Cotton Technological Research Laboratory

Indian Council of Agricultural Research

Annual Report
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I. Introduction

This is the forty-seventh Annual Report of the Laboratory and pertains to the calendar year 1970.

This Laboratory was founded by the Indian Central Cotton Committee in 1924, in view of the essential need for an authoritative and scientific estimation of the inherent quality of the new varieties of cotton evolved. The Laboratory came under the administrative control of the Indian Council of Agricultural Research from the 1st April, 1966, on the abolition of the Indian Central Cotton Committee.

The chief functions of this Laboratory are :

(*i*) to help the Agricultural Departments in evaluating the *quality of new strains* evolved,

(*ii*) to help the trade and the industry by furnishing true valuation of different *Trade Varieties* cultivated,

(*iii*) to carry out *basic research* on the physical and chemical properties of cottons in relation to quality and spinning performance,

(*iv*) to carry out investigations on the *ginning problems* of Indian cottons,

(*v*) to investigate the *greater and better utilisation* of cotton, cotton wastes, linters, cotton seed, etc.,

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

(*vii*) to disseminate *technical information.*

This Laboratory is concerned with testing and research on different aspects of cotton fibres, yarns and fabrics, and these are dealt with in the Ginning, Fibre Testing, Spinning, Yarn Testing, Physics, Chemistry, Microscopy, X-ray and Statistics Sections. This Laboratory maintains a good up-to-date Library of books connected with cotton technology. The Library contains 2,469 books, 84 of which were added during the year. The number of bound volumes is 2,421. The Library also received regularly about 150 journals dealing with textiles and allied subjects, 65 of which were subscribed for and the others received on exchange or complimentary basis.

New Equipment Purchased

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

(*i*) Single Pan Analytical Balance, Type 707-04,
(*ii*) Kelvinator Deep Freezer,
(*iii*) Thermolab Hot Air Oven,
(*iv*) Kjeldahl Digestion and Distillation Units (M-120),
(*v*) Variable Speed Motors (2), and
(*vi*) Vacuum Tube Volt Meter (Radart).

Distinguished Visitors

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

1. Dr. S. Y. Padmanabhan,
   Director, Central Rice Research Institute,
   Cuttack.
2. Dr. D. N. Srivastava,
   Deputy Agricultural Commissioner (P.P.),
   Indian Council of Agricultural Research,
   New Delhi 1.
3. Mr. Dimitar Ivanov Mitev,
   Scientific Collaborator,
   The Institute of Genetics and Plant Breeding,
   Academy of Agricultural Sciences,
   Bulgaria.
4. Mr. Robert Evans,
   Agricultural Officer,
   U. S. Department of Agriculture,
   Washington D.C., U.S.A.
5. Dr. S. Krishnamurthy,
   Head of the Department of Textile Technology,
   A. C. College of Technology, Madras 25.
6. Shri J. N. Mahalanobis,
   Additional Director of Agriculture (Marketing),
   Directorate of Agriculture, Marketing Branch,
   Calcutta 12.
7. Shri S. M. Chakraborty,
   Director (Textile),
   Indian Standards Institution,
   New Delhi.

8. Dr. N. L. Innes,
   Senior Cotton Breeder,
   Uganda, Kampala.
9. Dr. Mata Prasad,
   Retired Vice-Chancellor,
   Vikram University,
   Ujjain.
10. Dr. S. C. Sen Gupta,
    Director, Indian Lac Research Institute,
    Ranchi 10.
11. Mr. D. B. Moore,
    The General Secretary,
    The Textile Institute,
    Manchester, U.K.

In addition to the above, Dr. A. B. Joshi, Deputy Director General (C.S.), Shri K. P. A. Menon, Secretary, Shri S. Natarajan, Director, Budget, Audit & Accounts of the Indian Council of Agricultural Research, Dr. V. Santhanam, Head of the Regional Research Centre, Indian Agricultural Research Institute, Coimbatore, and Dr. T. H. Singh, Economic Botanist Cotton-cum-Zonal Coordinator, Ludhiana, visited this Laboratory on various occasions in connection with official work.

Staff Research Council

During the year under review, four meetings of the Staff Research Council were held. The first meeting was held on the 12th March, 1970, for considering and finalising the Research Programme of the Laboratory, for the year 1970. The second meeting was held on the 9th April, 1970, for considering and approving the revised procedure for purchase of stores and for finalising the arrangements connected with holding of the Central Zone Workshop under the All India Coordinated Research Project on Cotton. During the third meeting, which was held on the 2nd July, 1970, the half-yearly report for the period ending 30th June was considered and approved. The Fourth Plan proposals of the Laboratory and the important recommendations of the IVth meeting of the Directors of the Research Institutes under the Indian Council of Agricultural Research held at Simla, were also considered at this meeting. The fourth meeting was held on the 26th November, 1970, for considering the Annual Reports of the regional stations for the year ending the 30th September, 1970, and for discusing the research projects undertaken at the regional stations.

Inter-institutional Collaborative Projects

Under this programme, a meeting of the Directors of Central Sheep and Wool Research Institute, Jute Technological Research Laboratories and

Cotton Technological Research Laboratory, was held at Simla, on the 6th June, 1970, in the presence of Dr. K. K. Iya, Deputy Director General (A.S.), Dr. J. S. Kanwar, Deputy Director General (S.A.E.), and Shri M. R. Kolhatkar, Additional Secretary, Indian Council of Agricultural Research, to investigate the possibility of taking up collaborative projects on the problems of blending wool, jute and cotton at the above three Institutes. As decided at the meeting, the Director of Cotton Technological Research Laboratory visited the Central Sheep and Wool Research Institute, Malpura, Rajasthan, on the 21st and 22nd July, 1970, and had a detailed discussion in the matter with Dr. B. D. Patil, Director, Central Sheep and Wool Research Institute and Dr. S. B. Bandyopadhyay, Director, Jute Technological Research Laboratories in the presence of Dr. V. R. Bhalerao, Assistant Director General (Dairying), Indian Council of Agricultural Research. The Director also visited the Wool Grading and Marketing Training Institute of the Rajasthan Government at Jaipur. Accordingly, the following four project proposals have been sent to the Indian Council of Agricultural Research for consideration :

(*i*) Spinning from blends of: (*a*) cotton/wool and (*b*) cotton/jute or ramie, on cotton spinning machinery,
(*ii*) Felting properties of blends of wool and cotton,
(*iii*) Cleaning of raw-wool using mechanical devices :
  (*a*) fabrication of a device for cleaning raw-wool by removing large size vegetable matter present in it,
  (*b*) fabrication of a device for removing lighter impurities present in raw-wool, and
(*iv*) Gross and fine structure of wool from indigenous and improved breeds in relation to physical and mechanical properties of the fibre.

Membership on Other Organisations

The Director continued to be an *ex-officio* member on the following bodies :

(*i*) Indian Council of Agricultural Research Society,
(*ii*) Advisory Board of Indian Council of Agricultural Research,
(*iii*) Agricultural Sciences Technology Panel of the Indian Council of Agricultural Research,
(*iv*) Board of Management of the Victoria Jubilee Technical Institute, Bombay, and
(*v*) (*a*) Senate, (*b*) Academic Council, (*c*) Faculty of Science, (*d*) Board of Studies in Physics, and (*e*) Board of University Teaching for subjects in the Faculties of Arts and Science, of the Bombay University.

He continued to be a member of the Central Advisory Committee for Research and Liaison and also its Sub-Committee (Physics and Physical Testing) of the Bombay Textile Research Association.

The Director and other Scientific Officers of this Laboratory continued to represent the Indian Council of Agricultural Research on the verious Committees and Sub-Committees of the Indian Standards Institution dealing with Cotton Textiles. Dr. V. Sundaram continued to be the Vice-Chairman of TDC:1 (Physical Methods of Tests Sectional Committee), Chairman of TDC:2 (Cotton and Cotton Products Sectional Committee), and Convenor of TDC:1:1 (Sub-Committee for Physical Methods of Test for Cotton), TDC: 1:1:12 (Panel for Yarn Appearance Standards) and TDC 2:1:1 (Panel for Market Varieties of Cotton Fabrics).

Dr. V. Sundaram has been nominated as a representative of the Indian Council of Agricultural Research on the R & D Cell of the Cotton Textiles Export Promotion Council of the Ministry of Foreign Trade.

Post-graduate Training

The University of Bombay continued to recognise this Laboratory as a Post-Graduate Institution for guiding students for the M.Sc. and Ph.D. degrees in Textile Physics and M.Sc. degree in Physical Chemistry, during the year. Dr. V. Sundaram (Director) and Dr. R. L. N. Iyengar (Retired Scientist) continued to be teachers for guiding students for Ph.D. and M.Sc. degrees of the University of Bombay in Textiles Physics (by research). Dr. V. Sundaram (Director) and Dr. S. N. Pandey (Junior Scientific Officer) have been appointed as teachers for guiding students for M.Sc. degree of the University of Bombay in Physical Chemistry (by research). During the year, six members of the Research Staff were being guided for M.Sc. and one for Ph.D. degrees in Textile Physics (by research) of the Bombay University. During 1970, Sarvashri V. Venugopalan, P. N. Elayathu and A. V. Ukidve were awarded the M.Sc. degree in Textile Physics (by research) by the University of Bombay.

Expansion and Modernisation

The expansion and modernisation programme of this Laboratory has maintained a steady progress. The air-conditioning plant installed in the new building was fitted with automatic controls which were imported from the U.S.A. Most of the blow room machinery, except the rotary filter units imported from the U.K., has also been installed. These filter units are required to be fixed on M.S. frame and the job of providing the frame work has been assigned to the Central Public Works Department. For the commissioning of the new machinery, a complete change has to be brought about in the existing electrical fittings and points in the Spinning Building. The Indian Council of Agricultural Research has been requested to accord necessary administrative approval and financial sanction for undertaking this work.

The scheme for modernisation and strengthening of the Laboratory for intensive research on cotton during the Fourth Plan was sanctioned by the Council at an estimated cost of Rs. 22 lakhs. Appointments to some of the posts were made in the middle of August, 1970, while action regarding filling up the remaining posts is underway.

Application for the release of foreign exchange for the purchase of equipment was made as early as in October, 1968. However, due to procedural delay, the clearance lapsed and a fresh clearance certificate from indigenous angle had been obtained from the Directorate General of Technical Development in November, 1970.

Quotations have been obtained for Double-beam Spectrophotometer with accessories for infra-red spectroscopy work as well as for installation of controlled temperature and humidity plant in Spinning Division from the Central Public Works Department and private agencies, and these are under consideration of the competent authority.

For constructing an additional floor on the new building, the cost estimate is expected from the Central Public Works Department.

Staff Amenities

The construction of 16 Type I Quarters to provide residential accommodation to Class IV employees of the Laboratory has been approved by the Indian Council of Agricultural Research. The work has accordingly been entrusted to the Central Public Works Department for execution. Sanction has also been accorded by the Council for the construction of a compound wall around the staff quarters.

Finance

A statement showing the sanctioned budget grant of the Laboratory and the actual expenditure during the financial year 1969-70 is furnished in Appendix I. It will be noticed that the actual expenditure is Rs. 11.78 lakhs as against the sanctioned grant of Rs. 13.90 lakhs. The savings amounting to Rs. 2.12 lakhs arose out of savings under working expenses (Rs. 0.37 lakh) due to late filling up of certain posts and savings under capital expenditure (Rs. 1.75 lakhs) due to non-materialisation of purchase of X-Ray diffraction unit. Apart from this, an expenditure of Rs. 1.78 lakhs was incurred on Technological Schemes (including projects financed from P.L.480 funds) against the sanctioned grant of Rs. 2.00 lakhs, leaving an amount of Rs. 0.22 lakh unutilised.

Outstanding Achievements

During the year, considerable progress was made in the research

activities of this Laboratory. Major achievements are indicated below :

(*i*) Among the new strains evolved under the All India Coordinated Research Project and tested at the Laboratory, the following were found very promising from the point of view of their technological performance :

North Zone (Haryana, Punjab and Rajasthan):
A.218 and R.S.89.

Central Zone (Gujarat, Madhya Pradesh and Maharashtra):
B.59-1684, Khandwa 1, 66BH5/91, IAN.579(188), IAN.579(1456), Sujata, Giza 7 and N.28.

South Zone (Andhra Pradesh, Mysore and Tamil Nadu):
Sujata, M.C.U.5, M.C.U.4, Vijaya and Bharathi.

The comparative trials on *desi* and *G. hirsutum* strains at various locations in Maharashtra and Madhya Pradesh showed that *G. hirsutum* strains had recorded higher yields than *desi* types, in addition to being superior in technological performance.

Further, at the All India Workshop held at Coimbatore, the release of *G. hirsutum* strain E.L.156E, under the new name 'Bharathi', was recommended for replacing the *desi* strain K.7, in the rainfed tract of Tamil Nadu.

(*ii*) A number of samples of Trade Varieties and some improved strains were tested for oil, gossypol and protein contents. Gossypol content was high in samples of B.1007, 3943, Badnawar 1 and K.6 and low in Badnawar-glandless, 3435, 815-3-1-3362 and E.L.156E strains.

(*iii*) From the studies undertaken on the physico-chemical characteristics of cotton treated with decrystallising and swelling agents, it was observed that zinc chloride was a powerful swelling reagent for cellulose at certain concentrations and zinc chloride solution of more than 60 per cent concentration degraded the cotton fibre.

(*iv*) For the investigation of the microbial decomposition of cotton cellulose, 10 samples of raw cotton, yarn, fabric and healds were screened and some cultures, including three marine cultures, have been isolated.

(*v*) An investigation for the preparation of radio-resistant and radio-sensitive cellulose to obtain basic information on the chemistry of cotton cellulose, which was undertaken with the aid of P.L.480 funds came to a close during the year. Some of the main findings were as follows :

The effect of various chemical treatments on cotton showed that : (*a*) acetylation did not offer much protection against degradation by gamma-ray irradiation, (*b*) grafting showed slight protection, (*c*) allylation imparted protection at lower dosages, (*d*) benzylation proved to be radio-resistant, and (*e*) benzoylation offered maximum protection with as low a D.S. as 0.5 of benzoyl group.

The presence of reagents like ethylene diamine during irradiation of cellulose offered excellent protection while indole increased the harmful effects of radiation.

(*vi*) While studying the changes in density of cotton caused by changes in temperature and relative humidity, it was observed that : (*a*) when dry cellulosic fibres absorb moisture, the maximum density value is reached at a particular relative humidity which remains a characteristic of the sample, (*b*) swelling of fibres increases with relative humidity, and (*c*) the density of all modified cotton fibres show a declining trend with increase in the D.S. of the chemical groups.

(*vii*) Bundle strength tests at different gauge lengths on cottons in the raw state as well as after mercerisation showed that the strength uniformity ratio (the ratio of strength at 1/8″ gauge length to that at nominal zero gauge length) increased after mercerisation. Moreover, cottons which were less uniform (lower value of strength uniformity ratio) in the raw state showed greater improvement in uniformity after mercerisation.

(*viii*) A working formula was derived to obtain Balls Sorter mean length equivalent values (L) corresponding to the 2.5% span length values (L_1) obtained from the Digital Fibrograph, viz. $L = 0.844\ L_1 + 0.0769$.

(*ix*) Single strand tests were made on the Uster Automatic Tester and Scott Inclined Plane Tester on yarn samples of 80s count. The results were in conformity with those obtained on 20s, 30s, 40s and 60s counts.

(*x*) In the study of the influence of fibre length and strength parameters on spinning performance, it was observed that the bundle strength at 1/8″ gauge length and strength uniformity ratio influenced the yarn strength considerably. Further, a new measure termed as 'effective uniformity index' worked out from length parameters determined with the Digital Fibrograph showed better association with the C.S.P. values than the uniformity ratio.

II. Progress of Research

During the year under review, considerable progress has been made in the various research investigations undertaken at this Laboratory. A few papers based on the research work completed were published in suitable scientific and technical journals. In the case of a few more investigations, the experimental work had been completed and the results are being analysed. The work on the P.L.480 Project dealing with the effect of gamma-ray irradiation of raw and chemically modified cotton came to a close during the year. Some of the important results have been indicated under "Oustanding Achievements" in the previous section.

With regard to the Project on the Evaluation of Quality of New Strains of Cotton, it may be pointed out that nearly 1,500 samples were received from various trials under the All India Coordinated Research Project on Cotton. In many cases, the tests had to be carried out urgently so as to have the results for discussion at the respective Zonal Workshop Meetings held in April, May and June, 1970. Consequently, there was a heavy pressure of testing work in the earlier part of the year, which caused some dislocation in the progress of other research investigations.

The progress made in each Research Project is indicated briefly in the following pages :

1. Evaluation of the Quality of Cotton Samples Received from the State Agricultural Departments

A number of samples are received at the Laboratory for various tests from the State Departments of Agriculture. Some samples are obtained in connection with various research investigations at the Laboratory. The number of samples received during the years 1968, 1969 and 1970 together with the corresponding average figures for the quinquennium 1960-65 are given in Table 1.

The samples received from the State Departments of Agriculture 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

TABLE 1: NUMBER OF COTTON SAMPLES RECEIVED FROM THE STATE DEPARTMENTS OF AGRICULTURE

Types of test	Average for the quinquennium ending May, 1965	1968	1969	1970
Fibre and full spinning tests	857	632	587	485
Microspinning tests (with or without fibre tests	2,064	2,536	2,408	2,739
Fibre tests alone	213	102	115	28
Mill tests	**	20	10	11
Standard cottons	22	27	23	23
Trade varieties (lint)	90	23	20	25
Trade varieties (*kapas*)	**	52	57	28
Technological Research	634	39	16	—
Miscellaneous	40	—	255*	72*
Total	3,920	3,431	3,491	3,411

*Includes samples for chemical tests.
**Included under fibre and full spinning tests.

