https://doi.org/10.29321/MAJ.10.A03833

Handling Cotton seed, after release as Variety in Madras State

by

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Synopsis: In this article, the author gives a critical account of the multiplication and distribution of cotton seed in Madras State and the latest developments with suggestions for the future.

Introduction: The benefits of the improved varieties cannot be realized in full, until enough seed has been produced for a variety and grown on a commercial scale, over the entire area to which it is adapted. Proper provision should also be made to maintain the varietal purity, as otherwise much of the efforts and cost expended in developing the improved types may come to naught. The regular seed multiplication and distribution work on more scientific lines has been in steady progress in Madras State for nearly one and a half decades (Balasubramanyan, 1951 & 1955). This machinery is set in motion, by the cotton breeder who periodically makes available small amounts of "elite" seed of the variety. An account of the efforts made since the beginning of the present century, for the multiplication and distribution of cotton seed and the latest developments in Madras State is presented in this article.

A. EARLIER WORK: The *Karunganni (arboreum)* variety, in Tirunelveli district of Madras State, proved superior in both quality and yield, to *uppam (herbaceum)* variety in 1907–'08. The department hence arranged to sell pure *Karunganni* seeds to sow about 8000 acres. This work was partly helped by a grant from the British Cotton Growing Association. As a result of efforts by the department, the cultivation of *Karunganni* variety in Tirunelveli district was extended upto 18,000 acres in 1908–'09. Seed depots were opened in new places and seeds were sold. The cultivators kept the seed from their own crops for sowing, by the use of hand gins, since no ginning factory was established. Thus, the mixture of varieties grown earlier was replaced by "one variety" and the seed sown "broadcast" was "drilled" after the advantages of inter-culturing had been demonstrated. Subsequently, the establishment of ginning factories ousted the old hand gins and it became difficult for the cultivators to get back pure seed. Hence the policy of seed distribution had to be revised. The seed farm area was restricted to about 400 acres, which could be sown with the seed obtained on the Government Farm, at Koilpatti. The seed, from this, was sold to the cultivators and arrangements were also made with the other ginning firms to gin separately any consignment of cotton. This was adopted in about 20 villages and there was high demand for such selected seed, at 40 per cent over the rates of ordinary seed.

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* Paper received on 30—11—1964 (contested for the A. H. S. Sharma Rolling Shield and Medal, 1964).

Similarly, Cambodia *(hirsutum)* cotton was thoroughly established in the south of Madras State and proved an exceedingly valuable introduction by the department. In 1912, Cambodia cotton was estimated at 60,000 acres. Since there was great demand for the seed, the Department of Agriculture had to face many difficulties in the way of permanent improvements like (i) organisation of seed distribution (ii) supply of pure seed (iii) prevention of adulteration in seed and lint and (iv) building up confidence of the buyers and spinners. It was therefore decided to concentrate efforts on a comparatively small area and to establish a large Government seed farm with its own ginnery for demonstration and supply of seed. Thus, there was marked progress in the number of seed farms established and the improvements effected in methods of seed distribution.

B. PRESENT WORK: There are two main centres of seed multiplication work one being at Koilpatti and the other at Tiruppur, covering a total seed farm area of about 60,000 acres with the improved varieties of MCU. 3, MCU. 2, MCU. 1 and K. 6.

The initial quantity of the seeds is received from the cotton breeder who maintains the "elite rows" of the concerned variety. The self-fertilised seeds from the type plants of the variety are gathered and a plot called "Primordial nucleus" is raised by the breeder. This may be compared to "Nucleolus" plot practised in Egypt. The method of seed production in stages is shown in the diagram I.

DIAGRAM I.

