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COTTON VARIETIES AND RELATED STUDIES

BY

N. I. HANCOCK



An early prolific variety for Tennessee

KNOXVILLE, TENNESSEE

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SUMMARY

1. Every cotton variety has characteristic features, which are inherited but are influenced by environment.
2. Twelve plant characters are considered of varietal importance, and no one variety is superior in all.
3. Late-maturing varieties are not safely planted in Tennessee.
4. Prolific types make higher yields than non-prolific western types.
5. The most active blooming period is between July 22 and August 24.
6. Early bolls mature in less time than later ones.
7. Better grades are generally obtained from September and October pickings.
8. The length of lint is affected by the moisture content of the soil; an abnormally dry season causing the lint to be shorter.
9. Soils and fertilizers have little influence upon the length of lint, save as they may concern the moisture supply.
10. A combination of factors within the region may affect the lint.
11. A range of fiber lengths is typical of all varieties.
12. The cotton flower is self-fertilized, as a rule, but under certain conditions a large percentage of crossing takes place.
13. With proper storage, old seed will germinate well.
14. Old seed carry less disease, and therefore are preferred for planting as long as viable.
15. The strain number of a variety is important, and to assure purity, seed for planting should be obtained from the originator of the strain.
16. The quantity of seed may be increased from year to year with no severe changes in the variety, if the field is isolated and the seed properly saved.
17. Mixtures at the custom gin cause rapid deterioration of the variety.
18. Stoneville 2, D. P. L. 11 and 10, Delfos 719, and Acala 44-5 are recommended. Recent strains of Trice may be used on the northern border of the State, but at present seed of these, as well as Acala 44-5, are scarce.

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COTTON VARIETIES AND RELATED STUDIES

By N. I. Hancock

INTRODUCTION

Cotton ranks first among the cash crops of Tennessee. Until the reduction in 1933, the average planting for 10 years was a little more than a million acres. The area growing this crop lies principally in the western part of the State, from Decatur County to the Mississippi River, but extends, in scattered sections, through Middle Tennessee, and as far as Monroe County in the lower East Tennessee Valley. Numerous soil types are found in the State, and cotton appears to do well on all of them, except where the fertility is so high as to induce too great a vegetative growth. The climatic conditions, though varied, are not so extreme as to be a limiting factor in acreage expansion, except in upper East Tennessee and northern bordering counties. In fact, small patches of cotton are grown for home consumption in Hawkins, Sevier, and Knox Counties; and fairly high yields have been recorded the last 5 years in the varietal trials at Knoxville.

The average yield per acre of lint cotton in the State from 1923 to 1932 was 196 pounds; in 1933, 240 pounds; and in 1934, 256 pounds. These yields are considerably above the averages of the cotton-growing states, which were 169.9 pounds from 1923 to 1932, 208.5 pounds in 1933, and 169.2 pounds in 1934.[1]

Tennessee is on the northern line of the cotton belt, and, except in 1922, has suffered no serious damage from the boll weevil. While the pest appears practically every fall, it comes too late to affect the crop—and this undoubtedly is a contributing factor toward higher yields.

There are many essential considerations, such as marketing, fertilizers, and cultural methods, which enter into the question of the profitable production of cotton. One of the most important is the selection of a well-adapted variety. A fairly recent survey showed that at least 36 different varieties were planted in Tennessee, only a few of which are adapted to the State. It showed also that the quality of lint is influenced considerably by the kinds of varieties.[2] It is the purpose of this bulletin to discuss the varietal trials conducted by the Tennessee Experiment Station during the past 7 years and the studies of the various factors related to the yield and quality of lint.

The author wishes to express appreciation and gratitude for the ever kindly and helpful counsels of the late Professor S. H. Essary; and to Mr. Ben P. Hazlewood and Mr. Sam Odle, of the West Tennessee Experiment Station, Jackson; Mr. K. T. Hutchinson, of the Middle Tennessee State Teachers College, Murfreesboro; and Mr. S. E. Shipe, Knoxville, for supervision of the field work.

[1] Taken from U. S. Dept. Agr. Yearbook, 1935.

[2] Unpublished data, U. S. Bureau of Agr. Econ. and Tenn. Exp. Sta., Econ. Dept. cooperating.

A SHORT HISTORY OF VARIETIES

Cotton belongs to the Mallow family, or Malvaceae, and to the genus Gossypium. The species hirsutum is recognized as the one under which American upland varieties are grouped, but it is probable that a number of other species have entered into the composition of these upland strains. There are many records of seed introductions from Mexico and South America, where it is known that different species are grown.

OLD VARIETIES

Brief accounts of the old varieties are found in the publications of Tracy (21), 1895, and of Tyler (22), 1907. The following varieties were distributed in Tennessee prior to 1906: Bate's Little Brown Seed, Black Rattler, Boyd's Prolific, King, Cleveland, Dickson Improved, Griffin, Peeler, and Tennessee Green Seed. With the exception of Cleveland, all these varieties have been supplanted by new ones, among them Trice, which is probably a selection of Tennessee Green Seed.

Some of the more prominent old varieties are: Sugar Loaf, originated in 1843; Petit Gulf, 1840; Dickson and Wyche, 1858; Peterkin, 1870; and Sunflower, 1898. None of these are found today, but the blood lines of many new strains may be traced to them. From Sugar Loaf came Early King, which was planted extensively over Tennessee as late as 1915. From Wyche, given as a $2\frac{9}{32}$ staple, Truitt was selected. From Truitt came Russell, from Russell came Columbia, and from Columbia came the present Wilds long-staple strains. In 1904, D. A. Saunders crossed Mebane Triumph and Sunflower to get Foster. From Foster came Foster 120, from Foster 120 came Delfos 6102 and 631, from Delfos 6102 and 631 came the Delfos and Misdel strains of today. Cleveland is the oldest variety to retain its name. The present strains of this variety are probably far different from the parent. Other varieties retaining their identity and originated prior to 1910 are Acala, Rowden, Triumph, and Express.

VARIETAL ORIGIN

The variety, as such, does not seem to remain stable very long—most likely because of careless methods in saving seed, followed by promiscuous crossing. Sometimes a change in the environment induces off-type forms, better adapted to new surroundings. Acala 5 was selected by this method. At other times a pronounced change may occur for no apparent reason. Express, for example, originated as a single outstanding stalk in a field of Bohemian cotton near Paris, Texas, a section to which it was never adapted. Very often an attempt is made to combine the good qualities of two varieties by artificially crossing them, with subsequent selection of useful types. The Delta and Pine Land strains were obtained in this way. Too frequently, of late, types showing small differences are isolated and multiplied for commercial purposes The strain numbers are confusing to the grower, especially since new ones are being introduced every year. Finally, different names are given to the same variety. A grower may remember the neighbor or firm that furnished his seed but fail to recall the variety. Thus, a large

number of names have come about; and some method of classification is needed.

VARIETAL TYPES

Systems of grouping varieties into classes have been published by Tyler (22), Duggar (8), and Brown (1). More recently a list of varietal types was compiled and approved by cotton breeders of the experiment stations and the U. S. Department of Agriculture. This list is given in table 1. A description of each type has been published.[1]

Table 1.—*Standard varietal types*

Approved by Agronomy Section of Association of Southern Agricultural Workers, at 1935 meeting:

Acala 5	Delta and Pine Land 10	Mexican Big Boll
Acala 8	Delta Type Webber	Missidel [2]
Arkansas Rowden 40	Dixie Triumph	New Boykin
Cleveland 5	Dixie 14	Oklahoma Triumph 44
Cleveland Piedmont	Express Lightning	Pima
Cleveland Wannamaker	Express 121	Stoneville [3]
Cleveland 884	Half and Half	Station Miller
Cook 307-6	Kasch	Toole
Delfos [1]	Lone Star	Trice
Delta and Pine Land 4-8	Mebane	Wilds

[1] Delfos 6102 type. [2] Delfos 631 type. [3] Stoneville 2 type.

The results of the trials at the different stations show that all the present strains worth considering belong to one of these types. For instance, Acala 44-5 is classed with the Acala 5 type, and Cleveland 884-St. 4 with the Cleveland 884 type. The main object is to build a recognized system of registering cotton varieties of known origin and merit. No variety is subject to registration until it has passed through a period of trials at one or more experiment stations. The grower having a list of registered strains need not consider the many nondescript varieties on the market.

PLANT CHARACTERS AND STANDARDS

In many publications, cotton varieties are compared by their pounds of lint and money value per acre. These factors are the result of variable plant characters. It has been observed that almost every strain possesses certain characteristics of plant growth and behavior. These characteristics vary to some extent with the season and soil fertility, but their average over a period of years is representative.

CHARACTERS

The various characters are interrelated and represent the relative value of the variety. Some of the more important ones are given below, but the arrangement is optional, and the individual location should determine their significance.

1. Yield
2. Quality of lint
3. Earliness
4. Disease resistance
5. Size of boll
6. Storm resistance and ease of picking
7. Lint percentage
8. Prolificacy
9. Type of plant growth
10. Shedding
11. Lint index
12. Size of seed

[1] Journal American Society of Agronomy, Vol. 28, No. 1, January, 1936.

Earliness may not concern a grower in Shelby County nearly so much as one in Weakley or other northern-border counties; disease resistance would not be considered of as much importance in Rutherford County as in Lake County; a poor local marketing condition may cause a grower to regard lint quality as of little value—planters of Half and Half contend that its high lint turnout makes this variety a profitable one, although it has consistently given "untenderable cotton," or a staple below ⅞ inch; so that many times a great deal of emphasis may be placed upon a single character, almost to the exclusion of the others. Thus far no variety has been observed to excel in all these characters, but the leading strains have ranked well in most of them.

