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CONTENTS

THE

INDIAN COTTON GROWING REVIEW

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HALF A CENTURY OF COTTON RESEARCH IN MADRAS STATE

By

L. NEELAKANTAN, J. KRISHNAMURTHY, D. S. RAJAGOPALAN AND K. RAMANUJAM

(Department of Agriculture, Madras)

Rambling investigations in the search for yielding better quality breeds of Madras cottons during the first two decades of this century met with sporadic successes in the shape of a few strains bred at the Agricultural Research Station, Koilpatti. They gained currency under the names Company (term reminescent of East India Company days) strains. But they soon fell out of cultivation either from lack of stability or adaptability. Meanwhile the growing textile needs of the State demanded finer cottons in increasing quantities. These experiences drew the attention of the State Government who became seized of the importance for stabilising cotton improvement work in the State on more scientific lines. Accordingly, the post of a full time Cotton Specialist was created in 1920 with headquarters at the Cotton Breeding Station, Coimbatore. Since then breeding and agronomic investigations have been tackled by the Cotton Specialist and his staff scattered in different parts of the State. Field lay out, technique of breeding in regard to field score and laboratory examination have been upgraded on latest methods obtaining elsewhere in the country and the world. Research on fundamental problems came to receive special attention.

The cotton tract of the State has been cut up into different zones each characterised by a distinct agro-climate. At present breeding investigations are conducted at Koilpatti, Periyakulam, Srivilliputtur, Aduthurai, Palur, Avanashi, Tiruchengode, Bhavanisagar and Coimbatore. While the State has provided men and material, the Indian Central Cotton Committee has been generously financing breeding investigations in different centres of the State. The enthusiasm and painstaking researches of a long line of Cotton Specialists from 1920 to-date like Mr. G. R. Hilson, Sri. V. Ramanathan, Sri. R. Balusubrahmanyan, Sri. C. Jagannatha Rao, Sri. S.M. Kalyanaraman and Sri. N. Kesava Iyengar have been instrumental for substantial progress in the improvement of cotton cultivation in the State.

To-day Madras is in the fore-front among cotton growing states in the Union. The unselected bulk of the beginning of this century has been almost erased from the map of commercial cotton in Madras. The standard *desi* cottons under cultivation over more than two-thirds of the area

under unirrigated conditions are about 7/8th of an inch in staple. Very recently strains with an inch in staple have been evolved. In the case of Cambodia long staple varieties possessing staples more than one inch are under cultivation. The spinning capacity has been brought up from 20 counts to 34's in *desi* and from 30's to even 50's in Cambodia. Ginning percentages have been upgraded from a range of 25 to 30 in the years before 1920 to 32 to 38 in recent years. No less striking has been the progress in the matter of reduction in crop duration. The older strains for the irrigated areas needed seven months for completion of harvests. They have been replaced by new strains with duration rarely exceeding 5½ months to 6 months. This change has effected considerable economy in the irrigation bill of the cotton growers and has been instrumental for a phenomenal spread of these strains in the summer tracts where the short fallows after paddy are found to be congenial to the growth of Madras Cambodia Uganda strains. Among introductions, the most spectacular are P. 216F from the Punjab which is popular in the rice fallows of Deltaic regions of Tanjore and other areas in adjoining districts. Another is 'Andrews' a variety of the world famous Sea Island Cottons. It has a staple of 1-3/8 inch and yields about 800 lbs. of seed cotton per acre. It spins upto 80's counts. Research and cultivation of 'Andrews' cotton have gone over to Kerala after the recent States reorganisation.

For every cotton growing area in Madras State one specific standard strain, far superior in yield and quality to the original unselected bulk has been put across to the cultivators who get large supplies of pure seed through Seed Multiplication Schemes organised in the State. Among the strains which have become popular with the farmers of the State are Co. 2, MCU.-1, MCU.-2, K-2 and K-5. The last two belong to the *arboreum* species. More recently 9030-G (American) and 6186-9 (*desi*) have been evolved with far better qualities than the existing strains under cultivation and these await release. The qualities of resistance to pests and diseases are being introduced into the existing strains through choice of suitable parents from a world collection of wild and cultivated cottons and a planned hybridisation programme.

Simple agronomic and cultural methods based on proved experimental investigations have been adoped by the farmers and these also add to the yielding capacity of the strains.

Salient features of the findings from the agronomic investigations are as follow:- Early sowing in September, ridge planting, manuring at 40-60 lb. nitrogen, three acre inches of water at fortnightly intervals during early stages with closer intervals at bolling period were effective in enhancing yield of winter sown irrigated Cambodia. Early removal of *cholam* (*Sorghum*) stubbles and minimum preparatory and after cultivation were found economical for the rainfed black soil area. Mixing of indigo with the previous crops of *Irungu cholam* (a fodder variety of *Sorhgum dochna*) in the Tinnies tract and associated cropping of cluster beans with summer *cholam* preceding Cambodia cotton mitigated the ill effects of *cholam* on succeeding cotton. The March sown summer cotton in South Arcot suffered from serious defects like contabescence and shedding of floral forms recording poor yield. Early planting in December instead of March corrected these ill effects and trebled the yield. Manurial experiments on rainfed *desi* cotton at Kovilpatti established that cotton responded to direct application of nitrogenous manure whether organic or inorganic, if the rainfall was about 30 inches. Twenty pounds nitrogen per acre in the form of ammonium sulphate increased the yield of Karunganni cotton by 13 per cent.

Fig. 1. Cotton Breeding Station, Lawley Road, Coimbatore.

Fig. 2. Applying manure to standing Crop of Cambodia Cotton.

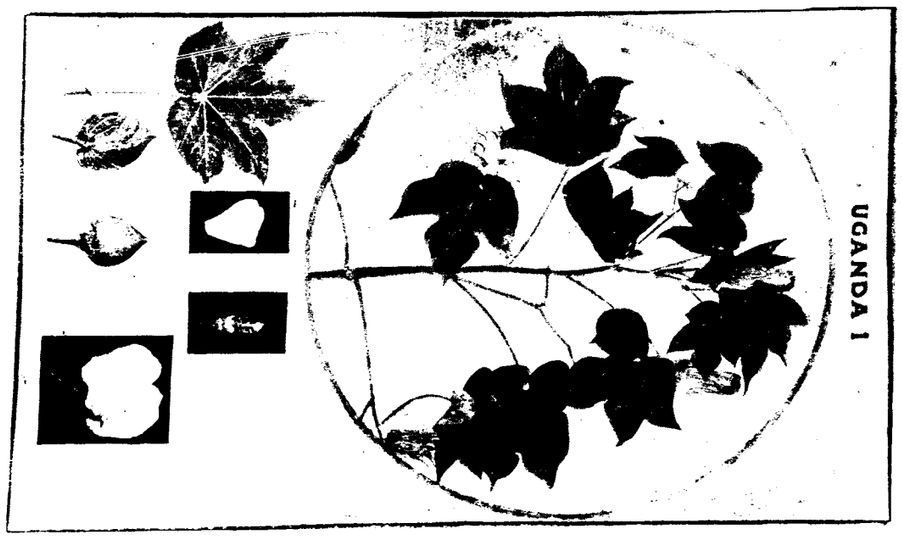


Fig. 3. Plant parts of Madras Cambodia Uganda 1 (a superior quality cotton for the irrigated area now under cultivation.)

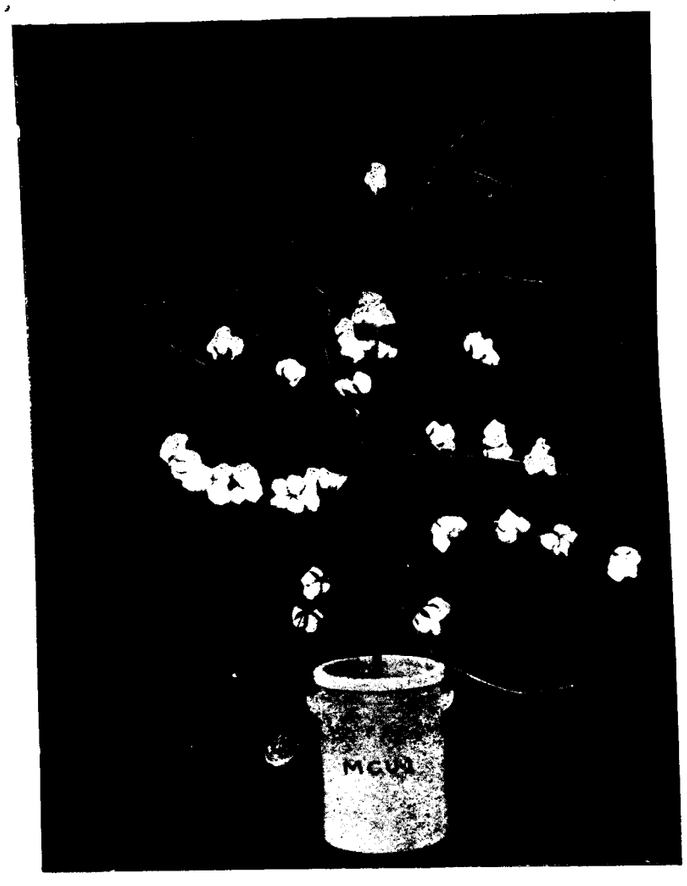


Fig. 4. Madras Cambodia Uganda 1 (M. C. U. 1) in bursting state.

Fig 5. Plant parts of Karunganni 2 (K. 2) an improved strain now under cultivation in the unirrigated black soils of the State.

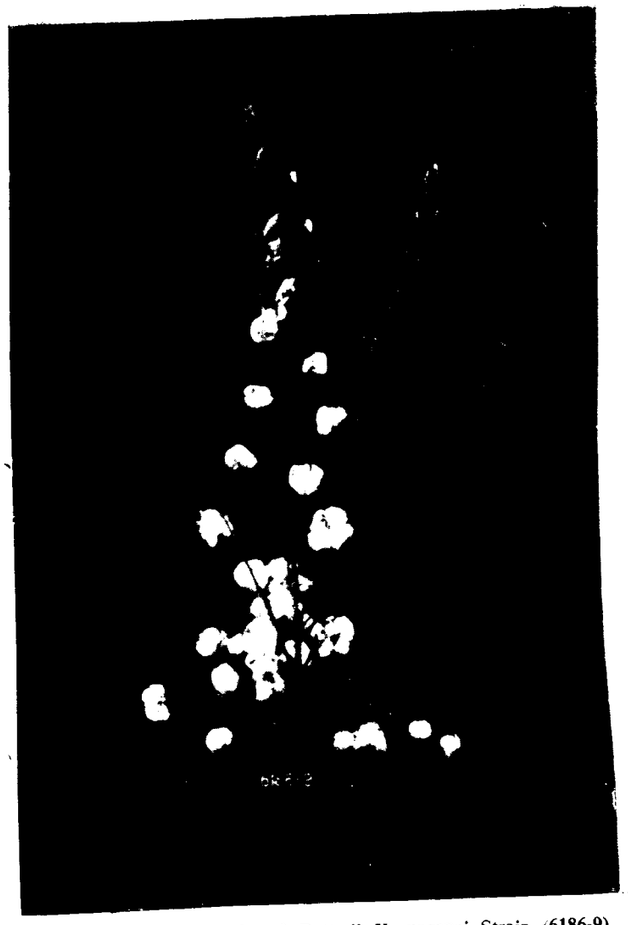


Fig. 6. A new "Bread and Butter" Karunganni Strain (6186-9) for the Unified Tinnies Tract.

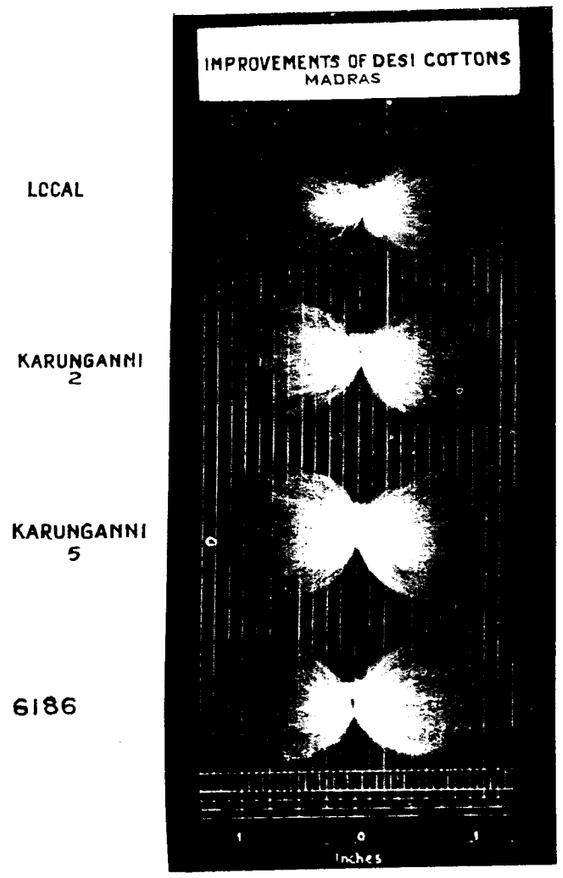


Fig. 7. Improvements of Desi Cottons, Madras.

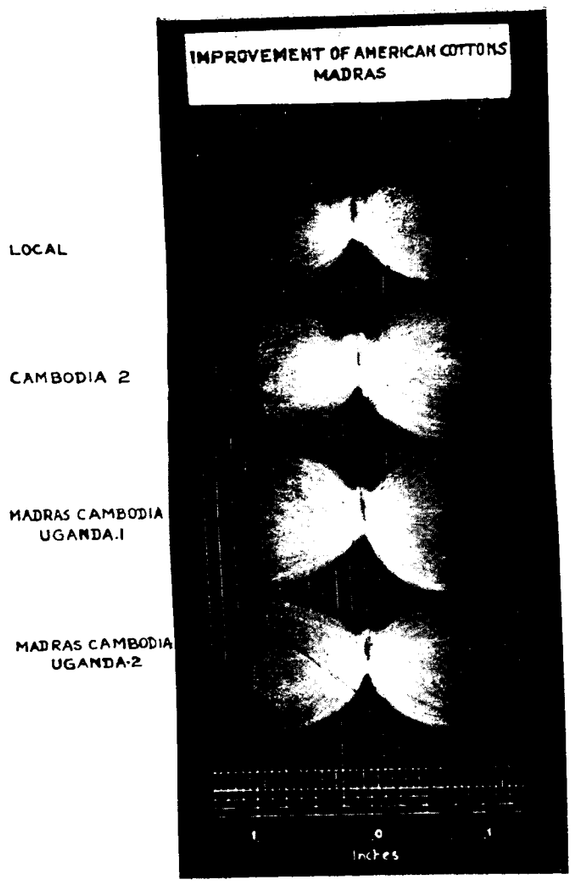


Fig. 8. Improvements of Cambodia Cotton, Madras.

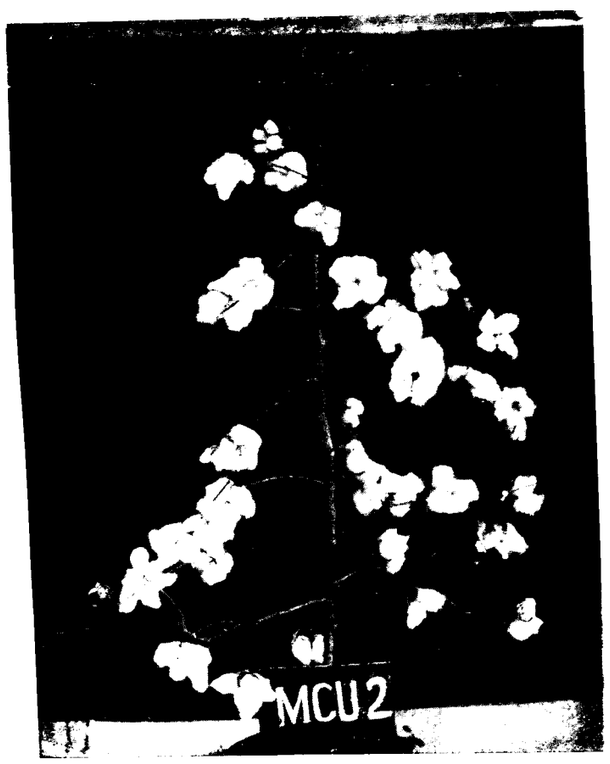


Fig. 9. Madras Cambodia Uganda 2 (M. C. U. 2) a superior quality cotton for the summer irrigated area.

Fig. 10. A Plant of P216F in Bursting Stage.

Important findings from fundamental research were as follow:

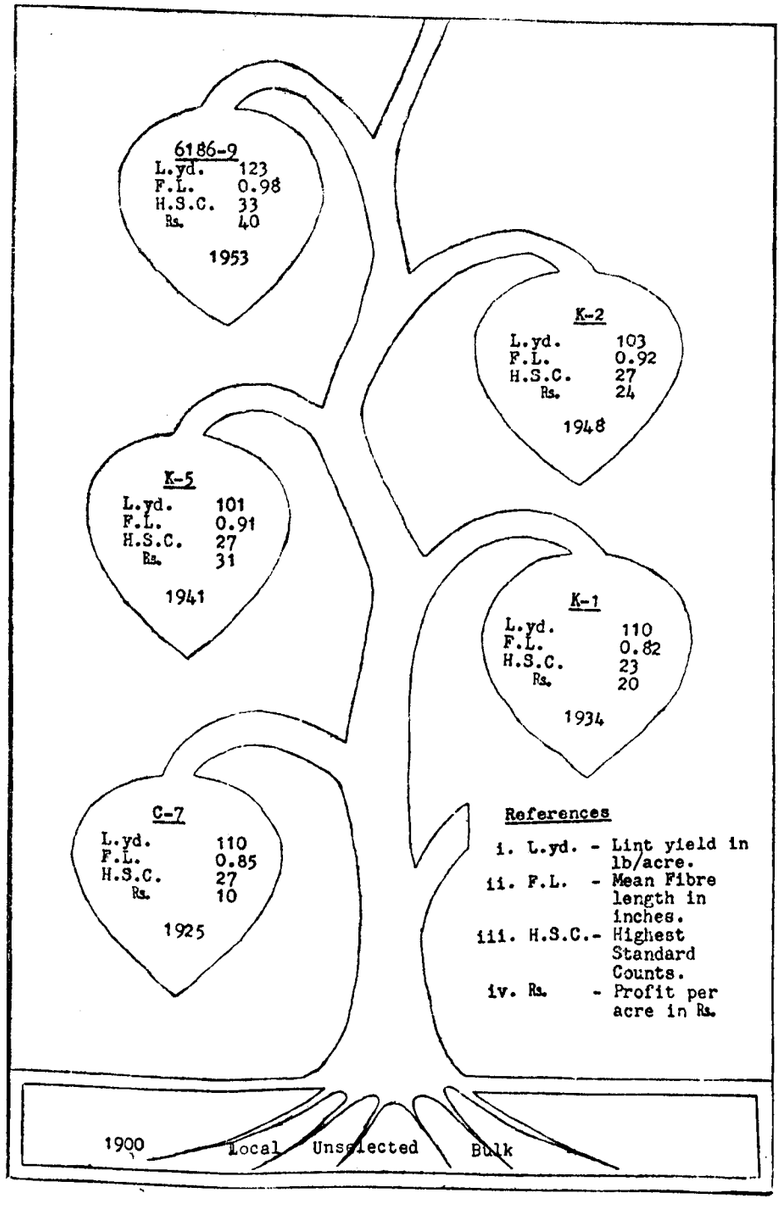
Vascular anatomy of the gynaecium revealed patterns specific to varieties. Pattern of inheritance was mendelian and simple. Fuzz was sub-epidermal and lint epidermal in origin. Lint hair differentiation continued after fertilisation. Ovules of the third, fourth and fifth positions were earlier to take in pollen tubes than the rest. Corolla opening was earlier in American cottons than in *desi* cottons. Anther dehiscence preceded unfurling of petals in Americans but was simultaneous with opening of the corolla in the Asiatics. Several mutants like dwarf, crinkled leaf, petaloidy, cleistogamy, types of lintlessness and pistillate were described. Inheritance of lintlessness, ghost spot, anthocyanin, chlorophyll deficiency, lint colour and pollen colour were studied. Sterile hybrids between *anomalum* and K-1 (a *desi* strain of *arboreum*) and between *raimondii* and a Cambodia strain of *hirsutum* were doubled with colchicine and rendered fertile. The incomplete type of boll dehiscence was monogenic and complementary to Wagad type of boll opening. Inducing apogamic reproduction through parthenogenesis with normally incompatible pollen was recorded. A natural cross between Asiatic and American was spotted in a cultivators' field and successfully cultured through cuttings at the Cotton Breeding Station, Coimbatore. Grafting has been developed in cotton for maintenance of rare and delicate varieties useful in breeding programmes. The cumulative effects of these improvements will be apparent from the following statistics compiled from available records for 1920 and 1957.

Year	Area (*in lakh acres*)	Production (*in lakh bales*)	Estimated State yield (*in lb. of lint per acre*)	Remarks
(1)	(2)	(3)	(4)	(5)
1920*	9.1	1.98	85	*Year when cotton improvement work has started in the State.
1957	12.0	3.60	120	

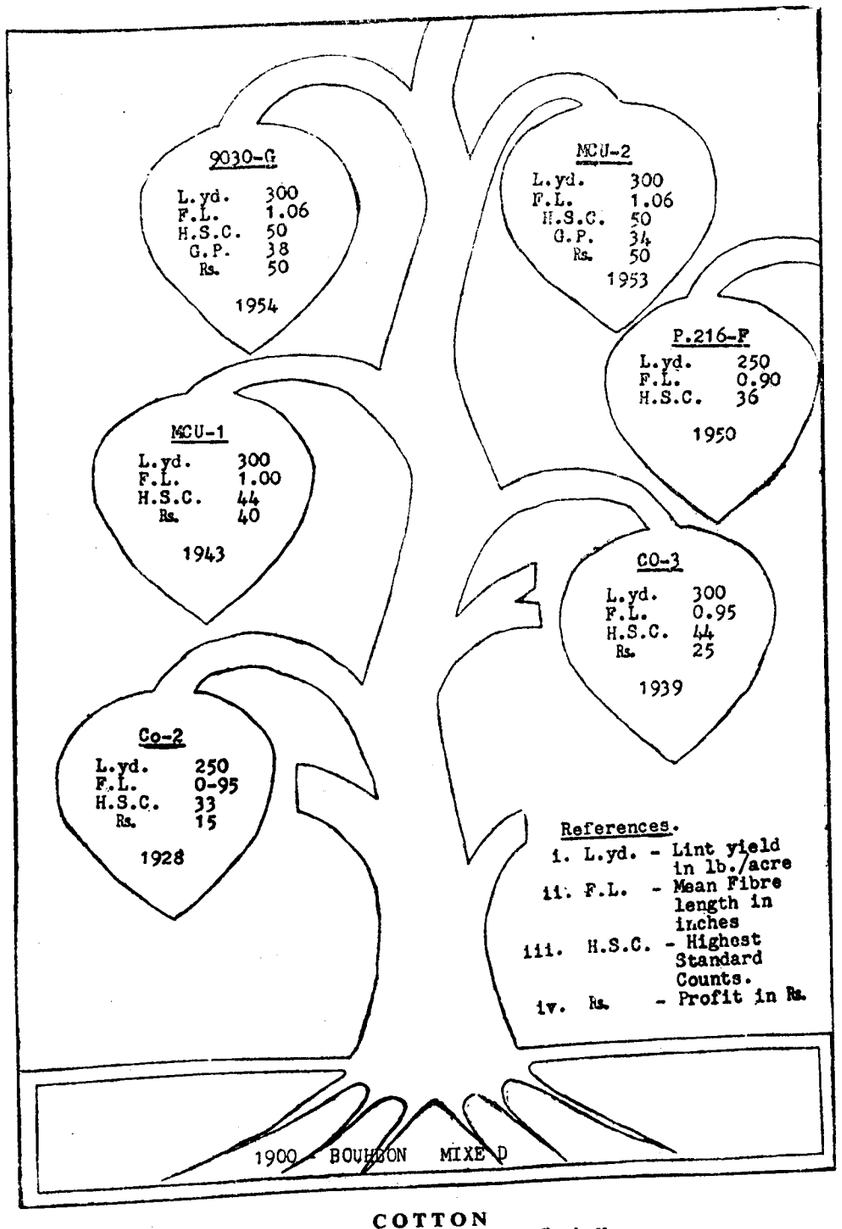
Thus the substantial improvements made in the economic characters of the Madras cottons have helped the cotton grower of to-day to secure greater cash return from an acre than what his predecessor was able to realise about fifty years ago.

These improvements are however not the last word. There are about a 100 mills in the State which need about 8 lakh bales of lint not to speak of the growing needs of the handloom and khadi industry. The present day production of about 3.6 lakh is barely sufficient. There is thus need for yet greater production. The target for *per capita* consumption of cotton in yardage has been stepped up from the existing level of 15 yards to about 20 yards at the end of the Second Five-Year Plan. Breeding investigations in the State have been intensified and it may not be a tall claim to make that by the time the Diamond Jubilee of Agricultural Research in the State is celebrated, Madras will be in a position to supply cotton far superior in quality and productivity than to-day.

Received: April 1958.



COTTON
Evolution Tree — Madras Desi.



COTTON
Evolution Tree — Madras — Cambodia

REVIEW OF FURTHER PROGRESS IN INTERSPECIFIC HYBRIDISATION WORK AT SURAT

By

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Introduction

The research work under the Scheme aims at exploring the possibilities of obtaining from crosses between American and Asiatic species of cottons fully fertile and stabilised types combining superior fibre qualities of the former with the adaptability to growth conditions in India of the latter.

As the species involved in the crosses possess different chromosome sets, the material synthesised from the crosses had a high degree of hybridity and other sterility-fertility complications. The work, therefore, fell in the category of fundamental-*cum*-economic nature and of long range. An account of progress made from time to time is being published in the interest of other cotton workers in India.

Earlier Patel and Thakar (1949) had published an account of studies to economic ends on the synthetic derivatives obtained through interspecific hybridization. Later on Patel and Patel (1954) reported about the evolution of an Indo-American strain 170-Co2 which went into general cultivation. Futher, Bhat and Patel (1955) gave an account of other strains evolved *viz.*, 134-Co2-M and 68 x 22 and further development of the work. The present note deals with some other aspects of work in progress such as use of wild types and perennial cottons in cotton improvement.

Role of the wild cotton G. anomalum *in improving the cultivated American and Indo-American strain:—G. anomalum* a wild Africa diploid species is resistant to red mites, leaf roller, boll worm, semi-loopers and other leaf eating caterpillars (Margabandhu 1941). It has profuse growth of epidermal hairs on its leaves which contributes to Jassid resistance. Its lint is characterised by fineness and considerable strength. The superior American cottons suffer heavily from jassids which is one of the limiting factors for direct introduction of these types in India. Moreover, some of the acclimatised upland types as well as the present Indo-American strains evolved at Surat lack in sufficient fibre strength due to which they do not spin higher count, even though possessing good fibre length. *G.anomalum* was first crossed to Co.2, an improved strain of acclimatised *G. hirsutum* (2n-52) cotton from Coimbatore and the triploid obtained was doubled by means of colchicine giving fertile hexaploid (2n-78) and its cytological study has been reported (Amin 1941, Iyengar 1944, Patel *et al* 1946). The hexaploid was backcrossed reciprocally to Co.2, thus producing pentaploids. The backcross population was studied in detail both cytologically as well as for agronomic characters. It was reported (Deodikar 1949) that some of the plants contained substituted chromosomes while some had added chromosomes of *G. anomalum*. This phenomenon of alien substitution and

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2. Agricultural Officer I/C Scheme for Interspecific Hybridization in Cottons at Surat.

alien addition in the races may help in eliminating economically undersirable wild characters except only those located on the transferred chromosome itself. The population further threw individuals possessing ginning outturn as high as 46.8 and fibre length 28.5 with fineness and strength. The material in subsequent generations *i. e.*, in F_3 gave very poor performance in all respects, the fibre qualities went down with a narrow range of only 20.2 to 24.6mm with hardly any plants having desirable combinations. The pentaploids were therefore, further backcrossed to Co2 twice. The F_2 populations had the following values.

	G.P.	Staple length
(Co2 x Ano.) F_1D x Co2F_2	30.6 to 41.1	19.6 to 25.0
(Co2 x Ano.) F_1D x Co2 x Co2F_2	34.2 to 39.7	20.0 to 23.6

No promising material was availiable from the above crosses.

Further attempts therefore, were made for exploring the pentaploid and hexaploid by outcrossing it with Indo-American and *barbadense* types as under :-

1. (Co2 x Ano.) F_1D x Co2 x B. C. 68
2. " x 134 - Co2 - M
3. " x S. I.
4. (Co2 x Ano.) F_1D x Tanguis x S. II.
5. (Co2 x Ano) $_1$FD x S. I.
6. (Co2 x 1027 A.L.F.) F_1D x (Co2 x Ano.) F_1D (H.H.)

Of the above crosses only the following appeared to be worth further study.

	G. P. (Range)	Staple length (Range)
1. H. H. F_4	29.2 to 41.3	22.4 to 29.5
2. (Co2 x Ano.) F_1D x Co2 x 68F_2	33.3 to 45.0	24.4 to 28.2
3. (Co2 x Ano.) F_1D x Co2 x 134-Co2-MF2	29.6 to 38.1	23.2 to 28.3

1952-53

The two outcrosses with Indo-American strains were studied in detail by trying the progenies in replications. The mean performance was as under:-

Progeny	G. P.	Halo length
1. (Co2 x Ano.) F_1D x Co2 x B.C. 68F_3	37.6	26.5
33- 1	35.3	25.5
33- 3	35.4	26.4
34- 3	34.6	24.6
36- 6	35.8	25.8
37- 8	33.3	27.2
38- 1		
2. (Co2 x Ano.) F_1D x Co2 x 134-Co2-MF_3	33.3	26.2
42-18	38.5	26.3
42-19	37.2	26.2
45- 2	35.5	23.4
50-19	35.6	25.7
51- 1	34.2	25.7
51- 4	35.1	26.2
51-17		

Note: H. H. means the cultures derived from the cross of two hexaploids *viz.* (Co2 x 1027 A.L.F.) F_1 D x (Co2 x *Anomalum*) F_1 Double.

It was observed from the above performance that the ginning outturn was maintained but staple length was going down in successive generations. It was also noticed that the fineness and strength were not being retained in subsequent generation. The promising material was carried further and studied as progeny row. These crosses were further crossed as under:—

1. (Co2 x Ano.) F_1 D x Co2 x 134-Co2 MF_3 x B.C. 68-24
2. (Co2 x Ano.) F_1 D x Co2 x B.C. 68F_3 x B.C. 68-24

From the double hexaploid cross some cultures were found to be promising for fibre qualities but were poor in yield and ginning outturn, and suffered from alternaria disease. During this year blackarm was observed and was severe in some cultures and the breeding policy was required to be modified accordingly. The disease resistance being one of the objectives, all further efforts were concentrated in search of plant material which possess a high degree of resistance in combination with other desirable characters.

The common experience in handling this material was that while making selection for yield and other characters, fibre fineness and strength obtained from *G. anomalum* parent observed in early generation were slowly lost at some stage of the other in latter generation. Similar experience was reported in *arboreum-anomalum* crosses. (Kalyanraman and Santhanam 1955). However, through pursued efforts some promising cultures are available which are tabulated below with their economic characters:-

Name of culture	Parentage	G.P.	Staple	Remarks
Co-ano.- 5	(Co2 x Ano) F_1 D x Co2 x S.I. F_5	37.5	28.4	F.W.x10^{-6} ozs.
„ - 6	(Co2 x Ano) F_1 D x Co2 x 68F_3 x 68-24F_3	34.8	29.8	0.105 „
„ - 8	„	35.9	30.5	Resistants to blackarm
„ -11	„	35.6	28.7	0.102
„ -12	„	37.3	28.1	0.106
„ -13	(Co2 x Ano) F_1 DxCo2 x 134-Co2-MF_3 x 68-24 F_3	35.7	26.8	
H.H. -25	(Co2 x 1027 A.L.F.) F_1 D x (Co2 x Ano) F_1 D F_8	32.2	28.6	
H.H. - 8	„	33.9	28.6	

Looking to the nature of segregation of the material involving *G. anomalum* a careful study from the early generation is necessary to help the breeder in retaining or rejecting the material. Secondly, a large number of population with intensive study for fibre weight, fibre strength and maturity is necessary. This is only possible if adequate technological help is available to Cotton Breeders.