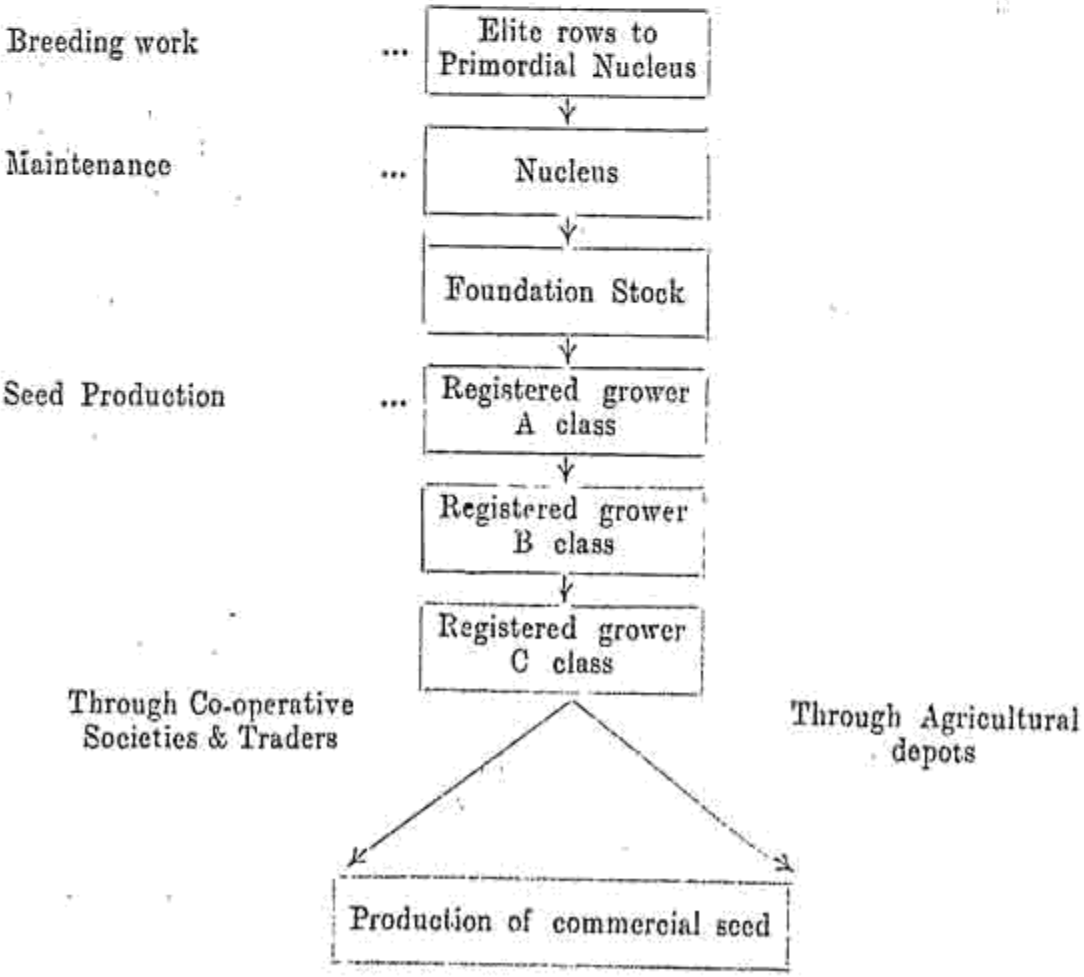

Diagram I showing the cotton seed production method practised in Madras State: *Primordial nucleus* would be raised in the middle of the Nucleus field to protect the primordial nucleus seed, from contamination. All the plants are self-fertilised.

Nucleus: The primordial nucleus becomes Nucleus in the next season. This plot should be surrounded by bulk or Foundation stock of the same variety to avoid contamination. The nucleus plot is subjected to careful roguing. These two stages are under the direct control of the sponsoring plant breeder.

Foundation stock: This is usually raised on the Government Farm from the selfed seeds of the Nucleus of the previous year, and the *kapas* is ginned under strict supervision at the gins available in the Government Research Stations to ensure thorough purity.

Registered growers "A" class: The growers are selected for this purpose, taking into consideration the general adaptation of the farm and equipment, ability of the grower, his integrity and other qualifications necessary for the production of pure seed.

Registered growers "B" class & C class: The pure seeds obtained from 'A' class grower is supplied to 'B' class grower for next season and it is continued further in the next season to C and so on.

Usually, it takes about 4 to 5 years for the Foundation stock to get multiplied and reach the level of supplying seeds to the large scale commercial production, as indicated in diagram I. Though the rate of seed multiplication increases generally ten times at every stage, it may vary depending on the availability of seed and variations in seasonal condition.

These registered growers get in agreement with the Government, accepting the following conditions:

(i) Only one variety should be grown in the entire holding of the farmer with the seeds supplied by the special staff under their direct supervision.

(ii) Off types should be removed from their fields with the help of the staff.