Technological Reports, one on the Trade Varieties and another on the Standard Indian Cottons. The technological research samples are utilised 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 1970, about 210 samples had been received as *kapas* and were ginned. Further, 32 samples of *kapas* of Trade Varieties were ginned for determining their ginning outturn.

The State-wise break up of the number of samples received from the State Departments of Agriculture and tested for different properties, on which reports were issued to the concerned officers in 1970, are given in Table 2.

TABLE 2 : NUMBER OF SAMPLES TESTED AND REPORTED FOR THE STATE DEPARTMENTS OF AGRICULTURE

State	Fibre and full spinning		Microspinning with fibre tests		Microspinning alone		Fibre tests alone		Total	
	Reports	Samples	Reports	Samples	Reports	Samples	Reports	Samples	Reports	Samples
A : Coordinated Project										
Maharashtra	—	—	12	171	2	12	—	—	14	183
Gujarat	11	93	24	220	—	—	—	—	35	313
Madhya Pradesh	4	53	11	174	2	17	—	—	17	244
Rajasthan	—	—	—	—	—	—	—	—	—	—
Punjab and Haryana	4	49	12	256	2	13	—	—	18	318
Uttar Pradesh	—	—	2	58	—	—	—	—	2	28
Mysore	2	16	11	152	2	25	—	—	15	193
Andhra Pradesh	—	—	3	30	—	—	—	—	3	30
Tamil Nadu	4	11	8	50	3	14	3	24	18	99
Others	—	—	5	84	1	48	—	—	6	132
Total	25	222	88	1,165	12	129	3	42	128	1,540
B : Other Schemes										
Maharashtra	31	147	2	20	46	512	1	8	80	687
Gujarat	11	67	—	—	42	327	4*	4*	57	398
Madhya Pradesh	2	6	2	15	—	—	—	—	4	21
Rajasthan	1	7	—	—	1	3	—	—	2	20
Punjab and Haryana	1	1	—	—	—	—	—	—	1	1
Uttar Pradesh	—	—	4	52	2	12	1	25	7	89
Mysore	21	64	2	6	27	210	2	22	52	302
Andhra Pradesh	2	5	—	—	10	81	—	—	12	86
Tamil Nadu	10	16	2	2	—	—	2	20	14	38
Others	1	1	—	—	2	8	1	2	4	11
Total	80	314	12	95	130	1,153	11	81	233	1,643

* Samples tested for presence of cut seeds.

TABLE 2 (*Contd.*)—*C : Tests at Regional Stations*

Station	Fibre properties tested			
	Mean fibre length	Fibre fineness	Fibre maturity	Fibre strength
Coimbatore	946	1,097	1,097	1,063
Dharwar	941	941	655	534
Hissar	201	447	92	—
Indore	501	501	477	442
Nanded	545	545	359	331
Nandyal	102	90	364	255
Sriganganagar	239	70	239	239
Surat	5,630*	4,043	4,082	1,953

*5,581 tested on Digital Fibrograph and 49 on Balls Sorter.

It may be mentioned that at the regional stations, the samples are tested for specified fibre properties only, while at the Laboratory, all the chief fibre properties are generally determined.

A. ALL INDIA COORDINATED RESEARCH PROJECT ON COTTON

The Laboratory continued to be actively associated with the All India Coordinated Research Project of Cotton initiated by the Indian Council of Agricultural Research with effect from the 1st April, 1967. Over 1,500 samples were received for fibre and spinning tests at the Laboratory from the various locations under this Project. In all, 128 reports, giving the test results, were issued.

A brief summary of the important test results on the samples from various trials conducted at different locations in the three zones—North, Central and South—is presented below :

NORTH ZONE

Out of 480 samples received from eight locations, 474 belonged to *G. hirsutum* and the rest to *G. arboreum* species.

G. hirsutum Trials

The Coordinated Varietal Trial (Normal Plant Type) was conducted at six locations, while the Coordinated Varietal Trial (New Plant Type) was conducted at two locations. The samples from Abohar and Hissar were received for full spinning tests and those from Bulandshahr, I.A.R.I. (New Delhi), Jullundur and Raya were received for microspinning.

The strains which recorded the best technological performance in the C.V.T. (Normal Plant Type), Br.04(a), are listed below :

Abohar	*Hissar*	*Jullundur*	*Bulandshahr*	*Raya*	*I.A.R.I. (New Delhi)*
R.S.89	A.218	H.275	R.S.67	R.S.67	J.127
R.S.88	R.S.88	R.S.89	A.218	R.S.88	J.34
A.218	H.275	R.S.88	R.S.88	Pramukh	A.218
H.275	R.S.89	A.218	R.S.91	—	J.132
R.S.67	R.S.53	R.S.91	—	—	—

The above table shows that the strains A.218 and R.S.88 fared well at five out of six locations. The strain A.218 has been consistently giving good technological performance for the last three seasons. It may also be pointed out that in the 15 trials conducted during the last five seasons at Abohar, the strain A.218 had recorded an average yield of 1,622 kg/ha. as against 1,566 kg/ha. for 320F (control). The spinning value of A.218 had an average H.S.C. of 46s as compared to 31s of the control 320F. The test results of the three seasons in the North Zone indicated that the strain A.218 has a mean fibre length over 25.4 mm (1.0″), Micronaire value below 4.0 μg/in. and bundle strength over 50.0 g/t. The strain was recommended for pre-release multiplication after screening for bacterial blight.

The other promising strains in this trial were R.S.89, R.S.88, H.275 and R.S.67.

In the case of C.V.T. (New Plant Type), Br.04(b), samples were received from Hissar and Sirsa for microspinning tests. The strains which recorded very good spinning performance at these two centres are listed below :

Hissar	*Sirsa*
H.297	H.14 (S.H.467)
H.S.B.1	H.297
S.S.264	H.S.B.1

The strains H.297 and H.S.B.1, grown at both the locations, showed good spinning performance. It may be mentioned that strain H.297 (formerly known as Culture 500) had recorded good spinning performance during the last season also.

In the case of Preliminary Varietal Trial (P.V.T.), Br.03, samples were received from Hissar, I.A.R.I. (New Delhi) and Jullundur for microspinning (40s count) tests. The promising strains are listed below :

Hissar	*Jullundur*	*I.A.R.I. (New Delhi)*
R.S.90	R.S.105	J.235
H.297	H.281	R.S.85
H.271	H.271	H.281
R.S.105	R.S.68	P.230
P.S.76	H.297	R.S.105
H.281	P.230	P.238

The strains R.S.105 and H.281 fared well at all the three places. The strains H.297 and P.230 also showed good performance at two of the three places.

Among the 37 samples pertaining to the Maintenance and Evaluation of National Collection of Cotton Germ Plasm, only one strain, viz. 495/69, fared well at 40s count (micro).

Samples belonging to various miscellaneous trials were received from Abohar, Jullundur and I.A.R.I. (New Delhi and Sirsa). The promising strains at the respective places are indicated below :

Abohar (M.V.T.) No. 1 and No. 2	:	In all, 34 strains out of 42 were found suitable for 40s count (micro). The promising strains were : A.218, A.298, A.278, A.290, A.294, A.295, A.296, A.300, A.301, A.304, A.306, A.308, A.309, A.310, A.313 and A.315.
Jullundur (Main, Semi-final and Micro-Varietal Trials)	:	J.127, J.135, J.145, J.176, J.182, J.205, J.216, J.217, J.218, J.219, J.225, J.226, J.228, J.229, J.230, J.232 and J.233.
I.A.R.I. (New Delhi) (New Exotic and New Plant Types)	:	Khartom, Delcerro, Acala 1517-D, Hopi Acala, Strain-A, C.S.10, 1021-849, A.59 and DPSL.
I.A.R.I. (Sirsa)	:	S.H.169 and S.H.467.

CENTRAL ZONE

Out of 739 samples received from the various locations in the Central Zone, 460 were from *G. hirsutum*, 109 from *G. arboreum*, 119 from *G. herbaceum* and 7 from *G. barbadense* trials. In addition, 44 samples belonging to hybrid trials, either inter-hirsutum or interspecific, were also tested.

G. hirsutum Trials

In the case of Coordinated Varietal Trial of *G. hirsutum* (irrigated), Br.04, the samples were received from Junagadh, Khandwa, Surat and Talod for full spinning and from Achalpur for microspinning. The first six strains ranked according to spinning performance are listed below :

Junagadh	*Khandwa*	*Surat*	*Talod*	*Achalpur*
B.59-1684	66BH5/91	B.59-1684	66BH5/91	M.C.U.5
B.1007	A.218	66BH5/91	B.59-1684	B.59-1684
Khandwa 1	B.59-1684	M.C.U.5	M.C.U.5	66BH5/91
66BH5/91	M.C.U.5	A.218	4763	A.218
B.147	Badnawar 1	Khandwa 1	A.218	4763
IAN.560	Khandwa 1	4763	Khandwa 1	IAN.560

The strains 66BH5/91 and B.59-1684 fared well at all the five locations. The strains M.C.U.5, A.218 and Khandwa 1 gave good performance at four locations.

It may be recalled that the strain 66BH5/91 had recorded H.S.C. of nearly 60s at Indore and Khandwa under rainfed condition in 1968-69 season. This year also it has recorded H.S.C. of 70s at Talod and H.S.C. above 50s at many other locations. Another promising strain which consistently recorded encouraging H.S.C. for the last three seasons at all the locations, under both irrigated and rainfed conditions, is B.59-1684. This strain recorded H.S.C. of 70s at Talod this year. The strain Khandwa 1, recommended for release for general cultivation last year, continued to maintain good performance not only in its home State of Madhya Pradesh, but also in Gujarat State. The other two strains, viz. A.218 from North Zone and M.C.U.5 from South Zone, also showed good performance in Central Zone. Both the strains recorded H.S.C. of about 60s at Talod.

The samples belonging to Coordinated Varietal Trial under rainfed conditions were received from Badnawar, Indore and Khandwa for full-spinning tests. The promising strains ranked according to performance are listed below :

Badnawar	*Indore*	*Khandwa*
B.59-1684	A.218	66BH5/91
66BH5/91	66BH5/91	B.59-1684
M.C.U.5	M.C.U.5	M.C.U.5
IAN.560	B.59-1684	4763
IAN.604	Badnawar 1	—

The strains B.59-1684, 66BH5/91 and M.C.U.5 fared well at all the three places.

The results of the above two trials indicate that the strains B.59-1684, 66BH5/91, M.C.U.5 and A.218 were promising under both irrigated and rainfed conditions. Most of the strains tried at various places, either under irrigated or rainfed conditions, were found to be above 25.4 mm mean fibre length and recorded H.S.C. of 40s and above, thus fulfilling the basic requirement of the length parameter and spinning potential in the Coordinated Varietal Trials.

In the case of Preliminary Varietal Trial, Br.03, samples were received from Badnawar, Khandwa, Indore, Surat, Talod and Junagadh under irrigated conditions, and from Indore and Achalpur from rainfed conditions. The following strains recorded satisfactory technological performance :

I. TRIALS UNDER IRRIGATED CONDITIONS

Normal Plant Type

Badnawar : E.L.592-2, 66BH5/39, B.61-2034, 66BH5/55, 66BH5/73, 66BH5/23, 4693 and Badnawar 1.

Khandwa : 66BH5/39, 66BH5/73, D.Hy.286, E.L.592-2, 66BH5/55, Badnawar 1 and 4420.

Surat : B.61-2034, H.B.26-1-2, E.L.592, 4593, E.L.192, 66BH5/55, 66BH5/73, 66BH5/23, K.W.62-501, Badnawar 1, 66BH5/39, Gujarat 67-E and IAN.576/3447.

Compact Plant Type

Junagadh : IAN.1327, IAN.1422, IAN.579, IAN.741, H.B.J.1-1700, K.C.4-1772, IAN.1466, IAN.10(199), G.C.2, IAN.604 and IAN.564.

Khandwa : M.C.U.5 and IAN.1422.

Surat : IAN.10(199), IAN.741, IAN.579, M.C.U.5 and IAN.604.

Talod : IAN.579(188), IAN.1422, Gujarat 67, IAN.741, IAN.10 (199), S.2986, IAN.1327, IAN.564, IAN.11-6, IAN.66, IAN.1466 and IAN.11-9.

Short Branch Type

Badnawar : IAN.579-1456, IAN.579-1595 and 69BH27/59.

II. TRIALS UNDER RAINFED CONDITIONS

Achalpur : IAN.1422, IAN.564 and IAN.604.

Indore : Badnawar 1, Gujarat 67, IAN.564, IAN.579 and IAN.1422.

In the case of Initial Evaluation Trial (Br.02) the strains 68BH25/7, 68BH25/10, 68BH25/28 and 68BH25/60 fared well at Achalpur, Badnawar, Indore and Khandwa when spun to 50s count (micro).

In addition to the above trials, many other trials of *G. hirsutums* were conducted at the various locations in the Central Zone and the following strains were found promising at the respective trial centres :

Indore : 66BH5/22, 66BH5/92 and B.61-2062.

Junagadh : H.B.J.1-1700, 1689 × UPA(62)38-1616, 170-Co.2 × Bobdale-1674, IAN.110(242)-5729 and IAN.741.

Surat : IAN.579(188), Gujarat 67 × H.152-62 and Gujarat 67 × 108 (seed from factory).

Talod : IAN.11-6-657, S.C.4-102 × Co-ano-8-3-2, Gujarat 67 × 6-21-17-711 and Co-ano-828-8.

G. barbadense Trials

Five *G. barbadense* strains were tried at Surat. The strains N.28 and Sujata recorded H.S.C. of 100s, while Giza 7, S.B.289-E and Andrews recorded 88s, 79s, and 72s H.S.C., respectively.

Two sets of samples belonging to "Exploitation of Hybrid Vigour and Development of Hybrid Cotton involving *G. barbadense*" were received from Surat. All the nine hybrids along with the control strain, Andrews, recorded H.S.C. over 70s. In the Minor Yield Trial, all the hybrids, namely B.C.68 × Tanguish, B.C.68 × Karnak and Co-ano-8-3-2 × USSR 76, were found suitable for 60s count.

G. arboreum Trials

Samples belonging to Coordinated Varietal Trial of *G. arboreum* were received from Akola, Badnapur, Buldana, Indore, Jalgaon, Nagpur, Nanded, Parbhani, Somnathpur and Washim. Only two strains namely B.10 × 24-A-67 and C.J.73 (Sanjay) were promising at 30s count at most of the locations. It was of interest to note that the *G. hirsutum* strains, such as B.1007, Badnawar 1 and Deviraj, grown as controls, were found suitable for 40s counts at many locations and in addition recorded higher yields than the *desi* strains.

G. herbaceum Trials

The samples from Coordinated Varietal Trial of *G. herbaceum* (Br.34) were received from Surat under irrigated conditions. Along with the control, *G. herbaceum* strain Digvijay, the strains 3200 and 2623 fared well at Surat, while 3200 and 2625 fared well at Broach.

It may be recalled that the strains 3200, 2623 and Digvijay had recorded promising technological performance during the last season at Surat.

Among the other *G. herbaceum* trials, the following strains fared well at 30s count when raised at Surat :

Preliminary Varietal Trial	:	2681, 500-1395-2-SB, 2649 and 2658-SB.
P.B.T. of Material in Advance Generation	:	2623, 2236-SB, 3943/5021 and 476.
I.E.T. of Dwarf Type	:	2646, 2660, 2634, 2643 and 2635.
P.R.T. of Wagad Crosses	:	2686/5225 and 2686.

SOUTH ZONE

From this zone, 314 samples were received. Out of these 239 belonged to *G. hirsutum*, 20 to *G. barbadense*, 24 to *G. arboreum* and 25 to *G. herbaceum* species. In addition, six strains were from hybrid trials.

G. hirsutum Trials

Samples belonging to Coordinated Varietal Trial (Irrigated) were received from Arabhavi for full spinning tests and from Coimbatore and Siruguppa for microspinning tests. The first six strains ranked according to spinning performance are listed below :

Arabhavi	*Coimbatore*	*Siruguppa*
M.C.U.5	M.C.U.5	M.C.U.5
M.C.U.4	M.C.U.4	E.L.S.111
Vijaya	Vijaya	E.L.S.117
Laxmi	33-III-1	Vijaya
33-III-1	E.L.S.117	33-III-1
E.L.S.111	E.L.S.111	M.C.U.4

The strains M.C.U.5, M.C.U.4, Vijaya and 33-III-1 gave good performance at all the locations. The other promising strains were E.L.S.111 and E.L.S.117.

In the case of Coordinated Varietal Trial (Rainfed), which was conducted at Adilabad, Dharwar, Gadag, Kovilpatti and Ranibennur, the strains M.C.U.5, E.L.909-2 and I.C.1589 recorded good technological performance.

In the case of Preliminary Varietal Trial (Irrigated), the strains AH.006, Vijaya, 9030-A.6, 6654 and E.L.S.139 from Arabhavi recorded good spinning performance at 50s count (micro). However, none of the strains from Siruguppa was capable of being spun to this count.

In the Initial Evaluation Trial, the following strains fared well :

Arabhavi : Laxmi and 66BH5/73.

Siruguppa : M.C.U.5 and 66BH5/73.

In the case of Miscellaneous Trial, a new exotic strain Reba-B.50 from Central Africa was tried under rainfed conditions at Coimbatore. It was found suitable for 40s count.

From the test results on samples from other Miscellaneous Trials of *G. hirsutum*, it was observed that the following strains had recorded good technological performance at the places indicated :

Dharwar : J.K.9, Acala 5675, M.C.U.1, F.2-B, J.K.77 and Hampi.

Srivilliputhur: E.L.0162, M.C.U.4, E.L.031 and M.C.U.5.

Tenali : F1-52, F1-33, Progeny 3400 and Progeny 3435.

Kovilpatti : 0107-1, E.L.909-BK.5, C.0050-10-1 and C.0157.

