Cotton Technological Research Laboratory

Indian Council of Agricultural Research

Annual Report
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Contents

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I. Introduction

The Cotton Technological Research Laboratory celebrated its Golden Jubilee befittingly in the last week of 1974, and this is the 51st Annual Report of the Laboratory covering the Calendar year.

Founded by the Indian Central Cotton Committee (ICCC) in 1924, the main function of the Laboratory has been to collaborate actively with the Departments of Agriculture and the Agricultural Universities in various parts of the country in evolving better quality cotton through research. For this purpose, initially the Laboratory started with the Spinning Division and various Research Sections, viz., Physical Testing, Fibre Physics, Chemistry, Microscopy and Statistics. During these fifty years the scope of its activities has steadily increased. A Test House was added in 1937 to issue authoritative Test Reports on cotton fibre, yarn and fabric, and thus serve the much felt need of the Trade and Industry. To carry out systematic research on pre-cleaning and ginning of Indian cottons, a Ginning Section was opened in 1941. In the last decade, sections like Microbiology and Biochemistry have been organised. Many sophisticated equipments, like X-ray Diffraction Unit, Infra-red Spectrophotometer, Electron Microscope, etc., have been added and the Laboratory has now excellent facilities for carrying out basic studies in Fibre Structure.

On the abolition of all Commodity Committees including the ICCC, the Laboratory came under the administrative control of the Indian Council of Agricultural Research (ICAR) from the 1st April, 1966. Since then, the research activities have been re-oriented and intensified. The research efforts of the Scientists of the Laboratory will be continued as in the past, to help the grower in producing more and better quality cottons and thus improve the economy of the country, as also in enhancing the utilisation of cotton and cotton plant by-products.

The chief functions of this Laboratory are :

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

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

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

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

(*v*) to help the trade and the industry by furnishing true valuation of different trade varieties cultivated;

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

(*vii*) to disseminate technical information.

This Laboratory maintains a good up-to-date Library of books on cotton technology. At the end of 1974, there were 2,977 books, 128 of which were added during the year. The number of bound volumes was 2,789. The Library received regularly about 180 journals dealing with textiles and allied subjects, 79 of which were subscribed for and others received on exchange or complimentary basis.

Golden Jubilee Celebrations of the Laboratory

The major event during the year under report was the Golden Jubilee Celebrations of the Laboratory. The function was inaugurated on the 29th December, 1974, by Shri Jagjivan Ram, Union Minister for Agriculture and Irrigation, under the Presidentship of Shri V. P. Naik, Chief Minister of Maharashtra. A special publication entitled "50 Years of Research", summarising the work carried out in the Laboratory during the last 50 years, was released on the occasion by Shri Jagjivan Ram. Further, release for commercial cultivation of five new improved varieties of cotton was also announced on the occasion. A two day Seminar on "Cotton Production and Technology" was also conducted in which several Scientists and Technologists from various institutions participated. The concluding session on the 31st December, 1974, was presided over by Shri A. P. Shinde, Union Minister of State for Agriculture and Irrigation. A brief summary of the proceedings of the Golden Jubilee Celebrations is given in Annexure I.

New Equipments Purchased

During the year, the following equipments were acquired for the use of the Laboratory :

1. "Hewlett-Packard" X-Y Recorder.
2. Densitometer.
3. Projection Microscopes.
4. "SORVALL RC-2B" High Speed Refrigerated Centrifuge.
5. "Type 7530 A" Soniprobe.
6. Automatic Fraction Collector.
7. "Diamond" Photography Enlarger.
8. "Techno" Shaking Incubator.
9. "B&L" Spectronic-20 Colorimeter.
10. Curing Oven.
11. "Systronic" pH Meter.
12. "SPINLAB Model 430" Fibrograph.
13. Toshniwal Fibre Fineness Tester.
14. Comb Sorters with Accessories.
15. Lea Strength Tester, Wall Mounting Type.
16. Lea Strength Tester, Floor Mounting Type.
17. Top-Pan Balance.
18. Lakshmi-Rieter High Speed Draw Frame.
19. Electronic Calculator, "DCM Moscal-1200".

Distinguished Visitors

Dr. M. S. Swaminathan, Director General, ICAR, Dr. A. B. Joshi, Director, Indian Agricultural Research Institute (IARI), New Delhi, Dr. D. R. Bhumbla, Deputy Director General, ICAR, Shri K. Krishna Das, Director, Audit and Accounts, ICAR, Shri C. S. Sridharan and Dr. C. Kempanna, Assistant Directors General, ICAR, and Dr. V. Santhanam, Project Co-ordinator and Head, IARI Regional Station, Coimbatore, visited this Laboratory in connection with official work.

Among the other distinguished persons who visited this Laboratory during the year under review, mention may be made of the following :

1.	Shri Jagjivan Ram, Union Minister for Agriculture and Irrigation, New Delhi.	
2.	Shri V. P. Naik, Chief Minister, Maharashtra State, Bombay.	
3.	Shri Annasaheb P. Shinde, Union Minister of State for Agriculture and Irrigation, New Delhi.	
4.	Academician M. V. Mukhamedjanov, Counsellor for Agricultural Affairs, USSR Embassy in India, New Delhi.	Russian Delegation
5.	Mr. N. F. Balbyshev, Assistant Counsellor for Agricultural Affairs, USSR Embassy in India, New Delhi.	
6.	Mr. Eugene J. Robert, Consultant.	World Bank Team
7.	Mr. David R. Kime, Consultant.	
8.	Dr. J. Sikorski, Reader in Textile Physics, University of Leeds, U.K.	
9.	Mr. M. A. Ghaffar, Director General, Cotton Research Institute, Giza, Egypt.	Egyptian Delegation
10.	Mr. Ahmed Ehsan, Director, Foreign Technical Co-operation Division, Foreign Relations Department.	
11.	Mr. Abdel Aziz Haroun Abou Sehley Director, Cotton Technology Research Division,	
12.	Mr. Salama Ibrahim Salama, Head, Industrial Crops Research Division, Agricultual Research Centre, Giza, Egypt.	

13. Mrs. Eugenia Iordanescu
14. Mrs. Ana Tomulescu
15. Mr. Maurice Tuperman

} Ministry of Light Industry (Textile Research Institute), Rumania

16. Dr. T. Radhakrishnan,
    Director,
    Indian Jute Industries Research Association,
    Calcutta.
17. Shri Chaudhary Randhir Singh,
    Member,
    National Commission on Agriculture,
    Government of India, New Delhi.
18. Shri C. Madhurai Nayagam,
    Cotton Adviser,
    Textile Commissioner's Office, Bombay.

In addition, a large number of distinguished scientists, technologists and industrialists visited the Laboratory on the occasion of the Golden Jubilee Celebrations.

Staff Research Council

During the year, three meetings of the Staff Research Council were held. The first meeting held on the 29th January and the 1st February, 1974, considered the progress of the work on each project and finalised the programme of research work for the year 1974. The second meeting was held on the 16th October, 1974, to review the progress of work on each project. At this meeting suggestions were made by the Director for checking the methods used for determining maturity by Micronaire, and the formula for maturity coefficient. Some details of the plans related to the celebration of the Golden Jubilee of the Laboratory were also finalised. The third meeting was held on the 27th December, 1974, to review the progress of the research projects as also to chart out the final plans for the celebration of the Golden Jubilee.

Inter-Institutional Projects

The following two collaborative research projects are under operation at this Laboratory in close collaboration with the Jute Technological Research Laboratory (JTRL) and Central Sheep and Wool Research Institute (CSWRI) :

1. Studies on spinning from blends of cotton with wool, jute and ramie on cotton system.
2. Studies on de-burring of raw wool using mechanical devices.

The first project was started from the 1st December, 1973, with the appointment of one Senior Research Assistant and some initial trials were carried out. However, the project could not be operated satisfactorily due to the delay in the appointment of a Spinning Technologist sanctioned for the project. Action for

recruitment to this post has been initiated by the Agricultural Scientists' Recruitment Board, New Delhi.

The second project was activated with the appointment of one Senior Fitter. A Laboratory gin was suitably adjusted for using the same as a de-burring device and various trials on old stock of raw wool samples were carried out. This project could not make much progress as the post of Senior Research Assistant sanctioned for the project could not be filled up so far on account of dearth of suitable candidates.

In addition to the above two projects, the ICAR sanctioned in October 1973, one more research project entitled, "Optimal blending of standard varieties of Indian cottons" to be undertaken at this Laboratory. However, it has not been possible to start work on this project as the required staff sanctioned to conduct it has not yet been appointed.

An inter-institutional three year collaborative project entitled, "Studies on the production and utilization of chitosan and allied products from prawn shell waste" has been sanctioned by the ICAR. The institutions involved are Central Institute of Fisheries Technology (CIFT), Cochin, CTRL, Bombay, and Bombay Textile Research Association (BTRA), Bombay. CIFT will be responsible for producing the chitosan, whereas CTRL and BTRA will explore the possibilities of utilization of chitosan in the textile industry, production of chitinase, etc.

Membership on Other Organisations

The Director and other Scientific Officers of the Laboratory continued to represent the ICAR and CTRL on various committees and institutions as in the past.

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

1. Executive Council, Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri.
2. Cotton Research Advisory Sub-Committee of the ICMF Cotton Development and Research Association.
3. Governing Council, Bombay Textile Research Association.
4. Various Committees of Indian Standards Institution (ISI).
5. Board of Management of the Victoria Jubilee Technical Institute (VJTI).

In addition, the Director was also appointed as a member of the following bodies during the year :

1. Indian Cotton Development Council (ICDC), Directorate of Cotton Development, Bombay.
2. Research Advisory Committee of the SITRA, Coimbatore.
3. Working Group for the finalisation of the project for the development of short duration cotton varieties of less than 5 to 6 months' duration at Amaravati (Maharashtra) and Hissar.
4. Member of Committee to examine and review research and development efforts required to meet the needs of the Textile Industry.
5. Member, Sub-Committee of ICDC on Research and Development.
6. Member, Editorial Board of Journal of Textile Association.

Post-Graduate Training

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

1	Dr. V. Sundaram (Director)	: M.Sc. and Ph.D. degrees in Physics (Textiles), M.Sc. degree in Physical Chemistry.
2.	Dr. R. L. N. Iyengar (Retired Scientist)	: M.Sc. and Ph.D. degrees in Physics (Textiles).
3.	Dr. N. B. Patil (Senior Physicist)	: M.Sc. degree in Physics (Textiles).
4.	Dr. V. G. Munshi (Senior Scienitfic Officer)	: — do —
5.	Shri M. S. Parthasarathy (Senior Spinning Technologist)	: M.Text. degree in Spinning Technology.
6.	Dr. S. N. Pandey (Junior Chemist)	: M.Sc. degree in Physical Chemistry.

Further Dr. S. M. Betrabet (Senior Microscopist) has been recognised by the University of Bombay as teacher for guiding students for Ph.D. degree in Bio-physics.

During the year, nine members of the staff were being guided for M.Sc. and two for Ph.D. degrees in Physics (Textiles) and two for M.Sc. degree in Physical Chemistry.

Deputation Abroad

Dr. V. Sundaram, Director, was deputed for a month from the 2nd February to the 4th March, 1974, as a Consultant for setting up a Cotton Testing Laboratory at the Walawe River Valley Project in Sri Lanka under an assignment of the Asian Development Bank. Shri L. R. Jambunathan, Senior Research Assistant, who was deputed for the same purpose for a period of eleven months from the 5th July, 1973, was granted an extension of three months to complete his assignment. He reported back for duty in the Laboratory on the 6th September, 1974. Both the officers submitted detailed reports to the Council on the work done by them during the period of assignment.

Further, Dr. V. Sundaram, Director, also submitted to the Council a detailed Report on his deputation to the USSR during August-October 1973 under the Indo-Soviet Protocol Agreement. A summary of the Report is given in Annexure II.

Expansion and Modernisation

The development and expansion programme charted out for the year under report received some setback due to failure of the Central Public Works Department (CPWD) to complete the constructional and electrical works and installation of the new controlled humidity and temperature plant as per assured time schedule. The Mechanical Processing Division (previously known as Spinning Division) which was initially proposed to be shut down for about a month in June 1974, to enable the contractors appointed by the CPWD to carry out the remaining wiring work for light and power and also installation of the new plant, had to be kept closed throughout the remaining period of the year due to the enormous delay in completing the various items of work. Both the works concerning light and power wiring and installation of controlled humidity and atmosphere plant were not completed before the end of the year. Action has been initiated for importing the automatic controls of the plant from the USA. The foreign exchange needed for the import of these controls has since been released by the Government of India. The trial runs of the new plant are being taken.

The construction of the second floor of the New Research Laboratory building has been almost completed together with the electrical fittings for light and power. This additional space will be utilized for accommodating the research sections which are presently facing congestion as soon as larger capacity electric meters and gas connection are provided there.

As desired by the ICAR, preliminary proposals for modernization and strengthening of the Laboratory during the Fifth Plan period at a total proposed outlay of Rs. 143 lakhs were prepared and submitted to the ICAR in October 1972. Subsequently, the ICAR intimated that non-functional buildings, such as staff-quarter should be deleted and the total cost should be restricted to Rs. 90 lakhs. Accordingly, revised proposals were submitted in August 1973. The ICAR communicated the approval of the Planning Commission to the outlay of Rs. 90 lakhs for the Fifth Plan proposals of the Laboratory in April 1974. However, during the intervening period, revised pay scales were prescribed for the various categories of posts in accordance with the Third Pay Commission. Hence, the entire proposals had to be revised deleting some of the posts, limiting the outlay to Rs. 90 lakhs. The revised proposals amounting to Rs. 90.25 lakhs, together with the E.F.C. Memo, were submitted to the ICAR in May 1974. Based on the comments received on the E.F.C. Memo, some of the administrative posts were again dropped and a fresh E.F.C. Memo was submitted to the ICAR in November 1974. This is under the active consideration of the ICAR and the Ministry of Finance. It is expected that the sanction will be communicated shortly.

Staff Amenities

The building consisting of the 16 Nos. Type I quarters intended for providing accommodation for the Class IV employees of the Laboratory was expected to be completed during the year under report. However, this construction work is still incomplete due to tardy action on the part of the CPWD.

The construction of 8 Nos. Type IV quarters intended for senior members of the staff could not be taken up during the year under report as the ban imposed by the Government of India on the construcion of non-functional buildings remained in force during this year also as a continued measure of economy.

Finance

A statement showing the sanctioned budget grant of the Laboratory and the actual expenditure during the financial year 1973-74 is furnished in Appendix I. It will be noticed that the actual expenditure is Rs. 16.50 lakhs as against the sanctioned grant of Rs. 13.92 lakhs. There is an excess expenditure over the sanctioned budget to the tune of Rs. 2.58 lakhs which is due to revision of pay scales on account of Pay Commission's recommendations and also due to increase in the cost of materials. An expenditure of Rs. 9.46 lakhs was incurred under the Fourth Plan Scheme for modernisation and strengthening of CTRL for intensive research on cotton against the sanctioned grant of Rs. 10.09 lakhs, leaving an amount of Rs. 0.63 lakh unutilized. The savings were due to non-materialisation of purchase of certain equipments. An expenditure of Rs. 3.91 lakhs was incurred on All India Co-ordinated Cotton Improvement Project (AICCIP) against the sanctioned grant of Rs. 1.77 lakhs. This excess expenditure is due to payment for a "Shirley Miniature Spinning Plant" which was provided for in the Scheme for 1972-73 but could not be purchased during that year. Action was taken to import the equipment through the Director General of Supplies and Disposals (DGS & D) and the required funds were paid to the DGS & D. Further, a sum of Rs. 0.17 lakh was incurred on "Scheme for response of Indian cottons to cross-linking treatment with a view to evolve cotton varieties most suitable for chemical finishing treatments" against the sanctioned grant of Rs. 1.00 lakh, financed from the Agricultural Produce Cess Funds. The savings were due to non-materialisation of purchase of certain equipments. Apart from this, a sum of Rs. 0.02 lakh was incurred on the "Scheme for studies of spinning from blends of cotton with wool, jute and ramie on cotton system—CTRL, Bombay, in collaboration with CSWRI, Malpura, and JTRL, Calcutta", against the sanctioned grant of Rs. 0.08 lakh. The savings were due to the late start of the Scheme and non-filling up of certain posts.

II. Progress of Research

During the year under review, considerable progress was made in the various research investigations undertaken at this Laboratory and several research papers were published. However, there was dislocation in work during the month of May due to the railway strike and the consequent disorganization of transport in the city. Further, the work in the Mechanical Processing Division was at complete standstill from the 1st of June to the end of the year due to rewiring and installation of the Conditioning Plant in this Division. This affected the working of quality evaluation of samples received from the Agricultural Departments. Actually no sample could be subjected to spinning tests from the month of May onwards, and a number of samples, therefore, remained without being tested at the end of the year.

The progress made in each research project is indicated briefly in the following pages :

Evaluation of the Quality of Cotton Samples Received from Agricultural Trials

The Laboratory receives a large number of samples for various tests from trials conducted by Agricultural Universities, the State Departments of Agriculture, etc. Some samples are obtained in connection with various research investigations at the Laboratory. The number of samples received during the years 1972, 1973 and 1974 together with the corresponding average figures for the quinquennium 1966-70 are given in Table 1 (*a*). The number of samples tested at various regional stations during 1974 is given in Table 1 (*b*).

The samples received from the agricultural trials are generally tested in the order of their receipt and the test results are sent to the officers concerned as quickly as possible. The results of tests on each of the Trade Variety and Standard Indian Cotton samples are reported in the form of a Technological Circular immediately after tests are completed. Later, the test results are consolidated for the whole season and published as two Technological Reports, one on the Trade Varieties and another on the Standard Indian Cottons. The technological research samples are utilized for the Laboratory's research work; no test reports are usually issued on such samples as the results are included in the relevant research papers published by the Laboratory. Besides these, some samples are received for miscellaneous tests, such as determination of quality of ginning, neppiness, oil content in cotton seed, etc. A few of the small samples received for tests are in the form of *kapas* and they are first ginned in the Ginning Section before they are tested for various properties. During 1974 about 35 samples had been received as *kapas* and were ginned. Further, 59 samples of *kapas* of Trade Varieties were ginned for determining their ginning outturn.

TABLE 1 (*a*) : NUMBER OF COTTON SAMPLES RECEIVED FROM DIFFERENT AGRICULTURAL TRIALS AND TESTED AT THE LABORATORY

Type of test	Average for the quinquennium 1966-70	1972	1973	1974*
Fibre and full spinning	597	600	418	309
Fibre and microspinning	2,250	1,869	2,080	1,796
Microspinning alone		1,033	816	46
Fibre test alone	143	112	80	58
Mill tests	14	18	8	14
Standard cottons	23	12	22	24
Trade varieties—lint	27	12	37	9
Trade varieties—*kapas*	42	51	49	47
Technological Research	272	48	63	107
Miscellaneous	100	—	—	—
Total	**3,468**	**3,755**	**3,573**	**2,410**

* A large number of samples could not be accepted for tests due to the dislocation in work caused by power-cut enforced by the Government of Maharashtra and by the rennovation work in Mechanical Processing Division.

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

Station	Length	Fineness	Maturity	Strength
Coimbatore	765	751	751	764
Dharwar	1,485	1,012	1,012	1,000
Hissar	297	1,444	287	287
Indore	679	679	679	679
Ludhiana	430	380	380	324
Nanded	963	957	963	1,000
Nandyal	630	642	200	796
Sriganganagar	362	265	6	265
Surat	4,354†	4,701	4,732††	3,516

† 4,347 samples were tested on the Digital Fibrograph and 7 samples on Balls Sorter.
†† 4,701 samples were tested by the Micronaire Spacer Technique and 31 samples by the Caustic Soda Method.

TABLE 2 : NUMBER OF SAMPLES TESTED

(A) *All India Co-ordinated Cotton Improvement Project*

State	Fibre and full spinning	Fibre and micro-spinning	Fibre tests	Total
Punjab	15	24	6	45
Haryana	12	24	137	173
Uttar Pradesh	—	9	38	47
Rajasthan	—	—	20	20
IARI, New Delhi	—	18	19	37
Madhya Pradesh	5	34	205	244
Gujarat	8	—	239	247
Maharashtra	8	101	200	309
Andhra Pradesh	—	—	63	63
Karnataka	—	12	180	192
Tamil Nadu	—	12	40	52
Total	**48**	**234**	**1,147**	**1,429**

(B) *Other State Schemes*

State	Fibre and full spinning	Fibre and micro-spinning	Micro-spinning	Fibre tests	Total
Punjab	3	—	—	—	3
Haryana	2	—	—	—	2
Madhya Pradesh	15	—	—	—	15
Gujarat	41	—	11	—	52
Maharashtra	36	12	11	16	75
Andhra Pradesh	9	—	12	54	75
Karnataka	27	—	—	—	27
Tamil Nadu	12	6	15	5	38
Total	**145**	**18**	**49**	**75**	**287**

Table 2 contains the number of samples which were actually tested for fibre characteristics and spinning performance. These samples have been grouped under two categories, viz. : (A) Co-ordinated Project and (B) Other State Schemes. Although 1,716 samples had been tested, reports were issued only on 1,126 samples, the break-up being 91 reports covering 839 samples under Co-ordinated Project and 84 reports covering 287 samples under State Schemes. Reports on the remaining 590 samples under Co-ordinated Project were kept pending as data on spinning performance were awaited. However, when it became clear, late in December 1974, that it would not be possible to carry out these spinning tests even during the first two months of 1975, before the arrival of fresh samples for tests, it was decided to issue reports on these samples based on the fibre tests only and necessary action was initiated. Hence the results of fibre tests on these samples have also been included for discussion in the present Report.