(iii) The entire produce obtained from the field should be delivered to the departmental agencies under pure and satisfactory condition.

Similarly, many leading cotton traders are also nominated as departmental agencies to purchase the *kapas* from the seed farm growers. They should also satisfy the conditions indicated below:

(i) The produce should be purchased and ginned at the approved ginning factory under the direct supervision of the special staff.

(ii) The drying of seeds, cleaning, bagging etc., should be done in the presence of the staff to their entire satisfaction and the lots with higher viability percentage only would be purchased by the department.

The purchase price of "good viable cotton seeds" would be usually fixed in advance at the time of procuring the *kapas*. The approved merchants, seed farm growers and the departmental officials meet together and fix the reasonable purchase price of seed, with some premium.

Methods for Maintaining Purity: (i) *Crop inspection and roguing:* The 'off types' or 'rogues' in cotton mostly appear due to mechanical admixture and to a lesser extent by natural cross pollination. It requires intimate knowledge of the crop and trained eye to detect 'off types' in a large bulk crop at the early stages of growth.

A special 'spot survey method' is used to work out the percentage of rogues. The population of a particular holding is first estimated as follows. Three or four spots of one cent each, depending upon the total area of the holding, are selected at random and the number of plants in each spot is counted and recorded. From the average population for one cent area, the total population of the entire holding is estimated. When the roguing work is completed the actual number of "off types" pulled out would be known. The percentage of this number to the total population is worked out and the impurity percentage arrived at.

(ii) *Storage of kapas at the village:* There are possibilities of admixture by improper storing of *kapas* at the houses of the farmers. Periodical visits are made and the approximate quantity harvested is recorded and separate and safe storage arranged.

(iii) *Transport to Ginning factories:* When the merchant purchases the *kapas* with some extra premium, few farmers may be tempted to mix other inferior *kapas*. Hence, the bagging of *kapas* and handing over to the merchant is done in the presence of the departmental staff, by recording the approximate quantity and number of bags delivered to the merchant. This is verified on arrival of the *kapas* at the ginning factory.

(iv) *Processing of kapas and seeds:* All the items at the factory, like ginning, collection of seeds, drying and cleaning of seeds, and bagging of seeds in gunnies and sealing the bags, are done under the strict supervision of the staff. Before bagging, seed samples are gathered for all the seed lots separately and sent for viability test.

By these systematic procedures, it has been possible to maintain the quality of the improved variety without deterioration. Venkoba Rao and Nageswara Rao (1958) also have reported in "N-14" cotton, that no deterioration was observed in quality even after several years, between seed nucleus and natural spread. They concluded that if roguing is done with care, the problem of contamination in multiplication is not serious.

It is also indicated that high percentage of mixtures might be due to deliberate admixture in trade and not due to chance crossing. Similarly Ansari and Samson (1951) studying this problem in Perso-American variety for 3 seasons, found that there was no significant difference in mean staple length and maturity in any season.

(v) *Selection of seed lot for next sowing:* Each holding of the seed farm area is personally inspected by the staff and the informations on purity, nature of crops, seed viability etc. are entered in the register. Based on these data, the best lots are selected for next sowings of the seed farm. The *kapas* from peak harvest season should be selected. The first and last pickings should be avoided. Guruswamy Raja and Sahul Hameed (1963) have found that seeds obtained from *kapas* that has been exposed to heavy rains before harvest, will germinate poorly. Hence, such *kapas* has to be rejected for purpose of next sowings.

C. Seed Testing: The seed testing item is having a very important role in running the seed multiplication and distribution work, more efficiently. A good and quick germinating seed is essential to establish a uniform stand of plants and get heavy yield. The study of the practical problems under this item may be focussed under the following topics.

(i) Medium for quick viability test (ii) Speed or rate of germination and other points for consideration. (iii) Methods of overcoming dormancy period (iv) Main causes for poor viability and (v) Proper storage of seeds.

(i) *Medium for test:* Since a large number of samples has to be tested within a short period, it is essential to fix a suitable medium for testing the seeds quickly. To achieve this object, an experiment was conducted with K. 2 and K. 6 strains using, tank silt, saw dust, sand and gunny piece or wool media for the viability test. A special treatment of presoaking the seeds for two hours before sowing was also combined in the experiment to compare this with the performance of the non-soaked seeds. The results are furnished in Table I.