G. barbadense Trials

In the case of Coordinated Varietal Trial, the strains S.B.1085-6, Sujata, S.B.101-A-6 and S.B.289-E recorded encouraging C.S.P. values of 100s count (micro) at Coimbatore under irrigated conditions and 60s count (micro) at Dharwar under rainfed conditions.

In the case of Miscellaneous Trials, the strains D.C.H.3, D.C.H.2, D.C.H.1 and Sujata fared well at Dharwar.

A sample of Giza 45 (reselection) received from the I.A.R.I., Regional Research Centre, Coimbatore, when spun on S.K.F. unit, recorded C.S.P. as high as 2,700 at 100s count (micro).

A sample of Sujata from a cultivator's field near Coimbatore was found suitable to spin up to 120s count (micro) on S.K.F. unit.

G. arboreum Trials

In these trials conducted at Kovilpatti, the strains 0078F and 0321 recorded almost similar technological performance as that of the existing strain, K.7.

G. herbaceum Trials

The following strains gave good spinning performance at 24s count (micro) at Dharwar and Raichur under rainfed conditions.

Dharwar : 2623, Digvijay, 3943 and 2693-2529.

Raichur : 2623, 3870-S.B. and Jayadhar.

During the period under report, three Workshop Meetings for North, Central and South (cum-All India) zones were held at New Delhi, Bombay and Coimbatore, respectively. The All India Workshop at Coimbatore recommended the release of *G. hirsutum* strain Bharathi (E.L.156E) to replace the existing *desi* strain K.7, in the rainfed tract of Tamil Nadu.

B. IMPROVED VARIETIES EVOLVED UNDER OTHER STATE SCHEMES

Although the major work of evolution of improved strains is being carried out in various States under the All India Coordinated Research Project on Cotton, some of the States and Agricultural Universities conduct experimental work on their own. Some of the interesting results observed while testing such samples are given below :

MAHARASHTRA

The improved strains D.Hy.79, D.Hy.82 and D.Hy.286 had been tried during the last four years at several places in Maharashtra. The average fibre and spinning test results obtained on the samples received and tested during

1970 are given in Table 3. It will be seen that all these three strains had practically the same fibre proprieties and spinning performance. Their spinning performance was good, although poorer than that observed last year.

Similarly, the strains C.C.1-1-3, C.C.1-1-3-BK and C.C.1-1-3-41 had been tested from a number of places in Maharashtra during the last few years. The average test results obtained on the samples received during 1970 are given in Table 3. It will be seen that all these three strains had practically the same fibre properties and the same spinning performance. Their performance this year is just similar to that during the last year.

TABLE 3 : TEST RESULTS OF SOME PROMISING IMPROVED VARIETIES

Variety	Mean fibre length		Fineness		Maturity co-efficient	Bundle strength zero gauge		H.S.C.
	mm	in.	Millitex	Micronaire value		g/t	lb/mg	
Parbhani, Kutki and Achalpur (Maharashtra)								
D.Hy.79	25·3	1·00	159	4·0	0·73	44·1	8·2	42s
D.Hy.82	24·7	1·01	157	4·0	0·73	46·5	8·7	41s
D.Hy.286	25·0	1·00	161	4·1	0·73	47·1	8·8	44s
Parbhani, Dhulia, Somnathpur and Nanded (Maharashtra)								
C.C.1-1-3	23·4	0·92	175	4·4	0·78	49·0	9·1	35s
C.C.1-1-3-BK	23·5	0·92	176	4·5	0·77	49·0	9·1	35s
C.C.1-1-3-41	23·9	0·94	176	4·3	0·79	49·0	9·1	37s
Surat and Navsari (Gujarat)								
3943	22·8	0·90	155	3·9	0·75	44·6	8·4	31s
Digvijay	26·8	0·85	142	3·6	0·71	45·6	8·5	37s
Talod and near about stations (Gujarat)								
S.C.8-126	30·4	1·25	153	3·9	0·72	42·8	8·0	41s
Gujarat 67	38·3	1·19	125	3·2	0·66	40·8	7·6	38s

GUJARAT

The improved strain 3943, which is a high yielding variety, had been tried in a number of places in Gujarat during the last few years. The average test results obtained on this year's samples are given in Table 3.

It will be seen that strain 3943 had fibre properties comparable to Digvijay but did not come up to Digvijay in spinning quality. Last year the spinning performance of strain 3943 was observed to be equal to that of Digvijay.

Similarly, an improved strain S.C.8-126 had been grown along with Gujarat 67 at a number of places in Gujarat this year also. The average test results obtained on the samples of these varieties during 1970 are given in Table 3. It will be seen that strain S.C.8-126 had slightly better strength than Gujarat 67 and gave slightly better spinning performance. Samples of succeeding seasons will have to be tested for confirmation of the quality of these cottons.

C. 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 subjected to actual mill tests for evaluating their performance at the mills. Only after the superiority of the new varieties is confirmed by 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 cooperative enough to undertake such tests on the samples sent to them.

During the year, mill tests were carried out on 11 samples. The comparative test results at the mill and the Laboratory are given in Table 4.

It will be seen that in Gujarat, the new variety S.C.8-126 gave better spinning performance than Gujarat 67. In Mysore, Vijaya gave slightly better spinning performance than Deviraj confirming last year's results.

All the three varieties, 3870-S.B., 3870-IV/1 and Westerns, from Hagari gave practically the same performance this season, while last year, the two improved strains were found to be better than Westerns 1. Between G.S.23 and Laxmi tried at Gadag, it was found that the new variety G.S.23 was not as good as Laxmi. In Andhra Pradesh, the two varieties 355-E.6 and Nandicum were observed to give almost the same spinning performance during this season.

D. 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 1970 are shown in Table 5. This supplements the prominent strains described under the All India Coordinated Research Project on Cotton.

TABLE 4 : COMPARATIVE MILL AND LABORATORY TEST RESULTS ON 1969-70 SEASON SAMPLES

Spinning Test Results

Place	Variety	Laboratory test results				Mill test results			
		Waste (%)	Count	Strength (lb)	t.m.	Waste (%)	Count	Strength (lb)	t.m.
Gujarat									
Talod	S.C.8-126	9·6	30s	68·6	4·0	18·5*	30s	73·7	4·0
„	Gujarat 67	11·1	30s	61·5	4·0	20·4*	30s	67·7	4·0
Mysore									
Gadag	G.S.23	10·5	40s	41·9	4·0	23·7*	40s	45·7	4·0
„	Laxmi	14·3	40s	44·3	4·0	24·7*	40s	47·8	4·0
Arabhavi	Vijaya	12·7	30s	65·4	4·0	9·4	30s	68·8	4·0
„	Deviraj	8·9	30s	61·3	4·0	9·9	30s	61·3	4·0
Hagari	3870-S.B.	14·8	20s	95·8	4·25	13·0	20s	99·4	4·0
„	3870-IV/1	14·8	20s	92·9	4·25	14·2	20s	95·7	4·0
„	Westerns 1	14·6	20s	90·2	4·25	15·9	20s	99·2	4·0
Andhra Pradesh									
Nandyal	355-E.6	14·2	30s	49·0	4·0	13·1	30s	51·6	4·0
„	Nandicum	16·2	30s	49·7	4·0	16·6	30s	53·1	4·0

* Combed

N.B.—The spinning system and machinery employed by the mills are in many cases different from those adopted at this Laboratory and hence the yarn strength values obtained are not strictly comparable.

TABLE 5 : RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1970

Variety	Place	Mean fibre length		Fibre length irregularity (%)	Fineness		Maturity coefficient	Percentage of M-H-I	Bundle strength	
		mm	in.		Millitex	Micronaire value			Tenacity 0″ gauge (g/t)	P.S.I. 0″ gauge (lb/mg)
Maharashtra										
Hy.106	Parbhani	27·2	1·07	24·7	142	3·6	0·74	—	49·5	9·2
Buri 1007	Somnathpur	27·0	1·06	23·0	142	3·6	0·73	—	42·9	8·0
Hybrid 4	Achalpur	27·4	1·08	25·9	150	3·8	0·72	—	39·7	7·4
Nimbkar 1	Kopargaon	27·3	1·07	21·4	169	4·3	0·73	—	40·7	7·6
H.139	,,	27·1	1·07	22·0	165	4·2	0·74	—	40·7	7·6
E.L.192	,,	27·2	1·07	28·4	142	3·6	0·68	—	42·9	8·0
Gujarat										
A.218	Junagadh	27·0	1·06	26·4	157	4·0	—	62-3-35	45·6	8·5
B.59-1684	,,	27·4	1·08	24·6	181	4·6	—	81-2-17	47·7	8·9
66BH5/91	,,	28·6	1·13	23·2	157	4·0	—	84-2-14	51·5	9·6
IAN.560	,,	28·7	1·13	23·2	154	3·9	—	73-4-23	47·7	8·9
IAN.604	,,	27·4	1·08	26·2	150	3·8	—	62-4-34	43·4	8·1
S.C.8-126	,,	31·5	1·24	20·7	165	4·2	—	63-4-33	42·3	7·9
Gujarat 67	,,	31·3	1·23	24·6	118	3·0	—	34-4-62	39·7	7·4
Deviraj	,,	28·2	1·11	19·3	169	4·3	—	73-3-24	41·8	7·8
IAN.579	,,	27·3	1·07	22·6	165	4·2	—	68-3-29	42·9	8·0
IAN.1327	,,	27·0	1·06	24·5	150	3·8	—	60-8-32	42·3	7·9
IAN.1422	,,	29·0	1·14	26·3	134	3·4	—	43-5-52	41·3	7·7
K.D.170	,,	28·1	1·11	28·0	142	3·6	—	52-6-42	42·9	8·0
IAN.579 (5858)	Surat	28·9	1·14	19·7	150	3·8	0·78	—	37·5	7·0
IAN.579 (188)	,,	29·2	1·15	22·0	142	3·6	0·73	—	39·1	7·3
IAN.579 (1456)	,,	30·5	1·20	23·3	146	3·7	0·76	—	39·1	7·3
G.67 × American very big boll	,,	30·5	1·20	18·1	181	4·6	—	73-4-23	42·3	7·9
G.67 × H.152-63	,,	30·4	1·20	24·4	142	3·6	—	65-5-30	46·6	8·7
G.67 × Stoneville	,,	30·3	1·19	19·1	169	4·3	—	66-5-29	40·7	7·6
G.67 × (Seed from factory)	,,	30·3	1·19	17·7	177	4·5	—	74-2-24	43·4	8·1
G.67 × Nectariless (H.4)	,,	30·7	1·21	20·5	181	4·6	—	68-4-28	42·3	7·9

TABLE 5 : *(Contd.)*

Variety	Place	Mean fibre length		Fibre length irregularity (%)	Fineness		Maturity coefficient	Percentage of M-H-I	Bundle strength	
		mm	in.		Millitex	Micronaire value			Tenacity 0″ gauge (g/t)	P.S.I. 0″ gauge (lb/mg)
Gujarat (Contd.)										
IAN.604	Surat	30·0	1·18	20·3	169	4·3	—	71-5-24	46·6	8·7
Sujata	,,	32·4	1·28	19·9	181	4·6	—	80-4-16	48·8	9·1
Giza 7	,,	31·9	1·26	20·8	165	4·2	—	77-3-20	45·6	8·5
N.28	,,	32·4	1·28	22·6	150	3·8	—	77-3-20	50·4	9·4
Andrews	,,	31·0	1·22	28·8	157	4·0	—	73-3-24	43·4	8·1
S.B.289E	,,	33·0	1·30	27·9	169	4·3	—	82-3-15	49·3	9·2
Hybrid 4	,,	30·5	1·20	20·4	185	4·7	—	61-5-34	41·3	7·7
A.218	,,	27·6	1·09	24·9	161	4·1	—	71-5-24	44·5	8·3
B.59-1684	,,	29·4	1·16	18·6	173	4·4	—	82-3-15	48·8	9·1
66BH5/91	,,	29·7	1·17	21·4	157	4·0	—	82-4-14	46·1	8·6
S.C.8-126	,,	32·0	1·26	25·7	161	4·1	—	54-5-41	40·2	7·5
IAN.560	,,	29·9	1·18	21·6	157	4·0	—	56-3-41	42·3	7·9
IAN.604	,,	28·7	1·13	26·5	150	3·8	—	57-5-38	39·1	7·3
4763	,,	29·6	1·17	23·6	157	4·0	—	56-5-39	42·3	7·9
M.C.U.5	,,	30·4	1·20	30·5	118	3·0	—	57-4-39	47·2	8·8
B.1007	,,	28·4	1·12	26·8	150	3·8	—	58-3-39	45·0	8·4
G.67 × Sea Island	,,	36·2	1·43	28·5	126	3·2	—	55-6-39	42·9	8·0
G.67 × Andrews	,,	29·7	1·17	18·2	165	4·2	—	74-3-23	42·9	8·0
Co-ano-8-3-2 × Sea Island	,,	34·9	1·37	28·7	142	3·6	—	65-5-30	41·8	7·8
G.67 × Giza 7	,,	35·4	1·39	26·2	126	3·2	—	46-4-50	43·4	8·1
G.67 × Tanguis	,,	36·6	1·44	28·1	134	3·4	—	65-4-31	42·9	8·0
Co-ano-8-3-2 × Tanguis	,,	35·6	1·40	29·3	142	3·6	—	65-4-31	42·9	8·0
E.L.123 × Sea Island	,,	34·6	1·34	32·1	114	2·9	—	46-4-50	43·4	8·1
G.67 × ESSR.76	,,	34·6	1·36	24·0	126	3·2	—	51-5-44	46·1	8·6
G.67 × Maraad	,,	35·3	1·39	27·2	126	3·2	—	61-4-35	44·0	8·2
Khandwa 1	,,	27·4	1·08	23·9	157	4·0	—	68-4-28	46·6	8·7
B.147	,,	28·3	1·11	23·4	161	4·1	—	68-4-28	40·7	7·6
Deviraj	,,	28·5	1·12	24·9	173	4·4	—	73-4-23	39·7	7·4
Gujarat 67	,,	29·2	1·15	30·0	150	3·8	—	53-4-43	37·5	7·0

TABLE 5 : (*Contd.*)

Variety	Place	Mean fibre lengh		Fibre length irregularity (%)	Fineness		Maturity coefficient	Percentage of M-H-I	Bundle strength	
		mm	in.		Millitex	Micronaire value			Tenacity 0″ gauge (g/t)	P.S.I. 0″ gauge (lb/mg)
Gujarat (Contd.)										
B.59-1684	Talod	27·6	1·09	25·8	173	4·4	—	79-3-18	48·8	9·1
66BH.5/91	„	27·7	1·09	27·4	173	4·4	—	76-3-21	50·4	9·4
S.C.8-126	„	30·6	1·21	23·4	146	3·7	—	65-5-30	40·7	7·6
IAN.560	„	28·5	1·12	26·7	154	3·9	—	56-5-39	46·6	8·7
IAN.604	„	27·4	1·08	26·9	122	3·1	—	45-4-51	44·0	8·2
4763	„	28·4	1·12	28·2	154	3·9	—	58-3-39	45·6	8·5
M.C.U.5	„	29·2	1·15	29·1	110	2·8	—	43-4-53	45·6	8·5
B.1007	„	27·9	1·10	29·7	154	3·9	—	56-4-40	47·2	8·8
Deviraj	„	27·0	1·07	27·0	154	3·9	—	64-4-32	40·2	7·5
Gujarat 67	„	31·2	1·23	26·2	110	2·8	—	39-6-55	40·7	7·6
Mysore										
D.C.H.3	Dharwar	30·1	1·19	30·8	118	3·0	0·62	—	43·4	8·1
D.C.H.2	„	27·7	1·09	25·5	118	3·0	0·64	—	40·7	7·6
E.L.S.117	Arabhavi	27·9	1·10	29·7	118	3·0	—	57-4-39	38·6	7·2
E.L.S.111	„	28·1	1·11	29·9	126	3·2	—	61-4-35	38·1	7·1
A.S.6	„	28·6	1·13	27·1	114	2·9	—	53-4-43	36·4	6·8
Vijaya	„	28·0	1·10	25·9	118	3·0	—	61-4-35	37·0	6·9
33-III-1	„	28·1	1·11	28·0	130	3·3	—	60-4-36	39·1	7·3
M.C.U.4	„	28·1	1·11	25·8	118	3·0	—	67-4-29	37·0	6·9
M.C.U.5	„	30·5	1·20	31·2	118	3·0	—	66-4-30	43·4	8·1
Tamil Nadu										
S.B.1085-6	Coimbatore	30·1	1·19	20·0	138	3·5	—	67-3-30	46·6	8·7
Sujata	„	29·0	1·14	18·1	157	4·0	—	66-5-29	47·7	8·9
E.L.031	Srivilliputhur	28·0	1·10	32·8	126	3·2	—	62-3-35	45·0	8·5
E.L.0162	„	28·4	1·12	32·8	126	3·2	—	70-4-26	48·2	9·0
M.C.U.4	„	27·8	1·09	31·5	154	3·9	—	75-3-22	48·2	9·0
M.C.U.5	„	27·2	1·07	29·9	146	3·7	—	64-3-33	47·2	8·8

TABLE 5 : (*Concld.*)

Variety	Place	Mean fibre length		Fibre length irregularity (%)	Fineness		Maturity coefficient	Percentage of M-H-I	Bundle strength	
		mm	in.		Millitex	Micronaire value			Tenacity 0″ gauge (g/t)	P.S.I. 0″gauge (lb/mg)
Andhra Pradesh										
A.102	Amaravati ..	27·2	1·07	24·8	142	3·6	0·73	—	41·8	7·8
Madhya Pradesh										
S.C.8-126	Khandwa ..	27·5	1·08	—	157	4·0	—	58-6-36	43·4	8·1
S.C.8-126	Badnawar ..	27·3	1·07	—	122	3·1	—	40-8-52	37·0	6·9
Gujarat 67	„ ..	27·2	1·07	26·3	118	3·0	—	38-7-55	35·4	6·6
A.218	Indore ..	27·4	1·08	24·0	146	3·7	—	51-5-44	45·6	8·5
S.C.8-126	„ ..	29·4	1·16	28·7	122	3·1	—	39-6-55	41·3	7·7
IAN.560	„ ..	27·4	1·08	22·6	146	3·7	—	55-6-39	43·4	8·1
IAN.604	„ ..	26·8	1·06	27·5	126	3·2	—	40-4-56	44·0	8·2
4763	„ ..	27·1	1·07	25·6	146	3·7	—	52-4-44	45·6	8·5
M.C.U.5	„ ..	28·8	1·13	29·1	122	3·1	—	65-4-31	46·1	8·7
B.59-1684	„ ..	27·0	1·06	23·0	142	3·6	—	76-3-21	45·0	8·4
66BH5/91	„ ..	27·7	1·09	20·3	161	4·1	—	75-3-22	50·4	9·4
Punjab										
R.S.83	Abohar ..	27·0	1·06	—	126	3·2	—	52-3-45	45·0	8·4
H.275	„ ..	27·0	1·06	—	130	3·3	—	53-5-42	46·6	8·7
A.218	„ ..	27·0	1·06	—	142	3·6	—	52-6-42	49·8	3·9
Haryana										
H.275	Hissar ..	28·1	1·11	—	114	2·9	—	54-9-37	46·1	8·6

2. Evaluation of the Quality of the Major Trade Varieties 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., Bombay, each season. Representative *kapas* samples of the varieties are procured from the State Departments of Agriculture for determination of ginning percentage. The fibre and spinning test results, ginning percentage and other test results on each variety of cotton are published as a Technological Circular as early in the season as possible, for the information of the cotton trade and industry. Such circulars were issued during 1970 on 44 Trade Varieties. The test results on all the Trade Varieties of the 1968-69 season were compiled and published as Technological Report No. 7 entitled, "Technological Report on Trade Varieties of Indian Cottons, 1968-69 Season". Most of the samples of the 1969-70 season have also been received and tested.

