the Laboratory are shown in Table 7.

TABLE 7 : RESULTS OF EXTRA LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1978

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
1	2	3	4	5	6	7	8	9
Andhra Pradesh								
EL·031 ..	Adilabad	27·7	1·09	142	3·6	0·66	41·3	7·7
L·147 ..	,,	27·4	1·08	134	3·4	0·66	40·2	7·5
AV·1661 ..	Amravathi	27·6	1·09	146	3·7	0·69	41·8	7·8
MCU·5 ..	,,	28·0	1·10	146	3·7	0·68	44·0	8·2
Gujarat								
Hybrid 4 ..	Idar	29·5	1·16	150	3·8	0·70	41·3	7·7
Varalaxmi ..	,,	31·2	1·23	110	2·8	0·59	46·1	8·6
Hybrid 4 ..	Palej	29·8	1·17	157	4·0	0·73	41·3	7·7
Hybrid 4 ..	Surat	29·0	1·14	165	4·5	0·81	46·6	8·7
YS+(Guj. 67× Moco) F1	,,	30·5	1·20	193	4·9	0·71	48·2	9·0
DH.70 ..	,,	27·7	1·09	142	3·6	0·67	50·4	9·4
Hybrid 5 ..	,,	33·0	1·30	114	2·9	0·59	45·6	8·5
HB·14 ..	,,	33·5	1·31	142	3·6	0·67	47·2	8·8
G. Cot. 100 ..	,,	28·2	1·11	146	3·7	0·67	47·7	8·9
NHH·1 ..	,,	29·2	1·15	157	4·0	0·68	43·4	8·1
GHH·3 ..	,,	27·2	1·07	165	4·2	0·71	46·6	8·7
Marrad ..	,,	28·7	1·13	173	4·4	0·84	50·4	9·4
ERB·4492 ..	,,	28·7	1·13	165	4·2	0·81	44·0	8·2
Menoufi ..	,,	28·4	1·12	169	4·3	0·82	50·4	9·4
Thanekar ..	,,	31·8	1·25	157	4·0	0·82	52·0	9·7
ERB·13754 ..	,,	28·4	1·12	165	4·2	0·80	46·1	8·6
ERB·13650 ..	,,	28·4	1·12	165	4·2	0·81	48·2	9·0
IAN·4903 ..	,,	27·7	1·09	138	3·5	0·80	43·4	8·1
GHB·16 ..	,,	32·8	1·29	134	3·4	0·65	44·0	8·2
Varalaxmi ..	,,	32·8	1·29	134	3·4	0·63	49·3	9·2
RHR·253 ..	,,	33·5	1·32	134	3·4	0·64	47·7	8·9
JBH·4208 ..	,,	32·8	1·29	134	3·4	0·64	46·6	8·7
GHB·10 ..	,,	33·8	1·33	138	3·5	0·65	48·8	9·1
GHB·14 ..	,,	33·0	1·30	142	3·6	0·67	49·3	9·2
GHB·7 ..	,,	33·5	1·32	142	3·6	0·68	46·6	8·7
JKH·11 ..	,,	33·8	1·33	130	3·3	0·63	44·5	8·3
Gujarat 67 ..	Talod	29·2	1·15	138	3·4	0·67	41·3	7·7
Karnataka								
Hybrid 4 ..	Raichur	28·3	1·11	150	3·8	0·72	39·7	7·4
Varalaxmi ..	,,	34·6	1·36	134	3·4	0·68	47·2	8·8
DS·59 ..	,,	28·7	1·13	161	4·1	0·69	45·0	8·4

TABLE 7 : RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1978—(*Contd.*)

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
1	2	3	4	5	6	7	8	9
S.I. Andrews	Shimoga	30·1	1·18	150	3·8	0·71	43·4	8·1
Menoufi ..	,,	27·4	1·08	161	4·1	0·85	42·3	7·9
Varalaxmi ..	,,	32·3	1·27	114	2·9	0·73	44·5	8·3
ERB. 44/92 ..	,,	27·4	1·08	173	4·4	0·86	40·2	7·5
Suvin 62/17 ..	,,	32·8	1·29	130	3·3	0·74	47·7	8·9
Marrad ..	,,	28·2	1·11	150	3·8	0·83	42·3	7·9
Varalaxmi ..	Siruguppa	33·6	1·32	114	3·4	0·82	42·9	8·0
DS·59 ..	,,	28·4	1·12	169	4·3	0·69	40·7	7·6
Madhya Pradesh								
Hybrid 4 ..	Barwaha	28·0	1·10	142	3·6	0·67	43·4	8·1
Hybrid 4 ..	Khargone	29·1	1·15	169	4·3	0·72	45·0	8·4
Hybrid 4 ..	Ratlam	27·9	1·10	157	4·0	0·68	38·6	7·2
Maharashtra								
Nimbkar ..	Baramati	28·0	1·10	157	4·0	0·72	40·7	7·6
Varalaxmi ..	,,	35·5	1·40	138	3·5	0·68	42·9	8·0
MCU·5 ..	Chikhli	29·6	1·17	126	3·2	0·63	46·1	8·6
RHR. 2/53 ..	Kopargaon	29·2	1·15	122	3·1	0·61	47·2	8·8
Varalaxmi ..	,,	31·0	1·22	118	3·0	0·60	46·6	8·7
NHH·1 (Irrigated) ..	Nanded	28·8	1·13	138	3·5	0·67	44·0	8·2
Tamil Nadu								
MCU·5 (F)	Periakulam	29·1	1·15	114	3·0	0·74	48·8	9·1
MCU·5 (N)	,,	30·0	1·18	130	3·1	0·76	45·0	9·0
MCU·8 (F)	,,	29·6	1·17	130	3·6	0·85	46·6	8·7
MCU·8 (N)	,,	30·1	1·19	118	3·4	0·85	45·6	8·5
Suvin	Tirupur	33·2	1·31	126	3·2	0·66	56·8	10·8

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 per-

formance under mill conditions. Only after the superiority of the new varieties is confirmed by mill tests at least 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.

During the year, mill tests were arranged on four new varieties pertaining to 1976-77 season and nine new varieties pertaining to 1977-78 season. The comparative test results at the mill and the Laboratory are given in Table 8.

TABLE 8 : COMPARATIVE MILL AND LABORATORY TESTS — SPINNING TEST RESULTS

Place	Variety	Laboratory Test Results				Mill Test Results			
		Waste %	Count	Strength	t.m.	Waste %	Count	Strength	t.m.
1	2	3	4	5	6	7	8	9	10
				(SKF)					
Andhra Pradesh									
Guntur ..	AV·1661	5·8	40s	51·2	4·0	2·6	40s	50·4	4·4
	MCU·5	9·8	40s	49·8	4·0	7·2	40s	45·1	4·6
Madhya Pradesh									
Khandwa ..	JK Hy·1	4·7	40s	51·7	4·0	1·6	40s	48·3	4·5
	Hybrid 4	5·2	40s	49·3	4·0	1·4	40s	49·6	4·4
Khandwa ..	68 KH.33/1146	4·6	40s	52·4	4·0	3·2	40s	42·3	4·2
	Khandwa 2	5·4	40s	45·3	4·0	3·6	40s	44·0	4·2
Maharashtra									
Kopargaon ..	RHR·253	1·8	80s	28·6	3·75	2·8	80s	29·4	4·0
	Varalaxmi	2·7	80s	28·9	3·75	4·4	80s	27·4	4·0
Nanded ..	NHH·1 (Rainfed)	3·4	50s	47·8	4·0	2·8	50s	46·4	4·4
	Hybrid 4 (Rainfed)	4·1	50s	40·6	4·0	4·0	50s	38·6	4·4
Nanded ..	NHH·1 (Irrigated)	3·8	60s	38·9	3·75	3·6	50s	39·5	4·4
	Hybrid 4 (Irrigated)	4·4	60s	31·9	3·75	3·6	50s	43·9	4·4
Tamil Nadu									
Coimbatore ..	CPH·2	7·9	40s	49·6	4·0	7·0	40s	39·3	4·0

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 AV.1661 gave better yarn strength than the control MCU.5 both at the mill and at the Laboratory.

JK.Hy.1 gave nearly the same yarn strength as Hybrid 4 at the mill and the Laboratory.

The sample of 68KH. 33/1146 gave significantly better yarn strength than Khandwa 2 at the Laboratory, but not at the mill, although the fibre properties were better. Confirmatory tests on fresh samples are proposed to be undertaken on these varieties.

Both the varieties, RHR.253 and Varalaxmi gave almost the same yarn strength at the Laboratory; but, at the mill, the performance of RHR.253 was slightly better.

Under rainfed conditions, NHH.1 recorded better yarn strength than Hybrid 4, both at the mill and at the Laboratory.

Under irrigated conditions, NHH.1 gave better spinning performance than Hybrid 4 at the Laboratory; but, at the mill, NHH.1 gave lower yarn strength than Hybrid 4 even for 50s count. Fresh samples of these are proposed to be tested for confirmation.

The sample of CPH.2 had recorded lower strength at the mill than at the Laboratory.

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

Lint samples of fair average quality of the major Trade Varieties of Indian Cottons are being obtained through the East India Cotton Association Ltd. (EICA), Bombay, each season. Representative *kapas* samples of the varieties are procured from the State Departments of Agriculture for determination of ginning percentage. The fibre and spinning test results, ginning percentage, and other data 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 47 varieties during 1978. The test results on all the Trade Varieties of 1976-77 season were compiled together and published as "Technological Report on Trade Varieties of Indian Cottons, 1976-77 Season". Most of the 1977-78 season samples have been received and tested.

Evaluation of the Quality of Standard Indian Cottons

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 cotton, 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 information of the Cotton Breeders and other research workers as early in the season as possible. During 1978, such circulars were issued on 23 varieties. The results on all the samples pertaining to 1976-77 season were consolidated and published at the end of the season as "Technological Report on Standard Indian Cottons, 1976-77 Season". Most of the samples of Standard Indian Cottons of the 1977-78 season have been received and tested.

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

During the period under report, 45 samples of different varieties, viz. MCU.5, Suvin, Hybrid 4, Varalaxmi and CBS.156, received from Chilakaluripeth, Padanandipadu, Parchuru, Vijayawada and Addanki in Andhra Pradesh were tested for ginning percentage, fineness and maturity.

In addition to the above, a set of six samples of Suvin cotton which was picked at different intervals was also tested.

The test results are given below :

Cotton	No. of samples	Range of		
		Ginning percentage	Micronaire value	Maturity coefficient
MCU·5	15	30·4 to 34·8	2·96 to 4·86	0·85 to 0·75
Suvin	14	25·6 to 31·4	2·80 to 4·10	0·88 to 0·68
Hybrid 4	10	31·4 to 36·0	2·88 to 4·38	0·81 to 0·72
Varalaxmi	8	29·1 to 33·3	3·14 to 3·54	0·87 to 0·73
CBS·156	4	28·6 to 32·8	2·56 to 3·18	0·74 to 0·70

Analysis of the results indicated considerable variation within each of the above properties. However, no systematic trend in the variation could be discernible for any of the cottons.

Study of the Effects of Nitrogenous and Phosphatic Fertilizers on the Yield and Quality of the Cotton, Hybrid 4

The main aim of the study was to assess in measurable terms the impact of the application of the two important types of fertilizers, Nitrogenous and Phosphatic, in suitable levels and combinations on the quality of the fibres of the variety, Hybrid 4. A split-plot design (3 replications) was adopted incorporating 12 manurial treatments, with four nitrogen levels

(N_1—180 kg/ha; N_2—240 kg/ha; N_3—300 kg/ha and N_4—360 kg/ha) in the main plots and three phosphorous (P_2O_5) levels (P_0—0 kg/ha; P_1—90 kg/ha and P_2—180 kg/ha) in the sub-plots.

The produce was evaluated for yield of seed cotton (kg per plot) and the quality characteristics such as length, uniformity, fineness, maturity and strength. The data have been statistically analysed and the following inferences drawn :

Yield : Graded doses of nitrogen make a significant impact on the yield while the effects of phosphorous levels turned out to be non-significant. The increase in yield due to nitrogen doses was observed up to the level N_3, that is 300 kg/ha, while N_4 remained at par with N_3. The interaction ($N \times P$) was also significant. N_2P_2 recorded the highest yield of 3,722 kg/ha, which was at par with N_3P_0 and N_4P_1.

Mean length : Both nitrogen and phosphorus levels did not have any significant impact on the mean length. The interaction ($N \times P$) was however quite significant, N_1P_1 giving the highest length (29.2 mm) and N_2P_1 the lowest (27.7 mm).

Length uniformity : The nitrogen and phosphorus levels exercised a significant influence on length uniformity (UR); N_3 and N_4 recorded significantly higher UR (48) than N_1 (46). The effect of phosphorus level to UR was found to be marginal, P_1 (48) and P_2 and P_0 (47). The interaction $N \times P$ was nonsignificant.

Fineness : N levels were not significant and P levels were marginally significant, P_2 (4.1) being a shade finer than P_1 and P_0 (4.2). The interaction ($N \times P$) was highly significant, N_4P_2 (3.9) being the finest and N_2P_0 (4.4) the coarsest, in comparison.

Maturity : N levels and the interaction ($N \times P$) were non-significant. P levels were just significant, P_1 (0.83) being better than P_0 (0.81).

Bundle strength : N or P levels had little influence on bundle strength. However, ($N \times P$) interaction was significant, N_2P_2 (39.5 g/t) giving the highest strength and N_2P_1 (36.4 g/t) the lowest.

Influence of Insecticide Treatments on the Quality of Cotton and Cottonseed

Thirty samples each of lint and cottonseed of 1977-78 season belonging to the entomological trial 'Chemical control of pest complex of G.Cot.100' conducted at Gujarat Agricultural University, Surat, were received during the year. The treatments given in the trial comprised application of ten different insecticides (including control) and three replications.

The lint samples were subjected to fibre and microspinning tests. 2.5% span length, uniformity ratio, bundle strength at zero and 3 mm gauge lengths, maturity coefficient, and Micronaire value were the fibre properties determined. The test data were statistically analysed. It was observed

that 2.5% span length, uniformity ratio, and bundle tenacity at 3 mm gauge length were the only fibre properties that significantly increased as compared to control, for most of the treatments.

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

Crosses have been effected amongst four *G. hirsutum* and three *G. barbadense* parents and F_1s raised during the current seasons, viz. 1977-78. Back crosses too have been effected in the field and these along with the parents and F_2s will be raised during next crop season, 1978-79. As the material for the season 1977-78 would be available only by the end of March, 1979, the testing work and statistical analysis could be done only after receipt of the samples.

Optical Scanning Technique for Determination of Fibre Fineness and Maturity

During the year under report, 30 cottons comprising five cottons each of the four botanical species and five hybrid varieties grown in India as well as five varieties of foreign cottons, were tested for the required fibre parameters by the standard methods and by Optical Scanning technique employing Fibrograph (Model 430). From the test data on the Fibrograph, a new index of fibre fineness termed Optical Fineness Coefficient (OFC) was computed based on the formula $\left(\frac{W}{A \times L}\right)^2$, where W represents the weight of the specimen beard, A the Optical density as read on the Digital Voltmeter, and L the 2.5% span length for the respective samples. Statistical analysis was carried out to assess the extent of association of the actual gravimetric fineness (GF) values with the respective OFC measures and Micronaire values.

It was observed that for the separate species groups and for all the cottons pooled together, the correlations with OFC were consistently superior to those with Micronaire values. It was also seen that 89% of the variations in GF values were explained by variations in Micronaire values.

In respect of measurement of maturity by scanning technique on the Fibrograph the method outlined in Spinlab Bulletin 107 had been tried for the 30 cottons studied for optical fineness measures. An optical index of maturity, according to the bulletin is given by the expression $\left(\frac{A}{W}\right)^2$, where A is the amount reading on the Digital Voltmeter and W is weight of the fibre beard for the same. Estimates of percentage mature fibres were worked out using the regression equation provided in the bulletin, viz.

$$FM = 187.2 - 1.23 \left[\frac{A^2}{W} + 0.091\ (750 - A)\right] - 1.30\ (2.5\%\ SL),$$

where 2.5% SL is the span length registered at 2.5%. On analysing the data of actual values of mature fibres by caustic soda method and estimated values predicted from the equation, a highly significant correlation of 0.912 was obtained. However, tests for significance showed that the difference between actuals and estimates are significant at 5% level. Further experimental work on more cottons is being carried out.

Fabrication of an Instrument for Estimating Cotton Fibre Maturity

The objective of the project was to develop an instrument for estimating the average maturity of cotton fibres arranged in the form of a thin tuft by a polarised light method which employs the fact that mature and immature fibres display different colour effects under specified conditions.