From the data, it is found that the gunny medium is the best method since it gives 76 per cent germination within four days of sowing, while the other media recorded between 61 to 68 per cent only within the same period, in presoaked treatment. In non-soaked treatment also, the gunny media indicated 65 per cent germination in 4 days while the other media gave values between 37 and 54. Thus, presoaking the seeds and testing them by rolling and tying inside the gunny piece is the ideal method for getting quick and reliable viability test.

(ii) *Speed or rate of germination:* The seedlings emerging from the seeds which germinate quickly, have a much better chance of living under field conditions, than those from slow germinating seeds of the same variety. The former is less likely to be attacked by disease or over run by weeds. The germination rate or speed is calculated by dividing the number of seedlings per 100 seeds obtained at each counting in the germination test, by the number of days, the seeds have been in germination. (Maguire 1962).

TABLE I

Results of Germination tests obtained with different media.

S. No.	Medium	Strain	Pre-soaked: Germinated seeds No. of days from sowing 2	3	4	5	6	7	8	9	10	Total	Non-soaked: Germinated seeds No. of days from sowing 2	3	4	5	6	7	8	9	10	Total
1.	Saw dust	K. 2	3	19	31	21	9	1	1	...	1	86	3	10	26	21	17	2	2	...	...	81
		K. 6	5	19	39	8	4	3	1	...	...	79	5	7	30	26	6	1	...	2	1	78
			4	19	35	15	7	2	1	...	...	83	4	9	28	24	11	2	1	1	...	80
				*68										*41								
2.	Sand	K. 2	6	7	45	9	7	3	2	2	...	81	5	4	23	27	9	4	3	...	...	75
		K. 6	10	13	48	4	3	3	2	1	...	84	9	11	22	21	5	2	3	1	1	75
			8	10	47	7	5	3	2	1	...	83	7	8	22	24	7	3	3	1	...	75
				*65										*37								
3.	Tank silt	K. 2	10	21	27	4	4	5	4	2	1	78	8	5	39	5	9	4	3	3	...	76
		K. 6	5	22	33	5	2	5	1	1	...	78	8	6	45	5	6	4	3	1	...	74
			8	23	30	5	3	5	2	2	...	78	6	6	42	5	7	4	3	2	...	75
				*61										*54								
4.	Gunny	K. 2	13	56	7	2	4	1	...	...	...	81	12	41	13	2	1	2	2	1	...	74
		K. 6	10	57	7	3	4	...	1	...	...	82	10	47	7	5	5	1	2	...	...	77
			12	57	7	2	4	...	...	...	...	82	11	44	10	4	3	2	2	...	...	76
				*76										*65								

NOTE: Pre-soaked — Seeds soaked in water for two hours before sowing.

* — Figures indicate the No. of seedlings observed upto 4th day after sowing.

The following three seed lots have got the same total germination percentages :

Lot No.	No. of days after sowing.						Total Germination per cent.
	4	5	6	7	8	9	
I	15	62	4	0	...	...	81
II	44	18	11	5	2	1	81
III	77	4	...	...	...	...	81

But the germination rates are differing as follows :

Lot.	Germination rate.	
I	$\frac{15}{4} + \frac{62}{5} + \frac{4}{6} + \ldots \ldots \ldots$	= 16.9
II	$\frac{44}{4} + \frac{18}{5} + \frac{11}{6} + \frac{5}{7} + \frac{2}{8} + \frac{1}{9}$	= 17.5
III	$\frac{77}{4} + \frac{4}{5} \ldots \ldots \ldots$	= 20.1

The lot No. III has to be preferred, since it has germinated and emerged faster by higher germination rating.

The application of this latest technique in selecting the seed lots will be highly useful in establishing a good field crop. This is specially important in getting stands under unfavourable conditions.

TABLE II

Rate of germination in different media.

S. No.	Media	Rate of germination. pre-soaked	non-soaked	Average rate
1.	Saw dust	21.7	19.1	20.4
2.	Sand	22.1	18.7	20.4
3.	Tank silt	21.7	18.9	20.3
4.	Gunny	27.9	24.7	26.3

From the table II, it would be interesting to note that "speed of germination" is distinctly clear in the gunny medium.

At present, the seed lots are selected based on viability percentage and purity level only. But, other additional points indicated below, should also be considered as followed in Egypt. (Wasi Hasan. 1963).