ALL INDIA CO-ORDINATED COTTON IMPROVEMENT PROJECT

This is the seventh year of the Project. Reports on various samples grown under advanced trials such as Co-ordinated Varietal Trial, Preliminary Varietal Trial, Pilot Project Trial, etc., for the North Zone were presented at the Zonal Workshop meeting held at Ludhiana, during April 1974. As the workshop meeting for the Central and South Zones had to be cancelled due to the railway strike, the test results were conveyed to respective Cotton Breeders.

The Project covered seven locations in the North Zone comprising of the States of Punjab, Haryana, Uttar Pradesh, Rajasthan and New Delhi; sixteen locations in the Central Zone comprising of the States of Madhya Pradesh, Gujarat and Maharashtra; and six locations in the South Zone comprising of the States of Andhra Pradesh, Karnataka and Tamil Nadu. A summary of the test results on the samples raised under various trials and conducted at different locations in the three zones is given below :

NORTH ZONE

G. hirsutum Trials

The Co-ordinated Varietal Trial was conducted : (*i*) for Normal Plant Type at Abohar, Bulandshahr, Faridkot, Hissar and Sirsa, (*ii*) for Short Branch Type at Abohar, Faridkot, Hissar, Kanpur and Sirsa, and (*iii*) for Short Duration Type at Abohar, Faridkot, Hissar, Kanpur, New Delhi and Sirsa.

Table 3 contains the data on the ranges of mean fibre length and fineness for the samples pertaining to all the three types while the data on the maturity and the bundle strength values are given in Table 4.

It will be seen from Table 3 that the mean fibre length for the Normal Plant Type samples ranged between 20.3 mm and 27.4 mm. The range of mean fibre length for Short Branch Type samples was between 20.6 mm and 28.7 mm, while that for the Short Duration Type was between 19.8 mm and 29.0 mm. Further, the Micronaire values ranged from 2.6 to 4.4, 2.8 to 5.4, and 2.5 to 5.0 for the samples pertaining to the Normal Plant Type, Short Branch Type and Short Duration Type, respectively.

TABLE 3 : SUMMARY OF DATA ON FIBRE LENGTH AND FINENESS OF THE STRAINS TRIED IN THE CO-ORDINATED VARIETAL TRIAL OF *G. hirsutum* Br04 RAISED AT DIFFERENT LOCATIONS IN NORTH ZONE

Location	Normal Plant Type			Short Branch Type			Short Duration Type		
	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)
Abohar ..	5	23.4 to 26.7 (24.6)	3.5 to 4.3 (4.0)	5	21.6 to 24.9 (23.2)	2.8 to 5.4 (3.6)	5	21.1 to 26.4 (23.3)	3.4 to 5.0 (4.1)
Bulandshahr ..	5	20.8 to 24.4 (22.5)	4.0 to 4.4 (4.2)	—	—	—	—	—	—
Faridkot ..	6	21.3 to 23.4 (22.4)	3.7 to 4.2 (4.0)	5 (Early sown)	21.8 to 24.1 (23.3)	3.6 to 4.1 (3.9)	5	19.8 to 23.4 (21.8)	3.7 to 4.6 (4.0)
				5 (Late sown)	21.8 to 24.6 (23.0)	3.9 to 4.4 (4.0)			
Hissar ..	12	22.4 to 27.4 (24.9)	3.2 to 3.7 (3.3)	11	20.6 to 24.9 (23.3)	3.5 to 4.6 (3.9)	17	22.1 to 25.9 (24.1)	3.7 to 4.9 (4.2)
Kanpur ..	—	—	—	5	22.4 to 28.7 (25.0)	3.7 to 4.3 (3.9)	5	24.6 to 25.7 (25.1)	3.7 to 4.5 (4.1)
New Delhi ..	—	—	—	—	—	—	18	23.6 to 29.0 (25.2)	3.1 to 4.0 (3.6)
Sirsa ..	6	20.3 to 26.2 (23.2)	2.6 to 4.2 (3.3)	6	20.8 to 23.6 (22.8)	3.0 to 3.8 (3.4)	5	21.1 to 23.6 (22.3)	2.5 to 3.6 (3.0)

TABLE 4 : SUMMARY OF DATA ON MATURITY AND BUNDLE STRENGTH OF THE STRAINS TRIED IN CO-ORDINATED VARIETAL TRIAL OF *G. hirsutum*, Br04 RAISED AT DIFFERENT LOCATIONS IN NORTH ZONE

Location	Normal Plant Type			Short Branch Type			Short Duration Type		
	No. of samples	Maturity	Range of bundle strength (g/t)	No. of samples	Maturity	Range of bundle strength (g/t)	No. of samples	Maturity	Range of bundle strength (g/t)
Abohar ..	5	Average to good	42.8 to 50.9 (47.7)	5	Low	40.7 to 46.1 (43.8)	5	Low to average	44.0 to 46.6 (45.1)
Bulandshahr ..	5	Average to good	41.8 to 45.6 (42.8)	—	—	—	—	—	—
Faridkot ..	6	Average	44.0 to 52.0 (48.7)	5 (Early sown)	Low to average	42.9 to 48.8 (45.5)	5	Average to good	43.6 to 48.8 (46.1)
				5 (Late sown)	Average	42.9 to 46.6 (44.6)			
Hissar ..	12	Low to average	43.4 to 46.1 (45.1)	11	Low to average	40.2 to 46.6 (43.9)	17	Average to good	42.9 to 52.0 (47.6)
Kanpur ..	—	—	—	5	Average to good	42.3 to 44.5 (43.0)	5	Average to good	42.9 to 47.2 (44.6)
New Delhi ..	—	—	—	—	—	—	18	Low to average	41.8 to 46.1 (43.6)
Sirsa ..	6	Low to average	45.6 to 47.2 (46.2)	6	Low to average	41.8 to 46.1 (45.2)	5	Low	45.6 to 48.2 (46.8)

It may be seen from Table 4 that so far as the Normal Plant Type is concerned, the maturity was average to good for most of the samples except for a few raised at Hissar. In the case of samples from Short Branch Type trials, the maturity was low for all the samples at Abohar and for a few samples at Faridkot and Hissar. It is seen from this table that the maturity was not up to the mark for samples raised under Short Duration Type trials at Abohar, New Delhi and Sirsa.

The range of bundle strength for the samples from the Short Branch Type trials was between 40.2 g/t and 48.8 g/t, while the range was between 41.8 g/t and 52.0 g/t for samples from both the Normal Plant Type and Short Duration Type trials.

Samples pertaining to Preliminary Varietal Trial were received from Bulandshahr, Faridkot, Hissar and Sirsa. The test results indicated that their mean fibre length ranged between 20.1 mm and 27.9 mm. The Micronaire value ranged between 2.4 and 4.6 . The maturity was very low in the case of most of the samples from Hissar. The bundle strength values were satisfactory ranging between 41.3 g/t and 50.4 g/t.

In the Initial Evaluation Trial, 40 samples were received from Hissar. Most of the samples recorded mean fibre length below 25.4 mm (1.00″). Although the maturity was low, the bundle strength values were average to good.

G. arboreum Trials

In the Co-ordinated Varietal Trial of *G. arboreum*, two sets, each containing twelve *arboreums* and six *hirsutums* were received from Hissar. The samples belonging to the first set had been raised under sprayed conditions and those belonging to the second set under unsprayed conditions. The mean fibre length for the *arboreum* samples raised under sprayed conditions ranged from 17.0 mm to 23.9 mm, while the same under unsprayed conditions ranged from 17.0 mm to 24.1 mm. The bundle strength values for the samples from both the sets were satisfactory. There was no noticeable difference in the fibre properties of the samples from both the sets.

Miscellaneous Trials

In the Miscellaneous Trial (indicated as GC.1 Varietal Trial) at Bulandshahr, five *arboreum* strains with one *hirsutum* strain, namely SH.131, were raised. The mean fibre length for the *arboreums* ranged between 16.0 mm and 19.8 mm. The bundle strength values were satisfactory. The *hirsutum* strain recorded mean fibre length of 21.3 mm with satisfactory bundle strength.

In another trial (indicated as GC.2 Varietal Trial) at Bulandshahr, six *hirsutum* strains with Pramukh as control were raised. The mean fibre length for all the samples was below 25·4 mm and the fibre maturity was low to average; however, the bundle strength values were average to good.

Nineteen samples were raised at IARI, New Delhi. The mean fibre length ranged between 22.6 mm and 27.2 mm. The maturity and the bundle strength values were satisfactory.

In order to evolve a long staple *G. hirsutum* cotton suitable for Mewar tract of Rajasthan, 20 strains were raised at Ajmer. The mean fibre length for these samples ranged between 20.0 mm and 28.2 mm. The fibre maturity was not satisfactory for most of the samples. The bundle strength values were average to good.

In the Pilot Project Demonstration Trial at Raya, only one strain, namely H.297, recorded mean fibre length over 25.4 mm (1.00''). The maturity, in general, was low and the bundle strength values were average to good. None of the samples fared well at 40s count.

CENTRAL ZONE

G. hirsutum Trials

In the Co-ordinated Varietal Trial, samples were received from Junagadh, Khandwa and Rahuri under irrigated conditions and from Achalpur, Badnapur, Badnawar, Indore, Junagadh, Nanded, Somnathpur and Talod under rainfed conditions. Samples specially identified for high ginning outturn were also received from Achalpur, Badnawar, Broach, Junagadh, Kutki, Nanded and Rahuri.

Tables 5 and 6 give the general summary of the test results of the trials in the Central Zone. It is seen from these tables that the mean fibre length for the strains raised under irrigated conditions ranged from 23.6 mm to 31.0 mm. The Micronaire values ranged from 2.7 to 4.8. The maturity was low for a number of samples raised at Junagadh and Rahuri. The bundle strength values ranged from 37.5 g/t to 49.3 g/t. As regards the samples raised under rainfed conditions, the mean fibre length ranged between 21.4 mm and 33.0 mm, while the Micronaire values were between 2.6 and 4.8. The maturity was low in the case of many samples from Achalpur, Badnawar, Indore, Somnathpur and Talod. The bundle strength values ranged between 38.1 g/t and 52.0 g/t. The ranges of mean fibre length, Micronaire value and bundle strength for the samples raised under high ginning type were from 21.3 mm to 32.5 mm, 2.8 to 5.1, and 34.8 g/t to 47.7 g/t, respectively. The maturity was low in the case of a few samples raised at Badnawar, Broach, Indore and Rahuri.

Co-ordinated Varietal Trials were conducted at Morena (Madhya Pradesh) and at Kopargaon, Rahuri and Nanded (Maharashtra) under irrigated conditions with entries approved for North Zone trials. The test results are summarised in Tables 7 and 8.

It can be seen from these tables that the mean fibre length ranged between 23.4 mm and 29.2 mm for the Normal Plant Type samples, between 22.4 mm and 28.4 mm for the Short Branch Type, and between 22.4 mm and 27.9 mm for the Short Duration Type. The Micronaire values ranged between 3.0 and 4.8 (Normal Plant Type), 2.9 and 4.9 (Short Branch Type), and 3.4 and 4.5 (Short Duration Type). The ranges of bundle strength values were between 33.2 g/t and 49.3 g/t, 34.3 g/t and 52.0 g/t, and 35.9 g/t and 49.8 g/t for the samples raised under Normal Plant, Short Branch and Short Duration Types, respectively. The fibre maturity was not satisfactory for a number of samples at Kopargaon, Nanded and Rahuri. There appeared to be no difference in the fibre properties of the samples sown early and late, at some of the locations.

TABLE 5: SUMMARY OF DATA ON FIBRE LENGTH AND FINENESS OF THE STRAINS TRIED IN THE CO-ORDINATED VARIETAL TRIAL OF *G. hirsutum* Br04 RAISED AT DIFFERENT LOCATIONS IN CENTRAL ZONE

Location	Irrigated			Rainfed			High Ginning Type		
	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)
Achalpur	—	—	—	6	23.9 to 29.2 (25.7)	2.7 to 4.7 (3.8)	3	21.8 to 24.6 (23.1)	4.2 to 5.1 (4.6)
Badnapur	—	—	—	14	26.2 to 30.0 (28.2)	3.2 to 4.7 (4.2)	—	—	—
Badnawar	—	—	—	16	21.4 to 26.6 (23.4)	2.8 to 3.4 (3.2)	12	21.3 to 26.4 (23.7)	2.8 to 4.0 (3.5)
Broach	—	—	—	—	—	—	5	24.6 to 28.2 (26.7)	3.5 to 4.8 (4.0)
Indore	—	—	—	16	22.1 to 26.9 (24.2)	2.6 to 3.8 (3.3)	14	21.6 to 25.4 (23.9)	2.9 to 4.2 (3.6)
Junagadh	12	23.5 to 26.9 (25.8)	3.1 to 4.8 (3.8)	16	22.9 to 27.7 (25.3)	3.4 to 4.5 (3.8)	10	24.6 to 28.2 (25.7)	3.0 to 4.8 (4.0)
Khandwa	5	23.9 to 26.9 (25.2)	3.1 to 4.2 (3.8)	—	—	—	—	—	—
Kutki	—	—	—	—	—	—	8	22.9 to 27.4 (25.6)	2.9 to 4.6 (4.0)
Nanded	—	—	—	7	24.9 to 33.00 (27.7)	3.2 to 4.8 (4.2)	7	25.7 to 32.5 (27.9)	3.2 to 5.0 (4.1)
Rahuri	9	27.2 to 31.0 (28.6)	2.7 to 4.2 (3.5)	—	—	—	7	23.6 to 27.9 (25.9)	3.4 to 4.7 (4.0)
Somnathpur ..	—	—	—	6	24.6 to 29.2 (25.9)	3.4 to 4.4 (3.9)	—	—	—
Talod	—	—	—	15	23.4 to 29.0 (26.3)	3.0 to 4.6 (3.7)	—	—	—

TABLE 6 : SUMMARY OF DATA ON MATURITY AND BUNDLE STRENGTH OF THE STRAINS TRIED IN THE CO-ORDINATED VARIETAL TRIAL OF *G. hirsutum* BR04, RAISED AT DIFFERENT LOCATIONS IN CENTRAL ZONE

Location	Irrigated			Rainfed			High Ginning Type		
	No. of samples	Maturity	Range of bundle strength (g/t)	No. of samples	Maturity	Range of bundle strength (g/t)	No. of samples	Maturity	Range of bundle strength (g/t)
Achalpur	—	—	—	6	Low to average	40.7 to 43.4 (42.3)	3	Average to good	38.6 to 44.0 (40.9)
Badnapur	—	—	—	14	Average to good	39.7 to 48.4	—	—	—
Badnawar	—	—	—	16	Low to average	39.7 to 46.6 (42.2)	12	Low to average	37.5 to 44.0 (40.7)
Broach	—	—	—	—	—	—	5	Low to average	40.2 to 46.2 (42.6)
Indore	—	—	—	16	Low to average	39.7 to 44.0 (43.0)	14	Low to average	38.6 to 47.7 (41.9)
Junagadh	12	Low to average	44.0 to 48.2 (46.3)	16	Average to good	41.3 to 48.2 (45.0)	10	Average to good	37.5 to 43.4 (40.9)
Khandwa	5	Average to good	45.0 to 49.3 (47.0)	—	—	—	—	—	—
Kutki	—	—	—	—	—	—	8	Low to average	36.4 to 44.5 (41.2)
Nanded	—	—	—	7	Average to good	38.1 to 44.5 (41.6)	7	Average to good	34.8 to 45.0 (39.4)
Rahuri	9	Low to average	37.5 to 43.4 (40.8)	—	—	—	7	Low to average	35.9 to 42.3 (39.0)
Somnathpur	—	—	—	6	Low to average	38.1 to 48.2 (42.7)	—	—	—
Talod	—	—	—	15	Low to average	44.0 to 52.0 (47.2)	—	—	—

TABLE 7 : SUMMARY OF DATA ON FIBRE LENGTH AND FINENESS OF THE STRAINS TRIED IN THE CO-ORDINATED VARIETAL TRIAL OF *G. hirsutum* BR04 (NORTH ZONE ENTRIES) RAISED AT DIFFERENT LOCATIONS IN CENTRAL ZONE

Location	Normal Plant Type			Short Branch Type			Short Duration Type		
	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)
Kopargaon ..	11	23.4 to 27.4 (25.0)	3.0 to 3.8 (3.4)	9	23.9 to 28.4 (25.8)	3.2 to 4.4 (3.7)	—	—	—
Morena ..	6	23.4 to 26.4 (24.9)	3.9 to 4.4 (4.1)	6 (Early sown)	22.4 to 24.6 (23.8)	3.8 to 4.9 (4.2)	5	22.4 to 24.1 (23.3)	3.4 to 4.3 (3.9)
				6 (Late sown)	23.1 to 24.4 (23.6)	3.6 to 4.6 (4.0)			
Nanded ..	10	24.4 to 29.2 (26.6)	3.4 to 4.8 (3.9)	8	22.4 to 26.9 (24.8)	3.7 to 4.6 (4.0)	15	23.6 to 27.9 (25.5)	3.5 to 4.5 (4.0)
Rahuri ..	12	23.6 to 27.9 (26.0)	3.6 to 4.7 (3.9)	12 (Early sown)	22.6 to 26.9 (24.9)	3.5 to 4.4 (3.9)	14	23.4 to 27.9 (25.5)	3.5 to 4.2 (3.8)
Rahuri ..	—	—	—	12 (Late sown)	22.4 to 25.4 (24.3)	2.9 to 3.8 (3.5)	—	—	—

TABLE 8 : SUMMARY OF DATA ON MATURITY AND BUNDLE STRENGTH OF THE STRAINS TRIED IN THE CO-ORDINATED VARIETAL TRIAL OF *G. hirsutum* BR04 (NORTH ZONE ENTRIES) RAISED AT DIFFERENT LOCATIONS IN CENTRAL ZONE

Location	Normal Plant Type			Short Branch Type			Short Duration Type		
	No. of samples	Maturity	Range of bundle strength (g/t)	No. of samples	Maturity	Range of bundle strength (g/t)	No. of samples	Maturity	Range of bundle strength (g/t)
Kopargaon ..	11	Low to average	36.4 to 41.3 (37.4)	9	Low to average	34.8 to 39.7 (37.4)	—	—	—
Morena ..	6	Average	45.6 to 49.3 (48.0)	6 (Early sown)	Average to good	46.1 to 48.8 (47.1)	5	Average	46.1 to 49.8 (48.4)
				6 (Late sown)	Low to average	44.5 to 49.3 (46.6)			
Nanded ..	10	Low to average	35.4 to 41.8 (38.8)	8	Low to average	34.3 to 41.3 (37.7)	15	Low to average	36.4 to 44.5 (40.9)
Rahuri ..	12	Low to average	33.2 to 41.3 (37.8)	12 (Early sown)	Low to average	35.4 to 41.3 (37.3)	14	Low to average	35.9 to 42.3 (39.1)
Rahuri ..	—	—	—	12 (Late sown)	Low to average	44.0 to 52.0 (47.2)	—	—	—

The spinning test was carried out only for a limited number of samples pertaining to the above trial. The promising strains may be listed as follows :

Location	*Trial*	*Count*	*Promising strains*
Khandwa	Irrigated	50s	70IH.452 and MCU.5
Rahuri	Irrigated	50s	DHy.286, MCU.5, IAN.6074, IAN.11-1 and CP.15/2
Badnapur	Rainfed	50s	IAN.4757, CP.15/2, B.68-2647, 66BH.5/91, IAN.579-188, MCU.5, 68BH.25/33, DHy.286 and J.1616
Somnathpur	Rainfed	50s	SRT.1, 70IH.452, CP.15/2, IAN.4757 and AC.719
Nanded	North Zone Entries (Normal Plant Type)	40s	H.297, SH.369 and J.239

Samples pertaining to Preliminary Varietal Trials were received from Badnawar, Indore, Jalgaon, Junagadh, Khandwa, Kutki, Nanded, Rahuri, Surat and Talod under Normal Plant Type, and from Achalpur, Borach, Indore, Jalgaon Junagadh, Khandwa, Kutki and Nanded under High Ginning Type. In addition, samples approved for the North Zone trials were also received from Morena.

The fibre test results for the Normal Plant Type trial indicated that their mean fibre length ranged between 22.4 mm and 32.8 mm. The Micronaire value ranged between 2.6 and 5.1, and the bundle strength values ranged between 34.8 g/t and 49.3 g/t. In the case of samples under High Ginning Type, the ranges of mean fibre length, Micronaire and bundle strength values were between 20.3 mm and 30.5 mm, 2.8 and 5.0, and 37.0 g/t and 47.7 g/t, respectively.

In the case of samples from Morena, the mean fibre length ranged between 22.1 mm and 24.9 mm, the Micronaire values ranged between 3.5 and 4.2, while the bundle strength values ranged between 46.1 g/t and 48.8 g/t.

Samples pertaining to Initial Evaluation Trial were received from Achalpur, Badnawar, Indore, Khandwa, Junagadh and Talod. A set of five samples pertaining to Compact Plant Type were also received from Junagadh. The fibre test results indicated that their mean fibre length ranged between 22.4 mm and 29.2 mm. The Micronaire values ranged between 2.6 and 5.1, while the bundle strength values ranged between 36.4 g/t and 53.6 g/t.

G. barbadense Trials

Samples belonging to Co-ordinated Varietal Trial of *G. barbadense* were received from Junagadh, Khandwa, Nanded, Rahuri, Surat and Talod. All the samples were raised under irrigated conditions. The following table gives the ranges of mean fibre length, fineness and bundle strength values.

Location	Range of mean fibre length (mm)	Range of fineness (Micronaire value)	Range of bundle strength (g/t)
Junagadh	28.4 to 33.8	3.3 to 4.1	42.9 to 50.4
Khandwa	28.4 to 30.0	2.9 to 3.1	41.8 to 46.6
Nanded	29.7 to 35.3	3.1 to 3.8	45.6 to 56.8
Rahuri	28.2 to 36.1	3.3 to 4.3	38.6 to 46.6
Surat	26.9 to 35.3	3.2 to 4.2	41.3 to 52.5
Talod	27.7 to 32.8	2.8 to 3.8	45.0 to 54.7

A set of six samples pertaining to the Preliminary Varietal Trial of *G. barbadense* was received from Junagadh. The fibre test results indicated that their mean fibre length ranged between 27.2 mm and 28.7 mm. The Micronaire values ranged between 3.6 and 4.7. The maturity and the bundle strength values were satisfactory.