The work carried out during the year comprised a study of the colour effects shown by highly immature and highly mature cotton fibres when viewed in polarised light. It has been found that a fully mature cotton fibre, disposed in the 45° position between crossed polaroids and illuminated by green light (550 m/v), shows the least intensity variation between the "additive" and "subtractive" positions of a suitably introduced first order red selenite plate. On the other hand, an immature fibre when observed in this manner appears dark in the subtractive position and bright in the additive position, thereby displaying a large difference in the intensity in the two positions of the selenite plate. This inequality in the intensity at the two positions of the selenite plate has been used to evolve an index for the degree of "immaturity" of a sample consisting of both mature and immature fibres.

The measurement is carried out on a monolayer of parallel fibres mounted on a glass slide and swollen with 18% caustic soda solution. The light used is of wave length 550 m/v isolated by an interference filter and the intensity of light emerging from the fibres in different optical conditions is measured by a photomultiplier.

On the basis of a detailed study of the intesnsity variations, an optical immaturity index has been arrived at. This index has been worked out for about 40 varieties of cotton covering a wide range of maturity levels and belonging to all the four major botanical species. The indices have been compared with the maturity coefficient obtained by standard method in which individual fibres are classified on the basis of lumen size and wall-thickness. The results from the two methods appear to be highly correlated when different species are considered separately. The association between the two sets of results, however, seems to be somewhat poor when the data on all the four species are pooled together. Tests on more samples are in progress.

Further Studies on the Cross-sectional Shape of Cotton Fibre

It was reported earlier that cottons belonging to *G. herbaceum* species (*desi* varieties) showed a tendency to have more circular shape of fibre cross-section from the very initial stages of boll development as compared to the cottons of *G. hirsutum*. During the period under report, fibres from cotton bolls of ERB.4530 belonging to *G. barbadense* species picked at weekly intervals of 35, 42, 49, 56 and 63 days were obtained and dehydrated at room temperature. The circularity of each of these cotton fibres was determined by measuring the perimeter and the area of cross-section using standard methods. It was observed that circularity of cotton fibres increased with the boll development. It was further noted that the circularity values of cotton fibres of AK. 235 and AKH.4 belonging to *G. arboreum* species, studied earlier, were much higher than those of ERB.4530.

In another study of the relation of cross-sectional shape with some of the fibre characters of *G. hirsutum* cottons, it was observed that the circularity was significantly correlated, positively with mean fibre length, secondary wall thickness and strength uniformity ratio and negatively with Micronaire fineness and perimeter. The study was further extended to cottons of the *G. herbaceum* species. As the circularity values are largely affected by the maturity of the cotton, it was decided that all the cotton varieties to be selected may be of the same maturity level, viz. 60%. Hence, a large number of cotton samples of *G. herbaceum* were screened for maturity by caustic soda method and 10 cotton samples were selected for cross-sectioning. One hundred cross-sections each for the 10 cottons were traced out with the help of Euscope and ground glass screen attached to a microscope at a magnification of 1350x.

Determination of the Spiral Angle of Cotton

The solvent exchange technique for obtaining dehydrated, but uncollapsed fibres from unopened bolls was standardised. Essentially the technique consists in removing the water present in the fibre by replacing the former with methanol and then removing the methanol with benzene. Various factors, such as the number of exchanges with the solvents, the time allowed for the exchange, the temperature and humidity of the air in which the final drying has been effected, etc., had been carefully studied and conditions for best results had been identified.

Fully mature but unopened bolls of 18 different varieties of cotton drawn from all the four major botanical species were collected and stored in aqueous formaldehyde whereby their turgid state was fully preserved. Fibres from four of the samples had been subjected to solvent exchange by the standardised procedure. Some fibres from the four samples had also been directly dried in

air so that they collapsed and developed a convoluted structure. The solvent exchanged and air dried fibres from the above four samples have been tested for x-ray angle and for the number of convolutions. Both these quantities were found to be lower for the solvent exchanged samples as compared to those for the directly dried fibres. The result demonstrated the effectiveness of the solvent exchange procedure in preventing the collapse of the structure and the formation of convolutions.

Relationship Between X-Ray Orientation and Tensile Properties of Cotton Fibres

Forty cotton samples belonging to the four major cultivated species covering a wide range of bundle tenacity from 35 g/t to 50 g/t at zero gauge length were selected. Bundle tenacity at zero and 3 mm gauge length and elongation at 3 mm gauge length were determined on the Stelometer. The samples are also being scanned on x-ray diffractometer to measure 20%, 40%, 50% and 75% x-ray angles for working out the relationship between the x-ray angles and the strength and elongation characteristics.

Study on Inheritance of Strength and Structural Parameters in Cotton Fibres

Lint samples from 99 single plants raised from earlier selections were tested for crystallite orientation and tenacity. On analysis of the data, it was concluded that further purification of the strains may not be necessary. Thus, the first phase of the project, viz. purification of parental strains, has been completed.

Fortythree samples were chosen on the basis of the test results from the present set and they were sown for raising the first hybrid generation.

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

The x-ray diffraction from yarns spun from cottons belonging to *G. hirsutum* and *G. barbadense* species were examined during the year. Analysis of the data strengthened earlier conclusions drawn from the results obtained on yarns from *desi* cottons that the index chosen for blend analysis is independent of the count and twist of yarns.

When three cotton/jute yarn samples with different blend compositions were analysed using the new method developed, it was found that there was considerable variation in the estimates when different portions of a yarn with a particular blend composition were analysed. As the jute/cotton yarns are considerably uneven, it was suspected that the uneveness was influencing the

analysis. This was confirmed by studying more uniform viscose/cotton yarns, for which the method was found to give satisfactory results.

A Study of the Crystallinity of Cotton by Infrared Methods

Study of the dependence of the relative intensity of the 342 cm^{-1} band on various factors like partial and total mercerisation, degree of polymerisation, etc., was continued. It was observed that samples hydrolysed after treatment with NaOH solution of concentration ranging from 10% to 13% showed an increase in the relative intensity of the band over that of their NaOH treated counterparts. This suggested that the small amount of cellulose II formed at these concentrations was relatively unstable and that during hydrolysis at least a part of it was converted to cellulose I. X-ray studies of these partially mercerised samples and their hydrolysates strengthened the above presumption inasmuch as the lattice conversion ratio (LCR) of the former was higher than that of the latter.

Kiered cotton cellulose was hydrolysed with 36% HCL, 85% phosphoric acid and concentrated sulphuric acid so as to obtain samples of relatively low degree of polymerisation (DP). However, DP of HCL treated sample remained rather high and the fall in the relative intensity of the band was only nominal. Both the other treatments gave low DP samples (average DP $\leq$ 30 for phosphoric acid treatment), but at the same time they produced conversion of cellulose I to cellulose II. The relative intensity of the 343 cm^{-1} band in the phosphoric acid treated sample was much lower than that in the thrice mercerised and hydrolysed material. Conversion of cellulose I to cellulose II as well as the reduction in the average DP may be responsible for this low intensity. Change in the pattern of intermolecular bonding plays a greater role than change in DP in reducing the intensity of the band especially when DP remains high. But when the average DP becomes low, the density of the lateral bands also get affected and hence the intensity is reduced further. In this connection, it is interesting to recall that for samples with a very low DP (such as cellulose pentaose) a band in this position is completely absent.

Cotton fibres treated with different concentrations of NaOH were stretched to 105% of the original length and the effect of stretch on various crystallinity indices was studied. Stretch mercerised samples showed only a marginal increase in crystallinity over that of the corresponding slack mercerised controls. Although the possibility of crystallisation and partial reconversion of cellulose II into cellulose I are evident from published cellulose x-ray data, these changes do not seem to affect the intensity of the 342 cm^{-1} band in any significant way.

Polarized spectra, of cotton fibres in the region below 600 cm^{-1} had been obtained. In this region there were about 8 bands, all being very weak except the one at 342 cm^{-1} which was of moderate intensity in crystalline

cellulose I. This band showed parallel polarisation. It is well known that the nature of coupling between adjacent units in a polymer chain affects the intensity of the band in the low frequency region. All the bands in the low frequency region get affected during conversion of cellullose I to cellulose II and a few even completely disappear.

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

Study of most of the physical and mechanical properties of Digvijay cotton fibres decrystallised by partial cyanoethylation and acetylation had been completed during the year. A comparison of the fibre properties showed that partial cyanoethylation was more effective in producing better decrystallisation than partial acetylation as measured by moisture regain and infrared crystallinity index. All the decrystallisation treatments had been adjusted by using proper reaction time and reaction mixture such that the partially acetylated samples had an acetyl content lying between 5% and 8% and the partially cyanoethylated samples had a nitrogen content lying between 1.3% and 1.7% irrespective of the pre-swelling NaOH concentration.

The above decrystallisation treatments have been extended to a finer variety, viz. PSH cotton, mainly with the intention of studying the effect of fineness on the results of such treatments. It was observed that at the very low levels of substitutions (used in the present study) which was preceded by swelling in NaOH, the physical and mechanical properties had almost the same trend as that observed in decrystallised Digvijay cotton fibres prepared in a similar manner. Regarding mechanical properties of the two different varieties, the control samples of the finer variety showed a higher fibre strength and strength uniformity and the same trend was kept after decrystallisation also.

Crosslinking of the fibres with dimethylol dihydroy enthylene urea (DMDHEU) and subsequent measurement of mechnical properties showed that crosslinking after decrystallisation results in a higher strength retention and strength uniformity ratio (UR) than crosslinking after a mere swelling in NaOH, though the strength loss was appreciable in both the cases. This observation is important as it makes clear that decrystallisation, by limited and controlled blocking of OH groups, resulted in a better distribution of crosslinks. However, since accurate measurement of crease recovery angle (CRA) for fibres is very cumbersome and often fails to give reproducible results, the same decrystallisation and subsequent crosslinking treatment has been carried out on yarn spun to 30s count from the same lot of Digvijay cotton fibre sample. Preliminary results were found to be promising. Mechanical properities and CRA values of these yarns are being evaluated.

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

The widely accepted unit cell for cellulose I, proposed by Meyer and Misch in 1937 is monoclinic, space group $\underline{P}\ 2_1$, and contains two cellobiose residues of two-fold screw symmetry. However, the structure of crystal lattice of native cellulose is a subject of some controversy. For instance, Dobb and co-workers observed recently a number of reflections in the electron diffraction (ED) patterns of ramie and cotton which can only be indexed in terms of a 'super-lattice'. However, Herbert *et al* have reported the existence of two different unit cells, one for cotton and ramie approximating Meyer and Misch model and the other for *Valonia* and bacterial cellulose. They also could not discern any systematic absence of odd-order 0k0 reflections in any of the cellulose diffraction diagrams and concluded that requirements of a two-fold screw axis are not met and the cellulose space group is probably not $\underline{P}2_1$. In view of this, using the ED technique standardised at CTRL, a systematic study was carried out to index a large number of reflections in the ED pattern of cotton cellulose. About 32 reflections could be indexed on the basis of Meyer and Misch model. The validity of the observations based on reciprocal net $a^X c^X$ when checked by constructing reciprocal net $b^X c^X$ revealed three reflections which could not be indexed on the basis $b^X c^X$ net. No systematic absence of odd-order 0k0 reflections was noted. The cotton cellulose therefore does not appear to fall into $\underline{P}2_1$ space group.

The ED patterns of 16 varieties of Indian cottons were analysed. It was observed that the variety Wagad belonging to *G. herbaceum* species has lower crystallinity and crystallite width perpendicular to 002 plane, as compared to other cottons. The crystallite orientation angle within the fibrils of Wagad was also larger as compared to the same in other cottons.

The ED analysis of mercerized and liquid ammonia treated cotton fabrics was completed. The intensity tracings (Plate II) showed that the transition of cellulose I to cellulose II in mercerized cotton and cellulose I to cellulose III in liquid ammonia treated cotton were incomplete and that on boiling in water, the liquid ammonia treated sample reverted to typical cellulose I. The lateral order was determined in terms of resolution factor (R) on mercerization and ammonia treatment. The R values increased considerably as compared to the untreated control, indicating decrystallization of cotton cellulose. The crystallite dimension perpendicular to 002 plane also showed reduction in width due to the chemical treatment. However, on boiling the liquid ammonia treated cotton in water, there was considerable increase in R value, approaching the R value of the untreated control. Further, there was also an increase in crystallite width approaching the value of the crystallite width in untreated control possibly due to recrystallization. This investigation was carried out in collaboration with Prof. E. H. Daruwalla, Director, UDCT.

Studies on various other chemical modifications of cotton cellulose using an improved technique of recording ED patterns with a high sensitive fast film are in progress.

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

Cellulase dissolution technique : Cross-sections of various esters and ethers of cotton cellulose were treated with cellulase and examined using the transmission electron microscope. The results have conclusively shown that the cellulase dissolution technique has much wider application and that it has distinct advantage over the cuene dissolution technique. Cuene, being a powerful swelling agent, distorts the original ultra-structure of the specimen and, in fact, seems to introduce artifact.

The acetylated and cyanoethylated cottons of low DS were highly susceptible to cellulase but acetylated, cyanoethylated and benzylated cottons of higher DS and benzoylated cottons of low DS were highly resistant to cellulase (Plate III) This also reveals that these latter modifications impart mildew and rot resistance to cotton. Particular mention may be made of the action of cellulase on allylated cotton of high DS. While cuene failed to dissolve any portion of the cross-section, cellulase-dissolution was very apparent (Plate IV) therby indicating that this modification does not impart any mildew or rot resistance. Thus cellulase dissolution technique besides serving as an effective analytical tool for the study of chemically modified cottons, has also an added advantage to serve as a quick method to evaluate cotton treated for mildew or rot resistance.

Optical anisotropy : Samples of cotton benzylated (0.33, 0.40, 0.45, 0.55, 0.63, 0.70 and 0.75 DS) and benzoylated (0.3, 1.5 and 2.1 DS) were prepared. Determinations of refractive indices of these samples are in progress.

Preparation of Nep Grade for Indian Cottons

It was mentioned in the last year's report that the work on very fine, medium fine and very coarse cottons had been completed. Based on the results, it was decided to select 320F, Hybrid 4 and Comillas cottons for preparing photographic nep grade standards to represent very fine, average and very coarse groups.

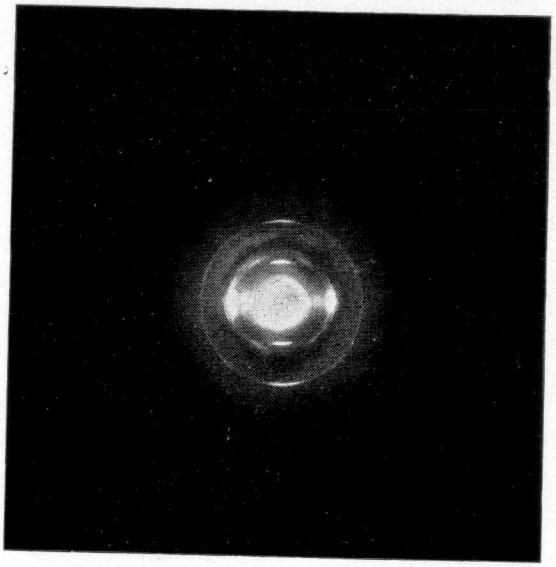
Work could not progress further because the card clothing of the cylinders of the Nepotometer had worn out due to bending of fillets and could not be replaced, being of special type, in spite of several attempts made through different manufacturers. Action is being taken to purchase a new model of Nepotometer which is commonly being used at present in Indian textile mills.

PLATE I

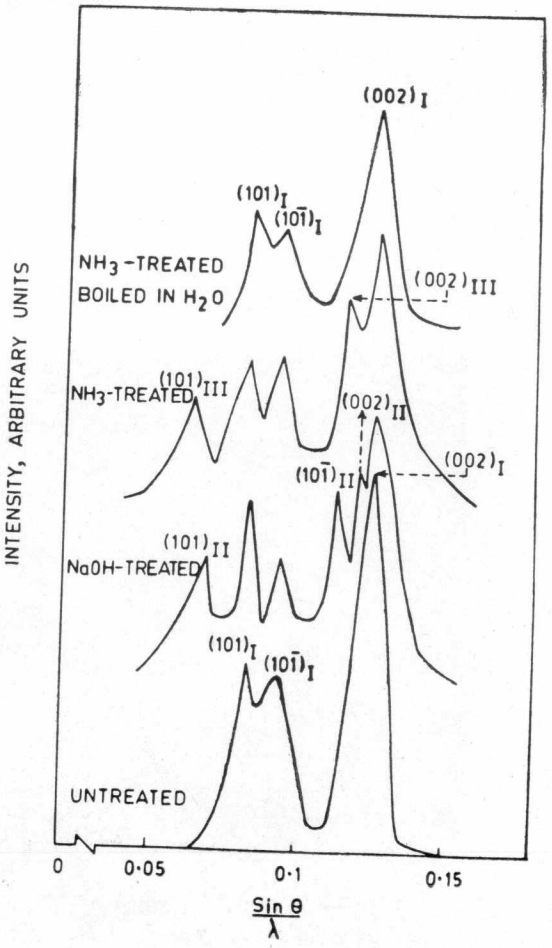
(a) Dr. V. Sundaram, Director, CTRL, Explaining a Point in the Fibre Testing Section

(b) The Distinguished Visitors in the Yarn Testing Section of CTRL

PLATE II



Electron Diffraction Pattern of Cell Wall Fragment of Liquid Ammonia-treated Cotton. Note Mixed Lattice of Cellulose I and Cellulose III (*see page 47*).