II. Use of wild type G. armourianum

The type was particularly used for transferring healthy leaf growth and fibre strength in cultivated American cottons.

A hexaploid (Co.2 x 1027 A.L.F.) F_1D. was crossed with *G. armourianum* thus producing a synthetic tetraploid. This tetraploid was further out crossed with Co2 and Cokerwild types. The material of the

latter cross was studied upto 10th generation but no stabilised forms were obtained. From the former cross a strain which is named as S.T. (Synthetic-Tetraploid) has been bred which is characterised by healthy leaf growth, round boll and long pedencle inherited from *armorianum* parent. From economic point of view it is of not immediate use as it is rather shy in bearing with very low ginning of 26.0% and fibre length about an inch. This strain has been further crossed to extra long staple Indo-American strains and the material is being studied in early generation.

III. Material involving perennial American cottons.

As compared to *Deshi*, *G. herbacemu* and *G. arboreum* *G. hirsutum* and *G. barbadenese* types are shallow rooted. The Indo-American strains also do not have deep root system as compared to *desi* types. These types, therefore, suffer, much from thrip attack and at times when there is droughty condition due to long break in the monsoon or deficit rainfall shedding is observed.

Some of the perennial American types commonly known as tree cotton or backyard cotton mostly found growing in the temples and bungalow compounds possess deep root system and good adaptability. For exploring such types a collection of such types existing round about Surat was made, out of which two types *viz.*, Exotic-3 and Y.S. were found to be well adapted under Surat conditions.

The plant of Exotic-3 grows to a height of about 10-15 feet and has purplish colour of foliage. The flower is yellow with prominent petal spot. The ginning outturn is 24 to 30% and the mean fibre length varies from 1.0 to 1.08". The Y. S. type is somewhat open in growth and possesses green foliage. The flowers are yellow with petal spot. In economic characters it is more or less similar, but appear healthier than Exotic-3.

These two types are found unsuited for cultivation under field conditions. On account of perennial nature, they do not make sufficient growth in the first year and while ratooning, involve so many complications of pests and diseases. It was, therefore, planned to utilized these types in crosses with Asiatic and Wild as well as cultivated American upland types. Later on they are crossed with Indo-American strains. Early attempts to synthesise types from crosses with Asiatic were of abortive nature due to sterility problems. The work therefore, was directed to effect crosses with upland types and three crosses *viz.*, Exotic-3 x Co2, Exotic-3 x Acala-8 and (Co2 x Y.S.) x (D. A. 12-2). The first and last crosses were studied in detail in the beginning and the second one was studied at later stage. The cross Exotic-3 x Co2 was carried upto F_9 generation ultimately isolating a few cultures but they had the ginning percentage ranging 27 to 29 with staple length from 26.7 to 27.8. The performance being unsatisfactory they were rejected for further study.

From the cross (Co2 x Y. S.) x D.A.12-2, semiperennial forms which were deep-rooted and hardy in growth were isolated but were found shy in bearing and low in ginning. Some of the annual forms were also isolated which also had comparatively deep-root system and healthier growth but were found to be very low ginning and also susceptible to blackarm diseases. Two cultures are being maintained as stock material which are:-

	G.P.	Staple length	Remark
1. Co2 - Y. S. - 12	27.0	27.0	Deep-rooted annual habit.
2. Co2 - Y. S. - 17	32.8	29.9	Deep-rooted semi-perennial habit.

The further hybridization work was taken up involving extra long staple Indo-American strains *viz.*, 134-Co2-M and B.C. 68. In the early generations the material appeared to be very promising, but since the occurrence of blackarm which started severely from the year 1954-55, many good cultures suffered heavily and had to be rejected. Fortunately the material being yet in fairly early generation it has become possible to isolate fairly to highly resistant cultures. The material is in F_6 generation and economic characters of a few promising cultures are given below:-

Name of Culture	Parentage	G.P.	Halo length	Remarks
A.P.- 4	134-Co2 - M x (Exotic - 3 x Acala-8) F_6	27.8	28.0	Strong fibre
A.P.- 6	,,	34.2	28.7	
A.P.- 14	,,	33.3	30.1	
A.P.- 15	,,	33.3	28.4	Fairly resistant to blackarm.
A.P.- 16	,,	33.8	28.5	
A.P.- 17	,,	34.7	27.5	Highly resistant to blackarm.
A.P.- 18	,,	36.1	27.9	
A.P.- 19	,,	35.0	27.6	
A.P.- 1130	,,	28.7	29.0	
A.P.- 10-1	68 x (Exotic - 3 x A. - 8) F_6	36.9	27.1	Fairly resistant to blackarm.
A.P.- 10-2	,,	37.4	27.7	,,

IV. New Inter-se-*Crosses*

The Indo-American derivatives were just like different pools with specific characteristics. In order to make permutation and combination of desired characters of such varied derivative types and breeding superior types to those already under cultivation about nine *inter-se*-crosses were effected and studied in details. The progenies under study seem to be very promising as they have healthy growth, resistance to jassids and having fairly a high degree of resistance to blackarm. The most promising are given below with their economic characters.

Progeny	Parentage	Yield per acre in Lbs.	Ginning percentage	Halo length in mm.	Mean fibre length in inches	Remarks
I.S.C. - 15	B.C. 289 x 134 - Co2 - MF_5	531	35.7	27.7	1.04	
I.S.C. - 16	,,	598	32.6	27.3		
I.S.C. - 58	,,	454	36.6	31.2	1.17	
I.S.C. - 19	B.C. 68 x 125 - Co2 - BF_5	426	33.0	28.0	1.07	
I.S.C. - 20	,,	534	33.7	27.5	1.08	
I.S.C. - 21	,,	546	32.4	27.9		
I.S.C. - 22	,,	726	35.1	27.8	1.03	
I.S.C. - 62	,,	589	36.7	26.6	0.96	Early maturing & highly resistant to blackarm.
I.S.C. - 34	B.C. 263 -1 x B.C 22F_3	581	37.1	29.7		
I.S.C. - 35	,,	455	35.0	27.8		
I.S.C. - 86	,,	568	36.7	29.8	1.10	
I.S.C. - 37	134 - Co2 - M x B.C. 68F_6	410	32.6	30.4		
I.S.C. - 66	(263 - 1 x B.C. 22) F_1 x B.C. 22F_3	326	35.6	27.6	1.14	
I.S.C. - 67	,,	570	34.0	30.7	1.18	
I.S.C. - 69	,,	471	35.5	28.3	1.13	
I.S.C. - 70	,,	447	36.2	29.0	1.18	
I.S.C. - 75	,,	389	34.6	29.0		
I.S.C. - 77	,,	362	36.7	27.7	1.18	
I.S.C. - 78	,,	379	34.5	28.7	1.15	
I.S.C. - 80	,,	356	33.2	27.7		
I.S.C. - 84	,,	265	33.2	29.3		
170-Co2 (Control)		367	36.5	25.3		

V. Breeding types specially for resistant to pests and diseases

A few cultures from Indo-American derivatives have been found to be jassid resistant. They were tested by the Plant Pathologist to Government, Bombay State, Poona and as reported by him these cultures were also found to be highly resistant to blackarm diseases. They are being further tested for economic characters. The most promising ones are mentioned below:-

Culture	Ginning percentage	Mean fibre length in inches	Halo length in mm.
125 - Co2 - 18	35.9	1.01	—
134 - Co2 - M - 21 - 1	26.6	—	31.3
134 - Co2 - M 21 - 2	32.3	1.23	—
B.C. 68 - G - 4	33.0 to 37.7	1.11 to 1.23	—

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A NOTE ON AGRICULTURAL EXTENSION WITH SPECIAL REFERENCE TO COTTON EXTENSION

By

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It has been repeatedly stated by both the Indian and the foreign experts that to achieve any tangible results in agricultural production, the gap between the agricultural research stations and the farmer should be properly bridged. Agricultural extension is the bridge that spans this gap. It is well nigh over half a century since agricultural experimentation was undertaken and useful results have been recorded at a large number of experiment stations, functioning in the four corners of the country. While the Departments of Agriculture are anxious that these useful results are carried to the door of the cultivator, it is difficult to put them into practice owing to either a complete indifference of the farmer to change from the time-honoured procedure or a lack of enthusiasm and a spirit of adventure owing to a low economic condition or want of confidence in the results advocated for adoption. This attitude of the farmers in India is perhaps largely responsible for the low agricultural production that the country suffers from today and the effects are manifest in a country-wide food deficit and an extremely low outturn per acre in practically every agricultural commodity. It has become a fashion in India to attribute the difficulties of the farmers to the erratic monsoon. Barring a few exceptional attempts made here and there by some enlightened cultivators, the majority of the Indian farmers are still carrying on the age-old agriculture learnt from their forefathers. Economists tell us that this is due to the inability of the farmer to go in for costly machinery and meeting high costs of fertilisation of the soil and battle against the pests and diseases. While this argument cannot be altogether ruled out, it must be admitted that backward countries like ours have battled against conditions far worse and have succeeded in making agriculture pay and that too, in a handsome way. It is, therefore, necessary to analyse the causes for the unresponsive approach of the Indian cultivator in a broad sense. It would appear that this seeming indifference or lack of enthusiasm or lack of faith in agricultural research is attributable to a sense of frustration in his outlook, which to a large extent is responsible for his attitude. The factors that go to make up agricultural production should be tackled severally and collectively alike by the farmers not only in their individual capacity but also by co-operative effort. Nothing can stand in the way of a community which has made up its mind to succeed in its efforts. Co-operation is a tool which would come in handy and pave the way for a more prosperous condition and a better way of living. It is admitted on all hands that the success of the Plan depends upon higher agricultural output per acre. It is also an accepted fact that the "battle for acres" should cease and the focus of attention should be on the production per acre.

In cotton, only the other day, the Minister for Food and Agriculture stated at the Annual Meeting of the Indian Central Cotton Committee that the acre yields of cotton in India were the lowest in the world, with India occupying the first position in

respect of acreage. For 20 million acres, we are producing 5 million bales. If this is compared with the production of the United States of America, we find that they produce 13 million bales from 15 million acres.

In another connection, some of the textile experts doubted the possibility of the country producing the 6 million bales fixed as the target for the Second Five-Year Plan. This appeared to sense a lack of ability on the part of the Indian farmer to strive for producing more even when the country is faced with an economic crisis. In reply, it was stated that this statement would be taken up as a challenge by the Indian cotton cultivator and that there would be a tremendous awakening and conscious effort to increase the country's production.

The Indian Central Cotton Committee and the Government of India have been operating schemes with a view to helping the cultivators to derive greater profits from their produce by growing improved varieties, by the application of minimum doses of fertilisers at the proper time and by adoption of improved methods of cultivation such as line sowing, inter-culturing, weeding, clean picking etc. as also by avoidance of the growing of *desi* and American cottons in the same field or alongside to facilitate picking separately and thereby obtaining better prices for the pure produce of either of them. It is stated that the farmers take their produce to the ginneries and that the mixing is done at the ginneries. While due credence may be given to the innocence of the cultivator with regard to the growing of different varieties and also to the carelessness in the processing at the ginneries, it must also be admitted that the farmer should no longer remain indifferent to this malpractice as the entire community goes into disrepute through such indulgence even by a few. It seems, therefore, necessary to create an atmosphere in which the maintenance of purity of the types would alone be tolerated and mixtures either in the field or in the ginneries would be tabooed. The role of the farmer in maintaining the purity of a cotton crop is of utmost importance and ignorance of the seriousness of the malpractice does not absolve him of the responsibility.

Another venue by which the production of Indian cotton can be enhanced is by the control of cotton pests and diseases. The greatest damage is done by the jassids and boll-worms in India. Also heavy losses are incurred by the mortality of the plant by the attack of either root-rot or blackarm or wilt. Recently, the grey mildew has also been causing concern in the Vidarbha region. In most of the cases, prophilactic methods of cultivation are essential. The habit of the culivators to cut the cotton plants at the ground level with a *kudali* has recently resulted in enormous losses from the boll-worms in Gujarat. Time and again, the Indian Central Cotton Committee has advocated the pulling out of the plants with a plant-puller and actually conducted the clean-up campaigns in the areas concerned for over several years. Notwithstanding this, the cultivators have practised cutting down the cotton plants, which resulted in the fresh shoots springing from the cut stumps and helping the insect to tide over from one season to another, propagating itself on the tender shoots. This has enabled the insect population to multiply many fold and the net result is seen in 30 to 50% loss of the cotton crop in Gujarat this year, as is reported in papers. Here is an instance throwing a flood of light on what the cultivator could have avoided and profitted by adopting the recommended method. The greater dependence for assistance in the control of pests or diseases, has to some extent, sapped the initiative, which the cultivator should possess on his own part in tackling the problem of his fields and crops. For the control of these pernicious

parasites, it is known that individual effort alone will not succeed. It must necessarily be a co-operative effort in a whole village and thus it should spread to a whole *taluka* or district. No governmental organisation can provide equipment to the tune that may be considered adequate to tackle the insect problems over an area of 20 million acres. It seems that it would be easier to do it on a village level basis by the Gram Panchayats undertaking to maintain on their own, sufficient equipment for undertaking these direct measures of control. The total loss on a country-wide basis is estimated at roughly 20% of the cotton crop, which in other words would mean, that if the pests and diseases are controlled, the production in the country would go up by at least 20% higher than what it is.

The other factor that contributes to higher production is the use of the seed of improved varieties evolved at the cotton breeding stations, as no variety is released for general cultivation unless found superior than that already under cultivation through series of rigid tests in cultivators fields for agricultural characteristics, in the Technological Laboratory of the Committee for all its fibre and yarn characteristics, and under normal mill conditions, which ultimately would absorb the production. The use of the improved seed would, therefore, mean the immediate enhancement of the quality, higher ginning outturn or increase in the acre yield.

The seed multiplication and distribution schemes functioning under the *aegis* of the Committee have been organised on the basis of keeping up a flow of seed through various stages of multiplication starting from the Government Farm, where care is taken to examine each and every plant for the purity of the characters for which it was selected, to the final stage of general cultivation. The various stages of multiplication constitute important links in the passage of the variety from its place of birth to its place of destination. The cultivators of the entire tract would, therefore, be the responsible custodians for the maintenance of purity of the variety. The occurrence of any impurity in the passage would indicate the inefficiency of those associated in the intermediate stages of multiplication. It is worthy of note that these stages have always been maintained at the level of the purity required, owing to the tendency of the cultivators in those tracts becoming increasingly varietal-purity-conscious and have thus contributed to a great improvement in the quality of the Indian cottons.

In conclusion, the achievement of the target of the Second Five-Year Plan should be taken up seriously by cotton cultivators all over the country in a spirit of national service and as a challenge to the ability of the Indian cotton cultivator. The Indian Central Cotton Committee and the Government of India would do all in their power to help the cultivators in their march towards the desired goal.

The role of the Farmers' Forum* in agricultural extension activities cannot be overemphasised. It must be realised that the problems of the farmers must be properly understood, and to a large extent, solved by the farmers themselves. Judging from the efforts made and the success achieved by the Farmers' Forum in a brief spell of three years of its existence, it would appear that it could greatly help solve the difficulties hitherto encountered by the farmers in increasing agricultural production through organised propaganda, co-operative methods and group discussions.

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PROGRESS IN THE IMPROVEMENT OF QUALITY OF *DESI* COTTONS OF MADHYA BHARAT

By

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Introduction

Madya Bharat comprises of three distinct agricultural divisions (i) Northern plain comprising the districts of Bhind, Morena, Gwalior, Shivpuri and Guna, (ii) Malwa plateau 1200 to 1800 ft. above sea level comprising of the districts of Rajgarh, Shajapur, Dewas, Ujjain, Mandsaur, Ratlam, Dhar, Jabua, Indore and Bhilsa, (iii) Nimar region, south of Vindhya and about 700-800 ft. above sea level. Cotton is principally cultivated in the last two regions. Whereas Malwa receives 40-50 inches, Nimar has only 20-30 inches of rainfall annually. Soils in both the regions are black, but the Nimar soils are somewhat lighter than those of Malwa region. The estimated acreage under cotton in Malwa and Nimar are 12 lac and 3 lac acres respectively. Cottons in the above areas are cultivated under rainfed conditions.

The early history of cotton in Central India is vividly described by Simlote (1956) and Gadkari and Simlote (1949). Mention is made there that as soon as the Institute of Plant Industry was established in the year 1924, the problem before it was to evolve a strain of Malvi that could gin to 30% and spin to 16s counts warp, the already existing strains being much inferior to these standards. Coventry (1920) states that the cotton grown on the Malwa plateau is found to be fine, long in staple, spinning 20s weft and giving a ginning outturn of 27% whereas that of Nimar is coarse having a ginning outturn of 33% and spinning to 10 to 12s reelings.

By 1932, Malvi 9, an improved variety over the local bulk was evolved and was actually recommended to the cultivators of Malwa in 1934-35 (Hutchinson and Kuber Singh, 1936). The yield of *kapas* of this variety was 440 lbs. per acre as compared to 380 lbs. of local. The ginning percentage was of the order of 32% whereas that of local was 29% and the spinning value was also 5 counts higher than that of local which was then spinning only to 12s warp. Since then the programme of selection of better varieties had been going on continuously having in view the yield, ginning percentage and spinning quality of the strains. It may now be said that the superior varieties evolved for Malwa yield about 300 lbs. of *kapas* per acre, having a ginning outturn of 32% and spinning 26s warp. At Nimar where the performances are still better, varieties having 500 lbs. and over yield per acre, ginning to 33% and spinning to 30s warp have been produced. This note is an attempt to trace the development of quality over the last 25 years, from the data so far collected of the fibre properties and actual spinning value of the varieties tried in the trials year after year in the cotton tract of Madhya Bharat.

Material and Methods

The data for this study are obtained from the fibre properties and the spinning value of the 10 lb. samples of varietal trials sent for regular spinning to Matunga Laboratory over the last 25 years. In order to study the trend of improvement the method adopted is to compare the means of the varieties tried in the trials over the tract.

Since superior control types such as Jarila, 197-3 have been imported from outside andincluded in the trials from time to time, their values have been omitted in calculating the yearly means. Data for the years 1942 and 1944 were not available and hence study is confined to those of 23 years. The data is presented in Table I.

TABLE I

S. No.	Season	Mean fibre length (inch)	Mean fibre weight per inch 10^{-6} ozs.	H.S.W. Counts
1	1931—32	0.73	0.204	12
2	1932—33	0.77	0.185	14
3	1933—34	0.79	0.209	14
4	1934—35	0.79	0.193	17
5	1935—36	0.82	0.199	18
6	1936—37	0.80	0.191	17
7	1937—38	0.80	0.197	21
8	1938—39	0.76	0.193	22
9	1939—40	0.77	0.179	18
10	1940—41	0.79	0.196	16
11	1941—42	0.77	0.200	19
12	1943—44	0.79	0.203	21
13	1945—46	0.81	0.177	26
14	1946—47	0.82	0.190	24
15	1947—48	0.83	0.177	26
16	1948—49	0.82	0.188	25
17	1949—50	0.84	0.178	23
18	1950—51	0.82	0.164	28
19	1951—52	0.83	0.166	29
20	1952—53	0.84	0.171	27
21	1953—54	0.84	0.176	26
22	1954—55	0.85	0.175	25
23	1955—56	0.85	0.176	26

The accompanying graph shows the least square trend lines fitted to the above data on the lines suggested by Ezekiel (1930) and Arkin and Colton (1947). Since there are odd number of values, for convenience sake, the middle year is taken as the origin year thereby assigning to it an X value equal to zero. The normal equation used for fitting the least square line :

(i) $\Sigma (Y) = Na + b \Sigma (X)$
(ii) $\Sigma (XY) = a \Sigma (X) + b \Sigma (X^2)$

is thus reduced to as follows as $(X) = 0$

(i) $a \Sigma (X) = 0$
(ii) $b \Sigma (X) = 0$

The normal equations are simplified as follows thereby eliminating the need of simultaneous equations.

(i) $\Sigma (Y) = Na$
(ii) $\Sigma (XY) = b \Sigma (X^2)$

The following equations for the trend line is worked out.

(a) Fibre length: $Y = 0.8056 + .0037\ X$
(b) Fibre weight: $Y = 0.1865 - .0014\ X$
(c) H.S.W. Counts: $Y = 21.5 + .694\ X$

(Origin: Middle year, i.e., 12th year in the graph).

Discussion

An examination of data shows that there is considerable seasonal variation in the properties considered. Progress in the line of selection for quality has gone on continuously as will be seen from the trend lines. Whereas in the year 1931 the varieties in hand were characterised by a mean fibre length of 0.73 inch, mean fibre weight of 0.204 and H.S.W. Counts of 12s, the varieties at present in hand are of the type with 0.85 inch in length having a mean fibre weight of 0.176 and spinning to an average count of 26s.

It will also be seen from the graph that the selection for higher length has gone on hand in hand with selection for finer types also.

Nazir Ahmed and Hari Rao Navkal (1946) have found that for Indian strains of this type there is a negative correlation as high as —0.74 between length and fibre weight. Hari Rao and Sen (1949) also working on a different set of samples of this type based on botanical classification have shown that this value is as high as —0.85. Nayar (1955) derived the value —0.606 exclusively for the *desi* types of this tract. All the above values which are highly significant are in conformity with the finding that when attention is paid for the selection of length, the result is selection for fineness also.

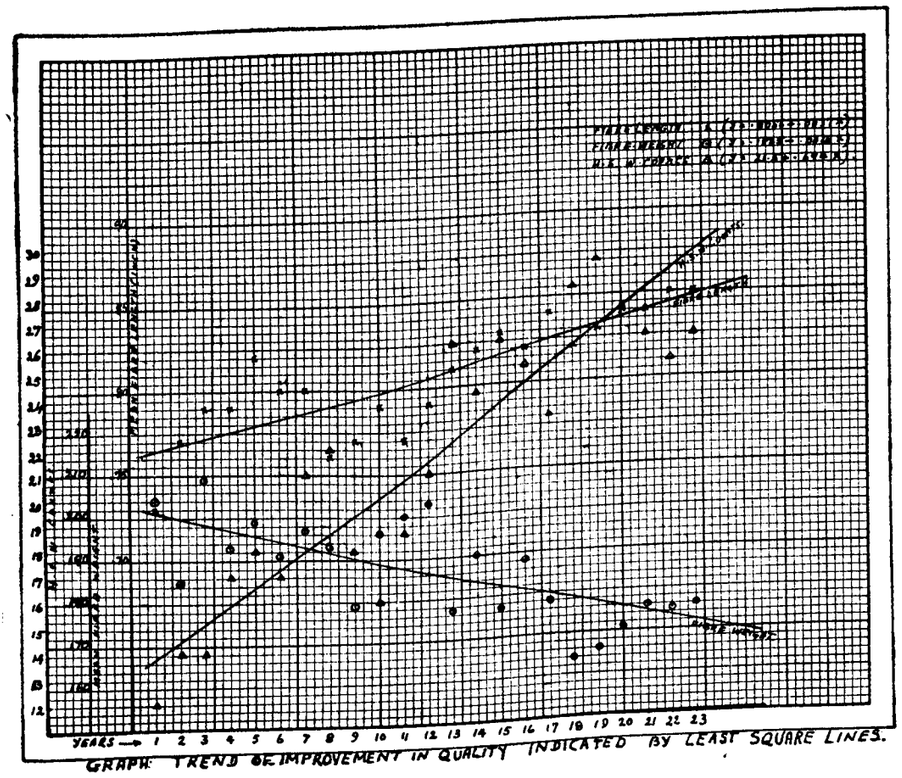
From the figures available from Bombay Cotton Annual (1954) it will be found that the spinnings of Madhya Bharat Mills are as follows:—

3%	Waste yarn
5%	1 to 10 counts
80%	11 to 20 counts
10%	21 to 30 counts
2%	Above 30s counts

The varieties in hand are sufficient to meet the quality requirements of the bulk of spinning mentioned above. Unless further improvement in quality is assured of an increased price in the local markets, cultivators are not likely to go in for quality strains. The case of D47-20 and D47-21, two good quality strains of Nimar may be taken for example. They are of the class of 34 counts. Yet the cultivators prefer to have only types like 197-3 and Maljari (D48-154) having better yielding and ginning outturn, but spinning only to 24s counts.

Summary

As a result of the trials conducted at the various stations in the cotton growing tracts of Madya Bharat superior strains have been evolved, within the last 25 years existence of the Institute of Plant Industry. Whereas the varieties in hand 25 years ago were characterised as having a mean fibre length of about 0.72 inch,this value for the present types is about 0.85 inch. The



GRAPH: TREND OF IMPROVEMENT IN QUALITY INDICATED BY LEAST SQUARE LINES.

fineness of the varieties have also been enhanced by 15%. The spinning value has risen from 12s. to 26s. The quality requirements for the bulk spinning of the Madhya Bharat Mills could thus be met. Further improvement in quality should go hand in hand with premium for quality since cultivators do not get the margin of profit for quality and perfer to grow higher yielders and ginners of 24s class, like 197-3 and Maljari (D48-154).

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RESPONSE TO SELECTION FOR STAPLE LENGTH IN FIFTEEN GENERATIONS OF *ARBOREUM* COTTON CROSSES

By

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Introduction

The method of hybridization, in preference to that of simple selection in natural population, is assuming incresiang importance in cotton breeding. This is because of the failure of the latter method to achieve certain objectives such as evolution of long-staple varieties suitable for the Indian conditions or introducing suitable varieties which are resistant to wilt.

The main feature of evolution of new varieties by the method of hybridization is the large amount of variability that is expected in the material and hence a greater scope for selection to achieve the desired object as compared to that available in the natural population.

With the introduction of variability, in the manner given above, the scope for further selection will depend on two factors *viz.*, (1) the amount of genetic variability present in the material and (2) the mean value of the character under study. When, the former is of no appreciable magnitude, futher selection should, however, depend on the mean value of the character (Panse, 1947). It will be interesting to know to what extent the crop would respond to continuous selection in successive generations. The method of continuous selection in successive generations, based on the mean values alone, was found to be effective by Winter (1929) and subsequently continued by Woodworth and others (1952) for raising the oil and protein contents of corn seed. They reported an increase of about 10.7 and 8.5 per cents in oil and protein contents respectively. In the end they have summarised that the strains developed by this process of selection were found to be quite useful in transferring these qualities to standard inbred lines.

In view of the results achieved by Winter and Woodworth and others for corn it was thought interesting to find out how far cotton crop, after adopting the method of hybridization, would respond to selection in continuous generations for staple length which is considered to be a most important economic character of the crop.

This study was made in the case of six *arboreum* cotton crosses made in the year 1940 and the results obtained so far are described in this paper.

Material

Material for the above study came from an experiment involving 99 crosses made between eleven superior and nine inferior types of *arboreum* cottons collected from different parts of India. It was started in the *kharif* season of 1940 with the object of studying the potentiality of various types with regard to the possible combination of economic characters.

In the first generation significant heterosis in yield and staple length were observed for all the crosses. The F_2 generation consisted of 60 out of 99 crosses and this number was further reduced to 16 in the F_3 generation.

It was observed that the magnitude of the genetic variability was of a higher order in the following six crosses as compared to the remaining ones. These six crosses, shown below, were therefore, continued from F_4 generation onwards.

D77 x Shan 764
B8 x Shan 764
Cwn 520 x Shan 764
R10 x Shan 764
D77 x Gao. 115
B8 x Jarila

From F_4 generation onwards the selection process consisted of first selecting progenies with high and low values of maximum halo-lengths and then selecting individual plants having maximum deviations from the corresponding plot mean, as this method has been found to be profitable for selecting individual plants (Panse, V. G. 1940).

The object of selecting plants in successive generations was to find the extent to which the mean values of maximum halo-length can be improved, so that a desired type can be developed which might prove to be useful for transferring this character of economic importance to other cotton strains. Although the selection of progenies was made for high and low values of staple lengths in successive generations the results for high line progenies, being more important, are discussed below.

Results

The mean maximum halo-length of the individual crosses obtained in F_3 to F_{15} generations are shown in the following table. The measurements of staple length were taken by Bailey's protractor as was the practice adopted by breeders when the experiment was started. The same method has been continued for keeping uniformity in measurements for relative comparisons in successive generations.

From eighth generation onwards the experiment included parental progenies which served as 'controls' for studying the seasonal effects.

TABLE I

Mean maximum halo-length (mms.) of selected progenies of six crosses in successive generations.

(Generations of high lines)

Cross	3	4	5	6	7	8	9	10	11	12	13	14	15
D77 x Shan 764 ..	22.5	25.3	27.5	29.5	31.0	31.5	32.1	29.2	29.4	31.0	28.6	28.3	27.2
B8 x Shan 764 ..	24.1	25.8	28.2	28.3	29.7	30.7	30.5	29.1	28.1	30.3	29.0	29.8	29.4
Cwn 520 x Shan 764..	24.6	25.9	27.4	28.9	30.4	31.1	31.4	29.8	28.6	30.2	27.9	—	—
R10 x Shan 764 ..	23.3	24.3	26.9	27.4	29.2	30.9	32.1	31.1	29.6	30.9	28.6	—	—
D77 x Gao. 115 ..	23.3	25.4	26.9	27.9	29.9	30.9	31.3	30.8	28.7	30.5	28.7	28.2	27.9
B8 x Jarila ..	26.4	27.2	29.4	31.8	32.8	32.9	33.8	32.0	29.9	31.4	28.7	—	—
Average of all Crosses	24.5	27.3	27.7	29.0	30.5	31.3	31.9	30.3	29.1	30.7	28.6		
Parental lines ..						28.3	28.5	27.3	25.1	26.4	25.1	25.6	24.6

It will be observed from the above table that the selection in successive generations, based on the mean value of halo-length, resulted in increasing the halo-length by 27 to 43 per cent of the initial values in the ninth generation. The maximum percentage increase (42.7) was noticed for the cross D77 x Shan 764 and least in the case of cross B8 x Shan 764. In F_{13} generation, however, the percentage increase was ranging between 8 to 21 and was due to the reduction in staple length values in F_{10} F_{11} generations as compared to those attained in F_9 generation. This reduction was however, due to the seasonal conditions which was corroborated by simultaneous reduction in the maximum halo-length of parental progenies grown in the corresponding seasons.

On account of the reduction in the maximum halo-length values after F_9 generation it was thought necessary to investigate whether the scope of further selection has stopped. This point could have been better studied by fitting the polynomial curves to the deviations of maximum halo-length of individual crosses from the parental means had they been available from F_3 generations. These deviations were, however available from F_8 generation and the polynomial curves were fitted to the data available from F_8 to F_{13} generations. Fitting polynomial curves to the deviations rather than to the actual values of halo-length helped to remove the seasonal variations in the halo-lengths and the polynomial coefficients would indicate the type of response curve of selection.

The values of the linear and quadratic coefficients estimated for each cross separately are given below.

Cross	Regression Coefficients			
	Up to F_{13} Generations		Up to F_{15} Generations	
	Linear	Quadratic	Linear	Quadratic
D77 x Shan 764	0.196	0.009	−0.043	−0.060
B8 x Shan 764	0.412*	0.114	0.417*	0.033
Cwn 520 x Shan 764	0.106	−0.048	—	—
R10 x Shan 764	0.226	−0.192	—	—
D77 x Gao. 115	0.256*	−0.076	0.056	−0.078
B8 x Jarila	−0.116	−0.131	—	—

* Significant on 5% level.

An inspection of the regression coefficients given above will show that the rate of increase in the mean maximum halo-length was significant for B8 x Shan 764 and D77 x *Gao.* 115 for data upto F_{13} generation. The linear regression coefficients for D77 x Shan 764 and Cwn 520 x Shan 764 were positive but the quadratic coefficient for the latter cross had negative value indicating a decrease in the halo-length of that cross. After F_{13} generation, therefore, only three crosses *viz.*, B8 x Shan 764, D77 x *Gao.* 115 and D77 x Shan 764 which indicated a scope for further increase in the staple length were continued. The regression cofficients estimated for the three crosses, which were continued after F_{13} generation, show that the cross B8 x Shan 764 has still further scope of selection for long staple length as the linear coefficient for this cross is positive and significant.

The above results, therefore, bring out the fact that the six crosses under study had different levels of potentiai store for selection. They also indicate that the progress of selection for staple length based on the mean values of the character, generally stops after F_9 or F_{10} generation and the desired genotype can be said to have been developed at that stage.