G. arboreum Trials

Samples pertaining to this trial were received from Badnapur, Nanded, Parbhani and Somnathpur. A set of seven samples approved for the North Zone trials was also received from Nanded. A few *hirsutum* strains were also raised in these trials to compare the yields and quality. As expected the *hirsutum* strains recorded better fibre characters than the *arboreums.*

G. herbaceum Trials

In the Co-ordinated Varietal Trial of *G. herbaceum*, 14 strains (10 *herbaceums* + 4 *hirsutums*) were raised at Junagadh. The mean fibre length for the *herbaceums* ranged between 20.1 mm and 21.6 mm, the Micronaire values ranged between 4.2 and 5.6 and the bundle strength values ranged between 40.7 g/t and 50.4 g/t. The four *hirsutum* strains recorded superior technological performance.

A set of 12 samples (9 *herbaceums* + 3 *hirsutums*) pertaining to the Preliminary Varietal Trial was received from Surat. The ranges of mean fibre length, fineness and bundle strength values were from 22.1 mm to 24.4 mm, 4.2 to 5.4, and 46.1 g/t to 50.9 g/t, respectively.

In the case of Initial Evaluation Trials at Surat, the test results on nine *herbaceum* strains indicated that their mean fibre length ranged between 22.6 mm. and 24.6 mm, the Micronaire values varied from 3.8 to 5.5, while the bundle strength values were between 44.0 g/t and 53.6 g/t.

The range of mean fibre length for the inter-*herbaceum* crosses raised in the Initial Evaluation Trial was between 21.3 mm and 23.4 mm, the Micronaire values ranged between 4.2 and 6.1, while the bundle strength values varied between 42.9 g/t and 53.6 g/t.

Miscellaneous Trials

A large number of trials with different objectives were conducted at various locations in Madhya Pradesh, Gujarat and Maharashtra. On comparing the fibre characters of these strains with those of controls, the following were found promising :

Location	*Trial*	*Promising Strains*
Madhya Pradesh		
Badnawar	Pilot Project Demonstration	66BH.5/91, KW.68-2970 and Khandwa 2
Badnawar	District Varietal Trial	—
Khandwa	Miscellaneous Trial	KH.33/1146 (Control : Khandwa 2)
Indore	Multi-location Trial	B.21, B.31, KH.33/1357, KH.33/116, C.32 and C.37 (Control : Khandwa 2)
Indore	Glandless Trial (Most of the samples in this trial were found to be very immature)	Igl.1 and Igl.70/2
Morena	Pilot Project Demonstration (North Zone entries)	H.297, D.40 and J.205 (Control : C.59-228)
Gujarat		
Junagadh	Pilot Project Demonstration (*barbadense*)	ERB.4488 and Giza 7 MCU.5 (*hirsutum* entry)
Thasra	IAN.579-188 selections	Selections 32, 99, 108, 96, 100, 28 and 199 (Control : Hybrid 4)
Badnapur	Long Staple Short Duration	MCU.5 and Hybrid 4 (Control: Laxmi)
Kutki	Miscellaneous Trial	Varalaxmi, MCU.5 and Hybrid (Control: L.147)
Kutki	Pilot Project Demonstration	MCU.5, Hybrid 4 and 66BH.5/91 (Control : AKH.4)
Maharashtra		
Nanded	Long Staple Short Duration	MCU.5, Hybrid 4 and J.34 (Control : Laxmi)
Nanded	Pilot Project Demonstration	IAN.579-188, Khandwa 2 and ND.9 (Control : L.147)
Parbhani	Long Staple Short Duration	MCU.5 and Hybrid 4 (Control : Laxmi)
Parbhani	Pilot Project Demonstration (North Zone entries)	J.207, L.147, H.297, SH.269, D.40, SH.167 and J.205 (Control : Laxmi)

In addition to these, samples of Suvin collected from different cultivators in Maharashtra were also received from Padegaon. The ginning percentage for these samples varied from 28.5 to 30.4, the mean fibre length ranged between 35.3 mm and 36. 1 mm, and the Micronaire value ranged from 3.1 to 3.7. The maturity was satisfactory for all the samples. The bundle strength values were also good ranging from 47.7 g/t to 50.4 g/t.

SOUTH ZONE

G. hirsutum Trials

The Co-ordinated Varietal Trial was conducted under irrigated conditions at Amravati and Srivilliputhur and under rainfed conditions at Arsikere, Dharwar and Raichur. The test results are compiled in Tables 9 and 10. Another trial of Short Duration Types was also conducted in the rice fallows at Tenali.

It may be seen from these tables that the mean fibre length for the irrigated samples ranged between 23.1 mm and 30.5 mm. The range of mean fibre length for the rainfed samples ranged between 22.6 mm and 30.5 mm, while the same was between 21.1 mm and 26.2 mm for the samples raised in the rice fallows at Tenali. The Micronaire values ranged between 3.4 and 4.4 for the irrigated samples and between 3.1 and 3.9 for rainfed samples. The samples raised under Short Duration Type at Tenali appear to be rather coarser as the Micronaire value ranged between 4.2 and 5.2. The maturity was, in general, low to average for the samples raised under irrigated and rainfed conditions, while all the samples raised in the rice fallows at Tenali recorded satisfactory maturity values.

The bundle strength values ranged from 35.9 g/t to 50.4 g/t for the irrigated samples, 36.4 g/t to 45.6 g/t for the rainfed samples, and 48.9 g/t to 54.7 g/t for the samples raised in the rice follows at Tenali.

Samples pertaining to the Preliminary Varietal Trial were received from trials at Amravati, Arabhavi and Srivilliputhur under irrigated conditions and from trials at Arsikere and Raichur under rainfed conditions. The mean fibre length for all these samples ranged between 23.4 mm and 32.8 mm with Micronaire value ranging between 2.8 and 4.7. The maturity was satisfactory for most of the samples from Amravati, Arabhavi, Srivilliputhur and Raichur. Many samples from Arsikere, however, were found to be immature. The bundle strength values, in general, were satisfactory except for a few samples raised at Arsikere.

The test results of 30 samples raised under the Initial Evaluation Trial at Arabhavi indicated that their mean fibre length ranged between 24.9 mm and 30.5 mm, They had low to average maturity and bundle strength.

G. barbadense Trials

A set of eight samples raised under Co-ordinated Varietal Trial was received from Arsikere. The mean fibre length ranged between 26.4 mm and 33.3 mm, while the maturity and bundle strength values were satisfactory.

TABLE 9 : SUMMARY OF DATA ON FIBRE LENGTH AND FINENESS OF THE STRAINS TRIED IN THE CO-ORDINATED VARIETAL TRIAL OF *G. hirsutum* BR04 RAISED AT DIFFERENT LOCATIONS IN SOUTH ZONE

Location	Irrigated			Rainfed		
	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)	No. of samples	Range of mean fibre length (mm)	Range of fineness (Micronaire value)
Amravati	16	25.9 to 30.5 (27.9)	3.4 to 4.2 (3.7)	—	—	—
Arsikere	—	—	—	14	22.9 to 30.5 (25.5)	3.2 to 3.8 (3.5)
Dharwar	—	—	—	14	22.9 to 27.9 (24.9)	3.1 to 3.7 (3.4)
Raichur	—	—	—	7	22.6 to 24.6 (23.7)	3.4 to 3.9 (3.7)
Srivilliputhur	17	23.1 to 30.2 (27.4)	3.4 to 4.4 (3.8)	—	—	—

TABLE 10 : SUMMARY OF DATA ON MATURITY AND BUNDLE STRENGTH OF THE STRAINS TRIED IN THE CO-ORDINATED VARIETAL TRIAL OF *G. hirsutum* BR04 RAISED AT DIFFERENT LOCATIONS IN SOUTH ZONE

Location	Irrigated			Rainfed		
	No. of samples	Maturity	Range of bundle strength (g/t)	No. of samples	Maturity	Range of bundle strength (g/t)
Amravati	16	Low to average	35.9 to 45.0 (40.9)	—	—	—
Arsikere	—	—	—	14	Low to average	36.4 to 41.3 (38.7)
Dharwar	—	—	—	14	Low to average	40.7 to 45.6 (42.9)
Raichur	—	—	—	7	Low to average	38.1 to 43.4 (40.2)
Srivilliputhur	17	Low to average	42.3 to 50.4 (47.6)	—	—	—

G. herbaceum Trials

The range of mean fibre length for the *herbaceum* strains tried in the Co-ordinated Varietal Trial at Raichur under rainfed conditions was between 20.8 mm and 21.3 mm. The maturity and bundle strength values were satisfactory. The *hirsutum* controls taken in this trial recorded superior performance in respect of mean fibre length and fineness.

Miscellaneous Trials

Many miscellaneous trials were conducted at various locations. The test results of the important trials are given below :

In the *Ad hoc* Trial conducted at Amravati, four strains, namely Hybrid 4, Varalaxmi, MCU.5 and Imp-A.179, were raised. Of these, Varalaxmi and MCU.5 recorded impressive fibre characters and spinning performance (50s count).

A Hybrid Vigour Trial under irrigated conditions was conducted at Nandyal. The three new hybrids, namely NHY.9, NHY.12 and NHY.17 isolated at Nandyal were examined along with Varalaxmi and Hybrid 4 and a *barbadense* strain, Giza 7. The mean fibre length values for NHY hybrids were found to be superior to those of other hybrids. Fibre maturity, in general, for all the hybrids was low while it was satisfactory for Giza 7. The bundle strength values were good for all the samples.

Samples of various pickings of Varalaxmi, Hybrid 4, CBS.156, CPH.1, CPH.2 and CPH.3 along with control MCU.5 and Mysore Vijaya were received from Arabhavi. The trial was conducted under irrigated conditions. The observations made on the fibre tests are as follows :

Varalaxmi : There was a deterioration in the mean fibre length for the last (5th) picking. However, the uniformity ratio, fineness and maturity remained practically same. Bundle strength values at both the gauge lengths showed a tendency to increase.

Hybrid 4 : There was a deterioration in the mean fibre length from 2nd to 5th pickings. Uniformity ratio, fineness and maturity remained unchanged. Bundle strength values for the later pickings were rather higher than those for the earlier pickings.

CBS.156 : There was a considerable deterioration in the mean fibre length from 2nd picking to the last picking. The uniformity in staple was also not satisfactory for the last two pickings (4th and 5th pickings). The bundle strength values for the last picking were higher than those of earlier pickings.

CPH.1 : There was a deterioration in the mean fibre length for the 4th and 5th pickings. However, uniformity in staple and Micronaire values were comparable and did not show any consistent trend (the Micronaire value for the second picking, however, was rather low). There was an increase in the bundle strength values for the later pickings.

CPH.2 : There was a deterioration in the mean fibre length. The uniformity in staple remained practically same for all the pickings. There was no

consistant change in the Micronaire values for different pickings. The bundle strength values, however, showed a tendency to increase for later pickings.

CPH.3 : There was a decrease in mean fibre length values for 3rd, 4th and 5th pickings. The uniformity in staple remained practically same. There was an increase in the bundle strength values for the later pickings.

MCU.5 : There was a noticeable decrease in the mean fibre length values with no definite change in the uniformity in staple and bundle strength.

Mysore Vijaya : There was a gradual deterioration in the mean fibre length values with gradual increase in the uniformity in staple. The fineness remained practically same. However, there was a decrease in the bundle strength values for the later pickings.

Another hybrid trial with Mysore Vijaya, MCU.5, IC.515, etc., as female parents, was conducted at Arabhavi. The observations made as regards the fibre characters of the 16 samples under this trial are as follows :

The test results of Hybrids of Mysore Vijaya indicated that their mean fibre length values were considerably higher than that of Mysore Vijaya. As regards the uniformity in staple, fineness, and bundle strength, the hybrids recorded comparable values.

In the case of hybrids of MCU.5, it was noted that the hybrid samples did not have any superiority over MCU.5, except as regards fibre length uniformity.

As regards the hybrids of IC.515, it was observed that the hybrids IC.515 × ELS.358 and IC.515 × 170Co.2 recorded significantly higher mean fibre length values over that of IC.515. However, these hybrids recorded lower values of fineness, maturity and bundle strength.

The crosses of 170Co.2 (Mysore Vijaya × 170Co.2 and IC.515 × 170Co.2) also recorded considerably higher mean fibre length values over that of 170Co.2. These hybrids had low maturity as compared to 170Co.2. Bundle strength values were also somewhat lower.

In the Pilot Project Demonstration Trial conducted at Raichur under rainfed conditions, the mean fibre length ranged between 17.8 mm for Raichur 51 (a *herbaceum* control) and 23.4 mm for GS.23. The maturity and the bundle strength values were average to good.

Test results on samples from Coimbatore pertaining to F_1 hybrids involving Gregg male sterile line indicated that the mean fibre length for the 12 samples of Gregg hybrids ranged from 23.4 mm for Gregg × CP.2/1 to 26.7 mm for Gregg × CP.25/1. They had satisfactory uniformity in staple. The maturity values were low to average and the bundle strength values were average to good. The hybrid Varalaxmi raised in this trial recorded mean fibre length over 30 mm with satisfactory uniformity in staple. The maturity was rather low while the bundle strength values were satisfactory. Hybrid 4 recorded mean fibre length of 26.2 mm with satisfactory uniformity. The maturity and the bundle strength values were rather low. The hybrid CBS.156 also from the same trial recorded mean fibre length of over 30 mm with satisfactory uniformity in staple and bundle strength. The maturity in this case was also not satisfactory. In the case of control MCU.5, the mean fibre length was over 28 mm. The uniformity in staple was rather low. The maturity and the bundle strength values were satisfactory.

TABLE 11 : RESULTS OF EXTRA-LONG STAPLE (27 mm & ABOVE) COTTONS TESTED IN 1974

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
Gujarat								
Hybrid 4	Karjaw	28.0	1.10	165	4.2	0.71	39.7	7.4
IAN.579-188	Khedbrahma	27.4	1.08	134	3.4	0.66	45.6	8.5
4530	Navsari	32.0	1.26	185	4.7	0.74	46.6	8.7
Hybrid 4	"	28.4	1.12	161	4.1	0.73	38.1	7.1
IAN.579-188	"	29.5	1.16	150	3.8	0.69	43.4	8.1
Hybrid 4	Sathamba	30.0	1.18	157	4.0	0.71	42.3	7.9
Gujarat 67	Surat	28.6	1.13	130	3.3	0.67	37.5	7.0
Hybrid 4	"	29.3	1.15	173	4.4	0.74	40.2	7.5
IAN.579-188	"	29.0	1.14	154	3.9	0.71	44.0	8.2
Hybrid 4	Talod	27.7	1.09	181	4.6	0.74	48.2	9.0
IAN.579-188	"	27.9	1.10	126	3.2	0.64	46.1	8.6
MCU.5	"	29.0	1.14	118	3.0	0.62	44.5	8.3
Hybrid 4	Viramgaon	27.9	1.10	181	4.6	0.73	47.2	8.8
IAN.579-188	"	28.7	1.13	161	4.1	0.70	50.4	9.4
MCU.5	"	30.5	1.20	142	3.6	0.66	52.5	9.8
Karnataka								
MCU.5	Dharwar	27.9	1.10	138	3.5	0.67	41.8	7.8
S.I. Andrews	Shiralkoppa	29.3	1.15	146	3.7	0.72	43.4	8.1
Madhya Pradesh								
Hybrid 4	Khargone	27.8	1.09	161	4.1	0.72	41.8	7.8
Hybrid 4	Ujjain	27.7	1.09	134	3.4	0.68	38.6	7.2
Maharashtra								
MCU.5	Nanded	32.0	1.26	134	3.4	0.66	45.6	8.5
ND.7	"	27.7	1.09	161	4.1	0.67	45.0	8.4
Hybrid 4	Parbhani	27.9	1.10	130	3.3	0.64	39.1	7.3
MCU.5	"	31.0	1.22	118	3.0	0.59	44.5	8.3
Tamil Nadu								
MCU.4	Rajapalayam	27.2	1.07	134	3.4	0.68	46.1	8.6
MCU.8	"	28.4	1.12	126	3.2	0.65	46.1	8.6
MCU.8	Srivilliputhur	30.2	1.19	146	3.7	0.67	48.2	9.0

The test results of two samples of Suvin, one collected from the progressive farmer and the other (Suvin BK.10) from IARI Regional Station, Coimbatore, indicated that the sample of farmer's field recorded mean fibre length as high as 36.6 mm, being much higher than that of Suvin BK.10 (33.8 mm). Both the samples have recorded excellent uniformity in staple. The maturity values were low to satisfactory and the bundle strength values at both the gauge lengths were encouraging. Both the samples have recorded very impressive spinning performance at 100s and 120s count when spun on SKF high drafting system.

In the trial of selecting *verticillium* resistant MCU.5, nine selections of MCU.5 with control were received from IARI, Coimbatore. The test results indicated that their mean fibre length ranged between 26.2 mm and 31.5 mm. The three selections, namely 9-7, 34-3 and 34-4 recorded higher mean fibre length values than the control. Fibre maturity was not satisfactory for all the samples including control. The bundle strength values were average to good.

EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS

The results of the detailed tests carried out on extra-long staple cotton samples received and tested at the Laboratory during 1973 are shown in Table 11. This supplements the prominent strains described under the All India Co-ordinated Cotton Improvement Project.

MILL TESTS

Selected improved varieties of cotton which possess promising characteristics and are considered superior to the current ones on the basis of the Laboratory tests, are subject to actual mill tests for their performance at the mills. Only after the superiority of the new varieties is confirmed by the mill tests, at least for two seasons, the varieties are recommended for large scale propagation. Necessary arrangements for carrying out mill tests are made by this Laboratory. A few mills have been co-operative enough to undertake such tests on the samples sent to them.

During the year, mill tests were carried out on five samples. The comparative test results at the mill and the Laboratory are given in Table 12.

It will be seen that in Gujarat, IAN.579-188 had given better spinning performance than Gujarat 67 and Hybrid 4 at the mill and the Laboratory. In Karnataka, 3870SB gave better spinning performance than Westerns 1, both at the mill and at the Laboratory.

NEW VARIETIES RELEASED DURING 1973-74

Shri Jagjivan Ram, Union Minister for Agriculture and Irrigation, officially released the following five new varieties on the occasion of the Golden Jubilee of the Laboratory on the 29th December, 1974. The release of these improved new varieties was the outcome of the collaborative endeavour between CTRL and AICCIP.

1. *Variety IAN.579-188, popularly known as VISHNU*

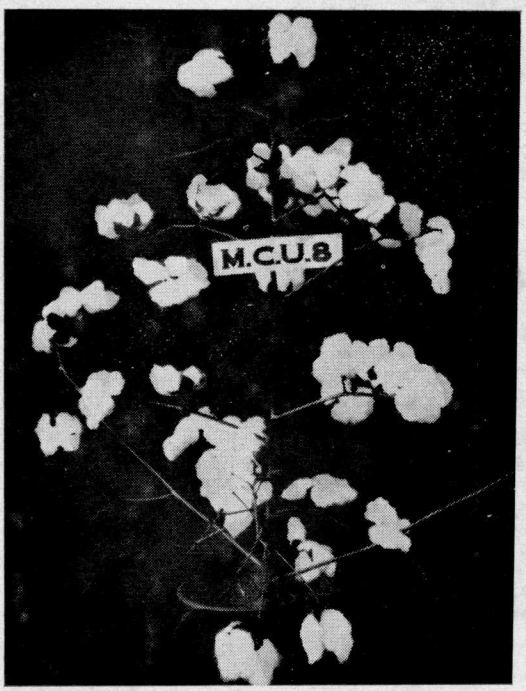
This is a high yielding better quality *hirsutum* variety identified in the All-India Workshop held in June 1972 and released by the Gujarat State Agrosco

TABLE 12 : COMPARATIVE MILL AND LABORATORY TESTS—SPININNG TEST RESULTS

Place	Variety	Laboratory Results				Mill Test Results			
		Waste, %	Count	Strength	t.m.	Waste, %	Count	Strength	t.m.
Gujarat									
Surat	IAN.579-188	11.5	60s	41.9*	3.8	6.9	60s	39.5	—
„	Gujarat 67	14.4	60s	30.5*	3.8	8.1	60s	34.3	—
„	Hybrid 4	8.1	60s	34.0*	3.8	6.8	60s	31.6	—
Karnataka									
Hagari	3870SB	12.1	18s	102.3	4.2	12.2	18s	91.0	4.8
”	Westerns 1	11.7	18s	91.7	4.2	11.2	18s	79.4	4.8

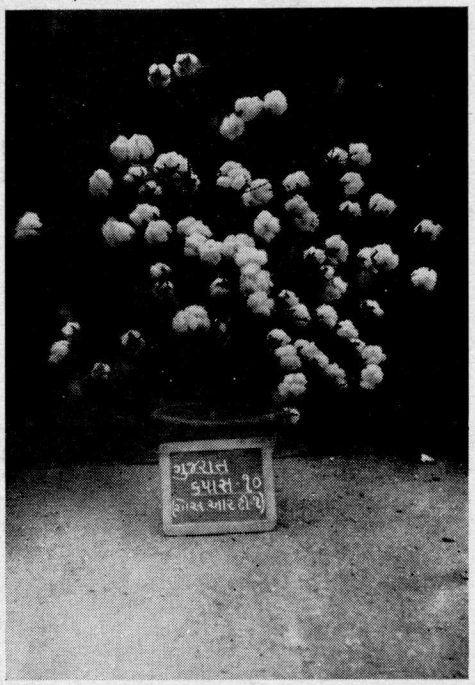
* SKF Drafting System.