Equatorial Intensity Tracing of Electron Diffraction Pattern of Cotton: Untreated, Mercerized, Liquid Ammonia-treated, and Liquid Ammonia-treated Boiled in Water, indicating Positions of Crystalline Peaks (*see page 47*).

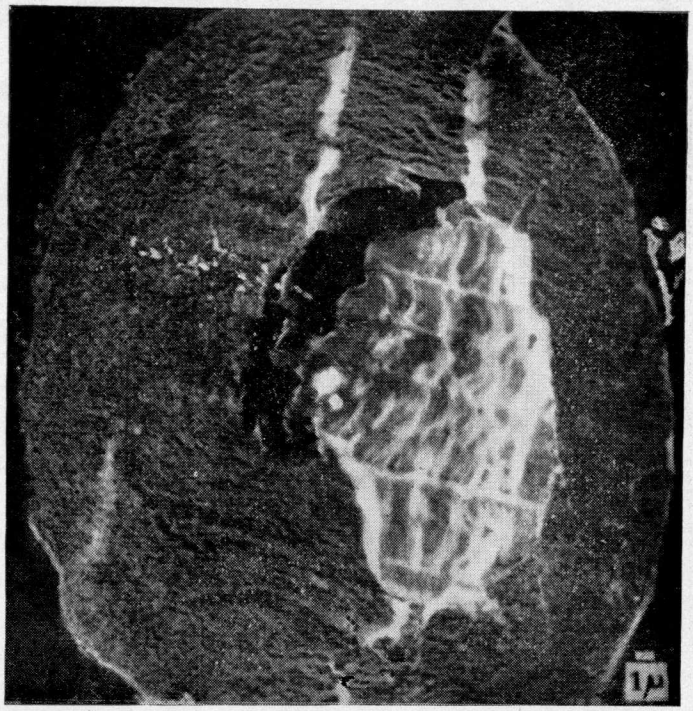


PLATE III—*Electron Micrograph of Cross-section of Benzoylated Cotton of 0.32 DS Immersed in Cellulase Enzyme for 1 hr. Note the Ineffectiveness of the Cellulase Enzyme and the Detachment of the Central Solid Mass from the Rest of the Section* (*see page 48*).

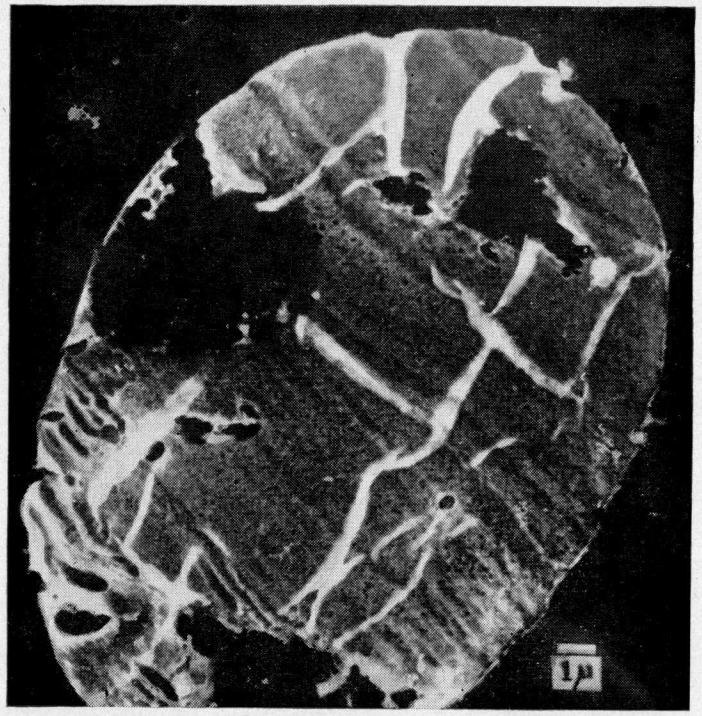


PLATE IV—*Electron Micrograph of Cross-section of Allylated Cotton of 1.24 DS Immersed in Cellulase Enzyme for 1 hr. Note the Partial Dissolution af the Section. Cuene does not Dissolve the Section* (*see page 48*).

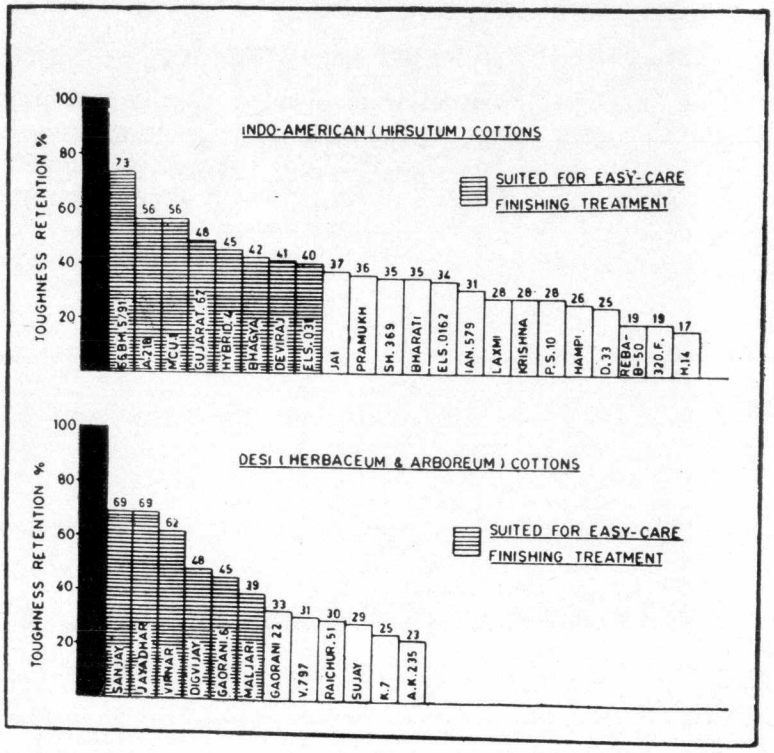


PLATE V—*Toughness Retention of Indian Cottons Screened for Easy-care Treatment* (*see page 53*).

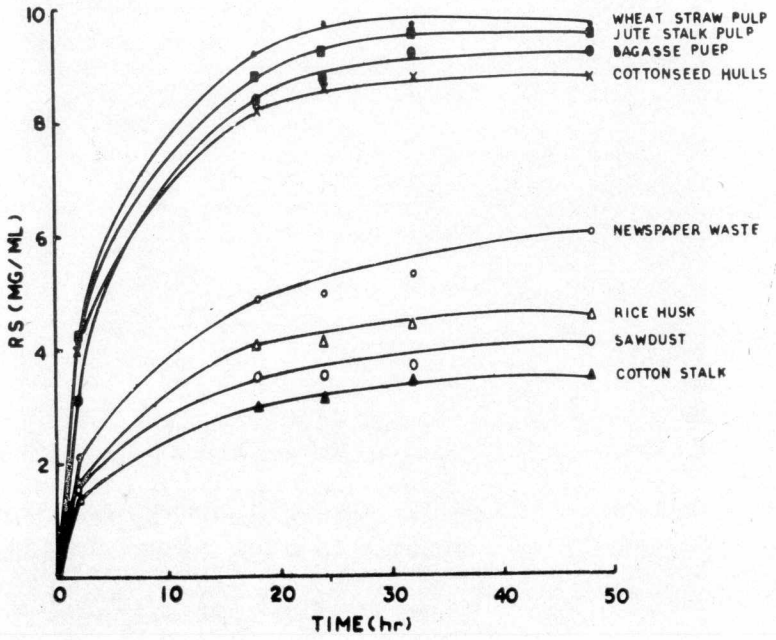


PLATE VI—*Hydrolysis of the Cellulosic Substrates with Cellulase of P. funiculosum* (*see page 58*).

Studies on Lakshmi-Rieter Drawing and Speed Frames

Two lots of Digvijay cotton were blended equally and processed on blowroom, card and 3 passages of Lakshmi-Rieter drawframe using four different combinations of break drafts. For comparison, another lot was processed on a conventional T & S drawframe with usual break drafts. The slivers were then processed through slubber, intermediate and finally spun to 30s count. Details regarding fibre, processed sliver and yarn properties are given in Table 9.

TABLE 9 : EFFECT OF DIFFERENT COMBINATION OF BREAK DRAFTS ON SLIVER AND YARN QUALITY

Medium Staple Mixing — Digvijay — 30s

Fibre Properties

2·5% span length (mm)	24·2
Uniformity ratio (%)	48
Micronaire value (μg/in.)	3·5
Stelometer bundle tenacity (g/t) :	
(*i*) Zero gauge	48·5
(*ii*) 3 mm gauge	29·8

Sliver and Yarn Properties

Combination	A	B	C	D	E
Break Drafts in Three D.F. Passages	1·7-1·7 -1·7	1·7-1·3 -1·3	1·3-1·3 -1·3	1·3-1·7 -1·7	Conventional (T & S)
U%					
Finisher Sliver	3·8	4·4	3·3	3·6	4·4
Slubber	5·3	5·1	5·3	5·7	6·2
Inter	5·5	5·8	5·6	5·8	6·2
Yarn	15·8	16·9	16·1	15·8	16·7
CV%					
Lea Counts	3·3	3·3	3·1	4·8	4·1
Lea Strength	7·2	7·2	7·9	9·8	10·0
S.T. Strength	13·1	11·4	12·0	12·4	12·3
Lea CSP	2371	2259	2284	2303	2267

The results reported in Table 9 show that the quality of slivers, rovings and yarns from conventional drawing was poorer than that of materials produced from the best combinations of break drafts in high speed drawing. Among the various break draft combinations, combination B employing break drafts of 1.7-1.3-1.3 in the three passages showed the poorest sliver and yarn quality. From overall considerations a lower break draft of 1.3 at all passages (combination C) seems to be preferable.

Studies on Strength of Cotton Fibre Bundles and Yarns in Non-Conditioned Atmospheres

Strength tests on lea samples covering a count range of 20s to 80s have been carried out at the Surat Regional Station of CTRL. The leas were initially conditioned by preserving them in a box at 65% r.h. Later, they were tested at each of the ambient humidities 25%, 35%, 45%, 55%, 65%, 75%, 85% and 95% r.h. The corresponding strength and count values were measured. The analysis of the results is in progress.

Contribution of Fibre Length and Fibre Strength to Yarn Strength

In order to examine the contribution of fibre length and fibre strength to yarn strength in general terms, about 20 samples have been tested partially. The work is in progress.

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

During the year under report, experimental work was continued for determining the various fibre and yarn characteristics of 60 samples of cotton representing all the four botanical species as well as some of the newly evolved hybrids. The cottons were spun to counts ranging from 20s to 80s. The lea CSP values for the yarns of each cotton for two suitable counts were determined. Evenness parameters from Uster Evenness Tester and nep content measures were also recorded.

The Fibre Quality Index (FQI) tentively proposed on the basis of an initial study is given by the formula:

$$Q = \frac{SL_{2.5\%} \times S_1 \times S_U \times Mc}{f}$$

where $SL_{2.5\%}$ indicates 2.5% span length on Digital Fibrograph, S_1 and S_U indicate strength at one-eighth inch gauge and percentage strength uniformity respectively, Mc, the maturity coefficient and f, the Micronaire value. As a new index of fibre fineness termed Optical Fineness Coefficient (OFC) from Digital Fibrograph measures has been recently developed in this Laboratory, the formula for FQI is sought to be revised by replacing Micronaire values with respective OFC measure. Further analysis is being carried out to assess the extent of association of the revised FQI with lea CSP values of the respective yarns processed from the cottons.

From the data of the various yarn quality parameters, a suitable index of yarn quality is also being worked out.

Optimal Blending of Standard Varieties of Indian Cottons

Spinning of individual varieties of Varalaxmi (Sup.), Hybrid 4 (FAQ) and MCU.5 (FAQ) was completed during the year. The cottons were

processed through blowroom, semi-high production card, high speed drawframe, can fed intermediate and ring frame. The counts spun were 60s and 80s for Varalaxmi, 40s, 50s and 60s for Hybrid 4 and 50s and 60s for MCU.5. Measurements were made of fibre orientation on card and drawframe slivers and of neps on card sliver. Yarn quality as well as the end breakage rate in spinning were assessed. Further work is in progress.

Studies in Physical Characteristics of Cotton Blends

Five varieties, viz. Sujay, 320F, V.797, Virnar and Deviraj differing in Micronaire value (3.3 to 5.1) have been selected. Of these varieties, Sujay, 320F and V.797 were processed as control samples and a common count of 30s was spun. Yarn tests such as lea strength, single thread strength, Uster evenness and ASTM yarn appearance were carried out on these control samples. Virnar and Deviraj will also be spun to 30s count. Virnar will then be blended in 50:50 proportion with Deviraj, 320F and Sujay separately and a common count of 30s will be spun and tested for yarn properties.

Blending of Cotton with Wool, Jute and Other Natural Fibres

A fairly large amount of yarn (about 20 kg of cotton-jute caddies and cotton-wool noil blends) was spun for weaving suitable fabrics, as it was proposed that samples of fabric produced from the same blends are to be displayed at the exhibition being organised in connection with the Golden Jubilee celebration of ICAR. The cotton used for blending with jute caddies was V.797 with a 2.5% span length of 23.6 mm and a Micronaire value of 4.8 μg/in. For blending with wool noils, a mixing of Y.1 and Maljari having a 2.5% span length of 22.6 mm and a Micronaire value of 5.0 μg/in. was used. In both cases, 6s yarn was spun from blends containing 75% cotton with 25% jute caddies or wool noil as the other component and have been handed over to the Weavers' Service Centre for weaving furnishing fabrics on handlooms.

Blending of Cotton with Man-made Fibres

During the year, a new cotton PSH was chosen for blending with 1.4 denier high tenacity polyester fibre manufactured in India.

The PSH cotton was combed to about 15% and the combed sliver was blended with polyester in the proportion of 75 : 25, 50 : 50, 33 : 67, cotton : polyester. The spinning of the individual components and the blends are in progress. The blends are proposed to be spun to 80s and 50s counts.

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

The method of measuring sonic velocity using the Pulse Propagation Meter has been standardised. The effect of specimen length, tension during measurement, the number of tests required, etc., have been studied and the optimum values for these variables have been arrived at.

While studying the influence of yarn geometry on sonic velocity, it was found that in samples having a common count (50s) and twist (TM-4), but differing in mean fibre length, the pulse velocity was lower for those spun from shorter fibres. Test results of sonic velocity measurements on yarns are given in Table 10.

TABLE 10 : RESULTS OF SONIC VELOCITY MEASUREMENTS ON YARNS SPUN FROM THREE DIFFERENT COTTONS

Sample	Mean fibre length (in.)	Sonic velocity* (km./sec.)	C.V. %
DS·59	1·13	2·9350 ± 0·0262*	4·5
Sujata	1·22	2·9661 ± 0·0439*	3·7
Sudan IOC	1·32	3·1445 ± 0·0265*	4·5

* With in $\pm \frac{2\sigma}{\sqrt{n}}$

The above results appeared to suggest that the pulse took more time to travel a given distance in yarn containing a large number of discontinuities. The influence of these discontinuities in effectively slowingdown the pulse was demonstrated by artificially increasing their number by cutting and knotting together the end of a polyester filament yarn. In this test, it was found that the pulse took progressively longer times to travel as the number of discontinuities increased, confirming that the effective pulse velocity in yarn depends on fibre length characteristics of the fibres from which it is spun.

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

For assessing the variation in Crease Recovery Angle (CRA) values amongst the Crease Recovery (CR) Testers, CRA of an ideal fabric, viz. polyester, was measured by all the three CR Testers and values of CRA obtained from all of them were found to be well in agreement.

To maintain the same conditions as in Shirley CR Tester, the load was increased from 1/2 kg to 2 kg in Monsanto CR Tester and from 600 g to 2 kg in Metrimpex CR Tester. The relaxation time was reduced in the case of both Metrimpex and Monsanto CR Testers from 5 min. to 1 min. The results indicated that the load and relaxation time had no appreciable effect on CRA values.