(a) *Test for cleanliness:* The broken seeds, infected seeds and other trash should not be allowed to remain with good seeds.

(b) *Test for larvae:* Of late, pink boll worm is frequently giving trouble to the crop. Further, bacterial blight caused by bacterium *Xanthomonas malvacearum*, lives in fuzz on cotton seed. This has to be observed and treated with sulphuric acid.

(iii) *Dormancy period:* The seeds may be perfectly viable but they may fail to germinate and appear in full for periods of weeks or months. Such seeds may be said to be in a resting condition or a condition of dormancy. Christidis (1957) has recorded in cotton that the rate of germination improves gradually, until in about two months time when it reaches its maximum. To test this aspect, a replicated trial was conducted by periodical test on the viability, at every month, from the date of harvest of the *kapas*. The particulars are presented in Table III.

TABLE III

Germination results obtained after different periods of storage from the date of harvest.

Replications	No. of seeds germinated on tests conducted after a resting period of		
	one month	two months	three months
I	34	57	71
II	42	72	87
III	56	63	85
IV	66	81	86
V	62	76	81
VI	76	87	95
VII	56	71	88
Total	392	507	593
Mean	56·0	72·4	84·7

Standard Error —2.2, C. D. at 5% level —6.8.

It has been found that the rate of germination has significantly increased upto third month, where it has reached the maximum viability. Usually, it takes a month or slightly more for the harvested *kapas* to be processed and ginned. The major part of the testing, under the seed procurement work comes during the second month, after the harvest of the *kapas*. At this stage, the procurement can be done safely, since further increase in germination can be expected later.

(iv) *Poor viability:* In summer cotton area of our State (Srivilliputhur area), the viability of MCU. 2 cotton seeds is comparatively very low to that of other cotton seeds. The procurement data for three years of this area given in the table below, will show the poor conditions of viability.

Particulars on viability percentage	I Year		II Year (Bags of 98 lb each)		III Year	
Total quantity bagged	10,170		9,309		15,446	
Below 50% viability	3,565	48%	239	13%	4,400	68%
Between 50–54%	532		607		1,552	
,, 55–59%	801		344		4,766	
,, 60–70%	4,145		5,253		4,181	
,, 71–80%	1,087		2,808		499	
,, 81–90%	40		148		48	
,, 91 and above	...		...		...	

In spite of the routine processing work, (Sieving, cleaning and drying) the seed viability of about 68 per cent of the total bags had to be rejected in one of the years. The causes for such poor viability may be assumed to be due to following reasons:

(i) *Non-fertility and immaturity:* This may be due to unfavourable weather conditions like excessive rains during harvest, or severe and prolonged drought. Most of the seeds float in water and can be removed.

(ii) *Oxygen deficit due to seed coat development:* Seeds require oxygen for germination. Some seed coats may be gas proof. This stops from obsorbing oxygen. Seeds may swell absorbing water but not germinate because it lacks oxygen. Experimentally such seeds were made to germinate by increasing oxygen content of air (Christidis and Harrison, 1955). Much work on this aspect is needed to rectify the above defect, since this region is one of the major procurement areas for the long staple cottons.

(iii) *Storage of seeds:* There is considerable evidence to the conclusion that rapidity of seed deterioration depends on moisture content of the cotton seed (Christides and Harrison 1955). Moisture content should not exceed 12 per cent to avoid deterioration. But this aspect has to be considered important and moisture testing equipment should be made available for the heavy procurement centres.

The experiments conducted on seed storage by the Cotton Specialist in 1948 have revealed the following indications.:

(i) Cotton seed bags could be stored in tiers of six bags. If more numbers are stored, the top layers recorded better values than the bottom layers both in total percentage and speed of germination.

(ii) Periodical sun drying of the seeds will help to maintain the seeds in a satisfactory condition for sowing.

(iii) Germination tests conducted in hotter months, are likely to lead to erroneous conclusions.

The seeds should be stored in dry and well ventilated place. Any weevil attack during storage should also be looked into and controlled by suitable dusting of insecticides.