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.

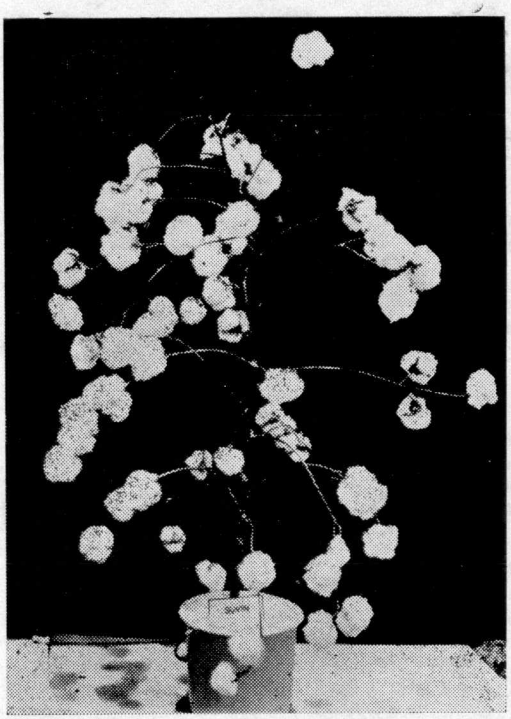


Plant of MCU.8

Plant of IAN·579 (VISHNU)

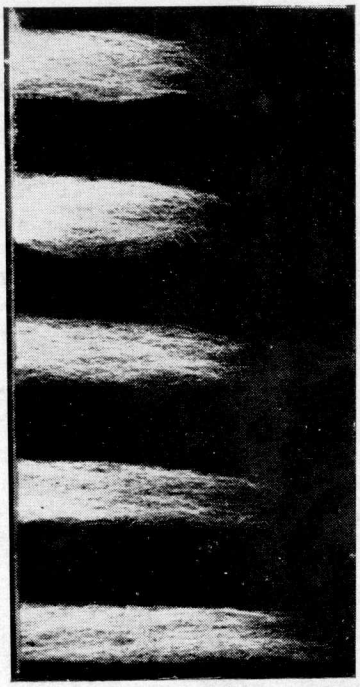


Plant of SRT·1



Plant of SUVIN

NEW VARIETIES 1973 - 1974

Variety	SPECIMEN PULL	Staple length, 32nd inch	Micro-naire value	Pressley strength index	Highest standard count
JYOTI		30	4.0	9.2	30s
SRT·1		32	5.0	9.4	40s
VISHNU		35	3.0	8.0	50s
MCU·8		35	3.3	8.0	60s
SUVIN		46	3.3	10.0	120s

in 1973. This variety recorded an average yield of 1979 kg/ha as compared to the control variety Deviraj with 1672 kg/ha. In spinning quality, it is better than Deviraj by about 20 counts.

2. *Variety CC.1-1-3, named as JYOTI*

This is an *arboreum* variety identified for release by the Cotton Workshop Panel in May 1973, to replace the variety Y.1 in the Khandesh tract in Maharashtra. Jyoti was approved for release by the Mahatma Phule Krishi Vidyapeeth Agresco in 1973. The new variety recorded, on an average, *kapas* yield of 515 kg/ha as compared to 459 kg/ha of Y.1. With a spinning value of 32s HSC it has recorded better performance than Y.1 in both mill and Laboratory tests

3. *Variety EL. 0162, named as MCU.8*

This is a superior long staple *hirsutum* variety identified in the All-India Workshop held in June 1972 for replacing MCU.4 in the irrigated summer Cambodia tract in Tamil Nadu and released by the State Agricultural Council in 1973. The new variety combines better yield and tolerance to pink bollworms. This possesses a staple length of 1-3/32 inches and is suitable for spinning good 60s count.

4. *Variety SRT.1*

This is a medium staple *hirsutum* variety identified as promising by the Cotton Workshop Panel in 1973 and released by the Gujarat State Agresco. This variety recorded on an average 27 to 34 per cent higher yield than Digvijay with earlier maturity of about two months. This variety possesses better fibre quality and spinning value than Digvijay.

5. *Variety SUVIN*

This is an extra-long staple *barbadense* variety identified as promising in the All-India Workshop in June 1972. With a staple length of 46/32 inches and spinning value of over 120s counts under Laboratory conditions and 100s to 120s counts in mill tests, this variety has been adjudged as equivalent to the best imported Egyptian cottons like Giza 45. This variety was evolved after screening a very large number of hybrid progenies and individual plants for major fibre characters like length, strength and fineness, fixing rigid norms for technological properties and after carrying out spinning tests under pilot plant and mill conditions. Suvin has an yield potential of 20 to 30 q/ha and has been promoted for development by a leading textile group in the Coimbatore tract during the 1974-75 season. This extra-long staple variety has also been reported to perform well in the Deccan Canal area in Maharashtra and Nagarjunasagar Project area in Andhra Pradesh.

In addition to the above, the Tamil Nadu Agricultural University, Coimbatore, announced the release of a new extra-long staple interspecific hybrid, CBS.156, for cultivation under irrigated conditions in Tamil Nadu.

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

Lint samples of fair average quality of the Major Trade Varieties of Indian Cottons are being obtained 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 of ginning percentage. The fibre and spinning test results, ginning percentage and other test results on each variety of cotton were published as Technological Circulars as early in the season as possible for the information of the cotton trade and industry. During 1974, many samples of 1973-74 season could not be tested due to renovation of the Spinning Laboratory and hence circulars were issued only on 11 Trade Varieties during the period. Tests are still to be carried out on the remaining varieties. The test results on all the Trade Varieties of 1972-73 season were compiled together and published at "Technological Report on Trade Varieties of Indian Cottons, 1972-73 Season".

Evaluation of the Quality of Standard Indian Cotton Varieties Maintained at Chief Cotton Research Stations

In order to assess the seasonal fluctuations in the characteristics of Indian cottons and with a view to judging the comparative superiority or otherwise of the newly evolved strains, a number of selected varieties of Indian cottons, called Standard Indian Cottons, are tested at the Laboratory every year. These are grown under identical conditions from year to year on the government farms under departmental supervision. Extensive fibre and spinning tests are regularly carried out on such samples. The results obtained on the samples received are published as Technological Circulars for the information of the Cotton Breeders and other research workers as early in the season as possible. During 1974, such circulars were issued only on two varieties. Many varieties of 1973-74 season could not be tested for reasons mentioned earlier and are awaiting tests. The results of all the samples pertaining to the 1972-73 season were consolidated and published at the end of the season as "Technological Report on Standard Indian Cottons, 1972-73 Season".

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

Preliminary Screening of Varieties

Seven crosses of Pima × Menoufi received from Surat and 19 lint samples received from IARI, New Delhi, and one sample from Regional Research Station, Hyderabad, were tested for bundle strength and elongation on Stelometer. Three cottons, viz. K.222, K.2262 and D.33, were selected for chemical finishing treatment as they had high toughness in raw state.

Varieties Treated in Yarn Form

Several varieties of cotton were treated with DMDHEU in yarn form for rapid screening with respect to strength-elongation characters. The varieties treated were : Varalaxmi, Suvin, Sujata, A.218, 66BH.5/91, Hampi, Krishna, V.797, AK.235, Sujay, MCU 8, Bharati, SH.369, IAN.579-1456, ELS.031,

Maljari and PS.10. The formulation used was 8% DMDHEU, 3% $MgCl_2$, 1% Polyethanol and 0.1% wetting agent. The samples were dried at 80°C for 7 min. and cured at 160°C for 3 min. to give a final add-on of 3-4 per cent. All the samples were analysed for nitrogen uptake.

Of the 18 varieties listed above, nine varieties have been screened for strength-elongation characteristics using Uster Single Thread Tester, while screening of the remaining cottons is in progress. Among the varieties so far screened, Varalaxmi, Krishna and Hampi seem to retain high percentage of elongation even after crosslinking.

Varieties Treated in Fabric Form

Eight varieties of cotton yarns, viz. MCU.1, Gujarat 67, Deviraj, Hybrid 4, A.218, 66BH.5/91, Sanjay and Digvijay, were woven into fabric at Chemicals and Fibres of India, Ltd. (CAFI).

Conditions for imparting wash and wear rating by crosslinking with the DMDHEU were standardised. A suitable drying and curing oven was fabricated locally as per our requirements. The method has now been standardised to obtain 3-4 per cent add-on. The crosslinked fabric samples are being tested for various properties.

Main Observations

The varieties 66BH.5/91 and Sanjay proved outstanding in the retention of tenacity and elongation on treatment with the resin both in fibre as well as in yarn form. Digvijay and MCU.1 showed promising results when treated in yarn form. Figure 1 illustrates the toughness retention of some of the varieties. High retention of elongation was also noted in DMDHEU treated yarn of Hampi, Krishna and Varalaxmi.

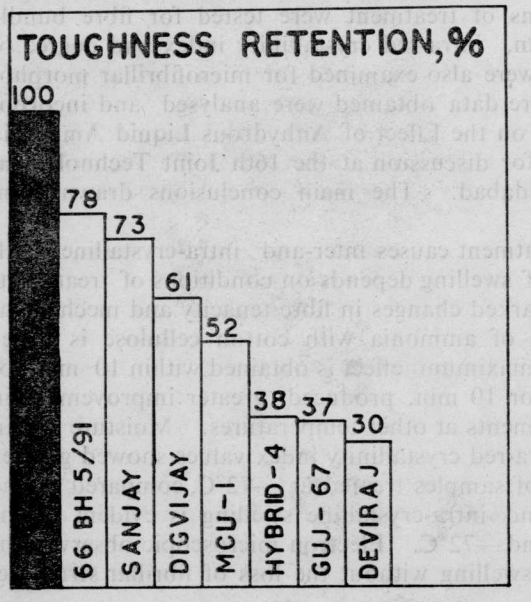


Fig. 1. Toughness retention of seven cotton yarns crosslinked with DMDHEU. Note the favourable performances of 66BH.5/91, Sanjay and Digvijay cottons

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

During the period under report, lint samples treated with formaldehyde under different conditions of treatments, were re-examined for formaldehyde content and moisture regain data to confirm the earlier results.

The results showed that the gross effectiveness of crosslink development in chemically modified crosslinked cottons could be evaluated by means of a measure of gel-fraction in cupriethylenediamine. 'Form W' process was found to be more effective than 'Form D' as is evident from gel-fraction data. These results are in conformity with the findings reported by other workers. Cotton cellulose treated with different reagents and crosslinked under 'Form W' and 'Form D' processes showed varying degrees of crosslinking depending on the type of chemical modification and condition of treatment. In both the processes, formaldehyde content increased gradually with increase of reaction time. For both the processes, the distribution of crosslinks in cellulose, measured as moles of formaldehyde per anhydroglucose unit from sol-gel data, was higher in case of samples treated with NaOH and $ZnCl_2$ than in the other samples. This difference has been attributed to the increased accessible sites in the cellulose samples caused by these two treatments.

A paper entitled "Sol-gel Studies of Chemically Modified Celluloses" was written up, utilizing these results, and presented at the All-India Chemists' Convention held at Madurai in December, 1974.

Study of the Effect of Anhydrous Liquid Ammonia Treatments on the Physico-chemical Properties of Cotton Fibre and Yarn

During the period under report, lint samples treated with anhydrous liquid ammonia under different conditions of treatment were tested for fibre bundle tenacity, elongation, moisture regain, infra-red crystallinity index and degree of polymerisation. Selected samples were also examined for microfibrillar morphology by electron microscope. Entire data obtained were analysed and incorporated in a paper entitled "A Study on the Effect of Anhydrous Liquid Ammonia Treatment on Cotton", submitted for discussion at the 16th Joint Technological Conference to be held at Ahmedabad. The main conclusions drawn from this study are given below :

Anhydrous liquid ammonia treatment causes inter-and intra-crystalline swelling in cotton fibre, and the extent of swelling depends on conditions of treatment. This treatment also brings about marked changes in fibre tenacity and mechanical properties (Table 13). Interaction of ammonia with cotton cellulose is faster than of other swelling reagents and maximum effect is obtained within 10 min. of treatment. Treatment at —20°C for 10 min. produced greater improvement in fibre tenacity compared to the treatments at other temperatures. Moisture regain and accessibility data as well as infra-red crystallinity index values showed greater degree of change in fine structure of samples treated at —72°C, compared to the sample treated at —20°C. Inter-and intra-crystalline swelling is evident in the case of samples treated at —40°C and —72°C. Electron microscopic observations confirm inter- and intra-crystalline swelling without the loss of fibrillar structure.

TABLE 13 : TENSILE AND MECHANICAL PROPERTIES OF COTTON TREATED WITH ANHYDROUS LIQUID AMMONIA AT DIFFERENT TEMPERATURES

Temperature	—20°C				—40°C				—72°C			
Treatment period	Tenacity, g/t ($\frac{1}{8}$″ gauge)	Elongation, %	Toughness	Stiffness	Tenacity, g/t ($\frac{1}{8}$″ gauge)	Elongation, %	Toughness	Stiffness	Tenacity, g/t ($\frac{1}{8}$″ gauge)	Elongation, %	Toughness	Stiffness
Control	22·2	5·3	0·52	418	22·7	5·9	0·67	385	20·7	6·1	0·63	339
Treated for 5 min.	22·3	5·4	0·60	413	23·3	7·0	0·81	333	—	—	—	—
Treated for 10 min.	25·5	6·5	0·76	392	23·7	7·6	0·90	312	22·5	7·9	0·89	285
Treated for 30 min.	24·5	6·5	0·80	377	24·3	6·6	0·80	368	22·4	7·8	0·87	287
Treated for 1 hr.	25·6	7·0	0·90	366	24·1	6·4	0·77	376	—	—	—	—
Treated for 2 hr.	—	—	—	—	24·2	7·6	0·92	318	—	—	—	—
Treated for 4 hr.	—	—	—	—	—	—	—	—	21·4	7·2	0·77	297
Treated for 18 hr.	—	—	—	—	—	—	—	—	21·4	7·2	0·77	297

This may be one of the factors for high increase in strength of yarn treated under "Prograde Process". Samples pre-treated with swelling reagents like ethylamine, ethylenediamine, zinc chloride, lithium hydroxide, and potassium hydroxide showed further marked increase in moisture regain and accessibility after the ammonia treatment. Ammonia treatment up to 10 min. does not have any adverse effect on chain length of cellulose. These data indicate that ammonia can be utilized in textile finishing for improving certain desirable properties with many advantages.

Oxidation and Hydrolysis of Chemically Substituted Cotton Celluloses

The acetylated cellulose sample of D.S. 2.34 and benzoylated sample of D.S. 1.08 were oxidised with potassium dichromate and oxalic acid for 24 hr. and 192 hr. Copper number determinations on these oxidised chemically modified samples showed that the oxidation was more in the case of benzoylated sample. Both these chemically modified samples (acetylated cellulose samples of D.S. 2.34 and benzoylated sample of D.S. 1.08) were hydrolysed with 2.0 N, 4.0 N and 6.0 N hydrochloric acid for 24 hr. at 70°C. On hydrolysis, acetylated sample showed more degradation.

Cotton cellulose was fully benzoylated to D.S. 3.0 by keeping the reactant cotton cellulose : benzoyl chloride : pyridine as 1 g: 7.5 ml : 42.5 ml. Cellulose benzoate of D.S. 3.0 has been sent to Bhabha Atomic Research Centre for irradiation with gamma rays to five different dosages, 1×10^6, 5×10^6, 1×10^7, 5×10^7 and 1×10^8 rads.

The oxycelluloses prepared by different specific oxidising agents are being studied for structural changes.

Evaluation of Protein Composition of Indian Cotton Seeds

During the period under report, acid hydrolysates of solvent extracted cotton seed meal were prepared. Acid hydrolysates were run on an Automatic Amino Acid Analyser at Bhabha Atomic Reserch Centre. After several trials, suitable concentration was worked out to obtain well defined peaks for interpretation of individual amino acids. Six solvent extracted cotton seed meals were analysed for amino acids using the above technique. Differences were observed in the proportion of some of the amino acids in the meal from different varieties. It will be very useful to carry out further work to examine a larger number of varieties.

Evaluation of Cottonseed Oil During the Stage of Production from the Seed through Refining, Bleaching, Hydrogenation, Deodorisation and Blending to Produce Vanaspati out of it

The All-India Cottonseed Crushers' Association (AICOSCA) Research Project on the Analytical Evaluation of cottonseed, cottonseed oil and cake during their processing and production was undertaken at this Laboratory with the major object of correlating the analytical characteristics with the different processing practices employed by different cottonseed oil mills. Considering the time consuming nature of some of analytical determinations (Gossypol, unsaponifiable matter

and cyclopropenoid fatty acids), and limited time available, it was decided to restrict the number of mills, the frequency of samples and the number of analytical characteristics. Five oil mills were selected for this study.

The mills A, B, C, D and E supplied 7, 2, 10, 5 and 1 sample lots, respectively. These sample lots were analysed for the following analytical characteristics :

Material	*Characteristics*
a. Cottonseed	1. Gossypol % (Free) 2. Gossypol % (Total) 3. Moisture % 4. Oil content %
b. Oil cake	All the above four
c. Extractions	—do—
d. Crude expeller oil	1. F. F. A. % 2. Colour 3. Unsap. % 4. Gossypol %
e. Alkali washed expeller oil f. Crude extracted oil g. Alkali washed extracted oil h. Refined and deodorised oil	All the above four

Limits of some of the analytical data have been given in a consolidated form in two different sets, viz. Gossypol values in Table 14, and contents of moisture, oil, F.F.A. and unsap. matter in Table 15. The following observations were made in respect of the various materials for gossypol :

In cottonseed samples received from different factories, free and total gossypol contents varied from 0.71 to 2.07 per cent and from 0.84 to 2.58 per cent, respectively. The free and total gossypol contents of the cakes from different mills ranged from 0.06 to 0.27 per cent and from 0.57 to 2.04 per cent, respectively. As expected, the total gossypol contents of seeds and cakes were higher than the respective free gossypol contents. Free and total gossypol contents of cakes were much lower compared to those of the seeds. The large reduction in the free gossypol contents of cakes, is no doubt, due to the cooking and expelling treatments of the seeds.

The extraction and extracted crude oils have lower gossypol contents compared to the cakes and expeller crude oils, respectively. The gossypol content of the alkali washed extracted oils was similar to that of alkali washed expeller oil.

The gossypol content values of crude 'expeller' oils from different mills ranged between 0.74 and 1.87 per cent, while those of alkali washed 'expeller' oil ranged from 0.002 to 0.12 per cent and those for refined and deodorised oil samples were between 0.001 and 0.006 per cent.

TABLE 14 : RANGE OF GOSSYPOL CONTENT OF SAMPLES FROM DIFFERENT MILLS

Mill	No. of lots tested	Seed		Cake		Oil Expressed			Extraction		Extracted oil	
		Free	Total	Free	Total	Crude	Alkali washed	Refined deodorized oil	Free	Total	Crude	Alkali washed
A	7	1·31- 2·07	1·94- 2·52	0·10- 0·27	1·17- 2·04	1·05- 1·87	0·005- 0·120	—	0·13- 0·17	1·04- 1·27	0·01- 0·14	— —
B	2	1·36- 1·79	1·90- 2·05	0·14- 0·26	1·43- 1·55	0·80- 1·78	0·012	—	—	—	—	—
C	10	0·82- 1·80	1·05- 2·58	0·09- 0·27	0·85- 1·17	0·74- 1·49	0·002- 0·013	—	0·08- 0·14	0·83- 1·10	0·28- 0·39	0·003- 0·005
D	5	0·71- 1·23	0·84- 1·52	0·06- 0·12	0·57- 0·92	0·97- 1·34	0·002- 0·003	0·001- 0·006	—	—	—	—
E	1	0·94	1·13	0·11	0·82	—	0·004	—	—	—	—	—
Overall range		0·71- 2·07	0·84- 2·58	0·06- 0·27	0·57- 2·04	0·74- 1·87	0·002- 0·12	0·001- 0·006	0·08- 0·17	0·33- 1·27	0·01- 0·39	0·003- 0·005

TABLE 15 : VALUES OF MOISTURE, OIL, F.F.A. AND UNSAPONIFIABLE CONTENTS OF SAMPLES FROM DIFFERENT MILLS

Mill	No. of lots tested	Seed		Cake		Oil Expressed				Refined and deodorized Extraction					Extracted Oil	
						FFA		Unsap.		Oil			FFA		Unsap.	
		Mois-ture	Oil	Mois-ture	Oil	Crude	Alkali washed	Crude	Alkali washed	FFA	Mois-ture	Oil	Crude	Alkali washed	Crude	Alkali washed
A	7	6·6- 10·6	20·5- 22·3	5·7- 10·6	6·8- 11·3	2·0- 3·5	0·11- 0·42	1·1- 1·5	1·1- 1·2		6·1- 11·9	0·59- 3·9	3·2- 3·6	0·11- 0·28	1·1- 1·4	—
B	2	7·9- 8·5	22·6- 24·5	7·9- 8·5	11·3- 12·0	2·0- 2·8	0·02- 0·15	0·95- 1·12	0·82- 0·92		—	—	—	—	—	—
C	10	7·9- 9·7	22·0- 24·7	7·8- 10·0	6·6- 12·9	2·2- 3·8	0·06- 0·12	0·72- 0·87	0·69- 0·83		9·5- 11·6	0·5- 1·1	2·3- 5·0	0·06- 0·08	0·97- 1·0	0·71- 0·87
D	5	9·9- 11·3	21·2- 23·5	10·6- 11·5	4·5- 8·3	2·4- 4·3	—	1·2- 1·7	—	0·05- 0·06	—	—	—	—	—	—
E	1	10·2	20·7	10·5	8·8	—	0·12	—	—	—	—	—	—	—	—	—
Overall range		6·6- 11·3	20·5- 24·5	5·7- 11·5	4·5- 4·3	2·0- 0·42	0·02- 1·7	0·72- 1·2	0·69- 0·06	0·05- 0·06	6·1- 11·9	0·5- 3·9	2·3- 5·0	0·06- 0·28-	0·97- 1·4	0·71- 0·87

Gossypol content values of crude 'extracted' oil samples were within the limits of 0.01 to 0.39 per cent, while those of alkali washed samples were from 0.003 to 0.005 per cent.