STANDARDS

There is some overlapping in the standards, for lint percentage may be stated as the combination of lint index and size of seed. Furthermore, it should be recognized that standards are flexible and may be changed from time to time. It is not proposed to set up definite measurements, but to give the minimum requirements which have been fulfilled by superior varieties in the Station trials.

1. Yield.—Stoneville 2 has been a consistent high yielder and may be taken as a standard for comparison.

2. Quality of lint.—Staple and grade are the commercial guides of lint quality. The grade is dependent largely upon environmental conditions, but staple length remains fairly constant, and $^{15}/_{16}$ to $1\,^{1}/_{16}$ inches is considered desirable for this State. The high-yielding varieties in the tests have given this range of lengths.

3. Earliness.—At least 20 per cent of the total yield should be open for the first picking, which is normally about 125 days from the date of a good stand.

4. Disease resistance.—Some years angular leaf spot is very injurious in the seedling stage. In a wet season, boll rot, or anthracnose, is often serious. There are no highly resistant strains, but these diseases can be reduced considerably by seed treatments. Fusarium wilt is found in some soils and many times it is the result of a poorly balanced plant-food supply. Thus far, the strains resistant to this disease are either too late-maturing in this State or their quality of lint is poor. Some seasons, verticillium wilt affects the crop, especially on the soils of Lake County. As yet, no variety of economic importance has been found resistant to this disease.

5. Size of boll.—The bolls are too small when more than 80 of them are required to give one pound of seed cotton.

6. Storm resistance and ease of picking.—The cotton of the small-boll strains of Express, Trice, Delfos, and other similar varieties falls out badly and is hard to pick. In general, the large-boll cottons are easier to pick and retain their cotton better through adverse weather conditions.

7. Lint percentage.—In the final analysis, pounds of lint cotton constitute the yield. However, a premium-staple variety with a lint percentage below 34 is seldom able to overcome the advantage of the higher-lint-turnout strains even though it may produce high yields of seed

cotton. This is true of Express, Trice, and other low-percentage cottons.

8. Prolificacy.—Varieties having short internodes on the fruiting limbs as well as the main axis are the high yielders. The long internodes characteristic of the western varieties are poor yielders.

9. Type of plant growth.—Varieties that have a vigorous, spreading type of growth are the high yielders. Stoneville 2 and the D. P. L. strains have this type.

10. Shedding.—Some strains of Trice and other varieties are known to shed excessively from season to season, and this character is not entirely due to environment.

11. Lint index.—This measures the amount of cotton on 100 ginned seeds, and at least 6.5 to 7.5 grams of cotton are obtained from 100 seeds of the well-bred strains.

12. Size of seed.—When 100 ginned seed weigh more than 16 grams they are apt to lower the lint percentage appreciably on account of their large size. Therefore, for Tennessee it is desirable to have an early, prolific, spreading, vigorous type, with staple length around 1 inch, lint percentage above 34, bolls less than 80 to the pound, lint index around 7 grams, and size of seed below 16 grams.

THE 144 STRAINS IN THE TRIALS OVER A 7-YEAR PERIOD

It is well to recall that selection within the variety has been practiced intensively by the breeder. These selections are usually given numbers to designate them and are called strains. The strains of a single variety may be very different in their type and adaptation. Acala 44-5 is an early, prolific strain, fairly well adapted to Tennessee, whereas Acala 8 is late, non-prolific, and poorly adapted. Cleveland 884-St. 4 has longer lint, and is earlier and more spreading than Wannamaker-Cleveland. Rowden 40 is earlier and more prolific than Texas Rowden. Hence, it is very important for the grower to keep in mind the strain number of the variety.

These strains were obtained from all the cotton-growing states and should be representative of most varieties grown over the South. Some of them gave such small promise of adaptability that they were eliminated after the first year. Others were carried for 2 and 3 years, while only 10 strains were continued in the main variety test for 7 years.

KEY TO TABLE 2

In table 2, 144 strains are listed. They are grouped as strains of the variety rather than the type, because a description of these types was not published in time to be included in this bulletin. Too much space would be required to give the results in detail on all these strains; hence, a number is assigned to each reason for discarding a strain, and a key is given at the top of the table. The words "good" and "fair" indicate those continued. For example, 105 under Acala, or Acala 105, is a poor yielder and late; most of the Delfos strains have too small bolls and low lint percentage, but Delfos 719 is an exception and is retained in the trials. Most of the Cleveland strains are too late, but 884-St. 4 is fairly early and has a good quality of lint. Mars Rose is a poor yielder, too late, and has a low lint turnout; it is also of the extreme cluster type

and its bolls are hard to pick. Half and Half is too short and the lint is generally of poor character.

Table 2—*Varieties and strains in the 7-year trials, showing those discarded and those continued, with reasons as indicated by key*[1].

Key; 1, Poor yielder of lint; 2, Too late; 3, Too short; 4, Poor lint turn-out; 5, Small boll; 6, Poor quality of lint; "Good" and "Fair" being continued.

Variety	Reasons for discarding or continuing
Acala	
105	1, 2
145	1, 2
8	1, 2
31	1, 2
34	1, 2
37	1, 2
5	1, 2
5-37	1, 2
16-8-4-1	1, 2
Arkoma	1, 2
Texas	1, 2
Indio (Cal.)	1, 2
Shafter (Cal.)	1, 2
Rast	1, 2
Rogers	1, 2
Burdette	1, 4
North Carolina	1, 2
14-6	Fair
44-1	Fair
44-5	Good
Cleveland	
13	2
14	2
20-3	2
52	2
5	2
6	2
6b	2
5-St. 4	2
7	2
7-1	2
5-2	2
1-1-16	2
Clevewilt	1, 2
Wannamaker	2, 3
Piedmont	3, 4, 6
Wilson Big Boll	3, 4, 6
884-St. 2	Fair
884-St. 4	Fair
College No. 1	
23-16	3, 6
23-13	3, 6
23-4	3, 6
Cook	
1010	2, 3
1616	2, 3
1627	2, 3
1954	2, 3
Delfos	
631	2, 4
6102	4, 5
2	4, 5
910	4, 5
911	4, 5
1341	4, 5
2103	4, 5
6102	4, 5
3234	4, 5
5555	4, 5
Misdel No. 1	4, 5
Misdel No. 2	4, 5
Foster, St. 3	4, 5
Foster, St. 4	4, 5
719	Good
D. P. L.	
4	2
6	2
4—28A-22	4, 5
4-8	Good
11	Good
10	Good
Dixie	
14	1, 6
Triumph	1, 6
Express	
5	4, 5
7	4, 5
8	4, 5
116	4, 5
41077	4, 5
Lightning	4, 5
Arkansas 17	4, 5
Farm Relief	
No. 1	Fair
Half and Half	
Summerour	3, 6
W. L.	3, 6
Reynolds	3, 6
Ballard	3, 6
Big Boll	3, 6
Crooks	3, 6
Lone Star	
65	1
284	1, 4
Saunders	2
Texas	2
Wilt Resistant	2
Startex	2
Mexican Big Boll	
14	1
6	1
6-1-9	1
54	1
18-2	1
18-8	1
18-87	1
6-19-38	1
Rowden	
Texas	2, 4
Miller	2, 4
37-102	2, 4
2119	2
2088	Fair
40	Fair
Stoneville	
1	2
2	Good
3	Good
5	Fair
2-A	Good
Triumph	
Mebane	1, 2
32-13	1, 2
29-9	1, 2
406	1, 2
Qualla	1, 2
Trice	
Tennessee	4
Mississippi	4
43	4
322	4
84-50	4
90-1	4
25-1-45	Fair
5-42	Fair
Wilds	
1	2
2	2
3	2
Miscellaneous	
New Boykin	2
Delta Type Webber	2
Ferguson	2
Hawkins	6
Truitt	2
Kasch	2
Kekohi	2
Williamson	2
Broadwell's Double-jointed	3, 6
Over-the-Top	3, 6
Vandiver's Heavy Fruiter	3, 6
Woods Ingold	1, 6
Sproulls Big Boll	2
Rucker	3, 6
Kings	3, 6
Simpkins	3, 6
Hastings Bank Account	3, 6
Poor Man's Friend	3, 6
Mortgage Lifter	3, 6
Greer's Wichita	2
Mars Rose	1, 2, 4

[1] Data on any strain listed will be sent upon request.

COMPLETE RESULTS ON 12 REPRESENTATIVE VARIETAL STRAINS

Results of trials with the 12 most representative strains are given in tables 3 to 13 and the final ranking is shown in table 14. Strains of all these varieties are grown to some extent in Tennessee. Half and Half and the Delta and Pine Land strains are the most popular, while Stoneville has increased in acreage the past 3 years.

Acala is the only western variety, and strain 44 was originated in Oklahoma; D. P. L. 4-8, D. P. L. 10, Delfos strains, and Stoneville 2 were originated in Mississippi; Cleveland 884, Express 7, and Farm Relief in South Carolina; Half and Half in Georgia; Mexican Big Boll 6 in North Carolina; Rowden 40 in Arkansas; and the Trice strains in Tennessee.

Express, Half and Half, and Mexican Big Boll have been discarded until more improved strains are introduced. New introductions of the other 9 varieties are promising and are being continued. When a new selection appears better than the parent, it replaces the parent in the trials, so that the original strain of every variety is not carried through all the years. The exceptions are found in the footnotes to the tables.