3. Evaluation of the Quality of the Standard Indian 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 in 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 Standard Cotton Circulars for the information of the Cotton Breeders and other research workers as early in the season as possible. During 1970, such circulars were issued on 33 samples. The results of all the samples pertaining to the 1968-69 season were consolidated and published at the end of the season as Technological Report No. 8 entitled, "Technological Report on Standard Indian Cottons, 1968-69 Season". Most of the samples of the Standard Indian Cottons of the 1969-70 season, have been received and tested.

4. Evaluation of Linter, Oil, and Gossypol Contents of Various Genetic Stocks for Evolving Varieties with Higher Oil Content and Low Gossypol Content

During the period under report, cotton seed samples of 40 varieties, belonging to different botanical species, were tested for moisture content, seed weight and oil content. The values of oil content of these samples ranged from 13.2 per cent (Comillas) to 22.1 per cent (IAN.1592-1456). Linter content and kernel content were also studied on 27 cotton seed samples of Trade Varieties. Linter content of these samples varied from

3.98 per cent (Cocanadas 2) to 12.83 per cent (H.14) and kernel content from 39.86 per cent (Comillas) to 59.74 per cent (Laxmi).

A study was also made on free gossypol content in kernel of 43 cotton seed samples and the values of gossypol were in the range of 0.43 per cent (g. glandless-3435) to 2.38 per cent (K.6). It was observed that the percentage of gossypol content was low in some varieties, such as Badnawar glandless (0.50), g. glandless-3435 (0.43), 815-3-1-3362 (0.68) and E.L. 156E (0.73), and high in varieties, such as B.1007 (1.93), 3943 (1.96), Badnawar 1 (2.00) and K.6 (2.38).

Study was also made on protein content in kernel of 35 cotton seed samples of different varieties and the values ranged from 31.51 per cent (N.14) to 41.94 per cent (C.1622-3409), the mean value being around 35 per cent. Further work on this project is in progress.

5. Physico-chemical Characteristics of Cottons Treated with Decrystallising and Swelling Reagents

During the period under report, purified lint samples of M.C.U.3 cotton were further treated with different concentrations of zinc chloride under varying conditions of treatment, including a wide range of temperature. All the treated samples along with the purified control sample were studied for various properties, such as iodine absorption, barium activity number, moisture regain, dye absorption and degree of polymerisation (D.P.). Studies were also made to determine the crystallinity of all the samples (including those prepared during the previous years) by acid hydrolysis method. Fibre bundle strength at 1/8″ gauge length and levelling of D.P. of all these samples were also determined. Degree of swelling of fibres treated with different concentrations of zinc chloride was also determined. Treatments with zinc chloride of concentration 60 per cent and above resulted in appreciable changes in crystallinity, D.P., barium activity number, moisture and dye absorption, compared to the untreated control. Fibre bundle strength at 1/8″ gauge length did not show any appreciable change with the treatment of zinc chloride up to 60 per cent solution at all the temperatures (10°C to 75°C) studied. Fibre elongation showed slight increase with the treatment of higher concentrations but did not follow any regular trend. Fibres treated with zinc chloride of concentrations from 60-80 per cent at the temperatures of 36°, 55° and 75°C were appreciably degraded and could not be tested for strength. These data are being analysed.

Further work on treatment with urea and with other swelling agents, such as ammonia, formic acid, phosphoric acid, etc., will be taken up.

6. Secondary Cell Wall Development of G. herbaceum and Indo-American Cottons

The effect of water stress and fertilisers on the fibre development and fibre properties is being investigated. During the year, the degree of thicken-

ing, a parameter of secondary cell wall development, was determined on fibres extracted from bolls of Gujarat 67 cotton (1968-69 season) ranging in age from 42 to 63 days, picked at intervals of seven days. The full-grown samples of Digvijay and Gujarat 67 cottons (1968-69) were tested for all the important fibre properties. The experimental work on this project is almost complete. The results are being analysed.

7. Structural Peculiarities of Indian G. hirsutum and G. herbaceum Cottons

In all, 32 samples of cotton belonging to American *hirsutum*, Indian *hirsutum* and *G. herbaceum* species were tested for the absorption of Carbolan Violet 2 R.S. dye. Density and alkali centrifuge values (ACV) were also determined on these cottons. Carbolan Violet 2 R.S. is a dye with large size molecule. The dye-uptake in American *hirsutums*, in general, seems to be higher than that in *G. herbaceums*. This indicates that the pore size is larger in American *hirsutum* than in *G. herbaceum* cottons. The higher density values of American *hirsutum* cottons indicate that crystallinity of these cottons is higher than that of *G. herbaceum* cottons.

The ACV values and the propanol-2 retention values of *G. herbaceum* cottons are lower than those of the American *hirsutum* cottons, which indicates that the total volume of void space in *G. herbaceum* cottons is smaller than in American *hirsutum* cottons. Further work, for confirming these trends, is in progress.

8. Investigation of the Microbial Decomposition of Cellulose in Indian Environments with Special Reference to Cellulolytic Enzymes Produced by Streptomyces and Fungi Isolated from Cotton and Cotton Products

In all, 10 samples of raw cotton, fabric, yarn and healds received from Gujarat and Pondichery were screened for viable count of bacteria, actinomycetes, yeasts and fungi. Four fungi and two actinomycetes, showing fairly high cellulolytic activity, were isolated by enrichment culture method. These cultures along with those isolated last year were tentatively identified up to genus: *Streptomyces* sp. (4 isolates); *Aspergillus* sp. (3); *Penicillium* sp. (1); *Fusarium* sp. (1); *Curvularia* sp. (3); *Scopulariopsis* sp. (2); *Paecilomyces* sp. (1) ; and *Sporotrichum* sp. (1).

Studies on the degradation of canvas cloth in sea water showed that thicker canvas resisted deterioration up to one month exposure. Thin canvas deteriorated very rapidly and did not last over 15 days of exposure. Among the various cultures isolated, one fungus showed high cellulolytic activity. The cellulolytic marine cultures incriminated were: *Micromonospora* sp. (1); *Aspergillus* sp. (2); and *Paecilomyces* sp. (1).

Twenty cultures were grown in eight media to study their comparative performance and to select the most appropriate medium for the growth of

each of the promising culture with respect to cellulase enzyme production. The results are summarised below :

*Cellulase Activity**

Organism	Reducing sugar, mg/ml filtrate
1. F4—*Penicillium* sp.	240
2. F9—*Aspergillus* sp.	125
3. MF1—*Aspergillus* sp. (marine)	135
4. S4—*Streptomyces* sp.	85

*Conditions of enzyme assay : 200 mg cellulose powder, 5 ml distilled water, 5 ml culture filtrate and 10 ml of 0.1 M acetate buffer (pH 5.6) were incubated for 2 hours at 40°C.

The isolates F4 and MF1 seem to be highly cellulolytic in terrestrial and marine environments, respectively. Experiments are being planned to study the potentiality of isolates F4 and some other cultures from the stock with respect to large scale production of cellulase enzyme.

A review entitled "Recent Development on Microbial Degradation of Cellulosic Textiles and Its Prevention" has been sent for publication.

9. Fabrication of an Extractor for Improving the Ginning of Kapas

It was mentioned in the previous Annual Report that pulley locking arrangement was faulty and was giving varying speeds when the machine was in operation. These defects were rectified. It was also observed that by making suitable changes in the speeds of Doffer and Reclaimer cylinders, the choking of *kapas* in the machine could be reduced and accordingly a set of two Vee-belt pulleys have been designed and got fabricated through a local firm. However, some minor alterations in the width of the pulleys are necessary to enable the machine to work smoothly. The work is in progress.

10. Investigation of the Preparation of Radio-resistant and Radio-sensitive Celluloses to Obtain Basic Information on the Chemistry of Cotton Cellulose

A comprehensive five year project (1965-70), on the above subject, was successfully completed during this year.

Under this project, raw and mercerised cottons, as well as cottons which had undergone various chemical treatments, like acetylation, benzylation, benzoylation, grafting with acrylonitrile and allylation, were subjected to gamma-ray radiation. The protective or sensitizing behaviour of the treatment towards radiation was evaluated by analysing these treated samples for the changes in their various physical and chemical properties. The chief findings may be summarised as follows :

(*i*) Gamma-ray radiation of untreated raw cotton cellulose caused degradation of cellulose. With increase in dosage, the cotton cellulose showed decrease in tensile strength and degree of polymerisation (D.P.).

At higher dosages of 5×10^7 roentgens and above, the cotton became brittle and powdery and could not be tested for tensile strength. The reducing groups, carboxyl groups and alkali solubility increased with dosage and were maximum at the highest dosage.

(ii) Cellulose when irradiated with gamma-rays produces oxycelluloses, which after chlorous acid and sodium borohydride treatments showed characteristics similar to those of oxycelluloses produced by oxidation of cellulose with potassium dichromate-oxalic acid reagent when oxidation of cellulose is known to take place at C_6 position. Hence, it is concluded that the oxycelluloses produced by irradiation of cellulose with gamma-rays are also oxidised mainly at C_6 position.

(iii) Mercerised cotton on irradiation with gamma-rays showed degradation similar to that of raw cotton in mechanical properties, but showed higher degradation with regard to chemical properties.

(iv) The analysis of the decomposition products obtained on irradiation of untreated cotton cellulose (to a dosage of 1×10^8 roentgens) by paper chromatographic technique, showed the presence of glucose, cellobiose, xylose and arabinose. In addition, the presence of 2 keto-gluconic and glucuronic acid was also indicated.

(v) Of the five chemical treatments, viz. acetylation, grafting, allylation, benzylation and benzoylation, studied on cotton,

(a) acetylation did not offer protection,
(b) grafting showed slight protection,
(c) allylation offered protection at lower dosages,
(d) benzylation proved to be radio-protective, and
(e) benzoylation offered maximum radio-protection.

(vi) The above chemically treated samples having varying degrees of substitution (D.S.) or pick-ups when assessed for the effect of substituent group on the radio-protection of cellulose showed that :

(a) The protective effect in the acetylated cellulose samples increased with D.S. up to a D.S. of 1.60, beyond which there appeared to be no change.
(b) In the case of acrylonitrile (AN) grafted samples of increasing pick-ups, it was observed that increase in graft pick-up did not have much effect on the radio-protection of cellulose.
(c) The allylated cellulose samples of varying D.S. in general showed degradation at a dosage of 1×10^7 roentgens, but at the initial dosage of 1×10^5 roentgens, they showed protection. This protective effect in allylated samples increased with increase in D.S., the one with D.S. 1.25 (highest D.S. prepared) showing highest protection.

(*d*) In the case of benzylated samples, at a D.S. as low as about 0.3, the protection offered to tensile strength by the benzyl group was about 10 per cent. Further increase in D.S. up to about D.S. 1.0 (highest D.S. prepared) did not seem to offer much increase in radio-protection.

(*e*) In the case of benzoylated samples, protection of about 50 per cent was found possible with as low a D.S. as 0.5.

(*vii*) The chromatographic analysis of the irradiated acetylated samples showed the presence of cellobiose and glucose. In addition, traces of arabinose were noted in the acetylated sample of D.S. 2.34.

(*viii*) On electron spin resonance analysis, it was observed that the benzoylated samples yielded lower radical concentration compared to raw sample. It appears that the radio-protection of benzoylated samples may be due to the energy transfer effects resulting in a lowering of localisation energy on cellulose.

(*ix*) The substitution of allyl group, which offers radio-protection to cotton cellulose at low dosage of irradiation, enhanced the overall radical yield, but the increase was due to localisation of damage at the substituent group. The nature of primary radicals and their intermediary reactions appear to play a significant role in the radiation damage of the allylated sample.

(*x*) Infra-red analysis of the acetylated samples (D.S. 1.02, 2.34) and allylated sample (D.S. 1.25) irradiated to 1×10^8 roentgens indicated that (*a*) oxidation and partial removal of the substituent group in acetylated samples, and (*b*) saturation and cross-linking of allyl group, were the main effects of irradiation with gamma-rays. In the case of benzoylated sample (D.S. 1.13) the protection offered to cellulose against degradation on gamma-ray irradiation was found to be due to the stability of the phenyl group.

(*xi*) Cellulose was irradiated in the presence of various reagents both under air and nitrogen to study the effect of these reagents on the radio-resistance of cellulose. The results are as under :

(*a*) The physical and chemical properties showed that replacing air by nitrogen during irradiation in the presence of various reagents had very little effect.

(*b*) The presence of amines and alcohols during irradiation offered radio-protection to cellulose molecule.

(*c*) Amongst the various reagents screened, ethylene diamine (EDA) offered maximum protection, while indole caused sensitization. The optimum concentration for EDA was 75-80 per cent for providing radio-protection to cellulose.

(*d*) The protective effect of aliphatic amines appeared to increase with the increase in the amount of amino-groups that are capable of forming the intermediate product ammonia. In the case of aromatic amines, increase in the phenyl group appeared to increase the radio-protective action.

(*e*) The presence of ethylene diamine during irradiation of acetylated cellulose samples showed neither protection nor sensitization.

The Final Report on the Project is under preparation. A paper entitled "Formation and Reactions of Radiation Induced Free Radicals in Chemically Modified Cotton Celluloses" has been sent for publication.

11. Studies on the Changes in Density of Cotton and other Textile Fibres with Changes in Temperature and Relative Humidity

Analysis of the experimental data of this project was continued during the year and the following conclusions were arrived at :

(*i*) When dry cellulosic fibres absorb moisture, there is an increase in their density up to a certain relative humidity (R.H.) level characteristic of the fibre and on further increase in R.H., the density decreases uniformly.

(*ii*) High correlations were observed between crystallinity values calculated from density and moisture regain. Crystallinity and swelling for the same type of fibre, were also correlated significantly.

(*iii*) The values of empty space derived from density data of all fibres, at different levels of R.H. indicate a curvilinear relationship between empty space and crystallinity in fibres.

(*iv*) The increase in degree of substitution of chemical compounds in cellulosic fibres caused a systematic decrease in density and the magnitude of this decrease varied depending on the type of chemical modification.

(*v*) Regression equations were worked out connecting density and the degree of substitution. Linear relationship was observed in the case of acrylonitrile grafted and acetylated cottons and curvilinear relationship in the case of allylated, benzoylated and benzylated samples. The equations were :

Acetylated Cotton:

$$Y = 20.6649 - 13.4831\ X$$

Acrylonitrile Grafted Cotton:

$$Y = 371.9245 - 240.3268\ X$$

Allylated Cotton:

$$Y = 111.5635 - 145.9794\ X + 47.762\ X^2$$

Benzoylated Cotton:

$$Y = 14.7625 - 9.6699\ X + 0.0021\ X^2$$

Benzylated Cotton :

$$Y = 46.8190 - 63.5654\ X + 21.7114\ X^2$$

where X = density and Y = degree of substitution.

The calculated values of D.S. from the observed density values showed good agreement in all the cases reported here.

During the work on this project, it was felt that the study of the effect of drying on changes in density of young fibres would throw some light on the development of crystallinity during the growth of the cotton fibres. Experimental work on this aspect of the problem was, therefore, taken up. Two cotton varieties, viz. Gujarat 67 and Digvijay, were selected for this purpose. Bolls ranging in age from 21 to 56 days for Digvijay and 21 to 63 days for Gujarat 67, picked at weekly intervals, were used for this study. These bolls had been preserved in aqueous solutions of formaldehyde. These bolls were taken out and immersed in water. The bolls were cut open under water and the fibres were very carefully removed from the seeds without exercising undue strain. The water from these fibres was removed by solvent exchange with dry methyl alcohol and n-pentane successively and then the fibres were introduced into the liquid medium for density measurements. Using the density gradient column, the density of samples was determined.

Tests on samples belonging to growth stages of 63, 56, 49 and 42 days have been completed. Further work is in progress.