Summary

The method of selection in successive generations on the basis of mean values of halo-length in the absence of genetic variability was used for six crosses of *arboreum* cottons. It was observed that the mean value could be increased by 27 to 43 per cent of the F_3 means in the ninth generation.

The rate of increase in the mean values of halo-length was studied by fitting second degree polynomial curves to the diviations of mean values from parental means to account for the seasonal effect. It was observed that the six crosses differed in their potentiality for selection.

The results based on the data of six crosses indicated that the selection for halo-length can be continued upto F_9 or F_{10} generation in general at which stage a genotype can be developed.

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STUDIES IN THE AGRONOMY OF GAORANI COTTON

VI. EARLY SOWING

By

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Introduction

It is well known that an early sown cotton crop gives higher yields. Hence one of the methods of increasing cotton production in the Hyderabad State advocated as a part of the 'Grow More Cotton' campaign was to sow cotton in the third week of May. As in Hyderabad State cotton is mostly grown as a dry crop, it is necessary to give irrigation to the field in which cotton is to be sown early. Some light irrigations are also necessary till the advent of the monsoon. The variety of cotton recommended to be thus grown was the improved American variety CO4-B40.

In the *Gaorani* tract of the Hyderabad State, cotton yields are comparatively low. With a view to find out better agronomic practices which can increase the yield of *Gaorani* cotton, several agronomic experiments have been carried out at the Cotton Research Station, Nanded since 1941. As early sowing is known to increase yield an experiment to find out the effect of early sowing on *Gaorani* cotton was carried out at the Cotton Research Station, Nanded from 1952-53 to 1954-55. The results of this experiment are discussed in the present paper.

Method and Material

In order to study the effect of early sowing on *Gaorani* cotton (*G. aboreum* L. race *indicum* H. S. & S.) a replicated randomised experiment was conducted at the Cotton Research Station, Nanded from 1952-53 to 1954-55. As the improved *Gaorani* variety *Gaorani* 6 is grown extensively in the *Gaorani* tract, this variety was used in the experiment. The experiment consisted of four replications and the following three treatments were included in each replication.—(1) Sowing on 20th May, (2) Sowing on 5th June, and (3) normal sowing after the advent of the monsoon. In the *Gaorani* tract before the 3rd Week of May the heat is so intense that it adversely affects germination. Hence the earliest sowing date included in the experiment was 20th May. The object of including a second sowing date *viz.*, 5th June (15 days later than the earliest sowing date) was as follows :—Although *Gaorani* cotton is grown as a dry crop, the early sown cotton crop has to be given light irrigations before the advent of the monsoon. Earlier sowing even by a few days has been observed to result in better growth and yield and hence it was desired to find out if for securing higher yields it was necessary to take back the sowing date as far back as 20th May. If by sowing cotton as late as 5th June instead of 20th May, the yields of *Gaorani* cotton can be increased sufficiently, there will be a saving in the number of light irrigations required to be given before the advent of the monsoon. Thus there were three plots in each replication and the gross size of each plot was 30 feet x 9 feet. In each plot there were six rows, the distance between two rows being 18 inches. One row on each flank and one foot at each extremity of the row were treated as non-

experimental. Thus the experimental portion of each plot had four rows and its size was 28 feet x 6 feet. Two seeds were dibbled in each dibble and the distance between two dibbles was 6 inches.

In case of the two early sowings one irrigation was given before sowing and one light irrigation was given after sowing. Another light irrigation was given after germination. Light irrigations were given at weekly intervals after germination till the advent of the monsoon after which no irrigations were given.

The normal sowing was undertaken after the advent of the monsoon.

The effect of early sowing on the following characters was studied : (1) final plant height, (2) yield of *kapas*, (3) number of bolls per plant, (4) boll size (weight of *kapas* from 50 bolls), (5) earliness (percentage of crop picked up to 15th December, (6) ginning percentage, and (7) weight of 100 seeds. Plant height and number of bolls per plant were recorded for 4 random plants in each plot.

Experimental Results

The combined analysis of variance for the seven characters of *Gaorani* 6 for the three seasons is given in Table I.

TABLE I

Combined analysis of variance for the seven characters of Gaorani 6 for the three seasons 1952-53 to 1954-55 at the Cotton Research Station, Nanded-Dn.

Due to	Degrees of Freedom	Final plant height (cms.)	Yield of *kapas* (seed cotton) per plot (ozs.)	No. of bolls per plant (a)	Boll size. Wt. of *kapas* from 50 bolls	Earliness (percentage of crop picked up to 15th Dec.)	Ginning percentage	Weight of 100 seeds (gms.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Blocks	9	105.16	94.23	2.71	12.38	8.60	.789	.1383
Years	2	6857.90	802.79	4.77	207.62	310.17	2.065	.2252
Treatments	2	4733.3**	2675.82	27.75	438.49	81.17	5.225	.0654
Years x Treatments ..	4	137.36	672.62**	4.01	238.19**	44.18**	1.940	.0738
Error	18	120.92	94.03	2.34	19.19	9.59	.952	.0288

(a) Degrees of Freedom are 6, 1, 2, 2 and 12 respectively, as the data for this character were available for 2 years only.

(b) * denotes significance at 5% level. ** denotes significance at 1% level.

It will be seen from the above table that the dates or sowing are significant for only final plant height.

The mean values of all the three seasons of each of the seven characters for the three sowing dates are given in Table II. The mean values of the seven characters for the three sowing dates for each of the three seasons are given in the Appendix. (Page 235)

TABLE II

Characters	Mean values for 20th May	5th June	Normal Sowing	S.E.	C.D. at 5% level
(1)	(2)	(3)	(4)	(5)	(6)
Final plant height (cms)	92.2	67.1	52.9	± 3.38	13.3
Yield of *kapas* per acre (Lb) ..	892	667	409	±121.3	Difference are not significant.
No. of bolls per plant	5.9	4.5	2.2	± 0.71	do
Boll size (weight of *kapas* from 50 bolls) (gms).	79.9	75.5	67.9	± 4.45	do
Earliness (percentage of crop picked upto 15th December) ..	93	93	89	± 1.92	do
Ginning percentage	31.2	30.8	32.1	± 0.40	do
Weight of 100 seeds (gms)	5.31	5.35	5.21	± 0.08	do

The values given in Table II show that the final plant height for the date 20th May is significantly higher than the final plant heights for 5th June and the normal sowing. Similarly the final plant height for 5th June sowing is significantly higher than that for the normal sowing. As regards the yield of *kapas* per acre the yield for the 20th May sowing is 892 lb., that for the 5th June sowing is 667 lb. and that for the normal sowing is 409 lb. However the differences in yield are not significant. Similar is the case with number of bolls per plant and boll size. Number of bolls per plant and the boll size are the highest for the 20th May sowing and those for the normal sowing are the least. However the differences in either number of bolls per plant or in boll size are not significant. As regards earliness, the crops sown on either 20th May or 5th June seem to mature somewhat earlier than that sown after the advent of the monsoon. However the differences in the percentages of crop picked upto 15th December are not statistically significant. The early sowing does not seem to affect either ginning percentage or weight of 100 seeds.

Discussion

According to Christidis and Harrison (1955) early sowing is beneficial for several reasons. One of these reasons is that plant sown early have at their disposal a longer period for flowering and maturity which results in higher yield. Vaidya (1953) found that pre-monsoon sowings gave tremendous increase in yield over monsoon sowing (normal). In the case of both the varieties, Dhar-43 (a *desi* variety) and Indore I (*hirsutum* variety) premonsoon sowing gave significantly higher yield and greater number of bolls per plant than the sowing after the commencement of the monsoon. Ramchandran and Sethu Raman (1955) also observed that at Palur in the Madras State yield differences in cotton due to different dates of sowing were significant for all the *hirsutum* varieties tested. The early sown crop always recorded the maximum yield of seed cotton per acre. In *Gaorani* cotton also there is a trend towards higher yield due to early sowing. The yield for the normal sowing was 409 lb. whereas that for 5th June sowing was 667 lb. and that for 20th May sowing was 892 lb. The

characters, final plant height, number of bolls per plant and bolls size also show the same trend. The final plant height for normal sowing was 52.9 cms, that for 5th June sowing was 67.1 cms and it was 92.2 cms for the 20th May sowing. Number of bolls per plant for the three sowings, normal, 5th June and 20th May was 2·2 4.5 and 5.9 respectively. Weights of *kapas* from 50 bolls for the same three sowings were 67.9, 75.5 and 79.9. Thus one of the reasons for comparatively low yields of *Gaorani* cotton seems to be its short growing season. If this period can be increased by sowing it earlier the yield is likely to go up due to better plant growth, more number of bolls per plant and bigger bolls. All these effects are evidently due to the fact that the earlier sown *Gaorani* plants have at their disposal a longer period for better vegetative growth, greater production of buds, flowers and bolls and better development of the bolls.

Regarding earliness Christidis and Harrison (1955) observed that in Greece date of sowing had a considerable affect on this character. The early sown crop matured earlier. In case of *Gaorani* cotton also the early sown crop matures somewhat earlier. However the differences in percentages of crop picked are not statistically significant.

However as pointed out by Christidis and Harrison (1955) the optimum time for sowing is largely determined by two factors *viz.*, soil temperature and moisture. Whereas too low soil temperatures at the time of sowing may prevent germination, very high temperatures are also harmful. In the *Gaorani* tract the temperatures during summer till the third week of May are quite high. Hence in this tract the earliest date for sowing seems to be 20th May. As regards moisture, the monsoon in this tract starts in June and by the third week of June, the soil becomes sufficiently moist for undertaking cotton sowings. Hence if cotton has to be sown on 20th May the field will have to be irrigated before planting can be undertaken. As the soils in this tract are black cotton soils which crack very badly on drying, it is better to give a light irrigation after sowing. After germination the crop requires to be irrigated lightly at weekly intervals till the advent of the monsoon. Thus it is evident that the advantage of early sowing can be taken by those cultivators only who have wells in their fields or who have other sources of irrigation. Those cultivators who can give even a few light irrigations to cotton can also increase their cotton yields by sowing cotton in the first week of June.

The non-significance of the differences in yield and number of bolls (although these differences are quite marked), seems to be due to the high significance of the interaction years X treatments (Table I). This is likely to be due to the fact that the three seasons during which this experiment was carried out were not similar. The total rainfall and its distribution showed a considerable variation during these three years. However the results of this experiment indicate that one of the methods of considerably increasing the yield of *Gaorani* cotton, as is the case with the American variety CO 4-B40, is to sow it in the third week of May under light irrigation. It is likely that some *Gaorani* varieties may respond better to early sowing than *Gaorani* 6. If higher production of *Gaorani* cotton is to be achieved it may be necessary to study the differential response of the already evolved improved *Gaorani* varieties to early sowing and to breed an improved *Gaorani* variety best suited for early sowing under light irrigation.

Summary

In the *Gaorani* tract cotton yields are comparatively low. With a view to find out better agronomic practices which can increase the yield of *Gaorani* cotton several agronomic experiments have been carried out at the Cotton Research Station, Nanded since 1941. As early sowing is known to increase yield, an experiment to find out the effect of early sowing on *Gaorani* cotton was carried out at the Cotton Research Station, Nanded from 1952-53 to 1954-55. The results of this experiment are discussed in the present paper.

Three dates of sowing were included in the experiment. In the *Gaorani* tract, before the third week of May, the heat is so intense that it adversely affects germination. Hence the earliest sowing date included in the experiment was 20th May. Another sowing date *viz.*, 5th June (15 days later than the earliest sowing date) was also included for the following reasons :—Although *Gaorani* cotton is grown as a dry crop, the early sown crop has to be given light irrigations before the advent of the monsoon. Earlier sowing even by a few days has been observed to result in better growth and yield and hence it was desired to find out, if for securing higher yields, it was necessary to take back the sowing date as far back as 20th May. If by sowing cotton as late as 5th June instead of 20th May, yields of *Gaorani* cotton can be increased sufficiently, there will be a saving in the number of light irrigations required to be given before the advent of the monsoon. The third sowing date was the normal sowing date after the advent of the monsoon.

The results of the experiment show that there is a trend towards higher yield due to early sowing. The yield for the 20th May sowing was higher than that for the 5th June sowing and the yield for the 5th June sowing was higher than the normal sowing. The characters final plant height, number of bolls per plant and boll size also show the same trend. The ginning percentage and weight of 100 seeds do not seem to be affected by the date of sowing.

One of the reasons why early sowing is beneficial is that plants sown early have at their disposal a longer period for flowering and maturity which results in higher yield. One of the reasons for the comparatively low yields of *Gaorani* cotton seems to be its short growing period. If this period can be increased by sowing it earlier, the yield is likely to go up due to better plant growth, more number of bolls per plant and bigger bolls. All these effects are evidently due to the fact that the earlier sown *Gaorani* plants have at their disposal a longer period for better vegetative growth, greater production of buds, flowers and bolls and better development of bolls.

Optium time of sowing is largely determined by two factors *viz.*, soil temperature and moisture. In the *Gaorani* tract the temperatures during summer till the third week of May are quite high and high temperatures are known to be harmful to proper germination. Hence in the *Gaorani* tract, the earliest date of sowing seems to be 20th May. As regards moisture, the monsoon in this tract starts in June. Hence if cotton has to be sown on 20th May the field will have to be irrigated before planting. As the soils in this tract are black cotton soils which crack very badly on drying it is better to give one light irrigation after sowing. After germination the crop requires to be irrigated lightly at weekly intervals till the advent of the monsoon. Thus the advantage of early sowing can be taken only by those cultivators who have wells in their fields or who have other sources of irrigation. However those cultivators who can give even a few light irrigations to cotton, can increase their cotton yields enormously by sowing cotton in the first week of June.

Acknowledgments

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APPENDIX

Sowing date Experiment, 1952-53 *to* 1954-55.

Cotton Research Station, Nanded.

			20th May	5th June	Normal sowing	Standard error	Critical difference at 5% level
Final plant height	(cm)	1952-53	62.70	45.25	33.02	± 4.40	15.24
		1953-54	122.05	85.82	76.52	± 5.89	20.40
		1954-55	91.70	70.28	49.22	± 6.06	20.98
Yield of *kapas* per acre	(Lb)	1952-53	1275	779	322	±83.6	289
		1953-54	697	510	376	±85.4	Not significant.
		1954-55	703	711	528	±65.1	Not significant.
No. of bolls per plant		1953-54	5.8	3.3	2.1	±0.49	1.7
		1954-55	5.8	5.8	2.3	±0.30	Not significant.
Boll size (weight of *kapas* from 50 bolls)	(gm)	1952-53	90.44	81.71	63.84	+1.14	3.94
		1953-54	81.07	70.67	71.18	+2.91	Not significant.
		1954-55	68.18	74.06	68.81	+2.15	Not significant.
Earliness (Percentage of crop picked upto 15th December)		1952-53	98.90	96.81	87.96	+1.68	5.81
		1953-54	95.05	94.53	93.76	+1.24	Not significant.
		1954-55	84.11	88.97	84.50	+1.68	Not significant.
Ginning percentage		1952-53	30.1	30.5	32.5	+0.52	1.8
		1953-54	31.8	31.5	32.2	+0.29	Not significant.
		1954-55	31.7	30.5	31.6	+0.60	Not significant.
Weight of 100 seeds	(gm)	1952-53	5.27	5.18	4.95	+0.08	Not significant.
		1953-54	5.24	5.54	5.38	+0.08	Not significant.
		1954-55	5.42	5.34	5.30	±0.09	Not significant.

Paper discussed at the Seventh Conference on Cotton Growing Problems in India, Chandigarh, 1956.

PRELIMINARY STUDIES ON THE REACTION OF LAXMI COTTON TO IRRIGATION AND MANURING UNDER THE TUNGABHADRA PROJECT

By

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Introduction

Laxmi Cotton, bred for the Dharwar American tract, is now spreading as a rainfed *rabi* crop in the Tungabhadra Project area and is the immediate agronomic variety available for irrigation cultivation. As such agronomic studies were designed at the Tungabhadra Agricultural Research Station, Dhadesugur, during 1955-56 to determine the optima in respect of manurial schedules, irrigational frequencies, time of planting, spacing etc. Observations on random plants were recorded in these experiments to study the reaction of the frame work of the plant and its ultimate fruiting potential in relation to these factors. The reaction of Laxmi cotton plant, as a unit, to irrigation and manuring is presented in this paper ; the data is preliminary and subject to confirmation. The lands in which the experiments were conducted were also disturbed by graders and as such local differences affected the consistancy of the data to some extent.

Experimental Results

I. IRRIGATION AND MANURIAL EXPERIMENT

Four levels of Nitrogen *viz.* 0, 30, 60 and 90 lb. per acre and five frequencies of irrigation *viz.* 0, 3, 6, 9 and 12, thus resulting in 20 treatments were laid out in randomised blocks replicated three times. All the Nitrogen was applied as a basal dressing through Ammonium Sulphate, Phosphoric acid being constant at 30 lb. of P_2O_5 per acre in all the treatments. Laxmi cotton was dibbled on ridges 2' apart on 17-9-1955 and there was no need for irrigation till the end of November as there were rains. Irrigations started from 1-1-1956, the frequencies being I_{12} weekly, I_8 once in 10 days, I_6 once in fortnight and I_3 once in three weeks.

Observations on plant height, total number of nodes, number of sympodial branches, fruiting nodes and bolls were recorded on eight random plants in each treatment in all the replications ; the data are presented in Table 1 and graphically in Fig. 1.

It would be seen from the data (Table 1) (page 241) that irrigation alone or manuring alone effected the plant to increase its yields to certain extent from the control; furthur response to increasing doses of manure alone or more frequent irrigations is not apparent. Irrigation and manuring together have effected the plant to further enhance its yielding capacity and at levels of 60 and 90 N per acre and with 9 to 12 irrigations the yielding potential of the plant has attained the maximum. The data is discussed in detail separately.

II. TIME OF APPLICATION OF NITROGEN TO COTTON CROP

Ammonium Sulphate and Ammonium Sulphate Nitrate at levels of 30N and 60N per acre were compared with different times of application. There were 7 types of application, the entire dose basically, 45 days after sowing, *i.e.*, at squaring 90

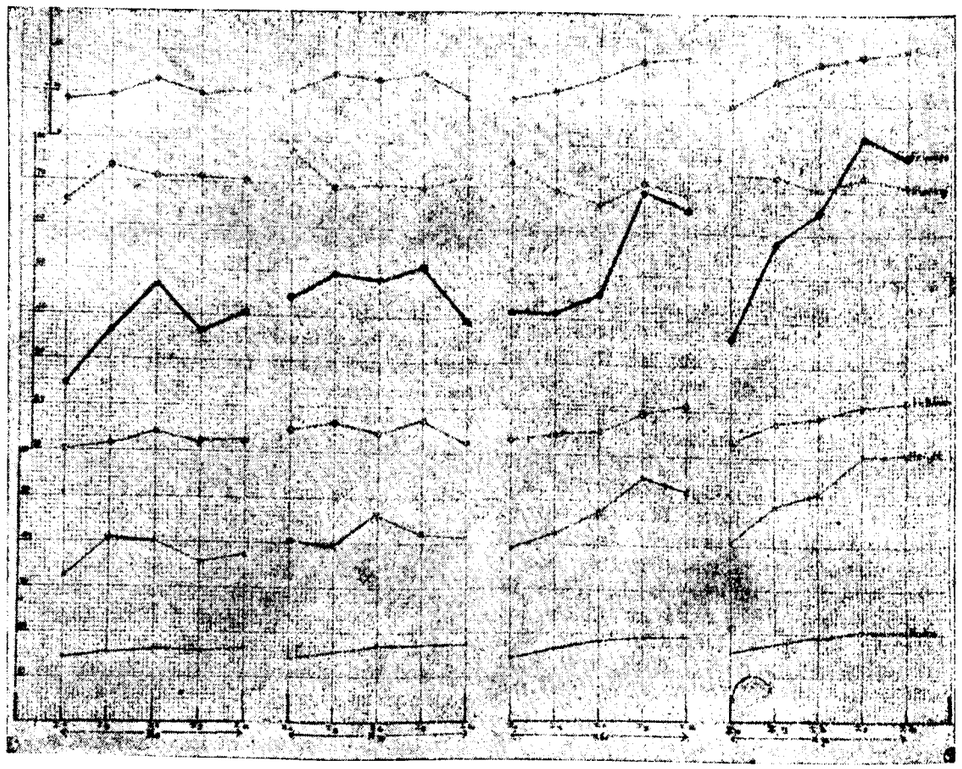

Fig. 1

Graph showing the effect of irrigation and manuring on some characters of Laxmi cotton

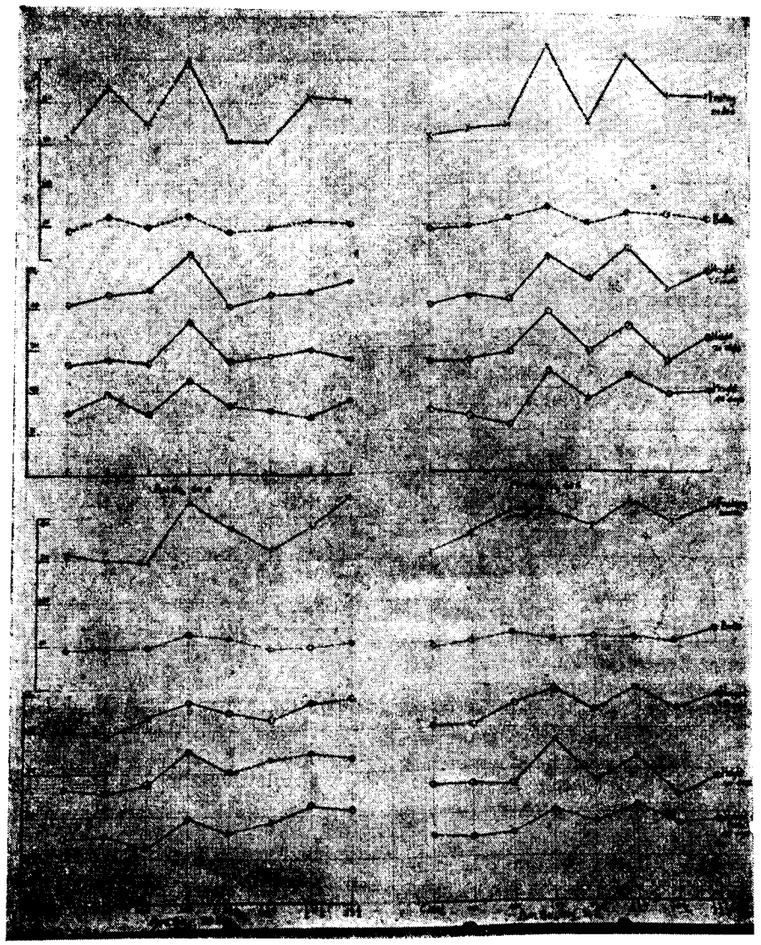

Fig. 2

Graph showing the effect of application of Nitrogen on some characters of Laxmi Cotton

days after sowing and the various combinations of split doses with no manure as control.

The resulting 32 treatments were sown in randomised blocks, replicated three times. The experiment sown on 28-9-1955 and received three irrigations in all.

Observations on plant height, number of bolls and number of fruiting nodes were recorded on five random plants in each treatment in all replications. The results are presented in Table 2 and are graphically represented in Fig. 2. The acre yields were not significant statistically but, an examination of the data would reveal that late application of Nitrogen or split dose does not appear to have any material advantage over basal application. It would also be seen that at low levels as 30N per acre, basic dose alone appears to be the best while at higher doses, a split dose of half at planting and half at squaring is only as effective as basal dressing. The differences between the two sources of Nitrogen are not obvious.

Discussion

Laxmi Cotton, bred for rainfed conditions, would immediately be grown under irrigation in the Tungabhadra ayacut ; agronomic studies with this variety to determine the optimum manuring irrigations time of sowing etc., would be of immediate benefit to reap substantial increases in yields. Harland (1955) while drawing attention to the role of agronomy in increasing yields pointed out that "it is on the physiology of yield in relation to nutrition acting on growth and development that we must largely look to, for increased yields in the future."

Two important factors that would contribute to increased yields would be irrigation and manuring and their interaction ; time of planting and spacing would also play an important role towards this end. All these factors which are operative at once and together determine the frame work of the plant and thereby its potential limit to produce fruit (Ferguson, 1955). The total number of nodes produced on the main stem, the sympodial branches and the fruiting nodes they produce are the major characters that define the plant's frame work ; a study of these major chacters was taken up in the trials under reference and their behaviour is discussed below :

(1) PLANT HEIGHT, TOTAL NODES AND INTERNODAL LENGTH

Crowther (1934 c.f. Hector) pointed out that the height of the plant is determined by the product of node number and internodal length and concluded that while elongation of the internodes is mainly controlled by water, the production of new nodes is determined by the Nitrogen supply.

In the present study (Table 1) it appears that Nitrogen alone would increase the plant height only to a small degree (6 to 8 cms) and the total number of nodes was fairly constant (14.4 to 15.5). Irrigation alone also increases the height only by 6-8 cms and the variation for node number is between 14.4 and 16.1. With increasing doses of Nitrogen and irrigational frequency, there is a gradual increase in plant height which appears to have been mainly contributed through an increase in the total number of nodes. Thus at 90N per acre and with 12 irrigations the plant height reached a maximum of 61 cms against 32.2 cms for control and the total number of nodes was 20.2 as against 14.4 for the control.

(2) SYMPODIAL BRANCHES, FRUITING NODES AND BOLLS

The number of sympodial nodes and the bolls they produce provide an exact measure of the yielding capacity of the plant. Studies in Punjab revealed that Nitrogen application increased boll number and boll size. There was no response to

Nitrogen application in Dharwar. In arid tracts like Hagari and Bellary which are in the Tungabhadra area, there was no response to Nitrogenous fertilisers under rainfed conditions ; some times there was a depression in yield (Panse, 1953).

During the current year the rainfall was heavy, there being no need for irrigation till December. It would be seen from Table 1 that manuring alone would bring an increase in the number of fruiting branches, nodes and bolls but there is no further increase with increasing doses of Nitrogen. There was also a slight increase in the percentage of shedding with addition of Nitrogen alone. Irrigation alone has also a similar effect. But Nitrogenous manuring in combination with irrigation, especially at higher levels of Nitrogen seems to increase the fruiting branches, nodes and bolls to a considerable extent ; the shedding percentage is also comparitively low. Thus with 90 lb. of N per acre and with 9 irrigations 22.2 sympodial branches 78.5 fruiting nodes and 21.9 bolls were recorded as against 10.3, 24.6 and 8.4 respectively for the control ; the differences between 9 and 12 irrigations are not marked.

It is also interesting to note that at such high levels of Nitrogen and low frequencies of irrigations as 3 and 6 the increase for these characters is there, but not to the extent as manifested with 9 and 12 irrigations. Thus it appears necessary that at higher levels of Nitrogen, more frequent irrigations would be needed to manifest the full effects of manuring ; or else irrigation may become a limiting factor and mask the manurial effects. This is also seen from the yield data of other manurial trials conducted at this station wherein there was a response in yield from no manure to manure, but the differences between 30N, 60N and 90N were not marked. These experiments received only 3-4 irrigations as irrigation was not a factor and it may be these 3 or 4 irrigations were not sufficient to manifest the full manurial effects at such high doses as 60N or 90N per acre.

An examination of the percentage of produce picked at various pickings also indicated that in treatments with no irrigation about 80 per cent of the produce was finished in the first picking alone while in treatments with higher dose of manure and more number of irrigations only about 55 to 60 per cent of the produce was picked in the first picking. Thus in these treatments it is the latter bolls that seem to have contributed to the high yields. Reynolds (c.f. Christidis and Harris, 1955) also reported an increase in bolls at late pickings with addition of Nitrogen. Thus the necessity for greater amounts of water with increased amounts of Nitrogen are obvious to mature the late bolls which contribute to the high yields. Ramanatha Ayyar and co-workers (1940) reported an increase in fibre weight with increase in irrigation water. In the present study, the first picking itself was taken rather late on 9-3-56 and later on, only one picking was taken on 9-4-56. As such, it would be necessary to take regular pickings and examine the produce separately for fibre characters so that the optimum number of irrigations without detrimental effect on fibre characters could be arrived at.

(3) TIME OF APPLICATION OF NITROGEN

For irrigated American Cotton in the Punjab and Sind where an excessive shedding of early fruits takes place, Nitrogen application during intensive flowering period is said to have given the best results (Panse, 1953). Results in various parts of U.S.A. and other countries were contradictory and Harris and Christidis (1955) pointed out that "generally speaking Nitrogenous fertilisers, even when containing a soluble form of Nitrogen should be applied at the time of sowing unless there is some special reason to the contrary" and this appears to hold good for Laxmi also.

TABLE I

Statement showing the effect of irrigations and manuring on some characters of the Laxmi cotton plant.

S. No.	Treatment	Plant characters (Mean per plant)							
		Height (cms)	Total nodes	Internodal length (cms)	Symp. branches	Fruiting nodes	Bolls	Shedding %	Percentage of 1 pick
1	I0 NO	32.2	14.4	2.23	10.3	24.6	8.4	65.8	75.9
2	13 NO	40.9	15.7	2.57	11.7	36.9	9.6	73.9	77.9
3	I6 NO	40.7	16.1	2.53	14.4	46.8	13.3	71.5	68.4
4	I9 NO	35.8	15.9	2.25	12.3	36.2	10.2	71.8	56.4
5	I12 NO	37.2	16.1	2.31	12.8	41.0	11.1	70.5	62.2
6	I0 N30	40.8	14.4	2.83	15.2	44.4	11.0	77.7	83.7
7	13 N30	39.4	15.9	2.47	16.7	49.7	15.3	69.2	72.3
8	I6 N30	46.7	17.2	2.71	14.1	48.3	14.4	70.2	67.7
9	I9 N30	42.4	16.8	2.52	17.2	51.8	15.8	69.5	58.5
10	I12 N30	41.4	17.1	2.42	12.3	39.2	10.7	72.7	77.7
11	I0 N60	39.6	14.7	2.63	13.3	41.8	10.2	75.5	88.8
12	13 N60	42.5	16.7	2.54	14.8	41.3	12.5	69.7	76.2
13	I6 N60	47.6	18.4	2.58	15.1	45.8	15.4	66.3	64.4
14	I9 N60	55.4	19.4	2.85	19.3	69.1	19.6	71.6	55.8
15	I12 N60	52.7	19.1	2.76	21.7	65.1	20.2	68.9	59.7
16	I0 N90	41.0	15.5	2.64	13.6	36.5	9.6	73.7	86.5
17	I3 N90	49.5	17.3	2.85	17.6	58.1	15.5	73.3	71.7
18	I6 N90	52.2	19.4	2.69	19.0	65.6	19.4	70.4	62.1
19	I9 N90	60.7	20.6	2.94	21.3	82.5	21.9	73.4	56.2
20	I12 N90	61.0	20.2	3.02	22.2	78.5	22.8	71.3	65.7

I=No. of irrigations
N=Nitrogen applied per acre

TABLE II

Statement showing the effect of time application of Nitrogen on some characters of the Laxmi cotton plant.