CRA of untreated control samples of sheeting, poplin, drill and cambric were determined by three operators in each of the three CR Testers. Sheeting fabric was crosslinked with DMDHEU at two levels. (*i*) wash and wear and (*ii*) durable press. Dry and wet CRA of these crosslinked sheeting samples were determined on Metrimpex and Monsanto CR Testers. Further work is in progress.

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

This ICAR *ad-hoc* Project was successfully completed. Plate V summarises the results of toughness retention of 34 varieties of Indian cottons subjected to DMDHEU treatment. Toughness is the most important single property of cotton indicating the energy absorbing capacity of the fibre, which influences the abrasion resistance, tear strength and wearlife of a crosslinked fabric. Cotton with medium strength (37.5 g/t to 45.5 g/t) and high elongation (over 8%) is more suited for easy-care finishing treatments than one with very high strength and low elongation. Further, toughness retention above 40% by a cotton after crosslinking may be considered as promising.

The wide variation in the toughness retention within *G. hirsutum* cottons after crosslinking treatment was apparent from the results. For instance, the cotton 66BH.5/91 has toughness retention of 73% whereas the variety H.14 has exhibited poor toughness retention of about 17%. Similarly, in the case of *G. arboreum* and *G. herbaceum* cottons, Sanjay and Jayadhar exhibited very high toughness retention.

The important contributions made through this project to date are summarised below:

(*i*) Specific Indian varieties among *desi* (*arboreum* and *herbaceum*), *hirsutum* and *barbadense* species which are suitable for easy-care finishing treatment were identified. Particular mention may be made of *desi* varieties like Sanjay and Digvijay with circular cross-sectional shape which have shown high retention of toughness character and high crease recovery angle after crosslinking treatments.

(*ii*) Pre-swelling followed by crosslinking has shown considerable improvement in the retention of mechanical properties of weak *hirsutum* cottons.

(*iii*) Many useful laboratory model equipments were fabricated, which include: (*a*) Padding Mangle, (*b*) Curing Oven, (*c*) Yarn Stretching Device and (*d*) Mercerising Unit.

(*iv*) A technique has been developed to predict crease recovery angle of fabric from yarn-pads which will be of considerable practical value.

(*v*) This project has brought out ample evidence to show that there is varietal response of cottons to finishing treatment. The information generated would be of considerable practical use to the breeder and

the textile industry. For instance, in the wake of modern processing technologies, the present day breeder has to be aware of the changes and should introduce new parameters in his breeding programmes. Response of cottons to easy-care finishing can be one such parameter. The textile industry too can exploit more economically and appropriately the varieties most suited for easy-care finishing treatments.

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

During the period under report, the study was continued by changing the two-step poly-set process already tried, into a single step one, so as to make the process more easy and convenient to the textile industry.

Cotton fabric was treated under the following three processes using dimethylol dihydroxy ethylene urea (DMDHEU) and methyl melamine (MMM) resins in poly-set process:

(*i*) Poly-set two step process;
(*ii*) Poly-set steps I and II combined in single step;
(*iii*) Conventional process.

Mixtures of DMDHEU and MMM resins were used in six different baths by varying the concentration of DMDHEU in the range from 4% to 15%, keeping the concentration of MMM at 10%. In Step I of the process (*i*), zinc acetate (5%) was used as catalyst, while zinc nitrate (0.6%) was used as catalyst in Step II. In process (*ii*) both the catalysts were added at the same time during resin treatment as a single step process, keeping the concentrations of the resins same. In conventional process (*iii*), DMDHEU was used alone. Treated fabrics along with control were studied for various chemical and physical properties. The results showed that single step process produced almost similar results as two step poly-set process. Hence, it can be conveniently used for producing resin finished fabrics with certain improved properties compared to conventional process. Further studies on blends are in progress.

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

During the period under report, exhaustive literature survey was carried out. The methods for the treatment of fabrics and the methods for estimation of various properties were standardised.

Cotton fabric samples were treated separately with 12% of dimethylol ethylene urea (DMEU) and 8% of DMDHEU for preliminary work. Migration of resins on cotton fabrics treated with 8% DMDHEU was studied at 60°C, 70°C and 80°C and dried for periods ranging from 0 to 60 minutes. After drying, the samples were cured at 100°C for 3 hr. The cured samples were studied for migration of resin by the method reported by Andrews and

Frick with certain modifications and these samples were subjected to test for estimation of moisture content, nitrogen content and formaldehyde content. Effects of various factors on resin migration are being ascertained.

Studies on Grafting of Vinyl Monomers onto Cotton Fabrics

During the period under report, survey of literature on grafting of vinyl monomers onto cotton cellulose was carried out. Preliminary treatments on grafting vinyl monomers onto cotton cloth was also carried out, in addition to standardising method for chemical initiation.

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

Phosphorylation using radiation technique : Cotton fabric samples were phosphorylated using diammonium hydrogen orthophosphate and urea by radiation processes (pre-irradiation and simultaneous irradiation methods). To minimise thermal degradation, trials were carried out to phosphorylate cotton fabric by radiation process using lower curing temperature. The observations indicated that cotton fabrics can be conveniently phosphorylated by radiation process to the same level of phosphorous content, 4.3 to 4.5%, as that by conventional method using a low curing temperature of 130°C as against 150°C used by the latter method.

As phosphorylation imparts flame-proofing characteristics to cotton fabrics, the phosphorylated samples were tested for strength and flame proofing properties by determining oxygen index. The data are given in Table. 11

TABLE 11 : STRENGTH AND OXYGEN INDEX OF FABRICS PHOSPHORYLATED BY DIFFERENT METHODS

Method	P%	Strength retained (%)		Oxygen index
		Warp	Weft	
Untreated-control	—	100	100	18·3
Pre-irradiation	4·5	56·9	49·4	37·0
Simultaneous irradiation	4·3	57·2	51·0	31·5
Conventional	4·5	41·3	37·4	32·0

Phosphorous content values (Table 11) were more or less in the same range in the fabrics treated by all the methods. It is interesting to note that the fabric phosphorylated by simultaneaous irradiation method showed flame proofing properties to the same extent, as judged by oxygen

index (31.5) compared to the conventional method (32.9) with better retention of strength. However, the fabric phosphorylated by pre-irradiation method showed better flame proofing properties as indicated by higher oxygen index of 37.0 with comparatively better retention of strength than the fabric phosphorylated by the other two methods.

Chemical Treatment : With a view to introduce more unsaturation on cellulose, trials were undertaken to prepare propargyl cellulose by three-step process.

Post-irradiation activity : Last year, an attempt to estimate post-irradiation activity of irradiated, allylated and irradiated celluloseen samples failed as the samples got dissolved in 70% zinc chloride solution. Further trials with varying concentrations of zinc chloride indicated that a concentration of 10% could be conveniently used to measure the post-irradiation activity of irradiated, allylated and irradiated celluloseen samples.

Studies on Absorbancy of Indian Cottons

Glycerine Retention Value (GRV) and water holding capacity of varieties, LD.133, Lohit, Gaorani 6, Gaorani 22, Gaorani 27, Digvijay, LSS, Westerns 1 and cotton waste from various stages of spinning were determined. In order to find out whether there existed any relationship between absorbancy and gross structural characteristics, selected samples are being tested for circularity, convolutions, etc.

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

2-aminophenol 4,6-disulphonic acid was purified, diazotised at low temperature and coupled with 'J' acid to get the 0, 0'-dihydroxy compound. The product was salted out, purified and metallized using 2% palladium chloride solution. The metallized dye was salted out and purified. Visible and infrared spectra confirmed the metallization of the dye. Characterisation of the bands of the IR spectrum is being done. Preliminary diffusion experiments were done using this metallized dye.

Cross-sections of cotton fibres dyed with the above metalized dye were examined in the electron microscope. Uniform dispersion as well as aggregation of dye molecules were located in the cross-section. Further work to study the diffusion is in progress.

Diffusion studies in cellophane as well as acetylated cellophane of various DS, using a purified direct dye, chlorazol Sky Blue FF, are in progress. The purpose of this study is to find out a relationship between DS and diffusion coefficients. Structural study of cellophane using XRD and ED was completed.

Studies on the Biosynthesis of Cellulose by Microorganisms and Higher Plants

The project on cellulose biosynthesis has been activated in collaboration with the Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri, to study the mechanism and to obtain enhanced rate of cellulose biosynthesis. Cellulose biosynthesis is being studied in three systems, viz. germinating seeds, developing cotton bolls and microorganisms.

Analytical procedures and the assay of enzyme involved in the cellulose biosynthesis using unlabelled substrates were standardised in the germinating seeds of mung bean (*Phaseolus aureus*).

Some preliminary experiments were conducted to standardise the pot-culture technique to grow cotton under Bombay's climatic conditions. After standardization, Laxmi and Suvin varieties of cotton were grown in the pots. Developing cotton bolls from one stage (20 days post-anthesis) of Suvin variety were collected and assayed for enzyme activity. The work on the assay of enzyme activity from other stages of developing bolls is in progress.

Laxmi and Suvin varieties were simultaneously grown in the field at MPKV, Rahuri. The bolls from different stages of these varieties were collected and dried. They were analysed for their content of cellulose, soluble sugars, total nitrogen and ash.

The biosynthesis of cellulose was also studied in the microorganism *Acetobacter xylinum*. The organism was grown in the medium containing glucose. A thin film was observed at the top of the medium after 48 hour incubation. The film (pellicle) was characterised as cellulose by its insolubility in 2% hot NaOH and chromatographic analysis of the acid and enzymic (cellulase) hydrolysate. The effect of different growth conditions on the rate of cellulose biosynthesis was also studied. A progressive increase in the cellulose synthesis was observed with increase in the incubation period up to 30 days. Shaking of inoculated flasks during incubation decreased the rate of cellulose synthesis. The organism still synthesised cellulose when glucose in the medium was replaced with other carbon sources like fructose, galactose, xylose and mannitol. The lyophilised cells of this organism also exhibited their ability to synthesise cellulose. The work on the enzymatic synthesis of cellulose by the particulate fraction of cell homogenate of this organism is in progress.

Fermentation Studies on Cellulase Production and Its Application

The earlier work on the saccharification of bagasse and wheat straw pulp (WSP) was extended to other six cellulosic substrates, viz. cottonseed hulls, cotton stalk, jute stalk, newspaper waste, rice husk and sawdust. These substrates were carefully bleached with sodium chloride and analysed for their ash, alpha-cellulose, lignin and pentosan contents. The ash content was maximum in rice husk (27%); it was 3% in cotton stalk and low in other

substrates. The alpha-cellulose content of bagasse, jute stalk, newspaper waste, and WSP was about 70% to 80% and the same in other substrates was around 55%. The lignin was removed by the bleaching treatment. However, cotton stalk and sawdust retained about 1% to 2% lignin. Cottonseed hulls had highest pentosan content (30%), while the other substrates had 14% to 20% pentosan content.

The bleached substrates were pulverized and sieved through 25 mesh screen, the screened portion was treated with *Penicillium funiculosum* (F4) cellulase (11.25 FP units) for 2 to 48 hours. The saccharification was determined by estimating the reducing sugar (RS) formed. It was noted that WSP, jute stalk, bagasse, and cottonseed hulls were more susceptible to cellulase as compared to newspaper waste, rice husk, sawdust and cotton stalk (Plate VI). The susceptible substrates could be hydrolysed to the extent of 80% to 90% using cellulase of 16.8 FP units, while the resistant substrates required more than 28 FP units to achieve 80% hydrolysis.

The hydrolysates of the cellulosic substrates were analysed by paper chromatography technique. All the hydrolysates showed the presence of cellobiose, glucose and xylose. In addition, cotton stalk, rice husk and WSP showed the presence of arabinose. Further, cotton stalk and sawdust hydrolystes revealed the presence of uronic acids.

Food yeasts, *Candida utilis* and *C. tropicalis* were grown in a synthetic (Johnson) medium containing the hydrolysates at 1% RS level. The cultures were also grown on 1% glucose. The cells were harvested at the end of 48 hours incubation and their crude proteins were estimated. The cultures could grow well on these hydrolysates and yielded around 45% to 50% protein as compared to 42% protein produced when grown on glucose alone. The better growth on hydrolysates could be due to the presence of other sugars in them.

The electrophoretic analysis of cellulase on polyacrylamide gel showed five clear protein bands.

Enrichment of Cattlefeed by Microbiological Methods

In our country, cattle and buffaloes are raised on straws of paddy, wheat and ragi despite their poor nutritional value especially with respect to protein. CTRL have a good collection of cellulolytic cultures including strains of *Penicillium funiculosum* and *Trichoderma viride*. A project was, therefore, started in 1978 in collaboration with Punjabrao Krishi Vidyapeeth (PKV), Akola, to investigate the possibilities of enriching the above mentioned straws with microbial proteins using the cultures available at CTRL and also to study their acceptability and digestibility. Research work carried out elsewhere have already indicated that physical and chemical treatment followed by microbial fermentation results in protein rich end products with improved digestibility.

A number of fodder samples and agricultural waste materials, viz. paddy straw, wheat straw, jowar stalks, rye straw and jowar stubbles, tur stalks, cotton stalks and groundnut shells were accordingly tested for supporting the growth of cellulolytic cultures. Paddy and wheat straw were cut to 3 to 5 cm, treated with 0.5 N H_2SO_4 (1 : 3 W/V), autoclaved at 15 lb pressure for 30 minutes and then ammoniated to pH 4.5 to 5.0. Preliminary studies indicated that these two straws were good sources for supporting the growth of microorganisms. Out of a few fungal cultures screened for this purpose, *P. funiculosum* and *Candida utilis* were found to be promising. The protein addition was maximum with *P. funiculosum* when grown on paddy straw as compared to wheat straw. *Candida utilis* performed well on both the straws. In general, there was a five-fold increase in crude protein with microbial fermentation. In another set of experiments, the straws were cut to 3 cm to 5 cm and boiled in 4% NaOH for 15 minutes. Alkali boiled and ammoniated straws did support the growth of *P. funiculosum* with a few more days of incubation than with acid treated and ammoniated ones.

On the basis of experiments at CTRL, large scale trials were planned at PKV, Akola, where two quintals each of paddy straw and wheat straw were acid treated, ammoniated and enriched with *P. funiculosum* and *C. utilis* respectively. The enriched samples were handed over to Prof. Honmode, Head of Animal Nutrition, to carry out feeding trials on goats. Results on the per cent digestibility, body weight, etc., are awaited. In the meantime, at CTRL, enriched straws along with respective controls are being analysed for total nitrogen, ammoniacal nitrogen, crude protein, crude fibre, ether extractives, nitrogen free extractives, lignin, cellulose, hemi-cellulose, ash, total sugars, pH and moisture.

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

Verticillium dahliae and *Fusarium oxysporum f. vasinfectum* are two fungal species, mainly soil-borne, which cause wilting of cotton. *Verticillium dahliae* is temperture sensitive and attacks only *hirsutum* varieties, whereas, *F. oxysporum* is very sensitive to soil temperature and attacks *arboreum* and *herbaceum* cottons as well. These two pathogens, thus, seriously limit the yield of cotton. The variety, MCU.5 is known to be susceptible to the attack by *V. dahliae* and it was, therefore, felt worthwhile to explore the possibility of controlling this pathogen by amending the soil with chitin or prawn shell waste.

Experiments were accordingly conducted in the laboratory using (*i*) Leonard jar assembly and (*ii*) pot culture methods. Chitin was applied to soil in two different doses, viz. 0.5% and 1.0% levels. To one set, a composite culture of authentic chitinoclastic microorganisms comprising *Bacillus* sp., *Flayobacterium* sp. and *streptomyces* sp. was inoculated. Two controls were maintained. One set which did not receive either chitin, chitinoclastic microorganisms or *Verticillium* served as uninoculated control, while another

set inoculated with only *Verticillium* served as inoculated control. To a third set both *Verticillium* and chitinoclastic microorganisms were inoculated. Artificially cultured *V. dahliae* was blended and mixed uniformly in all the soils already amended with chitin. Delinted seeds were sown in pots whereas pre-germinated seeds were planted in Leonard jars. In both the cases, typical wilt symptoms started appearing in inoculated controls during November 1978. Plants were healthy and greenish in chitin amended soil.

The same study was extended to field trials at Coimbatore where the incidence of this disease is very severe. An experiment was laid out in an uniformly infested plot at Sandehagowndenapalayam near CICR, Coimbatore, in a Randomized Complete Block Design with six treatments and four replications. The size of the individual plot was 23.62 sq. m in seven rows. The spacing between rows was fixed at 75 cm, whereas plant to plant it was fixed at 30 cm. Untreated healthy seeds of MCU.5 cotton variety were dibbled at the rate of three per hill on August 30, 1978. After 15 days, the plants were thinned out allowing 2 best plants per hill. A basal dose of Vijay complex (17 : 17 : 17) was applied at the rate of 120 g/row. Half of the total quantity of prawn shell waste was mixed with a composite culture of chitinoclastic microorganisms before the actual application. The treatment details are as follows :

1. Control
2. Prawn shell waste—500 kg/ha (i.e. chitin 50 kg)
3. Prawn shell waste—1,000 kg/ha (i.e. chitin 100 kg)
4. Prawn shell waste—500 kg/ha (i.e. chitin 50 kg) and chitinoclastic microorganisms
5. Prawn shell waste—1,000 kg/ha (i.e. chitin 100 kg) and chitinoclastic microorganisms
6. Town compost — 1,270 quintals/ha.