Study was also carried out to determine cyclopropenoid fatty acids in a few samples of cottonseed oil and keeping quality of groundnut oil, saffola oil, sesame oil, refined cottonseed oil, and Vanaspati. The data on keeping quality are given in Table 16.

TABLE 16 : DATA ON KEEPING QUALITY—PEROXIDE VALUES (MILLI-EQUIVALENTS OF PEROXIDE/100g OF SAMPLE)

(Sample kept in 100 ml beakers at 100°C)

Time in hours	Groundnut oil	Saffola refined oil	Sesame oil	Cottonseed refined oil	Vanaspati
0	7·8	6·0	2·5	5·0	0·92
1	10·4	9·5	—	8·2	—
2	12·0	11·9	—	—	—
4	12·6	14·9	8·7	20·0	—
6	17·2	22·8	—	—	—
8	21·4	26·9	14·5	—	—
12	24·6	31·4	18·7	—	—
17	27·6	43·3	22·7	49·6	6·3
24	38·7	50·0	—	56·3	10·7
30	—	64·6	30·7	81·8	12·6
36	—	78·0	—	—	—
41	—	—	—	88·5	—
47	—	—	—	—	—
52	—	—	—	—	21·9
70	—	—	—	—	35·0

Sesame oil, groundnut oil and Vanaspati appeared to have better keeping quality than cottonseed oil when tested at 100°C.

Cleaning of *Kapas* by the Newly Fabricated Laboratory Extractor

It was mentioned in the previous annual report that the machine was perfected for conducting trials on trashy Indian cottons. During the period under report, seven trashy *kapas* varieties obtained for the purpose were passed through the machine. The cleaning efficiency and the output of the machine were ascer-

tained. The uncleaned and cleaned *kapas* samples of each variety were ginned in a double roller gin and their ginning percentages were determined. Ginned lint samples from cleaned and uncleaned lots were also tested for fibre properties.

From the results obtained, the following observations were made :

1. Trash removed by the above machine ranged from 0.8 to 2.4 per cent.
2. The output of clean *kapas* from the machine was such that it can easily feed two single roller gins or one double roller gin.
3. There was no appreciable difference in the fibre length, strength and Micronaire values between the cleaned and uncleaned samples.

The work of carrying out Shirley Analyser tests on these samples is in progress.

It may be mentioned that several persons connected with the ginning industry have appreciated the design and working of the machine. Action has been initiated for exploring the possibility of commercial exploitation of this machine through the National Research Development Corporation Limited.

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

Chemically treated cotton : Cuene dissolution technique widely used in electron microscopical investigations to study chemically modified or crosslinked cottons has certain drawbacks. A technique is being evolved to replace it by a more specific "Cellulase dissolution technique". The results based on the electron microscope examination of cross-sections of normal cotton, cottons crosslinked with DMDHEU resin at different add-on and cottons acetylated to different degrees of substitution are encouraging. Further work is in progress.

Layer expansion technique was used to study over 50 samples of chemically treated cottons. Some of these had been treated with DMDHEU under varying conditions of crosslinking treatment, while a few others had been treated with specific reactive dyes as well as swelling agents. Some of these samples were supplied by Prof. E. H. Daruwalla and Prof. W. B. Achwal as part of collaborative work between CTRL and UDCT.

Enzyme-treated cellulosic substrates : Cellulase-treated cotton, wheat straw, saw dust, and bagasse, were examined by the Congo red dyeing technique in the light microscope to study the extent of damage. The damage was recorded by photomicrography. Further studies will be follwed up using electron microscopy techniques to study the effect of cellulase on these cellulosic substrates at the ultra-structural level.

Electron diffraction technique is being standardised to study the structure of cotton and other cellulosic substrates used for the enzyme production. In all 166 electron micrographs were taken during the year.

Better Resin-embedding Techniques for Microtomy of Textile Fibres, Yarns and Fabrics

Photomicrographs of longitudinal and cross-sectional views of various textile fibres, natural as well as man-made, have been taken using Projectina. These

textile fibres include various cottons, ramie, sisal, wool, rayon, nylon, orlon, and polyester. As regards microtomy, it was found that a thin coating of partially polymerised mixture of methyl methacrylate and butyl methacrylate given to the fibre bundle before packing in Hardy microtome gives good results in the case of man-made fibres. However, difficulty was experienced in getting cross-sections of cotton good enough for photomicrography using this technique. Conventional techniques using gelatin, collodion, and paraffin-wax are, therefore, being tried for the preparation of blocks and taking cross-sections, on Spencer Rotary Microtome.

Production and Characterisation of Cellulases

Enzymic Hydrolysis of Cotton and Crystalline Cellulose

Effect of cellulase enzyme produced by *Penicillium funiculosum* on crystalline celluloses, viz., cotton, hydrocellulose, 'Avicel-PH-101' and 'Avicel-Rc-581', was investigated. Differential response of the cellulose substrates to enzyme action could be attributed to their differences in gross or particle size, surface area, crystallinity, and crystallite dimensions. Hydrocellulose obtained from cotton was most resistant, and Avicel-Rc-581 was most susceptible. X-ray diffraction studies revealed that the crystallinity increased by 7-10 per cent due to enzymic hydrolysis with no appreciable change in the crystallite dimension indicating that the enzyme action was confined primarily in the para-crystalline region on the surface. The results are summarised in Table 17.

TABLE 17 : ENZYMIC HYDROLYSIS OF COTTON AND CRYSTALLINE CELLULOSE BY *P. funiculosum*

Cellulose substrate	C_1 Units/ml†	Crystallinity, %		Crystallite dimension ⊥ to (002) Planes, A°	
		Untreated	Treated	Untreated	Treated
Cotton	40	70	80	61	61
Hydrocellulose	22	78	85	66	68
Avicel-PH-101	60	63	70	53	52
Avicel-Rc-581	105	58	68	54	55

† One ml of the enzyme filtrate producing 100 μg reducing sugars in the assay system is one C_1 unit.

A paper based on the above findings entitled "Enzymic Hydrolysis of Cotton and Crystalline Cellulose", by S. M. Betrabet, V. G. Khandeparkar and N. B. Patil was published in *Cellulose Chem. Technol.*, 8, 339-344 (1974).

Purification and Characterization of Cellulase

The cellulase was subjected to fractionation on DEAE Sephadex at pH 3.5 employing a gradient of NaCl 0.1-0.2 M. Six protein peaks were eluted. All

the peaks were having C_1, Cx, and cellobiase activity and hence need further purification.

An assay method for determining cellobiase activity was standardized. It was found out that crude filtrate of *P. funiculosum* is rich in cellobiase.

Polyacrylamide electrophoresis technique was standardised to separate the components of cellulase.

The cellulase of *P. funiculosum* was stable at 50°C at pH 5.6 and retained about 65 per cent of its original activity up to a period of 24 hr. Further if the enzyme is incubated with its substrate, a complex is formed (cellulose-cellulase) which is stable at 50°C for 48 hr.

Concentration of Cellulase

The cellulase was precipitated by chilled (—20°C) solvents, viz., alcohol, acetone and isopropanol. It was noted that isopropanol at 1 : 5 ratio could precipitate the enzyme effectively. Dry enzyme precipitate was redissolved in water and lyophilized into white powder.

Growth Studies and Development of New Media

Penicillium funiculosum had wide adaptability towards growth conditions, viz., temperature 20° to 35°C, pH 2.5 to 7.0 and growth period 2 to 8 days. The new media devised were superior to *Trichoderma viride* medium (TVM) and have produced 2 to 2.5 times more enzyme.

Some work on utilization of oilseed meals, viz., castor, cottonseed, coconut, groundnut, soyabean, sunflower, etc., as complex nitrogen source in the growth medium of *P. funiculosum* is in progress.

PATENT : Application for a patent namely, "A Method for the Production of Highly Active Thermostable Cellulase Enzyme by a Fungus *Penicillium funiculosum* (Isolate F4) and Its Mutants" was filed in April, 1974.

Isolation and Study of the Thermophilic Amylolytic Micro-organisms to Produce Desizing Enzymes Stable at High Temperatures

A new isolation programme for amylolytic organisms was undertaken. Several new soil, compost, and manure samples were collected from various places and mesophilic and thermophilic cultures were isolated by enrichment culture techniques. In all 20 new cultures were isolated.

The morphological studies carried out by Gram's staining and spore staining methods indicated that most of the cultures belong to *Bacillaceae* family.

The pH of the soil, compost, or manure samples used for the isolation of the amylolytic cultures was determined and it was found that the pH varied from 5.0 to 8.0

Starch agar plates containing 0.05% starch in 0.2M phosphate-citrate buffer (pH 5-7) were prepared. About 1 cm diameter wells were bored and growth medium of the organism under test was added to it. It was incubated at temperatures from 30° to 55°C for 4 hr. When the plate was flooded with iodine solution clear zones around each well was observed; larger the zone better is the

enzyme activity. A single plate could be used to study about six isolates at different pH and temperatures simultaneously by this technique.

It was noted that some of the mesophilic cultures produce enzymes active at high temperatures. However, all the thermophilic cultures were poor in activity at a temperature below 40°C.

Some Optical and X-ray Studies on Cotton Fibres

Swollen and stretched samples were prepared. Fibres belonging to several cotton varieties covering a wide range of initial orientation were swollen in NaOH and stretched to : (*i*) original length, (*ii*) 5 per cent above the original length, and (*iii*) 7 per cent above the original length. Tests on these samples are being taken up.

A Study of the Bulk Resilience of Cotton

A beginning was made in the fabrication of the proposed instrument for which a plan had already been prepared last year. A cylindrical compression chamber for the fibres and a piston to compress the sample have been fabricated.

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

The equatorial and meridional x-ray diffraction profiles of the samples taken up for this study were resolved and studied. The observations are summarized below, where ϕ and $\propto$ denote the spiral angle and the crystallite orientation angle respectively and the subscripts indicate the pertinent reflections.

1. ϕ_{040} was generally greater than ϕ_{002} for *G. barbadense* and *G. hirsutum* cottons. This trend was often reversed for *G. herbaceum* and *G. arboreum* cottons.
2. The differences between ϕ_{040} and ϕ_{002} were generally significant for all cottons, while those between $\propto_{040}$ and $\propto_{002}$ were not. However, the differences between $\propto_{040}$ and $\propto_{002}$ were significant in the case of those samples from *G. herbaceum* and *G. arboreum* for which the values of ϕ_{040} were less than those of ϕ_{002}.

Wall thickness and convolution angle of the samples were determined. Measurements of circularity were completed. Analysis of the data are in progress.

Studies on Linear Density and Its Influence on Fibre Tenacity

Tests on linear density (vibroscopy method) breaking load and elongation at break were extended so as to cover a total number of 300 randomly chosen single fibres from each of the five selected cottons. These data served to confirm the various relationships between different parameters observed and reported earlier on the basis of tests on a limited number of fibres. In order to

explain the relationship between linear density and breaking load, it was felt necessary to obtain data on wet strength of fibres. Accordingly, a device to facilitate tests on single fibres of cotton in the wet state was fabricated and fitted on to the Instron Tensile Tester.

It was seen that the wet strength increased at all levels of fibre linear density. The increase was particularly marked for fibres having a higher linear density or wall thickness with the result that the plot of breaking load *versus* linear density did not level-off.

The data on wet fibre strength are also being analysed in the light of the changes that are known to take place in the structure of cotton fibres when the latter are immersed in water (i.e., limited swelling and hence loosening of the structure by disruption of H-bonds as well as formation of new H-bonds between lamellae chains).

Tests are also in progress for mapping out changes in fibre tenacity as a function of cell wall development/linear density. For this purpose, fibres from unopened bolls collected at various stages of growth are being used.

Study on the Quality of Samples from Entomological Trials

Effect of Insecticide Treatments on the Quality of Sujata Cotton

In continuation of the last annual report, the collected data on Sujata cotton for four seasons were analysed. A paper was written up based on this study in collaboration with the Entomologist, IARI Regional Station, Coimbatore, and was sent to the Indian Journal of Entomology, New Delhi, for publication.

Response of Suvin Cotton to Insecticide Treatments

After completing the study on Sujata cotton, it was proposed to study some more newly developed varieties with a view to compare the varietal response to different treatments. For this purpose, 14 samples of Suvin variety (1972-73 season) were collected from the project carried out at Coimbatore, under the title 'Relative Efficacy of Insecticides in the Control of Bollworms'. The samples were subjected to microspinning and fibre tests. On analysing the fibre test results, it was observed that there were significant variations in 2.5% span length and bundle strength at 1/8 in. gauge length, with a trend of increase in fibre length and reduction in bundle strength as compared with the standard treatment (Table 18). It will be seen that although the strength was reduced in general due to the treatments, better results were shown by the treatment T13 (Monocrotophos + Dichlorovos) which gave higher length with no loss of strength compared to the standard treatment T1. In the case of remaining fibre tests, viz. Micronaire fineness, maturity coefficient and bundle strength at zero gauge length, no definite trend was observed although the variations were significant.

The study will be continued after receiving more samples of Suvin and other varieties.

TABLE 18 : EFFECT OF DIFFERENT TREATMENTS ON FIBRE LENGTH AND BUNDLE STRENGTH OF SUVIN COTTON DURING 1972-73 SEASON

No.	Treatment	2·5% span length (in.)	Bundle strength (g/t) at 1/8 in. gauge
T1	[(Carbaryl + Methyl Parathion)] (Standard) ..	1·42	35·5
T2	Dicrotophos	1·44	35·2
T3	Chloropyrophos	1·41	32·2
T4	Tetrachchlorvinphos	1·42	34·7
T5	Methomyl	1·42	32·3
T6	Methyl Trithion	1·42	34·1
T7	MIPC	1·45	32.8
T8	Leptophos	1·41	36·5
T9	Methamidophos	1·42	33·4
T10	Fernitrothion + Malathion	1·50	33·1
T11	Cytrolane + Malathion	1·43	32·4
T12	Monocrotophos + Chlorophenamidine ..	1·49	33·0
T13	Monocrotophos + Dichlorovos	1·51	34·3
T14	Carbaryl + Molasses	1·48	32·3
	Critical difference	0·03	2·1

Studies in Physical Characteristics of Cotton Blends

Two varieties of cotton, viz., A.51-9 and C.Indore 1, differing widely in Micronaire value but having more or less similar values for other properties were selected for blending during the year under review.

The two varieties were blended in the proportion of 100 : 0, 75 : 25, 50 : 50, 25 : 75, and 0 : 100 and processed through Blow-room, Carding, Drawing, Slubber and Inter. In each case two common counts, viz., 20s and 24s were spun on the ring frame under identical conditions. Fibre properties of the blends and controls, Uster evenness of the material at different stages and the yarn properties were studied.

The work done so far on the blending has been written-up and sent for publication in the Indian Textile Journal.

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

Some of the cotton samples chosen for the study were tested, after conditioning in the standard 65% rh, at ambient humidities of 55%, 45%, 35% and

25% rh. Tests at the two lower humidity levels (35% and 25% rh) were conducted at Indore during February-March when the atmosphere at this place is comparatively dry. Tests on the remaining cottons and those at still lower humidities will be conducted during the same months of 1975.

Evaluation of Nep Potential of Indian Cottons by Nepotometer

In order to standardise the procedure for tests on the Nepotometer, it was decided, taking into consideration the preliminary observations, to process 20 grains (1.30 g) and 25 grains (1.62 g) of each sample at two different running times, viz., 4 min and 6 min, and to study which of these combinations correlates better with fibre properties and also with yarn evenness, neps in yarn and yarn appearance grade of yarns spun from cotton. Ten cottons from each of the three fineness groups according to Micronaire value, viz., 3.0 to 3.9, 4.0 to 4.9 and 5.0 and above, were tested for nep potential, Micronaire fineness and immature fibres. Yarns spun from these cottons were also tested for the above mentioned yarn properties.

Analysis of the results indicated that nep potential was significantly dependent on fineness (Micronaire value) and percentage of immature fibres in a cotton. It also showed significant relation with yarn appearance grade index and neps in yarn. It appeared to have no correlation with Uster value (U%). When the results were considered groupwise it was observed that, for fine group, 25 grains weight of the sample with 4 minutes running time gave better correlation with Micronaire value than the other combinations. Further analysis for all the groups together indicated that there was no systematic and definite trend to conclude that out of the four combinations tried, any particular combination was better than the others, so far as the relationship between nep potential and fibre and yarn properties was concerned.

Studies on Fibre Elongation Characteristics of the Different Varieties of Indian Cottons

During this period, 10 samples from each of the four botanical species were tested for bundle strength at zero gauge and 1/8 in. gauge lengths and percentage breaking elongation and the results of these tensile properties are given below :

TABLE 19 : AVERAGE STRENGTH AND ELONGATION PROPERTIES OF COTTONS ACCORDING TO SPECIES

Species	Bundle Strength, g/t		Percentage breaking elongation
	zero gauge	1/8 in. gauge	
G. arboreum	41·6	24·8	5·8
G. herbaceum	42·1	25·2	5·4
G. hirsutum	38·8	23·4	6·2
G. barbadense	41·3	31·6	8·2

It will be seen from Table 19 that bundle strength at zero and 1/8 in. gauge lengths for *hirsutum* cottons were lower than those for cottons of other species. *Barbadense* varieties recorded higher strength at 1/8 in. gauge length. *Herbaceum* cottons recorded the lowest elongation and *barbadense* cottons the highest elongation, while *hirsutum* and *arboreum* cottons had intermediate values.

Ten samples from *G. hirsutum* species were tested for bundle strength and percentage breaking elongation on the Instron Tensile Tester.

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

This work was undertaken to find out a direct measure for mean length (ML) of cotton fibres on Digital Fibrograph. Forty cottons covering a wide range in ML from 16.5 mm to 34.5 mm were selected. ML was determined by the Balls Sorter adopting the Standard CTRL method. Span length (SL) measurements at 5.5% were made on the Digital Fibrograph. It may be seen from Figure 2 that 5.5% SL was practically the same as ML by the Balls Sorter which was also nearer to Indian Classer's staple length. The value of the correlation between these parameters was highly significant. Hence, 5.5% SL could be taken as numerical equivalent of ML for routine determinations. A note based on these findings has been sent to the Journal of Textile Association for publication.

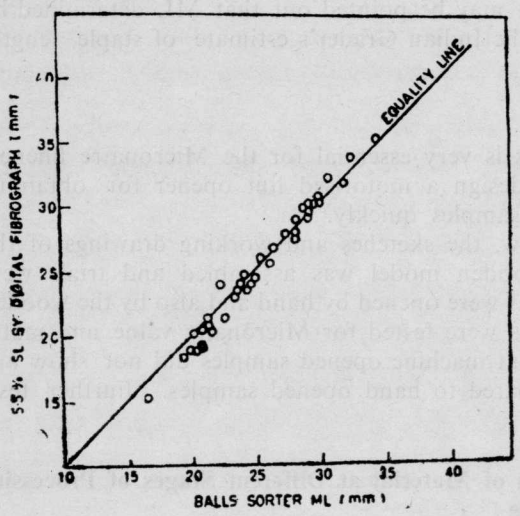


Fig. 2. Relationship between 5.5% span length and Balls Sorter mean length

Standardisation of the Fibre Pattern Preparation by the Baer Sorter

Nine cottons were taken up to standardise the fibre pattern preparation by the Baer Sorter adopting different technique like CTRL (C), CTRL modified (CM) and Shirley Institute (S). Parameters like ML, effective length, percentage short fibres and dispersion percentage were determined and the data are given in Table 20.

TABLE 20 : MEAN LENGTH AND PERCENTAGE SHORT FIBRES BY CTRL, CTRL MODIFIED AND SHIRLEY INSTITUTE TECHNIQUES

Cotton	Mean length (in)			Percentage short fibres		
	C	CM	S	C	CM	S
Punjab Desi	0·60	0·57	0·58	4·2	8·8	10·7
G.46	0·81	0·72	0·70	15·2	26·0	27·1
Digvijay	0·88	0·77	0·79	6·0	17·0	15·7
Deviraj	0·94	0·82	0·79	15·6	30·1	31·4
Buri 1007	1·04	0·89	0·86	15·4	29·7	32·7
Gujarat 67	1·04	0·83	0·85	18·6	38·9	36·5
170Co.2	1·06	0·93	0·91	14·3	26·6	28·6
Hybrid 4	1·02	9·94	0·91	17·8	28·5	31·5
MCU.5	1·14	0·91	0·93	14·4	36·7	30·8

The values of ML and percentage short fibre values obtained by 'CM' and 'S' techniques were found to be quite in agreement with each other. On the other hand, the values of ML determined by 'C' technique were found to be higher and of percentage short fibres lower than the corresponding values determined by the 'CM' and 'S' techniques. It may be pointed out that ML determined by using the 'C' technique is close to the Indian Grader's estimate of staple length.

Fabrication of Lint Opener

Proper opening of the samples is very essential for the Micronaire fineness test. Hence, it was proposed to design a motorised lint opener for obtaining desired level of opening of small samples quickly.

During the period under review, the sketches and working drawings of the lint opener were prepared. A wooden model was assembled and trials were taken on 12 samples. These samples were opened by hand and also by the wooden machine. Both the type of samples were tested for Micronaire value and maturity coefficient. It was observed that machine opened samples did not show any change in these properties as compared to hand opened samples. Further tests are in progress.