SEASONAL AND CULTURAL CONDITIONS

In Tennessee the cotton-growing season extends from around the first of May to the first of September. In a normal season the plants begin to square about the middle of June, to bloom and set bolls from the middle of July to the latter part of August. June, July, and August are all therefore critical months of the growing season.

It is known that the cotton plant reacts decidedly to climatic changes, but it is difficult to measure the association of these changes with the yields. The late planting dates at Knoxville in 1928 and 1929, along with the lower mean temperatures, probably caused the poor yields during these years. The dry season of 1930 at all three stations evidently influenced the yields. Cotton matures earlier at Jackson than at Knoxville; the percentage of cotton harvested at first picking is larger, without an exception. In 1933, when the planting dates and yields were practically the same, there was a difference of 21.2 per cent in favor of Jackson.

In 1934 at Knoxville the yield was abnormally high. This may be explained in part by data from the field notes taken each week: Plant beds in fine condition and temperature high at planting time, May 2. Light showers fell May 5 and 10; cotton up to a good stand May 12. Was thinned, nitrated, and plowed May 18 and 19. It turned cold May 20, night temperatures down to 49° F. on 24th, and remained cold until June 8. June 9 it turned hot, with fairly high temperatures and intermittent rains until June 17. Squares were observed at this time. From June 18 to July 22 there were very high temperatures, with light showers, and the first blooms were seen July 5. It continued dry and hot, with only two showers, until August 14. From August 15 to September 1 there were heavy rains, but the temperatures remained high, and very little shedding took place. First open bolls were seen September 3. The varietal trial covers nearly an acre, and only two

skips over 3 feet were recorded in the entire area. It is evident from these notes that rather heavy July and August crops were set.

The field notes show that the crop made practically the same progress at Jackson as it did at Knoxville until July 20. From this date until August 20 there was no rainfall and the temperatures were abnormally high, so that excessive shedding set in and the crop never recovered. Hence, a detailed description of the season at each station would need to be given for an explanation of the variations in yield.

EXPERIMENTAL METHODS

Location.—The field experiments are located in 3 widely separated sections of the State—at Jackson, on a typical cotton soil of West Tennessee, the Memphis silt loam, with an elevation of 450 feet; at Murfreesboro, on Decatur loam, with an elevation of 610 feet; at Knoxville, on Cumberland loam, with an elevation of 1,046 feet. The land chosen for this work was cultivated without any crop rotation, but its fertility is above the average.

The seed were always obtained from the originator of the variety and in sufficient quantities to last for a number of years, so that the behavior of the variety would not be affected by a change of seed.

Each variety was planted in single-row plots, 60.5 feet long, and repeated 10 times. The plots were arranged systematically, every fifth one being a check of standard variety. In order to avoid plant competition, varieties having similar growth habits are given adjacent plots; guard rows are planted along the sides of the experiment, and 4 feet are taken off at the ends of the rows.[1] In 1934 the field was divided into 10 blocks of equal length, the variety planted at random in each block, and 2-row plots used.

The land is turned, and in early spring (depending upon the weather) furrows or rows are laid off 3 feet apart; an application of mixed fertilizer, about 200 pounds, is placed in the furrow; and beds are thrown up in the usual manner. Planting is done as nearly as possible around the first of May, and at the rate of 1½ bushels of seed per acre.

The plants are thinned soon after they are up, leaving single plants 8 to 12 inches apart. At the same time they are "dirted" and a side dressing of nitrate of soda is applied at the rate of 100 pounds per acre. Shallow and frequent cultivations are given afterward.

The first picking is made, if possible, 125 days from the time of a normal stand. At this picking two 100-boll samples are taken of each variety. These samples are obtained by gathering 25 well-matured bolls at random on each of 8 plots. A composite sample of one pound is retained from each of the remaining pickings.

Samples of 100 grams each are taken from the 100-boll and composite field samples. There are 8 of these 100-gram samples to represent each variety. They are ginned on a 10-saw machine, and from them are determined lint percentage, size of seed, and lint index. The size of boll is calculated from the original weight of the 100-boll samples.

Classers of the U. S. Bureau of Agricultural Economics, Division of

[1] In another experiment over a 4-year period, no plant competition was found on soils of similar fertility to those of the varietal trials.

Cotton Marketing, at Memphis, grade and staple samples of lint from all the varieties each year. In 1928 and 1929 this work was done by the Tennessee Cotton Growers Association.

The money values are calculated as the average of the daily spot quotations on the Memphis market from September 15 to December 15 of each season.

Table 3—*Yield, expressed in pounds of seed cotton per acre*[1]

Variety	1928	1929	1930	1931	1932	1933	1934
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
JACKSON							
Acala 44	1616	2127	959	1570	1459	1536	942
Cleveland 884	1508	2076	919	1326	1274	1546	938
D. P. L. 4-8	1528	2270	869	....	1380	1540	1000
D. P. L. 10	....	....	....	1753	1485	1805	1088
Delfos 911	1568	1970	752	1586	1506	1699	1187
Express 7	1016	2085	884	1549	1351	....	....
Farm Relief, St. 1	....	....	....	1456	1305	1543	927
Half and Half (Summerour)	1448	1886	942	1464	....	....	....
Mexican Big Boll 6	1328	1766	732	....	....	....	....
Rowden 40	1592	1224	960	1421	1457	1605	1128
Stoneville 2	1464	2337	845	1718	1555	1754	1170
Trice 5	1260	1929	827	1500	1303	1509	1009
MURFREESBORO							
Acala 44	1302	969	917	959	1224	....	....
Cleveland 884	1242	722	853	1440	1166	....	....
D. P. L. 4-8	1691	1053	970	....	1152	....	....
D. P. L. 10	....	....	....	1390	1216	....	....
Delfos 911	1950	866	853	1131	1193	....	....
Express 7	1867	777	869	1247	1157	....	....
Farm Relief, St. 1	....	....	....	1173	1190	....	....
Half and Half (Summerour)	1420	672	874	989	....	....	....
Mexican Big Boll 6	1954	804	816	....	....	....	....
Rowden 40	1369	688	842	1408	1147	....	....
Stoneville 2	1698	1061	919	1254	1231	....	....
Trice 5	1635	823	836	961	1128	....	....
KNOXVILLE							
Acala 44	710	748	1432	1749	1863	1593	2179
Cleveland 884	365	457	917	1650	1621	1679	2069
D. P. L. 4-8	266	517	1267	....	1762	1608	2355
D. P. L. 10	....	....	....	1672	1764	1907	2393
Delfos 911	496	677	1311	1749	1828	1725	2623
Express 7	820	530	1095	1714	1720	....	....
Farm Relief, St. 1	....	....	....	1549	1357	1560	2149
Half and Half (Summerour)	443	405	1097	1308	....	....	....
Mexican Big Boll 6	400	611	1117	....	....	....	....
Rowden 40	73	114	1194	1654	1685	1595	2245
Stoneville 2	321	792	1366	1982	1958	1725	2714
Trice 5	622	869	1313	1502	1590	1048	2277

[1] Delfos 719 first entered tests 1932; Acala 44-5, 1932; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

A statistical analysis of the varietal data was made by "Students" method; but in 1934 the planting arrangement was changed, and the data are now analyzed by the method of "variance." In all the tables, the data opposite the variety are the average of 8 to 10 samples; there are always variations between these samples, which are measured by the standard error. But these analyses and standard errors would probably be of no interest to the layman or grower and are not given in this publication.[1]

YIELDS OF SEED COTTON

Each yield in table 3 is the mean, or average, of 10 plots. Every year, except 1933 and 1934, each variety was in the trials 30 times. For

[1] These analyses and standard errors will be sent upon request to those scientific workers who may be interested in them.

instance, Cleveland 884 was planted 190 times over the 7-year period; Half and Half, 120 times; Express, 150 times; so that a fair opportunity was given for the productiveness of the variety to become known.

Different varieties appear as leaders from season to season. In 1928, Acala 44 leads at Jackson, Delfos and Mexican Big Boll 6 at Murfreesboro, and Express 7 at Knoxville. In 1931, D. P. L. 10 leads at Jackson, Cleveland 884 and Rowden 40 at Murfreesboro, and Stoneville 2 at Knoxville. In the dry season of 1930 none of the varieties appear to much advantage, and Half and Half never ranks high as a yielder of seed cotton.

Certain varieties are adapted more than others to a given season and soil fertility. This is very striking, even within the limits of soil variation in a small experimental area. "A good Cleveland year," "a good Delfos year," "a good Trice year," and "Half and Half a poor-land variety" are common expressions. In selecting the most productive strain one should be guided by the record it makes over a period of time under a variety of conditions. The table shows that Stoneville 2,

Table 4—*Yield expressed in pounds of lint per acre*[1]

Variety	1928	1929	1930	1931	1932	1933	1934
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
JACKSON							
Acala 44	593	804	357	593	529	588	326
Cleveland 884	556	747	312	450	441	542	315
D. P. L. 4-8	590	885	335	...	517	616	379
D. P. L. 10	...	...	...	620	525	671	654
Delfos	501	650	251	502	542	630	408
Express 7	336	688	283	488	413	...	...
Farm Relief, St. 1	...	...	...	515	462	551	319
Half and Half (Summerour)	617	811	400	622	...	...	...
Mexican Big Boll 6	451	600	249	...	...	...	...
Rowden 40	563	404	319	460	492	554	374
Stoneville 2	518	843	295	609	572	629	395
Trice	408	632	269	465	422	496	319
MURFREESBORO							
Acala 44	453	360	344	362	456	...	...
Cleveland 884	419	260	308	489	415	...	...
D. P. L. 4-8	625	404	366	...	434	...	...
D. P. L. 10	...	...	...	492	442	...	...
Delfos	575	277	291	362	425	...	...
Express 7	560	256	281	414	385	...	...
Farm Relief, St. 1	...	...	...	446	433	...	...
Half and Half (Summerour)	564	285	380	420	...	...	...
Mexican Big Boll 6	650	269	280	...	...	...	...
Rowden 40	435	238	295	484	409	...	...
Stoneville 2	572	370	327	445	449	...	...
Trice	510	268	272	298	386	...	...
KNOXVILLE							
Acala 44	245	277	551	631	683	629	765
Cleveland 884	121	156	329	566	554	619	704
D. P. L. 4-8	96	198	489	...	654	676	857
D. P. L. 10	...	...	...	607	645	723	835
Delfos	145	216	448	552	649	642	949
Express 7	263	169	364	562	548	...	...
Farm Relief, St. 1	...	...	...	570	479	577	786
Half and Half (Summerour)	173	170	473	558	...	...	...
Mexican Big Boll 6	126	201	393	...	...	...	...
Rowden 40	24	39	415	537	541	561	741
Stoneville 2	107	286	494	674	689	628	933
Trice	189	266	434	438	526	565	724

[1] Delfos 719 first entered tests 1932; Acala 44-5, 1932; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

the D. P. L. strains, and Delfos 719 are the most consistent producers of seed cotton.