D. Enforcement of Cotton Legislation : Since more than two improved strains are cultivated in different tracts of Madras State, the enforcement of various cotton Acts, will ensure the purity of the strain and the reputation of the State, in trade. The cotton Ginning and Pressing Factories Act (Madras) will effectively check the various malpractices of watering and mixing in the processing stages. The provisions of the cotton Transport Act have to be strictly applied especially in border zones by tightening vigilance on road and rail transport of seed and *kapas*.

The Madras Cotton Control Act, aimed at the control of a variety of cotton grown in a zone and at prevention of mixing in any stage, will tighten up the measures taken towards maintenance of quality from the field stage. This act, though proposed for the last three years to be implemented in stages, could not be done for want of sufficient quantity of seeds to be supplied in full for that particular area. To achieve this aim, the following procedure can be adopted.

(i) Foundation seed has to be raised in advance in 2 or 3 holdings at the proposed area, with the help of a leading ryot under the strict departmental supervision.

(ii) To start with, a few contiguous villages have to be first selected and covered with the seeds obtained from the previous Foundation stock crop raised in the ryot's field.

(iii) The multiplication cycle is continued in this specific block of convenient area, by utilising the seeds of the previous season, under A, B & C classes until a sufficient area is covered with the improved strain.

(iv) At this stage, the villages covered so far and the adjacent areas that could be managed with the available seeds may be brought under the Madras Cotton Control Act.

(v) Such scheme of work may be planned in advance and multiplication work done in separate blocks. After 2 or 3 seasons, an entire tract can thus be brought under the Act, without much difficulty.

Conclusion : The large scale production of quality seeds involves the co-operative efforts of the Department of Agriculture, ryots and the private agencies. The present problems in covering extensive areas under improved strain, lie in the following causes :—

(i) Insufficient quantity of Foundation stock.

(ii) Deterioration of viability under storage condition and

(iii) Non-availability of seeds in village level.

The first cause may be eliminated if arrangements are made to raise Foundation stock seeds on ryot's holding under the strict supervision of the department. If necessary a "Foundation Seed Project" may be initiated where the Foundation seed could be rapidly produced from the Nucleus seeds and distributed over a larger area. Or this work can be entrusted under direct supervision of the department, to the capable co-operative organisations, after devising suitable methods for maintaining purity. Since the number of growers required for this purpose is small, only the most dependable growers located in an area, with favourable soil and climate should be chosen.

The causes for decline in germination percentage and vigour are mainly due to high temperature, damage by pests and seed moisture. Harrington (1964) studying on seed preservation has recommended the following thumb rules:—

(i) The life of a seed is doubled for each reduction of 1 per cent seed moisture in the 13 per cent to 3 per cent seed moisture range.

(ii) The life of a seed is doubled for each drop of 10°F in storage temperatures.

The damage by pests (weevil etc) during storage can be avoided by application of suitable pesticides and periodical drying of the seeds. The temperature of the store room should be kept at the normal level by providing proper ventilation.

The ryots easily get the local seeds at the village level, whereas the seeds of the improved ones are available only in block depots. Therefore arrangements have to be made to move the improved seeds upto the small village level by organising the "cotton improvement groups" within a block area. These groups should have members of farmers with representation from department of Agriculture and cotton trade of the locality.

It is essential that the existing laws or Acts of cotton have to be implemented early to control the purity and prestige of our long stapled cottons. Greater attention is to be focussed to ginning of the various varieties of *kapas*, if we place paramount importance on production of first class cottons. After ginning, the seeds intended for sowing may be seed treated with chemicals or treated with hot air at 55°C for five minutes, to kill larvae of boll worms. The seeds should be cooled before packing. The seeds which are not intended for sowing should be arranged to go to crushing and the bad seeds are eleminated from sowings.

After the release of a strain for general distribution, it would be useful if the Research Stations maintain small seed multiplication plots, wherein the purity of the strain must be under test every year. If any deterioration is really noticed due to any genetic cause, secondary selection may be effected to evolve a better one, by overcoming the noticed defect. The nucleus seeds can quickly be changed to a better one and the defect is rectified, before it assumes serious drawback.

Summary: The earlier work and later developments in seed multiplication and distribution work on cotton in Madras State are discussed. Practical problems on maintaining purity, conducting germination tests, and period of seed dormancy, have been worked out and some useful results were obtained. Organisation of "Cotton improvement groups" for covering large areas in short periods and practical importance of enforcing cotton crop control measures in achieving quality, are also indicated.

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