12. Effect of Swelling and/or Decrystallising Treatments on the Strength-Length Gradient of Cotton in Relation to Its Structural Parameters

Crystallinity of samples treated with 98 per cent ethylene diamine (EDA) was estimated and was observed to be in the range of 42 to 46 per cent. In order to prepare samples with a crystallinity range different from that obtained with 90 per cent EDA treatment or the mercerisation treatment, 10 samples were treated with 70 per cent EDA. The crystallinity of these samples, determined by the moisture sorption method, was found to be in the range of 50 to 55 per cent.

Crystallinity of one more cotton (Californian) was determined after giving the three treatments, viz. Mercerisation, EDA 98 per cent and EDA 70 per cent.

Strength uniformity ratio (the ratio of tenacity at 1/8″ to that at zero gauge) was calculated both for raw as well as mercerised samples. This ratio was found to be higher for mercerised cottons. It was also observed that the improvement was more in the case of cottons which in the raw state had shown comparatively low uniformity ratio. This revealed that cottons which were less uniform in the raw state, showed greater improvement in uniformity, after mercerisation.

Orientation, one of the fine structure parameters influencing the fibre tenacity, is being determined from X-ray diffraction patterns. For this purpose, X-ray photographs of fibre bundles, raw as well as treated samples, have been taken and the photographs are being analysed. Further work is in progress.

13. Physico-chemical and Structural Properties of Gamma-ray Irradiated Cellulose in Relation to some other Oxycelluloses

A series of oxycelluloses with increasing oxygen consumption, comparable to those obtained by the irradiation of cellulose with gamma-rays, were prepared by the action of three specific oxidising agents, viz. : (*i*) sodium meta-periodate which oxidizes cellulose molecule at C_2-C_3 position, (*ii*) potassium dichromate in sulphuric acid, and (*iii*) potassium dichromate-oxalic acid which oxidize cellulose molecule at C_6 position. Copper number of these oxycelluloses was determined to find out the extent of oxidation. Cellulose was oxidized with sodium meta-periodate solution of two concentrations, 0.01 and 0.1 molar, for different periods of time. The oxygen consumption and copper number of these oxycelluloses ranged from 0.13 to 7.59 and 0.18 to 69.37, respectively. Cellulose oxidized with potassium dichromate (0.1N) in sulphuric acid (0.2N) for varying lengths of time had an oxygen consumption ranging from 0.42 to 12.42 and copper number from 0.18 to 18.24, respectively. Cellulose treated with increasing volumes of 2.0N potassium dichromate in the presence of 2.0N oxalic acid for four hours produced oxycelluloses having copper number ranging from 0.18 to 15.04.

14. Investigation on the Twisting/Untwisting Behaviour of Cotton Fibres in Water

A large number of fibres from Comillas cotton were examined for their rotations in water and those which showed more than about five rotations were preserved for further investigations. Most of the fibres exhibited anticlockwise rotations as seen from above, during immersion in water. Careful measurements of the number of convolutions (both S and Z types estimated separately) revealed that fibres rotating in the anticlockwise direction possessed an excess number of Z-type of convolutions and vice-versa. In a few cases, where the S and Z type of convolutions could be measured unambiguously, it was noticed that a 1:1 correspondence existed between the number of rotations in water and the excess number of convolutions over the test length of fibres. Certain segments of the fibres were not very translucent under the microscope. Hence unambiguous measurement and characterisation of convolutions over the entire test length was not always possible for every fibre tested. In this respect, Egyptian cottons, e.g. Giza 45, appeared to be more translucent. This cotton is now being used for testing and selecting fibres that exhibit appreciable number of clockwise rotations so that a complementary study could be made.

15. Investigations on the Transformation of Cellulose I to Cellulose II Lattice brought about by Swelling Cotton Fibres in Aqueous Solutions of Caustic Soda

This study involves an estimation of the amount of residual crystalline cellulose I present in cellulose fibres after the latter are swollen in an alkali solution of optimum concentration. For this purpose, individual fibres of

cotton (Giza) and ramie were swollen slack in 24 per cent (w/w) sodium hydroxide solution at room temperature for one hour. These were washed in water and dried under room atmosphere. Hydrolyzed samples of cotton and ramie, subsequently swollen in sodium hydroxide solution, were also prepared for the study. X-ray diffraction photographs of some of the samples were taken. Only a qualitative examination of these patterns could be made so far. This indicated the presence of weak intensity due to crystalline cellulose I in the diffraction pattern of the swollen cotton fibre sample. The pattern of the swollen ramie sample, on the other hand, showed no such trace. A detailed analysis of all the samples will be made using the new X-ray unit after it is installed and put into operation.

16. Studies on the Changes in the Shape of Cotton Fibre due to Different Chemical Treatments

It was reported that changes in circularity due to treatment with various concentrations of sodium hydroxide, potassium hydroxide and zinc chloride were studied on two samples each of two cottons, viz. NC·14 and Auburn, having different maturities. This study was further extended by treating all the four samples with various concentrations (60, 70, 80 and 90 per cent) of ethylene diamine (EDA). It was observed that the maximum change in circularity occurred at about 80 per cent EDA.

It is generally believed that cotton fibres initially grow in tubular form and collapse to various shapes on dehydration. In order to study the effect of drastic dehydration, cotton bolls in preserved condition were obtained, fibres were separated from the bolls in wet condition and were allowed to dehydrate at different temperatures, viz. 30°C (room temperature), 100°C and 150°C in an oven for about four hours. About 200 cross-sections of fibres from each of the treatments were traced out and the circularity determined. It was observed that the fibres which were dried at 30°C had more circularity than those dried at 100°C and 150°C. It is proposed to extend this study on a few more cottons.

In order to study the effect of alkali at different temperatures on the cross-sectional shape of the fibres, the four samples were treated with 15 per cent sodium hydroxide solution at various temperatures, viz. 0°C, 20°C, 40°C, 60°C, 80°C, and 98°C. It was observed that the circularity of the cotton fibre decreased progressively with increase in temperature of alkaline liquor. It is proposed to extend this study with other concentrations of sodium hydroxide.

17. Studies on the Effect of Various Factors on Yarn Characteristics

As reported earlier, yarn samples of three counts (20s, 30s and 40s) were mercerised with and without tension and the yarn evenness, yarn strength and twist in yarn were determined before and after mercerisation. During the period under report, the data were further analysed to study the changes

in yarn evenness, strength, C.V. in strength, etc., due to mercerising treatment. The following observations were made : The relationship between U per cent and mean strength remained practically the same for control, slack and stretch mercerised samples while that between U per cent and tenacity decreased to a small extent for slack mercerised samples and remained the same for control and stretch mercerised samples. Although, the relationships between U per cent and C.V. per cent in strength, and between U per cent and percentage strength irregularity were highly significant before treatment, these were found to be non-significant after mercerisation due to apparent increase in U per cent values.

In order to study the influence of various length parameters on yarn irregularity, 30 cottons spun to three counts had been tested for yarn irregularity with Uster Evenness Tester. The length parameters had also been determined with the Digital Fibrograph and the Balls Sorter. During the period under report the entire data were analysed and the following conclusions were drawn :

(*i*) The length parameters appear to have similar correspondence with all the three irregularity indices (Uster value, index of irregularity and excess of irregularity). Hence, for all practical purposes and for routine work, determination of Uster value is sufficient to get necessary information on yarn irregularity.

(*ii*) The length parameters may have greater influence on the irregularity of yarn of count very close to or higher than the Highest Standard Count of the cotton under study. They may have comparatively less influence if the sample is spun to a count below its optimum.

(*iii*) Parameters denoting fibre length variation have greater association with yarn irregularity indices than those denoting mean fibre length alone.

(*iv*) The short fibre content merely expressed as a percentage of fibres having length below a definite value may not have appreciable influence on the yarn irregularity.

(*v*) Any parameter which relates the length estimating the content of short fibres with the estimate of fibre length nearer to the roller setting, such as uniformity ratio, floating fibre index (F.F.I.) or fibre length irregularity percentage, etc., may have good correspondence with yarn irregularity.

(*vi*) Knowledge of uniformity ratio in a cotton sample along with its 2.5 per cent span length will give sufficient information to predict the performance of a cotton as regards irregularity in yarns spun out of it and it may not be necessary to determine F.F.I.

(*vii*) In general, the various measures used for expressing yarn irregularity had better correlations with fibre length parameters determined using the Digital Fibrograph than with those determined using the Balls Sorter. Hence, it may be concluded that as compared to Balls Sorter, the Digital Fibrograph is not only a rapid testing instrument but also gives parameters of fibre length which are more useful for prediction of yarn irregularity.

18. Fabrication of a Miniature Spinning Plant with O.M. System of Super High-Drafting

During the year, the fabrication of the plant was completed; for this purpose several parts were designed and made in the Laboratory's Workshop. As there is no foundry in the Laboratory, the parts which required casting were obtained from some local foundries and these were then fitted after necessary shaping. The driving motor was fixed and temporary electric connections were provided for working of the motor. All the driving and driven parts were adjusted ensuring smooth working. The performance of the unit was scrutinised by actual spinning test. The working of the fabricated plant was satisfactory.

19. Study of the Spinning of Mixings of Different Cottons

During the year, six mixings were processed for testing. Particulars of the six mixings are given below :

Mixings suitable for 40s and above

Mixing	Store No.	Cotton	Mean fibre length (mm)	Micronaire value	Maturity coefficient	H.S.C.
1.	693216	M.C.U.2	25·6	3·2	0·67	44s
	690967	Badnawar 1	26·0	3·3	0·73	45s
	691605	Laxmi (Raichur)	23·4	3·6	0·71	34s
2.	691105	M.C.U.1	25·4	4·3	0·79	41s
	691106	Badnawar 1	26·0	3·3	0·73	45s
	691605	Laxmi (Raichur)	23·4	3·6	0·71	34s
3.	690001	Deviraj	26·0	4·2	0·73	38s
	693216	M.C.U.2	25·6	3·2	0·67	44s
	690967	Badnawar 1	26·0	3·3	0·73	45s

Mixings suitable for about 30s

4.	690110	Gaorani 46	21·9	5·2	0·83	30s
	691605	Laxmi (Raichur)	23·4	3·6	0·71	34s
	691602	Narmada	23·0	4·3	0·76	31s
5.	690337	L.147	22·3	3·7	0·72	28s
	691605	Laxmi (Raichur)	23·4	3·6	0·71	34s
	690302	320F	22·1	4·5	0·81	30s
6.	691605	Laxmi (Raichur)	23·4	3·6	0·71	34s
	691602	Narmada	23·0	4·3	0·76	31s
	690337	L.147	22·3	3·7	0·72	28s

20. Adaptation of Micronaire Instrument for the Determination of Fibre Weight per Unit Length of Very Coarse Desi Cottons

During the period under report, determination of the Micronaire value of all the *desi* cottons using a plug of 60 grains and a pressure of 6 lb in the Micronaire was completed. Also, the Micronarie values of the same cottons using a plug of 50 grains and a reduced pressure of 4 lb in the Micronaire were determined. The statistical analysis of the data is in progress.

21. Effect of Pests and Diseases on the Quality of Cotton

The fibre tests on 10 samples of Gaorani 46 and four samples of B.147 from Nanded (Maharashtra), pertaining to 1966-67 season, were completed. With the completion of these tests, the results of all the fibre tests on 268 samples received from different agricultural centres were available. The data could not be combined since the treatments and varieties differed from season to season. Hence, the results of each season are being separately analysed. So far the results of 170-Co.2, 320F, Vijalpa, N.14 and 216F have been analysed. The results are given in Table 6 (page 40).

22. Determination of Balls Sorter Equivalent Values of Mean Fibre Length of Cotton for Different Values of 2.5 per cent Span Length and Uniformity Ratio of Digital Fibrograph

During the year under report, statistical analysis was carried out on the test results of 1,903 samples for which experimental evaluation of mean fibre length by Balls Sorter and span length measurements on Digital Fibrograph were made during the previous year.

For the purpose of correlation analysis, the length data were broadly grouped into three classes on the basis of mean fibre length, in order to study the effect, if any, of the relationship between the length parameters at different length levels. The first group of 160 cottons had mean length below 0.85″, the middle group of 1,471 had mean length lying between 0.85″ and 1.14″ and the third group of 272 with mean length exceeding 1.14″. The simple correlation coefficients obtained between the mean length and span length values were as follows :

Group	Mean length (in.)	Number of cottons	Simple correlation coefficient between mean fibre length and 2·5% span length	Regression equation
First	Below 0·85	160	+ 0·9640**	$L=0·865\ L_1+0·0530$
Second	0·85 to 1·14	1,471	+ 0·9759**	$L=0·786\ L_1+0·1397$
Third	1·15 and above	272	+ 0·9662**	$L=0·828\ L_1+0·1063$
	All cottons	1,903	+ 0·9891**	$L=0·844\ L_1+0·0769$

** Highly significant at 1 per cent level.

TABLE 6 : EFFECT OF INSECTICIDAL TREATMENTS ON FIBRE PROPERTIES OF COTTON

Treatment	Variety	Place	Season	Seed and fibre properties that have significantly increased
Endrin + BHC + DDT	170-Co.2	Poona	1963-64	Reflectance percentage (+ Rd)
Carbaryl	,,	,,	1964-65	Bundle strength (zero gauge)
Endrin + Malathion	216F	Raya	1963-64	,,
Telodrin	,,	,,	1964-65	,,
Malathion	,,	,,	,,	Bundle strength and maturity coefficient
Sevin (Carbaryl)	,,	,,	,,	Oil content
All treatments	320F	Ludhiana	1963-64	Bundle strength (zero gauge)
All treatments (excepting BHC + DDT)	,,	,,	,,	,, (1/8″ gauge)
Telodrin	Vijalpa	Surat	,,	Fibre length and maturity coefficient
Carbaryl	,,	,,	,,	Fibre length, fibre fineness and bundle strength (1/8″ gauge)
DDT + BHC	,,	,,	,,	Fibre length
Carbaryl	N.14	Nandyal	,,	Bundle strength (zero gauge) and maturity coefficient
Endrin	,,	,,	,,	Micronaire value, bundle strength (zero gauge and 1/8″ gauge) and maturity coefficient
Telodrin	,,	,,	,,	,, ,,

In Table on page 39, L stands for estimated mean length and L_1 represents observed values of 2.5 per cent span length on Digital Fibrograph. The values of the standard error of estimate obtained from the simple correlation coefficient values were all very low, of the order of 0.02. Contrary to expectation, the multiple correlation coefficient values worked out with respect to 2.5 per cent span length as well as uniformity ratio did not show any significant improvement over the simple correlation coefficient obtained.

The general regression equation obtained from the present study(1) and the existing prediction equation (2) are, respectively :

$$L = 0.844\ L_1 + 0.0769 \quad (1)$$
$$L = 0.898\ L_1 + 0.0565 \quad (2)$$

To assess the degree of accuracy of the predicted values of mean length from given results of 2.5 per cent span length measurements, in comparison with the conversion equation now in use, four calibration check samples supplied by the United States Department of Agriculture with standard values of span length measurements and corresponding values of mean length by Suter Webb, were used for prediction purposes. The values obtained are as follows :

Calibration sample	2·5% span length (in.)	Equivalent mean length by Suter Webb (in.)	Predicted value (in.) of mean length from the given span length values from	
			Equation (1)	Equation (2)
"O"	0·88	0·80	0·82	0·84
"P"	1·05	0·97	0·96	1·00
"Q"	1·18	1·08	1·07	1·12
"R"	1·30	1·15	1·17	1·22

It is found that the existing equation (2) over-estimates Balls Sorter equivalent values to a significant extent, whereas the predicted values from the new equation (1) compare well with the standard values at all levels.

During the current year, the study of length evaluation by Balls Sorter and by Digital Fibrograph was continued by carrying out tests on 1,959 samples of 1969-70 season, in order to confirm the findings of the analysis already made. Statistical analysis of the test data is in progress.

23. Comparison of the Single Strand Tests made on the Uster Automatic Tester and the Scott Inclined Plane Tester

The values of single yarn strength and per cent elongation at break obtained on Uster Automatic Tester and Scott Inclined Plane Tester have been compared. In the previous Annual Reports, the data on yarn samples spun to 20s, 30s, 40s, and 60s counts have been furnished. During the period

under review, three samples of yarn spun to 80s counts were tested on the two instruments. The conclusions were in confirmity with earlier findings. The single yarn strength values obtained on both the instruments were almost on par, while per cent breaking elongation values obtained on the Uster Automatic Tester were slightly higher than those obtained using the Scott Inclined Plane Tester. The single yarn strength and per cent elongation at break obtained on the Uster Automatic Tester were correlated significantly with corresponding values obtained on the Scott Inclined Plane Tester.

24. Studies on the Influence of Fibre Length and Strength Parameters on Spinning Performance

During the year under report, statistical analysis was carried out on the fibre test results obtained from a preliminary study on 20 samples and skein C.S.P. values for 30s (P_{30}) and 40s (P_{40}) counts of the yarn processed from these cottons.

The simple correlation coefficients obtained were as follows :

Fibre properties		With skein C.S.P. values	
		at 30s counts P_{30}	at 40s count P_{40}
Mean fibre length	(L)	+ 0·4978*	+ 0·4760*
2·5% span length	(L_1)	+ 0·4010	+ 0·3741
50% span length	(L_2)	+ 0·5565**	+ 0·4833*
Uniformity ratio	(u)	+ 0·3926	+ 0·2814
Floating fibre percentage	(F)	− 0·3866	− 0·2877
Fineness by Micronaire	(f)	− 0·0728	− 0·0692
Percentage of mature fibres	(M)	+ 0·1845	+ 0·2497
Bundle strength at 0″ gauge length	(S_0)	+ 0·3937	+ 0·2702
Bundle strength at 1/8″ gauge length	(S_1)	+ 0·7297**	+ 0·6931**
Strength uniformity, i.e. $\frac{\text{strength at 1/8″ gauze length}}{\text{strength at 0″ gauge length}}$	(S_u)	+ 0·6926**	+ 0·7110**

The association of the various fibre characteristics with spinning potential as revealed by the values of correlation coefficients, was mostly according to expectation, the fibre length and strength factors contributing most. Of the fibre strength measurements, the values at 1/8″ gauge length showed higher values of correlation with skein C.S.P. values than bundle strength at zero gauge length. Similarly, strength uniformity, or the ratio of strength at 1/8″ gauge length to strength at zero gauge length, was found to be highly associated with spinning performance.