Study on the Evenness and Strength of Material at Different Stages of Processing with Different Systems of Processing

It was not possible to carry out much work in this project as rewiring and installation of new conditioning plant was going on in the Mechanical Processing Division. During the period, only two cottons, viz., Krishna and Hybrid 4, were spun to 40s and 50s counts, respectively, on four different ring frames, viz., 3-roller, A500, SKF and GX2. Samples of material at different stages of processing were tested for unevenness.

The yarns were tested for strength and irregularity. It has been proposed to complete the study on five cottons from each count range.

Standardization of Imperfection Indicator

With the introduction of new machinery in the Mechanical Processing Division it was found desirable to study variation in the imperfections in the yarns spun with three different systems in vogue now, viz., 3-roller, A500 and SKF. In the last report, the work carried out on yarns of 50s count spun on SKF and on yarns of 40s count spun on 3-roller systems was reported. During the period the work was extended for yarns of 40s count spun on SKF and A500 systems. The results are tabulated in Tables 21 and 22.

TABLE 21: IMPERFECTION INDICATOR TEST RESULTS FOR 25 SAMPLES OF 40s COUNT SPUN ON SKF SYSTEM
(Imperfection at —50, 3,3 positions, 125 metres of yarn)

Parameter	Range	Mean	CV%	SE%	CD%	CD for mean
U%	14·40-20·10	17·45	3·9	1·24	3·5	0·6
Thin places	2-128	33	43·5	13·8	38·9	13
Thick places	43-265	136	18.4	5.8	16.4	22
Neps	27-398	156	13·3	4·2	11·9	19

TABLE 22 : IMPERFECTION INDICATOR TEST RESULTS FOR 23 SAMPLES OF 40s COUNT SPUN ON A500 SYSTEM
(Imperfection at —50, at 3,3 positions, 125 metres of yarn)

Parameter	Range	Mean	CV%	SE%	CD%	CD for mean
U%	17·94-26·81	20·90	5·13	1·62	4·59	1·0
Thin places	39-466	154	36·11	11·42	32·30	50
Thick places	124-755	291	15·44	4·88	13·81	40
Neps	50-499	185	11·24	3·55	10·05	19

It was concluded that 10 bobbins in a sample will have to be tested which will give the accuracy for the above two systems as follows :

System	*Accuracy*			
	U%	Thin places%	Thick places%	Neps%
For 40s SKF	2·5	27·5	11·6	8·4
For 40s A500	3·2	22·8	9·8	7·1

Effect of Different Systems of Processing on the Spinning Performance of Superior Quality Cottons

It was already reported that tests on Giza 45, Sujata, Sudan XG2VS and Hybrid 4 had been completed. During the period under report Varalaxmi was taken up for processing. Control (carded) was spun to counts of 50s, 60s and 70s. Laps were prepared on the Sliver Lap machine. 8% comber noil was extracted and the comber sliver is being utilised for further processing.

Studies on Blends of Indian Cottons with Polyester Staple Fibre

During the initial part of the year, blending tests were undertaken with combed Varalaxmi, using three proportions of 75 : 25, 50 : 50 and 33 : 67, respectively, of cotton and indigenous polyester fibres. The samples were spun to 50s count. It was noticed that while the strength and evenness of the blended yarns were quite satisfactory, the neppiness was slightly high due to the greater immaturity of the cotton used.

Further work on the project had to be suspended due to rewiring and installation of new airconditioning equipment in the Mechanical Processing Division.

A Study of the Performance of the Modern Blow Room Line

Due to dislocation of work in the Mechanical Processing Division, on account of rewiring and installation of new airconditioning equipment, progress of work in this project was restricted. Trials were completed on Hybrid 4 using one of the four possible processing combinations on the modern blow room and on cotton Krishna processed on the old blow room.

Evaluation of Techniques Used for Measurement of Neps at Different Stages of Processing

All the 26 cottons selected for the study last year were evaluated for neppiness by the Readex method as well as for nepping potential by the Nepotometer. Evaluation of nep contents of the processed materials in the form of card and drawframe slivers and rovings was also completed. The yarns were evaluated by the Uster Evenness Tester as well as for appearance by comparison with ASTM Boards. The results showed that there was a slight tendency for neps to increase in the blow room process, while carding and subsequently drawing resulted in a substantial reduction in the nep content of the processed material. Further, an increase in nep content was noticed in the roving compared to the draw frame sliver in some cases. Individual differences in these trends observed for certain cottons are being analysed in detail.

Study of Yarn Strength for Different Counts in Relation to Chief Fibre Properties

In this investigation, an attempt was made to find out the length, fineness or strength required for getting a desired strength in a yarn of a specified count. For this purpose, the fibre and yarn test results of a number of samples tested at

the Cotton Technological Research Laboratory during the 1969-70, 1970-71 and 1971-72 seasons were made use of. The results pertained to 545 samples of 20s yarns, 1118 samples of 30s yarns, 864 samples of 40s yarns and 495 samples of 50s yarns. The lea CSP values of the yarns of each count were grouped into class intervals of 50 so that minor variations in CSP could be eliminated and the average values of the chief fibre properties, viz., mean length (1), Micronaire value (f) and fibre bundle strength at nominal zero gauge (s), were obtained for each of the CSP groups. These data represent the average values of the chief fibre properties which would enable the production of yarn of the specified counts with various strength values. On the basis of these data, the present study was undertaken. Detailed analysis showed that the mean length plays a major role in the contribution to yarn strength while fibre strength is next in importance for the strength in yarns of 40s and 50s and fineness in the case of 20s and 30s counts.

The following equations were derived for obtaining the values of CSP corresponding to the values of the mean length, fineness and strength. These would enable a choice of appropriate increase in length, fineness or strength in the cottons used to produce yarns of a desired strength for the range of values indicated.

									Range of values			
20s	C	=	163·7	l	—	1883·3	l	=	21·0	to	23·7	mm
	C	=	—523·5	f	+	4205·8	f	=	4·2	to	4·8	
30s	C	=	145·8	l	—	1802·0	l	=	21·8	to	27·2	mm
	C	=	—517·8	f	+	3897·2	f	=	3·7	to	5·1	
40s	C	=	163·0	l	—	2480·1	l	=	24·2	to	28·5	mm
	C	=	165·5	s	—	5566·0	s	=	43·2	to	46·0	g/t
30s	C	=	174·2	l	—	3071·0	l	=	25·8	to	28·4	mm
	C	=	66·1	s	—	1295·3	s	=	41·8	to	47·8	g/t

It may be noted that the above equations are valid only within the ranges of the values of the fibre properties shown. It is observed that the above equations show a remarkable consistency in the length—CSP relationship. An increase of 1.0 mm in the mean length causes an increase of about 140 in the CSP value for all the counts.

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

The project was activated with the appointment of one Senior Research Assistant to start some trials on processing of the blends. However, due to the delay in the appointment of a Spinning Technologist sanctioned for the project, not much progress could be made; this post is yet to be filled up.

Samples of jute and ramie were received from JTRL, Calcutta, and of different wools from CSWRI, Malpura. Experimental trials were carried out by micro-spinning technique for processing of ramie on the cotton card to produce sliver for blending with cotton at the draw frame. It was found that pure ramie could not be processed since the web from the doffer did not have enough fibre cohesion to be collected through the trumpet into the calendar rollers. Chemical treatments of the ramie fibre with certain chemicals have given encouraging results in successful processing at the card.

Some blending experiments on blending of ramie with polyester fibre were carried out at CTRL for scientists of JTRL when they visited our Laboratory and the yarns have been collected by them for further testing at JTRL. Results are awaited.

Studies on Deburring of Raw Wool Using Mechanical Device

During the period under report, various modifications and adjustments were made in the parts of the Laboratory Gin for using the gin as a deburring device. Various trials were carried out on old stock of raw wool samples. From the trials it was observed that hard vegetable impurities were removed from the raw wool without difficulty, while the smaller size softer vegetable impurities were crushed in the device and were partly added to the cleaned wool. No damage to the wool-hair was observed during the process.

In order to conduct experiments on large-scale, action is being taken to set up a commercial single roller gin. Further work is in progress.

Survey of the Condition of Ginning Factories in India

The questionnaire duly filled in by the factories from Maharashtra State were scrutinised, and 33 samples of *kapas*, lint and seed were collected from the factories through the survey investigators. *Kapas* samples were ginned in Laboratory Gin and the laboratory ginned and factory ginned lint samples were tested for fibre properties, while seed samples were tested for percentage of cut seeds present. The samples were tested for spinning performance at BTRA.

The data collected through the questionnaire and by tests on samples mentioned above, were analysed and a report was written up. Similar reports had been prepared for Gujarat State by ATIRA and Tamil Nadu by SITRA. A consolidated report was prepared and presented at the Golden Jubilee Seminar of the CTRL in December 1974.

Further work is in progress.

ICAR Project on Chitosan

An inter-institutional three-year collaborative project entitled, "Studies on the production and utilization of chitosan and allied products from prawn shell waste" has been sanctioned by the ICAR. The institutions involved are : (*i*) Central Institute of Fisheries Technology (CIFT), Cochin, (*ii*) CTRL, Bombay, and (*iii*) Bombay Textile Research Association (BTRA), Bombay.

Preliminary studies regarding application of chitosan in dyeing and printing of reactive dyes carried out in collaboration with Prof. E. H. Daruwalla, Research Adviser, BTRA, has been very encouraging. Improvement in colour value and better fixation of the dye was observed in chitosan-treated fabrics. Further, when used for printing, chitosan-printed portions of the fabric took up more dye giving two-tone effect and in the thinner fabrics the printed portions showed transparency along with increased colour uptake. Further work on the Project is being taken up.

RESEARCH WORK DONE AT REGIONAL STATIONS

COIMBATORE

In order to evaluate the technological performance of Madras-Cambodia-Uganda cottons grown under different agro-climatic conditions, the samples were collected from seven locations in Tamil Nadu and tested for fibre length. The mean length values ranged from 25.7 mm to 31.0 mm.

INDORE

The effect of Cycocel (CCC) spray on the quality of Khandwa 2 variety grown during 1972-73 season at Khandwa was studied. The treatment combinations, 80 ppm of CCC with the full dose given at 40-50 days and 20 ppm of CCC with half the dose applied at 40-50 days and the other half at 80-100 days proved beneficial towards the significant improvement in fibre length. Other quality characters were unaffected.

NANDED

Cotton seeds of L.147 were soaked in different concentrations of Succinic acid and grown at Nanded during 1970-73 seasons. Seed-soaking treatments did not have significant effect on the fibre properties.

SURAT

Data pertaining to the research project "The Genetical Selection for Fibre Strength" collected during three seasons (1971-73) were statistically analysed and following important conclusions were drawn :

1. *Herbaceum* cottons recorded higher PSI than *hirsutum* cottons.
2. Both *herbaceum* and *hirsutum* cottons showed wide seed to seed and plant to plant variations in PSI.

III. Publications

During the period, two Technological Reports, eight Research Publications and one Annual Report were published, and 24 Technological Circulars were issued. Further, 16 articles were published in various journals, conference proceedings, etc., and six articles were sent for publication.

A. Technological Reports

No. 15. Technological Report on Trade Varieties of Indian Cottons, 1972-73 Season

No. 16. Technological Report on Standard Indian Cottons, 1972-73 Season.

B. Research Publications (CTRL Publication—New Series)

No. 43. A note on the comparative merits of roller ginning and saw ginning—by D. G. Shete and V. Sundaram (reprinted from *Cotton Development Journal*, January, 1974 issue).

No. 44. Structural peculiarities of *G. herbaceum* cotton—by (Smt.) K. L. Datar, S. M. Betrabet and V. Sundaram (reprinted from *Textile Research Journal*, December, 1973 issue).

No. 45. Is there a varietal response of cotton to mercerization and cross-linking treatments?—by S. M. Betrabet, M. S. Sitaram and V. Sundaram (presented at the symposium on Finishing Textiles held by the Textile Association (India), Bombay, November, 1973).

No. 46. Definitions of some technical terms used in cotton development, trade and technology—by V. Sundaram (reprinted from *Cotton Development Journal*, April, 1974 issue).

No. 47. Proportion of fibre strength utilised in the single yarn—by R. L. N. Iyenger and A. K. Gupta (reprinted from *Textile Research Journal*, July, 1974 issue).

No. 48. Some functions involving fibre properties for estimating yarn tenacity—by R. L. N. Iyengar and A. K. Gupta (reprinted from *Textile Research Journal*, July, 1974 issue).

No. 49. Analysis of seeds of commercially grown Indian cottons—by S. N. Pandey, N. Thejappa and V. Sundaram (reprinted from All India Cotton Seed Crusher's Association Newsletter, April, 1974 issue).

No. 50. Determination of cotton fibre maturity with the Micronaire instrument using two different techniques—by K. N. Seshan, Harirao Navkal and V. Sundaram (reprinted from *Textile Research Journal*, November, 1974 issue).

C. Articles and Papers

(*a*) *Published*

1. Interferometric Fibre Stapler : Further studies—by K. R. K. Iyer and G. F. S. Hussein (published in *Journal of the Textile Association*, September, 1974 issue).
2. Enzymic hydrolysis of cotton and crystalline cellulose—by S. M. Betrabet, V. G. Khandeparkar and N. B. Patil (published in *Cellulose Chemistry and Technology*, Vol. 8, No. 4, 1974 issue).
3. Instrumental grading of raw cotton—by V. G. Munshi (published in *ISI Bulletin*, Vol. 26, No. 7, 1974 issue).
4. Evaluation of the Micronaire value of small cotton samples by the Toshniwal Fibre Fineness Tester—by A. K. Antony, D. R. Bhandari and R. P. Bhardwaj (published in *Journal of the Textile Association*, June, 1974 issue—short communication).
5. Technological evaluation of improved varieties of cotton in Mysore State—by M. S. Sitaram, P. G. Oka, V. G. Munshi and V. Sundaram (published in the *Mysore Journal of Agricultural Sciences*, Vol. III, March, 1974 issue).
6. Comparative performance of different single yarn testing instruments—by V. G. Munshi (published in *Journal of Textile Association*, Vol. 35, No. 2, 1974 issue).
7. A special publication entitled "50 Years of Research", brought out on the occasion of Golden Jubilee Celebration of the Laboratory in December, 1974.
8. Cotton Technological Research Laboratory—Fifty years of fruitful service to the nation (1924-1974)—by V. Sundaram (published in the Technological Laboratory Club Souvenir, December, 1974).
9. Technological performance of new varieties of cotton—by V. Sundaram and P. G. Oka (published in the Technological Laboratory Club Souvenir, December, 1974).
10. Blending Indian cottons with polyester fibres—by M. S. Parthasarathy and B. Srinath (published in Technological Laboratory Club Souvenir, December, 1974).
11. Indian cottons for easy-care fabrics—by S. M. Betrabet (published in Technological Laboratory Club Souvenir, December, 1974).
12. Some reminiscences—by R. L. N. Iyengar (published in Technological Laboratory Club Souvenir, December, 1974).

13. Studies on Chemically Modified Cotton. Part V. Effect of zinc chloride treatment on physico-chemical properties—by S. N. Pandey and (Smt.) Prema Nair (proceedings—15th Joint Technological Conference—ATIRA, BTRA and SITRA, 1974).

14. Studies on linear density, wall thickness and breaking strength of cotton fibres—by G. S. Patel and N. B. Patil (proceedings—15th Joint Technological Conference—ATIRA, BTRA and SITRA, 1974).

15. Influence of some of the physical and fine structural characteristics on the strength uniformity of native cottons—by A. Rajagopalan, N. B. Patil and V. Sundaram (proceedings—15th Joint Technological Conference—ATIRA, BTRA and SITRA, 1974).

16. Spinning performance of some Indian cottons in polyester-cotton blends—by B. Srinath, M. S. Parthasarathy, S. M. Betrabet, N. B. Patil and V. Sundaram (proceedings—15th Joint Technological Conference—ATIRA, BTRA and SITRA, 1974).

(*b*) *Sent for Publication*

1. Place and environment effect on seed weight and oil content of cotton seed—by S. N. Pandey and N. Thejappa (Mysore Journal of Agricultural Sciences).

2. Studies on glandless cotton seed—by S. N. Pandey and N. Thejappa (Indian Journal of Agricultural Science, New Delhi).

3. Studies on some physical parameters of cotton fibre and their influence on breaking strength—by G. S. Patel and N. B. Patil (Textile Research Journal, U.S.A.).

4. The effect of insecticide treatments on the quality of Sujata cotton—by V. G. Munshi and (Smt.) S. B. Pai (Indian Journal of Entomology, New Delhi).

5. Direct estimation of mean length of cotton fibres by Digital Fibrograph—by (Kum.) I. K. P. Iyer and V. G. Munshi (Journal of the Textile Association).

6. Study on relationship between oil, protein and gossypol in cotton seed kernels—by S. N. Pandey and N. Thejappa (Journal of American Oil Chemist Society, U.S.A.).

D. Annual Report

1. Annual Report of the Cotton Technological Research Laboratory for the calendar year 1973.

E. Technological Circulars

1. Nos. 108 to 113 on Standard Indian Cottons.
2. Nos. 1777 to 1794 on Trade Varieties of Indian Cottons.

STANDARD INDIAN COTTONS

1972-73 Season

S.C. No.	*Variety*	*S.C. No.*	*Variety*
108	Hampi	111	AK.277
109	AK.235	112	LSS
110	Jayadhar	113	320F

TRADE VARIETIES OF INDIAN COTTONS

1972-73 Season

T.C. No.	*Variety*	*T.C. No.*	*Variety*
1777	Sanjay	1786	Desi (Punjab)
1778	Narmada	1787	Rajasthan (Desi)
1779	Khandwa 2	1788	LSS
1780	MCU.4	1789	Hybrid 4 (Sathamba)
1781	Y.1	1790	Hybrid 4 (Karjan)
1782	Gujarat 67 (Idar)	1791	Hybrid 4 (Navsari)
1783	Krishna	1792	Badnawar 1 (Ujjain)
1784	J.34	1793	Khandwa 2 (Khargone)
1785	Sanjay (Botad)	1794	Maljari (Khargone)

VI. Extension

This Laboratory has no farm attached to it and no field work is carried out directly under its own charge. All the field work is carried out at various agricultural stations in the States and the samples of the improved cotton strains evolved under different research projects are tested for quality characteristics either at the main Laboratory or at its Regional Stations. This Laboratory does not directly deal with the farmers but indirectly helps them through the State Departments of Agriculture. Further, the Technological Circulars issued on Trade Varieties of Cotton are useful to the growers, the trade and the industry as these circulars indicate the quality of the commercially grown crop.

The Laboratory also renders considerable assistance to those engaged in cotton trade, to other government and civic organisations, etc., by undertaking tests on samples received from these organisations, by imparting training in cotton technology and by supply of useful testing instruments.

Testing Work

Apart from the research samples received from various agricultural stations, this Laboratory continued to receive a number of samples of fibre, yarn and cloth for special tests from commercial firms as well as from government and semi-government organisations. Such samples were tested on payment of the prescribed fees. The number of such samples received for various tests during the year 1974, together with the corresponding figures for 1972, 1973 and for the quinquennium 1966-70 are given in Table 23.

TABLE 23 : NUMBER OF SAMPLES RECEIVED FOR PAID TESTS

Type of test	Average for the quinquennium	1972	1973	1974
	1966-70			
Spinning	14	5	10	2
Fibre (EICA)†	68	21	123	66
Fibre (others)	81	327	244	92
Yarn	109	22	43	37
Cloth	81	43	46	26
Moisture	75	84	11	76
Miscellaneous	21	11	12	1
Total	**449**	**513**	**489**	**300**

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

The total test fees realised during 1974 for carrying out tests on these samples amounted to Rs. 7,964 against Rs. 16,261 during 1973.

Apart from the usual tests of routine nature, the following special investigations were carried out :

1. Four samples, viz., cotton lint, 36s comber waste, 36s flat strips and 80s roller strips were received for ascertaining the ash content. The results indicated that the ash content was maximum in the flat strips (2.23%) and minimum in comber waste (1.61%).
2. The denier, staple length and tenacity of a sample of viscose fibre were determined using oil-template method.
3. One sample of polyester (Jailene, 0.9 denier) was received for cross-sectional and longitudinal micro-photograph. The micro-photographs at magnifications of 1000× and 1500× were supplied.
4. Three samples, viz., umbrella cloth weft sateen, umbrella cloth square fabric and long cloth, which were Schreiner calendered, were received for comparing the effect of finish. By taking photomicrographs, it was found that Schreiner embossed lines were visible in the first and third sample, while they were not visible in the second sample.
5. Ten polyester samples received from Sir Padampat Research Centre, Kota, were also tested for crystallinity and crystallite orientation using x-ray diffraction methods.

Training Facilities

The Laboratory is conducting two training courses, each of two months' duration, for persons employed in Cotton Trade or Co-operative Marketing Societies. One course is for those in Bombay city and the other for those coming from mofussil centres. However, at the request of the Madhya Pradesh State Textile Corporation, two training courses were conducted for training 12 persons deputed by them, instead of the usual training course for mofussil persons. During the year, the following students were selected and given training in fibre tests and elements of statistics :

1. Shri Mahesh Mishra	Candidates deputed by the Madhya Pradesh State Textile Corporation Limited, Bhopal
2. Shri Krishnanand Banavalikar	
3. Shri Vijaykumar Jain	
4. Shri Ramesh Chandra Tiwari	
5. Shri Prakashchandra M. Bagora	
6. Shri Shahuddin Hasmi	
7. Shri Sushilkumar Gupta	
8. Shri S. N. Saxena	
9. Shri Virendra Kumar Kimtee	
10. Shri Syed Sarwar Hussain	
11. Shri O. P. Negi	
12. Shri Girish Mishra	

13. Shri Madhukar Anandrao Amboday
    C/o India United Mills Limited No. 5
    Bombay
14. Miss Loisa D'Cunha
    C/o Raj Prakash Spinning Mills Limited
    Bombay 400 002
15. Shri Dhrupad Kisonlal Marfatia
    C/o Kisonlal Marfatia & Company
    Bombay 400 001

Technical Guidance to Ginning Factories

Technical guidance in settings and adjustments of Double Roller Gins for proper ginning of 'Varalaxmi' cotton was given to technical staff working in Messrs. Patel Volkarts factory at Raichur. Technical guidance for proper ginning of 'Sujata' and 'Suvin' cottons was given to the Technical Staff employed in Laxmi Mills Ginning Factory, Coimbatore.