Prawn shell waste and compost were applied to one month old crop in rows. Composite soil samples were collected at monthly intervals for the estimation of pH, ammoniacal nitrogen, moisture holding capacity, and for the enumeration of *Verticillium* and chitinolytic microorganisms. Wilt symptoms and large scale infestation are expected to occur during second week of January 1979.

Preliminary studies have indicated that the culture filtrate with crude chitinase preparation of *Bacillus* sp. grown on Skerman's medium containing 0.25% colloidal chitin damage the cell wall of *V. dahliae* previously grown on Richard's broth as evidenced by the cotton blue staining technique. Electron microscopy has confirmed this finding.

Analysis and Grading of Cotton Linters

Linters of four varieties, viz. L.147 (Mill run and II cut), Hybrid 4, Laxmi (All, I and II cut) were analysed for chemical composition.

The fluidity range of these linter samples (6-9 Rhes) revealed that they are better suited for cellulose acetate manufacture.

A Laboratory Model Saw Gin and Delinting Machine in this connection, have been recently installed. Preliminary trials were being carried out to gin and delint various varieties of cotton selected for the purpose.

Evaluation of Protein Composition of Indian Cottonseeds

During the period under report, 10 cottonseed samples were selected for amino acid analysis. Seed samples were dehulled, kernel separated, powdered and extracted with petroleum ether to remove oil. The cottonseed meal after extraction was hydrolysed with glass distilled 6N HCl at 110°C for 24 hours. The hydrolysate was freed of acid and then diluted with buffer solution. These samples were used for analysis of amino acids on the Amino Acid Analyser. Out of these, six samples were analysed at the Nuclear Research Laboratory (NRL), Indian Agricultural Research Institute, New Delhi. The data showed that amino acid contents varied from variety to variety. Lysin content in the samples varied from 3.53 g/16 g nitrogen (Laxmi) to 4.68 g/16 g nitrogen (Varalaxmi). Arginin content varied from 10.70 g/16 g (Laxmi) to 12.66 g/16g nitrogen (Suvin) and Methionine from 1.01 g/16 g (Laxmi) to 2.35 g/16 g nitrogen (Varalaxmi). Similar variation was observed in many other cases also. The results on cotton meal samples which were run at BARC are being worked out.

Fatty Acid Composition of Cottonseed Oil of Different Varieties

From an earlier work on 20 cottonseed oil samples, it was observed that the separation of some of the fatty acids was not satisfactory. Therefore, it was decided to run the samples on a different column. A new column with Free Fatty Acid Phase (FFAP), which gave satisfactory separation of fatty acids was selected accordingly. Methyl esters of cottonseed oil of 20 samples were freshly prepared and run on gas chromatograph in FFAP column at 200°C using flame ionization detector. The individual fatty acids were identified with the help of known standard fatty acids. Duplicate tests were found sufficient to give satisfactory values as determined by statistical analysis. Five more samples were analysed for fatty acid contents. From the results it is observed that cottonseed oil contains high percentage of linoleic acid and showed marked variation among the varieties. Linoleic and oleic acid varied from 48.4% (Khandwa 1) to 54.4% (Digvijay) and 16.7% (Deviraj) to 20.6% (Khandwa 1), respectively.

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

From time to time samples of cotton seeds of different varieties were collected and were crushed to extract oil by solvent extraction procedure.

The oils thus extracted were converted to methyl esters and were subjected to alumina treatment. The alumina treated methyl esters had been titrated with standard HBr to determine the contents of malvalic acid and sterculic acid. It was observed that the contents of malvalic and sterculic acids ranged from a maximum amount of 1.29% and 1.35% in 22 cottons (*G. arboreum*) to a minimum of 0.59% and 0.62% in Deviraj (*G. hirsutum*) cotton.

Utilization of Cotton Stalk

The experimental work for the preparation of particle boards utilising cotton plant stalks was continued by conducting trials to produce in a single step process laminated boards having better appearance. Trial was also conducted to examine the suitability of finer particles of cotton plant stalks, for use as moulding powder. Attempts made to prepare cheaper quality boards using lignin (a waste product from paper mills) as binding material proved successful and further investigation is under way to improve the physical and chemical properties of the boards thus prepared.

To find out other possible industrial utilization of cotton plant stalks, its detailed chemical analysis was carried out. The samples having particles of 25 mesh size were used for the analysis of ash, benzene soluble matter, alcohol soluble matter, water soluble and cold 5% caustic soda soluble matter contents. Analysis for cellulose content, hemi-cellulose content and lignin content was also carried out.

With a view to assess the feasibility for the commercial exploitation of the know-how, large size boards from cotton stalk particles of different mesh sizes were to be prepared taking into consideration primarily the cost aspect of the board preparation. Since this Laboratory did not have adequate facility for large scale board preparation, the Punjabrao Krishi Vidyapeeth (PKV), Akola, was approached with the Project, as per the suggestion of Staff Research Council, for technical collaboration. Discussions were held with the Project Director and the Vice-Chancellor of PKV for speedy execution of the project, so that the know-how could be released in the Golden Jubilee Year of ICAR.

Studies on Deburring of Raw Wool Using Mechanical Device

Special slide rails required for the installation and adjustment of electric motor have been completed. The electric motor was installed on proper foundation. The work of proper alignment of parts and running the device as a ginning machine is in progress.

Research Work Done at the Regional Quality Evaluation Units

Coimbatore

An investigation was undertaken at Coimbatore to study the effect of ratooning on the fibre properties of CBS.156 variety during 1977 and 1978 seasons. The 12 main treatments consisted of ratooning after different pickings with different sprouts on the plants and 4 sub-treatments of different levels of nitrogen. The lint samples from all the treatments were tested for important fibre properties. It was observed that fibre length was unaffected by both the treatments. The ratooning treatments affected significantly fineness and maturity. Ratooning after the sixth picking with all sprouts produced fibres of low micronaire value associated with the lowest maturity. Nitrogen treatments did not affect both fineness and maturity. Data on fibre strength are being analysed.

Surat

(*a*) The work on the project "Genetical Selection for Fibre Strength" was carried out on the similar lines as during the previous year. The following inferences were drawn from the data collected :

1. *G. herbaceum* varieties possessed higher strength than *G. hirsutum* varieties but they also tended to display higher variation in their within-plant values.

2. Out of the 10 varieties belonging to *G. hirsutum* and *G. herbaceum* species, the tenacity values of the selected plants of IAN.579-188 and NC.4168 showed significant increase as compared to the control. Remaining varieties did not show any improvement.

(*b*) For the studies on 'Fuzz Colour in Cotton', three cottons each were selected in three categories of fuzz colour : dark green, light green and white. From these cottons, nine crosses were made to get suitable combination of the three categories of fuzz colour. The F_1s of these crosses were obtained and evaluated for seed fuzz colour, seed damage rate and seed weight. It was observed that green colour of the fuzz was the dominant character. The seed damage rate was low for all cottons. On the whole, the green fuzz seed (102 mg) and white fuzz seed (98 mg) appeared to possess similar weight.

The F_1s and the parents have been again sown this season. Suitable crosses will be effected in the field and the material studied later.

Hissar

(*a*) A field experiment on the effect of defoliants, Gramoxone (1, 1 dimethyl 4, 4-dipyridyllium dichloride) and Boll's eye (dimethyl arsenic acid) on the fibre characteristics of H.14 cotton was conducted for the three seasons 1974 to 1977 in randomized block. There were 10 defoliant treatments. These treatments had no significant effect on fibre properties. A similar experiment was carried out to study the effect of Gramoxone on the yield and fibre characteristics of G.27 cotton. In this experiment also the Gramoxone treatments had no influence on the fibre properties.

(*b*) An experiment was laid in randomized block with four replications for the seasons 1974 to 1977 to evaluate the effect of new planting pattern on the fibre quality. The planting patterns combined different row-widths and different inter-row widths. It was found that the effect of reducing the row-width from 60 cm to 30 cm did not produce significant effect on yield and fibre quality.

Indore

The investigation to find out the differences in the properties of fibres obtained from different positions in the cotton boll was undertaken under irrigated conditions at Indore in 1977-78 season. The trial, using two hybrids JKHy.1 and Hybrid 4, was laid in randomized block with four replications. Three pickings of the crop were studied separately. Each boll was divided into four parts — base, middle-1, middle-2, and tip. Samples were obtained from each part separately, and tested for ginning percentage and chief fibre properties. It was observed that ginning percentage, fineness, maturity and strength were highest for the fibres from the basal portions and lowest for the fibres from the tip portions. Reverse trend was noticed for fibre length.

3. Publications

During 1978, one Annual Report, two Technological Reports, eighteen Research Publications and seventy Technological Circulars were issued, in addition to five papers presented at Conferences.

A. Annual Report

Annual Report of the Cotton Technological Research Laboratory for the Year 1977.

B. Technological Reports

No. 21. Technological Report on Trade Varieties of Indian Cottons, 1976-77 Season.

No. 22. Technological Report on Standard Indian Cottons, 1976-77 Season.

C. Research Publications (CTRL Publication—New Series)

No. 106. Present Day Long Staple Indian Cottons and the Spinner— by M. S. Parthasarathy and V. Sundaram (reprinted from *Journal of Indian Society for Cotton Improvement*, special issue, 1977).

No. 107. Relationship Between Appearance and Uster Evenness Parameters of Yarn — by A. V. Ukidve, (Kum.) C. R. Raje and P. G. Oka (reprinted from *Journal of the Textile Association*, January 1978 issue).

No. 108. Effect of Mercerisation on the Spiral Angle of Different Varieties of Cotton — by K. R. Krishna Iyer, N. B. Patil and R. P. Nachane (reprinted from *Indian Journal of Textile Research*, Vol. 2, December 1977 issue).

No. 109. Behaviour of Bifunctional and Polyfunctional Reactive Dyes Applied to Cotton Cellulose — by S. M. Betrabet, V. B. Bagwe and E. H. Daruwalla (reprinted from *Journal of the Society of Dyers and Colourists*, September 1977 issue).

No. 110. Variation in Strength-Elongation Characteristics of Indian Cottons at Different Gauge Lengths — by V. G. Munshi, (Smt.) S. D. Pai and (Smt.) J. K. S. Warrier (reprinted from *Journal of Indian Society for Cotton Improvement*, March 1978 issue).

No. 111. Know Your Cotton : (3) Hybrid 4 (Sankar 4) — by V. Sundaram, P. G. Oka and N. P. Mehta (reprinted from *Journal of Indian Society for Cotton Improvement*, March 1978 issue).

No. 112. Amylase from *Bacillus subtilis*-159 for Desizing — by S. G. Gayal and V. G. Khandeparkar (reprinted from *Indian Journal of Textile Research*, March 1978 issue).

No. 113. Effect of Cellulase on the Morphology and Fine Structure of Cellulosic Substrates, Part I : Wheat Straw Pulp — by S. M. Betrabet and K. M. Paralikar (reprinted from *Cellulose Chemistry and Technology*, November-December 1977 issue).

No. 114. Effect of Cellulase on the Morphology and Fine Structure of Cellulosic Substrates, Part II : Bagasse and Sawdust — by S. M. Betrabet and K. M. Paralikar (reprinted from *Cellulose Chemistry and Technology*, March-April, 1978 issue).

No. 115. Quick Estimation of Some Length and Length Variation Parameters by Digital Fibrograph—by (Kum). I. K. P. Iyer and V. G. Munshi (reprinted from *Journal of the Textile Association*, November 1978 issue).

No. 116. Effect of Accelerating Potential on the Determination of Structural Parameters of Cellulose by Electron Diffraction Technique — by K. M. Paralikar and S. M. Betrabet (reprinted from *Journal of Applied Polymer Science*, January 1978 issue).

No. 117. Strides in Long Staple Cotton Cultivation in India — by V. Sundaram, M. S. Parthasarathy and V. G. Munshi (reprinted from *Textile and Dyestuffs*, November 1978 issue).

No. 118. Quantitative Analysis of Wool/Cotton Blends : An Infrared Method—by (Mrs.) P. Bhama Iyer, K. R. Krishna Iyer and N. B. Patil (reprinted from *Journal of Applied Polymer Science*, September 1978 issue).

D. Articles and Papers Published

1. Fine Structural Changes in Native and Mercerised Fibrous Cellulose brought about by Ethylenediamine and Methyl Alcohol — by P. K. Chidambaraswaran, S. Sreenivasan, N. B. Patil, H. T. Lokhande and S. R. Shukla (*Journal of Applied Polymer Science*, November 1978 issue).

2. Qualitative Improvement in Cotton Production : A Technological Analysis — by M. S. Parthasarathy, V. Sundaram and V. G. Munshi (*Daily Cotton Market Report*, Annual issue, 1978).

3. A New Method for the Determinaton of Yarn Hairiness by Digital Fibrograph — by (Mrs.) S. B. Pai and V. G. Munshi (*Textile Research Journal*, December 1978 issue).

4. Effect of Storage on Cotton Quality — Letters to the Editor — by V. Sundaram and M. S. Parthasarathy, and also by L. R. Jambunathan (*Journal of the Textile Association*, March 1978 issue).

5. Spinning of Cotton-Jute Blends on the Cotton System — by B. Srinathan, A. S. Sathe, M. S. Parthasarathy and V. Sundaram (*Indian Journal of Textile Research*, September 1978 issue).

E. Papers Presented at Conferences/Seminars

1. Studies on Cross-sectional Shape of Cotton Fibres : The Relation of Cross-sectional Shape of Raw Cotton with Other Fibre Characters — by B. M. Petkar, P. G. Oka and V. Sundaram (presented at the 19th Technological Conference held at ATIRA, Ahmedabad, in February 1978).

2. Improved DP Cotton by Two-step Polyset Process : Part I — Crosslinking of Cotton Cellulose with Dimethylol Ethylene Urea— by S. N. Pandey and (Smt.) Prema Nair (presented at the 19th Technological Conference held at ATIRA, Ahmedabad, in February 1978).

3. Studies on Grafting of Styrene on to Cotton—by N. Thejappa and S. N. Pandey (presented at the 19th Technological Conference held at ATIRA, Ahmedabad, in February, 1978).

4. Strides in Long Staple Cotton Cultivation in India—by V. Sundaram, M. S. Parthasarathy and V. G. Munshi (presented at the National Textile Seminar, New Delhi, in April 1978).

5. Enzymatic Sacharification of Cellulosic Materials — by (Kum.) A. S. Dighe, V. G. Khandeparkar and S. M. Betrabet (presented at the 19th Annual Conference of Association of Microbiologists of India, at Baroda, in November 1978).

F. Technological Circulars

TRADE VARIETIES OF INDIAN COTTONS

T.C. No.	*Variety*	*T.C. No.*	*Variety*
1919	L.147 (Adilabad)	1942	Hybrid 4 (Khargone)
1920	Comillas (Assam)	1943	320F (Sriganganagar)
1921	MCU.5 (Chirala)	1944	Westerns 1 (Bellary)
1922	SRT.1 (Karjan)	1945	Laxmi (Baramati)
1923	Krishna (Vijayawada)	1946	V.797 (Viramgam)
1924	Suyodhar (Bagalkot)	1947	Nimbkar (Baramati)
1925	Narmada (Khandwa)	1948	Hybrid 4 (Amalner)
1926	Khandwa 2 (Khandwa)-	1949	C. Indore 1 (Bhilwara)
1927	Deviraj (Gokak)	1950	Digvijay (Palej)
1928	Bikaneri Narma (Sriganga-nagar)	1951	Hybrid 4 (Palej)
		1952	Varalaxmi (Baramati)
1929	SRT.1 (Palej)	1953	Badnawar 1 (Ratlam)
1930	G.1 (Sriganganagar)	1954	Laxmi (Hubli)
1931	Deviraj (Dhrangdhra)	1955	Jayadhar (Hubli)
1932	Hybrid 4 (Idar)	1956	Wagad (Morvi)
1933	Varalaxmi (Idar)	1957	Buri 147 (Malegaon)
1934	Sujay (Surat)	1958	J.34 (Bhuchhu)
1935	Sanjay (Botad)	1959	Hampi (Raichur)
1936	Mysore 14 (Arsikere)	1960	Laxmi (Raichur)
1937	G.22 (Bidar)	1961	Hybrid 4 (Raichur)
1938	Virnar (Ratlam)	1962	Y.1 (Sayada)
1939	S.I. Andrews (Shimoga)	1963	Varalaxmi (Raichur)
1940	B.1007 (Khamgaon)	1964	Suvin (Tirupur)
1941	Maljari (Khargone)	1965	MCU.5 (Chikhli)

STANDARD INDIAN COTTONS

S.C. No.	*Variety*	*S.C. No.*	*Variety*
152	V.797 (Viramgam)	164	H.14 (Hissar)
153	Gujarat 67 (Talod)	165	LSS (Abohar)
154	Laxmi (Gadag)	166	Buri 147 (Yavatmal)
155	Buri 147 (Yavatmal)	167	MCU.5 (Periakulam)
156	Narmada (Khandwa)	168	Varalaxmi (Siruguppa)
157	K.8 (Kovilpatti)	169	Hampi (Siruguppa)
158	Hybrid 4 (Surat)	170	Hybrid 4 (Surat)
159	Bharathi (Kovilpatti)	171	Deviraj (Arabhavi)
160	Jayadhar (Dharwar)	172	Sujay (Surat)
161	Hampi (Siruguppa)	173	Deviraj (Junagadh)
162	Digvijay (Broach)	174	Sanjay (Amreli)
163	Narmada (Khandwa)		

4. Extension

Since CTRL has no farm attached to it, field work is carried out at various Central Institutes, Agricultural Universities and Regional Units in different States and, hence the Laboratory does not directly come into contact with farmers. However, the Laboratory renders indirectly, valuable assistance to growers by undertaking tests on samples sent by the trade, the industry, the government and civic organisations, etc., by imparting training in cotton technology and by supplying various testing instruments for assessing quality of cotton.