S. No.	Treatment	B. 45d.90d	Mean per plant					
			Height (cms)			Sympodial branches	Fruiting nodes	Bolls
			45 days	90 days	Final			
1	Control		15.2	28.1	38.6	7.9	38.3	10.3
2	$AMSO_4$ 30N	1 0 0	19.7	35.1	46.8	9.8	43.8	12.5
3	" "	0 1 0	12.5	27.4	43.9	8.0	29.1	9.5
4	" "	0 0 1	15.3	25.7	38.8	7.9	29.6	9.3
5	" "	½ ½ 0	18.5	33.1	42.6	7.7	32.1	9.0
6	" "	0 ½ ½	16.2	30.3	44.2	9.3	37.2	11.2
7	" "	½ 0 ½	22.6	34.7	46.9	7.6	38.0	9.5
8	" "	⅓ ⅓ ⅓	21.5	33.7	47.6	7.6	45.0	10.4
9	Control		15.7	24.6	36.4	6.4	27.4	8.0
10	$AMSO_4$ 60N	1 0 0	20.7	37.1	49.1	8.8	41.0	12.1
11	" "	0 1 0	15.2	26.7	45.8	9.2	41.6	12.2
12	" "	0 0 1	14.7	26.9	40.6	7.3	35.9	10.5
13	" "	½ ½ 0	22.0	33.1	49.9	9.0	43.7	11.5
14	" "	0 ½ ½	18.0	27.3	44.3	9.0	37.8	11.6
15	" "	½ 0 ½	17.4	23.9	44.8	8.6	38.9	10.2
16	" "	⅓ ⅓ ⅓	18.2	28.5	48.0	8.6	42.8	13.9
17	Control	⅓ ⅓ ⅓	14.6	25.6	37.4	6.0	26.9	7.8
18	$AMSO_4$ NO3 30N	1 0 0	22.7	36.5	53.4	9.6	49.5	12.1
19	" "	0 1 0	14.1	26.9	44.1	7.9	34.5	9.8
20	" "	0 0 1	19.3	27.5	43.1	9.3	43.7	12.2
21	" "	½ ½ 0	15.0	28.2	43.2	8.1	30.4	9.8
22	" "	0 ½ ½	16.1	27.0	40.1	7.0	30.8	8.9
23	" "	½ 0 ½	13.8	29.8	44.0	8.8	41.6	11.6
24	" "	⅓ ⅓ ⅓	17.7	27.2	46.3	9.0	40.4	10.4
25	Control		14.5	27.6	45.4	8.4	35.1	10.1
26	$AMSO_4$ NO3 60N	1 0 0	24.2	38.5	52.5	11.0	54.0	14.3
27	" "	0 1 0	11.6	28.9	41.9	8.0	34.1	11.9
28	" "	0 0 1	13.7	26.5	42.9	7.9	33.8	9.8
29	" "	½ ½ 0	23.2	35.1	54.7	10.3	51.4	13.0
30	" "	0 ½ ½	17.8	29.0	46.5	7.3	34.3	10.5
31	" "	½ 0 ½	18.8	26.9	44.0	9.1	41.9	12.9
32	" "	⅓ ⅓ ⅓	19.1	32.9	48.9	8.9	41.3	11.3
	Mean for controls		15.0	26.4	40.5	7.2	31.9	9.0

B=Basal dressing ; 45d=applied 45 days after sowing; 90d=applied 90 days after sowing.

The results (Fig. 2) would indicate that plants receiving a basal dressing take a good initial start and maintain this throughout their growth period as would be seen from the periodical growths. The number of bolls is also more for the treatments that received the entire dose as a basal dressing. It is also seen that at 30 lb. of N per acre only the treatment with the entire dose given basically is the best while at 60N, the split dose of 30N at planting and 30N at squaring is only as good as initial application ; this on the other hand would involve additional labour and expenses.

Summary

1. Laxmi cotton, would immediately be grown under irrigation under the Tungabhadra ayacut. Plant characters such as height, total nodes, sympodial branches, fruiting nodes, bolls etc., which effect the frame work of the plant and its fruiting potential were studied in some of the manurial and irrigational experiments designed to study the agronomy of Laxmi cotton under the Tungabhadra Project ; the effect of irrgation and manuring on these characters is discussed.

2. Increasing manurial doses and irrigational frequency has increased the plant height considerably which appeared to have been contributed mainly by an increase in the number of nodes.

3. High manurial doses with frequent irrigations also increased the production of sympodial branches fruiting nodes and bolls. It appears necessary to irrigate the cotton crop at 10 day intervals with applications of 60 to 90N per acre to get maximum returns.

4. Observations on periodical growths and production of sympodial nodes and bolls revealed that split dose of application of Nitrogenous fertilisers had no advantage over basal dressing.

Acknowledgment

The work was carried out as part of the programme of the scheme to evolve a suitable American cotton for the Tungabhadra Project area financed by the Government of Hyderabad. Dr. Ch. Krishnamurthy, formerly Agronomist helped in designing the agronomic trials and the irrigational-*cum*-manurial trial, where the observations were recorded by the author as a co-ordinated experiment between the soil research and cotton sections.

The author is thankful to Sri V. K. Bederker, Cotton Research Botanist to the Government of Hyderabad, under whose guidance the work was carried out.

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STEM-BREAK DISEASE OF COTTON INCITED BY *MACROPHOMINA PHASEOLI*

By

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A cotton variety Virnar (*Gossypium arboreum* var *neglectum* forma *bengalensis* H. & G.) occupies an area of about one million acres in East and West Khandesh districts of Bombay State. The crop is sown by the third week of June and harvested by the end of October. A stem-break disease of this cotton variety causing about 10% annual loss to one month old seedlings has been observed on an extensive scale. The same disease has been noticed on Kumpta cotton *G. herbaceum* var. *acerifolium* in Dharwar district, Mysore State, indicating that the disease may be widespread on other cotton varieties at several places in India.

The disease symptoms were first described by Dastur who considered the disease to be non-parasitic and attributed it to the mechanical damage caused by strong winds. In describing the disease symptoms, however, he pointed out that there was slight reddish-brown necrosis on the bark, in places where the stem snapped and caused falling over of the entire top shoot portion. Several of the later investigators have failed to find out the true nature of the stem-break disease thus accepting the concept of mechanical damage theory put forth by Dastur.

In the course of detailed examination of the diseased plants of cotton in the Agricultural Research Station at Jalgaon, the senior author first noticed the distribution of the disease in such regular sequence, that too often affecting plants which appeared to be quite robust, that it became evident that there must have been some predisposing cause for the stem-break disease.

The highest percentage of disease incidence occurred during July when the temperature at noon rose up to 30-35°C. with humidity up to 85%.

Detailed microscopic examination of the diseased spots where the breaking takes place, revealed that the stem-break disease was incited by a strain of *Macrophomina phaseoli* (Maubl.) Ashby.

The first visible symptom of the disease is the discoloration and browning of the infected bark tissue. In due course, the diseased bark which is usually one to one and half inches above ground begins to peel off and becomes finely shredded (Fig. 1)! Due to collapsing of the central pith tissue and the outer cortical cells, the stem becomes brittle and breaks down with the weight of green tops. Microscopic examination of the shredded bark indicated the presence of numerous sclerotia and pycnidia containing large, ellipsoidal, glassy spores so characteristic of *M. phaseoli.* The lesions on the stem were always localised and caused no infection of roots by spread of the diseased patch.

The fungus was readily isolated in artificial culture from diseased bark portions. On various media including potato dextrose agar, the growth is very rapid at 28

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to 30°C. often covering the entire Petri plate within 24 hours. By artificially inoculating healthy cotton seedlings in pots, the pathogenic nature of the fungus isolate has been established.

Macrophomina phaseoli has a large host range and incites diseases popularly termed as "charcoal rot." On some of the hosts, only sclerotial stage is known while on others like jute, legumes etc., numerous pycnidia are also produced. On cotton in India, *M. phaseoli* is known to widely occur causing the root-rot, and several investigations with reference to the aetiology of the disease and control measures have been carried out. On cotton so far, only the sclerotial stage of *M. phaseoli* has been reported and that too in the root portions. The stem-break disease is a new type of symptom produced by the pycnidial strain of the same fungus. The localised necrosis on the bark portion preceding stem breaking is incited by the wind-borne pycnidiospores. In Texas and in Israel the charcoal rot inciting fungus on cotton has been described in detail but there is no mention of the type of stem-break symptom referred to in the present study.

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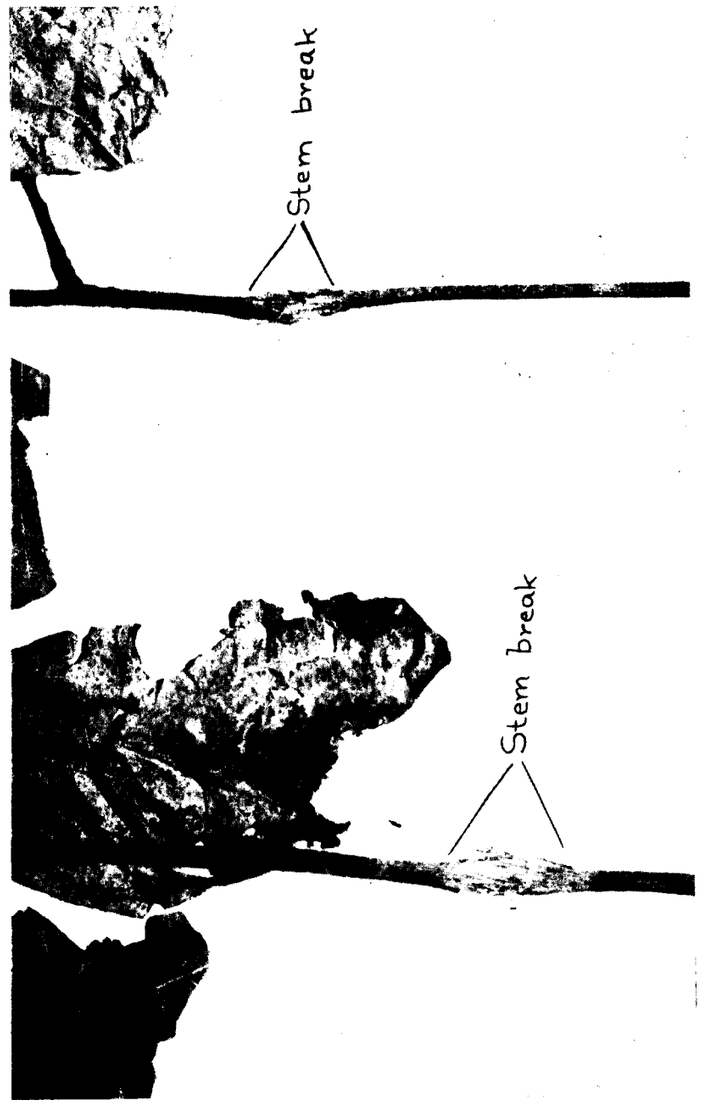
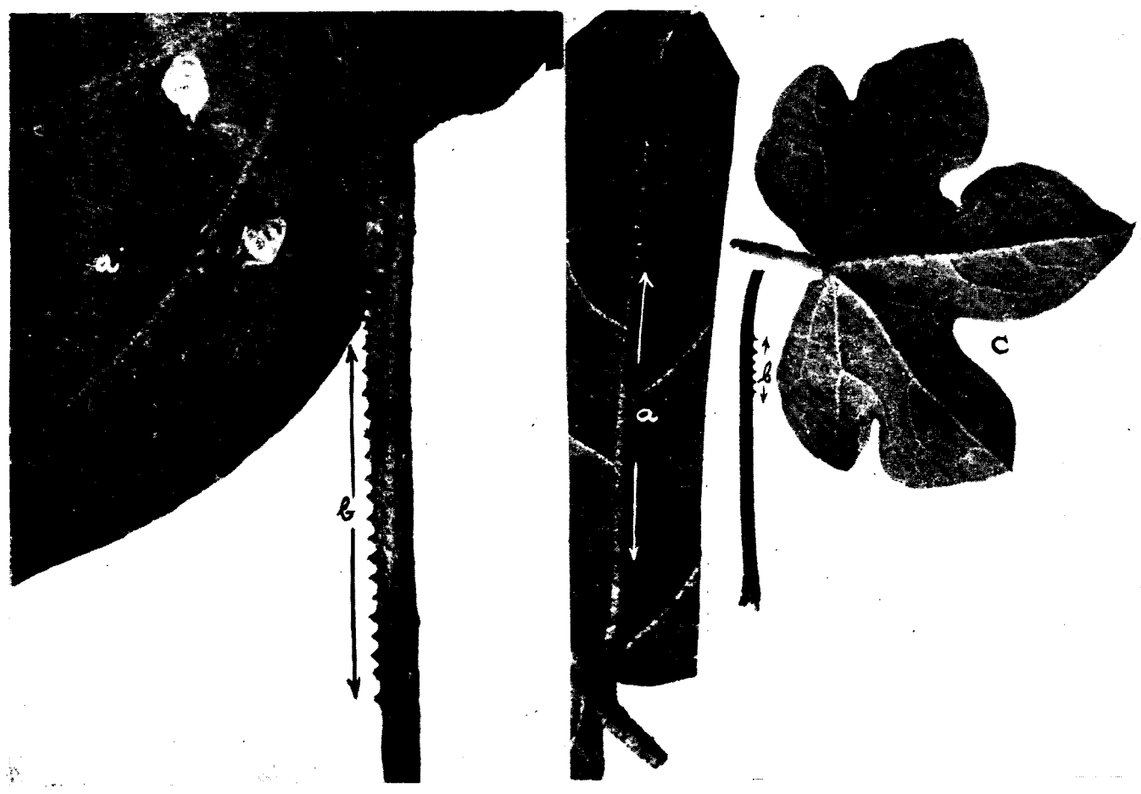


Fig. 1. Diseased bark of the stem.



Figs. 1 - 2. RICANIA FENESTRATA on cotton : 1. A portion of an infested cotton leaf : (a) Nymphs on the left, (b) A row of eggs on the leaf stalk. 2. (a) A row of eggs on the leaf vein, (b) eggs on leaf stalk. (c) Healthy leaf.

Fig. 3. Cast skin and Adults of RICANIA FENESTRATA on cotton. Cast skin with anal tuft (a) dorsal view (b) ventral view.

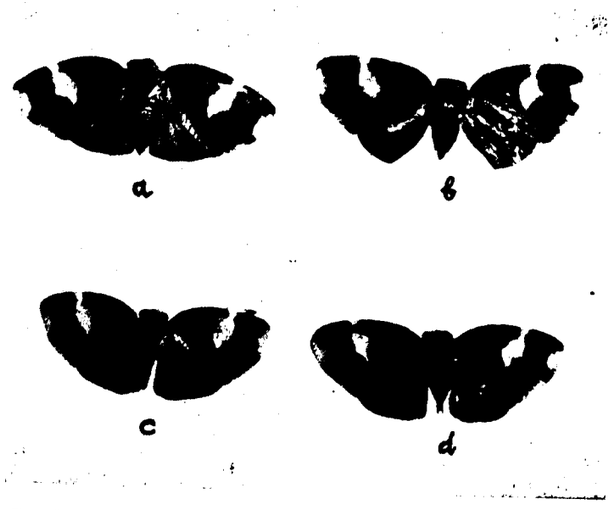


Fig. 4. Cast skin and Adults of RICANIA FENESTRATA on cotton. Adults : (a) Female- dorsal view (b) Female ventral view. (c) Male - dorsal view and (d) Male - ventral view.

RICANIA FENESTRATA FABRICIUS—A POTENTIAL PEST OF COTTON

By

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Ricania fenestrata Fabricius (Ricaniidae, Hemiptera) is reported by Hutson (1919) and Light (1929) as one of the minor pests of tea in Ceylon. Chattarjee and Bose recorded this insect on the forest plants like *Canthium didynum*, *Santalum album* and *Zizyphus oenoplia* in South India. Puttarudriah and Maheswariah (1954) noted it as a pest of *Jasminum flexile*, Vahl.-Var. *travancorense* around Bangalore and listed garden and vegetable plants like *Aganosoma dichotoma*, *Jasminum auriculatum*, *Erythrina indica*, *Citurs decumana*, *Rosa centifolia*, *Dahlia variabilis*, *Canna indica*, *Solanum melongana*, *Lycopersicum esculentum*, etc., as its host plants particularly when they are closely situated to Jasmine. They have also worked out its biology and habits on Jasmine.

During the month of December 1957 the writers observed *R. fenestrata* Fabricius assuming the positon of a potential pest on cotton, in the Laboratory compound. Eggs in large numbers were found inserted within the tissues of stalks, midribs and veins of cotton leaves and even of young and tender shoots of cotton plants by making slits (Figs. 1-2) by the ovipositors of adult females. Number of nymphs (Fig. 1a) of all instars and adults were found to be actively feeding by sucking the sap of the plant causing disfiguration and later dying up of attacked parts. Nymphs collected from the field were successfully reared to adults on cotton leaves in the Laboratory. (Figs. 3-4).

The appearance of this insect on cotton, though observed for the first time, seem to be becoming common and the damage caused to the crop shows that it may assume the status of a serious pest. Further studies on this insect with reference to the host plant are under way.

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RELATIONSHIP BETWEEN RELATIVE HUMIDITY OF ATMOSPHERE AND MOISTURE REGAIN OF *KAPAS* AND LINT AT DIFFERENT GINNING STAGES

By

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The object of the present investigation is to find the relationship between the relative humidity of the atmosphere in the ginning room and the moisture regain* of samples of *kapas* taken at different stages of ginning and of lint after ginning in different types of gins. With this end in view the temperature and relative humidity of the atmosphere at a particular stage of the ginning process were recorded, while at the same time a sample of *kapas* or lint, as the case may be, was taken for the determination of the moisture regain. This investigation was made possible by the acquisition of the Shirley Moisture meter, which is an electronic device depending on the principle that the electric resistance of a cotton fibre is closely related to its moisture regain. The method is quick taking only a couple of minutes for a test and gives quite an accurate value, the average deviation between the corrected values obtained by this instrument and the moisture regain values obtained by the oven method being about 0.2 per cent in the case of lint samples and slightly higher in the case of *kapas* samples. But for the availability of this instrument the testing of nearly 1,500 samples tested in connection with the present investigation could not have been possible.

It may be mentioned that the data were collected during the routine analysis of cotton samples and not through any controlled experiments. Further no statistical analysis of the data has been attempted but only general conclusions that could be drawn from the trend of the values have been enunciated. These conclusions should, therefore, be considered subject to the above limitations and may be taken as an approximate indication of the general behaviour.

Material and Method

At the Technological Laboratory the following procedure is adopted for ginning a sample of *kapas*. A specified weight of *kapas* taken out from a *borah*, in which it was lying stored, is opened out in the opening machine and weighed again. A definite weight of this *kapas*, the weight depending on the gin employed, is ginned and the lint obtained is weighed. In the present investigation the moisture regain of the *kapas* was determined at three stages, *viz.* (1) before opening, (2) after opening and (3) before ginning. Similarly the moisture regain of the lint sample obtained from (1) the single roller gin, (2) the double roller gin and (3) the saw gin, was also determined. As already stated, the temperature and relative humidity of the atmosphere at the time of taking the sample were recorded. The material studied comprised of the following 18 varieties:—(1) Sind Sudhar, (2) 1027 A.L.F., (3) P.A. 4F, (4) P. A. 289F/43, (5) P. A. 289F/K.25, (6) Verum, (7) Tando J.M., (8) Broach, (9) Umra, (10) Wagad, (11) Jarila, (12) Buri 107, (13) Mollisoni, (14) Sind N.R., (15) M.4, (16) Cambodia, (17) Jayawant, and (18) Gaorani.

* The moisture regain of a sample is the weight of the moisture present in the sample expressed as a percentage of the bone-dry weight. This term has been employed in the present investigation instead of the moisture content, which is normally used and which is the moisture present expressed as a percentage of the initial weight of the sample, because the Shirley Moisture Meter gives reading in terms of the regain only.

For a proper understanding of the moisture-humidity relationship, aimed at in the present enquiry, it is necessary to have an idea of the moisture regain of the sample of *kapas* or lint which has attained equilibrium condition in the atmosphere of a particular humidity. So far as lint is concerned data are available in the exhaustive work of Urquhart and Williams (1924) and of Wiegerink (1940). That the same figures could be applied in the present case was verified in the present investigation, by finding the moisture regain by the oven method, of a number of samples of ginned lint conditioned at different relative humidities. As regards the *kapas* samples, no such data are available and, therefore, they were determined by conditioning for about a week four samples of *kapas* at each of the relative humidities, 40 50, 60, 70 and 80 per cent and finding the moisture regain of these samples by the oven method. The temperature of the oven was maintained at 102°-104°C, instead of at 110°C., as in the case of lint samples, because there was a marked decomposition of the contents of the seed at higher temperatures. However, constant weight was not attained even after heating for seven or eight hours, although the reduction in weight was very small after six hours of heating. Hence the weight after six hours heating was taken as the "dry-weight" of the sample. This procedure was uniformly followed in the case of all *kapas* samples. The results obtained from the four replicate tests for each humidity were found to agree well with one another and their mean values have been utilised in the present enquiry.

Before taking up the results for consideration, some points require to be noted. In the present investigation different cottons were tested at different periods of the year. Not only the original moisture content of the *kapas* at the time of packing into the *borah* but also the changes in the atmospheric humidity during the storage might have varied from cotton to cotton. Besides though the range of relative humidity covered in the present investigation was from 35 to 80 per cent., the frequency, however, was not spaced uniformly over the whole range; there was a heavy concentration between 60 and 70 per cent R.H. and the number of readings for the very high and very low humidities was rather small, as can be seen in Table I. Moreover, besides the variation in the relative humidity, there was variation in temperature also, but in the present investigation as attention is concentrated on the changes in the former, the changes in the latter may be source of some small error. Furthermore the determination of the humidity by using the hair-hygrograph may be another source of error. On account of these limitations, while discussing the present results emphasis will be laid on broad general trends of variation of the moisture regain in relation to the atmospheric relative humidity at the time and not on the minor variations.

Results

The values of the moisture regain for the samples of kapas at three stages of ginning and of lint obtained from the three gins are given in Table I and are graphically represented in Fig. 1. Table I also contains the number of readings from which the mean value of the moisture regain was obtained in each case. The results for each stage are now considered one after the other.

(*a*) Kapas *before opening*:—In this stage the *kapas* taken out from a *borah*, in which it had been kept stored for a number of days or months, is dealt with. The sample, whose moisture regain was determined, was taken when the *kapas* was weighed before feeding into the opener. The results obtained (Column 3 of Table I, and Fig. 1a)

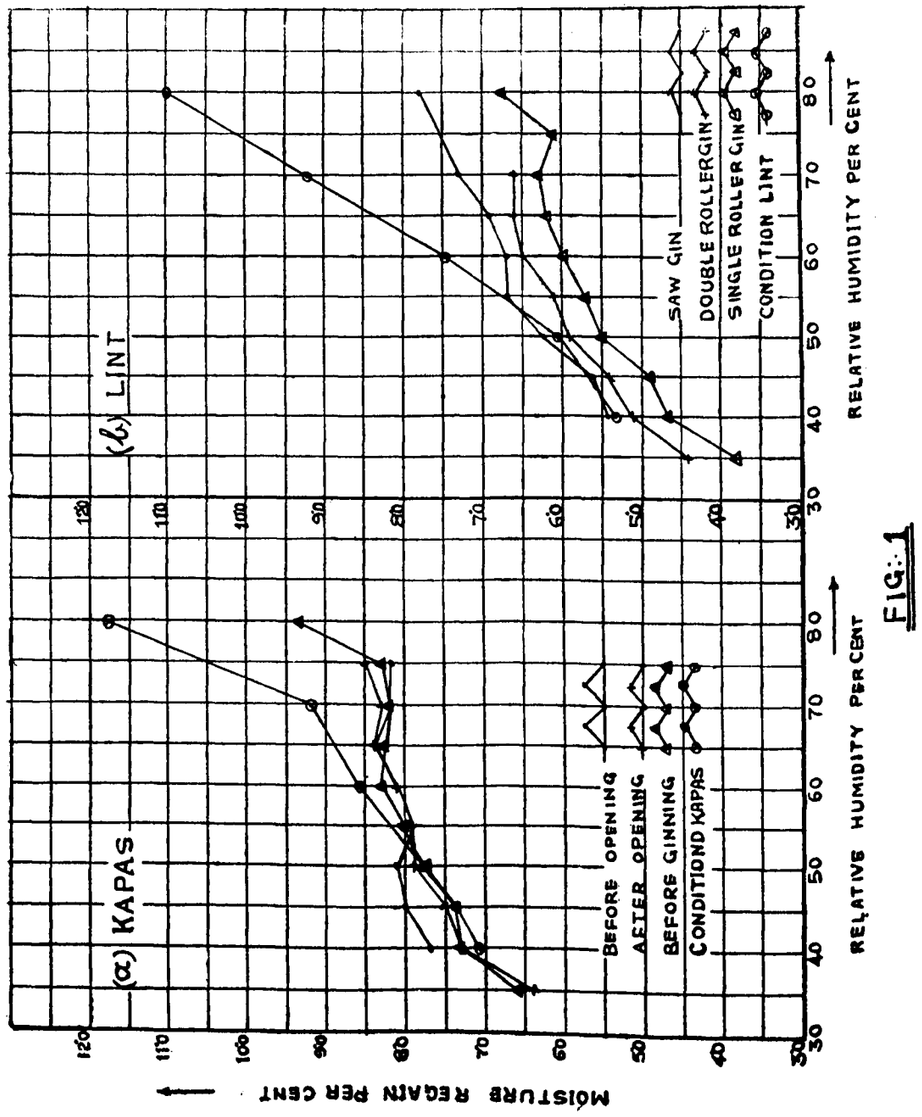

FIG: 1

TABLE I

Values of the moisture regain (per cent) at different values of atmospheric relative humidity for sample of kapas *at different stages of ginning and of lint from different gins.*

Mid point of range of R.H. per cent	*Kapas*							Lint						
	Before opening		After opening		Before ginning		After conditioning	Single roller gin		Double roller gin		Saw gin		After conditioning
	No. of readings	Regain	No. of readings	Regain	No. of readings	Regain	Regain	No. of readings	Regain	No. of readings	Regain	No. of readings	Regain	Regain
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
35			4	6.4	12	6.6		6	3.8	5	4.4			
40	12	7.7	9	7.3	43	7.3	7.1	12	4.7	15	5.1	15	5.4	5.3
45	15	8.0	11	7.5	48	7.4		20	4.9	14	5.4	13	5.6	
50	15	8.1	19	7.9	68	7.8	7.8	29	5.5	26	5.9	16	6.2	6.0
55	9	7.9	9	7.9	41	8.0		17	5.7	16	6.1	10	6.7	
60	33	8.1	34	8.1	110	8.3	8.6	65	6.0	65	5.3	37	6.7	7.4
65	36	8.4	36	8.4	140	8.3		49	6.2	53	6.6	38	6.9	
70	24	8.2	24	8.3	87	8.2	9.2	36	6.3	35	6.6	19	7.3	8.8
75	5	8.2	5	8.5	7	8.3		4	6.1					
80					12	9.4	11.9	7	6.8			3	7.8	11.0

If the number of readings for any humidity was less than three, that value of moisture regain was not taken into consideration.

showed that in this case the moisture regain varied very little, from 7.7 to 8.4 per cent only, and that this variation was not much influenced by the atmospheric humidity. It will be noticed that in the lower humidities the moisture regain of those samples was higher and in the higher humidities lower than the respective values for conditioned *kapas*. This finding is not as surprising as it may appear at first sight, for from what has been stated above, it is clear that the sample has been in contact with the atmosphere of the room for only a short interval of time and as such its moisture regain could be affected very little by the atmospheric humidity at the time. The moisture regain would depend primarily on what it contained while packing, as modified by the conditions of atmospheric humidity during storage.

(*b*) Kapas *after opening:*—This is the next stage where, while passing through the opener, the *kapas* moving speedily through the air is helped to be conditioned to some extent. The effect of this is seen in the results obtained (Column 5 of Table I, and Fig. 1a), which indicate a trend of increase with the rise of humidity. In the lower humidities the regain of these samples is only slightly higher than that for conditioned *kapas* while in the higher humidities it is considerably lower. This shows that though there is some pronounced influence of the atmospheric humidity at the lower levels, the time of contact of the sample with the air was not sufficient to approach anything like equilibrium conditions at the higher humidities.

(*c*) Kapas *before ginning:*—In this stage the *kapas* that had been conditioned to some extent in the previous stage was kept exposed to the atmosphere of the room for some time. It may, therefore, be expected that the influence of the atmospheric humidity is more appreciable in this case. This is reflected by the results obtained (column 7 of Table I and Fig. 1a), for there is a closer agreement between these values and those for conditioned *kapas* upto 60 per cent R.H., beyond which there is little distinction between the values for the present stage and those for the previous stage.

In order to test rigorously whether a straight line gives the best fit for the data from 35 to 65 R.H. the method of orthogonal polynomials was used. The components of the total sum of squares due to linear, quadratic, etc., terms were found out and successively tested for significance against error. The contribution of the linear component to the total sum of squares was highly significant (at 1 per cent level) whereas additions due to quadratic, cubic, etc. were successively lesser in magnitude and not at all significant. Straight line is therefore, the best fit. The fitted straight line is given below:

$$R_1 = 0.055\ H + 4.92 \quad \ldots\ldots\ldots (1)$$

where R_1 is the moisture regain of the *kapas* before ginning and H is the relative humidity (per cent) of the atmosphere. It shows that for a change of relative humidity of 10 per cent, there is a change in the regain of about half a per cent.

(*d*) *Lint from single roller gin:*—Coming to the lint samples, it will be seen, from column 10 of Table I and Fig. 1b, that the moisture regain is very low at low values of the relative humidity The regain which was only 3.8 per cent for 35 per cent R.H. rose rapidly with the increase in humidity reaching 6.8 per cent at 80 per cent R.H. Broadly speaking the variation of the regain in this case appears to run parallel to that of conditioned lint with a constant deficit of half to one per cent upto 55 per cent R.H., after which the deficit increased with increase of humidity. In order to understand the cause of this observed variation we may consider what actually happens during the ginning process. In this gin the lint is removed from the seed in thin strips which come into intimate contact with the atmosphere on the one hand and with the roller which gets heated during the ginning process on the other. The temperature of the lint was determined and it was found that, when the room temperature was 30° to 34°C, the temperature of the lint between the knife and the roller was 53° to 54°C, on the top of the roller about 47°C, from the roller strip about 43°C, on the floor 36° to 40°C. and when stored in the *borah* 33° to 37°C, It is thus seen that the lint is raised to a considerably higher temperature and cools off rapidly as it passes from the roller. Even after storing its temperature is higher than the room temperature. The intimate contact of the lint with the atmosphere would account for the variation with the atmospheric humidity and the heating up of the lint would account for the relative deficit in the value of the moisture regain.

In order to fit a curve for these data calculations were made as stated earlier. The linear component was highly significant (at 1 per cent level). The excess due to quadratic was significant at 5 per cent level. However, additions due to cubic, etc., were not at all significant. Though in a strict sense, quadratic should be taken as the best fit, in view of the rough nature of the data, the straight line can be deemed to give a good fit for the data from 35 to 65 per cent R.H. The fitted straight line is given by :

$$R_2 = 0.076\ H + 1.47 \quad \ldots\ldots\ldots (2)$$

where R_2 is the moisture regain of the lint obtained from the single roller gin. The increase in the regain for a rise of 10 per cent R.H. is about three quarters of a per cent in this case, as against about half a per cent in the case of *kapas* before ginning.

(*e*) *Lint from the double roller gin:*—The regain data obtained for these samples (Column 12 of Table I and Fig. 1b), show a similar trend of variation as was observed in the previous case. The curve depicting the variation in the present samples runs practically parallel to that in the case of lint from single roller gin, there being an almost constant difference of about half a per cent between the two. As in the case of single roller ginned lint in the present case also the regain values run parallel to those obtained for conditioned lint but with a deficit of about quarter to half a per cent, upto 55 per cent R.H., beyond which the difference between the two increases with increase of humidity. It will be noticed that the deficit in the case of double roller ginned samples is not as great as in the case of single roller ginned samples. This is because of the fact that while in the single roller gin the temperature of the lint rose up to 53° to 54°C,* in the case of the double roller gin it rose to 45° to 49°C only, the lower heating being responsible for the reduced deficit.

As regards the fitting of a curve, the linear component was highly significant (at 1 per cent level) in this case also and the excess due to quadratic was significant at 5 per cent level. However, additions due to cubic etc. are not at all significant. For the same reasoning as in the previous case the straight line can be taken to be a very good fit for the data from 35 to 65 per cent R.H. The fitted straight line is given by:

$$R_3 = 0.072\ H + 2.11 \quad \ldots\ldots\ldots (3)$$

where R_3 is the moisture regain of the lint from double roller gin. It will be seen that the rate of increase of the regain with humidity is nearly the same as was observed in the case of the single roller ginned lint.

(*f*) *Lint from the Saw Gin:*—The values of regain obtained for these samples (Column 14 of Table I and Fig. 1b), also denote the same trend as was observed in the other two previous cases, the actual

* *Note:*—The higher temperature in the single roller gin as compared with that in the double roller gin is due to the higher roller speed in the former case.

values being, however, slightly higher than those observed before. In fact all the three curves in Fig. 1b corresponding to lint samples from single roller gin, double roller gin and saw gin run parallel to one another with some small gap in between them.

Another interesting point is noticed in the case of saw ginned lint. That is the moisture regain of these samples practically coincides with those of conditioned lint upto 55 per cent R.H. beyond which the deviation between the two sets of values increases with humidity. The cause of this observation is two-fold. Firstly the temperature of the lint does not reach as high a level as was observed in the case of the other two gins, the rise in this case being only about 5°C. Secondly the contact with the atmosphere is more thorough in this case. The fibres pulled out from the seed are carried away in a strong draft of air and formed into a fine web. Thus all the parts of the fibres come into very intimate contact with the atmosphere which helps them to get conditioned fairly well. It is thus seen that the conditioning is almost thorough for humidities upto 55 per cent R.H. beyond which, probably, the period of exposure is not sufficient for proper conditioning.