This has helped to improve the grade and quality of these cottons in the above factories.

Supply of Equipments

The following items were supplied during the year 1974 :

1.	Laboratory Model Gins with Electric Motors	19
2.	Laboratory Model Hand Gins	44
3.	Ginning Percentage Balances	12

V. Conferences and Sympoisa

The Director and/or other Scientists of the Laboratory participated in the following scientific and technological conferences and meetings connected with the work of this Laboratory :

	Meeting	*Place*	*Date and Month*
1.	Fifteenth Joint Technological Conference at BTRA	Bombay	8th to 10th January
2.	Meeting at BTRA to discuss Joint Project on Ginning	Bombay	10th January
3.	Scientific Panel for Agricultural Sciences Technology	New Delhi	17th January
4.	Seminar on Cotton Improvement during the Fifth Plan and Field Day of the IARI Regional Research Station	Coimbatore	25th January
5.	Inter-institutional Collaboration on Jute, Ramie and Wool, etc.—discussion at JTRL	Calcutta	25th February
6.	State Joint Directors of Agriculture (Cotton)/Deputy Director of Agriculture (Cotton)/Cotton Development Officers and Cotton Specialists	Bombay	14th March
7.	Eleventh Meeting of the Indian Cotton Development Council	Bombay	16th March
8.	Fortyfifth Meeting of TDC 1 in joint session with TDC 1 : 8	Bombay	10th April
9.	Meeting of the Vice-Chancellors and others for Boosting Cotton Yields in Maharashtra State	Poona	19th April
10.	Meetings of ICAR Directors, including Project Co-ordinators and Vice-Chancellors	New Delhi	26th April to 2nd May
11.	Grading of Raw Cotton	Bombay	26th August

	Meeting	*Place*	*Date and Month*
12.	Meeting of the Committee to Review the Research and Development Efforts to Meet the Needs of the Textile Industry	Bombay	29th October
13.	Thirtyfirst All India Textile Conference	Sholapur	5th and 6th November
14.	Seminar on Sophisticated Machinery	Bombay	12th November
15.	Twentyfirst Meeting of the Textile Division Council, TDC	Madras	28th November
16.	Twentyfourth Meeting of TDC 1:1	Bombay	4th December
17.	Fortysixth Meeting of TDC 1 held in Joint Session with the 3rd Meeting of TDC 1:8	Bombay	5th December
18.	Seminar on Cotton Production and Technology	Bombay	30th and 31st December

Dr. S. M. Betrabet was invited to give a talk on "Cellulolysis of cotton fibre in Indian environment and cellulase enzyme" to the members of the Association of Microbiologists of India, Bombay, in November, 1974. The lecture highlighted CTRL's contribution during last one decade in this field.

VI. Summary of the Report

The Cotton Technological Research Laboratory celebrated the Golden Jubilee befittingly in the last week of 1974, and this is the 51st Annual Report of the Laboratory covering the calendar year.

The research activities and the testing work progressed satisfactorily as in the past. During the year under review, the Laboratory continued to collaborate actively in the research for development of new strains of cotton by evaluating the quality characteristics of the improved cotton strains evolved at various cotton research centres and was the co-ordinating centre on Cotton Technology under the All India Co-ordinated Cotton Improvement Project. The scheme for modernisation and expansion of the Laboratory made some further headway, but the Mechanical Processing Division had to be shut down from June till the end of the year, due to the inordinate delay in the wiring and installation of the new controlled humidity and atmosphere plant, by the Central Public Works Department. The construction of the second floor of the New Research Laboratory building has been almost completed. Several new items of equipment and books were purchased by the Laboratory during the year.

During the financial year 1973-74, the actual expenditure was Rs. 16.50 lakhs as against the initial sanctioned grant of Rs. 13.92 lakhs; this excess was mainly due to revision of pay scales. An expenditure of Rs. 9.46 lakhs was incurred under the Fourth Plan Scheme for modernisation and strengthening of the CTRL for intensive research on cotton against the sanctioned grant of Rs. 10.09 lakhs, leaving an amount of Rs. 0.63 lakh unutilized. Apart from this, an expenditure of Rs. 3.91 lakhs was incurred on the AICCIP against the sanctioned grant of Rs. 1.77 lakhs; this was due to payment towards cost of an equipment provided for in the previous year's budget. Further Rs. 0.17 lakh and Rs. 0.02 lakh were incurred on an ICAR Scheme financed from the Agricultural Produces Cess Fund and an inter-Institute Project against the sanctioned grants of Rs. 1.00 lakh and Rs. 0.08 lakh, respectively. The savings were due to the non-materialisation of purchases of certain equipments and non-filling up of various posts.

Research Activities

During the year, considerable progress was made in the various research investigations undertaken at this Laboratory and a number of research papers were published. However, there was dislocation in work in May due to the railway strike, and from June to the end of the year, due to re-wiring and installation of the new Conditioning Plant in the Mechanical Processing Division. This also affected the working of the quality evaluation of samples from May onwards. A large number of samples, therefore, remained without being tested at the end

of the year. The progress made in the important research investigations during 1974 is indicated briefly below :

Test reports were issued on 1,126 samples, pertaining to various trials conducted at different Research Stations. While fibre tests were completed on 590 more samples, test reports on these had not been issued as spinning tests on these samples had not been completed. The following five new varieties were officially released for general cultivation in the tracts indicated :

IAN.579-188 (Vishnu)	—Irrigated areas in Gujarat
CC.1-1-3 (Jyoti)	—Khandesh tract of Maharashtra
MCU.8	—Irrigated Summer Cambodia tract of Tamil Nadu
SRT.1	—Rainfed *herbaceum* area of Middle and South Gujarat
Suvin	—Irrigated areas of Coimbatore in Tamil Nadu

In the study of varietal response to chemical finishing, it was observed that the varieties Sanjay and 66BH.5/91 were outstanding with respect to retention of strength and elongation after resin treatment both in fibre as well as in yarn state. Other strains found promising were : Digvijay, MCU.1, Hampi, Krishna, and Varalaxmi.

The crosslink development in chemically modified crosslinked cottons was evaluated by gel-fraction in cupriethylenediamine. It was observed that the samples pre-treated with NaOH and $ZnCl_2$ had a higher distribution of crosslinks, measured as mole of formaldehyde per anhydroglucose unit, possibly due to increased accessible sites in cotton cellulose caused by these two treatments.

The effect of anhydrous liquid ammonia treatment on cotton was also studied. The results indicted that ammonia could be utilized in textile finishing for improving certain desirable properties. The treatment causes inter- and intra-crystalline swelling in cotton fibre and brings about marked changes in fibre tenacity and mechanical properties.

When acetylated and benzoylated cotton celluloses with varying degrees of substitution were oxidised with potassium dichromate and oxalic acid it was observed that benzoylated sample showed greater effect of oxidation. However, when these samples were hydrolysed with hydrochloric acid, acetylated samples showed more degradation.

To evaluate the protein composition of Indian cotton seeds, hydrolysates of solvent extracted cotton seed meal of six samples were prepared and analysed using the Automatic Amino Acid Analyser at BARC. Differences were observed in the proportion of some of the amino acids from different varieties.

In a project sponsored by the All India Cotton Seed Crushers' Association, detailed analyses were carried out on samples of cotton seed, oil cake and cotton seed oil at different stages of processing received from various oil mills in the country. In addition, the keeping quality of cotton seed oil was studied in com-

parison with other edible oils like groundnut, sesame and safflower oils as well as with *vanaspati*.

The extractor fabricated in the Laboratory was tested for its efficiency with seven trashy *kapas* varieties. The trash removed ranged from 0.8 to 2.4 per cent. The output of clean *kapas* through the extractor was sufficient to feed a double roller gin. The fibre qualities were not affected.

Electron diffraction technique was being standardised to study the structure of cotton and other cellulosic substrates used for enzyme production with a view to elucidate the mechanism of enzymic hydrolysis of cellulose.

Crystallinity of cellulase enzyme-treated cellulose determined by X-ray diffraction revealed that the crystallinity increased by 7.1% with no appreciable change in the crystallite dimension on enzymic hydrolysis of crystalline celluloses, viz., cotton hydrocellulose, and two samples of commercial microcrystalline cellulose.

To get photomicrographs of longitudinal and cross-sectional view of various textile fibres, better resin-embedding techniques were studied. Partially polymerised mixture of methyl methacrylate and butyl methacrylate gave good results for man-made fibres.

Based on earlier studies, application was filed for a patent on "A method for the production of highly active thermostable cellulase enzyme by a fungus *Penicillium funiculosum* (isolate F4)". The enzyme will have several practical applications.

The work of isolation and identification of thermophilic bacteria producing desizing amylase was continued. In all 20 new cultures were isolated. It was noted that some of the mesophilic cultures produce enzymes active at high temperatures. All the cultures, however, were poor in activity at temperatures below 40°C.

Optical and X-ray studies on swollen and stretched cotton fibre samples covering a wide range of initial orientation is in progress.

In the study of crystallite orientation in cotton fibres, the 002 and 040 profiles were resolved. Significant differences in the spiral angle values of the two profiles were noted. Species-wise differences in the orientation angle and spiral angle of the two profiles were also observed.

Linear density and strength determinations were continued on the Instron Tensile Tester for individual fibres. It was seen that the wet strength increased at all levels of fibre linear density. The increase was particularly marked for fibres having a higher linear density or wall thickness. Tests are also in progress for mapping out changes in fibre tenacity as a function of cell wall development/ linear density.

Fibre tests and microspinning tests were carried out on 14 samples of Suvin from some insecticidal trials with a view to find whether there was any deleterious effect of the insecticides on the cotton fibre quality. Compared to the standard treatment of (Carbaryl + Methyl Parathion), treatment with (Monocrotophos + Dichlorovos) was found to be advantageous, resulting in higher fibre length without loss of fibre strength.

In order to study the evenness and strength of material at different stages of processing, two more cottons, viz., Krishna and Hybrid 4, were spun on four different ring frames and the samples of material at different stages of processing were tested for their properties. It is proposed to complete the study on five cottons from each count range.

Continuing the study on standardization of testing with Imperfection Indicator, yarns of 40s counts spun on SKF and A500 systems were tested for yarn evenness and imperfections. It was concluded that 10 bobbins in a sample will have to be tested to get results with a satisfactory degree of accuracy.

Tests at the humidity levels of 35% and 25% were completed under the studies on bundle strength of cotton in the non-conditioned atmospheres. Further work is in progress.

The analysis of the results of the evaluation of nep potential of Indian cottons by Nepotometer indicated that nep potential is significantly dependent on fineness (Micronaire value) and percentage of immature fibres in a cotton.

In the study on fibre elongation characteristics of different varieties of Indian cottons, 10 samples from each of the four botanical species were tested for bundle strength at zero and 1/8 in. gauge lengths. It was noted that *barbadense* varieties had the highest elongation while *herbaceum* had the lowest elongation.

In order to find out a direct measure for mean length (ML) of cotton fibres on Digital Fibrograph, 40 cottons were tested by Balls Sorter and Digital Fibrograph. Analysis of the results indicated that ML by Balls Sorter and 5.5% span length of Digital Fibrograph were numerically equal.

For the proper opening of samples for Micronaire fineness tests, a motorised lint opener (wooden model) was designed and fabricated. Trials on the machine-opened and hand-opened samples are in progress.

Varalaxmi cotton, after combing, was blended with polyester fibres, using different blend compositions. Tests carried out on yarns spun to 50s count from these blends showed that while the strength and regularity of yarns were satisfactory, the yarns were highly neppy due to the fibre immaturity of the Varalaxmi cotton.

Two cottons, Hybrid 4 and Krishna, were taken up for trial to study the performance of the Modern Blow Room Line. Tests on Hybrid 4 using one of the four possible processing combinations on the modern blow room were completed. These tests are being conducted for ensuring cleaning efficiency as well as production of good quality yarns.

The study to evaluate the neppiness of cottons at different stages of processing and by different instruments was continued with 26 cottons. The results are being analysed.

In the study of yarn strength for different counts in relation to chief fibre properties, detailed analysis showed that the mean length plays a major role in the contribution of yarn strength while fibre strength is next in importance for the strength in yarns of 40s and 50s counts and fineness in the case of 20s and 30s counts.

The Project on "Studies on spinning from blends of cotton with wool, jute and ramie on cotton system" was activated in collaboration with JTRL and

CSWRI. Experimental trials by microspinning technique were carried out both for processing ramie and for blending ramie with polyester fibre.

Studies on deburring of raw wool using mechanical device were taken up. Suitable modifications were made in a Laboratory model gin and preliminary tests were conducted on several samples.

The data collected on ginning factories in Maharashtra in collaboration with BTRA were analysed. The data obtained on similar surveys conducted by ATIRA in Gujarat State and by SITRA in Tamil Nadu as well as the data collected by CTRL and BTRA in Maharashtra were incorporated in a joint report.

Preliminary studies regarding application of Chitosan in dyeing and printing of cotton fabrics with reactive dyes showed that there was better fixation of dye in Chitosan treated fabrics.

VII. Personnel

A large number of posts have been filled up during the period under report. A few Class I posts remained vacant on account of the existence of a ban on the filling up of scientific and technical posts. However with the setting up by the Government of India of the Agricultural Scientists' Recruitment Board (ASRB), the ban was lifted and the Board took up the work of recruiting candidates to fill up vacancies in the ICAR and the Institutes under the Council. Some of the senior Class I posts vacant in this Laboratory were also included in the advertisements issued by the ASRB, but recruitment could not be made during the year in view of the large number of vacancies.

Appointments

The following appointments were made during the year :

S. No.	*Name*	*Post*	*Date of appointment*
1.	Dr. S. N. Pandey	Junior Chemist	1-8-1974
2.	Kum. I. G. Bhatt	—do—	3-8-1974
3.	Shri L. R. Jambunathan	Junior Quality Evaluation Officer	25-11-1974
4.	Shri A. K. Gupta	Senior Research Assistant	1-1-1974
5.	Dr. A. P. Banerji	—do— (Biochemist)	2-9-1974
6.	Dr. (Smt.) P. Bhama Iyer	—do— (Physics)	2-9-1974
7.	Smt. Santa V. Nayar	Senior Research Assistant	6-9-1974
8.	Shri Ram Parkash	—do—	1-10-1974
9.	Shri G. F. S. Hussain	—do—	1-10-1974
10.	Dr. R. S. Wahi	—do— (Biochemist)	2-12-1974
11.	Shri S. Aravindanath	Research Assistant	1-1-1974
12.	Shri A. K. Ahuja	—do—	1-1-1974
13.	Kum. P. V. Adelkar	—do—	1-1-1974
14.	Shri P. M. Patil	—do—	1-1-1974
15.	Shri A. J. Shaikh	—do—	1-1-1974
16.	Shri R. M. Gurjar	—do—	1-1-1974
17.	Shri K. H. Sawakhande	—do—	1-1-1974
18.	Shri S. Sreenivasan	—do—	2-9-1974
19.	Shri K. Jayachandra Rao	—do—	2-9-1974
20.	Kum. C. S. Ajgaonkar	—do—	2-9-1974

S. No.	Name	Post	Date of appointment
21.	Shri R. P. Nachane	Research Assistant	2-9-1974
22.	Shri L. D. Deshmukh	—do—	2-9-1974
23.	Shri D. N. Makwana	—do—	2-9-1974
24.	Shri S. B. Jadhav	—do—	2-12-1974
25.	Shri R. M. Modi	Photographic Assistant	1-1-1974
26.	Kum. N. S. Tipnis	Senior Laboratory Assistant	1-1-1974

Retirements, Resignations, Transfers and Discontinuation of Services

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

S. No.	Name	Post	Date of resignation
1.	Shri S. S. Iyer	Senior Research Assistant	20-5-1974
2.	Shri A. Kalimuthu	-do- (Electrical)	8-6-1974
3.	Shri Joe D'Souza	-do- (Microbiology)	30-6-1974
4.	Dr. A. P. Banerji	-do- (Biochemist)	30-10-1974
5.	Kum. Lalitha Padmanabhan	Research Assistant (Statistics)	8-3-1974
6.	Shri P. K. Bhatnagar	-do- (Testing)	15-6-1974
7.	Shri Y. P. Tripathi	-do- -do-	1-8-1974
8.	Kum. C. S. Ajgaonkar	-do- -do-	16-11-1974

Shri E. Kesavankutty, Research Assistant at Nanded, was transferred to a similar post at this Laboratory on the 18th November, 1974. Shri I. H. Hunsikatti, Research Assistant at Dharwar, was transferred to a similar post at the Regional Station at Surat on the 1st July, 1974. Shri M. L. Sounkaria, Senior Research Assistant (Ginning), was relieved on the 17th August, 1974, to take up the post of Senior Technical Assistant (Engg.) at ICAR Headquarters.

Awards

Dr. S. M. Betrabet was elected a Fellow of the Textile Institute, Manchester, in March, 1974, and Fellow of the Royal Microscopical Society, Oxford, in July, 1974.

VIII. Appendices

APPENDIX I

FINANCIAL STATEMENT

Expenditure and Receipts of the Laboratory during 1973-74

	Sanctioned grant (Rs.)	Actual Expenditure (Rs.)	Savings (−) Deficit (+) (Rs.)
A. EXPENDITURE			
I. Technological Research			
Technological Research Laboratory including regional stations (Non-Plan)			
(a) Capital expenditure including expansion of Laboratory	3,77,450·00	3,68,979·00	(− 8,471·00
(b) Working expenses	10,14,550·00	12,80,905·00	(+) 2,66,355·00
	13,92,000·00	16,49,884·00	(+) 2,57,884·00
II. Scheme for Modernisation and Strengthening of CTRL for Intensive Research on Cotton (Plan)	10,09,000·00	9,45,955·00	(−) 63,045·00
III. All India Co-ordinated Cotton Improvement Project	1,76,500·00	3,90,555·00	(+) 2,14,155·00
IV. Schemes financed from A. P. Cess Funds :			
Scheme for response of Indian cottons to crosslinking treatment with a view to evolve cotton varieties most suitable for chemical finishing treatments	1,00,200·00	17,437·00	(−) 82,763·00
Scheme for studies from blends of Cotton with Wool, Jute and Ramie on Cotton system—CTRL, Bombay, in collaboration with CSWRI and JTRL.	8,300·00	2,040·00	(−) 6,260·00
B. RECEIPTS			
Sale proceeds of vegetables, fruits, vegetable plants, seedlings, etc.			33·00
Sale proceeds of vehicles, machine-tools, plants, equipments and other non-consumable stores			1,95,300·00
Analytic and testing fees			17,961·00
Rent			21,181·00
Fees for training, application fees, etc.			5,257·00
Sales of publication, etc.			2,146·00
Interest on loan and advances granted to employees			27·00
Leave salary and pension contribution, etc.			3,467·00
Miscellaneous receipts (including sale of waste cotton)			49,055·00
			2,94,427·00

APPENDIX II

Scientific and Technical Staff Working at the Cotton Technological Research Laboratory as on the 31st December 1974

Director		Dr. V. Sundaram, M.Sc., Ph.D., A.R.I.C., F.T.I.
Senior Microscopist		Dr. S. M. Betrabet, M.Sc., Ph.D., F.T.I., F.R.M.S.
Senior Physicist		Dr. N. B. Patil, M.Sc., Ph.D.
Senior Spinning Technologist		Shri M. S. Parthasarathy, M.Text. (Bom.), M.Sc., Tech. (Manchester), A.M.C.S.T.
Senior Testing Technologist		(Vacant)
Senior Scientific Officers		Dr. V. G. Munshi, M.Sc., Ph.D., F.T.A.
		(One post vacant)
Chemist		(Vacant)
Statistician		(Vacant)
Instrumentation Technologist		(Vacant)
Spinning Technologist		(Vacant)††
Junior Spinning Technologist		Shri B. Srinathan, B.Sc. (Text.)
Junior Physicists		Shri P. G. Oka, M.Sc. *
		Dr. K. R. Krishna Iyer, M.Sc., Ph.D.
Junior Engineer		Shri H. V. Tamhankar, L.M.E., L.E.E.
Junior Microbiologist		Shri V. G. Khandeparkar, M.Sc.
Junior Ginning Technologist		Shri D. G. Shete, L.M.E.
Junior Chemists		Dr. S. N. Pandey, M.Sc., Ph.D.
		Kum. I. G. Bhatt, M.Sc. @
Junior Quality Evaluation Officers		Shri L. R. Jambunathan, B.Sc., A.M.I.C.T., L.T.I. (at Surat)
		(Vacant at Coimbatore)
Junior Scientific Officer (*Statistics*)		Shri G. S. Rajaraman, M.A.
Junior Scientific Officer (*Physics*)		Shri P. K. Chidambareswaran, M.Sc.
Junior Scientific Officer (*Testing*)		Shri A. V. Ukidve, M.Sc.
		(Two posts vacant)
Senior Research Assistants	(*Statistics*)	Shri K. Venkateswaran, B.A.*
		Shri K. Chandran, B.A.
- do -	(*Spinning*)	Shri K. S. Bhyrappa, L.T.T., A.T.A.
		Shri S. Chandrashekar, L.T.M., A.T.A.
		Shri H. R. Lakshmi Venkatesh, D.T.T.
		Shri A. S. Sathe, B.Text.††
- do -	(*Physics*)	Shri A. W. Shringarpure, B.Sc.
		Dr. (Smt.) P. Bhama Iyer, M.Sc., Ph.D.
		(One post vacant)
- do -	(*Chemistry*)	Smt. Vatsala Iyer, M.Sc.
		Shri M. S. Sitaram, B.Sc.@
		Shri N. Thejappa, B.Sc.
- do -	(*Instrumentation Foreman*)	Shri G. S. Patel, B.Sc.
- do -	(*Instrument Technician*)	Shri K. M. Paralikar, M.Sc.
- do -	(*Biochemist*)	Dr. R. S. Wahi, M.Sc., Ph.D.
- do -	(*Technical Information*)	(Vacant)
- do -	(*Electrical*)	(Vacant)
- do -	(*Microbiology*)	(Vacant)
Senior Research Assistants (*Testing*)		
Shri S. Ramanathan		Shri K. R. Kamath, B.Sc.
Smt. S. B. Pai, B.Sc. (Hons.)		Shri P. K. Jairam, B.Sc.
Smt. K. L. Datar, M.Sc.		Kum. I. K. P. Iyer, B.Sc.
Shri S. R. Ganatra, B.Sc.		Smt. S. D. Pai, B.Sc.
Shri S. G, Nayar, B.Sc. LL.B.		Shri. A. K. Gupta, B.Sc. (Hons.)
Shri B. M. Petkar, B.Sc. (Hons.)		Shri G. F. S. Hussain, M.Sc.
		(One post vacant)
Research Assistants (*Statistics*)		Smt. J. K. Iyer, M.Sc.
		Shri D. V. Mhadgut, M.Sc.
		(One post vacant)