Testing Work

Apart from the research samples received from various agricultural stations, this Laboratory continued to receive a number of samples of fibre, yarn and cloth for special tests from commercial firms and government and semi-government organisations, on payment of the prescribed test fees. The number of such samples received and tested during the year 1978 together with the corresponding figures for 1976, 1977 and for the quinquennium 1971-75 are given in Table 11.

TABLE 11 : NUMBER OF SAMPLES RECEIVED FOR PAID TESTS

Type of test	Average for the quinquennium, 1971-75	1976	1977	1978
Spinning	10	22	67	67
Fibre (EICA)*	16	250	189	163
Fibre (Others)	193	77	154	126
Yarn	37	42	61	20
Cloth	48	61	60	110
Moisture	73	—	1	—
Miscellaneous	8	4	25	26
Total	385	456	557	512

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

The total fees realised during 1978 for carrying out paid tests on these samples amounted to Rs. 30,134.10 against Rs. 27,344.20 during 1977.

The special tests which were carried out during the year included the following :

1. Three samples of cotton lint of the varieties HC.101, Acala 1517 and Coker 417, received from the River Valleys Development Board, Sri Lanka, were subjected to fibre, spinning and yarn tests.

2. A sample of Suture Surgical Thread sent by the Research and Development Group, BARC, was tested for knotted breaking strength and cross-sectional diameter.

3. Two samples of Micro Crystalline Cellulose Powder were received from a cellulose products firm for the determination of x-ray crystallinity.

4. Three Tanzanian Cottons were received from an Indian consultancy firm of engineers for a spinning mill in Tanzania, for the determination of fibre quality and spinning potential using micro-spinning technique.

5. A number of polyester fibre samples from an indigenous producer were received for determination of tensile strength and elongation by Instron Tensile Tester.

6. A piece of paper for identification of constituents and photo micrograph at a magnification of X 550 was received from a Petroleum Company. The tests revealed that the fibres had an appearance similar to that of a mixture of wool cells.

7. A spinning mill of South India sought advise on a problem of roller lapping during adverse climate conditions, especially on the intensity of lapping that varied when different synthetic cots were used. Tests on the three samples received in this connection showed that the wax content of the samples was higher than normal and could have been the possible reason for the problem experienced by the mill, especially since test for honey-dew attack was negative.

Training

The Laboratory is conducting two full time training courses, lasting eight weeks each, one from July to September and the other from September to November, for those deputed by cotton trading organisations in Bombay

and mofussil centres. During 1978, the following persons attended the training course which consisted of lecture and practical work on methods of evaluation of cotton fibre quality and interpretation of the test results, including statistical analysis :

1. Shri C. R. Shah,
C/o. M/s. Arjan Khimji & Co.,
28, Mittal Chambers,
Nariman Point,
Bombay 400 021.

2. Shri J. T. Thakkar,
C/o. M/s. Khimji Brothers,
Western India House,
17, Sir P. M. Road,
Bombay 400 001.

3. Shri S. M. Kapadia,
C/o. M/s. Kanji Shivji & Co.,
57, Jolly Maker Chamber No. 1,
5th Floor, Nariman Point,
Bombay 400 021.

4. Shri B. J. Joshi,
E-32 Mirani Nagar,
Ganesh Gawde Road,
Mulund, Bombay 400 080.

5. Shri Z. M. Kadri,
C/o. Gujarat State Co-op. Marketing Federation Ltd.,
P. B. Navrangpura 4042,
Ahmedabad 380 009.

6. Shri R. P. Rathi,
C/o. M/s. Navkishore Rathi,
Twisa Gin Compound,
P. Box No. 26,
Amravati, Maharashtra.

7. Shri N. B. Desai,
C/o. The Dharwar Dist. Co-op. Marketing Federation Ltd.,
Hubli, Karnataka.

8. Shri S. Muthu Srinivasan,
Department of Agricultural Marketing,
No. 188, 3rd North Cross Street,
Anna Nagar, Madurai 625 020.

5. Conferences and Symposia

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

S. No.	Meetings/Conferences	Place	Date	Names of the Officers who attended the meeting/conference
1.	19th Joint Technological Conference sponsored by ATIRA, BTRA and SITRA, held at ATIRA, Ahmedabad.	Ahmedabad	10-2-1978 and 11-2-1978	Shri P. G. Oka, Dr. S. N. Pandey, Shri B. M. Petkar, Smt. Prema Nair and Shri N. Thejappa
2.	Meeting to review the progress of research under Integrated World Bank Cotton Development Project.	Nagpur	22-2-1978	Dr. V. Sundaram
3.	Panel Meetings and 14th Meeting of the Research Advisory Committee of SITRA, held at SITRA, Coimbatore.	Coimbatore	23-2-1978 and 24-2-1978	Dr. V. Sundaram
4.	Meeting of the Scientific Panel for Post-Harvest Technology of ICAR.	New Delhi	1-3-1978 and 2-3-1978	Dr. V. Sundaram
5.	Seminar on "Production, Planning and Control in Cotton Spinning Mills", organised by Management Development Institute, New Delhi.	Baroda	10-3-1978	Dr. K. R. Krishna Iyer
6.	Conference of the Directors of New ICAR Institutes.	Delhi	10-3-1978 to 13-3-1978	Dr. V. Sundaram
7.	Meeting of Germplasm Committee and North Zone Panel Meeting of AICCIP.	Hissar	19-3-1978 to 21-3-1978	Dr. V. Sundaram and Shri P. G. Oka
8.	Meeting of Executive Council of Mahatma Phule Krishi Vidyapeeth, held at Agricultural College, Poona.	Poona	9-4-1978	Dr. V. Sundaram
9.	Seminar on "Quality Control with Instrumentation", organised by Textile Association, Bombay.	Bombay	17-4-1978	Shri P. G. Oka, Shri A. V. Ukidve and Shri S. G. Nayar
10.	Central Zone Workshop Meeting of AICCIP.	Junagadh	9-5-1978 and 10-5-1978	Dr. V. Sundaram and Shri P. G. Oka

S. No.	Meetings/Conferences	Place	Date	Names of the Officers who attended the meeting/conference
11.	Fourth Meeting of the Sub-Committee on Research and Development of the Indian Cotton Development Council held at Directorate of Cotton Development, Bombay.	Bombay	15-5-1978	Dr. V. Sundaram
12.	South Zone Meeting of AICCIP.	Coimbatore	25-5-1978	Dr. V. Sundaram.
13.	Symposium on Uster Control Instruments for Textile Industry, organised by Messrs. Voltas Ltd., Bombay.	Bombay	5-6-1978	Shri M. S. Parthasarathy
14.	Fifth Meeting of Indian Cotton Development Council, Bombay.	Bhatinda	15-7-1978 and 16-7-1978	Dr. V. Sundaram
15.	Meeting of Task Force to go into the details of the Programme of Research Project Files.	New Delhi	10-8-1978 and 11-8-1978	Dr. V. Sundaram
16.	Fourth Management Committee Meeting of CICR.	Coimbatore	3-10-1978	Dr. V. Sundaram
17.	Conference of Directors of ICAR Institutes, held at Sugarcane Breeding Institute, Coimbatore.	Coimbatore	4-10-1978 to 7-10-1978	Dr. V. Sundaram
18.	Second Review Committee Meeting of ICDP held at Marathwada Agricultural University Campus, Parbhani.	Parbhani	9-11-1978	Dr. V. Sundaram
19.	Nineteenth Annual Conference of Association of Microbiologists of India.	Baroda	9-11-1978 to 11-11-1978	Dr. V. G. Khandeparkar and Kum. A. S. Dighe
20.	Fifth Management Committee Meeting of CICR.	Nagpur	13-11-1978	Dr. V. Sundaram
21.	Sixteenth Meeting of the Indian Cotton Development Council, held at Directorate of Oilseeds Development, Hyderabad.	Hyderabad	27-11-1978 and 28-11-1978	Dr. V. Sundaram
22.	Workshop-Cum-Seminar under AICCIP.	Hyderabad	30-11-1978 to 2-12-1978	Dr. V. Sundaram Dr. V. G. Munshi and Shri P. G. Oka

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

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

6. Summary of the Report

This is the 55th Annual Report of CTRL covering the calendar year 1978. The Laboratory continued to collaborate actively with research workers and agricultural scientists for evolving new strains of cottons. Various research projects on fundamental studies in fibre physics, ginning, spinning technology, textile chemistry, microscopy and microbiology were undertaken, in addition to the regular testing and evaluation work on textile materials and several papers based on these investigations published during the year. Many new items of equipment and books were purchased and added.

Research Activities

The progress made on various research investigations during 1978 is summarised below :

Under AICCIP and various schemes sponsored by Agricultural Universities, State Governments, etc., 1,943 samples were tested for fibre quality and spinning performance during 1978 as against 1,658 tested last year.

At the All India Workshop of AICCIP held at Hyderabad, the release of the following varieties was recommended :

Variety Released	*Variety Replaced*	*Tract*
H.655C	H.14	Haryana
H.777	B.N. and H.14	Haryana
Godavari (NHH.1)	Hybrid 4	Marathwada tract of Maharashtra.
Savitri (RHR.253)	Varalaxmi	Irrigated areas of Deccan Canal tract of Maharashtra.
Suguna (CPH.2)	—	Southern and Central Districts of Tamil Nadu and parts of Andhra Pradesh.

In addition, the release of the following varieties was announced by the respective State Governments during the meeting :

Variety Released	*Variety Replaced*	*Tract*
Amaravathi (AV.1661)	MCU.5	Rainfed tract of Nagarjunasagar Project area of Andhra Pradesh.
Mahanandi (355E.6)	Nandicum	Northerns tract of Andhra Pradesh.
Sangam (V.14)	Krishna	Rice fallows area of Andhra Pradesh.
Saraswathi (12009)	Gaorani 6	Gaorani tract of Andhra Pradesh.
Srisailam (1512)	Mungari	Mungari tract of Andhra Pradesh.
SRT.1 (G.cot.10)	—	Rainfed tracts of Maharashtra.

A *desi* variety, HD.11 was recommended by the Panel for pre-release seed multiplication to replace G.27 in Haryana.

During 1978, Technological Circulars were issued on 47 trade varieties and 23 standard cotton samples and Mill Tests were arranged on four new varieties pertaining to 1976-77 season and nine new varieties pertaining to 1977-78 season.

As part of the study of the variability in the ginning out-turn and the fibre characters of the extra-long staple cottons grown in Andhra Pradesh and Tamil Nadu, 45 samples received from five places in A.P. were tested for ginning percentage, fineness and maturity. Analysis of results indicated considerable variation without any definite trend.

In order to study the effect of nitrogenous and phosphatic fertilisers on the yield and quality of Hybrid 4 cotton, four levels of nitrogen (N) and three levels of phosphorus (P) treatments were tried adopting split-plot design for the experiment. Evaluation of the produce for yield and quality characteristics revealed that the combination of (180 kg N + 90 kg P)/ha recorded highest value for length (29.2 mm), while the combination (300 kg N + 180 kg P)/ha recorded highest yield (3,722 kg/ha). As regards fibre strength, (240 kg N + 180 kg P)/ha recorded the highest value.

Statistical analysis of the results of fibre tests on samples from an entomological trial at Surat consisting of applications of 10 different insecticides showed that only some fibre properties, viz. 2.5% span length, uniformity ratio and bundle tenacity at 3 mm gauge length, were significantly increased as compared to control in most of the treatments.

To study the varietal variability and mode of inheritance, eight *hirsutum* and four *barbadense* varieties were classified into two categories, viz. low and

high Uniformity Ratio (UR) on the basis of UR determined by Fibrograph. On the basis of tests for UR on lint from F_1 crosses of these varieties, it has been observed that high UR may be the dominant character.

Using the optical scanning technique with the Digital Fibrograph, the optical fineness coefficient (OFC) values of 30 cottons were computed based on the formula $\left(\frac{W}{A \times L}\right)^2$ where W represents the weight of the fibre beard, A optical density as read on the Digital Voltmeter and L the 2.5% span length for the respective samples. The gravimetric fineness values of these cottons were observed to be better correlated with OFC values than with Micronaire values when the values were analysed separately for each species groups as well as for the values for all the cottons pooled together. It was also seen that 89% of the variations in gravimetric fineness values were explained by variations in OFC results, as against 84% accounted for by variations in Micronaire values. An Optical Index for maturity is also being worked out using scanning technique.

In connection with the work for developing an instrument for estimating average maturity of cotton fibres arranged in the form of a thin tuft, by a polarised light method, colour effects shown by highly immature and highly mature fibres when viewed in polorised light have been studied. Based on the intensity variations, an optical maturity index has been arrived at for 40 varieties of cotton and compared with the maturity coefficient obtained by the standard NaOH method. The results from both the methods were highly correlated when considered species-wise. However, when the data on cottons of all the four species were pooled, the correlation was poor.

Studies on the cross-sectional shape of cotton fibres from the cotton bolls of ERB.4530 belonging to *G. barbadense* species picked at different weekly intervals have shown that circularity of fibre cross-section increases with boll development. Further, in the case of *G. hirsutum* cottons it was observed that the circularity of fibre cross-section was significantly correlated positively with mean fibre length, secondary wall thickness and strength uniformity ratio, and negatively with Micronaire fineness and perimeter.

In connection with a study on the determination of spiral angle of cotton, the solvent exchange technique was standardised for obtaining dehydrated, but uncollapsed fibres from unopened bolls. The x-ray angle and number of convolutions per unit length were measured for solvent exchanged and air dried fibres from four samples. The solvent exchanged samples recorded lower values than the directly dried fibres evincing the effectiveness of the solvent exchange technique in preventing the collapse of the structure and the formation of convolutions.

Forty cotton samples having a wide range of bundle tenacity from 35 g/t to 50 g/t at zero gauge length were tested for bundle tenacity at zero and 3 mm gauge lengths and elongation at 3 mm gauge length and the same

samples are being scanned for various x-ray parameters to establish a relationship between x-ray orientation and tensile properties.

Purification of parental strains was completed in connection with the study on inheritance of strength and structural parameters. Based on the results of x-ray angle and breaking tenacity, 43 samples have been chosen for sowing in order to raise the first hybrid generation.

Analysis of x-ray diffraction data on yarns spun from cottons belonging to *G. hirsutum* and *G. barbadense* species strengthened the earlier conclusions that the index chosen for blend analysis is independent of the count and twist of yarns. When three cotton/jute yarn samples of different blend compositions were analysed, it was observed that the results were affected appreciably by yarn irregularity.

Samples hydrolysed after treatment with NaOH of concentrations ranging from 10% to 13% showed an increase in the relative intensity of the 342 cm^{-1} band over that of the NaOH treated counterparts suggesting the relative instability of cellulose II formed and partial conversion of cellulose II to cellulose I during hydrolysis. It is also observed that in the case of samples of very low degree of polymerisation, the intensity of the band decreased with decrease in DP. In this connection it is interesting to note that the band is completely absent in the spectrum of cellulose pentaose.

Determination of the physical and structural properties of Digvijay cotton fibres decrystallised by partial cyanoethylation and acetylation showed that partial cyanoethylation was more effective in producing better decrystallisation, than partial acetylation. A similar trend was also observed when these studies were extended to PSH cotton, which is a finer variety. The strength retention and uniformity ratio of the decrystallised and DMDHEU crosslinked fibres were higher than those for the swollen and crosslinked fibres, though the strength loss was appreciable in both the cases.