A further study was made of the measure of uniformity ratio obtained on the Digital Fibrograph in the context of assessment of the quality of cotton. It was felt that the value of uniformity ratio for long and extra-long staple cottons were appreciably underestimated as compared to cottons of shorter staple. Hence, a uniformity measure, which gives due weightage for the

staple length of cotton, also appears to be preferable. An ideal uniformity ratio (I.U.R.), for all the 20 cottons included in the preliminary study, was worked out using the formula, $I.U.R. = 51.3 + \frac{7.3}{L_1}$, where L_1 represents span length at 2.5 per cent. The ratio of observed uniformity ratio, to the ideal uniformity ratio in each case, which could be termed as the effective uniformity index, for the particular cotton, is suggested as a new quality measure of uniformity. The correlation coefficients between the effective uniformity index and yarn C.S.P. values at 30s and 40s counts for the 20 cottons, were 0.4448 and 0.3366, respectively.

Experimental evaluation of span length measurements on the Digital Fibrograph and bundle strength measurements at both zero and 1/8″ gauge lengths were carried out on 76 samples of cotton belonging to the medium and long staple varieties during the year under report.

25. Research Work Done at Regional Stations

DHARWAR

Investigation on the effect of gibberallic acid (G.A.) treatment of Laxmi cotton flowers and its effect on fibre quality was carried out for three seasons. It consisted of treatments with three different concentrations of G.A. The untreated and treated bolls were analysed for ginning percentage, mean fibre length, mean fibre weight, fibre maturity and fibre bundle strength. No significant effect of G.A. was observed on the above characters.

INDORE

An experiment was undertaken to find out the influence of boll size on the fibre properties. Badnawar 1 and B.59-1684 grown in 1967-69 seasons were selected. The big and small size bolls of these varieties were collected separately and the fibres from these were tested. It was observed that the fibres from small bolls were significantly finer and stronger compared to those from big bolls. The boll size had no influence on fibre length and fibre maturity.

SURAT

A preliminary investigation was carried out to determine the optimum gin settings with the Bardoli hand-gin for the removal of green fuzz occurring in patches in some hybrid cottons. It was indicated that tight roller settings and high gin speeds induced a greater seed damage and fuzz removal. If sufficient care was exercised to avoid high gin speeds and tight roller settings, the incidence of green fuzz in the lint could be reduced. The green fuzz seeds were found to be heavier and rather less prone to damage in ginning than the white fuzz seeds. Further work will be carried out using Laboratory Model Gin.

III. Publications

During the year, two Technological Reports, three research publications, three articles, one miscellaneous publication and two Annual Reports were published, and 77 Technological Circulars were issued. Further, five articles were sent for publication and three articles contributed for being presented at a conference. The details are given below :

A. Technological Reports

No. 7. Technological Report on Trade Varieties of Indian Cottons, 1968-69 Season.

No. 8. Technological Report on Standard Indian Cottons, 1968-69 Season.

B. Research Publications (*C.T.R.L. Publications—New Series*)

No. 20. Studies on Swelling of Cellulose. Part I: Intracrystalline swelling and decrystallization in zinc chloride treated cotton cellulose–by S. M. Betrabet, E. H. Daruwalla, H. T. Lokhande and M. R. Padhye. (Reprinted from *Cellulose Chemistry and Technology* (Rumania), **3**, 309-323, 1969.)

No. 21. Effect of Foliar Application of Fertilizers on the Fibre Quality of Laxmi Cotton—by M. S. Sitaram and E. S. Abraham. (Reprinted from *Indian Journal of Agricultural Sciences*, **40** (9), 772-775, 1970.)

No. 22. A Study on Wax Content and Its Relation to Moisture Regain and Tensile Strength of Cotton Fibre—by S. N. Pandey and R. L. N. Iyengar. (Reprinted from *Textile Research Journal*, **40** (12), 1053-1058, 1970.)

C. Articles and Papers

(*a*) *Published*

1. C.T.R.L.—A Vital Link Between Breeders and the Textile Industry—by V. Sundaram. (Published in *Indian Farming*, Vol. XX, No. 5, August 1970 issue.)

2. Colour and Lustre of Cotton—by P. G. Oka and V. Sundaram. (Published in *Indian Farming*, Vol. XX, No. 6, September 1970 issue.)
3. Towards Self-Sufficiency in Superior Quality Cotton—by V. Sundaram (Published in "*Commerce*," 1970 Annual issue.)

(*b*) *Sent for Publication*

1. Cottonseed—A Valuable Agricultural Product—by S. N. Pandey.
2. Instrumental Evaluation of Cotton Quality—by V. G. Munshi and C. A. S. Aiyar.
3. Study of Cottonseeds from Different Stages of Growth—by S. N. Pandey.
4. Importance of Yarn Testing in Quality Control Programme—by V. G. Munshi.
5. Formation and Reactions of Radiation Induced Free Radicals in Chemically Modified Cotton Celluloses—by P. K. Chidambareswaran, V. Sundaram and Jai Prakash.

(*c*) *Contributed at the 12th Joint Technological Conference, Sponsored by ATIRA, BTRA and SITRA—February 1971*

1. A Critical Assessment of Various Methods of Fibre Length Measurement of Cotton—by V. Venugopalan, R. L. N. Iyengar and V. G. Munshi.
2. Density of Textile Fibres. Part I : Design and performance of Modified Density Gradient Tube for measurement of density under various conditions of temperature and relative humidity—by Jai Prakash and P. N. Elayathu.
3. Influence of Some Fibre Length Parameters on Yarn Irregularity—by A. V. Ukidve, V. Sundaram and P. G. Oka.

D. Annual Reports

1. Annual Report of the Cotton Technological Research Laboratory for the Calendar Year 1966 (issued through the Indian Council of Agricultural Research).
2. Annual Report of the Cotton Technological Research Laboratory for the Calendar Year 1968.

E. Miscellaneous Publication

Testing House Rules and Regulations, and Schedule of Fess for Various Tests.

F. Technological Circulars

(*i*) Nos. 35 to 67 on Standard Indian Cottons.

(*ii*) Nos. 1610 to 1653 on Trade Varieties of Indian Cottons.

Standard Indian Cottons—1968-69 Season

S.C. No.	*Variety*	*S.C. No.*	*Variety*
35	Gaorani 22 (Maharashtra)	42	Sea Island Andrews
36	L.S.S.	43	K.6
37	Jayadhar	44	Laxmi (Maharashtra)
38	H.14	45	Narmada
39	Gaorani 22 (Mysore)	46	Laxmi (Mysore)
40	Laxmi (Tamil Nadu)	47	Gaorani 46
41	Westerns		

1969-70 Season

48	A.K.235	58	Deviraj (Gujarat)
49	Narmada	59	Deviraj (Mysore)
50	H.14	60	Sanjay (Amreli)
51	320F	61	M.C.U.1 (Winter)
52	L.S.S.	62	Jayadhar
53	Digvijay	63	Gaorani 22 (Maharashtra)
54	A.K.277	64	Gaorani 46
55	Gujarat 67	65	Laxmi (Mysore)
56	V.797	66	Laxmi (Tamil Nadu)
57	Gaorani 22 (Mysore)	67	Westerns 1

Trade Varieties of Indian Cottons—1968-69 Season

T.C. No.	*Variety*	*T.C. No.*	*Variety*
1610	K.6	1614	M.C.U.1 (Rainfed)
1611	Westerns	1615	Gujarat 67 (Kutch)
1612	Suyodhar	1616	Oomras (Barsinagar)
1613	Laxmi (Tamil Nadu)		

1969-70 Season

T.C. No.	*Variety*	*T.C. No.*	*Variety*
1617	Virnar (Khandesh)	1636	Buri 1007 (Vidarbha)
1618	Laxmi (Maharashtra)	1637	320F (Punjab)
1619	M.C.U.2 (Summer)	1638	Y.1
1620	Sanjay (Botad)	1639	M.C.U.1 (Coimbatore)
1621	Bengal Desi (Punjab)	1640	L.S.S.
1622	Ganganagar 1 (Desi)	1641	L.147 (Adilabad)
1623	Maljari	1642	Virnar (Khandesh)
1624	H.14	1643	Laxmi (Raichur)
1625	Deviraj (Nagar)	1644	Badnawar 1
1626	A.K.277	1645	A.K.235 (Akola)
1627	Kalyan (Bavla)	1646	Narmada
1628	Digvijay (Dabhoi)	1647	V.797
1629	Gaorani 6 (Bhainsa)	1648	Laxmi (Gadag)
1630	Digvijay (Palej)	1649	Deviraj (Manavadar)
1631	Deviraj (Mysore)	1650	Comillas
1632	Gujarat 67	1651	Jayadhar (Hubli)
1633	Gaorani 46	1652	Buri 147 (Vidarbha)
1634	Sea Island Andrews (A.P.)	1653	Sanjay (Maharashtra)
1635	Gaorani 22 (Maharashtra)		

IV. 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 research stations in the States and the samples of the improved cotton strains evolved under different research projects are tested for quality characteristics at the main Laboratory as well as at the regional stations maintained under its charge. 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 inasmuch 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 cotton, yarn and cloth for special tests, from commercial firms and 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 1970, together with the corresponding figures for 1969 and for the quinquennium 1960-65 are given in Table 7.

TABLE 7 : NUMBER OF SAMPLES RECEIVED FOR PAID TESTS

Type of test	Average for the quinquennium ending May, 1965	1969	1970
Spinning	52	2	18
Fibre (E.I.C.A.)*	148	27	63
Fibre (Others)	155	166	46
Yarn	168	119	74
Cloth	158	90	44
Moisture	933	68	78
Miscellaneous tests	16	32	24
Total	1,630	504	347

*These samples from the East India Cotton Association Limited, Bombay, are tested free of charge as the E.I.C.A. 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 1970, for carrying out tests on these samples, amounted to Rs. 9,864.00 against Rs. 10,279.50 during 1969.

Apart from the usual tests of routine nature, some of the special interesting investigations carried out during the year under report, are listed below :

1. Three samples of PVC cloth were tested for their breaking strength, both warpway and weftway.
2. One sample of rubberised canvas was received for tests of breaking strength and elongation at a particular load.
3. Three cones of high tenacity synthetic yarns were received for determination of denier.
4. One sample of hair belting yarn was received to determine worsted count.

Training Facilities

The Laboratory is conducting two training courses, each of two months duration, for persons employed in Cotton Trade and Co-operative Marketing Societies, one for those in Bombay City and the other for those coming from mofussil centres. During the year, the following seven students were selected and given training in fibre tests and elements of statistics :

Shri B. E. Banaji	..	The Tata Mills Ltd., Bombay 1.
Shri D. P. Mathuria	..	M/s. Khimji Damji & Co., Bombay 1.
Shri U. R. Shah	..	M/s. Bhaidas Cursondas & Co., Bombay 1.
Shri C. L. Kamat	..	India United Mills, Bombay 1.
Shri D. A. Rajaram	..	M/s. D. V. Aswathnarayan Rao, Bellary 1.
Shri V. R. Sirur	..	M/s. Cotmac Pvt. Ltd., Hubli.
Shri K. K. Hulgi	..	M/s. Cotmac Pvt. Ltd., Hubli.

Supply of Equipments

There was continued demand for the instruments fabricated at the Laboratory. The following instruments were fabricated and supplied to various organisations :

Laboratory Model Gins	12	Halo Length Discs (Small Size)	11
G. P. Balances	21	Halo Length Discs (Large Size)	9
A. N. Stapling Apparatus	2	Halo Length Cards	24
Steel Combs	42		

V. Conferences and Symposia

The Director and/or other Scientific Officers of the Laboratory participated in the following scientific and technical conferences and meetings connected with the work of this Laboratory.

Conference/Meeting	*Place*	*Date*
Sasmira's Fifth Technological Conference	Bombay	12-1-1970 to 14-1-1970
First All India Wool Technological Conference	Bombay	19-1-1970 and 20-1-1970
Sixteenth Meeting of the Standing Working Committee of the Textile Division Council	New Delhi	27-2-1970
38th Meeting of the Physical Methods of Test Sectional Committee TDC-1	Bombay	18-3-1970
First Meeting of Panel for Market Varieties of Cotton Fibres TDC2:1:1	Bombay	24-3-1970
Workshop Meeting of Cotton Research Workers of Northern Zone	New Delhi	1-4-1970 to 3-4-1970
5th Meeting of the Indian Cotton Development Council	Bombay	18-4-1970
Meeting of the Advisory Board of the I.C.A.R.	New Delhi	21-4-1970
Annual General Meeting of the I.C.A.R. Society	New Delhi	22-4-1970
Seminar on Ring Spinning arranged by B.T.R.A.	Bombay	24-4-1970
Workshop Meeting of Cotton Research Workers of Central Zone	Bombay	5-5-1970 to 7-5-1970
Fourth Meeting of the Directors of Research Institutes under the I.C.A.R.	Simla	4-6-1970 to 7-6-1970
Fourth All India Workshop Meeting of Cotton Research Workers (including Southern Zonal Meeting)	Coimbatore	10-6-1970 to 13-6-1970

Conference/Meeting	*Place*	*Date*
39th Meeting of the Physical Methods of Test Sectional Committee TDC-1	Bombay	14-8-1970
Meeting of the Scientific Panel on Agricultural Sciences Technology of the I.C.A.R.	New Delhi	18-8-1970 and 19-8-1970
I.C.A.R. Seminar on Methodology of Studying Productivity in Agriculture	New Delhi	19-8-1970 to 21-8-1970
Panel for Market Varieties of Cotton Fabrics TDC 2:1:1	Madurai	21-9-1970
30th Meeting of TDC 2 in Joint Session with TDC 2:1	Madurai	22-9-1970
6th Meeting of the Indian Cotton Development Council	Bombay	17-10-1970
Thirteenth Indian Standards Convention of Indian Standards Institution, New Delhi	Bombay	13-12-1970 to 20-12-1970
Meeting of the Representatives of Test Houses and Various Users of Testing Services	Bombay	14-12-1970

It may be mentioned that the Laboratory was responsible for organising and holding the Workshop Meeting of the Cotton Research Workers of the Central Zone, under the All India Coordinated Research Project on Cotton. In addition to the above, a series of internal seminars were organised during the year.

A Conference of the Senior Research Staff of the Laboratory and Senior Research Assistants in charge of the regional stations was convened on the 27th November, 1970. Dr. R. L. N. Iyengar, ex-Director, Shri Hari Rao Navkal, Retired Senior Research Officer, and Shri R. Krishnamourthy, Assistant Breeder, Indian Agricultural Research Institute, Regional Centre, Coimbatore, also participated in the Conference. The Proceedings of the Conferrence are given in Appendix III.

VI. Summary of the Report

This is the forty-seventh Annual Report of the Laboratory and pertains to the year 1970.

The research activities and the testing work progressed satisfactorily as in the past. During the financial year 1969-70, a sum of Rs. 11.78 lakhs had been spent against a sum of Rs. 13.90 lakhs sanctioned. The savings amounting to Rs. 2.12 lakhs arose due to delay in filling up of sanctioned posts and in the purchase of certain scientific equipments provided for. Apart from this, an expenditure of Rs. 1.78 lakhs was incurred on technological schemes (including projects financed from P.L. 480 funds) against the sanctioned grant of Rs. 2.00 lakhs.

Some further progress has been made in the expansion and modernisation programme of this Laboratory. The airconditioning plant has been fitted with automatic controls imported from the U.S.A. Most of the imported blow-room machinery has been installed. The Council has been approached for its approval to undertake complete rewiring of the Spinning Section to enable the commissioning of the new spinning machinery.

1. During the year, over 3,100 samples of cotton received from breeding, agronomic and other trials at the various centres of research in the cotton growing States were evaluated for quality by testing for fibre properties and spinning performance at the Laboratory. Of these, 1,540 belonged to the trials conducted under the All India Coordinated Research Project on Cotton and the rest to other State schemes. In addition, fibre tests were carried out on a large number of samples at the nine regional stations maintained by the Laboratory. Arrangements were made for having some of the most promising improved strains, such as 355-E.6, G.S.23, S.C.8-126, Vijaya, 3870-S.B. and 3870-IV/1 tested in leading textile mills.

In North Zone, the main varieties under cultivation at present are 320F and H.14. The test results for the last three years revealed that the strain A.218 is distinctly superior to 320F. It is understood that this strain (A.218) has recorded nearly the same yield as that of 320F. Another strain of superior quality is R.S.89 from Rajasthan. This strain has recorded higher yield than A.218 during 1969-70 season.

As regards the promising strains in Central Zone, it may be mentioned that many strains belonging to *G. hirsutum* species, viz. B.59-1684, A.56-347,

66BH5/91, etc., recorded encouraging technological performance. Further, the two strains, A.218 from North Zone and M.C.U.5 from South Zone, gave very good performance at several places in the Central Zone. In addition to this, many hybrid trials were found successful as the strains, viz. Hybrid 4 and IAN cultures [(IAN.579(188) and IAN.579 (1456)], in these trials, recorded execptionally high yields with encouraging technological performance compared to the existing control varieties. Among *G. barbadense* strains tried at Surat, the strains N.28, Sujata and Giza 7 recorded good spinning perforformance at 80s count.