YIELDS OF LINT

Pounds of seed cotton multiplied by the lint percentage gives the amount of lint the variety produces. Therefore, those varieties which show high yields of seed cotton in table 3 do not necessarily show high yields of lint in table 4; lint percentage varies considerably between different strains of cotton. Cook (6) shows the danger of judging varieties by their lint percentages.

For example, at Jackson, in 1928, there are six varieties which make higher yields of seed cotton than Half and Half; yet in table 4 this variety has the largest amount of lint cotton. This is the result of the high lint percentage in Half and Half. Lint of quality, however, is the product which the grower must market, and, as stated previously, varieties which are very low in lint percentage can hardly overcome this disadvantage by their yields of seed cotton.

Some varieties, such as Acala 44, the D. P. L. strains, and Stoneville 2, have fairly high lint percentages as well as yields of seed cotton. In table 4 it is seen that they generally also have large yields of lint.

Table 5—*Length of lint, in 32nds of an inch*[1]

Variety	1928	1929	1930	1931	1932	1933	1934
JACKSON							
Acala 44	30	32	28	30	31	35	32
Cleveland 884	33	34	30	34	33	35	32
D. P. L. 4-8	30	32	30	..	32	35	32
D. P. L. 10	..	..	..	33	32	34	33
Delfos 911	36	36	33	34	36	35	34
Express 7	35	36	34	34	37	..	..
Farm Relief, St. 1	..	..	..	34	34	36	33
Half and Half (Summercour)	24	26	24	26	..	..	..
Mexican Big Boll 6	32	32	30	..	..	..	..
Rowden 40	31	30	31	33	32	34	32
Stoneville 2	33	32	31	34	32	34	33
Trice 5	28	32	30	33	33	35	33
MURFREESBORO							
Acala 44	30	32	30	31	33	..	..
Cleveland 884	34	35	31	32	32	..	..
D. P. L. 4-8	30	30	30	..	31	..	..
D. P. L. 10	..	..	..	33	32	..	..
Delfos 911	35	36	34	34	34	..	..
Express 7	35	36	34	34	35	..	..
Farm Relief, St. 1	..	..	..	34	34	..	..
Half and Half (Summercour)	26	26	24	26	..	..	..
Mexican Big Boll 6	30	31	31	..	..	..	..
Rowden 40	30	31	31	33	31	..	..
Stoneville 2	32	35	32	33	32	..	..
Trice 5	30	32	30	33	33	..	..
KNOXVILLE							
Acala 44	30	32	30	32	33	34	32
Cleveland 884	34	33	31	34	35	34	34
D. P. L. 4-8	30	30	30	..	32	34	34
D. P. L. 10	..	..	..	33	33	35	33
Delfos 911	37	36	34	34	37	34	34
Express 7	30	36	35	35	37	..	..
Farm Relief, St. 1	..	..	..	34	34	35	33
Half and Half (Summercour)	26	26	24	26	..	..	..
Mexican Big Boll 6	31	31	30	..	..	..	..
Rowden 40	31	32	31	32	34	35	33
Stoneville 2	33	33	31	34	33	34	34
Trice 5	30	32	30	34	33	34	34

[1] Delfos 719 first entered tests 1932; Acala 44-5, 1932; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

The yields in tables 3 and 4 are greater on the average than those obtained under general farm conditions. Yields of this kind are associated with small plot areas, especially when converted to the acre basis, as calculated in these tables.

LENGTH OF LINT

This character is largely inherent, so that length of lint is nearly constant for each variety. In table 5 it is seen that the length of lint seldom varies more than $\frac{3}{32}$ of an inch for any one strain, although the tests were conducted on very different soil types. Also classers are known to differ as much as $\frac{1}{16}$ of an inch on a given sample, and some allowance for variations in this respect should be made.

A very dry season affects the length to some extent. In 1930, 8 out of 10 strains had shorter lint than usual at Jackson, 7 out of 10 at Murfreesboro, and 9 out of 10 at Knoxville.

The cotton of Half and Half is always shorter than $\frac{7}{8}$ inch, and some seasons it was even shorter than $\frac{13}{16}$ inch. In the market, cotton shorter than $\frac{7}{8}$ inch is called "untenderable" because it is not allowed to be tendered against a future contract on the Exchange. Cotton of this kind carries a discount instead of the premium which other varieties receive when their lint is longer than $\frac{7}{8}$ inch.

It is true that Half and Half becomes mixed with longer cottons to such a degree that the classer may staple this variety as a full $\frac{7}{8}$-inch

Table 6—*Earliness, expressed in percentage of total crop harvested at time of first picking, or 125 days from date of normal stand*[1]

Variety	1928	1929	1930	1931	1932	1933	1934
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
JACKSON							
Acala 44	45.0	69.1	68.9	56.5	49.3	48.9	69.2
Cleveland 884	28.0	51.1	32.6	25.1	41.5	34.4	54.7
D. P. L. 4-8	34.0	58.4	62.2	....	44.6	43.6	63.1
D. P. L. 10	....	....	....	34.0	30.6	30.9	55.5
Delfos 011	36.0	63.0	70.0	34.0	54.1	51.9	74.0
Express 7	65.0	63.0	60.3	49.8	47.9	....	....
Farm Relief, St. 1	....	....	....	41.0	40.2	46.5	59.3
Half and Half (Summerour)	40.0	47.6	51.9	29.3	....	....	....
Mexican Big Boll 6	45.0	50.0	60.6	....	....	....	....
Rowden 40	31.0	41.0	43.4	37.3	36.3	40.8	65.7
Stoneville 2	50.0	68.2	68.0	49.7	40.1	52.8	72.7
Trice 5	70.0	71.2	69.3	57.1	48.5	60.5	81.4
KNOXVILLE							
Acala 44	....	....	43.1	44.4	43.5	36.7	32.0
Cleveland 884	....	....	17.3	21.9	30.3	13.5	17.7
D. P. L. 4-8	....	....	26.9	....	30.2	18.4	16.0
D. P. L. 10	....	....	....	19.2	31.5	15.5	19.1
Delfos 011	....	....	30.9	24.8	36.6	25.1	32.4
Express 7	....	....	32.4	28.6	29.4	....	....
Farm Relief, St. 1	....	....	....	26.4	28.0	20.3	19.8
Half and Half (Summerour)	....	....	21.9	24.1	....	....	....
Mexican Big Boll 6	....	....	23.5	....	....	....	....
Rowden 40	....	....	19.0	29.8	23.8	21.4	22.6
Stoneville 2	....	....	30.2	20.7	26.5	31.3	31.3
Trice 5	....	....	44.0	47.9	44.7	34.0	38.0

[1] Delfos 719 first entered tests 1932; Acala 44-5, 1932; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

NOTE.—The first pickings at Murfreesboro were taken too late for the data on earliness to be comparable.

or even $^{15}/_{16}$-inch. Continued practice of this kind will cause the cotton to lose its uniformity and character, and is not recommended.

The manner of ginning influences the staple. A cotton may be cut up considerably by too high speeds of the saws, or a very tight roll, or other operating factors. The U. S. Bureau of Agricultural Engineering has made some valuable recommendations along this line (4).

The results given in this table show that a cotton of medium staple, around one inch, can be regularly produced in Tennessee when the proper varieties are chosen.

EARLINESS

Different methods of measuring earliness have been tried. Blooming or open-boll counts at a certain period are of little value unless they are expressed in terms of total blooms and bolls. But shedding and the size of boll may add serious errors to these counts. A variety having a total yield of 2,000 pounds would require a larger number of bolls than one of 1,500 pounds; yet at a given period the proportionate number of open bolls for the two might be the same. Then, too, there are the errors in counting. Earliness in these trials is measured by the weight of cotton at a given period as expressed in percentage of the total weight (table 6). The period is as nearly as possible 125 days from the time of a normal stand.