Using the electron diffraction (ED) technique developed at CTRL, 32 reflections were indexed in the ED patterns of cotton cellulose, on the basis of Meyer and Misch unit cell. It was observed that cotton cellulose does not fall into $P2_1$, space group, due to the presence of odd order reflections in the ED pattern of cellulose I. The ED technique was also used for line broadening analysis of 16 varieties of Indian cottons belonging to different botanical species. It was found that the values of crystallinity, crystallite width and crystallite orientation within the fibrils of Wagad cotton (*G. herbaceum*) were lower as compared to other cottons. The ED patterns of chemically modified cottons such as mercerized, liquid ammonia treated, and boiled in water, etc., were analysed to determine the structural changes brought about by these treatments.

Since cellulase enzyme of *Penicillium funiculosum* (F_1) is highly potent and capable of dissolving native cellulose, a cellulase dissolution technique using the same has been developed, with which electron microscopical observations were carried out on a few cellulose esters and esthers. The results confirmed

that the cellulase dissolution technique in addition to serving as an effective analytical tool for the study of chemically modified cotton, has an added advantage to serve as a quick method to evaluate cotton modified for mildew and rot resistance.

Digvijay cotton was processed on blowroom, card and three passages of Laxmi Rieter drawframe using four different combinations of break drafts and the slivers processed through slubber and intermediate were spun to 30s count. On comparison of these materials with that produced from conventional T & S drawframe, it was observed that the best combinations of break drafts in high speed drawing produced materials which are superior to those from conventional drawing. A lower break draft of 1.3 at all passages was found to give the best performance of high speed drawing for this cotton.

In connection with the studies on strength of cotton fibre bundles and yarns in non-conditioned atmosphere, lea samples covering a count range of 20s to 80s were subjected to strength tests after conditioning the sample at 65% rh and also at different ambient humidities 25%, 35%, 55%, 65%, 75%, 85% and 95% rh.

About 20 cotton samples were tested for fibre length; out of these about 18 samples were tested for strength using a revised procedure, in connection with the study on contribution of fibre length and fibre strength to yarn strength.

For the formulation of suitable indices of fibre and yarn quality for assessing the spinning potential of cotton, 60 cotton samples were spun to counts ranging from 20s to 80s and CSP values, evenness parameters and nep content measures of the yarns were determined. From these data as well as from the data on Optical Fineness coefficient from Digital Fibrograph measures computed at the Laboratory, a suitable new index of yarn quality is being worked out.

In connection with blending studies of standard varieties of Indian cottons from Maharashtra State, spinning was completed of Varalaxmi, Hybrid 4 and MCU.5. Various processing parameters, the end breaking rate in spinning and yarn quality were assessed.

Five varieties of cotton differing in Micronaire values have been selected out of which three varieties, viz. Sanjay (Micronaire value 3.3), 320F (Micronaire value 4.3) and V.797 (Micronaire value 4.8) were spun to a common count of 30s. Yarn tests, viz. lea strength, single thread strength and Uster evenness, were carried out and ASTM Grades determined for each sample.

Bulk Spinning Trials were undertaken with 20 kg blends of V.797 with jute caddies in the proportion of 80 : 20 cotton : jute and a mixing of Y.1 and Maljari with wool noils in the proportion of 75 : 25 cotton : wool. 6s yarns were spun with suitable twist factors from both the blends for the purpose of weaving on handlooms to produce upholstery/blanket fabrics to be exhibited at ICAR Golden Jubilee Celebrations next year.

PSH cotton sliver was blended after combing to about 15%, with high tenacity polyester in the proportion of 75 : 25, 50 : 50, 33 : 67 cotton : polyester. The blends are proposed to be spun to 80s and 50s counts.

The method for measuring sonic velocity using the pulse propagation meter has been standardised. By studying the effect of specimen length, tension during measurement, the number of tests required, etc., the optimum values for the above variables have been found out. While studying the influence of yarn geometry on sonic velocity, it was observed that the effective pulse velocity in yarn depends on length characteristics of the fibres from which the yarn is spun.

In order to assess the variation in CRA values measured by Monsanto, Metrimpex and Shirley CR testers, CRA of an ideal polyester fabric was determined by all the three CR testers. The values were found to be well in agreement. Further, it was found that in the case of Monsanto and Metrimpex CR testers increase in load and decrease in relaxation time had no appreciable effect on CRA values.

In the study on the response of Indian cottons to crosslinking treatments with a view to evolve cotton varieties most suitable for chemical finishing treatments, it was observed that cotton with medium strength and high elongation was more suited for easy-care finishing treatments. Further, cotton samples having toughness retention above 40% after crosslinking might be considered as promising. The important contributions made through this project were: (*i*) specific Indian varieties among *desi*, *hirsutum* and *barbadense* species, which were suitable for easy-care finishing treatments were identified, (*ii*) pre-swelling followed by crosslinking imparted considerable improvement in the retention of mechanical properties in weak *hirsutum* cottons, (*iii*) many laboratory model equipments such as padding mangle, curing oven, yarn streching device and mercerising unit were fabricated, (*iv*) a technique for predicting crease recovery angle (CRA) of fabric from yarn pads was developed.

Cotton fabrics were treated with mixtures of DMDHEU and MMM resins in different proportions under: (*i*) polyset two-step process, (*ii*) polyset step I and II combined in a single step, and (*iii*) conventional process, and the results of physical and chemical tests of the treated fabrics revealed that single step process produced almost similar results as that of two-step polyset process, with certain improved properties in comparison to conventional process.

Migration studies of resins on cotton fabrics treated with 8% DMDHEU was made at 60°C, 70°C and 80°C, dried for periods ranging from 0 to 60 minutes and cured at 100°C for 3 hours. Treated as well as control samples were analysed for moisture content, nitrogen content and formaldehyde content.

Preliminary treatments on grafting venyl monomers on to cloth was carried out in addition to standardising method for chemical initiation.

The fabric samples could be conveniently phosphorylated by radiation

technique, using both pre- and simultaneous irradiation methods to the same level of phosphorous content as that obtained by conventional method. The analysis of the treated fabrics showed that the sample phosphorylated by pre-irradiation method had very good flame proofing properties combined with better retention of strength.

To induce more unsaturation on cellulose, trials were carried out to prepare propargyl cellulose by three step process. Attempts were made to determine post-irradiation activity of allyl cellulose using 10% zinc chloride instead of 70%.

To measure the absorbancy of different cotton varieties, glycerine retention value (GRV) and water holding capacity of cottons LD.133, Lohit, Gaorani 6, Gaorani 22, Gaorani 27, Digvijay, LSS, Westerns 1, as well as cotton waste from various stages of spinning were carried out.

In connection with the electron microscopical investigation of dye diffusion and dye aggregation in unmodified and modified cotton fibre, preliminary experiments were completed using a purified metallised dye. The cross-sections of dyed cotton fibres, on examination under electron microscope, revealed uniform dispersion with location of aggregates of dye molecule in the cross-section. Diffusion studies on cellophane and acetylated cellophane of various DS were continued using purified chlorazol Sky Blue FF for finding out the relationship between DS and diffusion coefficients. Structural study of cellophane using x-ray diffraction and electron diffraction was completed.

The biosynthesis of cellulose is being studied in three systems, viz. germinating seeds, developing cotton fibres and a microorganism. The objective of this basic study is to find an answer to the problem of immaturity in some of the long staple cottons developed in recent years. First, the analytical procedures and the assay of enzyme involved in cellulose biosynthesis were standardised using particulate fraction of germinated moong bean. Secondly, the enzyme activity from particulate fraction of 20-day-old fibres of Suvin variety was studied. Thirdly, the rate of cellulose biosynthesis was studied in the micro-organism, *Acetobacter xylinum*, under various conditions of growth.

Eight bleached cellulosic substrates were subjected to hydrolysis by cellulase of *Penicillium funiculosum*. Of these, the pulps of wheat straw, jute stalk, beggasse and cottonseed hulls were comparatively more susceptible and could be hydrolysed to the extent of 80% to 90%. Chromatographic analysis of the hydrolysates revealed the presence of cellobiose, glucose, xylose and in some cases arabinose and uronic acid. Food yeasts grown on the enzymatic hydrolysates of the substrates yielded 45% to 50% single cell protein.

Food yeasts, *Candida utiltis* and *C. tropicalis* grown in a synthetic medium containing 1% reducing sugar level of hydrolysates were compared with those grown on 1% glucose with respect to their crude protein content, and it was found that the cultures grown on the hydrolysates yielded 45% to 50% protein. This higher yield may be due to presence of other sugars in the hydrolysates.

Several fodder samples were tested for their suitability for growing cellulolytic cultures and it was observed that paddy and wheat straws were good sources for supporting growth of microorganisms. Out of the few fungal cultures tried, *P. funiculosum* and *Candida utilis* were found promising as there was a five-fold increase in crude protein on fermentation. The protein addition was maximum with the former when grown on paddy straw than wheat straw, while the latter performed well in both the straws. Large scale feeding trials are being conducted in collaboration with PKV, Akola.

Leonard jar and pot culture studies have shown that amending soil with chitin/prawn shell waste has been found to control *Verticillium* wilt in MCU.5 cotton variety. The culture filtrate of *Bacillus* sp. was found to extensively damage the cell wall of *V. dahliae* and was confirmed by light microscopy and electron microscopy studies. Large scale trials are in progress at Coimbatore to confirm the result.

Linter samples of four varieties, viz. L.147 (Mill run and II cut), Hybrid 4, Varalaxmi and Laxmi (all I and II cut) were analysed for chemical composition. The fluidity range of these linter samples (6-9 Rheus) revealed their suitability for cellulose acetate manufacture.

Out of the 10 cottonseed samples selected for amino acid analysis under the project on evaluation of protein composition of Indian cottonseed, tests on six samples were carried out at the Nuclear Research Laboratory (NRL), New Delhi. The results indicated wide variation in the amino acid content among varieties.

Methyl esters of freshly prepared 20 samples of cottonseed oil were run on gas chromatograph in FFAP column at 20°C using Flame Ionization Detector. From the results it was observed that cottonseed oil contains about 48% to 54% linoleic acid and about 17% to 21% oleic acid.

Oils from cotton seeds of 24 different varieties of cotton were subjected to tests for the determination of two important cyclopropenoid fatty acids, malvalic acid and sterculic acid. It was found that malvalic acid content varied between 0.59% and 1.23%, while sterculic acid content varied between 0.6% and 1.4%. Seeds of Deviraj cotton (*G. hirsutum*) contained the least amounts while seeds of G.22 cotton (*G. arboreum*) had the highest amounts of the two fatty acids.

Trials were conducted to produce laminated boards having better appearance using cotton plant stalk in a single step process. Attempts were also made to examine the feasibility of finer particles for use as moulding powder. In order to prepare cheaper quality boards, lignin was tried as binding material. PKV, Akola, was approached for technical collaboration in the preparation of large size boards.

Work for converting a gin into a mechanical device for deburring raw wool was continued by fixing slide rails and electric motor for installation.

7. Personnel

A. Appointments

Scientific Staff (SRA)

The undermentioned six candidates who came out successful in the ARS Examinaton held in February 1978, have been posted at CTRL with effect from the dates shown against them :

S. No.	*Name*	*Date*
1.	Shri R. P. Nachane	21-8-1978
2.	Shri N. Ramesh Babu	21-8-1978
3.	Shri S. Ganesan	26-8-1978
4.	Dr. P. B. Lal Chaurasia	29-8-1978
5.	Shri U. N. Borkar	8-9-1978
6.	Dr. N. C. Vizia	11-9-1978

Technical Staff

1. Shri M. S. Sitaram to the post of Quality Evaluation Officer, T-6, with effect from 5-10-1978.
2. Shri Premchand Rana to the post of Driver/Mechanic, T-1, with effect from 3-5-1978.
3. Shri S. B. Kamble to the post of Laboratory Assistant, T-1, with effect from 1-8-1978.
4. Shri B. B. Gayakar to the post of Driver, T-1, with effect from 1-12-1978.

Administrative Staff

1. Shri P. R. Paranjape to the post of Accounts Officer on deputation from the office of the Chief Auditor, Central Railway, with effect from 15-2-1978.
2. Shri Govindan Moosad, Smt. S. S. Dongare and Shri G. Sasidharan to the posts of Assistants, with effect from 16-8-1978.
3. Shri M. P. B. Nair to the post of Junior Stenographer, with effect from 6-10-1978.
4. Shri A. P. Natu to the post of Jr. Clerk, with effect from 4-12-1978.

Supporting Staff

Sarvashri M. Y. Chandanshive, S. M. Sawant, B. R. Jadhav (all with effect from 1-5-1978), M. B. Gurve, N. R. Kamble (both with effect from 10-7-1978), A. R. Gujar, E. T. Gurav, S. M. Sable (all with effect from 15-12-1978) and K. P. Somasekharan (with effect from 16-12-1978) to the posts of Supporting Staff, Grade I.

B. Assessment and Promotions

(*a*) *Scientific Assessment*

The first five yearly assessment of the eligible Scientific Staff of CTRL for the periods ending December 31, 1975, and December 31, 1976, were carried out by Agricultural Scientists Recruitment Board and higher scale of pay/promotions/advance increments, were granted as detailed below:

Dr. S. M. Betrabet and Dr. N. B. Patil, grade S-3 Scientists were granted higher scale of pay of Rs. 1800-100-2000-125/2-2250 personal to them with effect from July 1, 1976, and July 1, 1977, respectively.

Promotions

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

Advance Increments

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

(*b*) *Technical Assessment*

The five yearly assessment of the eligible technical personnel of CTRL for the periods ending December 31, 1975, December 31, 1976, and December 31, 1977, were carried out and promotions / advance increments granted as detailed below:

Promotions

Sr. No.	*Name*	*Grade to which promoted*	*Effective date of promotion*
1.	Shri H. V. Tamhankar	T-7 (Rs. 1100-1600)	1-7-1977
2.	Shri D. G. Shete	T-7 (Rs. 1100-1600)	1-7-1978
3.	Shri K. S. Bhyrappa	T-5 (Rs. 650-1200)	1-7-1976
4.	Shri S. R. Ganatra	T-5 (Rs. 650-1200)	1-7-1976

Promotions—(Contd.)

Sr. No.	*Name*	*Grade to which promoted*	*Effective date of promotion*
5.	Shri S. G. Nayar	T-5 (Rs. 650-1200)	1-7-1976
6.	Smt. S. B. Pai	T-5 (Rs. 650-1200)	1-7-1976
7.	Shri W. R. Sharma	T-5 (Rs. 650-1200)	1-7-1976
8.	Shri A. W. Shringarpure	T-5 (Rs. 650-1200)	1-7-1976
9.	Shri M. S. Sitaram	T-5 (Rs. 650-1200)	1-7-1976
10.	Shri P. B. Gurjar	T-I-3 (Rs. 425-700)	1-7-1976
11.	Shri Sitaram Nagoo	T-I-3 (Rs. 425-700)	1-7-1976
12.	Shri M. M. Shaikh	T-I-3 (Rs. 425-700)	1-7-1976
13.	Shri N. O. Anthony	T-2 (Rs. 330-560)	1-7-1976
14.	Shri Pushotam Vira	T-2 (Rs. 330-560)	1-7-1976
15.	Shri A. K. Antony	T-5 (Rs. 650-1200)	1-7-1977
16.	Shri R. Dwarkanath	T-5 (Rs. 650-1200)	1-7-1977
17.	Shri S. N. Nagwekar	T-5 (Rs. 650-1200)	1-7-1977
18.	Shri R. B. Pawar	T-I-3 (Rs. 425-700)	1-7-1977
19.	Shri E. S. Abraham	T-5 (Rs. 650-1200)	1-7-1978
20.	Shri K. V. Ananthakrishnan	T-4 (Rs. 550-900)	1-7-1978
21.	Smt. R. P. Bhatt	T-4 (Rs. 550-900)	1-7-1978
22.	Shri C. R. S. Moni Iyer	T-4 (Rs. 550-900)	1-7-1978
23.	Shri G. Viswanathan	T-4 (Rs. 550-900)	1-7-1978
24.	Shri R. K. Landge	T-I-3 (Rs. 425-700)	1-7-1978

Advance increments

Sr. No.	*Name*	*Grade*	*Number of increments*	*Effective date of increments*
1.	Shri K. V. Ananthakrishnan	T-II-3 (Rs. 425-700)	Two	1-7-1976
2.	Smt. R. P. Bhatt	T-II-3 (Rs. 425-700)	Two	1-7-1976
3.	Shri C. R. S. Moni Iyer	T-II-3 (Rs. 425-700)	Two	1-7-1976
4.	Shri V. B. Suryanarayanan	T-II-3 (Rs. 425-700)	Two	1-7-1976
5.	Shri G. Viswanathan	T-II-3 (Rs. 425-700)	Two	1-7-1976
6.	Shri V. V. Kshirsagar	T-II-3 (Rs. 425-700)	Two	1-7-1976
7.	Shri R. K. Landge	T-2 (Rs. 330-480)	Two	1-7-1976
8.	Shri H. B. Tambe	T-1 (Rs. 260-430)	Two	1-7-1976
9.	Kum. S. R. Jage	T-II-3 (Rs. 425-700)	Two	1-7-1977

Sr. No.	*Name*	*Grade*	*Number of increments*	*Effective date of increments*
10.	Shri K. Chandran	T-4 (Rs. 550-900)	One	1-7-1978
11.	Shri S. Chandrashekar	T-4 (Rs. 550-900)	One	1-7-1978
12.	Kum. I. K. P. Iyer	T-4 (Rs. 550-900)	Two	1-7-1978
13.	Shri K. R. Kamath	T-4 (Rs. 550-900)	One	1-7-1978
14.	Shri H. R. Laxmivenkatesh	T-4 (Rs. 550-900)	One	1-7-1978
15.	Smt. S. D. Pai	T-4 (Rs. 550-900)	Two	1-7-1978
16.	Smt. Girija Radhakrishnan	T-II-3 (Rs. 425-700)	One	1-7-1978
17.	Shri Tula Ram	T-II-3 (Rs. 425-700)	One	1-7-1978
18.	Shri T. B. Dangle	T-I-3 (Rs. 425-700)	Two	1-7-1978
19.	Shri Popat Jairam Ahire	T-1 (Rs. 260-430)	One	1-7-1978
20.	Shri R. A. Dalvi	T-1 (Rs. 260-430)	One	1-7-1978
21.	Shri G. D. Narkar	T-1 (Rs. 260-430)	One	1-7-1978

(*c*) *Administrative*

1. Shri K. S. Ram Narayan was promoted to the post of Assistant Administrative Officer with effect from 17-6-1978.
2. Shri F. X. Mayers was promoted to the post of Superintendent with effect from 17-6-1978.
3. Shri P. D. Sonawane was promoted to the post of Assistant with effect from 1-9-1978.