Another interesting fact which requires special mention is that in the comparative trials of *desi* and *G. hirsutum* types under rainfed conditions, the *G. hirsutum* strains have recorded higher yields in various locations in Maharashtra and Madhya Pradesh. It need not be pointed out that the *G. hirsutum* strains are superior to *desi* in spinning potential. This indicates that the replacement of *desi* strains by *G. hirsutum* types will result not only in increasing the total production of cotton but also in the production of better quality cottons than the existing types.

In the case of important *G. hirsutum* trials conducted at centres in South Zone, the strains M.C.U.5, Vijaya, M.C.U.4, etc., continued to record good technological performance this year also. In addition, the *G. barbadense* strain, Sujata, has continued to record good performance. Sujata also gave good technological performance when grown at several centres in the Central Zone.

On the basis of the technological performance, the new *G. hirsutum* strain, Bharathi, has been found suitable for the replacement of existing *G. arboreum* variety, K.7, in the rainfed Karunganni tract of Tamil Nadu.

2. A number of samples of Trade Varieties and certain improved strains were tested for oil, gossypol and protein contents. Gossypol content was observed to be high in B.1007, 3943, Badnawar 1 and K.6 and low in Badnawar glandless, 3435, 815-3-1-3362 and E.L.156E strains.

3. Lint samples of M.C.U.3 cotton were treated with zinc chloride of various concentrations at different temperatures. The treated samples were tested for iodine absorption, barium activity number, moisture regain, dye absorption, D.P. and crystallinity. It was observed that zinc chloride was a powerful swelling reagent for cellulose at certain concentrations; maximum swelling of cotton was observed on treatment with 70 per cent solution of zinc chloride for 2 hours. Treatment of cotton with 60 per cent solution showed appreciable change in crystallinity, D.P., barium activity number, moisture and dye absorption. Zinc chloride solution of more than 60 per cent concentration degraded the cotton fibre to an appreciable extent.

4. To study the effect of water stress and fertilizers on the fibre development, fibre properties were determined on the fibres extracted from bolls of Gujarat 67 and Digvijay cottons of different age growths, from 42 to 63 days, collected at weekly intervals. The results are being analysed.

5. In all, 32 cotton samples belonging to American *hirsutum*, Indian *hirsutum* and *herbaceum* species were tested for absorption of Carbolan Violet 2 R.S. dye, density and alkali centrifuge value (ACV). It was noted that American *hirsutum* cottons appeared to have larger pore size and higher crystallinity than *herbaceum* cottons.

6. Ten samples of raw cotton, yarn, fabric and healds were screened for viable count of bacteria, actinomycetes, yeasts and fungi. Four fungi and two actinomycetes were isolated by enrichment culture method. The cultures were identified up to genus as : *Streptomyces* sp. (4), *Aspergillus* sp. (3), *Scopulariopsis* sp. (2), *Paecilomyces* sp. (1), and *Sporotrichum* sp.(1).

Some cellulolytic marine cultures were also identified as : *Micromonospora* sp.(1), *Aspergillus* sp. (2), and *Paecilomyces* sp. (1).

Twenty cultures were grown in eight different media to study their comparative performance and to select the most appropriate medium for the growth of each of the promising cultures with respect to cellulase enzyme production. A review entitled "Recent Development on Microbial Degradation of Cellulose Textiles and Its Prevention" was sent for publication.

7. The project, "Investigation of the Preparation of Radio-resistant and Radio-sensitive Celluloses to Obtain Basic Information on the Chemistry of Cotton Cellulose", financed out of P.L.480 funds, was completed during the year. Under this project, raw and mercerised cottons, as well as cottons which had undergone various chemical treatments, like acetylation, benzylation, benzoylation, grafting with acrylonitrile and allylation, were subjected to gamma-ray radiation. The damage due to radiation was evaluated by analysing these samples for the changes in their various physical and chemical properties. The results will be published shortly. Some of the main findings are given below :

The effect of various chemical treatments on cotton showed that : (*i*) acetylation did not offer protection, (*ii*) grafting showed slight protection, (*iii*) allylation imparted protection at lower dosages, (*iv*) benzylation proved to be radio-resistent, and (*v*) benzoylation offered maximum radio-protection even at a low D.S. of 0.5 of benzoyl group.

The analysis of the degradation products of irradiation of raw cotton by chromatographic analysis showed the presence of glucose, cellobiose, xylose and arabinose. In addition, the presence of 2 keto-gluconic acid and glucuronic acid was also indicated, while the acetylated samples showed the presence of cellobiose and glucose.

The electron spin resonance analysis of benzoylated samples indicated that the protection offered by these samples may be due to energy transfer effects. In the case of allylated samples, the allyl group appeared to protect the cellulose molecule by undergoing changes within itself.

The presence of reagents like ethylene diamine during irradiation of cellulose offered excellent protection, while indole increased the harmful effects of radiation.

8. The strength uniformity ratio, which is the ratio of the tenacity at 1/8″ gauge to that at zero gauge, was observed to be higher for mercerised samples than for the corresponding raw cottons. Cottons which were less uniform in the raw state showed greater improvement in uniformity after mercerisation. Further work is in progress.

9. A series of oxycelluloses were prepared by the action of three specific oxidising agents, viz.: (*i*) sodium metaperiodate, (*ii*) potassium dichromate and sulphuric acid, and (*iii*) potassium dichromate and oxalic acid. The copper number values of these oxcycelluloses were determined. Other chemical and physical properties of these oxycelluloses are being examined.

10. The changes in yarn evenness, strength, C.V. in strength, etc., due to mercerisation were studied and their relationship examined. To study the influence of the length parameters on yarn irregularity, 30 cottons had been spun to three counts in each case and tested for yarn irregularity.

Some of the important conclusions were as follows :

(*a*) Fibre length variation had greater association with yarn irregularity than mean fibre length alone.

(*b*) In general, various measures used for expressing yarn irregularity had better correlation with fibre length parameters determined using the Digital Fibrograph than with those determined using the Balls Sorter.

11. A large number of fibres of Comillas cotton, which were examined for their twisting / untwisting behaviour in water, exhibited anticlockwise rotation during immersion in water. Generally, fibres rotating in the anticlockwise direction possessed an excess number of Z type of convolutions. A large number of tested fibre samples have been preserved for further investigation. This study is being continued using Giza 45 cotton fibres also.

12. An investigation on the transformation of cellulose I to cellulose II lattice brought about by swelling cotton and ramie fibres in aqueous solution of caustic soda was undertaken. X-ray diffraction photographs of some of the cotton and ramie samples examined indicated the presence of weak intensity due to crystalline cellulose I in the swollen cotton fibre sample while no such trace was seen in the swollen ramie sample. Detailed study is in progress.

13. During the period, four cotton samples were treated with 60, 70, 80 and 90 per cent concentrations of ethylene diamine (EDA) for studying the changes in the shape of cotton fibre. It was observed that the maximum change in circularity occurred with 80 per cent EDA. From an experiment conducted to study whether the changes in circularity due to various chemical treatments were of permanent nature, it was noted that it may not be possible to deform the circular shape of the treated fibre. It was also observed from another experiment that the fibres dried at lower temperature had more

circularity than those dried at higher temperature. When cotton fibre samples were treated in sodium hydroxide solution at different temperatures, it was observed that circularity decreased progressively with increase in temperature.

14. The data obtained earlier from the studies on the changes in density of cotton and other textile fibres with changes in temperature and relative humidity were analysed further and some more observations noted. Some of these were : (*a*) when dry cellulosic fibres absorb moisture, the maximum density value is reached at a particular relative humidity which remains a characteristic of the sample; (*b*) swelling of fibres increases with increase in relative humidity; (*c*) values of empty space derived from density data of all fibres at different levels of R.H. indicate a curvilinear relationship between empty space and crystallinity in fibres; and (*d*) density of all modified cotton fibres showed a declining trend with increase in the degree of substitution of the chemical groups. To study the development of crystallinity during the growth of cotton fibres, fibres from bolls of different ages of Digvijay and Gujarat 67 cottons are being examined for density.

15. The fabrication of a miniature spinning plant with O.M.S. system of super high-drafting was completed during the year and the plant was working smoothly.

16. To study the effect of pests and diseases on the quality of cotton, fibre tests were carried out on 10 samples of Gaorani 46 and four samples of B.147 from Nanded, pertaining to the entomological trials conducted during the 1966-67 season. The data on these and earlier samples were analysed. The results showed that in the case of trials with 170-Co.2, 320F, Vijalpa and N.14 cottons the fibres from plants sprayed with carbaryl had higher bundle strength than those from unsprayed control plants.

17. Based on the test results of over 1,900 cotton samples, regression equations have been worked out to estimate the mean length equivalent (L) from the 2.5 per cent span length values (L_1) obtained from the Digial Fibrograph for different staple length groups. The general equation applicable for all cottons is $L = 0.844\, L_1 + 0.0769$. Verification with actual test data has shown that this equation is better than that currently in use.

18. For comparing the single strand tests made in the Uster Automatic Tester and Scott Inclined Plane Tester, three samples of yarn were spun to 80s counts and tested on both the instruments. The conclusions were found to be in conformity with those observed for 20s, 30s, 40s and 60s counts earlier.

19. For studying the influence of fibre length and strength parameters on spinning performance, the fibre test results obtained from a preliminary study on 20 samples and skein C.S.P. values for 30s and 40s counts of yarns processed from those cottons were analysed. The results showed that the bundle strengths at 1/8″ gauge length and the strength uniformity ratio influenced yarn strength considerably. Further, a new measure, termed as 'effective uniformity index', worked out from the values of length parmeters

determined with the Digital Fibrograph, showed better association with the C.S.P. values than the uniformity ratio.

Publications

During the year, two Technological Reports, three research publications, three articles, one miscellaneous publication and two Annual Reports were published. Besides, 77 Technological Circulars on selected Standard Indian Cottons and major Trade Varieties were issued. Further, five articles were sent for publication in various journals and three articles contributed at a scientific conference.

Training

During the year, training courses for persons employed in the Cotton Trade and Co-operative Marketing Societies, etc., were conducted and seven persons completed the course successfully.

Fabrication and Supply of Instruments

There was continued demand for the instruments fabricated at the Laboratory. During the year, 12 Laboratory Gins, 21 Ginning Percentage Balances, 2 A.N. Stapling Apparatus, 11 Halo Length Discs (Small Size), 9 Halo Length Discs (Large Size), 24 Halo Length Cards and 42 Steel Combs were fabricated and supplied to those who had asked for them.

VII. Personnel

During the year, the scheme for modernisation and strengthening of the Laboratory for intensive research on cotton in the Fourth Five Year Plan was sanctioned by the Council, at an estimated expenditure of Rs. 22 lakhs, with *inter alia* the following complement of staff :

Staff	*No. of posts*
Senior Scientists (Rs. 1100-1400)	3
Senior Scientific Officer (Rs. 700-1250)	1
Junior Scientific Officers (Rs. 400-950)	5
Assistant Quality Evaluation Officers (Rs. 350-900)	2
Senior Research Assistants (Rs. 325-575)	6

In addition, one post of Junior Scientific Officer (Rs. 350-900) was also added to the complement of the Laboratory on the non-Plan side, with effect from the 16th September, 1970.

Dr. S. M. Betrabet, Senior Scientific Officer, who had proceeded to U.S.A. on the 26th August, 1968, on foreign assignment to take up the Post-Doctoral Associateship of National Academy of Sciences, returned to India and joined the Laboratory on the 21st September, 1970. Dr. S. N. Pandey, Junior Scientific Officer, who was appointed to officiate as Senior Scientific Officer *vice* Dr. S. M. Betrabet, accordingly reverted to his original post from the 20th September, 1970.

The P.L.480 Project (Grant No. FG-IN-186) entitled, "Investigation of the preparation of radio-resistant and radio-sensitive celluloses to obtain basic information on the chemistry of cotton cellulose", terminated on the 14th August, 1970, and the Fourth Five Year Plan Scheme was put into operation with effect from the same date.

Kumari I. G. Bhatt, Junior Scientific Officer, who was working under the P.L.480 Project, was transferred to a similar post on the non-Plan side, with effect from the 16th September, 1970. Shri P. K. Chidambareswaran was appointed to the post of Junior Scientific Officer, from the 2nd February, 1970.

The incumbents of the two posts of Senior Research Assistants, under the P.L.480 Project (viz. Smt. Vatsala Iyer and Shri A. W. Shringarpure) were also transferred to the posts of Senior Research Assistants under the Fourth Five Year Plan Scheme.

The Technological Unit attached to the Sub-Centre at Ludhiana under the All India Coordinated Research Project on Cotton, started functioning at Ludhiana, with the transfer of Shri Ram Parkash, Research Assistant, who joined there on the 5th July, 1970.

Shri N. S. Shah, Junior Scientific Officer, under the P.L.480 Project, resigned his post at the Laboratory for better prospects and was relieved on the afternoon of the 14th August, 1970. Sarvashri K. S. Shama Rao and V. Venugopalan, both Research Assistants, were relieved of their duties with effect from the afternoon of the 17th August, 1970 and the 31st December, 1970, respectively, to take up appointments under the Textiles Committee, Bombay. Shri V. A. Shukla, Research Assistant at Sriganganagar, was also relieved from the 21st September, 1970. Shri P. D. Vakil, Senior Research Assistant, retired from the services of the Laboratory from the 30th December, 1970, after a long and successful career of more than 32 years.

Four Research Assistants were recruited during the year. Of these, two persons, viz. Shri G. Faruk Sulaiman Hussain and Kum. Charulata R. Raje, were appointed from the 16th April, 1970, and the third, Shri B. S. Ganvir, from the 6th November, 1970, at this Laboratory. Shri E. Kesavan Kutty was appointed at the regional station at Nanded from the 16th April, 1970.

Shri V. V. Kshirsagar was appointed as Conditioning Plant Operator, from the 16th November, 1970.

Three Research Assistants (viz. Sarvashri P. V. Sivasankara Pillai, K. John and K. Presannan) were appointed for a short duration of about three months from April, 1970, to relieve the heavy pressure of testing of cotton samples.

A list of scientific and technical staff working at this Laboratory as on the 31st December, 1970, is attached (Appendix II).

V. SUNDARAM
Director

VIII. Appendices

APPENDIX I

FINANCIAL STATEMENT

Expenditure and Receipts of the Laboratory During 1969-70

A. Expenditure

	Sanctioned Grant (Rs.)	Actual Expenditure (Rs.)	Savings (—) Deficit (+) (Rs.)
I. TECHNOLOGICAL RESEARCH			
Technological Research Laboratory including regional stations			
(*a*) Capital expenditure including expansion of Laboratory	3,03,500	1,28,905	(—)1,74,595
(*b*) Working expenses	10,86,800	10,49,558	(—) 37,242
Rs.	13,90,300	11,78,463	(—)2,11,837
II. TECHNOLOGICAL SCHEMES including P.L.480 Projects	1,99,637	1,77,364	(—) 22,273

B. Receipts

	Rs.
Sale of Products (gins, etc.)	72,645
Sale of Vehicles, Machines, Tools, Plant Equipment, etc.	9,061
Analytic and Testing Fees	10,379
Rents	18,497
Fees for Training, Application Fees, etc.	2,995
Sale of Publications	5,405
Interest on Loans and Advances	36
Miscellaneous Receipts :	
Receipts towards overhead charges for P.L.480	
Project No. FG-IN-155	15,899
,, FG-IN-185	33,754
Other Miscellaneous Receipts (including sale of cotton)	26,443
Foreign Service Contribution	3,699
Total	1,98,813

APPENDIX II

Scientfic and Technical Staff Working at the Cotton Technological Research Laboratory as on the 31st December, 1970

Director	Dr. V. Sundaram, M.Sc., Ph.D., A.R.I.C.
Senior Scientific Officers	Dr. S. M. Betrabet, M.Sc., Ph.D. (on foreign assignment up to the 21st September, 1970)
	Shri R. P. Neogi, B.Sc., B.Sc. (Tech.) (Manch.), A.M.C.T. (Eng.)
	Dr. V. G. Munshi, M.Sc., Ph.D.
	Dr. N. B. Patil, M.Sc., Ph.D.
Junior Scientific Officer (Spinning)	Shri B. Srinathan, B.Sc. (Text.)
Junior Scientific Officers	Dr. S. N. Pandey, M.Sc., Ph.D. (officiating as Senior Scientific Officer up to the 19th September, 1970, *vice* Dr. S. M. Betrabet on foreign assignment)
	Shri G. S. Rajaraman, M.A.
	Kum. I. G. Bhatt, M.Sc.
	Dr. K. R. Krishna Iyer, M.Sc., Ph.D.
	Shri P. K. Chidambareswaran, M.Sc.