Research Assistants	*(Spinning)*	(Two posts vacant)
- do -	*(Workshop)*	(Vacant)
- do -	*(Testing)*	
Smt. J. K. S. Warrier, B.Sc.		Shri E. Kesavan Kutty, B.Sc.
Shri T. K. M. Das, B.Sc.		Shri R. S. Chauhan, M.Sc.
Shri V. Jose Joseph, B.Sc.		Kum. P. S. Kulkarni, B.Sc.
Smt. S. P. Bhatawdekar, M.Sc.		Shri R. Sreenivasan, B.Sc.
Shri P. Bhaskar, M.Sc.		Shri S. G. Gayal, M.Sc.
Shri G. Varadraj Rao, M.Sc.		Kum A. K. Desphande, M.Sc.*
Smt. Prema Nair, M.Sc.		Kum. R. Girija, B.Sc. (Hons.)*
Shri C. R. Sthanusubramoni Iyer, B.Sc.		Shri S. Aravindanath, M.Sc.
Shri K. V. Ananthakrishnan, B.Sc.		Kum. P. V. Adelkar, B.Sc.
Smt. R. P. Bhat, B.Sc.		Shri R. M. Gurjar, M.Sc.
Kum. S. R. Jage, B.Sc.		Shri S. Sreenivasan, M.Sc.
Shri G. Viswanathan, B.Sc.		Shri R. P. Nachane, M.Sc.
Shri V. B. Suryanarayanan, B.Sc.		Shri D. N. Makwana, M.Sc.
Kum. C. R. Raje, M.Sc.		Shri S. B. Jadhav, M.Sc.
Shri B. S. Ganvir, B.Sc.		(Two posts vacant)

Regional Stations

Station	*Senior Research Assistant*	*Research Assistant*
Coimbatore	Shri S. K. Iyer, B.A. Smt. Santa V. Nayar, B.Sc.	Shri C. P. Venugopalan, B.Sc.*
Dharwar	Shri E. S. Abraham, B.Sc.	Shri A. J. Shaikh, M.Sc. Shri K. Jayachandra Rao, M.Sc.
Hissar	Shri S. N. Nagwekar, B.Sc.*	
Indore	Shri W. R. Sharma, B.Sc.	(Vacant)
Ludhiana	——	Shri A. K. Ahuja, M.Sc.*
Nanded	Shri A. K. Antony, B.Sc.	Shri K. H. Sawakhande, M.Sc. Shri L. D. Deshmukh, M.Sc.*
Nandyal	Shri R. Dwarkanath, B.Sc.	Shri Y. Subrahmanyam, M.Sc.*
Sriganganagar	Shri Ram Parkash, B.Sc.*	Shri Tula Ram, B.Sc. (Hons.)
Surat	——	Shri M. C. Bhalod, B.Sc.* Shri P. V. Varadharajan, M.Sc. Shri I. H. Hunsikatti, B.Sc. Shri P. M. Patil, M.Sc.*

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* Under the All India Co-ordinated Cotton Improvement Project.

@Under the scheme for response of Indian cottons to crosslinking treatments with a view to evolve cotton varieties suitable for chemical finishing treatments.

††Under the scheme for studies on spinning from blends of cotton with wool, jute and ramie on cotton system.

The posts sanctioned under the Fourth Plan for Modernisation and Strengthening of Cotton Technological Research Laboratory for intensive research on cotton, have since been taken as regular posts under the Laboratory.

IX. Annexures

ANNEXURE I

Summary Proceedings of the Golden Jubilee Celebrations of the Laboratory

The Golden Jubilee Celebrations of the Cotton Technological Research Laboratory were held from the 29th to the 31st December, 1974. The function was inaugurated by Shri Jagjivan Ram, Union Minister for Agriculture and Irrigation, and was presided over by Shri Vasantrao P. Naik, Chief Minister of Maharashtra.

Welcoming the delegates, Dr. V. Sundaram, Director of the Laboratory gave a brief history of the Laboratory and some of its main achievements. He also pointed out that during the last seven years, the work of the Laboratory in collaboration with other scientists working on cotton under the All India Co-ordinated Cotton Improvement Project (AICCIP) had resulted in the release of 21 new strains of cotton. The Laboratory is also having collaborative projects with other institutions of ICAR, like the Jute Technological Research Laboratory (JTRL), Central Sheep and Wool Research Institute (CSWRI) and Central Institute of Fisheries Technology (CIFT) as well as with Institutes under the Council of Scientific and Industrial Research (CSIR), such as, ATIRA, BTRA and SITRA. He also gave a brief idea of the present work and proposed future programmes of work.

Dr. M. S. Swaminathan, Director General, ICAR, complimented the scientists of the Laboratory for the good work they have done. He also paid tributes to the former Directors and the Scientists of the Laboratory who had established a reputation for the institution as well as to distinguished agricultural scientists who had worked in the field of cotton and who were responsible for the evolution of several new varieties of cotton in collaboration with the Laboratory.

Shri R. G. Saraiya, a former Vice-President of the Indian Central Cotton Committee (ICCC) who was closely associated with the establishment of this Laboratory as well as guiding its activities as a member of the ICCC during the period 1924 to 1966, paid rich tributes to the work done by the Laboratory. Shri D. L. Sen, a former Director of the Laboratory from 1946 to 1951 and Dr. R. L. N. Iyengar another former Director of the Laboratory from 1957 to 1966 also spoke a few words on the occasion giving their reminiscences.

Dr. V. Santhanam, Project Co-ordinator (Cotton), announced the release of five new varieties of cotton during 1973-74. These are :

1. IAN.579-188 also known as 'Vishnu', spinnable to 50s counts, for Gujarat tract.
2. Jyoti, spinnable to 32s counts, for Khandesh tract of Maharashtra.

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1. IAN.579-188 also known as 'Vishnu', spinnable to 50s counts, for Gujarat tract.
2. Jyoti, spinnable to 32s counts, for Khandesh tract of Maharashtra.

3. MCU.8, spinnable to 60s counts, for irrigated summer tracts of Tamil Nadu.
4. SRT.1, spinnable to 36s to 40s counts, for *herbaceum* tract of South Gujarat.
5. Suvin, an extra-long staple cotton spinnable to 120s counts, for irrigated area of Tamil Nadu.

Shri Jagjivan Ram released a comprehensive volume, entitled "50 Years of Research", covering about 300 pages in which the research contributions of the CTRL from 1924-1974 have been summarised. He also released the new varieties of cotton for general cultivation.

Shri Jagjivan Ram recalled the great reputation India had in ancient times as regards the fine quality of textiles. He congratulated the agricultural scientists and cotton technologists for evolving new varieties of cotton. He also emphasised the need for developing medium staple cottons in view of the policy of the government to supply standard cloth at controlled prices to the vulnerable sections of population. The need for proper utilisation of the cotton seed and improvement of ginning in India was also mentioned by him. The Minister assured that all help for promoting cotton research in the country will be given and referred to the proposed establishment of the new National Institute for Cotton at Nagpur.

Shri V. P. Naik, Chief Minister of Maharashtra, expressed an optimistic note that the country could become self-sufficient in cotton and suggested discontinuation of cotton import. He commended the work on hybrid cotton and the hybrid cotton seed production programme. The need for remunerative prices to the cotton growers was emphasised.

The inaugural function came to an end with a vote of thanks by Dr. S. M. Betrabet, Senior Scientist of the Laboratory.

The Seminar on cotton production and technology was held on the 30th and the 31st December, 1974. The First Session, held under the Chairmanship of Dr. M. S. Swaminathan, Director General, ICAR, dealt with various aspects of the production of cotton to meet the requirements of textile industry. Four background papers, dealing with the requirements of industry, the state of agricultural research and technological characteristics of new strains, and the proposed programme for cotton development, had been circulated to the delegates earlier and these were discussed in detail.

The Second Session was concerned with the ginning of cotton. Two background papers, one dealing with the research contribution from the CTRL and the other giving a summary of the recent technical survey of gins in the States of Maharashtra, Gujarat and Tamil Nadu, were circulated to the delegates. These were discussed in detail. At the end of the Second Session there was a special lecture on cotton seed utilisation. The Second Session was presided over by Dr. R. L. N. Iyengar, a former Director of CTRL.

In the Third Session, invited lectures on future trends in technology, covering all aspects like yarn production and fabric production as well as chemical processing and finishing were delivered by four leading scientists and technologists of the country. This Session was chaired by Shri Ratansi Mulji, Chairman of Finlay Group of Mills.

The concluding Session was presided over by Shri A. P. Shinde, Union Minister of State for Agriculture and Irrigation, when the summaries of discussion held in

first and second Sessions were presented, along with the main recommendations. In his address, Shri Shinde complimented the Director of CTRL and his staff on the occasion of the Golden Jubilee. He also praised the excellent work done by the agricultural scientists in evolving quality cottons as well as hybrid cottons in our country. Shri Shinde drew the attention of the gathering to the Rajasthan Canal expected to be completed by 1975-76. He said that Rajasthan would soon be ready to play a pivotal role in the cotton economy of the country, and he was hopeful that India would emerge as the foremost cotton growing country in the world. He further stated that Indian agriculture was passing through a phase of crisis, but the country's cotton development had made a spectacular progress which was possible only because of the good work done by the agricultural scientists and cotton technologists. He, however, suggested that efforts should be made to evolve disease-resistant varieties and make the hybrid seed production more remunerative.

Before concluding the Session, the Director of CTRL announced that a meeting held at the Laboratory by the various agricultural scientists and technologists working on cotton had decided to form a Society, to be named the "Indian Society for Cotton Improvement", in order to facilitate better exchange of ideas between scientists working in agriculture and technology as well as persons engaged in trade and industry.

The main recommendations of the seminar are summarised below :

I. Production of Hybrid Cotton Seed

The Seminar suggested the followning protocol for hybrid seed production :

1. The programme of seed production should be specifically linked with the targetted coverage of commercial types of hybrid cotton in different States.
2. The ultimate sale price of hybrid seed to the cotton farmers should include only a reasonable profit and to cover possible risks in hybrid seed production.
3. The production of nucleus seed of the parent varieties involving any hybrid cotton should be the responsibility of the cotton breeder who has developed the hybrid.
4. The supply of parent seeds to other States shall be at the breeder to breeder level and at rates at which the parent seed is supplied to seed producers in the respective States.
5. Further multiplication of the parent seed and organisation of hybrid seed production in the respective States should be through the Departments of Agriculture and the private seed producers depending on the policy followed by the respective States.

II. Extension of Area Under Hybrid Cottons

1. The Seminar observed that there is considerable risk in extending commercial cultivation of hybrid cotton to unsuitable areas with significant

decline in yield and quality and hence recommended that spread of hybrid cotton of long staple quality should be limited to only irrigated tracts where good crop management practises can be ensured.

2. The Seminar recommends that produce of different pickings of flushes of hybrid cotton be properly labelled and graded as there is difference in fibre quality in the different flushes.
3. The Seminar recommends that in order to ensure proper testing for yield and variation of type of new hybrids, it should be co-ordinated with the trials under the AICCIP and released only after adequate tests.

III. Strategy for Increasing the Productivity of Rainfed Cottons

The Seminar noted that since nearly 75 per cent of the total cotton area in the country grows rainfed cotton, major efforts should be made to step up productivity from these areas.

Among these, the Seminar identified :

1. Physiological approach for screening varieties for drought tolerance.
2. Concept of a plant type with increased physiological efficiency.
3. Development of varieties with higher ginning outturn.
4. Development of suitable hybrid cottons specifically suited for rainfed areas.

IV. Ginning

The main recommendations were :

1. Some of the existing roller gins in various States should be renovated properly.
2. The textile industry should give adequate premium for well ginned cotton. A certification scheme of baled cotton may be useful for this purpose.
3. The operating staff engaged to run the gins should undergo proper training, preferably at CTRL.

ANNEXURE II

Summary of "Cotton in the Union of Soviet Socialist Republics"

—A Report on a Visit to USSR

Submitted by Dr. V. Sundaram, Director, CTRL

Under the Indo-USSR Protocol Agreement, Dr. V. Sundaram, Director, Cotton Technological Research Laboratory, was deputed to USSR for a five weeks' study tour from 26th August, 1973 to 3rd October, 1973. As desired by the ICAR, he submitted a detailed Report in March, 1974 and a summary of the report is given below :

The USSR is one of the most important cotton growing countries of the world and competes with USA for occupying the top position in terms of cotton production. The total crop produced during 1972 was about 7.3 million tonnes of seed cotton. Uzbekistan and Turkmenia are the two major cotton growing Republics in USSR. Of these, Uzbekistan alone accounts for about 70% of the total cotton production in USSR.

The major Research Institutes visited during the tour included the Zaitzev All-Union Institute for Cotton Selection and Seed Production Research (Tashkent), the All-Union Scientific Research Institute of Cotton Growing (Tashkent), the Plant Protection Research Institute (Tashkent), the All-Union Institute of Cotton Ginning Industry (Tashkent), the Research Institute for Chemistry and Technology of Cotton and Cellulose (Tashkent), the Turkmenia Institute of Land Cultivation (Ashkabad), the Turkmenia Institute of Selection and Seed Production of Long Staple Cotton (Eoloton) and the Central Research Institute of Cotton Industry (Moscow). In addition, three Collective Farms, a Ginning Factory and a Textile Mill were also visited.

A number of factors have contributed to the rapid increase in cotton production in USSR during the last 50 years. Consolidation of cotton growing areas into large State and Collective Farms has been a major factor in stepping up production, as this system offers ideal conditions for intensive cultivation, including mechanised operations. Further, there is a quick transfer of technology and communication of research findings to the cultivators, as only a few thousand farms have to be dealt with, as against several million individual farmers in India. Irrigation facilities are continuing to be developed and in the cotton growing Republics, cotton receives the first priority on newly developed lands. The entire cotton growing area is under irrigation, while in India less than 25% of the cotton area is irrigated.

The climatic conditions in USSR, viz., the wide difference between daily maximum and minimum temperatures during boll formation period, the absence of disturbing rains during plant growth, the low humidity conditions and the extreme

cold in winter resulting in freedom from various pests, etc., are conducive to plant growth and good boll formation.

Only varieties belonging to *G. hirsutum* and *G. barbadense* species are at present under cultivation in USSR. The *G. herbaceum* cottons which covered a large area about 40 years ago, have been completely replaced. It may be noted that the two tetraploid species *G. hirsutum* and *G. barbadense* are inherently better in yielding capacity than the two diploid species *G. arboreum* and *G. herbaceum*, referred to commonly as *desi* cotton in our country. Further, only 10% of the area in USSR is devoted to cultivation of extra-long staple *barbadense* types of cottons, as the demand for cotton of such high quality is limited.

Cotton growing regions in USSR are to the north of all cotton growing regions in other parts of the world. In addition, some of the regions in USSR are also at much higher altitudes. This has brought in a great restriction on the cotton growing season in USSR, as extreme low temperatures prevalent during late autumn to early spring, are not suitable for cotton. Another factor is the longer daylight hours in summer, ranging from about 13 hr. in April and October to about 16 hr. in July. Hence, the cotton breeding research work in USSR has been directed to selection of short duration varieties which would flower and give high production under long-day conditions and which would complete harvesting before frost sets in.

With the increase in mechanisation of agriculture and harvesting of cotton by machines, greater emphasis has been given towards developing sympodial compact plant types, with bolls of large size. In view of the absence of branching, the number of plants in unit farm area can be considerably increased, which also would contribute to the total yield.

One of the basic requirements to get a good crop of cotton is the availability of certified good quality seeds. In the USSR, there is a very good seed multiplication and distribution system, by which only up to third generation seed is used for cultivation. In order to ensure proper care of the material, special payment is being made to seed producing farms.

High level of fertilizer application is being practiced in USSR and it has been estimated that 45 kg N, 15 kg P_2O_5 and 45 kg K_2O are required to produce one tonne of seed cotton. The actual doses of fertilizers applied and trace elements used are based on soil analysis data. Special emphasis is given to research for reducing cotton production costs.

Wilt infection is a major problem in cotton growing regions in USSR. The extra-long staple *barbadense* type cottons can withstand *verticillium* wilt, but are susceptible to *fusarium* wilt. However, *fusarium* wilt is not a major problem now as a number of varieties have been developed which are resistant to this disease. *Verticillium* wilt is still the major disease problem and in some cases the infection is very high resulting in crop losses up to 40 per cent. The major problem of *verticillium* wilt is being tackled from various angles. New varieties having greater resistance to wilt are being developed by suitable breeding programmes. At the same time, wilt in the field is controlled by the use of lucerne (*Medicago sativa*) or sorghum in some places as rotation crops, by use of chemicals like "Uzgen" and by biological methods using antagonistic fungi such as *Trichoderma viride*.

Integrated pest control is being practised, especially to control *Helliothis* sp. which is a major pest. Chemical pesticides, microbial agents (e.g. *Bacillus thurin-*

gensis) and natural predators and parasites of the pest (e.g. *Trichogramma*) are being used in this programme. In addition, field sanitation (burning away plant debris after harvest) is also being practised to control wilt disease as well as pests.

Another major problem faced is high soil salinity and high water table in many areas. This is being tackled by leaching the salts through drainage system.

Cultivation practices have been mechanised as far as possible, although further improvements are being tried. About 45 to 50% of the total cotton production is harvested by machines at present and the percentage of machine harvesting is expected to increase substantially in the curent decade.

The importance of taking proper care during growing, harvesting and storage of seed-cotton is being appreciated by the farm workers in USSR, as the price realised is based on the quality of seed-cotton. Four grades of seed-cotton are recognised for this purpose, based on moisture content, trash content and fibre strength. In each cotton growing zone, the fourth grade cotton receives only 40 to 50% of the price paid for the first grade.

Commercial ginning of seed-cotton in USSR is carried out using saw gins as in USA; however, extra-long staple *barbadense* type cottons are ginned using roller gins. After ginning, the seeds are passed through delinting machines for removal of linters or fuzz fibres.

Laboratory models of saw gin, roller gin and delinting machines have been developed. Further, some of the conventional fibre testing machines have been modified to make them partially or fully automatic. Although these modifications have speeded up testing work, they are not comparable to the modern high speed testing machines like Fibrograph employed in USA, India and other countries. Spinning tests are generally carried out only on samples from later stages of trial in USSR. On the other hand, the small scale spinning technique developed at the CTRL has been helpful in assessing the spinning performance of samples from early stages of cotton breeding trials in India. The integrated approach of fibre and spinning tests on samples from early stages of trial have helped in the better assessment of quality and in the development of several superior quality strains in our country during the last few years.

Another interesting development in USSR is the classification of commercially grown vartieies of cotton into seven quality types. This is possible because cotton growing in USSR is carried out under controlled conditions from sowing to harvest.

Very little information could be obtained on technological developments. There is close collaboration between the various East European Countries and USSR in this field. Instruments developed for quality evaluation are being manufactured and marketed through Poland. Some types of machinery which have been developed with joint efforts, such as BD-200 Open-end Spinning Frame, are marketed through Czechoslavakia. About 500 Open-end Spinning Frames are reported to be in operation in USSR at present and more are being installed. Another development has been the combined spinning and doubling machine.

Utilisation of radiation-induced reaction and polymerisation of acrylonitrile on cotton is being experimented upon for developing cotton fabrics with greater rot resistance. The effects of gamma-ray irradiation on cotton and cellulose acetate are being investigated in great detail.

Utilisation of cotton plant by-products has been receiving great attention in USSR. Each ginning factory is equipped with delinting machines to remove the

linters or fuzz fibres from the seeds after ginning. Processes have been developed for preparation of cellulose acetate films and triacetate fibre from cotton linters. A plan to set up a plant with a capacity of 50,000 tonnes for this purpose in Uzbekistan is underway. Another plant is being set up for preparation of pressed boards from cotton stems. Extraction of organic acids from cotton leaves is being tried on pilot plant scale. The seeds, excepting the quantity required for sowing, are used for extracting oil. Another important development is with regard to the industrial utilization of the toxic substance gossypol found in cotton seeds. Research work is in progress to use it as a dye for cellulose acetate fibres. It was also learnt that some immuno-depressent drugs are being prepared using gossypol as the basic material.

Based on the information gathered during the tour, a number of recommendations pertaining to various aspects of cottcn breeding, development and utilization have also been included in the Report.