On fitting orthogonal polynomials it was found that the linear component of the total sum of squares is highly significant (at .1 per cent level) whereas additions due to quadratic, cubic, etc. are comparatively negligible in magnitude and not at all significant. Straight line is therefore the best fit for the data from 40 to 65 per cent R.H. and that is given by

$$R_4 = 0.065\ H + 2.86 \ldots\ldots\ldots (4)$$

where R_4 is the moisture regain of the lint from the saw gin. It will be noticed that the rate of increase of moisture regain with humidity is somewhat lower than the value obtained in the case of the two roller gins.

Conclusion

The following conclusions can be drawn from the present investigation.

(1) The moisture regain of the *kapas* before opening was not found to be affected very much by the atmospheric humidity of the room at the moment.

(2) The moisture regain for the *kapas* after opening, however, showed a tendency to rise with the increase of atmospheric humidity.

(3) This tendency was more pronounced in the case of *kapas* before ginning, though the regain values did not correspond to those of conditioned *kapas* for the respective humidities.

(4) The moisture regain for lint samples from single roller gin increased rapidly with increase of humidity, but the actual values were almost uniformly less, than those for conditioned lint by half to one per cent upto 55 per cent R.H.

(5) In the case of lint from double roller gin also a similar trend of variation was noted, though the deficit from the regain values of conditioned lint in this case was less, being quarter to half per cent upto 55 per cent R.H.

(6) For saw ginned lint the regain values were practically coincident with those for conditioned lint upto 55 per cent R.H.

(7) Beyond 55 per cent R.H., however, the difference between the observed moisture regain and that for conditioned lint at the corresponding R.H. increased with increase of humidity for lint samples from all the three gins.

(8) From the above it follows that the moisture regain of any sample of *kapas* or lint is determined by the following factors: (*i*) its previous history, (*ii*) the relative humidity of the room, (*iii*) the temperature to which the lint is heated and (*iv*) the period and closeness of contact of the lint or *kapas* with the atmosphere.

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COTTON NOTES

(March-May, 1958)

The Weather and Crop Conditions

The weather was mostly dry and hot during the period under review. As the harvesting of cotton was over in almost all the cotton growing States in the country, the weather conditions during the period were not of much consequence so far as cotton is concerned.

In Rajasthan and Uttar Pradesh, the cotton sowing has commenced in the irrigated areas. The germination of cotton in Uttar Pradesh is reported to be satisfactory. It is reported that in Madhya Pradesh, the cultivators have started preparation of fields for the next sowing.

Acreage and Production

According to all-India fourth cotton crop estimates for 1957-58 issued by the Directorate of Economics & Statistics, New Delhi, in May 1958, the area under cotton during the season was 19.20 million acres against 19.48 million acres in the corresponding adjusted estimate of last year showing a decrease of 1.4%. The forecast covers the period upto the end of January, 1958 and past experience has shown that the area reported in the fourth estimate forms roughly 95% of that reported in the final estimate. The total area under cotton may, thus, be estimated at 20.2 million acres.

The State-wise details are given below :-

	Area (*thousand acres*)	
	1957-58	1956-57
Andhra Pradesh	989	991
Assam	35	35
Bihar	5	8
Bombay	10,697	10,714
Kerala	21	22
Madhya Pradesh	1,954	2,212
Madras	853	830
Mysore	2,306	2.514
Orissa	23	23
Punjab	1,523	1,413
Rajasthan	578	549
Uttar Pradesh	196	147
Delhi	1	1
Himachal Pradesh	1	1
Tripura	19	20
Total :	19,201	19,480

It will be seen that the decrease in area during the current season has been shared mainly by Madhya Pradesh and Mysore and has been attributed to unfavourable weather conditions at the sowing time. However, the decrease has been offset to some extent by increases recorded mainly in Punjab, Uttar Pradesh and Rajasthan States.

The varietal details are as under :-

Varieties	Area (*thousand acres*)	
	1957-58	1956-57
Bengals	1,121	879
Americans	3,204	3,365
Jarila (Including Virnar and 197/3)	3,318	3,213
H. 420 (Including Verum, 91 and others)	776	754
Oomras	1,597	1,910
Hyderabad Gaorani ..	1,562	1,748
Malvi	1,086	1,211
Broach Vijay	1,386	1,491
Surti Suyog	781	725
Dholleras	2,135	1,933
Southerns	2,181	2,196
Comillas	54	55
Total :	19,201	19,480

Among the different varieties of cotton, the decrease in area has occurred mostly in Oomras, Hyderabad Gaorani, Malvi and Broach-Vijay. Some increase in area has, however, been reported in the case of Bengals, Dholleras and Jarila varieties.

The area according to staple length groups is as under :-

	Area (*thousand acres*)	
	1957-58	1956-57
Long Staple	7,268	7,528
Medium Staple	8,602	8,541
Short Staple	3,331	3,411
Total :	19,201	19,480

It will be seen that as regards staple lengths, the decrease in acreage has been mainly in long staple cotton.

The details of the production estimates have not so far been published but the condition of the crop is reported on the whole satisfactory. The production of cotton in Punjab and Madras is reported to be higher by 3 to 7% this season as compared to corresponding period last season, while in Bombay, Mysore and Andhra Pradesh, the cotton production is reported to be lower by 5 to 6%. In Madhya Pradesh, however, the production this year is reported to be as low as 28%. On the basis of the information so far available, the over-all production of cotton in India up to the end of January, 1958, is reported to be lower by about 6% this season as compared to the corresponding period last season.

The trade estimate as on 31st May, 1958, indicates a production of 5,295,000 bales against 5,247,000 bales estimated as on the 31st April, 1958.

Ginning and Pressing

Cotton pressed during the 8 months (September 1957 to April, 1958) of the 1957-58 season was 3,307,000 bales against 2,545,000 bales during the corresponding period last year.

Imports.

On 8th April, 1958, it was announced that 30,000 bales of raw cotton of 1-3/16" staple length and above from soft currency areas will be permitted for import. The licences will be issued to mills only on the basis of their consumption of Sudan and Egyptian cottons for the last 3 years. A portion of the quantity will, however, be reserved for distribution to new mills. The cottons allowed are :—(1) All Karnak and Menoufi, (2) Giza 30—fully good and better (3) Dandera (Giza 31) fully good and better,(4) Ashmouni fully good and better, (5) GS down to CG6S, (6) GL down to G6L, (7) Private Estate Sudans down to Grade VI, (8) Tanguis and Pima cotton (9) B. P. 52 Grade UNWG and Alyan cotton. Another quantity of 30,000 bales of same varieties under similar conditions were subsequently allowed for import on 26th May 1958. The quantity of cotton imported during the first 8 months (September 1957—April 1958) of cotton season with that for the corresponding period last year were as follows:-

	Sept. 1957—April 1958	Sept. 1956—April 1957
	In '000 bales of 392 lbs. each	
East Africa	57	58
Sudan	52	45
Egypt	39	35
U.S.A.	102	291
Others	—	17
Total :	250	446

Exports.

It was announced on 21st May, 1958, that a quota of 15,000 bales of cotton of staple length 3/4" and below and 35,000 bales of staple length 23/32" and below will be allowed for export.

The total quantity of cotton exported to each country during the period September, 1957 to April, 1958, as compared to the corresponding period during the last season is as under :-

	Sept. 1957—April 1958	Sept. 1956—April 1957
	(thousand bales)	
United Kingdom ..	5	15
U.S.A.	8	4
Europe	16	21
Japan	74	121
China	—	26
Others	2	4
	105	191

Mill Consumption.

The quantities of Indian and Foreign cotton consumed during the period from 1st September, 1957 to 31st March, 1958 were 2,651,000 and 341,000 bales respectively against 2,724,000 and 339,000 bales during the corresponding period last year.

Mill Stock.

The figures of stocks of Indian and foreign cotton held by the mills on the 31st March, 1958, were as under :-

	Stocks of cotton on 31st March 1958	1957
	(In '000 bales of 392 lbs. each)	
Indian	1,298	1,222
Foreign	147	200
	1,445	1,422

Supply and Distribution.

The position regarding the supply and distribution during the current (1957-58) season would be as under :-

	Indian	Foreign	Total All Cotton
	(In '000 bales of 392 lbs. each)		
Supply			
Opening stocks—			
Mills ..	1,120	220	1,340
Trade ..	504	97	601
	1,624	317	1,941
Estimated Production	5,200	—	5,200
Imports ..	—	500	500
Total-Supply	6,824	817	7,641
Distribution :			
Mill Consumption ..	4,650	600	5,250
Ambar Charkha	50	—	50
Exports ..	250	—	250
Extra-factory consumption	270	—	270
	5,220	600	5,820
Stocks at the end of the Season with mills and trade ..	1,604	217	1,821
Total-Distribution ..	6,824	817	7,641

Cotton Textiles.

The figures of production of cloth by mills and exports of mill-made cloth during the period January to April, 1958, as compared with those in the corresponding period of 1957 are given below :-

	Production 1958-1957		Exports 1958-1957	
	(in million yards)			
January ..	436	484	53.38	95.91
February ..	391	435	51.52	70.82
March ..	406	453	52.44	82.06
April ..	408	464	42.32	80.34

June-1958. *Editor.*

BOMBAY COTTON MARKET REVIEW

(March-April, 1958)

(i) Indian Cotton Prices :

During March, the forward as well as Spot Cotton Markets ruled steady to firm while in April, the prices were somewhat easy due to absence of demand from the Mills.

The prices quoted for the Indian Cotton Contract and trends on specified dates are indicated below:—

March, 1958

Indian Cotton Contract March delivery opened at Rs. 659/- and rose steadily to Rs. 690/- on the 13th due to reduction in export duty and the release of an export quota of Bengal Desi. The prices registered a further rise to Rs. 696/- on 22nd due to the reduction in excise duty. This was maintained when the contract matured on the 25th.

The May delivery contract which opened on the 1st at Rs. 656/- moved in line with the March Contract and closed at Rs. 681/- on the 31st.

April, 1958

The May delivery opened at Rs. 673/- on the 1st and on rumours of an export quota rose to Rs. 677 on the 5th. From that date, it ruled easy due to lack of mill demand and closed at Rs. 648/- on the 30th.

As usual, the spot prices moved in line with those of the futures. The opening, highest, lowest and closing prices in the Spot Market were as shown below:—

Variety.	January, 1958				February, 1958			
	Opening	Highest	Lowest	Closing	Opening	Highest	Lowest	Closing
M. G. M. Jarila 25/32" ..	695	720	712	720	720	720	667	674
M.G.M.B. Jarila 25/32" ..	720	745	735	735	730	730	685	697
M.G.M.P. Jarila 25/32" ..	730	755	745	745	740	740	705	715
M. G. Khandesh Jarila 25/32" ..	740	765	757	760	760	760	735	742
M. G. Vijay 26/32"	905	930	925	925	920	920	885	885
M. G. Ankleswar 27/32"	935	965	955	955	950	950	915	915
R. G. P. A. 320F 27/32"	870	875	835	835	830	830	803	803
R. G. P. A. 216F 28/32" ..	880	880	870	870	865	865	840	840
M. G. Bengal fine	560	605	555	585	595	595	578	586

(ii) Foreign Cotton Prices:

(The review of foreign cotton prices is based on Daily Quotations, Dock Delivery new mill terms, very kindly being supplied by a prominent cotton firm).

Except for the first fortnight of the period, the Egyptian prices showed a downward tendency. In the prices of other foreign varieties a steady to easy tone was witnessed.

March, 1958	*April, 1958*
EGYPTIANS	
The prices registered a steady rise during the first fortnight and then started a downward trend and closed lower than the opening prices.	There was a marked downward tendency during the month.
EAST AFRICAN	
The prices were almost steady during the month although there was a slight downward tendency in the prices of Jinja towards the month-end	The prices opened at a lower level and remained steady throughout the month.
AMERICAN	
The prices registered a slight downward tendency during the month.	The prices were steady.
PERUVIANS	
The prices receded during the period.	
SUDAN	
The prices were almost steady but closed lower in some of the varieties.	Prices were steady throughout.

On the 8th April, 1958, it was announced that 30,000 bales of cotton of staple length of 1.3/16 and above from the Soft Currency areas will be permitted for import by the actual users. A similar quota on the same condition were released for import on 26th May, 1958.

Imports of cotton into India during the eight months of 1957-58 season were as follows:—

September, 1957 to April, 1958

(000 bales of 392 lbs. each).

East African	57
Sudan	52
Egyptian	39
U.S.A.	102
Total ..	250

WHAT THE SCIENTISTS ARE DOING?

(i) D.C. 109—AN OUTSTANDING *DESI* COTTON FOR THE PUNJAB

Out of a total area of about 12.8 lakh acres under cotton in the Punjab, about 12 lakh acres or roughly 94 per cent are irrigated which grow medium and long stapled American cottons. The remaining area, which is only about 6 per cent of the total, is cultivated with *desi* cottons like Mollisoni 39 and Mollisoni 60-A2. These cottons, though good yielders possessing high ginning outturn, are short in staple and can spin only up to 6-8 counts. Past work towards the improvement of these cottons resulted in the evolution of a strain, 231 Rosea, which surpassed the old strains in the matter of ginning outturn but failed to combine improvement in quality.

Efforts to secure strains combining the high yield and ginning percentage of the existing strains together with superior quality were continued in the scheme for improvement of cotton in the South Eastern districts of the Punjab functioning under the aegis of the Committee since 1945. Trials undertaken in the scheme have now yielded promising results with the isolation of an outstanding strain, *viz.*, D.C. 109. In yield trials conducted during 1956-57, this strain gave a creditable performance possessing a rare combination of high yield, high ginning outturn, superior fibre length and good spinning capacity. While the existing strain M60-A2 gave an average yield of 1461 lbs. of seed cotton per acre with a ginning outturn of 38.5 per cent and a spinning capacity of 6 counts, the respective values recorded by the new strain D.C. 109 were 1616 lbs., 41.2 per cent and 23 counts. In cash return, the new strain fetched an average increase of Rs. 290 per acre over the existing strain, the respective values being Rs. 889 and Rs. 599 for D.C. 109 and M60-A2. The comparative performance of the two strains is set forth in the following table:—

	D.C. 109	M60 A2
1. Yield of *kapas* per acre in lbs.	1616	1461
2. Yield of lint per acre in lbs.	666	562
3. Ginning percentage ..	41·2	38·5
4. Mean fibre length in inch	0·97	0·68
5. Mean fibre weight per inch (x10⁻⁶ oz)	0·201	0·302
6. Pressley Strength Index ..	8·2	7·2
7. Highest Standard Counts	23	6
8. Cash return per acre (Rs.)	889	599

In view of the outstanding performance recorded by the new strain D.C. 109 large-scale district trials with it in the cultivators' holdings are being undertaken so that the release of the strain which fetches an increased cash return of about Rs. 290 per acre, for general cultivation in those pockets where American cottons cannot be grown for the time being, may be hastened up.

(ii) MADRAS CAMBODIA UGANDA NUMBER 2 - A LONG STAPLE COTTON FROM MADRAS

There is a gap of 6 to 7 lakh bales between the production and consumption of cotton in India. This gap is being covered by the imports of long staple cotton varieties from different countries—U.S.A., Egypt, Sudan, East Africa, Peru and others. The research programme of the Indian Central Cotton Committee has, therefore, been directed towards developing superior long staple varieties which could replace the imported long staple cottons. In this context, the evolution of MCU-2, suitable for cultivation in the summer cropped area, stretching over about 60,000 acres in the districts of Madurai, Ramanathapuram and Tirunelveli of Madras State, is of great interest. This new cotton has been derived from crosses between the Madras Cambodia, and the imported strains of Uganda and Sea Island cottons. It has been found to be best suited for cultivation in the summer season commencing from March to middle of August in the above districts. This cotton possesses a staple length of 1.1/32" to 1.1/16" and has been adjudged suitable for spinning 36 to 38's counts with a count strength product of 1797 at 30's and 1591 at 40's and Pressley Strength Index of 7.03 and is considered one of the best quality cottons grown in India on a commercial scale at present. It yields about *three-fourths* of a bale of lint per acre and gin *34 per cent*. Besides these characters, it is capable of maturing within a short space of 5 to 5½ months and is ideally suited for growing in the summer cropped area where paddy is sown in rotation with cotton.

The Madras Government has put into operation a Certification Scheme to ensure that the seed of the required purity is distributed to the cultivators in the tract. Further, roguing of the fields and pooling, ginning and pressing under departmental supervision would entitle the cultivators of this variety a certificate of purity issued by the Department under the scheme. The certified bales have been generally found to fetch a better price in the market in comparison with the uncertified material.

The Indian Central Cotton Committee has also been financing jointly with the State Government a scheme for multiplication and distribution of seed of this variety with a view to covering the entire summer cropped area with this superior strain of cotton. This scheme has been in operation from 1954 and during the year 1956, 7,102 maunds of seed had been distributed to cover 60,250 acres. The gross extra income derived by the cultivators of this variety was estimated at Rs. 55.81 nP. per acre and the total extra income obtained by the cultivators in the tract was of the order Rs. 26,41,184.

(iii) HORMONE SPRAYING INCREASES COTTON YIELD IN UTTAR PRADESH

With a record of acre yield at the lowest level amongst the cotton growing countries of the world and a production target of 65 million bales fixed for attainment by 1960-61, the need for finding methods for enhancement of cotton yields in India has assumed a great importance and all avenues in this direction are being exploited in a vigorous and systematic manner to achieve this objective. The chief among them is the evolution of improved varieties that have inherently a greater yield potential compared to the local types. Other methods employed are adjusting the time of sowing, application of fertilizers, giving timely and adequate irrigation, adoption of prophylactic measures against pests and diseases, etc. Application of chemical hormones is a more recent innovation.

It has been found that application of these hormones inhibit the shedding of buds, flowers and bolls, which is a common feature in cotton, and thereby increase the yield to an appreciable extent. The first practical results from this method were obtained at Punjab and Indore where 216F and Bhoj cottons respectively were found to give high yields when sprayed with the hormone ∝-naphthalene acetic acid. The increase in yield was of the order of about 100 lbs. of *kapas* per acre while the cost of spraying worked out to only Rs. 3 to Rs. 4 per acre.

These encouraging results were considered by the Committee and by way of confirmation, it recommended that such trials should be taken up in the different States with a view to studying the possibilities of enhancing the present low yield levels by this method. Pursuant to these recommendations, trials were undertaken in many States.

Results of experiments conducted in Uttar Pradesh in 1957 go to corroborate the results obtained at Punjab and Indore indicating the distinct possibility of increasing the yield level of cotton by spraying hormones. Trials conducted at Uttar Pradesh consisted of spraying ∝-naphthalene acetic acid (Planofix) in two doses of 5 and 10 parts per million applied at two different stages *viz.*, at bud formation and at flowering. The varieties used were the Punjab American 216F at Raya and the *desi* cotton 35/1 at Muzaffarnagar and Meerut.

It was found that spraying of the hormone at 5 parts per million at the bud-formation stage gave higher yields compared to the control at all the three centres. The increases ranged from 52 lbs. per acre for 216F cotton at Raya, and 194 lbs. and 102 lbs. for 35/1 at Muzaffarnagar and Meerut respectively. The trials are being repeated for collecting confirmatory evidence on the advantage of spraying the hormone. The results of experiments from other States are also awaited. If successful, there is no doubt that it will open up a new vista of improving the present low yields of cotton.

REVIEW OF WORK DONE UNDER THE INDIAN CENTRAL COTTON COMMITTEE'S SCHEMES—1956-57

In accordance with the Committee's decision at its meetings held in October, 1949, a review of work done in the different States under the Committee's schemes is being placed before the Committee at its annual meeting since 1948-49. This review was subsequently prepared in respect of each scheme since 1953-54 in accordance with the decision made by the Committee at its meeting held in February, 1953. The review of work done under Committee's schemes during 1956-57 has been prepared accordingly and is set forth below.

The progress of work done in 1956-57 is given under the following heads:—

(*i*) Agricultural Research,

(*ii*) Physiological Research,

(*iii*) Technological Research,

(*iv*) Extension of area under improved varieties, and

(*v*) Statistics.

During the year under review, 47 research schemes, 22 seed multiplication and distribution schemes and 1 marketing survey scheme were in operation besides the work on technological research all of which cost the Committee about Rs. 12.8 lakhs.

I. AGRICULTURAL RESEARCH

PUNJAB

There are six schemes in operation in the reorganised Punjab State. Three of these aim at the evolution of improved strains for the different cotton tracts while two schemes are intended to study the agronomy and the manurial requirements of the cotton crop in the different ecological regions of Punjab. The sixth scheme aims at the study of insect pests of the cotton crop and their control.

(i) *Scheme for breeding extra long staple cotton in the Punjab.*

The original object of the scheme was to evolve American varieties of cotton with a staple length of one inch and above. As this object was realised in the evolution of strain LL.29 possessing a mean fibre length of 1.02″, the object was modified to the evolution of strains with mean fibre length of 1.1/8″ and above.

The results of trials conducted on cultivators' fields in Ferozepore district with the promising strains LL.43, LL.53 and LL.54 against 320F as control indicated, for the second year in succession, the superiority of the strain LL.54 in yield over the standard. During the year, it recorded on an average 27 lbs. of seed cotton more per acre over strain 320F. It is proposed to continue trials with these strains for one more year to collect more data on yield levels and to conduct mill tests. Extensive trials with the strains LL.53 and LL.54 are also planned in the areas coming under the Bhakra Nangal Project.

(ii) *Scheme for breeding American cotton suitable for central and sub-montane districts of the Punjab.*

The original object of the scheme was to evolve American types of cotton capable of replacing short staple *desi* grown in sub-montane tracts of the East Punjab. As this object has been achieved by the evolution of a strain 320F further work is directed towards the breeding of superior strains combining high yielding capacity, early maturity and adaptability of 320F with a staple over an inch, ginning over 35% and greater resistance to Jassids than 320F.

In one set of Main Strain Trials conducted during the year, strain J.34 gave the highest yield, registering its superiority over 320F for the fourth year in succession. In the second set, the performance of strain J.41 was found to be better than others in respect of yield, ginning percentage and mean fibre length.

In the Preliminary Strains Trial, the promising strain J.34 excelled 320F in yield, while as many as 26 types were found superior to 320F in fibre length. Very promising material has also been noted to be available in the lower breeding stages.

(iii) *Scheme for improvement of cotton in South-Eastern districts of the Punjab.*

The original object of the scheme when it was put into operation in 1945 was to breed improved strains of *desi* and American cotton for the Hariana tract (*viz.*, Hissar, Rohtak, Karnal and Gurgaon districts). Since partition, the emphasis was laid on the breeding of early maturing strains of Punjab American cotton which could be successfully grown under the peculiar agro-climatic conditions of the tract. This object was subsequently achieved to a large measure with the evolution of strains 216F and H.14 and hence the present objective is to evolve strains with longer and finer staple than strains 216F and H.14, *i.e.*, with staple above 1″. A secondary object of the scheme is breeding of high yielding strains of *desi* cotton capable of spinning 15-20 counts.

Out of sixteen strains along with six long linted strains from Abohar tested during the year in large scale trials, two strains surpassed 216F and compared favourably with H.14 in yield. All the strains recorded fibre length above 1 inch combined with

higher ginning percentage than the standard type. In overall performance, strains 85F and A.C. 88 appeared to be the most promising. These strains were also found to be earlier than others.

Re-selection with a view to isolating jassid resistant type from the promising strain AC-53 has yielded four promising progenies. These are proposed to be tested in the coming season.

In the *desi* cotton improvement work, the new hybrid strain D.C. 98 manifested superiority over M. 60-A2 in lint length, ginning percentage and other technological characters but as it fell short in yield, further re-selection is being done to improve this character.

Of the other *desi* varieties tried during the year, strain D.C. 109 was found to be superior to M. 60-A2 in respect of yield, ginning percentage and fibre length. This strain recorded a yield of 1616 lbs. of *kapas* per acre against 1461 lbs. of M. 60-A2 and possessed a spinning capacity of 23 H.S.C. compared to 6's of M. 60-A2. In view of its marked superiority, extensive trials are proposed to be undertaken with this strain in the districts.

(iv) *Scheme for cotton manurial trials in the Punjab.*

The object of the scheme is to obtain information on the exact manurial requirements of American cotton in relation to other controlling factors, *e.g.*, sowing date, spacing, rotations, irrigation and types of fertilizers in different ecological regions of the cotton growing tracts of the Punjab.

It was found that response to Nitrogen was low during the year at both Abohar and Hansi due mainly to attack of jassids. The optimum doses were found to be 53 lbs., 100 lbs. and 36 lbs. at Abohar, Hansi and Jullundur respectively. However, trials conducted on cultivators' fields indicated that maximum yield was obtained with 98 lbs. at Abohar, 83 lbs. at Hansi and 20 lbs. at Jullundur. Higher doses of ammonium sulphate were found not only to increase the yield of cotton but also of the succeeding wheat crop. It was found that application of ammonium sulphate in two doses, *viz.*, half at thinning and half at flowering proved to be the best. No increase in yield was found to result from direct application of super-phosphate. Experiments conducted on the effect of sowing time on the yield of American cotton indicated that the optimum sowing time was in the month of April up to the 1st week of May at Hansi and Jullundur while the month of May proved to be the best time for sowing at Abohar. It was also observed that closer spacing of $2' \times 1'$ gave higher yields than wide spacings at all the three centres.

(v) *Scheme for the study of agronomy of American cotton in the Punjab (erstwhile Pepsu).*

The object of the scheme is to test the different American varieties and to carry out experiments on irrigation, different dates of sowing and different doses of manure.

A comparison of varieties indicated that strain 320F/35 proved to be promising both at Faridkot and Rauni while H.14 was found to fare well only under dry conditions at Faridkot. It was found that under average soil conditions and optimum sowing time in April, a spacing of $2\frac{1}{2}' \times 1\frac{1}{2}'$ was the best. In late sowings closer spacing of $2' \times 1'$ appeared to be more suitable. From irrigation-*cum*-manurial trials, it was found that application of 80 lbs. Nitrogen with 7 irrigations gave the highest yield. Intercropping of cotton with *moth* was found to give a net increased return of Rs. 33 per acre over cotton alone. This practice was also found to reduce the incidence of root-rot which is common in these areas.

(vi) *Scheme for the study of insect pests of cotton crop and their control in the Punjab.*

The objects of the scheme are (*i*) to find out the correlation between various cultural practices and the incidence of different pests, (*ii*) to find out correlation between climate (both Macro and Micro) and the population of different pests, (*iii*) to try various new chemicals against various pests and to study their effect on the insect mortality and also other related points like phytotoxicity, hazards to manual workers and farm animals and economics as regards cost of the operations and additions in yield of crop etc., and (*iv*) to try various spraying and dusting machines and to find out the most appropriate ones.

Trials conducted during the year with different insecticides indicated that against thrips attack, spraying with 0.1% DDT suspension was the most effective and cheapest remedy. Endrin 0.02% emulsion was equally effective but was costlier. Phosphatic insecticides like Malathion and Basudin proved efficaceous in bringing about complete mortality in the initial stages but they were found to have less residual effect compared to DDT and Endrin. Large scale field trials are in progress at Ludhiana and Patiala with different insecticides to work out effective schedule of insecticidal measures against all the major pests of cotton.

BOMBAY

There are 12 schemes in operation in the reorganised Bombay State. While a majority of them is aimed at the evolution of improved strains for the different cotton growing tract, few of them seeks to study the agronomic requirements of the crop to obtain maximum yields. One scheme has the objective of producing hybrid seed for large scale cultivation.

(i) *Scheme for interspecific hybridisation in cotton at Surat.*

The object of the scheme is to obtain, if possible, fully fertile hybrids between Asiatic and American cottons possessing the desirable characters of both, particularly the good staple length of the Americans and the hardiness of the Asiatic types.

Two popular strains, *viz.*, 170-Co2 and 134-Co-2-M have been evolved as a result of past work in the scheme. The results of 27 district trials conducted during the year indicated that on an average, strain 170-Co-2 gave as good or slightly higher yield than the local improved *herbaceum* strain in black cotton soils of South Gujerat and *goradu* soils of Middle and North Gujerat under supplementary irrigated conditions. The extra-long staple cotton strain 134-Co2-M was found to fare well in the lighter soils of Sabarkantha district in North Gujerat. In other tracts it suffered from blackarm subsceptibility and recorded low yields. Amongst the other extra long staple hybrid strains the most promising one was found to be the strain 68 × 22-5-E-5 combining the same level of yield as Vijalpa with superior fibre length of 1.02". Work in this scheme has been intensified by launching a new scheme for breeding Indo-American cottons at Surat since the 1st March, 1957.

(ii) *Scheme for improvement of Mathio cotton at Amreli.*

The original object of the scheme was to improve Mathio mixture in respect of yield, ginning percentage and quality and to test at Amreli the early strains of Wagad evolved at Viramgam with a view to replacing the inferior Mathio by early *herbaceums.*

As a result of work carried out during the first fifteen years of the scheme a superior spinning and high yielding strain 'Pratap' was evolved to replace the Mathio mixture.

The present object is to evolve a variety superior to Pratap.

As a result of work done towards this objective, a promising strain *viz.*, C.J. 73 has been isolated. During the year, seven district trials were conducted in the Amreli district and ten in the Saurashtra region with this strain against the existing strain Pratap. Of the three successful trials in the Amreli district, strain C.J. 73 gave significantly higher yield than Pratap in one trial while in the other two trials, it recorded numerically higher yields, though the increases were not significant. In the two successful trials in the Saurashtra region, C.J. 73 gave higher yield over Pratap in one while in the other Pratap scored over C.J. 73. The all-round superiority of C.J. 73 over Pratap has also been evident from the average performance of the two strains for the past 6 years on the Agricultural Research Station, Amreli, where C.J. 73 recorded mean yield of 533 lbs. seed cotton 35% ginning and 35's H.S.C. compared to the respective values of 473 lbs., 34% and 26's of Pratap.

Since 1954-55, six mill tests have also been carried out on these two strains and, on an average, lint of C.J. 73 was valued at Rs. 751 per candy while lint of Pratap was valued at Rs. 733.

(iii) *Scheme for cotton breeding in Khandesh.*

The objects of the scheme are (*i*) to test extensively the improved strain 197-3, a cross between (Jarila × N.R.) subsequently named as Virnar, in order to determine its suitability to Khandesh tract; (*ii*) to improve further the fibre and other characters of 197-3 by crossing it with other types, and (*iii*) to study the secondary selections in Jarila to produce better strains.

The results of yield trials conducted on three Government farms and five centres in the Khandesh cotton zone during the year indicated that strain Y1 was equal to the existing strain Virnar in yield of seed cotton but superior to it in fibre fineness and ginning capacity. Results of mill tests indicated that the yarn of Y1 is stronger than that of Virnar and its lint was valued at Rs. 10 more per candy over that of Virnar.

Three new cultures possessing higher yield than Virnar have also been isolated in a large scale yield trial conducted on three Government farms.

(iv) *Scheme for breeding American cotton at Achalpur.*

The object of the scheme is (*a*) to evolve strains better than B.0394 and 0396 which have a staple from 7/8" to 15/16" and ginning percentage of 33 and capable of spinning up to 40's H.S.C. and (*b*) to evolve new improved disease and jassid resistant strains either by selection or hybridisation for different tracts with ginning percentage of 33 to 35 and spinning performance of 40's H.S.C.

Results of the Varietal Trials conducted during the past three seasons in the 4 centres at Achalpur, Yeotmal, Nagpur and Buldana have indicated that the strain 147 proved to be superior to the existing strain Buri 0394 in ginning outturn and halo length while being equal to it in yield. Strain 0296-7 combined significantly better yield and ginning outturn than B.0394 with the same halo length. In view of their superior performance, these strains are being subjected to district trials and the results are awaited.

(v) *Scheme for breeding* arboreum *cotton at Akola.*

The objects of the scheme are (*i*) to isolate strains superior to H.420 possessing a staple length of 13/16" to 14/16", a ginning outturn of 37% and a spinning capacity of 30's counts and (*ii*) to evolve for the drier parts of Vidharbha, a variety capable of yielding more than local Jadi, with a ginning percentage of 40, staple length of 13/16" and capable of spinning over 25's counts.