It has been stated that early maturity is due in part to the soil and climatic conditions as well as the variety. This character, however, is largely inherited, and the early cottons at Knoxville mature earlier at Jackson. The D. P. L. strains open fairly late at Knoxville, but on lands

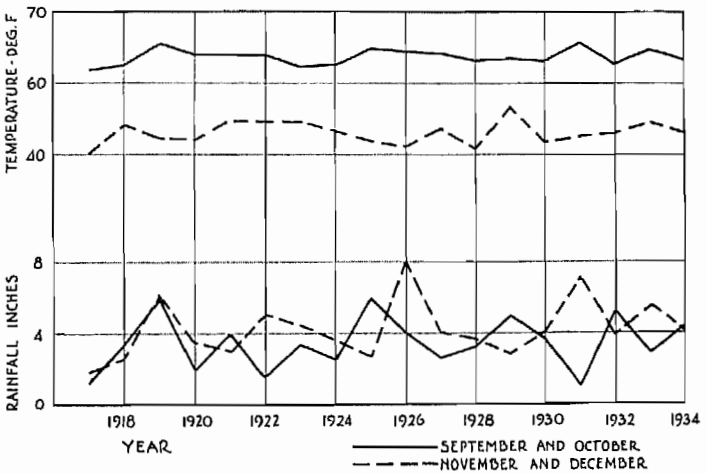


Fig. 1—The average temperature and rainfall at Jackson from 1918 to 1934. September and October compared with November and December.

of medium fertility in West Tennessee the lateness of their maturity is not considered a serious handicap. California Acala is too late on almost

all the soil types, but matures safely on the red upland soils around Murfreesboro when early planting is followed.

Under local conditions the fertility and topography of the land strongly influence the maturity. On a very rich or poorly drained soil the cotton plant makes too much vegetative growth, and maturity is retarded. Soils of this kind should not be planted to cotton in this State.

Fertilizers influence maturity. It may be either hastened or retarded by the kind, rate, and time of application. These factors will be discussed in another publication.

As shown in Fig. 1, rainfall is less and temperatures are higher in September and October than in November and December. Therefore, picking conditions are better, and superior grades are obtained when most of the cotton is gathered in September and October; but an early-maturing variety should be planted to make this possible.

Trice is the most rapid-maturing, and, in fact, the earliest of all the 144 strains that have been in the trials. Delfos 719, Express 7, and Acala 44-5 rank next, followed by Stoneville 2. The D. P. L. strains, Rowden

Table 7—*Lint percentage, or "turnout"*[1]

Variety	1928	1929	1930	1931	1932	1933	1934
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
JACKSON							
Acala 44	36.7	37.8	37.2	37.8	36.3	38.2	34.6
Cleveland 884	35.5	36.0	34.0	34.0	34.6	35.1	33.6
D. P. L. 4-8	38.6	39.0	38.6	....	37.5	40.0	36.6
D. P. L. 10	....	....	....	35.4	35.4	37.2	34.8
Delfos 911	32.0	33.0	33.4	31.7	34.0	37.1	34.4
Express 7	33.1	33.0	32.0	31.5	30.6	....	....
Farm Relief, St. 1	....	....	....	35.4	35.4	35.7	34.4
Half and Half (Summerour)	42.6	43.0	42.5	42.5	....	....	....
Mexican Big Boll 6	34.0	34.0	34.1	....	....	....	....
Rowden 40	35.4	38.0	33.2	32.4	33.8	34.5	33.1
Stoneville 2	35.4	36.1	34.9	35.5	36.8	35.9	33.8
Trice 5	32.4	32.8	32.6	31.0	32.4	32.9	31.6
MURFREESBORO							
Acala 44	34.8	37.2	37.5	37.8	37.3	....	....
Cleveland 884	33.8	36.0	36.1	34.0	35.6	....	....
D. P. L. 4-8	37.0	38.4	37.8	....	37.7	....	....
D. P. L. 10	....	....	....	35.4	36.4	....	....
Delfos 911	29.5	32.0	34.1	32.0	35.6	....	....
Express 7	30.0	33.0	32.3	33.2	33.3	....	....
Farm Relief, St. 1	....	....	....	38.0	36.4	....	....
Half and Half (Summerour)	39.7	42.5	43.5	42.5	....	....	....
Mexican Big Boll 6	33.3	33.5	34.3	....	....	....	....
Rowden 40	31.8	34.6	35.0	34.4	35.7	....	....
Stoneville 2	33.7	34.9	35.6	35.5	36.5	....	....
Trice 5	31.2	32.6	32.5	31.0	34.2	....	....
KNOXVILLE							
Acala 44	34.5	37.0	38.5	36.1	36.7	39.5	35.1
Cleveland 884	33.1	34.1	35.9	34.3	34.2	36.9	34.2
D. P. L. 4-8	36.2	38.3	38.6	....	37.1	39.8	36.4
D. P. L. 10	....	....	....	36.3	36.6	37.9	34.9
Delfos 911	29.3	32.0	34.2	31.6	35.5	37.2	36.2
Express 7	32.1	32.0	33.3	32.8	31.0	....	....
Farm Relief St. 1	....	....	....	36.8	35.3	37.0	36.6
Half and Half (Summerour)	39.1	42.1	43.1	40.8	....	....	....
Mexican Big Boll 6	31.5	33.0	35.2	....	....	....	....
Rowden 40	32.8	34.0	34.8	32.5	32.1	35.2	33.0
Stoneville 2	33.5	36.1	36.2	34.0	35.2	36.4	34.4
Trice 5	30.4	30.7	33.1	29.2	33.1	34.3	31.8

[1] Delfos 719 first entered tests 1932; Acala 44-5, 1932; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

40, Half and Half, Mexican Big Boll, and Farm Relief are fairly late at Knoxville, but rather early at Jackson. Cleveland 884 is late at Knoxville, and some years it is late at Jackson. With the exception of Acala 44-5 and Triumph 44, all varieties of western origin are too late for Tennessee.

LINT PERCENTAGE

Lint percentage, lint index, and size of seed are so interrelated that they might be discussed together. Lint percentage, being the ratio of the weight of lint to the weight of seed cotton, is dependent upon the weight of seed as well as the amount of lint around them (table 7).

Generally, lint percentages are higher in a dry season, because the seed are lighter, and hence the ratio of the lint to seed is greater. In the dry season of 1930 lint percentages at the three stations were appreciably high. In a previous paper by Hancock (12) it was shown that the relationship between lint percentages and weight of seed is linear; that is, the lighter the seed the greater the lint percentage, and vice versa; but the association is not strong enough to indicate the outcome in every instance.

Obviously, small seed lose less moisture than large ones, and a small-seeded variety like Half and Half may not be affected a great deal by seasonal differences. It is apparent also that lint percentage may be influenced by the manner of ginning and picking.

For a long time it was held that only short cottons gave high lint turnouts, but improved strains of recent years contradict this opinion to some extent. D. P. L. 11 has an average of 41 per cent and a commercial staple of 1 1/16 inches; and some of the Acala strains, 39 per cent and 1 1/32 inches.

Trice and Express are the only varieties in the table having an average turnout below 34 per cent. These varieties, though early, have never been widely distributed in Tennessee on account of their low lint percentage.

Any one variety presents variations in this character. These differences, however, fall around an average which is typical of the strain—Acala 44, around 37 per cent; Half and Half, 42 per cent; Trice, 32 per cent; Stoneville 2, 35 per cent.

LINT INDEX AND SIZE OF SEED

Lint index measures the abundance of lint on the seeds by taking the weight of lint on 100 of them (tables 8 and 9). In 1918 Meloy (15) published a table which enables one to calculate this character, when lint percentage and seed weight are given. Meloy's table was recalculated by Hancock (12); an interval of .5 per cent intsead of 1 per cent was taken in the lint-percentage column, and the ranges were extended. It was shown that lint index as calculated from the revised table [1] agreed well with the actual amount of cotton obtained from 100 seeds of the variety.

The grower may gain a false impression of the actual lint given by

[1] Mimeographed copies of this table will be sent to anyone upon request.

Table 8—*Lint index, expressed in grams of lint on 100 seed*[1]

Variety	1928	1929	1930	1931	1932	1933	1934
	Grams	Grams	Grams	Grams	Grams	Grams	Grams
JACKSON							
Acala 44	7.33	7.35	6.45	7.35	6.02	7.97	5.76
Cleveland 884	6.85	7.88	5.67	7.21	6.31	7.54	5.76
D. P. L. 4-8	7.51	7.36	6.54	....	6.00	8.00	5.73
D. P. L. 10	....	....	....	6.60	5.75	7.33	5.93
Delfos 911	5.41	5.67	5.02	5.18	5.92	7.93	6.04
Express 7	5.02	5.91	5.64	5.26	5.24	....	....
Farm Relief, St. 1	....	....	....	8.52	6.85	8.72	6.55
Half and Half (Summerour)	7.73	8.68	7.35	8.46	....	....	....
Mexican Big Boll 6	6.95	7.47	6.17	....	....	....	....
Rowden 40	7.42	7.88	6.65	7.44	7.47	8.42	5.91
Stoneville 2	5.65	6.48	5.93	6.60	5.58	6.75	5.41
Trice 5	5.75	6.16	5.52	5.84	5.26	6.89	5.26
MURFREESBORO							
Acala 44	7.00	7.33	6.60	7.35	6.90	....	....
Cleveland 884	7.72	7.30	6.18	6.71	6.60	....	....
D. P. L. 4-8	6.76	7.51	6.43	....	6.13	....	....
D. P. L. 10	....	....	....	6.60	6.31	....	....
Delfos 911	5.01	5.18	5.15	5.18	6.28	....	....
Express 7	5.14	5.91	5.75	5.91	5.53	....	....
Farm Relief, St. 1	....	....	....	8.58	6.90	....	....
Half and Half (Summerour)	7.68	8.46	7.65	8.12	....	....	....
Mexican Big Boll 6	7.03	6.77	6.31	....	....	....	....
Rowden 40	7.52	8.14	7.26	7.02	6.75	....	....
Stoneville 2	5.41	6.46	6.03	6.85	6.02	....	....
Trice 5	5.62	5.75	5.52	6.29	5.92	....	....
KNOXVILLE							
Acala 44	6.83	7.93	7.51	6.75	7.05	8.62	7.00
Cleveland 884	7.13	7.97	6.75	7.07	6.95	8.22	7.72
D. P. L. 4-8	7.03	7.81	6.85	....	6.76	7.68	6.90
D. P. L. 10	....	....	....	6.90	6.90	7.35	7.00
Delfos 911	4.57	6.11	5.67	5.04	7.13	7.93	7.93
Express 7	5.41	6.11	5.02	5.67	5.38	....	....
Farm Relief, St. 1	....	....	....	8.22	7.95	9.10	8.61
Half and Half (Summerour)	7.67	8.68	7.91	8.00	....	....	....
Mexican Big Boll 6	6.17	7.13	7.26	....	....	....	....
Rowden 40	6.89	8.24	7.54	6.95	6.82	8.61	7.13
Stoneville 2	5.26	7.03	6.75	6.43	6.60	6.90	6.31
Trice 5	5.36	6.07	5.91	5.71	5.91	7.07	6.35