C. Transfers

Scientific Staff

1. Shri A. J. Q. Shaikh, Scientist-S-1, has been transferred from the Quality Evaluation Unit of CTRL at Dharwar to that at Nanded with effect from 18-8-1978.
2. Shri K. H. Sawakhande, Scientist-S, was transfered from the Quality Evaluation Unit of CTRL at Nanded to that at Dharwar with effect from 21-8-1978.

Administrative Staff

1. Shri K. Sudhakaran, Assistant, who was transferred to the Tuber Crops Introduction and Evaluation Centre of Central Tuber Crops Research Institute, Cuttack, was reverted to CTRL with effect from 25-7-1978.

2. Shri B. Ramamurthy, Stenographer, has been transferred to CTRL from the Regional Station of the Central Institute for Cotton Research, Coimbatore, with effect from 10-10-1978.

Supporting Staff

Shri T. S. Mhaske, Supporting Staff Grade I, was transferred from CTRL to the Quality Evaluation Unit at Nanded.

D. Retirements

Technical Staff

1. Shri K. S. S. Panicker, Driver, Grade T-1, retired voluntarily from service with effect from 12-12-1978.

Administrative Staff

1. Smt. I. A. Fernandes, Strenographer Grade I, retried from service with effect from 31-8-1978.

Supporting Staff

1. Sarvashri Mubarak Raju Nawab and G. M. Kadam, both Operatives, retired voluntarily from service with effect from 31-5-1978 and 23-9-1978, respectively.

E. Resignations

Scientific Staff

1. Smt. A. P. Sindkar, Scientist-S, resigned from service with effect from 23-10-1978.
2. Shri C. V. Simon, Scientist-S, resigned from service with effect from 28-10-1978.

Technical Staff

1. Shri M. K. K. Menon, Sr. Technical Assistant, resigned from service with effect from 1-4-1978.

Supporting Staff

Sarvashri M. T. Aldar, A. G. Shirke, M. P. Salunke and G. M. Shedge, all Supporting Staff Grade I, resigned from service with effect from 4-6-1978, 3-7-1978, 2-9-1978 and 16-11-1978, respectively.

F. Training Course

1. Dr. N. B. Patil attended the Training Course in Administrative Vigilance, at New Delhi, from April 22 to May 8, 1978.
2. Shri M. S. Parthasarathy, attended the ARS Training Coordinators Meeting at Central Staff College for Agriculture, Hyderabad, on December 1 and 2, 1978.
3. Dr. N. B. Patil, attended the course in Agricultural Research Management held at Central Staff College for Agriculture, Hyderabad, from December 17 to 31, 1978.

G. Lectures

Shri M. S. Parthasarathy, Scientist S-3 of the Laboratory, delivered two lectures on 'Cotton Developed During 1970' and 'Blowroom Performance', to the participants of the refresher course in Spinning at Textile Association, Bombay, in September 1978. He also gave three lectures on 'Cottons', 'Blowroom Opening and Cleaning', and 'Blending of Cottons with Man-made Fibres' to trainees from Tanzania at Tata Mills, Bombay, during July-August 1978 in addition to a lecture given to trainees from Maharashtra Cooperative Spinning Mills Federation, at VJTI, Bombay.

H. Summer Institute

Dr. R. N. Adsule, Scientist S-1, attended the Summer Institute on 'Nuclear Tools as Analytical Aids in Agricultural Research', held at Nuclear Research Laboratory, New Delhi, from June 28 to July 27, 1978, sponsored by the Indian National Science Academy.

I. Deputations/Foreign Assignments

Shri T. N. Ramamurthy, Scientist S-2 (Fibre Technology), worked on an assignment as Wool Processing Consultant with the Food and Agricultural Organisation in Bhutan for a period of 3 months from June 22, 1978.

J. Awards/Honours Received

Shri R. M. Modi, Photographer, bagged the Asian Cultural Centre for UNESCO (ACCU) prize of 6,000 yen for his photograph 'Bathing Beauty' in the third photo contest held in Tokyo in June 1978 with the theme of children of Asia. This photograph was adjudged third among 6,245 entries received from 15 countries.

K. Obituary

S/Shri W. R. Sharma, Junior Quality Evaluation Officer, Grade T-5, and P. S. Lad, Supporting Staff, Grade-I, expired on December 15, 1978, and November 29, 1978, respectively.

8. Appendices

APPENDIX I

FINANCIAL STATEMENTS

Expenditure and Receipts of the Laboratory During 1977-78

	Sanctioned Grant (Rs.)	Actual Expenditure (Rs.)	Savings(—) Deficit(+) (Rs.)
1	2	3	4
A. EXPENDITURE			
I. Technological Research Laboratory including Regional Station (Non-Plan)			
(*a*) Capital expenditure including expansion of Laboratory	4,33,000	4,32,549	(+) 2,549
(*b*) Working expenses	24,56,000	24,72,888	(+) 16,888
	28,89,000	29,05,437	(+) 19,437
II. Scheme for Modernisation and Strengthening of CTRL for Intensive Research on Cotton (Plan)	34,00,000	33,76,000	(—) 24,000
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	82,700	24,900	(—) 57800
(*b*) Studies on spinning from blends of cotton with wool, jute and ramie on cotton system (in collaboration with CSWRI and JTRL)	12,000	11,951	(—) 49
(*c*) Studies on debarring of raw wool using mechanical devices (in collaboration with CSWRI)	8,000	5,126	(—) 2,874
(*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 obtian basic information needed for the development of potentially new useful cotton products ..	90,000	42,395	(—) 47,605
(*e*) Optimal blending of standard varieties of Indian cottons	5,92,000	39,084	(—)5,52,916
(*f*) Studies on the production and utilisation of chitosan and allied products from prawn shell waste	20,760	16,701	(—) 4,059
(*g*) Regional Committee No. 7	19,570	7,354	(—) 12,218

APPENDIX I *(Contd.)*

B. RECEIPTS

	(Rs.)
Analytic and testing fees	35,982
Rent	35,469
Fees for training, application fees, etc. ..	8,119
Receipts from services rendered by the Institute	1,950
Sale of publications	3,208
Interest on loans and advances granted to employees	662
Miscellaneous receipts (including sale of waste cotton)	41,060
	1,26,450

APPENDIX II

Scientific and Technical Staff Working at the Cotton Technological Research Laboratory as on 31-12-1978

(List does not include vacant posts)

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

Scientific Staff

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

Technical Staff

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

Technical Staff—(Contd.)

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

Quality Evaluation Units at Outstations

Station	Quality Evaluation Officer, Grade T-6	Jr. Quality Evaluation Officer, Grade T-5	Sr. Technical Assistant (Q.E.), Grade T-4	Technical Assistant (Q.E.), Grade T-II-3	Scientist, Grade S-1	Scientist, Grade S
Coimbatore ..	—	Shri A. K. Antony, B.Sc.	Smt. Santa V. Nair, B.Sc. Shri C. P. Venugopalan, B.Sc.	—	—	—
Dharwar ..	—	Shri E. S. Abraham, B.Sc.	—	—	—	Shri K. H. Sawakhande, MSc.
Guntur ..	—	Shri R. Dwarkanath, B.Sc.	—	—	—	Shri Y. Subramanyam, M.Sc.
Hissar ..	—	Shri S. N. Nagwekar, B.Sc.+	—	—	—	—
Indore ..	—	—	—	—	—	Shri S. B. Jadhav, M.Sc.
Ludhiana ..	—	—	—	—	—	Shri A. K. Ahuja, M.Sc.+
Nanded ..	—	—	—	Shri S. M. Mohile, B.Sc.+	Shri A. J. Shaikh, M.Sc.	Shri L. D. Deshmukh, M.Sc.*

QUALITY EVALUATION UNITS AT OUTSTATIONS—*Contd.*

Station	Quality Evaluation Officer, Grade T-6	Jr. Quality Evaluation Officer, Grade T-5	Sr. Technical Assistant (Q.E.), Grade T-4	Technical Assistant (Q.E.), Grade T-II-3	Scientist, Grade S-1	Scientist, Grade S
Sriganganagar	—	—	Shri Ram Parkash, B.Sc.+	Shri Tula Ram, B.Sc.	—	—
Surat	Shri L. R. Jambunathan, B.Sc., A.M.I.C.T., L.T.I.	—	Shri M. C. Bhalod, B.Sc.	Shri R. S. Darade, B.Sc.+	Shri P. V. Varadarajan, M.Sc.	Shri P. M. Patil, M.Sc.*

Explanations for symbols used :

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

\+ Under the All India Coordinated Cotton Improvement Project.

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

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

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

APPENDIX III

STATEMENT SHOWING THE TOTAL NUMBER OF EMPLOYEES AND THE NUMBER OF SCHEDULED CASTES AND SCHEDULED TRIBES AMONGST THEM AS ON THE 31ST DECEMBER, 1978

Class	Permanent/ Temporary	Total number of employees	Scheduled Castes	Percentage of total employees	Scheduled Tribes	Percentage of total employees	Remarks
Class I	Permanent	35	—	—	—	—	
	Temporary	8	2	5	—	—	
Class II (Gazetted rank)	Permanent	11	—	—	—	—	
	Temporary	1	—	—	—	—	
Class II (Non-Gazetted rank) ..	Permanent	38	4	11	—	—	
	Temporary	—	—	—	—	—	
Class III	Permanent	54	6	12	—	—	
	Temporary	39	5	—	2	2	
Class IV (excluding Safaiwala) ..	Permanent	35	7	21	1	4	
	Temporary	22	5	—	1	—	
Class IV (Safaiwala)	Permanent	2	2	100	—	—	
	Temporary	3	3	—	—	—	

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.

(4) Persons in the categories of Scientific and Technical Cadre are appointed to the next higher grades on the basis of assessment as per Technical Service Rules and Agricultural Research Service Rules of ICAR

APPENDIX IV

STATEMENT SHOWING THE NUMBER OF RESERVED VACANCIES FILLED BY MEMBERS OF SCHEDULED CASTES AND SCHEDULED TRIBES DURING THE YEAR 1978

Class of post	Total No. of vacancies		Scheduled Castes			Scheduled Castes		Scheduled Tribes					Remarks
			No. of Vacancies Reserved		No. of SC candidates appointed	No. of ST candidates appointed against vacancies reserved for SCs in the 3rd year of carry forward	No. of reservations lapsed after carrying forward for three years	No. of vacancies reserved		No. of ST candidates appointed	No. of SC candidates against vacancies reserved for STs in the 3rd year of carry forward	No. of reservations lapsed after carrying forward for three years	
	Notified	Filled	Out of Col. 2	Out of Col. 3				Out of Col. 2	Out of Col. 3				
1	2	3	4	5	6	7	8	9	10	11	12	13	14
I. Posts filled by direct recruitment													
Class I	—	(A)	—	—	—	—	—	—	—	—	—	—	—
Class II(Gazetted)	—	—	—	—	—	—	—	—	—	—	—	—	—
Class II(Non-Gazetted)	—	—	—	—	—	—	—	—	—	—	—	—	—
Class III	7	7(B)(C)(D)	—	—	1	—	—	—	—	—	—	—	—
Class IV(excluding safaiwala)	9	9(C)	—	—	—	—	—	—	—	—	—	—	—
Class IV(Safaiwala)	—	—	—	—	4	—	—	—	—	—	—	—	—
II. Posts filled by promotion													
Class I	—	—	—	—	—	—	—	—	—	—	—	—	—
Class II(Gazetted)	1	1(E)	—	—	—	—	—	—	—	—	—	—	—
Class II(Non-Gazetted)	1	1(E)	—	—	—	—	—	—	—	—	—	—	—
Class III	2	2(E)	—	—	1	—	—	—	—	—	—	—	—
Class IV(excluding safaiwala)	—	—	—	—	—	—	—	—	—	—	—	—	—
Class IV (Safaiwala)	—	—	—	—	—	—	—	—	—	—	—	—	—

(A) Since the posts are filled up by ICAR Headquarters, they are not shown in the statement. (B) One post of Driver was filled up by appointment of a Class IV employee. (C) One post was filled up with orthopaedically handicapped person. (D) Two posts (one in Class III and one in class IV) were filled up with ex-servicemen. (E) The posts have been filled up on the basis of seniority-cum-suitability.

9. Annexures

ANNEXURES I

New Equipments Purchased During 1978

1. Laboratory Model Saw Gin (10 saw) and Delinting (10 saw) Machines
2. Bajaj Double Roller Gin with accessories
3. Laxmi Rieter Sliver Lap Machine
4. Laxmi Rieter High Speed Comber
5 PS-Mettler High Speed Cone/Cheese Winder
6 Sheffield Micronaire
7. TKI Yarn Evenness Tester, Type FY-26
8. KMI Tensile Strength Tester
9. KMI Motorised Wrap Reel (British System-10Cop)
10. Mettler Balance, Model M-5
11. Mettler Analytical Balance, Model H54 AR
12. Hydraulic Press with High Pressure Pump
13. Power Operated Mini Pulveriser
14. Laboratory Modular Fermenter
15 Tempo Muffle Furnace (Refractory)
16 ADCO Constant Temperature Water Bath
17. ADCO Thermostatic Hot Oven (Chamber Size: 20″ × 20″ × 24″)
18. EC Scientific Calculator No. 65

ANNEXURE II

Distinguished Visitors to CTRL During 1978

1. Dr. John A. Richards,
   Assistant Education Advisor,
   British Council Division,
   British High Commission, Bombay.

2. Prof. C. S. Whewell,
   Department of Textile Industries,
   University of Leeds, UK.

3. Mr. K. P. Teh,
   Mr. E. Kletter, and
   Mr. Y. Sachs. } World Bank Team

4. Prof. Ahmed Ismail Kheiralla,
   Professor of Cotton Breeding,
   Gazira Research Station,
   Wad Medani, Sudan.

5. Dr. A. I. Ismailove,
   Tashkent Institute of Bio-Organic Chemistry,
   Uzbek Academy of Sciences,
   Kujbeshev Street 16, USSR.

6. Dr. St. Clair Forde,
   Senior Research Scientist and Co-ordinator of Research,
   Caribbean Agricultural Research & Development Institute,
   St. Augustine,
   Trinidad, West Indies.

7. Dr. Roger W. Smith,
   Agricultural Research Advisor,
   Ministry of Overseas Development,
   London, UK.

8. Mr. Li Chi-Chen,
   Mr. Chen Chai-Chu,
   Mr. Cheng Chuu-Sen,
   Mr. Wang Yu Ying, and
   Mrs. Yang Hung. } Academy of Agricultural Science, Peking, Peoples' Republic of China

9. Dr. J. B. Weaver,
   Agronomy Department,
   University of Georgia, USA.

10. Mr. B. Malimovsky,
    Counsellor (Agriculture),
    Embassy of USSR, New Delhi.