Senior Research Assistants (Testing)

Shri C. A. S. Aiyar, B.Sc.	Shri S. R. Ganatra, B.Sc.
„ S. Ramanathan	„ S. G. Nayar, B.Sc., LL.B.
„ P. N. Elayathu, M.Sc.	„ A. Rajagopalan, B.Sc.
Smt. S. B. Pai, B.Sc. (Hons.)	„ A. V. Ukidve, M.Sc.
„ K. L. Datar, B.Sc.	„ B. M. Petkar, B.Sc.
	(One post vacant)

Senior Research Assistant	(*Ginning*)	Shri D. G. Shete, L.M.E.
- do -	(*Electrical*)	„ H. V. Tamhankar, L.M.E., L.E.E.
- do -	(*Spinning*)	„ K. S. Bhyrappa, L.T.T.
		„ S. Raghupathi, D.T.T.
- do -	(*Statistics*)	„ K. Venkateswaran, B.A.
- do -	(*Microbiology*)	Dr. A. J. Desai, M.Sc., Ph.D.
- do -	(*Bio-chemistry*)	(Post vacant)

Research Assistants (Testing)

Shri K. R. Kamath, B.Sc.
„ P. K. Jairam, B.Sc.
„ V. Venugopalan, M.Sc.*
„ N. Thejappa, B.Sc.
Kum. I. K. P. Iyer, B.Sc.
Smt. S. D. Pai, B.Sc.
Kum. T. T. Annamma, B.Sc.
Shri A. K. Gupta, B.Sc. (Hons.)
Smt. J. K. S. Warrier, B.Sc.
Shri T. K. Madhusudana Das, B.Sc.
„ Jose Joseph, B.Sc.
„ K. Vijayan, M.Sc.
Smt. S. P. Bhatawdekar, M.Sc.
Shri P. Bhaskar, M.Sc.
Shri C. Varadaraj Rao, M.Sc.
Smt. P. Nair, M.Sc.
Shri C. R. Sthanu Subramoni Iyer, B.Sc.
„ K. V. Anantha Krishnan, B.Sc.
„ S. Vasudevan, B.Sc., B.Tech.
Kum. R. R. Nayak, B.Sc.
„ S. R. Jage, B.Sc.
Shri G. Viswanathan, B.Sc.
„ V. B. Suryanarayanan, B.Sc.
„ G. Faruk Sulaiman Hussain, M.Sc.
Kum. C. R. Raje, M.Sc.
Shri B. S. Ganvir, B.Sc.
(Three posts vacant)

Research Assistants (Statistics)

Shri K. Chandran, B.A.
(Two posts vacant)

Research Assistants (Spinning)

Shri N. K. Haridas, D.T.T.
„ H. R. Laxmi Venkatesh, D.T.T.

Research Assistant (Workshop)

Shri M. L. Sounkaria, D.M.E.

Regional Stations

Station	*Senior Research Assistant*	*Research Assistant*
Coimbatore	Shri S. K. Iyer, B.A.	Smt. S. V. Nayar, B.Sc.
Dharwar	Shri M. S. Sitaram, B.Sc.	Shri E. S. Abraham, B.Sc.
		Shri I. H. Hunsikatti, B.Sc.
Indore	Shri N. C. Chiplonkar, M.Sc., D.C.T.	Shri G. S. Patel, B.Sc.
Nanded	Shri W. R. Sharma, B.Sc.	Shri S. P. Ingole, M.Sc.
Nandyal	Shri R. Dwarakanath, B.Sc.	—
Sriganganagar	—	(Post vacant)
Surat	Shri L. R. Jambunathan, B.Sc., A.M.I.E.T.	Shri R. C. Sankalia

*Resigned with effect from the 31st December, 1970, afternoon.

APPENDICES

All India Coordinated Research Project on Cotton

(*a*) *Laboratory :*

Junior Physcist	Shri P. G. Oka, M.Sc.
Senior Research Assistant	Shri Radha Ballabha, M.Sc.

(*b*) *Outstations :*

Station	*Senior Research Assistant*	*Research Assistant*
Coimbatore	—	Shri C. P. Venugopalan, B.Sc.
Hissar	Shri S. N. Nagwekar, B.Sc.	—
Ludhiana (Sub-station)	—	Shri Ram Parkash, B.Sc.
Nanded	—	Shri E. Kesavan Kutty, B.Sc.
Nandyal	—	Shri Y. Subramanyam, M.Sc.
Sriganganagar	Shri A. K. Anthony, B.Sc.	—
Surat	—	Shri S. S. Iyer, B.Sc.
		Shri M. C. Bhalod, B.Sc.

Scheme for Modernisation and Strengthening of Cotton Technological Research Laboratory, for Intensive Research on Cotton During the Fourth Five Year Plan

Senior Research Assistants	Smt. V. Iyer, M.Sc.
	Shri A. W. Shringarpure, B.Sc.

APPENDIX III

Proceedings of the 22nd Conference of the Senior Research Staff of the Cotton Technological Research Laboratory and Senior Research Assistants in charge of the Regional Stations held on the 27th November, 1970

Present :

Dr. V. Sundaram (Director), *in the chair*
Dr. R. L. N. Iyengar (Retd. Director)
Shri Harirao Navkal (Retd. Senior Research Officer)
Shri. R. Krishnamourthy (Assistant Breeder, Coimbatore)
Dr. S. M. Betrabet
Shri R. P. Neogi
Dr. V. G. Munshi
Shri B. Srinathan
Shri P. G. Oka
Dr. S. N. Pandey
Shri G. S. Rajaraman
Kum. I. G. Bhatt
Dr. K. R. Krishna Iyer
Shri P. K. Chidambareswaran
Shri D. G. Shete
Shri H. V. Tamhankar
Shri S. Ramanathan
Shri P. N. Elayathu
Smt. S. B. Pai
Smt. K. L. Datar
Shri S. R. Ganatra
Shri S. G. Nayar
Shri A. Rajagopalan
Shri A. V. Ukidve
Shri B. M. Petkar
Shri K. S. Bhyrappa
Shri Radha Ballabha
Shri S. Raghupathi
Shri K. Venkateswaran
Dr. A. J. Desai
Smt. Vatsala Iyer
Shri A. W. Shringarpure
Shri V. Venugopalan
Shri A. K. Gupta
Smt. J. K. S. Warrier
Shri K. R. Kamath

Regional Stations :

Shri L. R. Jambunathan
Shri N. C. Chiplonkar
Shri M. S. Sitaram
Shri W. R. Sharma
Shri R. Dwarkanath
Shri S. K. Iyer
Shri S. N. Nagwekar
Shri A. K. Antony
Shri C. V. Raman

Director welcomed the distinguished members to the Conference, particularly Dr. R. L. N. Iyengar, ex-Director, Shri Harirao Navkal, Retired Senior Research Officer and Shri R. Krishnamourthy, Assistant Breeder, Indian Agricultural Research Institute Regional Centre, Coimbatore, who had taken keen interest in this Conference and spared their valuable time for participating in it. He also thanked Shri Krishnamourthy for kindly agreeing to give a talk on the "Evolution of superior germ plasm cottons" for the benefit of the research staff of the Laboratory. The various subjects on the agenda were then taken up seriatum.

Subject 1 : Green Fuzz in Hybrid Cottons, by Shri L. R. Jambunathan

Abstract : Patches of green fuzz are often found to occur in the ginned lint of some hybrid cottons. The ginning conditions leading to the removal of considerable fuzz in ginning are being investigated. It is seen that tight roller settings and high gin speeds are conductive to a greater seed damage rate and fuzz removal. If sufficient care is exercised to avoid high gin speeds and tight roller settings, the incidence of green fuzz in the lint could be reduced. The green fuzz seeds are heavier and rather less prone to damage in ginning than the white fuzz seeds. The study is in progress and the breeding aspects of the problem also will be taken up. The seeds of different fuzz colour will be segregated, their progenies raised and their different characteristics studied in an attempt to see if the green fuzz seeds could be eliminated altogether without sacrificing any desirable features of the hybrids.

The author described in brief the experiment and the results obtained.

THE CHAIRMAN then enquired whether the lint was checked for presence of excessive broken seeds.

SHRI JAMBUNATHAN answered in the affirmative and stated that the percentage of cut seeds was of the order of 10 to 14 per cent.

SHRI SHETE wanted to know the type of gin used for this investigation.

SHRI JAMBUNATHAN replied that the Bardoli Gin was used.

SHRI RAJARAMAN wanted to know whether the green fuzz was observed on all the seeds. He was informed that the green fuzz was noticed on only a few seeds.

SHRI KRISHNAMOURTHY desired to know in this context, whether F_1s or stabilized varieties were studied. From his experience, greenish fuzz did occur in earlier stages of hybrids, particularly in *hirsutum-barbadense* crosses, but in later generations, which became pure, the greenish colour in the fuzz disappeared on selection. He further pointed out that there were also a number of *hirsutum* varieties like Mex-50A with green fuzz, which did not present any difficulties during ginning.

SHRI JAMBUNATHAN said that F_5s were studied in the present investigation.

THE CHAIRMAN enquired whether this was the problem for Hybrid 4 and whether any fibre tests had been carried out on the fuzzy matter. It was stated that the variety was not Hybrid 4 and that no tests were carried out on the fuzz.

SHRI SHETE remarked that the design of the Bardoli Gin was very crude and accurate settings could not be made with it. This type of gin would not be suitable for ginning *kapas* with fuzzy seeds.

DR. IYENGAR corroborating Shri Shete's remarks observed that the Bardoli type hand gin was hardly the type suitable for this kind of investigation. It would present a wrong picture as compared to ginning by power gin. The Laboratory Gin could be used for this purpose. But he enquired of the object of this investigation and whether the green fuzz created any trouble in processing.

SHRI JAMBUNATHAN informed that the green fuzz did not pose any problem in spinning as the green fuzz spread into the entire mass of the fibres and did not remain as separate lumps.

SHRI SHETE pointed out that even presence of two per cent cut seeds in the lint is not desirable in ginning. He re-emphasised that the Bardoli Gin was not suitable for this type of investigation and the results obtained could not be relied upon.

SHRI KRISHNAMOURTHY observed that for this type of investigation the size of seeds should be uniform and enquired whether the size of the seeds with and without green fuzz were similar.

The consensus of opinion of the members was that the deductions based on the findings of Bardoli Gin cannot be generalised and would not have any practical value. Hence, the experiment should be repeated on the power gin. Further, it would be desirable to ensure *prima facie* that the characteristic was present in lint from pure and established varieties and in advanced stages of multiplication before undertaking such an investigation.

Subject 2 : Gibberallic Acid Treatment on Laxmi Cotton Flowers and Its Effect on Fibre Quality, by Shri M. S. Sitaram

Abstract : Investigation on the effect of gibberallic acid (G.A.) treatment on Laxmi cotton flowers and its effect on fibre quality was carried out for three seasons (1966-1969). The treatments consisted of T_1=Control; T_2=25 ppm of G.A.; T_3=50 ppm of G.A. and T_4=100 ppm of G.A. The experiment was laid in randomized lines, with four replications. The treated and untreated (Control) bolls were collected and analysed for ginning percentage, mean fibre length, mean fibre weight, fibre maturity and fibre bundle strength. The statistical analysis revealed that there was no significant effect of G.A. on the physical properties of cotton fibres.

The author gave a summary of the results obtained from the study.

THE CHAIRMAN, observed that, in general, no fibre property had shown any improvement with G.A. spray in this investigation.

DR. PANDEY enquired why higher doses of G.A. had not been used.

SHRI SITARAM replied that higher doses might harm the cotton bolls. At this stage, SHRI KRISHNAMOURTHY referred to similar work carried out by the Cotton Physiologist, Coimbatore, on M.C.U.5 and P.R.S.72 varieties treated with G.A., CCC and NAA and said that the seedlings were sprayed three to four times and the entire plant drenched. In the experiment with G.A., variety P.R.S.72 was used. The experiment was conducted in pots. The seedlings were completely sprayed with an acqueous solution of G.A. (100 ppm) at square formation stage. The treatment was repeated three weeks later. The G.A. tended to increase the fibre length and reduce the fibre weight. Bundle strength appeared to be slightly higher. He suggested that this experiment should be conducted in a glass house with small doses of insecticides.

In reply to an enquiry from Dr. Iyengar, SHRI SITARAM stated that the boll size was not affected by the treatments.

Finally, it was observed that the main objective of the hormone treatments and similar trials were usually laid out with the main objective of increasing the yields and accordingly there was very little effect on the fibre characters in such experiments.

Subject 3 : Effect of Boll Size of Cotton on Fibre Properties of Lint, by Shri N. C. Chiplonkar

Abstract : Boll size is one of the important plant characteristics that affects the yield of cotton. Of late, bigger bolls are often favoured for increasing the yield of cotton. The present investigation was undertaken to find out how far the change in boll size would influence fibre properties. Two *G. hirsutum* varieties, Badnawar 1 and B.59-1684, were selected for this study. They were grown during 1967-68 and 1968-69 seasons in randomised block design; the produce of big bolls and small bolls were ginned separately and the corresponding lint samples were tested for fibre properties. The statistical analysis of the results showed that fibres from smaller bolls were significantly finer and stronger than fibres from big bolls. The bolls size did not affect fibre length and fibre maturity.

The author described the salient findings from the investigation.

SHRI KRISHNAMOURTHY observed that the desirability or otherwise of breeding for bigger boll size cotton is a controversial one. In Russia and U.S.A., the trend is for growing bigger size bolls (6 g-12 g). In India, some advocated breeding for medium boll size (5 g-5·5 g for Co.2), but with a larger number of bolls.

In reply to an enquiry from some members, regarding the sampling procedure adopted for the bolls tested, SHRI CHIPLONKAR answered that no sampling procedure was adopted at the station, but 15 bolls received from the cotton breeder were tested.

SHRI NEOGI wanted to know whe ther boll size had any relationship with plant size.

THE CHAIRMAN remarked that there is no such relationship because the variety P.R.S.72 has small plant size but big bolls.

Subject 4 : Critical Assessment of Various Methods Used for Determination of Fibre Length of Cotton, by Shri V. Venugopalan

Abstract : Various types of instruments have been designed for the determination of fibre length of a sample of cotton. Since these instruments work on different principles and produce the test results in different parameters, a critical assessment of the comparative merits of the different methods from different angles is called for.

The aim of the present investigation is to make a comprehensive study of most of the length measuring methods presently in use. It also attempts to examine in detail the various concepts of length, to consider the differences observed between them and also to offer theoretical explanations for the observed differences. The inter-relationship between the different length parameters have also been worked out. Based on these findings, a critical comparison is made of the various methods with a view to assess their relative advantages. This has been done, taking into consideration, the time taken

for testing and other factors, such as convenience, accuracy of the test results, cost and machanical delicacy of the instruments.

The author gave a brief resume of the observations he had made from the study.

SHRI NAVKAL observed that in his experience, the effective length by the Baer Sorter was more precisely determined than the mean by the same instrument. In practice, he had found that those who determined the effective length agreed with each other better than those who determined the mean.

THE CHAIRMAN remarked that the Upper Half Mean and effective length from Uster Stapler were 12 per cent higher than the mean length obtained by the Balls Sorter.

In reply to Shri Chiplonkar, SHRI VENUGOPALAN stated that the mean length of the samples tested ranged from 0·58 in. to 1·35 in.

SHRI JAMBUNATHAN remarked that for neppy cottons, Balls Sorter tests seem to be a little tedious and, therefore, Fibrograph would be preferable.

DR. BETRABET pointed out that nowhere in the world, Balls Sorter is being used and as such there is no point in making observations using Balls Sorter values as standard.

THE CHAIRMAN, however, observed that the Balls Sorter is used in the United Arab Republic (Egypt).

DR. BETRABET suggested that it would be desirable to use a more widely adopted method, e.g. the Suter-Webb Comb Sorter or Baer Sorter as a standard in place of the Balls Sorter.

DR. IYENGAR opined that it was not advisable to use A.N. Apparatus as standard, since it involved considerable personal errror.

THE CHAIRMAN added that the accuracy of A.N. Apparatus depended on various factors, such as skill of the operator, the sharpness of the blades used for cutting, the fibre tuft, etc.

SHRI UKIDVE suggested that Fibro-sampler gave unbiased value and sufficient number of tests should be carried out on that device with a view to confirm the observations made by the author.

THE CHAIRMAN said that the use of Fibro-sampler was not always feasible as it needed larger quantity of material for tests for giving reliable results.

The final conclusion of the study, namely that the 2·5 per cent span length obtained from the Digital Fibrograph was the most quick and convenient, was generally accepted. The Digital Fibrograph is expensive and has to be imported. If this instrument goes out of order, proper servicing facilities and spare parts are not available in India.

Subject 5 : Changes in Density of Cotton Fibres at Different Stages of Growth, by Shri P. N. Elayathu

Abstract : After a very brief survey of various methods for the determination of density, the density gradient column method had been selected for the density determination. A modified density gradient column was designed and fabricated at the Laboratory for this purpose.

The changes taking place in the fine structure of cotton fibres during growth have been studied in terms of the differences observed in crystallinity of fibres as derived from their density values. The study also throws light on the part played by various factors in influencing the changes in the density values of the fibres.

The author gave a gist of this study undertaken by him and the conclusions arrived at.

SHRI JAMBUNATHAN remarked that density of fibres was generally low at the young age of 24 days.

SHRI SITARAM enquired whether maturity as determined by dyeing technique was related to crystallinity or not.

DR. BETRABET explained that there was no relationship between the two and the crystallinity might not be so low if the fibres were carefully purified. Maturity was a grosser parameter where the thickness of cell well, as a result of cellulose deposition, was mainly considered. Dyeing technique was not very accurate as penetration of dye in the material depends on the type of dye used, pore size, etc., while in the Density Gradient Method, liquid entered all the pores of the fibre.

SHRI SITARAM observed that in the earlier stages, the fibres were not as much cellulosic as they were after sufficient maturity period.

DR. KRISHNA IYER noted that there was only slight variation in crystalline amorphous ratio.

SHRI NAVKAL wanted to have an idea of the magnitude of the error associated with the density determination to which SHRI ELAYATHU replied that it could be measured accurately up to the 3rd decimal.

DR. PANDEY enquired how the crystallinity values obtained by gradient column and iodine absorption method were related.

SHRI ELAYATHU replied that there was a linear relationship between the two indices.

DR. BETRABET remarked that iodine absorption method as a matter of fact gave accessibility values and not the crystallinity values, whereas the Density Gradient Method gave the actual value of density from which the crystallinity value could be calculated.

THE CHAIRMAN enquired whether the D.P. value and the density value as obtained by the Gradient Method had any relationship.

SHRI ELAYATHU replied that they were correlated.

At the end of the Conference, there were two illuminating lectures :

Lecture 1 : "Electron Microscopial Study of Cottons Treated with Inter and Intra-crystalline Swelling Agents", by Dr. S. M. Betrabet.

Lecture 2 : "Evolution of Superior Germ Plasm Cottons", by Shri R. Krishnamourthy.

V. SUNDARAM