[1] Delfos 719 first entered tests 1932; Acala 44-5, 1932; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

his variety when lint percentage is depended upon as a measure of it. For example, in 1930 at Jackson, D. P. L. 4-8 has a lint turnout of 38.6 per cent, lint index of 6.5 grams, and seed weight of 10.4 grams, so that its lint percentage is due largely to the low weight of seed and not to the abundance of lint around the seed. In 1933 at Jackson, D. P. L. 4-8 has a lint turnout of 40 per cent, lint index of 8 grams, and seed weight of 11.9 grams; and in this case the abundance of lint around the seed was the most important factor contributing to lint percentage.

Half and Half has a combination of high lint index and small seed, which probably accounts for its continued high lint percentage. Farm Relief has relatively large seed, with an average weight around 15 grams; but its high lint index, an average around 8 grams, enables this variety to maintain a lint percentage comparable with other strains.

It is observed in these tables that lint index and seed weight are affected by environment. There was a severe local drouth in 1934 at Jackson, and the lint index and the seed weights are uniformly lower than in 1933, although similar varieties were planted both years.

Table 9—*Size of seed, expressed in the weight of 100 seeds*[1]

Variety	1928	1929	1930	1931	1932	1933	1934
	Grams	Grams	Grams	Grams	Grams	Grams	Grams
JACKSON							
Acala 44	12.4	12.1	10.9	11.7	10.4	13.3	10.7
Cleveland 884	12.5	14.0	10.9	13.8	11.9	14.2	11.6
D. P. L. 4-8	11.8	11.6	10.4	....	9.8	11.9	10.0
D. P. L. 10	....	....	....	12.1	10.3	12.6	10.8
Delfos 911	11.3	11.5	9.7	11.2	11.5	13.4	11.4
Express 7	9.5	12.1	11.8	11.6	10.2	....	....
Farm Relief, St. 1	....	....	....	15.4	12.3	15.4	12.4
Half and Half (Summerour)	10.4	11.3	9.8	11.5	....	....	....
Mexican Big Boll 6	13.5	14.5	12.2	....	....	....	....
Rowden 40	13.7	16.2	13.4	15.3	12.5	15.9	12.2
Stoneville 2	10.3	11.5	10.8	11.9	9.5	12.0	10.4
Trice 5	12.1	12.3	11.3	13.2	11.2	13.9	11.5
MURFREESBORO							
Acala 44	12.8	12.4	11.9	12.1	11.4	....	....
Cleveland 884	15.2	13.2	11.7	13.0	11.8	....	....
D. P. L. 4-8	11.6	11.8	10.8	....	10.2	....	....
D. P. L. 10	....	....	....	11.9	10.8	....	....
Delfos 911	11.9	11.1	10.0	11.1	11.5	....	....
Express 7	11.9	12.1	11.1	11.9	11.2	....	....
Farm Relief, St. 1	....	....	....	13.8	11.8	....	....
Half and Half (Summerour)	11.9	11.7	10.2	10.9	....	....	....
Mexican Big Boll 6	13 8	13 4	13 2	....	....	....	....
Rowden 40	15.9	15.4	13.9	14.4	12.0	....	....
Stoneville 2	10.6	11.8	11.0	12.6	10.5	....	....
Trice 5	12.6	12.2	11.6	13.9	11.4	....	....
KNOXVILLE							
Acala 44	12.8	13.7	11.9	12.1	11.8	13.3	12.7
Cleveland 884	14.4	15.4	12.0	13.5	13.4	13.7	15.1
D. P. L. 4-8	12.3	12.4	10.9	....	11.5	11.3	12.0
D. P. L. 10	....	....	....	11.8	11.8	12.0	12.9
Delfos 911	11.1	13.1	10.9	11.2	13.0	13.3	13.3
Express 7	11.7	13.0	9.9	11.6	12.2	....	....
Farm Relief, St. 1	....	....	....	14.3	14.3	15.4	15.1
Half and Half (Summerour)	12.1	12.1	10.4	11.6	....	....	....
Mexican Big Boll 6	13.6	14.5	13.5	....	....	....	....
Rowden 40	14.1	16.1	14.0	14.8	14.4	15.8	14.4
Stoneville 2	10.5	12.8	11.7	12.3	11.7	12.0	12.0
Trice 5	12.5	13.6	11.9	14.0	12.1	13.8	13.6

[1] Delfos 719 first entered tests 1932; **Acala 44-5, 1932**; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

When the data are examined over a period of time, however, both characters may be distinguished as varietal traits. For example, a seed weight of 12.5 grams and a lint index of 5.8 grams are fairly typical of Trice; of Half and Half, a seed weight of 10.5 grams and a lint index of 8 grams; of Acala 44, a seed weight of 12.0 grams and a lint index of 7.1 grams.

SIZE OF BOLL

Counting the number of bolls required to make a pound of seed cotton is the customary way of measuring their size. It is seen in table 10 that the size varies considerably with respect to any one variety. The variations, however, are not unusual, since the measurement is dependent upon the weight of seed cotton, which is affected by the amount of moisture under the local environment.

The dry season of 1930 caused the bolls of all varieties to be smaller than in other seasons. As a rule the bolls at Knoxville are larger than at Jackson, which is perhaps due to the more humid atmosphere in East Tennessee during the fall.

Table 10—*Size of boll, expressed in number of mature bolls required to make one pound of seed cotton*[1]

Variety	1928	1929	1930	1931	1932	1933	1934
	JACKSON						
	Bolls	Bolls	Bolls	Bolls	Bolls	Bolls	Bolls
Acala 44	80	71	82	68	76	66	79
Cleveland 884	87	66	92	71	79	75	84
D. P. L. 4-8	77	65	82	..	76	76	85
D. P. L. 10	..	..	..	78	79	80	89
Delfos 911	87	75	92	83	71	62	74
Express 7	95	78	92	80	84	..	..
Farm Relief, St. 1	..	..	..	64	75	67	71
Half and Half (Summerour)	75	66	78	62	..	..	..
Mexican Big Boll 6	72	67	78	..	..	..	..
Rowden 40	67	53	76	61	66	60	72
Stoneville 2	66	64	76	70	76	73	76
Trice 5	86	71	89	72	76	70	76
	MURFREESBORO						
Acala 44	79	70	87	76	76	..	..
Cleveland 884	70	70	90	74	75	..	..
D. P. L. 4-8	70	71	87	..	72	..	..
D. P. L. 10	..	..	..	77	75	..	..
Delfos 911	78	80	97	82	71	..	..
Express 7	80	85	92	83	82	..	..
Farm Relief, St. 1	..	..	..	65	75	..	..
Half and Half (Summerour)	66	68	82	67	..	..	..
Mexican Big Boll 6	76	69	74	..	..	..	..
Rowden 40	62	55	76	60	71	..	..
Stoneville 2	76	69	85	71	75	..	..
Trice 5	82	77	90	76	78	..	..
	KNOXVILLE						
Acala 44	75	64	77	70	74	65	71
Cleveland 884	77	64	80	72	78	76	74
D. P. L. 4-8	70	66	78	..	79	75	76
D. P. L. 10	..	..	..	80	85	82	76
Delfos 911	90	72	89	87	67	62	62
Express 7	91	80	91	75	84	..	..
Farm Relief, St. 1	..	..	..	62	75	66	69
Half and Half (Summerour)	70	64	76	72	..	..	..
Mexican Big Boll 6	79	63	70	..	..	..	..
Rowden 40	69	61	68	63	68	60	68
Stoneville 2	72	62	74	68	72	72	73
Trice 5	83	72	80	76	76	70	72

[1] Delfos 719 first entered tests 1932; Acala 44-5, 1932; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

This character, however, is typical of the variety. Express has, on an average, the smallest bolls, Rowden 40 and Delfos 719 the largest. The D. P. L. strains and Cleveland 884 have medium-small bolls, while Acala 44, Stoneville 2, and the later Trice strains have medium-large ones.

The cotton boll grows rapidly and reaches its maximum size in about 3 weeks. Fig. 2 shows the growth of the boll at 3-day intervals from the blossom to the age of 21 days, and the relative sizes may be seen as the boll becomes older. At the age of 27 days the size appears no larger than at 21 days. These bolls were obtained from 5 plants in a pure line of Trice. The plants were adjacent and within a space of 8 feet in the row.