The overall performance of the strains tested during the past few years in Varietal Trials indicate that strain 13-A appeared to be promising in all the four centres—Akola, Buldana, Yeotmal and Nagpur. Trials of this strain on the cultivators' holdings remain to be done. Among the strains tested in the Preliminary Varietal Trial during the last 4 seasons, strains AK 277 and AK 235 were found to be the best. In a Strains Trial conducted towards the second part of the objective of the scheme, five strains *viz.*, II 101, No. 315, II 24, AK 72 and AK 20 were found to be significantly superior to the standard set for the scheme recording ginning percentage ranging from 41.2 to 44 and halo length from 21.1 to 22.2 mm.

(vi) *Scheme for improvement of Cotton in Aurangabad and Bhir districts.*

The object of the scheme is the evolution of wilt resistant, high yielding and high ginning strains of *indicum* or Verum type capable of spinning 20's to 24's counts and suitable for cultivation in Bhir district and plains of Aurangabad district of Bombay State.

Among the three improved varieties, *viz.*, 3591, 2513 and N. 1422 subjected to district trials during the year in the Aurangabad and Bhir districts along with Gaorani 12, 197-3 and the local as controls, the variety 3591 recorded the highest yield of *kapas* at Karanpura in Aurangabad district while all the three improved strains and Gaorani 12 gave significantly higher yield than the local and 197-3 at Sillod.

The above three strains were also tested in the Main Varietal Trial together with another strain 4829 with local and 197-3 as controls. The results indicated that all the four improved varieties were better than 197-3 though on a par with the local in respect of yield. The four strains were also found to gin 4% more than the local. The two most promising strains 3591 and 4829 are reported to be adjudged suitable for spinning 25's respectively compared to 19's of 197-3 and 8's of the local. Further confirmatory trials are in progress.

All the varieties included in the major field trials were tested for wilt resistance in wilt sick soil and 11 strains were found resistant to the disease under field conditions.

(vii) *Scheme for improvement of cotton in Parbhani district.*

The original objects of the scheme were (*a*) production of wilt resistant and high ginning strain from Gaorani 12 or other basic material suitable for entire Parbhani district, if possible, (*b*) maintenance of improved *hirsutum* strains bred for Ghat area of Aurangabad district and (*c*) study of wilt resistance under field conditions at Parbhani and under optimum conditions of temperature and infection at Poona. As these objects were achieved with the evolution of the improved strain 'Daulat' (2204) the object has been re-orientated as follows—

> "To evolve by selection and hybridisation a strain superior to Daulat (2204) in fibre length ginning percentage, boll size and wilt resistance."

In district trials conducted during the year with six varieties, the new strain Daulat proved its superiority over the local in the Gaorani 6 zone while the local outyielded Daulat in the Gaorani 12 zone. Of the other varieties tested, the high yielding type 4166, selected from Bulk Gaorani proved to be the most promising recording on an average, 23% and 10% higher yield than strain Daulat and the local respectively in five trials. Among the four strains tested in the Varietal Trial, strain 4826 was found to record higher lint yield than strain Daulat and the local with a spinning capacity equal to Daulat. Encouraging results were also given by strain 4166 which recorded higher yield than Daulat during the season consistent with its high yield level during the past five seasons also. This strain also manifested a high degree of wilt-resistance recording a mortality of 8.3% under controlled conditions at Poona. It is, however, late and slightly inferior to Daulat in spinning performance.

Of the 53 new varieties tested for wilt resistance under field conditions, nine pure strains and three hybrid strains were found to be resistant to wilt under field conditions. Of the 14 old cultures and 20 new promising pure and hybrid strains subjected to pot culture for wilt resistance, one culture *viz.* 4661-1-823-1-1 of Gaorani 12 parentage was found to manifest 100% wilt resistance. High degree of resistance has also been recorded by three old cultures and the high yielding strain 4166.

(viii) *Scheme for production of hybrid seed in Bombay State.*

The object of the scheme is to encourage the production of hybrid seed by giving a subsidy of Rs. 5 per lb. of seed produced.

During the year an area of about 838 acres was covered by hybrid cotton as against 545 acres during the previous year. It is estimated that about 1,200 lbs. of hybrid seed will be produced during 1956-57 by the cultivators and 46 lbs. on the Government farm at Surat. Thus the total quantity of hybrid seed produced would be about 1,246 lbs. against a total quantity of 1,110 lbs. produced in 1955-56.

(ix) *Scheme for simple manurial experiments in the cultivators' fields in Bombay State.*

The object of the scheme is to study the effect of fertilisers on the yield of cotton in cultivators' fields in the three cotton growing tracts of Karnatak, Gujerat and Maharashtra of Bombay State. The work in Karnatak was transferred to the Mysore State after the re-organisation of States.

The manurial experiments were conducted on variety 2087 in Surat, Virnar in East Khandesh and Laxmi and Jayadhar in Dharwar districts. Manurial treatments, as in the previous year, consisted of three levels of N, *viz.*, 0, 20 lbs. and 40 lbs., one of P at 20 lbs. P_2O_5, one of K at 40 lbs. K_2O per acre and their combinations. The six treatments were N O, N1, N2, N 1 P, N2 P and N 2PK

The results obtained during the year indicated that there is good response to manurial application in both Surat and East Khandesh districts. In Surat, application of ammonium sulphate alone was the most profitable, the increase in yields due to 20 lbs. and 40 lbs. N being 69 lbs. and 114 lbs. or 23.2 and 38.3 per cent respectively. In East Khandesh, unlike last year, all the fertilizer applications proved to be economical. Especially high response was obtained with the full combination of 40 lbs. N, 20 lbs. P_2O_5 and 40 lbs. K_2O, the increase in yield being 219 lbs. or 67.6% over no-manure. Significant increases of 78 lbs. and 118 lbs. of seed cotton per acre were also obtained with the application of ammonium sulphate alone at 20 lbs. and 40 lbs. N per acre respectively.

(x) *Scheme for study of Agronomy of long staple American cotton at Amravati in Bombay State.*

The object of the scheme is to study the Agronomy of long staple American cotton and to obtain the maximum *kapas* yield.

The results obtained during the year confirmed the previous findings that pre-monsoon sowing was more advantageous than normal sowing; the former recorded a yield of 1168 lbs. of seed cotton per acre as against 648 lbs. only per acre in the latter. The crop was not benefitted by post-monsoon irrigations as no increases in yield or ginning outturn resulted therefrom.

Unlike last year, the increase in yield obtained during the year due to the application of nitrogen was not significant. The response to 40 lbs. N was 19.1 % over O lb. N and this dose was found to be the most economical. Application of 40 lbs. N. was found to result in a net increased return of Rs. 23 per acre in the case of variety No. 91 and Rs. 46 in the case of Buri 0394. However, with increasing amount of nitrogen, it was found that ginning outturn and fibre length tended to show a decrease. Adoption of narrow spacings of 18" × 9" for type No. 91 and 2' × 1' for Buri 0394 respectively were found to result in significantly higher yields than wider spacings, in conformity with the results of the previous season. In general, the combination of pre-monsoon sowing, adoption of a spacing of 2' × 1' and application of 40 lbs. N/acre with no post-monsoon irrigation was found to be the best treatment to obtain optimum yields from Buri 0394.

(xi) *Cotton Wilt Breeding Scheme, Poona.*

The breeding of wilt resistant types originally formed part of the Broach Breeding Scheme, but as it was considered desirable that this work should be done under optimum conditions of wilt infection and as the required conditions, especially specified soil temperature in pots, were difficult to maintain at Broach, this part of the work was transferred to Poona in June, 1935, together with similar work on cotton for the Jalgaon tract.

The objects of the revised scheme are:—

(*i*) To evolve 100 per cent wilt resistant types of cotton for Bombay and Mysore States where the soil dwelling fungus persists and brings about serious losses if resistant varieties of cotton are not grown.

(*ii*) To carry out fundamental research work on root-rot of cotton and to adopt suitable technique for testing cotton against root-rot,

(*iii*) To investigate *anthracnose* and leaf-spots of cotton and devise some suitable control measures.

Investigations conducted during the year indicated that a good number of progenies of strains 98-41 Digvijay and 2087 manifested a high degree of resistance to wilt.

Regarding the work on root-rot of cotton, a method has been devised to test the susceptibility of different cotton varieties to the causative organism *viz.*, *Macrophomina phaseoli* by artificial inoculation. Work on testing for resistance based on this new method is proposed to be undertaken during the next season.

Trials directed towards exploring methods of controlling *anthracnose* conducted on Virnar cotton indicated that delinting of seed with commercial sulphuric acid gave effective control of the external seed-borne infection.

(xii) *Co-ordinated Crop-Weather Scheme, Poona.*

The Co-ordinated Crop-Weather Scheme envisages the recording of systematic crop and weather observations, at a network of selected experimental farms in India, so as to ensure that, in future, all the relevant biological and meteorological factors will be available, recorded according to one standard plan. Such data, collected for a sufficiently long period, will provide a proper basis for working out reliable crop-weather relationships.

The main indications obtained from correlation studies of weather factors and the growth and yield of cotton during the year were the following:—

In the central parts of India, (*i*) greater rainfall and number of rainy days during the period of branching increased the number of branches produced; (*ii*) more rainfall and number of rainy days during the boll-formation period reduced the number of bolls and (*iii*) higher maximum temperature during the boll-formation period increased the number of bolls. In South India, more sunshine during the boll-formation period was found to decrease the number of bolls.

RAJASTHAN

Two schemes are in operation in this State for the improvement of cotton in Kotah/Bundi and Mewar areas.

(i) *Scheme for improvement of cotton in Kotah/Bundi area in Rajasthan.*

The objects of the scheme are (*i*) to breed improved American varieties of cotton suitable for cultivation in Kotah/Bundi irrigated area and (*ii*) to study the conditions for their successful growth.

From the results of a varietal trial conducted during the year with four American cotton varieties *viz.*, M.48-4, M.48-46, M.49-398 and M.49-435 with C. Indore-1 as control, it was found that the two strains *viz.*, M.48-4 and M.49-435 recorded significantly better yields than the control. The differences between the four strains and the control in ginning outturn and halo length were not significant. The results of the spinning tests are awaited.

(ii) *Scheme for improvement of cotton in Mewar.*

The object of the scheme is to evolve a variety of American cotton (*G. hirsutum*) superior to C. Indore-1 for growing under irrigated conditions and also to find out an indigenous improved variety superior to local *desi* cotton for *barani* tract of Mewar.

In the American cotton improvement work, three strains, *viz.*, M.48-4, M.50-542 and M.52-953 were found to record significantly better yield than the control C.-Indore-1 in the trial at the Bhat Farm. In varietal trials conducted with nine promising American strains isolated in the scheme, using C. Indore-1 as control, strains M.48-4, M.52-953, M. 50-707 and M. 51-902 were observed to possess a better combination of economic characters than the control though their yield level was on a par with the control. In another trial conducted with four long linted strains from the Punjab, *viz.*, LL.43 LL. 45, LL.53 and LL.54 against C. Indore-1, it was found that though all the strains were inferior to the control in yield, they were significantly superior to the control in ginning outturn, halo-length and earliness.

No work could be carried out on *desi* cotton during the year because of heavy and continuous rains received during the beginning of sowing season which caused water-logged conditions.

MADHYA PRADESH

There are three schemes in operation in Madhya Pradesh of which two are schemes for breeding improved varieties and one a survey scheme.

(i) *Long staple American cotton breeding scheme, Badnawar.*

The object of the scheme is to evolve a long staple American cotton possessing a mean fibre length of 1" and over capable of spinning 40's H.S.C. and above.

In the district trials conducted in cultivators' fields, all the four C.T.I. types tested *viz.*, 1-4, 1-6, 4-19 and 4-21 proved to be better than the control, Indore-2, in yield, staple length and ginning outturn, C.T.I. 4-21 recording the highest staple. It is proposed to repeat the trials on a larger scale with type C.T. I. 4-21.

In a Varietal Trial conducted with 13 types derived from interspecific crosses involving *arboreum* and *hirsutum* parents, besides the wild types *thurberi* and *tomentosum*, it was found that the effect of the season on the types was very pronounced with the result that their performance during the year was not consistent with that of the previous year. Unlike in the last season, many of the C.T.I. types recorded yields only equal to the control, Indore-2, while two of them were even significantly poorer compared to the control. In ginning percentage, however, all the interspecific hybrids except two were significantly superior to Indore-2 by 1.4 to 7.0%, the promising type C.T.I. 1-4 again being the highest as last year. In fibre length, three *tomentosum* derivatives *viz.*, C.T.I. 1-6, 4-2 and 4-25 recorded a staple of 1" and over which is the target set for the scheme.

(ii) *Scheme for improvement of Nimar cotton.*

The object of the scheme is (*i*) to evolve a strain of *desi* cotton that combines the yielding capacity of Maljari (D.48-154) with the ginning percentage of 197-3 (Virnar) (*ii*) a strain of American cotton suitable for cultivation in the Nimar tract of Madhya Pradesh, superior to Buri 107 in yield, staple length and ginning percentage.

Results obtained from 9 District Varietal Trials conducted with the improved variety Maljari against 197-3 (Virnar) as control, indicated that strain Maljari gave an average increased yield of 160 lbs. of *kapas* per acre more than Virnar. In cash returns it was equivalent to Rs. 66 more per acre over 197-3. In the Strains Trial laid out with 22 promising selections, against Maljari and Virnar as controls, three strains *viz.*, MJ-1, MJ-4 and K.55-565 were found to give significantly better yield than the controls. The strain K.55-565 also recorded significantly better ginning outturn than the better of the two controls in this character, *viz.*, 197-3 and possessed the same halo length as the better control Maljari.

In the work for the improvement of American cottons two improved American varieties A.51-9 and A.51-10 were found to record numerically higher yield than the control Buri 0394 though the increases were not significant. Both the varieties, however, recorded significantly better ginning outturn than the control. Seeds of strain A.51-9 are proposed to be distributed among the cultivators by the Cotton Extension Department to ascertain its performance in the tract.

(iii) *Scheme for surveying cotton areas in Malwa.*

The object of the scheme is to select single plants from cultivators' fields and bulk samples of seed cotton from ginneries from all over the Malwa region and to test them with a view to isolating a strain of *desi* cotton for Malwa better than Bhoj or Jarila in yield by 10%, spinning 24's and ginning 35% and over.

As the scheme commenced quite late in the season by which date cotton pickings were almost over in Malwa region there was very limited scope for single plant selections from cultivators' fields. However, 30 single plants were selected and laboratory studies on these revealed that 5 of them combined halo length of 23 m.m. or above and a ginning percentage of 35 or over. These five plants together with another 5 plants which were high ginners (40% or over) and 2 plants which had a halo length of 23 m.m. or over have been selected for further trials in the next season. Besides cultivators' fields, survey operations were extended to village cotton markets and cotton ginneries and in all 580 *kapas* samples were collected. Halo length measurements of these samples indicated that the cottons of the districts surveyed *viz.*, Indore, Ujjain, Ratlam and Dewas had halo length ranging from 20 to 25 m.ms. and ginning percentage from 33 to 41%. Promising material has been retained for further studies. Further, 142 bulk samples of cotton seed were also collected from the heaps of different ginneries and these are proposed to be sown for further selection.

The survey covered an area of nearly 8,222 square miles in 4 districts out of the 12 districts of Malwa region.

MADRAS

Five schemes for evolution of improved strains in the different cotton growing tracts of the State are in operation in Madras.

(i) *Scheme for production of extra-long staple cotton of 1-3/16" in Madras.*

The object of the scheme is the evolution of a superior quality American cotton possessing 1-3/16" staple and capable of spinning 50's H.S.C.

Trials conducted during the year indicated that though the new strain 0484-A-1 proved to be as adaptable as MCU-2 in respect of yield it was below the standard set for the scheme with regard to quality. Out of the nine strains tested in the Main Strain Trial, L0313 was found to be promising in respect of staple length but it fell short in yield as compared to MCU-2. Four other strains were also observed to possess halo length superior to MCU-2. Results of spinning tests of these strains are awaited. Promising material exceeding the control MCU-2 in halo length and ginning outturn has also obtained in the lower stages of breeding and are undergoing further purification.

(ii) *Scheme for improvement of long staple American cotton as a winter crop in Central districts of Madras State.*

The object of Part I of the scheme is to evolve long staple American cotton more remunerative and superior to the existing strains Madras Uganda 1 in quality with a ginning percentage up to 38% and suitable for cultivation in the entire Cambodia area.

The object of Part II of the scheme is to explore the possibilities of growing Sea-Island cotton as a rainfed crop in *Modan* and *Kumeri* lands of the West Coast districts.

In the Cambodia cotton improvement work, the results of 27 successful district trials out of a total of 35 conducted during the year, in Coimbatore and Salem districts with the new strain 9030-G against M.C.U.1 as control, indicated that the new strain was consistently superior to M.C.U.1. While the yield levels obtained in the different trials showed a wide variation from 600 to over 2,400 lbs. per acres depending upon the soil fertility and the attention paid to the crop, the average yield recorded by the strain 9030-G was 1364 lbs. of *kapas* per acre compared to 1140 recorded by the existing strain M.C.U.1. In total lint outturn per acre it registered an increase of 79 lbs. over M.C.U. 1. In fibre length and bundle strength it was equal to M.C.U. 1 but was definitely superior in fibre fineness. The new strain was also found to be more tolerant to jassid and stem-weevil attack compared to M.C.U. 1 though slightly late maturing. In terms of cash return, strain 9030-G fetched an average net increase of Rs. 119 per acre over strain M.C.U.1. In mill tests conducted on lint samples of strains 9030-G and M.C.U.1 collected during 1955-56 and 1956-57, it was found that strain 9030-G yielded stronger yarns and its lint was valued at Rs. 50 and Rs. 25 more per candy over M.C.U.1 in 1955-56 and 1956-57 respectively.

In view of its superior performance, it is proposed to release the new strain 9030-G for general cultivation in the winter Cambodia tract in place of M.C.U.1 shortly.

With the reorganisation of the States, the work on Sea-Island cotton at Pattambi and Mangalore has been transferred to the Kerala and Mysore States, from 1st November, 1956. The work relating to Sea-Island cotton has also been greatly intensified and a separate scheme for the development of Sea-Island cotton in the country is in operation since May, 1957. The work done under this scheme is reviewed separately.

(iii) *Scheme for breeding unirrigated Cambodia cotton in Madras State.*

The object of the scheme is to evolve a hardy and productive type of Cambodia cotton with a staple exceeding 15/16" capable of spinning 40's warp counts and suitable for cultivation as an unirrigated crop in the Central and Southern districts of the Madras State.

The yield data collected from 11 Scattered Block Trials out of a total of 16 trials conducted on cultivators' holdings in the unirrigated Cambodia tract, revealed that the promising strain 9030-8-5 was on a par with M.C.U.1 in yield of *kapas*, while the new strain P.K. 719 included in the district trials for the first time, was slightly better in respect of quality. However, strain 9030-8-5 recorded higher spinning value than P.K. 719. Mill tests on these strains have been arranged for assessing their quality.

In the Main Strain Trials, all the nine strains under study recorded high lint yields ranging from 205 to 296 lbs. per acre exceeding the target fixed for the scheme (130 lbs. per acre). Strain 9030-8-5 recorded the highest ginning percentage of 38. Strains P.K. 485, 9030-D, P.K. 924 and P.K. 860 combined significantly better halo-length and high ginning percentage. Full scale spinning tests of the most promising strains have been arranged and the results are awaited.

(iv) *Scheme for breeding of an early variety of cotton suitable for cultivation as an off-seasonal crop in the rice fallows of Madras State.*

The object of the scheme is to evolve an early maturing variety of cotton which combines long staple and high ginning and at the same time fits in the agricultural time-table of deltaic tracts of Tanjore district where paddy is the main crop.

The trials conducted during the year confirmed the relative earliness and desirable yields of the Punjab American strains P216F, P23F and H.14 as compared to the local strains M.C.U.1 and M.C.U.2. It was also found that compared to the strain P216F which is at present recommended for cultivation in the rice fallows, strain P23F appeared to be better

in quality with the same level of yield as P216F. Scattered Block Trials with these two strains are proposed to be conducted during 1957-58. It was found that application of N at 60 lbs. per acre as early application, 75 lbs. as early application, and 75 lbs. as late application gave increased yields at Aduthurai, Coimbatore and Palur respectively. Adoption of two plants per hole was also found to enhance the yields.

(v) *Scheme for improvement of Tinnevellies and Karunganni cottons in Madras State.*

The object of the scheme is the production of a strain of *arboreum* cotton suitable for cultivation in the Central and Southern districts of Madras State, with a mean fibre length of 1-1/32" and above and a spinning value of 40's H.S.C., maintaining at the same time the ginning percentage of 33 and yielding capacity of about 125 lbs. of lint per acre.

Scattered Block Trials conducted during the years confirmed the superiority of the new strain 6186-9 for cultivation in the entire Karunganni tract, recording on an average, 341 lbs. of *kapas* per acre compared to 282 lbs. and 331 lbs. of the existing strains K.2 and K.5. Cultivation of this new strain in place of K.2 and K.5 would fetch an extra income of Rs. 30 per acre. It is estimated that saturating the entire area of 5.6 lakhs under Karunganni with this new strain 6186-9 would result in an additional production of about 30,000 bales of cotton stapling 15/16". Steps are under way to multiply the seed of this strain for release to cultivators in large scale.

MYSORE

There are 7 research schemes in operation in Mysore State for breeding improved varieties of cotton, apart from two schemes for physiological investigations which are dealt with under a separate head.

(i) *Scheme for breeding long staple American cotton in Mysore State.*

The object of the scheme is (*a*) to evolve strains of American cotton superior to those already under cultivation and resistant to red-leaf disease and (*b*) to evolve short duration cottons which can be fitted in for rotation in rice fallows.

Prior to the inception of the present scheme, an improved strain of Mysore American cotton *viz.*, M.A. II had been evolved which possessed a staple of 7 8" and gave 30% ginning outturn.

Subsequent work done under the scheme has resulted in the evolution of a superior strain M.A.V. which now occupies almost all the rainfed areas growing Upland cotton in the State.

The present work under the scheme is directed towards the evolution of strains superior to M.A.V., particularly in respect of fibre-properties and resistance to red-leaf disease.

Comparative trials with M.A.V. and Laxmi cotton were conducted in cultivators' fields in fifteen selected villages in the *taluks* of Honnali, Harihar and Davangere representing both black and red soils. From the data obtained during the current year as well as during the past three seasons, it was found that Laxmi cotton was more suitable for black soils while M.A.V. was better suited to red soils. However, M.A.V. comes up equally well like Laxmi cotton in black soils also during years of lesser rainfall during the period of growth.

All the four promising strains *viz.*, 14-2, 30-1, 28-2 and 35-4 tested in the M.A.V. cotton growing area were found to compare favourably with strains M.A.V. and MU-1 in yield. They also possessed greater resistance to red-leaf disease than strain M.U-1.

(ii) *Scheme for improvement of Dharwar-American Cotton.*

The object of the scheme which terminated on the 3rd April, 1957, was to substitute Laxmi cotton (*a*) with any of the exotic types or interspecific hybrids evolved at Surat or (*b*) by synthesising a new desirable strain at Gadag.

Results of district trials conducted during the year with the two sub-selections of Laxmi cotton *viz.*, A. 7 and B. 2 proved to be disappointing as both of them were observed to be practically on a par with Laxmi in yield. Further trials with these strains are, therefore, proposed to be discontinued. The strain No. 71 derived from cross between BC 68 CW-3-3-B-8 and Laxmi is, however, reported to have shown promise in the advanced stage of trials. In a comparative trial laid out with promising early long staple selections from Indo-American types, three cultures of I HU, one of I HV one of I HW, one of I H × and 3 of I HY were found to be promising in respect of yield and quality. Further trials with these are in progress.

(iii) *Scheme for breeding Cambodia cotton in Bellary district in Mysore State.*

The object of the scheme is (*i*) to evolve a long staple American cotton suitable for an irrigated *rabi* crop of Tungabhadra Project area and (*ii*) to evolve a type suitable for the rainfed tracts not served by the Project. The work of the first part is conducted at Siruguppa and that of the latter at Hagari.

In trials conducted during the year under irrigation in the Tungabhadra Project area, strain M.A.2 was found to record the highest yield. In quality, however, the other strains tested *viz.*, M.C.U-2, Laxmi and 2196-4 proved superior to M.A.2. In trials conductted at Hagari, it was found that while many of the selections tested in the Bulk Yield Trials and Small Bulk Trials proved to be superior to the control Westerns-1 in ginning outturn and halo-length, none of them reached the level of yield recorded by it.

(iv) *Scheme for botanical improvement of Kumpta cotton.*

The object of the scheme is the evolution of a variety equal to Kumpta cotton in earliness and superior to it in yield, ginning percentage and quality.

Trial of extra State types conducted during the year indicated that though superior in ginning outturn and fibre length, strains Laxmi, Virnar and N. 14 were inferior to Jayadhar in yield. Dig-Vijay of Gujarat proved to be superior to Jayadhar in lint yield but was late maturing. Amongst the hybrid material under study, a few promising selections have been isolated from crosses involving types like Jayadhar, Suyog, KFT, B.D. 8, etc.

(v) *Scheme for improvement of Westerns cotton in Mysore and Andhra States.*

The object of the scheme is to evolve an early maturing cotton with a staple of 13/16" and over, ginning 33% capable of spinning 30's warp counts and having a low waste percentage.

District trials conducted in Mysore during the year with Jayadhar and another sister of Jayadhar *viz.*, 2-3-69, in comparison with Westerns-1, indicated that strains Jayadhar and 2-3-69 gave numerically higher yields than Westerns-1. Similar trials undertaken in Kurnool and Adoni *taluks* of Andhra State indicated that while being equal to Westerns-1 in yield, both the strains, Jayadhar and 2-3-69 surpassed it in respect of halo-length and ginning outturn. In Bulk Yield Trials, five strains, *viz.*, 4282, 4509, 3870-IV/1, 4717-1-3 and 4272-1-4-3-4-5 were found to combine all the economic characters at Siruguppa, while strains 2-3-68-1/5, 4688-1 and 4939-1 proved to be outstanding in lint yields at Kurnool and Adoni.

(vi) *Scheme for breeding perennial cottons at Dharwar.*

The objects of the scheme are:

(*a*) to produce intra-*hirsutum* and *hirsutum-barbadense* hybrids (F_1 s) possessing resistance to blackarm, red leaf blight and boll-worms suitable for growing either as such or by budding on perennial stocks;

(*b*) to evolve pure breeding perennial types resistant to the above pests and diseases and suitable for cultivation in grass and waste lands; and

(*c*) to produce inter-Asiatic perennial hybrids (F_1s) which will be high yielding, high ginning and amenable to easy ginning in addition to possessing satisfactory fibre length for hand spinning purposes.

Trials conducted during the year indicated that the promising hybrid Co.4-B.40 × Quebradinho maintained its superiority this year also recording an yield of 330 lbs. of *kapas* per acre against 272 lbs. of last year. The F_1s of crosses between the drought resistant type *Jahagirdar* and other blackarm resistant annuals, also performed well during the year, recording yields ranging from 129 to 369 lbs. of *kapas* per acre, ginning outturn from 35 to 38% and mean halo length from 23 to 27 m.m.

(vii) *Scheme for breeding American cotton resistant to blackarm.*

The object of the scheme is to breed blackarm resistant cottons mainly for Bombay-Karnatak, where blackarm is a very serious disease affecting American cottons.

All the 33 exotic varieties obtained from Sudan, U.S.A., Tanganyika, Ceylon, U.S.S.R. and Nyasaland and tested in non-replicated plots against Laxmi cotton as control, proved to be highly susceptible to blackarm and yielded very little produce. They had, therefore, to be discarded. In a preliminary yield trial conducted with the three promising cultures *viz.*, XAB5, 170-Co.2-22 and 125 Co.2-18-2 with strain Laxmi as control, strain XAB recorded significantly better yield than the control while all the three cultures registered high degree of resistance to blackarm combined with desirable halo length. Further confirmatory trials are to be laid out—with these cultures. Further, a total of 250 selections made from the interspecific bulks, *viz.*, 170-Co.2, 125-Co.2, 125-Co.2-18, 134 CW, 134-Co.2 CW and BC 134 CW-3-1-7 and also from other types like Jinja, XAB5, 2196-4 and Co.4-B.40 were tested along with Laxmi as control in non-replicated plots. The results have been very promising and it was found that while a majority of the cultures maintained their high resistance status, a good number of them also combined higher yield levels than Laxmi with all the desirable fibre characters as those of Laxmi. The selections from 170-Co.2, 125 Co.-2-18-2-4 and 2196 were found to be particularly promising.

ANDHRA PRADESH

There are four schemes in operation in this State of which three are for breeding superior varieties for the different tracts while one aims at finding out the most economical type of cotton for mixed cropping in the ceded districts.

(i) *Scheme for breeding Cambodia cotton at Nandyal in Andhra Pradesh.*

The object of the scheme is to evolve (1) long staple high yielding American type as a *rabi* crop under irrigation in the Tungabhadra Project area and (2) an American cotton that can be grown as rainfed crop in the regions of the ceded districts *viz.* Kurnool, Cuddaph and Anantapur, not served by the Project to replace the low yielding *desi* type of poorer quality.

Results of district trials conducted during the year indicated that the promising strain 327 gave the highest yield for the second year in succession compared to strains M.A.2 and Laxmi and the local cottons, maintaining at the same time its relatively higher resistance to blackarm. This strain proved to be the most promising in the trials conducted on the station also recording higher degree of resistance to blackarm compared to Laxmi combined with the same level of yield and ginning outturn.

(ii) *Scheme for improvement of white Northerns cotton in Andhra Pradesh.*

The object of the scheme is to evolve a type suitable for cultivation in the whole tract having varying climatic and soil conditions and possessing the high spinning qualities of N.14 combined with the yielding capacity of local varieites and ginning percentage of at least 30.

District trials conducted during the year with the most promising strain 122 along with two other strains *viz.*, 5001 and 5975 with N. 14 as control indicated that for the second year strain 122 proved to be the best recording better halo length and ginning percentage compared to the other strains. The general yield levels were poor during the year due to the damage caused by the untimely heavy showers received soon after sowings. All the eleven strains tested in the Bulk Yield Trials were found to be either better than or on a par with the control N. 14 in spinning performance. In respect of monetary return per acre strains 122, 123 and 516B were found to be superior to N. 14.

(iii) *Scheme for evolution of white linted cotton for Coconadas tract in Andhra Pradesh.*

The object of the scheme is to evolve an early maturing, medium stapled, high yielding, white linted variety of cotton with a ginning outturn of 35% suitable for growing as a mixed crop with *Sajja* (*bajra*), Korra (*Setaria italica*), groundnut or chillies in the early season and as a pure crop in the late season for covering the entire area of Cocanadas tract including the "Chinnapathi" cotton tract of the Vishakapatnam district and for placing the red northerns grown in the Kurnool district.

None of the nine varieties, *viz.*, 197-3, Pratap, H.420, B.5, M.5.A, K.19, K.21, K.22 and K.32 tested in the Bulk Yield Trials in July, August and September sowings was uniformly good in all the three sowings. The lint outturn of most of the types was, however, better than both Chinnapathi and Cocanadas 2. A total of 9 medium stapled, white linted extra-state types comprising of 53 Asiatic and 44 American varieties were studied in observation rows. It was found that while many of the *desi* cottons out-yielded both Cocanadas 2 and Anakapalli white in July sowings in the August and September sowings none of them reached the yield level of Cocanadas 2. The yield of American cottons was generally poor in all the sowings though a few types in July and August sowings yielded on a par with Cocanadas 2. The yield performance of each of these varieties indicated that no one variety was uniformly suited to all the three sowings.

In the "Chinnapathi" improvement work it was found from the trials conducted during the season that varieties Pratap, 197-3, H.420 and M.5.A. appeared to be promising from the point of adaptability and productivity. In the district trials conducted, with the first two strains in the "Chinnapathi" tract both the strains recorded significantly better yield than Chinnapathi local.

(iv) *Scheme for the trial of cotton selections evolved in the Mungari scheme under mixed cropping conditions.*

The object of the scheme is to try the selections evolved in the Mungari cotton improvement scheme under mixed cropping conditions with groundnut or *Setaria* in various proportions in comparison to the local *Hingari* type of cotton for yield and quality and fix up a type most economical for mixed cropping.