The shape of the boll is also characteristic of the variety and less variable than the size. Thus far no methods have been suggested for measuring shape. Brown (2) classifies this character into 6 groups and illustrates them by drawings.

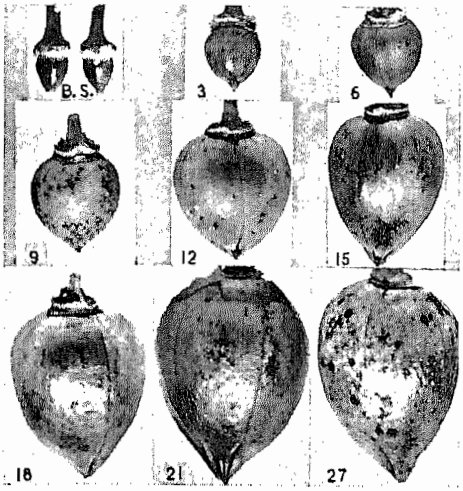


Fig. 2—The relative growth of the cotton boll from bloom to 27 days. "B.S." represents blossom stage; figures represent age of boll in days.

Table 11—*Value per acre for both lint and seed*[1]

Variety	1928	1929	1930	1931	1932	1933	1934
JACKSON							
Acala 44	$127	$139	$ 33	$ 39	$ 38	$ 68	$ 44
Cleveland 884	123	138	30	34	34	64	42
D. P. L. 4-8	125	153	32	....	37	71	48
D. P. L. 10	....	....	....	45	39	77	51
Delfos 911	131	125	25	38	45	73	55
Express 7	80	132	30	37	36	....	....
Farm Relief, St. 1	....	....	....	38	36	66	44
Half and Half (Summerour)	115	129	29	30	....	....	....
Mexican Big Boll 6	97	109	24	....	....	....	....
Rowden 40	122	84	32	34	37	64	50
Stoneville 2	112	156	30	46	43	73	53
Trice 5	88	110	26	34	33	58	43
MURFREESBORO							
Acala 44	$ 92	$ 75	$ 33	$ 23	$ 35	....	....
Cleveland 884	88	57	31	36	31	....	....
D. P. L. 4-8	132	84	35	....	32	....	....
D. P. L. 10	....	....	....	36	34	....	....
Delfos 911	139	63	31	28	32	....	....
Express 7	134	58	30	32	31	....	....
Farm Relief, St. 1	....	....	....	33	33	....	....
Half and Half (Summerour)	101	45	28	20	....	....	....
Mexican Big Boll 6	143	56	29	....	....	....	....
Rowden 40	93	49	29	36	30	....	....
Stoneville 2	125	81	34	32	34	....	....
Trice 5	108	57	26	23	30	....	....
KNOXVILLE							
Acala 44	$ 53	$ 55	$ 66	$ 44	$ 52	$ 72	$129
Cleveland 884	27	35	41	42	44	72	120
D. P. L. 4-8	20	39	58	....	49	77	143
D. P. L. 10	....	....	....	44	49	84	139
Delfos 911	36	49	49	42	56	76	163
Express 7	63	39	48	44	46	....	....
Farm Relief, St. 1	....	....	....	42	38	67	132
Half and Half (Summerour)	33	27	34	27	....	....	....
Mexican Big Boll 6	28	34	51	....	....	....	....
Rowden 40	18	21	45	38	43	65	127
Stoneville 2	22	61	54	51	53	73	158
Trice 5	43	61	62	34	41	65	126

[1] Delfos 719 first entered tests 1932; Acala 44-5, 1932; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

Round, blunt bolls are usually associated with short staple; and long, pointed ones with long staple. There are exceptions, however; the bolls of Farm Relief are fairly round and blunt, but the staple is 1 1/16 inches to 1⅛ inches. Delfos 719, with the same staple, has bolls far different from its parent, Delfos 6102, a type of long, pointed bolls.

MONEY VALUE

It is difficult to determine the true money value of a variety because of its varied characters and other economic factors. The data in table 11 should be considered in a relative way.

An early variety, like Trice, has the largest percentage of its cotton picked by the middle of October, and the premium on improved grades might offset its lower yields. The premiums on different lengths vary considerably. In 1928 and 1929 a 1 1/16-inch cotton brought from $7.00 to $10.00 more per bale than a ⅞-inch one, whereas in 1932 and 1933 the premium had narrowed from $3.00 to $5.00. Recently the value of the seed has increased out of all proportion to what it was formerly, and a variety may offset its low lint percentage by the weight of its

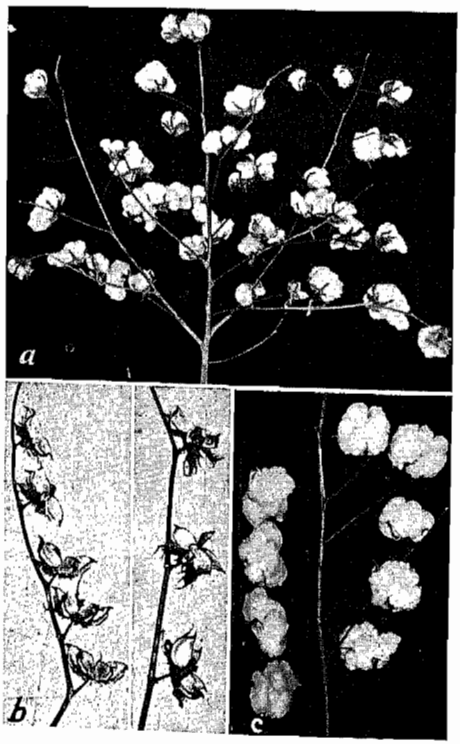


Fig. 3—Types of plant growth: (a) Spreading, prolific; (b) left, prolific fruiting limb, characteristic of eastern varieties; right, non-prolific fruiting limb, characteristic of western varieties; (c) vegetative limb showing numerous bolls on secondary fruiting limbs.

seed. Finally, the classer has no method of measuring uniformity, strength, and other characters in which the variety may be superior, and consequently no values are given because they are not recognized by the market.

It will be seen in the table that the range in the values of the different varieties was very large during the period of high prices, in 1928 and 1929. Since that time, a period of low prices has continued, and the spread between the values is less significant. Stoneville 2, the D. P. L. strains, and Delfos 719 rank high in money value almost every year.

TYPE OF PLANT GROWTH

The type of growth a variety makes is influenced by soil fertility, distance between plants, and the season. Under normal conditions, however, this character is typical of the variety, as seen in table 12.

A spreading, prolific type—Stoneville 2—is seen in Fig. 3, a.

Prolificacy is well illustrated in Fig. 3, b. The fruiting limb on the left is shorter than the one on the right and the bolls are closer together. In a spreading, prolific plant the vegetative limbs also contribute a large percentage of the bolls. In Fig. 3, c, the limb on the right is a vegetative one, and the numerous bolls on the secondary fruiting limbs will add appreciably to the yield of this plant.

Table 12—*Type of plant growth and its relation to yield—Mebane Triumph, western-grown; Stoneville 2, eastern-grown*

KNOXVILLE

Variety	Year	Yield per acre	Bolls per plant	Height of plant	Vegetative branches per plant	Fruiting branches per plant	Per cent bolls on vegetative branches	Per cent bolls on fruiting branches	Distance per boll on vegetative branches	Distance per boll on fruiting branches	Plants per acre
				Inches					Inches	Inches	
Mebane Triumph	1931	1481	7.10	34.15	.43	8.96	5.82	94.18	23.5	12.14	11,200
Stoneville 2		1983	13.61	37.20	1.67	9.44	24.90	75.10	11.9	9.37	11,800
Mebane Triumph	1932	1837	6.95	35.9	.62	11.90	5.56	94.44	30.8	11.99	13,800
Stoneville 2		2310	12.90	36.9	1.46	12.50	16.75	83.25	14.6	8.70	13,640
Mebane Triumph	1933	1665	8.52	40.4	.63	15.1	2.95	97.05	49.40	12.9	12,480
Stoneville 2		2167	15.53	38.8	2.08	13.9	22.24	77.76	13.09	9.01	12,240
3-year average											
Mebane Triumph		1661	7.52	36.81	.53	11.98	4.78	95.22	34.56	12.34	12,493
Stoneville 2		2154	14.01	37.63	1.74	11.94	21.30	78.70	13.20	9.02	12,560

PROLIFICACY

The non-prolific western varieties were never superior yielders in the trials, but their quality and percentage of lint are high. It is true that all of them are late-maturing, but this would not account entirely for their low yields.

A variety typical of each section was chosen—Stoneville 2 the eastern,

and Mebane Triumph the western. They were repeated 8 times in 3-row plots. Each season after the last picking, 225 plants were taken at random from the middle rows of each variety and measured. The pickings were done carefully, and broken limbs or missing burs do not enter as serious errors.

In table 12 it is seen that the yields of Stoneville 2 are consistently around 500 pounds more than those of Mebane Triumph, although the stand, height of plants, and fruiting branches per plant are practically the same for the two varieties.

Stoneville 2 has almost twice as many bolls per plant, 3 times as many vegetative branches, and 7 times as many bolls on the vegetative branches. The distance between the bolls on both the fruiting and vegetative limbs of Stoneville 2 is decidedly shorter than on those of Mebane Triumph. The bolls of Mebane Triumph are larger, but this does not offset its non-prolificacy. Prolificacy is generally characteristic of eastern varieties and makes it possible for more bolls per plant to be set. Buie (5) has published data on the growth habits of the cotton plants.