Results of trials conducted during the year indicated that for mixed cropping, the three *Mungari* cultures *viz.*, K.28, 4616 D-2 and R-1 were more suitable than the local *Hingari*. It was also found that groundnut-cotton mixture was more beneficial in red soils while *Setaria*-cotton proved to be the most economical in the black soils. No monetary differences were observed between the three proportions of cotton and the component crop *viz.*, 1 : 1, 1 : 2 and 1 : 5. With regard to the time of sowing, it was found that while it did not influence the yield of cotton, early sowing gave increased yields in respect of the component crops and was, therefore, more advantageous.

UTTAR PRADESH

Two schemes for breeding of improved varieties of cotton are in operation in Uttar Pradesh.

(i) *Scheme for improvement of cotton in Rohilkhand tarai area in Uttar Pradesh.*

The objects of the scheme are (i) to evolve a *desi* variety suitable for growing under *barani* conditions in the sub-montane districts of Uttar Pradesh and (ii) to evolve hardy American types which can be grown under irrigation in restricted localities as a rotation crop with sugarcane.

Trials conducted during the year indicated that strains derived from 35/4 × Parb. G.703 and C.520 × C.402 were numerically superior in respect of yield to the control, 35/1, at Nagina and Meerut respectively. At the other two farms, namely, Muzaffarnagar and Kiserwa, where similar experiments were conducted, 35/1 out-yielded the others. The above two strains were found to be promising in respect of spinning value also having been adjudged suitable for spinning 21's and 20's against 16's of the control. It was further noted that derivatives from crosses involving 197-3 proved to be superior in yield and quality to the standard strain 35/1.

It was found from trials conducted with early and late maturing American types that varieties like L.S.S., C/Am-4 and 320F were suitable for cultivation in the *tarai* areas.

(ii) *Scheme for improvement of cotton in Western and Central districts of Uttar Pradesh.*

The object of the scheme is to evolve by acclimatisation, hybridisation and selection, superior long stapled cottons of *desi* and American varieties suitable for cultivation in Western and Central Uttar Pradesh. With regard to *desi* cottons, the target is a strain superior to 35/1 while in the American cottons the object is to isolate a strain superior to 216F.

In the work for the improvement of *desi* cottons, one strain *viz.*, 35/4 × Parbhani G.703 was found to record numerically higher yield than the control, 35/1 in the Main Strain Trial. In spinning capacity however, it recorded the same value of 12's H.S.C. as 35/1. Another strain, *viz.*, 51/50 registered a spinning capacity of 19's H.S.C. but in respect of yield, it was significantly poorer than the control. Other strains possessing superior quality have also been isolated and further trials are in progress.

As regards American cottons, the Punjab American cotton strain 216F is at present recommended for general cultivation in the districts of Bulandshahar, Aligarh, Mathura, Agra and Etah. The results of the district trials conducted with the three strains, 216F, H.14 and M.4 on cultivators' fields in the main cotton growing districts of the region, indicated that strain 216F and H.14 recorded the same level of yields at Aligarh and Mathura, while no significant differences in yield were noticed between the three strains at Bulandshahar and Etah.

The results obtained from the time of sowing trial, indicated that the April sown crop gave significantly higher yield than the May sown crop both at Bulandshahar and Raya, besides recording superior ginning outturn.

ASSAM

The only scheme in operation in this State is the Schemes for improvement of Hill cotton in Assam.

The object of the scheme is to evolve high yielding strains of coarse short staple cotton with high ginning percentage and to explore the possibilities of increasing the yield per unit area by adopting such cultural practices, suitable to the conditions prevailing in the hilly regions in Assam.

In a varietal trial conducted with six promising strains *viz.*, MKR 168-1-49, D.46-2-1, G.135-49, CH. 109, G.84-1, and G.27-51 against the local bulk as control the yield differences were not significant. Strain D.46-2-1, however, was found to record the highest ginning outturn of 47.5% compared to 45.7% of the local bulk.

In the combined spacing and seed rate trials, no significant difference in yield was observed either due to the three spacings of 9", 12" and 15" both ways or the three seed rates of one seed, two seeds, and three seeds per hole. In mixed cropping trials mixtures of cotton with groundnut and sunnhemp, gave same levels of yields. Cotton when sown alone produced higher yields, as expected.

ORISSA

Scheme for research on cotton in Orissa.

The original object of the scheme was to undertake a botanical survey of the cotton areas of Orissa and to acclimatise American and other varieties of cotton under the Hirakud Dam Project. This has now been re-orientated to the development of strains of American cotton with a mean fibre length of 1" and capable of spinning 40's H.S.C. at the main station Chakuli and the development of *arboreum* cotton strains with 13/16" staple and ginning outturn of 33% at the sub-station, Arkabahali. In addition, botanical survey of cotton areas in the districts of Sambalpur and Sundargarh is also envisaged in the scheme.

The results of Varietal Trials conducted during the *kharif* season under irrigated conditions indicated that M.C.U-1 recorded the highest yield of 1283 lbs. followed by Buri 0394 and L.S.S. In the unirrigated trials, P216F was found to be promising recording higher yields than Buri 0394 and Laxmi.

Co-ordinated scheme for the Development and Improvement of Sea-Island cotton in different States of India.

This new All-India scheme put into operation in May, 1957, has the following objects:

(*a*) To cultivate the promising Sea-Island cotton variety 'Andrews' in the three States of Kerala, Mysore and Assam over a total area of 3 lakh acres to produce about 2.25 lakh bales of cotton and thereby reduce the import of long staple cotton of 1.3/16" and above by that quantity.

(*b*) To survey areas suitable for cultivation of Sea-Island cotton in the three States.

(*c*) To improve the fibre strength and ginning percentage of 'Andrews' by selection and make the cotton more remunerative and suitable for spinning 80's counts.

(*d*) To conduct agronomic research to improve the yield and quality of 'Andrews' in all the three States.

(*e*) To arrange for ginning and marketing of the produce in all the three States.

From the available quantity of 1063½ lbs. of Andrews cotton seed, 135 acres of Sea-Island cotton crop were raised, during the year in 26 primary centres in the States of Kerala, Mysore and Assam for multiplication of pure seed. Exploratory trials were also conducted in Tripura, Manipur, West Bengal and the Andamans and Nicobar Islands, both on the Government farms and on the cultivators' fields.

From the primary centres, a quantity of 23,000 lbs. of *kapas* has already been pooled from Kerala alone by the middle of December. Pickings are still in progress and a second flush is also expected in many centres and the final yields are yet to be estimated. It is programmed to raise 2,500 acres in Kerala, 2,400 acres in Mysore and 100 acres in Assam during 1958-59 from the seeds recovered after ginning of the current year's produce.

Research work conducted in the scheme during the year indicated that 60 lbs. of nitrogen maximised the yield with a spacing combination of 2' × 9". Closer spacing was also found to increase the yields. Improvement of the yield and quality of 'Andrews' cotton was also attempted employing Mass-pedigree selection methods and a large number of plants has been selected for further work.

II. PHYSIOLOGICAL RESEARCH

Three physiological schemes are in operation, one each at Indore, Dharwar and Mysore.

(i) *Scheme for Cotton Physiological Research at Indore.*

The object of the scheme is to obtain, as far as possible, precise knowledge of the interrelationship between the soil and climatic factors and the growth of different varieties of cotton and to endeavour to utilise the knowledge thus gained for improving the quality and yield of cotton in general.

The work in this scheme was an outcome of the investigations undertaken in the scheme for Cotton Physiological Research which was operated in the Punjab from the 15th March, 1935 to the 31st March, 1944. The present scheme commenced functioning from the 1st March, 1944 and terminated on the 28th February, 1957.

A few of the important results of practical value obtained in the scheme are mentioned below:

It was found that red-leaf disease prevalent in Sind-American cottons in Sind could be remedied and yield increases ranging from two to four maunds of seed cotton per acre could be obtained by the application of ammonium sulphate.

In South Gujerat (Surat) the optimum spacing for obtaining maximum yields was determined to be 6′ × 2″. Application of nitrogen up to 75 lbs. per acre was found to be beneficial.

Spraying of Dhar 43 cotton with aqueous solution of alpha-naphthalene acetic acid at 10 p.p.m. during the square period was found to result in yield increases ranging from 25 to 50%.

In Malwa tract, maximum yields were obtained with the adoption of early sowing, close spacing and manuring with nitrogen. The optimum sowing time was from the 25th May to the 10th June, in water-logged lands and from the 1st to the 20th June in well drained soils. The optimum spacing was found to be half square foot per plant *i.e.* 9″ × 8″ or 12″ × 6″.

Results from experiments conducted for four years in Mewar (Rajasthan) dispelled the popular belief that *desi* cottons yielded higher than Americans and it was found that it was more profitable to grow Americans in place of *desi*. Prior post-monsoon irrigations were observed to increase the yields of American cottons three to four times.

Deficiencies of Potash and Phosphate were found to be the main reason for the lack of response to nitrogen and the low yields of Egyptian cottons in the Mysore State. When nitrogen was supplemented with application of 100 lbs. of P_2O_5 and 100 lbs. of K_2O, an increased yield of 200 to 300 lbs. of seed cotton per acre was obtained.

(ii) *Scheme for Cotton Physiological Research, Dharwar.*

The object of the scheme is to study the cotton plant under Bombay-Karnatak conditions, and to apply the knowledge gained for increasing the yields and acreage under finer types of cotton.

The data obtained from a complex experiment laid out to study the effect of several fertiliser combinations indicated that nitrogen and phosphate and their combinations improved the characters like dry weight of plant, flower and boll number and boll weight but that potash had no effect on these characters.

The experiment designed to study the effect of application of chemical hormones on the growth and yield of Laxmi cotton was repeated at Dharwar and Gadag with five hormones *viz.*, 2.4-D, IAA, NAA, TIBA and Nexy AA. The results obtained at Dharwar indicated that none of the hormones had any beneficial effect on dry weight per plant, flower and boll production, setting percentage or yield under Karnatak conditions. The trials at Gadag were vitiated due to insect attack.

The results obtained from another experiment undertaken during the year indicated that burning *jowar* stubbles or straw in the cotton field at the rate of 460 maunds per acre resulted in a significant yield increase of 100 lbs. seed cotton per acre.

(iii) *Scheme for Cotton Physiological Research, Mysore.*

The object of the scheme is to investigate the causes for low yields of Egyptian cottons under Mysore conditions.

The results of trials conducted in the past indicated that deficiencies in respect of phosphate and potash were responsible for the low yields of Egyptian cottons in the area and that when these two nutrients were applied, there was a significant increase in yield levels. The trials undertaken during 1956-57 at the V. C. and Babbur Farms also supported the above finding. In order to maximise the yields, the most economic dose of fertilisers was found to be 50 lbs. of N and 100 lbs. each of P_2O_5 and K, which combination recorded an yield of 442 lbs. during the year compared to 235 lbs. of the control. It was found from analysis of data collected from experiments conducted during 1955-56 at Babbur Farm that an acre of Egyptian cotton crop under irrigated conditions absorbed from the soil about 186 lbs. of N. 90 lbs. of P_2O_5 and 186 lbs. of K_2O, the quantities being variable depending on crop growth conditioned by the season.

The results of three sowing data experiments conducted at Babbur Farm and one at V.C. Farm indicated that (*i*) for winter season the optimum sowing time at Babbur was from the end of October to 10th November and in summer the first fortnight of April constituted the best time of sowing, (*ii*) at V.C. Farm the optimum sowing time was the first week of November.

III. TECHNOLOGICAL RESEARCH

During the year, the total number of samples received for tests was 3808 as against 3699 in the previous year recording a small increase of 3 per cent. Most of these samples were tested and the results presented in 907 reports of various categories as against 796 issued last year registering an increase of 14 per cent. Tests on improved varieties from distributed seeds in various stages of multiplication for the past six seasons indicated that there was no general decline in spinning quality as the stage advanced except in a few isolated cases and in the latest stages. Mill and Laboratory tests were carried out on as many as 32 samples during the period.

Tests for the cotton trade and the textile industry.

To serve the interests of both breeders and the textile industry, Technological bulletins on trade varieties of Indian cottons and on standard Indian cottons grown in the Experimental farms besides Technological circulars on each trade variety were issued. The Testing House of the Laboratory received as many as 1104 samples for various tests during the year on which reports were issued on about all of them during the period.

An apparatus for measurement of rigidity of fibre-bundles in which torsional oscillation method is employed was devised in the Laboratory and tests are in progress. Further, a number of parts for the small hand-operated card being fabricated in the Laboratory for determining the nep-potential of a small sample of cotton were prepared during the period. All tests in connection with the effect of agronomical treatments on neppiness of cotton have been completed during the period and the results await statistical analysis. It is proposed to carry out spinning tests with the new patented miniature spinning plant and compare the results with those obtained with the present micro-spinning technique on the one hand and with the full scale spinning on the other. Standards for fibre-maturity determination by the dye-absorption method are being prepared to be sent to the Technological Assistants at the Breeding Stations to see how far this method could be employed there for this purpose. The determination of oil-contents of different varieties of cotton seeds was continued during the year. Besides the above, a number of investigations were carried out at the Laboratory and a large number of scientific articles based on the results obtained were published or are under preparation.

IV. EXTENSION OF AREA UNDER IMPROVED VARIETIES

The work for the extension of area under improved varieties was continued as usual in close co-operation with the State Departments of Agriculture. This involved the multiplication of pure seed under departmental supervision and its large scale distribution to the growers of selected areas. Assistance was also rendered in some areas for the orderly marketing of the produce of improved varieties.

In all, 22 seed multiplication and distribution schemes were in operation in 1956-57. The present annual expenditure on this account is of the order of 0.82 lakhs of rupees. Furthermore, in order to increase cotton production in the country, the Central Government sanctioned and operated a number of extension schemes which, *inter alia*, provided funds for distributing pure seed of improved varieties on a large scale.

Besides the seed actually distributed through Government and Departmental agencies, a large quantity of improved seed was retained by the cultivators themselves for sowing. The area covered by improved varieties of cotton in 1956-57 was 10.9 million acres or 55% of the total *viz.* 19.8 million acres, the corresponding figures for 1955-56 being 13.6 million acres, 67% and 20.3 million acres respectively.

Of the improved cotton varieties under distribution mention may be made of 216F, 320F and H.14 in the Punjab; Kalyan, 134-Co.2-M (Devitej), 170-Co.2 (Deviraj), Pratap, Vijay, Digvijay, Vijalpa, Virnar, H.420, Buri 0394, M.5.A (Malini), No. 91, Gaorani 6 and 12 and 2204 (Daulat) in Bombay; MCU-1, MCU-2, K.2 and K.5 in Madras; C.2, Westerns-1, N. 14 and 881F in Andhra Pradesh; Jayadhar, Laxmi, Westerns-1, M.A.5, Sel. 69 in Mysore State; C. Indore-2, Maljari and Buri 0394 in Madhya Pradesh; Ganganagar-1 and C. Indore-1 in Rajasthan and 35/1 in Uttar Pradesh. In addition, seeds of the Sea-Island cotton "Andrews" were also multiplied in the States of Kerala, Mysore and Assam.

The mill consumption of cottons in India in 1956-57 reached an all-time record of 52.3 lakh bales comprising 46.6 lakh bales of Indian cotton and 5.7 lakh bales of foreign cotton compared to the total consumption of 49.7 lakh bales in 1955-56 of which 43.7 lakhs constituted Indian and 6 lakh bales foreign cotton. In comparison with the mill consumption in 1950-51 not only has the mill consumption of Indian cotton increased by 86 and that of foreign cotton decreased by 48% in 1956-57 but the percentage of consumption of Indian cotton to the total mill consumption had increased from 69% to 89% during the same period. This favourable turn has been brought about not a little due to the research and extension activities under the schemes sponsored by the Committee as well as the Cotton Extension Schemes financed by the Government of India.

The additional income to growers of improved varieties of cotton during 1956-57 is estimated at Rs. 22.1 crores.

V. STATISTICAL WORK

During the year under review, the Committee's office continued to collect and supply monthly reports on cotton stocks, production, consumption, imports, exports and prices of cotton to the International Cotton Advisory Committee, Washington. The prices and arrivals of *kapas* at the up-country markets were received from the various cotton market committees and a weekly summary statement

and a monthly review distributed as usual to those interested.

A monthly review on the state of foreign trade in cotton in principal countries including position as to production, distribution and consumption of cotton received by a special arrangement with the Director General of Commercial Intelligence and Statistics, Calcutta, were circulated to the trade and textile mills interested. Extracts from the weekly cotton and general economic review by Mr. Dudley Windel, Economist, Liverpool were distributed to the members of the Indian Central Cotton Committee.

A summary of the monthly (now quarterly) progress reports on the cotton extension schemes in the States was prepared and sent to the different State authorities.

The work of collection and compilation of statistics relating to the following items was continued:—

(*a*) Area under improved varieties of cotton.

(*b*) Area under irrigated cotton.

(*c*) Production of improved varieties of cotton.

(*d*) Imports of foreign cotton classified by staple length.

(*e*) Consumption of Indian and foreign cotton in mills.

(*f*) Stocks of cotton held by mills and trade classified by varieties.

(*g*) Receipts at mills of raw cotton classified by varieties.

(*h*) Exports of Indian cotton by sea classified by varieties.

(*i*) Weekly prices and arrivals of *kapas* in the up-country markets.

(*j*) Prices and yield per acre of cotton and its competing crops.

(*k*) Ginning and pressing of cotton.

The following leaflets dealing with cotton statistics of various types were published:—

(*i*) Statistical leaflet No. 1, entitled "Report on the staple length of the Indian cotton crop of 1955-56 season."

(*ii*) Statistical leaflet No. 2, entitled "Stocks of Indian raw cotton held in the Indian Union by the Mills and the Trade on the 31st August, 1956."

(*iii*) Statistical leaflet No. 3, entitled "Receipts at Mills in the Indian Union of raw cotton classified by varieties, in 1955-56 season."

(*iv*) Statistical leaflet No. 4, entitled "Exports by sea of Indian raw cotton classified by varieties, 1955-56 season."

(*v*) Statistical leaflet No. 5, entitled "Reports of the accuracy of the all-India Cotton Forecast of 1954-55 and 1955-56 seasons."

(*vi*) Bulletin entitled "A study of the prices and arrivals of *kapas* in the up-country markets, during the 1955-56 season."

(*vii*) A bulletin on the cotton seed prices in India, during the 1955-56 season.

WORLD COTTON SITUATION

GOVERNMENT REGULATIONS

Brazil

By decree of February 24, 1958, the Government of Brazil has raised the support price for lint cotton from those announced in November last year. The guaranteed support price for lint cotton from the 1957-58 crop, basis Type 5, is now 549.45 cruzeiros per arroba of 15 kilograms, representing an increase of 6 per cent from the previously announced level.

Sudan

The Government has approved the setting up of "The Sudan Cotton Exporters Associations." The aims of this organization will be to maintain and extend existing markets for Sudan cotton, to create new markets, to foster, promote and develop the sale of Sudan cotton in world markets.

The Government has announced a reduction in the export duty on Sakel type cotton from 4.30 cents per pound to 2.87 cents, effective from March 20, 1958. The export tax on American types remains unchanged. The current rates are as follows :

Type	Equivalent cents per pound
Sakel	2.87
American irrigated	2.87
Nuba (raingrown)	2.58

The following is a statement by the Sudan Gezira Board concerning sales policy for 1958 :

'The policy for 1958 is to offer the cotton crops of the Gezira, Alternative Livelihood Schemes, Gash, and Nuba Mountains for sale by free and frequent public auctions, which will be open to all buyers without discrimination. While there is cotton to be sold, auctions will be held on Tuesdays, Wednesdays and Fridays every week except on the occasions of public holidays, and the procedure at these auctions will be as in 1957.

'Types of all cotton from the 1958 crop will be shown as early in the season as possible.

'While the Sudan Gezira Board reserves the right to change its system of sale, it has no intention of doing so unless there is an appreciable change in circumstances.

'This policy has the full support of the Government of the Republic of the Sudan.'

Japan

The Ministry of International Trade announced on March 26th that the link percentage between exports of cotton products and import allocations of raw cotton has been reduced from 70 per cent to 65 per cent effective April 1. This percentage at one time was 100 but the Government intends eventually to eliminate this system.

Egypt

On March 26, 1958 the Government reduced the export tax on cotton by 50 piasters per kantar (equivalent to 1.45 cents per pound). The new rates compared to the old are as follows :

Variety	Old Equivalent	New U.S. cents
Extra long staples ..	7.99	6.54
Medium staples	4.02	2.57

On the same date the governments minimum support prices were increased to 78 tallaries per kantar (45.14 cents per pound) for extra long staples and 66.55 tallaries per kantar (38.51 cents per pound) for medium staples. The new support prices are based on market prices as of March 22 and represent an increase of about 13 per cent over the previous support prices.

United States

The Department of Agriculture announced on April 23 that a cotton export sales programme similar to the current programme will be in effect during the 1958-59 marketing year, and that it will be supplemented by a "payment-in-kind" programme to encourage exports from commercial stocks. Under the 1958-59 export sales programme the same procedures will be followed as in 1957-58. Cotton will be offered for sale under this programme immediately but will not be delivered until August 1, 1958. The cotton then must be exported within 9 months or August 1, 1959, whichever is the earlier. It is noted that less than 1.4 million bales now remain in CCC inventory stocks. An additional 3.1 million bales of 1957 crop cotton are under loans which have a maturity date of August 1, 1958.

Under the new payment-in-kind programme, exporters will register their export sales with CCC. The programme applies to exports on and after August 1, 1958, but sales made before August 1st for shipment on or after that date may be registered with CCC at any time after the programme provisions are announced in the near future.

There was no announcement as to the minimum acceptable offering price for CCC cotton under the export sales programme for next season or in regards to the rate of payment under the new "payment-in-kind" programme.

COTTON IN THE U.S.S.R.

Summary of a report by M. Edouard Senn and Jean Lhuillier on their mission to the U.S.S.R., to be published in Coton et Fibres Tropicales, periodical of the Institut de Recherches du Coton et des Textiles Exotiques, 29 rue d'Artois, Paris VIII.

The basic philosophy of the Supreme Presidium of the U.S.S.R. is to attain the same standard of living of the capitalist countries and eventually to surpass it.

In 1956, production in the U.S.S.R. reached 4.3 million tons of seed cotton, equivalent to 1,488,000 tons (6,860,000 bales) of raw cotton. (Production of fabrics was 5,452 million meters). The U.S.S.R., therefore, is now second only to the United States as a cotton producer and, in fact, obtains an even better average yield for the country as a whole.

With the ultimate aim of catching up with the United States, the U.S.S.R. intends to raise production to 7 million tons of seed cotton (about 11 million bales) by 1966 and to 10 million tons (16 million bales) by 1970. These targets are considered to be sufficient to meet domestic requirements and supply the demand from Eastern Europe. To implement this programme, the area sown to cotton will be expanded from the present 2 million hectares to more than 4 millions.

In order of importance, the Republics interested in cotton production are as follows :

	Cultivated area in 1956 Hectares*
Uzbekistan	1,300,000
Kirghizie	72,500
Turkenemi	191,200
Tadjikistan	164,900
Azerbaidjan.. ..	201,000
Kazakistan	109,900

* One hectare equals 2.471 acres.

The Republic of Uzbekistan, which already produces close to 3 million tons of seed cotton, is scheduled to produce more than 6 millions under the expansion programme. Tashkent is the leading centre in this area. Cotton is cultivated in the valleys of two large rivers—the Syr Daria and the Amou Daria —which are important for supplying electric power and for irrigation purposes.

In the cotton growing areas of Uzbekistan, two things are particularly noticeable.

First, the physical characteristics and fertility of the land which can be adapted fairly easily to irrigation. Second, there is no evidence of any serious parasites as there is in the United States. Plant disease is limited to early attacks of mites and thrips.

Without detracting from the effectiveness of the technical services directed toward improving cotton cultivation, these two factors—favourable soil and little disease—are responsible for the high average yield which is expected to show further improvement in the fairly near future.

At present, 3.1 million hectares of all crops are in cultivation in Uzbekistan of which 2.3 millions are irrigated. Irrigation is being rapidly extended but up to now has been applied mainly to existing land and not to bring new land into cultivation. About 65 per cent of irrigated land is sown to cotton and in certain areas cotton has been grown for six successive years. Cotton production in Uzbekistan is shown in Table below.

One of the biggest problems in growing cotton in Russia is low temperatures. Early frosts have caused a reduction in yields during the present season. Genetists are currently working on how to shorten the growing period for cotton.

Cotton production is regulated through the following organizations :

(1) The Science Academy engaged in pure research and with problems not dealt with by the Uzbekistan Academy of Agricultural Science.

(2) The Gosplan, chief of the Council of Ministers who plans and co-ordinates production activities—labour, raw materials, power, and investment, etc.

(3) The Council of Ministers of the Republic, a local political organization.

(4) The Gosplan and the Council of Ministers of the Supreme Soviet which co-ordinates, on a national scale, the programmes set up by the 15 Republics.

(5) The Minister of Agriculture of Uzbekistan who is responsible for putting into effect the decisions taken.

(6) The "Sovkhozes," the "Kolkhozes" and the Tractor machine stations which are concerned with the actual carrying out of the production plans.

COTTON PRODUCTION IN UZBEKISTAN

Year	Area	Yield	Production of seed cotton	Area	Yield	Approximate production of lint cotton
	1,000 *hectares*	Quintals *per hectare*	1,000 *tons*	1,000 *acres*	Pounds *per acre*	1,000 *bales*
1913	421	12	516	1,040	378	823
1940	920	15	1,383	2,273	464	2,207
1956	1,300	22	2,860	3,212	679	4,564

Assuming 34.6 percent lint yield.

The Sovkhozes are state farm enterprises whose scale of operation is large enough to justify a completely independent organization under the control of the Minister of Agriculture of each Republic. There are about 100 sovkhozes in Uzbekistan and 5,000 in the U.S.S.R. as a whole. Kolkhozes are collective farms which cultivate relatively small areas individually. There are 1,900 kolkhozes in Uzbekistan served by about 250 tractor stations. In 1956, 80 per cent of the total earnings of the kolkhozes in Uzbekistan came from cotton.

The system of *cotton pricing* in Uzbekistan consists of two elements—the base price which relates to a theoretical yield for any given region and the other, in the nature of a productivity premium. In the case of cotton, every quintal produced in excess of "norm" benefits from a 50 per cent premium above the base price. Normal production varies according to the region being 15 quintals per hectare in the less favourable areas, rising to 20 quintals per hectare in the Boukhara area and 25 quintals per hectare in Tashkent.

Prices for seed cotton of average staple length are as follows :

Quality	1956 Rubles per quintal	1957 Rubles per quintal
1st	350	354
2nd	300	266
3rd	260	201
4th	180	150

For extra long staples, these prices are doubled.

Higher margins for quality are designed to raise the standard of production and this policy has been very successful. In Uzbekistan 64 per cent of the total crop in 1956 was of first quality compared to 46 percent in 1940. The average price for the cotton crop in Uzbekistan in 1956 was 305 rubles per quintal.

In this method of price fixing, it is necessary to fix a base price which is sufficient to cover all legitimate costs incurred by the average producer and production premiums must be set at levels which can reasonably be attained by producers. The results of this price policy can be assessed in the fact that in 1956 only 270 of the 1,900 kolkhozes in Uzbekistan produced less than 15 quintals per hectare compared to 485 in 1955. The aim is to reduce the present 238 work days per hectare to 50 to 60 days by 1960, which would make more labour available for other work.

Tashkent is the basic cotton *research* center where "the Cotton Institute of Tashkent" and "the Institute of Genetics and Plant Physiology" are the two most important research bodies.

The main medium staple variety in the U.S.S.R. is 108F. About 83 per cent of the total cotton acreage in Uzbekistan and the entire Azerbaidjan and Kazakistan is planted with this variety. 108F comprises about 75 percent of the total cotton crop in the U.S.S.R. The staple length is 32-33 mm (1-1/4"). Long staple varieties are 2 i 3 and 54-76 i having a staple length of 41 mm (1-5/8") and 38-40 (1-1/2"-1-9/16") respectively but these are being replaced by new varieties. Earlier yielding varieties, 6022-6015, are being introduced with staple length of 40 to 41 mm (1-9/16"-1-5/8") and which have greater resistance to wilt and better technical qualities.

The Institute of *Mechanization* for Central Asia, established in 1957, is primarily concerned with cotton mechanization. To date, only 12.7 per cent of the total crop in Uzbekistan is harvested by machine. Aside from harvesting, machines are in use for sowing, hoeing, thinning and defoliation.

The *Irrigation* Institute for Central Asia was set up in 1925 to study the possibilities for controlling and distributing water supplies. Drainage poses many problems : heavy loss of water from the canals, flooding and the salinity of the land.

The irrigation potential in the cotton growing areas is of the order of 10 million hectares compared to the 2.3 million hectares presently under irrigation. A limiting factor in the development of irrigation is the need to modernize the old irrigation system as well as providing for planned extensions. About 60 percent of the old system has been brought up to date leaving about 900,000 hectares still to be modernized and about 500,000 hectares under the expansion programme planned to 1965. Canal construction covers about 30,000 hectares but potentially this could easily be expanded to cover 100,000 hectares.

The two biggest problems which the U.S.S.R. has to face in achieving its production targets are, on the one hand, land recovery and development and the elimination of salinity and, on the other, harvesting. Most of the good land is already being cultivated. Harvesting problems relate to the development of mechanical picking and the need to dry cotton made necessary by the fact that gins are operating through ten months of the year.

Extracts from April 1958 issue of "Cotton" the monthly publication of the International Cotton Advisory Committee, Washington D.C.

SUMMARY OF CURRENT LITERATURE

SOILS, FERTILIZERS AND CULTIVATION

EFFECT OF SPACING ON AGRONOMIC AND FIBRE CHARACTERISTICS OF IRRIGATED COTTON. R. H. Peebles *et. al.* (*Tech. Bull.* 1140, *Arizona Agric. Exp. Sta.*, 1956. From *Field Crop Abs.*, **10**, 3, 1957, p. 194.) In 1951-52, the effects of spacing on Upland and American-Egyptian cotton were determined as regards yield, earliness, boll weight, lint percentage, seed and lint indices and fibre length, strength and fineness. Rows were spaced 36 or 38 in. apart. Spacing at 2-6 in. in the rows compared with 12-16 in. increased lint yield by 9.5 per cent for Upland and 12.9 per cent American-Egyptian cotton.

Earliness in American-Egyptian cotton was greatest at 6 in. spacing but in Upland cotton, maturity was much retarded at 2 and 4 in. spacing and varied little between 6 and 16 in. Boll weight of Upland cotton declined as spacing was reduced, and, for both types, the sharpest decrease occurred when plants were spaced closer than 6 in. Lint percentage and lint index declined as spacing increased in American-Egyptian cotton. Close spacing often reduced fibre strength.

INCREASE THE YIELD OF RAINFED COTTON BY MULCHING (A NOTE). A. B. Samad *et. al.* (*Ind. Cott. Grwg. Rev.*, **11**, 2, 1957, p. 129). At Pattambi in the drylands of the West Coast of Malabar, a very small scale preliminary observation trial was laid down in 1954-55 to ascertain whether mulching with green leaves would tide cotton sown immediately after the paddy harvest over periods of drought resulting from precarious rainfall. The variety P.216F was sown at 18 × 6 in. spacing and thinned to one plant per hole at three weeks ; ammonium sulphate to supply 20 lb. nitrogen was applied before sowing and again one month after sowing. Mulching was carried out at one, two and four weeks after sowing. From an early stage, mulched plants were superior in all aspects of growth, comparative figures for mulched and non-mulched being : final height, 62.6 and 33.6 cm. respectively ; squares per plant, 20 and 8.9 ; bolls per plant, 3 and 0.7 ; total yield 32 and 12 oz. seed cotton. Weeds were very sparse in mulched plots.

INFLUENCE OF TIMING OF IRRIGATION ON YIELD, QUALITY AND FRUITING OF UPLAND COTTON. A. E. Spooner *et. al.* (*Agron. J.* **50**, 2, 1958, p. 74). A study to determine the effects of timing of irrigation treatments on the yield, quality and fruiting of Upland cotton was conducted in 1955 and 1956 at the Experiment Station, Fayetteville, Arkansas.

The treatments were :

1. Control (no irrigation).
2. Irrigation started when the first bolls were twenty days old and continued, through the remainder of the fruiting season.
3. Irrigation started at first bloom and continued through the remainder of the fruiting season.
4. Irrigation as needed throughout the season.

After each irrigation cycle was started the soil moisture was not allowed to drop below 50 per cent available moisture for the remainder of the fruiting season.

Increased yields amounting to approximately a bale per acre were obtained from all treatments. It was also noted that maturity was delayed by irrigation ; the peak of fruiting was extended by approximately two weeks ; shedding was significantly decreased by irrigation and boll size significantly increased ; proper irrigation stabilized and generally improved lint quality.

* * *

PESTS AND DISEASES

COTTON CROP LOSS DUE TO PESTS IN THE UNITED STATES. In recent years insect ravages have caused cotton crop losses estimated at an annual cost of $250 million, while in a single year, 1950, boll weevil depredations caused damage estimated at $750 million. Approximately $50 million is spent annually on insecticides, and a further $20 million on applying them. Farmers have millions of dollars invested in spraying and dusting equipment, and custom application by aeroplanes has greatly increased in recent years. Nevertheless, it is estimated that insect pests still take one bale in seven.

With the reports of growing pest resistance to certain insecticides, other approaches to control are being investigated. These include improved cultural practices, and the treatment of cotton seed with systemic insecticides, while at the Brownsville Laboratory in Texas experiments have shown that a certain nematode carrying a bacterial disease will find its way through the entrance hole in a green cotton boll and destroy the pink bollworm larva. The same nematode will also penetrate a boll weevil-punctured square, find the larva or pupa, and kill it. In preliminary laboratory experiments from 80 to 90 per cent of the pink bollworms and boll weevils were killed in this way.

WHAT'S NEW IN CONTROL OF COTTON INSECTS. CONVENTIONAL CHEMICALS. D. F. Martin. (*Procdgs. Cott. Prodtn. Confce., Alabama*, December 1956. From *Field Crop Abs.*, **10**, 4, 1957, p. 260). Recent results in the control of cotton insects by phosphorus insecticides, Thiodan and calcium arsenate are discussed. For the control of thrips (*Frankliniella* spp.) three applications of Dieldrin at 0.1 lb. per acre at weekly intervals were best. For the control of boll weevil (*Anthonomus grandis*) Guthion was successful at 0.25 to 0.5 lb. per acre, and bollworm was controlled by the addition of DDT at 0.5 lb. per acre or an increased dosage of Guthion. Methyl parathion applied at 0.25 to 0.5 lb. per acre gave good control of the boll weevil, and, when 0.5 to 1.5 lb. DDT per acre was added, control of bollworm and the cabbage looper (*Trichoplusia ni*) also. EPN at 0.5 lb. per acre gave good weevil control and was equivalent to 0.34 lb. Endrin per acre. Promising control of the leaf perforator (*Bucculatrix* sp.) was obtained by using 0.375 to 0.5 lb. Phosdrin per acre.

TIMING INSECTICIDE APPLICATIONS FOR COTTON INSECT CONTROL. C. Lincoln and T. F. Leigh. (*Agric. Exp. Sta. Fayetteville, Ark., Bull.* 588, May 1957. pp. 46). Since the cotton plant customarily produces more fruit than it can bring to maturity, it is considered that complete control of insect pests is unnecessary. The objective should rather be to hold pest populations at a level that will allow the plant to make a full crop without delay in maturity or loss in quality. To do this economically, soil fertility, soil moisture, weather, cotton variety, stage of development and spacing must be considered in relation to insect infestations. Pest resistance is a further factor limiting the economic value of insecticides, and it is pointed out that if insecticide usage can be reduced, the development of resistance will be slowed down.

Experiments on the timing of insecticide applications for cotton insect control have been conducted in Arkansas for several years. This bulletin summarizes these experiments and discusses their implication in relation to the control of boll weevil, bollworms, spider mites, thrips, fleahopper and tarnished plant bugs.

In stressing the value of predator co-operation it is pointed out that serious outbreaks of spider mite and aphid are usually a result of their predators having been killed by early application of insecticides. If application can be delayed until August, the hazard of these outbreaks is greatly reduced. The movement of predators from other plants into cotton depends on the magnitude of the predator populations and the relative attractiveness of cotton and competing hosts, presumably in terms of available prey. The persistence of predators in cotton depends on the availability of prey to encourage reproduction, continued immigration, and the delayed use of insecticides which are generally destructive to predator populations.

BAYER 17147 AS COTTON INSECTICIDE. C. F. Rainwater (*Agric. Chem.* **11**, 2, 1956, pp. 32 and 107. From *Rev. App. Ent.*, **45**, Ser. A, 10, 1957, p. 407). In further tests of Bayer 17147 as a cotton insecticide it was applied in emulsion sprays and dusts at approximately 0.25 to 1 lb. per acre under weather conditions favourable for the insect. At Brownsville, Texas, where infestation was very heavy, ten weekly applications of 5 per cent dust reduced the percentage of bolls infested by the pink bollworm (*Platyedra gossypiella*) and the number of larvae per boll from 53.2 and 1.4 to 1.3 and 0.02, respectively, and the percentage of squares punctured by the boll weevil (*Anthonomus grandis*) from 90.6 to 14.6 ; they also increased the yield from 668 to 2,702 lb. seed cotton per acre and improved its quality.

Fewer details are given of the results obtained in areas of Texas and Louisiana, where *A. grandis* had apparently developed resistance to chlorinated-hydrocarbon insecticides, and in Mississippi and South Carolina, but 0.25 to 0.5 lb. Bayer 17147 per acre in sprays and dusts consistently gave better control of *A. grandis* than did the chlorinated-hydrocarbons usually recommended. In addition it kept aphids and mites to non-injurious levels and resulted in large increases in yield. These doses did not give satisfactory control of the bollworm (*Heliothis zea*), however, and it is suggested that DDT should be added to Bayer 17147 for simultaneous control of this and other pests.

It is considered that Bayer 17147 is no more dangerous to apply than some other phosphorus insecticides, but further investigations on the possibility of harmful residues on any part of the crop used to feed animals are necessary before it can be recommended.

"DELNAV" : A NEW PESTICIDE FOR COTTON. (*World Crops*, September 1957). A new pesticide which three years of extensive tests have proved to be extremely effective in controlling a wide range of crop pests, has been announced by the Hercules Powder Company of the United States. Chemically the product is described as dithiophosphate of dioxane. It is now commercially known as "Delnav" and is recommended by various United States authorities for use on cotton.

Depending on the type of insect and whether dusts or sprays are used, it has been found to be effective in a range of from ¼ to ½ lb. of active material per acre. In the extensive testing period when the materials were used according to these recommendations no damage to the treated plants was observed. Tests to date have also shown that "Delnav" possesses a lower degree of toxicity to warm-blooded animals than is shown by most phosphate insecticides currently in use, but the normal precautions used in handling these insecticides should be taken.

METHODS FOR THE MASS REARING OF THE PINK BOLLWORM. E. S. Vanderzant *et. al.* (*J. Econ. Ent.*, **49**, 4, 1956, p. 559. From *Rev. App. Ent.*, **45**, Ser. A, 9, 1957, p. 359). Two methods of rearing *Platyedra gossypiella* in the laboratory are described. In the first, aseptic, method, fresh peas, or peas or beans that had been allowed to sprout, were autoclaved at 15 lb. pressure for 15 and 20-25 minutes, respectively, infested with newly-hatched larvae and kept at 840F. The larvae entered the seeds and did not reappear until they reached the fourth instar. When pupae were found, these and the remaining larvae were collected, and the larvae were transferred to wet cotton-wool to pupate. The largest and most rapidly developing larvae were obtained from sprouted peas ; pupae were formed in 14 days and weighed about 20 mg., so that they were comparable with field individuals. Larvae reared on fresh peas were smaller, but all pupated in 15-18 days and gave rise

to normal moths. Pupae were formed in 16-17 days on sprouted beans and weighed 13 mg. The same method used with sprouting cotton seeds was unsuccessful, probably because autoclaving destroyed some essential nutrient.

For the second method, delinted cotton seeds were soaked, allowed to sprout and then dipped in a solution of Butoben and methylcellulose for five minutes and allowed to dry before being infested with newly hatched larvae or eggs about to hatch. The infested seeds were kept at a mean temperature of about 80° F. and 70-90 per cent. relative humidity. The larvae entered the seeds, and left them to pupate after 11 or more days, which is comparable with their behaviour on cotton squares. The pupae averaged 18.1 mg. in weight. The coating applied to the seeds prevented drying and inhibited mould growth for about a week, which was sufficient to permit larval development. Microbial decomposition within sprouting peas and beans rendered this method unsuitable for them.

A METHOD OF PRODUCING COTTON VARIETIES RESISTANT TO GUMMOSIS. D. Verderevsky and K. Voitovich. (*Khloplovodstvo* (Cotton Raising), **7**, 5, 1957, p. 37. From *Rev. App. Myc.*, 36, 10, 1957, p. 644). In studies, begun in 1954, at the Moldavian Station of the Pan-Soviet Institute of Plant Protection, U.S.S.R., seeds of the commercial cotton varieties, 108-F, 611-B and OD-1, and two prospective varieties, 3521-U and 6466-U, selections from Ukr. NiHi, were inoculated with a suspension of *Xanthomonas malvacearum* using the vacuum infiltration method. All the infected plants (80 per cent) were destroyed and the healthy ones reinoculated by applying the bacterial suspension with powdered glass to the lower leaf surfaces on stems of young plants. Again the remaining healthy plants were repeatedly inoculated. Of the 19,000 plants of 108-F, 97,000 of 611-B and 42,000 of OD-1 thus tested, 7, 17, and 212, respectively, were selected as immune.

In repeated inoculations the 1956 seed generation of the 1955 selection produced over 90 per cent immune plants. Many of the first generation of selected plants did not differ morphologically from the original plants.

A NEW VIRUS DISEASE OF COTTON IN TEXAS. D. W. Rosberg. (*Pla. Dis. Reptr.*, **41**, 9, 1957, p. 726.) In 1956 a considerable number of cotton plants in the greenhouse and screenhouse of the United States Pink Bollworm Research Centre, Brownsville, Texas, developed virus-like symptoms which were characterized by a pronounced veinclearing of affected older leaves, accompanied by the development of chlorotic areas at the tips of smaller veins. Veinbanding, intervenal yellowing, and mottling gradually developed. Young terminal leaves first exhibited spotted invervenal yellowing and a slight to severe downward cupping. Frequently young leaves exhibited typical mosaic symptoms and puckering. All leaves developed intervenal red spotting of varying intensity, followed by degeneration of the chlorophyll and abscission. The infected plants were stunted and the terminal internodes shortened. The bolls were one-half to two-thirds normal size, with mottled bracts, and contained small and poorly filled seeds.

In many respects the symptoms of the Texas cotton virus disease resembled those of leaf curl disease of cotton reported in Sudan and Nigeria, and leaf crumple virus disease of cotton in California. However, veinbanding, conspicuous red spotting, and defoliation of older buff-coloured leaves are not reported as symptoms of the latter diseases. Moreover transmission of the virus by grafting to *Hisbicus cannabinus*, which is susceptible to the African leaf curl virus, has not been successful. Experiments to date suggest that the virus is not seed-transmitted.

TEMPERATURE AS A FACTOR IN THE INFECTION OF COTTON SEEDLINGS BY TEN PATHOGENS. C. H. Arndt. (*Pla. Dis. Reptr., Suppmt.* 246, 15-8-1957.) A number of pathogens have been shown to infect cotton seedlings and cause damping-off. The incidence of the diseases due to these pathogens varies greatly from year to year, and they are not always controlled by the fungicides used for seed treatment. This is especially true when soil conditions are favourable for seedling infection by soil-inhabiting pathogens. The discovery of more effective fungicides for their control is dependent upon detailed information of the environmental conditions under which these pathogens infect cotton seedlings.

This paper presents data on the infection of cotton seedlings by ten pathogens through a temperature range of 18° to 36° C. as follows : *Ascochyta gossypii*, 18°-27°; *Botryodiplodia phaseoli*, 18°-36°; *Colletotrichum gossypii*, 18°-33°; *Fusarium moniliforme*, 18°-36°; *F. oxysporum* f. *vasinfectum*, 18°-36°; *Pythium ultimum*, 18°-27°; *Rhizoctonia solani*, 18°-33°; *Thielaviopsis basicola*, 18°-30°; *Verticillium albo-atrum*, 18°-21°; and *Xanthomonas malvacearum*, 21°-36°. The latter produced lesions only on the cotyledons. *Botryodiplodia phaseoli* was a more aggressive parasite of the cotyledons than of the hypocotyls. Descriptions of the lesions caused by several pathogens are also included as an aid to identification of the causal pathogens under field conditions.

CHEMICAL CONTROL OF PINK BOLLWORMS OVERWINTERING IN THE SOIL. I. Shiller and A. J. Chapman. (*J. Econ. Ent.*, **49**, 5, 1956, p. 718. From *Rev. App. Ent.*, **45**, *Ser. A*, 11, 1957, p. 443). In tests in Texas in 1944 and 1953-55 on the possibility of reducing the survival of larvae of *Platyedra gossypiella* overwintering in cotton bolls left in the field, weighed quantities of open infested bolls were buried in the soil under cages equipped with traps, and the effectiveness of different insecticide treatments was based on emergence records from treated and untreated lots.

In 1944 the bolls were buried at depths of 2, 4 and 6 in. and a 1 : 1 emulsion of D-D (a proprietary mixture of 1, 3-dichloropropene and 1, 2-dichloropropane) and water was poured into furrows 1·5 in. deep and immediately covered with soil. Treatment with the emulsion at rates of 25 5, 51 and 102 U.S. gals. per acre reduced emergence by 42, 82 and 89 per cent, respectively, as compared with no treatment.

In 1953-54 the bolls were first sprayed with emulsions at a rate equivalent to 25 U.S. gals. per acre and then buried 2 in. deep, and it was found that 6 lb. gamma BHC, 8 lb. endrin and 10 lb. parathion, aldrin or heptachlor per acre reduced emergence by 90-97 per cent ; in 1954-55, similar treatment with these materials, except that heptachlor was used at 20 lb., and with 8 lb. gamma BHC and 10 lb. isodrin, reduced it by 65 to 90 per cent. Treatment in one or other year with 10 lb. diazinon or dieldrin, 16 lb. EPN, 2-16 lb. Bayer L 13/59, 20 lb. strobane or DDT and 21 lb. chlordane per acre caused lower but significant reductions, and 15 lb. malathion, 10 lb. chlorthion or am. cyanamid 4124 and 30 lb. parathion were ineffective.

DEVELOPMENT OF WILT INFECTION IN COTTON IN RELATION TO NEMATODE POPULATIONS. W. L. Martin *et al.* (*Phytopath.*, **46**, 1956, p. 285. From *Pla. Dis. Reptr., Supplement* **248**, 1957, p. 133.) In Louisiana development of the wilt *Fusarium oxysporum* f. *vasinfectum* was studied in cotton growing in steam-sterilized soil artificially infested with populations of nematodes alone, with the fungus alone, and with combinations of nematodes and *Fusarium*. Pure populations of *Meloidogyne incognita*, *M. incognita acrita*, *Trichodorus* sp., *Tylenchorhynchus* sp. and *Helicotylenchus* sp. were used. The nematodes reproduced abundantly on the cotton varieties Deltapine 15 (wilt-susceptible) and Coker 100 Wilt (wilt-resistant). Of the five nematodes used in the tests, only *Meloidogyne incognita* and *M. incognita acrita* significantly increased incidence of wilt in the two varieties. Severe injury to the cotton was recorded as a result of infestations of *Meloidogyne* only. Little or no injury was caused by the other three genera.

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GENERAL BOTANY, BREEDING, ETC.

THE PROGRESS OF RECENT BREEDING WORK ON COTTON IN CEYLON. D. V. Aryanayagam and R. T. Wijewantha. (*Tropical Agriculturist*, **112**, 3, 1956, p. 251). This paper records the work carried out at the Hambantota Cotton Research Station during the period 1952-56. The main objective of the selection work was the evolution of a cotton generally superior to the existing commercial variety, BP79. The strain S6-06, selected from 5143 Cambodia, has finally been chosen for multiplication and general cultivation throughout Ceylon under the name HC101 (Hambantota Cotton 101). Extensive tests have proved the new strain superior to all others included in the trials at every stage of testing. It has a ginning percentage of 33·8 and effective fibre length of 42/32 in. Moreover it produced the strongest yarns, spinning up to 50's satisfactorily, and had the best yarn appearance, especially in respect of neppiness.

THE RESULTS OF STUDYING THE RESISTANCE OF COTTON PLANTS TO LATE SPRING FROSTS. I. B. Naumovic. (*J. Sci. Agric. Res., Yugoslavia*, 9, 25, 1956). In the new regions where cotton is grown in Yugoslavia, low temperatures due to occasional late frosts in the spring are the greatest obstacles in the way of its proper development. With the object of breeding varieties which are both cold resistant and commercially satisfactory, selections were made from the plants which survived most favourably the late spring frosts which occurred from May 20-22, 1952, and which lasted for five hours at 0° to—6° C. The best selections proved to be the strains 942 and 944. In these strains the period to boll opening has been reduced by eleven and twelve days respectively as compared with the commercial control variety 182 ; their yield is considerably higher and the fibre is of good quality averaging Strict Middling to Full Middling.

EMBRYOLOGICAL STUDIES FOLLOWING INTERSPECIFIC CROSSES IN *Gossypium*. *1.—G. hirsutum* × *G. arboreum*. J. B. Weaver. (*Amer. J. Bot.*, **44**, 1957 p. 209. From *Pla. Bree. Abs.*, **27**, 4, 1957, p. 694). In the cross *G. hirsuthum* × *G. arboreum*, the hybrid endosperm and maternal tissue developed only when the egg cell was not fertilized or the zygote failed to divide, large ovules without embryos being produced. With double fertilization, endosperm development ceased about six days after pollination and was followed by embryo starvation. Production by the hybrid embryo of a substance detrimental to endosperm growth is regarded as the probable cause of abortion.

Vigorous hybrids were raised with the aid of mixed pollination and embryo culture ; lethal genes could not therefore have been responsible for embryo failure.

GENETIC RECOMBINATIONS IN A HYBRID INVOLVING THREE SPECIES OF *Gossypium*. C. F. Lewis. (*Agronomy J.*, **48**, 8, 1957, p. 455.) An allotetraploid between two 13-chromosome species, *G. arboreum* and *G. thurberi*, was crossed with the cultivated tetraploid *G. hirsutum* to produce an allotetraploid involving three species of *Gossypium*. In the F_2 progeny of this hybrid two-thirds of the plants died in the seedling stage and 43 per cent of the surviving plants were sterile.

The F_2 and F_3 progenies were extremely variable in plant habit, seed cotton production, and all lint properties. Transgressive segregation was observed for some characters.

The correlation between F_2 plants and the mean values of their F_3 progenies was highly significant for leaf index, seed index, and lint strength, length, fineness and shape of cross section, but not significant for lint perimeter and lint index. A high positive correlation was found in both F_2 and F_3 between lint fineness and lint shape which appears to be a developmental correlation.

THE GENETICS OF FLOWERING RESPONSE IN COTTON. 1.—FRUITING BEHAVIOUR OF *Gossypium hirsutum* VAR. *marie-galante* IN A CROSS WITH A VARIETY OF CULTIVATED AMERICAN UPLAND COTTON. C. F. Lewis and T. R. Richmond. (*Genetics*, **42**, 4, 1957, p. 499). This paper is the first of a series in which the fruiting response of certain taxonomic varieties and geographic races of American Upland cotton will be reported. The experiment reported here was de-

signed to study the genetics of fruiting response in a stock of *marie-galante* native to Central America. With this object the inheritance of flowering response was studied in a cross between a short-day *marie-galante* and Deltapine-14, a day-neutral strain of *G. hirsutum*. *Marie-galante* remained vegetative when grown in the field during the long days of summer, but set fruit when grown during the short days of winter in a greenhouse. Deltapine-14 set fruit in about the same length of time in both environments.

Under long-day conditions all F_1 plants initiated fruit forms, but only about one-half of the plants developed a flower. This showed that neither parent was completely dominant and that the F_1 was very near a threshold level for ability to flower. In each backcross the recurrent parent tended to be dominant, which suggested that the genetic background of each strain strongly influenced the expression of the genes controlling time of flowering. The segregating populations did not reveal a simple genetic ratio ; neither was the segregation typical of quantitative inheritance.

Under short-day conditions all plants flowered, but even with a favourable photo-period *marie-galante* carried a lateness factor not associated with response to length of day.

It is concluded that failure to flower in the normal growing season in the Cotton Belt does not, of itself, rule out the possibility of utilizing photoperiodic cottons in genetic and breeding research.

NEW BREEDING TECHNIQUE FOR PRODUCING HYBRID COTTONS. (*Uganda Cott. Assen. News Letter*, 15-1-1958). In a report issued by the United States Department of Agriculture it is stated that a new technique for breeding hybrid cottons has been developed which offers a practical means for large-scale production.

In recent field trials, certain chemicals known as "selective gametocides" have been found to prevent pollen from developing in some varieties of cotton, with the result that the plant so treated cannot fertilize itself. If another variety is planted nearby that is unaffected by the chemical spray or untreated, it can provide pollen to fertilize the male sterile plants, and a hybrid offspring can be obtained.

While it is recognized that plant breeders have produced many excellent hybrids with outstanding yield and quality characteristics, such crosses are usually obtained by hand-pollination in carefully controlled greenhouse experiments. The problem has been to find a practical way to produce hybrids in the field.

Field trials were undertaken with four green-leafed varieties planted in 40-foot rows between alternating rows of a red-leafed cotton. and considerable success in obtaining potentially useful hybrids was obtained.

THE EFFECT OF PLANT HAIRINESS OF COTTON STRAINS ON BOLL WEEVIL ATTACK. W. K. Wannamaker. (*J. Econ. Ent.*, **50**, 6, 1957, p. 418. From *Pla. Bree. Abs.*, **28**, 1, 1958, p. 122). Field trials were made in North Carolina on a series of hairy Upland cottons including F_1 hybrids between Pilrose and other hairy types with special reference to resistance to *Anthonomus grandis*. MU8 and Pilrose, which carry the major genes for hairiness, H_1 and H_2 respectively, were significantly more resistant to attack than the other types. Certain unknown intensifying genes seem to supplement the action of H_1 and H_2. It is suggested that certain hair characteristics, such as distribution, density and length, influence the resistance to the boll weevil.

SOURCE OF RESISTANCE OF COTTON STRAINS TO THE BOLL WEEVIL AND THEIR POSSIBLE UTILIZATION. S. G. Stephens. (*J. Econ. Ent.*, **50**, 6, 1957, p. 415. From *Pla. Bree. Abs.*, **28**, 1, 1958, p. 122). In this review the preference of *Anthonomus grandis* for certain species is mentioned. Observations made on the Upland group of *Gossypium hirsutum* cottons are recorded. These show that red plant colour, which is determined by the dominant gene R_1, increased hairness, controlled by two dominant genes, H_1 and H_2, and absence of stem glands, a recessive character, *gl*, render cotton less attractive to boll weevils.

FIBRES, YARNS, SPINNING, ETC.

THE DETECTION OF FUNGAL GROWTH IN CELLULOSIC TEXTILES. G. R. F. Rose *et al.* (*Text. Res. J.*, **27**, 2, 1957, p. 99. From *Rev. App. Myc.*, **34**, 8, 1957, p. 488). At the National Research Laboratories, Ottawa, a modification of the Pianese IIIb staining test has proved useful in the detection of certain fungal hyphae in or on cotton, flax, viscose rayon, jute, sisal and hemp fibres. The procedure causes scarcely any swelling and therefore does not impair the structure of the fibres, nor is it appreciably affected by the presence of dyes in the material. The stain is specific for microbiological damage. It should be of great assistance in the routine examination of cellulose fibres subjected to fungal contamination in the later stages of growth or during harvesting, as in the case of cotton, or in the course of fibre separation processes involving microbiological action as in the retting of flax.,

RAPID METHOD OF PREPARING FIBRE SECTIONS FOR MICROSCOPICAL EXAMINATION. F. Frunello. (*Tinctoria*, **57**, 7, 1957,, p. 276. From *B.C.I.R.A., Summ. Curr. Lit.*, **37**, 22, 1957, p. 729.) The method described consists in the inclusion of the fibre tuft to be examined in a sufficiently rigid metallic support preventing the fibres from bending during cutting and enabling sections perpendicular to the fibre axis to be obtained. The support, which can be used repeatedly, consists of a simple brass foil (0.5 mm. thick) with a hole in the centre ; a nylon-threaded needle is passed through the hole and returned, to form a loop by means of which the fibre wick to be examined (with the same thickness as the hole diameter) is drawn into the hole of the foil. The fibres are then cut on both sides of the foil, giving a minute section enclosed in the brass foil for microscopical examination.

COTTON IN AFRICA

A637—A NEW COTTON VARIETY FOR NYASALAND. J. M. Munro. (*Nyasaland Farmer and Forester*, **4**, 1, 1957, p. 13). A new variety—A637—is to replace CLB (Crown Land Bulk) as the commercial cotton of Nyasaland. CLB has been grown since 1933. It is a mixture of the older Nyasaland Upland variety and better yielding strains selected from the South African cotton U4, and for many years has given better yields than any variety tested against it in Nyasaland.

A637 is one of the "Albar" cottons which have been distributed from the Namulonge Research Station in Uganda and have, as their main characteristic, a resistance to bacterial blight which attacks the cotton plant most severely in hot and humid conditions.

In Nyasaland, A637 has been proved the best of a group of Albars tested over the last two seasons on the experimental stations. Both 1955 and 1956 were wet years, with heavy blackarm infection in the trials, and the resistance of A637 enabled it to outyield CLB by more than 30 per cent—in some cases it yielded over twice as much as CLB. In the 1957 season trials were carried out in all the cotton growing districts, both at research centres and in African cotton gardens. The final yield figures for the average of 175 plots are given below with the ginning return for an average of 8 roller ginned samples from the Lower River. (Commercial saw ginning gives approximately 2 per cent. less.)

Variety	*Seed cotton lb. per acre*	*Yield % of CLB*	*Ginning outturn %*
DLB	617	100	32.4
CL20	603	98	31.7
A637	706	114	33.9

1957 was a dry season and blackarm damage was practically nil. Yield differences would have been much greater in a wet season.

COTTON IN THE AMERICAS

United States

1957-58 Season. In February the Department of Agriculture forecast a further decline in the cotton crop, the estimate indicating an output of 11,010,000 bales compared with 11,788,000 bales announced in January. The estimated yield per acre has dropped from 413 lb. at the beginning of November to 390 lb. The season's American-Egyptian crop is calculated at 81,000 running bales, compared with last season's 50,300 bales.

1958-59 Season. Cotton farmers have been warned by the Secretary for Agriculture that cotton acreage allotments might drop to around 13 million acres (about 25 per cent below the present minimum) in 1959, when the legislation which established the present minimum of about 17,600,000 acres would expire. After that date the allotment would be set at a total acreage which normally would produce a crop of 10 million bales.

The 1958 planted acreage, allowing for announced Soil Bank withdrawals, will be around 14 million acres, and may be reduced further if Soil Bank funds are increased by Congress. Such a small acreage could result in an acute shortage of desirable grades and staples in the following season should weather conditions again be unfavourable, as the CCC stocks of desirable White grades will be virtually exhausted at the end of the present season, and the new crop will be the only source of supply.

The Department of Agriculture is reported to be planning a cotton export subsidy next season payable in kind. This subsidy may be flexible and paid in undesirable spotted and off-coloured cottons from the CCC stocks at big price discounts.

In 1957 cotton farmers placed about 3 million acres in the Soil Bank at an average rate of $54·15 per acre. The national average payment rate for 1958 has been announced at $58 95 per acre, and the Soil Bank target has been set at 2.7 to 3.7 million acres.

TEXAS RELEASES AUSTIN COTTON (*What's New Crops Soils*, **9**, 8, 1957, p. 28. From *Pla. Bree. Abs.*, **28**, 1, 1958, p. 119). The Texas Agricultural Experiment Station has developed an open-boll type of cotton from Stoneville 20 x Empire back crossed to Empire. It is highly resistant to race 1 of bacterial blight and tolerant to race 2 and the wilt-nematode complex. Under disease conditions it gives yields 5-100 per cent better than other open-boll varieties. It gives satisfactory yields under drought conditions but performs best under normal rainfall or irrigation. Its staple length is $\frac{30}{32}$ in. to $\frac{32}{32}$ in. with fibre satisfactory for yarn, and seed of good quality for cottonseed products.

West Indies Federation

1957-58 Season. Antigua. Of the estimated 4,893 acres planted with cotton, 4,000 were sown with MSI, 876 with VH8 and 17 with VH10. Harvesting began in February and with favourable conditions a record crop of about 2,590 bales (400 lb.) may be expected.

Montserrat. The crop is estimated at 750 bales.

Nevis. In Nevis 3,000 acres were planted with cotton. Germination was good and the crop is progressing satisfactorily. A crop of 1,062 bales is expected.

St. Kitts. Approximately 877 acres were planted from which it is hoped to harvest 575 bales.

St. Vincent. It is expected that about 500 bales will be produced as compared with 430 bales produced in 1956-57.

BOOK REVIEW

MONOGRAPHS ON INDIAN OIL SEEDS AND VEGETABLE OIL INDUSTRY

The Indian Central Oilseeds Committee will bring out a series of twelve monographs before the end of 1958 out of which two have been recently published. The first one "THE VANASPATI INDUSTRY" by Dr. G. S. Hattiangdi with a *Foreword* from Dr. M. S. Randhawa, I. C. S. comprises of 100 pages divided into 8 Chapters as below:

I. Vegetable Oil Products

II. Hydrogenation of oils

III. Fundamentals of Vanaspati manufacture

IV. Production control and factory administration

V. Nutrition value of Vanaspati

VI. Coloration of Vanaspati

VII. Production, marketing and consumption of Vanaspati in India

VIII. Recent researches and lines of future development.

The subject matter dealt with is illustrated with 15 photographs and 4 diagrams. The price is Rs. 8/- per copy.

The second Monograph entitled "SOLVENT EXTRACTION OF VEGETABLE OILS" by Shri H. V. Parekh covers 210 pages distributed over nine Chapters:

I. Review of different methods of production of Vegetable Oils

II. Solvent extraction of Vegetable Oils

III. Solvent extraction process and machinery

IV. Application of Solvent extraction process to various oilseeds

V. Solvents

VI. Economic aspects of Solvent extraction process

VII. Review of Solvent extraction industry in India

VIII. Application of Solvent extraction process to village *ghani*

IX. Recent researches and lines of future development.

The text is illustrated with 14 photographs and 36 drawings. The price is Rs. 12/- per copy.

Both these monographs are printed on superior offset paper, bound with rexine cover 11" x 8" provided with art paper jacket bearing an attractive illustration of the factory.

Being the first comprehensive treatise of its kind on the subject written by specialists in the line, these two monographs will prove valuable additions to the libraries of universities, scientific institutions and the relevant industry, in addition to being hand-book of useful information to all persons interested in the subject.

The monographs are published by the Secretary, Indian Central Oilseeds Committee, Hyderabad-1, from whom copies can be had.

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Announcement

PRIZES TO COTTON BREEDERS FOR EVOLVING LONG STAPLE COTTON VARIETIES

The amount of prizes announced previously for award to cotton breeders to encourage the breeding of long staple cotton varieties has since been revised. The following prizes are now proposed to be awarded for the different categories:—

CATEGORY I (Cottons with mean staple length exceeding 1-1/8")

Two or more prizes of the value of Rs. 3,000 each plus a gold medal of the value of Rs. 500 for each person.

CATEGORY II (Cottons with mean staple length between 28/32" and 1-1/8")

One award each of the value of Rs. 2,000 plus a gold medal of Rs. 300 for each person in each of the following classes:—

(*a*) Asiatic cotton .. .. irrigated

(*b*) Asiatic cotton .. .. unirrigated

(*c*) American cotton .. .. irrigated

(*d*) American cotton .. .. unirrigated

While evaluating the merits of a strain for the award, primary emphasis will be on the fibre quality of the strains but due weightage will also be given to other characters like yield, ginning percentage and resistance to pests and diseases. Secondary selections would not qualify for any prize and the achievements reported after the 1st April 1957, alone would be eligible for consideration under this scheme.

The following Expert Sub-Committee will consider both the merits of the strains entering the competition as well as the person/s responsible for the evolution of the strains:—

President, Indian Central Cotton Committee,
Vice-President, Indian Central Cotton Committee,
Agricultural Commissioner with the Government of India,
Director of Agriculture of the State concerned,
One Senior Cotton Breeder (to be nominated in consultation with the Agricultural Commissioner), and
The Secretary, Indian Central Cotton Committee.

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