SHEDDING

In the trials, some of the Trice strains were just as prolific and had as large bolls as Stoneville 2 and D. P. L. 4-8, but the latter varieties continued to make more seed cotton. Observations of Kearney and Peebles (13) suggested to the author that Trice might be shedding excessive numbers of its blooms and bolls. Daily blooming counts were recorded on each variety, and after the cotton had been gathered, counts were made of the picked bolls, or burs. The difference between the blooms and the picked bolls is the number or per cent shedded. The data do not include the small squares that never reached the flowering stage. Each variety is repeated 8 times and the average plot

Table 13—*The shedding of blooms, and its relation to yield of seed cotton—average plot*

Variety	Year	JACKSON			KNOXVILLE		
		Blooms	Shedding	Yield	Blooms	Shedding	Yield
			Per cent	Pounds		Per cent	Pounds
Rowden Texas	1931	752	51.6	5.18	755	52.1	6.12
Stoneville 2		1304	53.3	6.62	1295	48.3	8.35
D. P. L. 4-8		1441	54.3	6.68	1228	45.7	8.60
Trice 84-1		1620	64.2	6.08	1469	56.6	8.01
Mebane Triumph	1932	839	52.9	6.31	601	27.3	8.35
Stoneville 2		1265	46.4	7.11	1238	36.6	10.50
D. P. L. 4-8		1334	47.7	6.96	1172	34.5	10.03
Trice 84-1		1344	59.1	6.12	1304	51.2	8.88
Mebane Triumph	1933	860	54.1	5.96	721	44.3	6.94
Stoneville 2		1374	48.4	7.89	1300	46.2	9.03
D. P. L. 4-8		1230	47.5	7.06	1337	46.5	8.63
Trice 84-1		1502	63.9	6.34	1492	60.5	7.98
3-year average		1247	53.6	6.52	1159	45.8	8.45

is given in table 13. The Trice strain has the highest percentage of shedding during each of the 3 years at each station—about 14 per cent higher than either D. P. L. 4-8 or Stoneville 2. Trice also has a larger number of blooms, and its prolificacy may account in part for the

shedding; but the western varieties, with their small number of blooms, have high shedding percentages in 4 of the 6 trials.

The lower shedding percentages of D. P. L. 4-8 and Stoneville 2 all three years at each station may be partly responsible for their high yields. There is strong evidence in this table that shedding is typical of some strains, although subject to environmental influences like other characters.

FINAL RANK OF THE VARIETIES

It would be very difficult to measure plant type and shedding on all the varieties. Table 14 is constructed from the data in tables 3 to 11.

Table 14—*Percentage of times each variety ranked among the first four, over a 7-year period, at Jackson and Knoxville, and a 5-year period at Murfreesboro*[1]

Variety	Average no. times in trial	Yield seed cotton	Yield lint cotton	Money value	Length of lint	Earliness	Lint per cent	Size of boll	Size of seed	Lint index
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Acala 44	19	63.1	73.6	73.7	31.5	100.0	94.7	47.3	42.1	68.4
Cleveland 884	19	21.0	5.1	21.0	78.9	00.0	21.1	15.8	00.0	52.6
D. P. L. 4-8	16	43.8	81.2	75.0	25.0	00.0	93.7	25.0	93.7	43.7
D. P. L. 10	10	70.0	90.0	100.0	20.0	00.0	60.0	00.0	80.0	10.0
Delfos 911	19	78.9	42.1	63.2	100.0	66.6	21.1	31.6	63.1	15.7
Express 7	15	26.7	6.6	26.6	100.0	75.0	00.0	00.0	53.3	00.0
Farm Relief, St. 1	10	00.0	10.0	30.0	80.0	00.0	50.0	80.0	00.0	90.0
Half and Half	12	16.6	66.6	00.0	00.0	00.0	100.0	83.3	91 6	t00.0
Mexican Big Boll 6	9	11.1	22.2	11.1	22.2	00.0	00.0	66.6	00.0	33.3
Rowden 40	19	31.6	21.0	21.0	42.1	8.3	00.0	100.0	00.0	94.7
Stoneville 2	19	78.9	84.2	73.6	78.9	91.6	63.1	68.4	78.9	00.0
Trice 5	19	15.8	10.5	15.8	52.6	100.0	00.0	10.5	10.5	00.0

[1] Delfos 719 first entered tests 1932; Acala 44-5, 1932; Trice 5-42, 1932; Cleveland 884-St. 4, 1931.

In these tables no variety is found to be superior in all the characters. Half and Half is first in lint percentage but last in lint quality; Trice is first in earliness but very low in lint percentage; Cleveland has high lint quality but is late; Farm Relief is superior in lint index, but a poor yielder of seed cotton.

The matter is complicated further by the action of environment upon these characters. In 1929, at Jackson, Stoneville 2 leads in yield of seed cotton, but in 1928 is sixth; in 1933, D. P. L. 4-8 had 43.6 per cent of its cotton open at Jackson but only 18.4 per cent at Knoxville; at Jackson, 67 bolls of Rowden 40 were required for a pound of cotton in 1929, and 76 in 1930; the staple length of Cleveland 884 at Jackson was $^{34}/_{32}$ inch in 1931 and $^{30}/_{32}$ inch in 1930.

The comparative values of these varieties are made clearer in table 14. Each variety was given a place every time it ranked among the first 4 in any character. For instance, Acala 44 appears 12 times out of 19 in yield, or 63.1 per cent of the times it was in the trials; Mexican Big Boll, one time out of 9, or 11.1 per cent; Stoneville 2, 15 out of 19 times, or 78.9 per cent.

The strength of the variety in any character may be readily seen upon further examination of this table. Half and Half does not have a place at all in money value, length of lint, or earliness, and 8 out of 12

times, or 66.6 per cent, in yield of lint. Express fails in lint percentage, in lint index, and in size of boll. Trice, is not given a place in lint percentage or lint index and only 3 times out of 19, or 15.8 per cent, in yield; Rowden 40 fails in lint percentage, Cleveland and the D. P. L. strains in earliness, and Stoneville 2 in lint index. Later strains of Acala 44 and Delfos gave these varieties a place in all the characters.

It is emphasized that the basis for choosing a variety is the average it makes in all these characters. Stoneville 2, the D. P. L. strains, Delfos 719, and Acala 44-5 placed well in most of them and are recommended at this time. Some recent strains of Trice may be used in the extreme northern sections of the State, but at present, seed of these Trice strains, as well as Acala 44-5, are not available.

The D. P. L. strains are better adapted to soils of poor fertility, Stoneville 2 to the soils of medium fertility, and Delfos 719 to the richer uplands and bottom lands.

D. P. L. 4-8 and D. P. L. 10 have been discontinued by the breeders. D. P. L. 11A is the strain recommended at the present time. It has a very high lint percentage—around 41 per cent—and is an inch in staple. This strain, however, has smaller bolls and is harder to pick than either D. P. L. 4-8 or D. P. L. 10.

There are a number of strains of Stoneville. No. 2, No. 3, No. 5, and the new Stoneville 2A strain, are all adapted to Tennessee conditions, and there is very little difference in these strains. Stoneville 2A is more compact and somewhat earlier than the others.

Delfos 719 is so different from other Delfos strains that it might well be taken for another variety. The bolls are large, very similar to those of Rowden. The lint percentage is considerably higher than that of other Delfos strains—around 36 per cent—and the staple averages 1 $\frac{1}{16}$ inches.

SOME FACTORS ASSOCIATED WITH EARLINESS

It is shown in table 13 that because of shedding, blooming records are not always an accurate index of the yield. They do indicate, however, the time when the plant is most active in its effort to put on bolls and whether or not these time periods vary much from season to season.

BLOOMING RECORDS

A test of these periods for different varieties was located within a short distance of the varietal trials and planted at the same time. Daily blooming records were kept on each of 8 plots representing a variety. The average total number is divided by the average number for the given time interval, and expressed in percentage. For instance, at Jackson, in 1928, the average number of total blooms of the early variety was 1751; the average number to July 21 was 117, or 6.67 per cent; the average number from July 22 to August 23 was 1,620, or 92.51 per cent; after August 24 there was an average of 14 blooms, or 0.79 per cent. At Knoxville, in 1928 and 1929, the plantings were so late that the records for these years are not included in the final averages.

Table 15 shows very clearly that the most active blooming period

Table 15—*Blooming, and its relation to earliness*

Percentage of blooms for each time interval

Varietal group[1]	Year	JACKSON			KNOXVILLE		
		To July 21	July 22 to August 23	August 24 through September	To July 21	July 22 to August 23	August 24 through September
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Early	1928	6.67	92.55	0.79	0.00	31.20	68.80
Mid-early		3.99	92.19	3.82	0.00	19.18	80.82
Late		0.77	97.27	1.96	0.00	9.15	90.85
Early	1929	16.70	80.30	3.00	0.00	54.36	45.64
Mid-early		17.29	80.90	1.81	0.00	29.53	70.47
Late		4.01	78.04	17.95	0.00	34.59	65.41
Early	1930	25.19	73.94	0.87	6.54	91.92	1.54
Mid-early		15.89	83.04	1.07	2.47	96.35	1.18
Late		9.88	88.55	1.57	2.88	92.98	4.14
Early	1931	11.93	83.24	4.83	6.11	90.35	3.54
Mid-early		10.54	83.22	6.24	2.20	91.88	5.92
Late		2.12	80.83	17.05	1.85	89.01	9.14
Early	1932	10.69	88.79	0.52	11.53	85.08	3.39
Mid-early		5.92	88.21	5.87	8.71	87.07	4.22
Late		7.98	90.02	2.00	7.43	85.09	7.48
Early	1933	24.03	66.17	9.80	0.33	73.22	7.45
Mid-early		21.37	69.98	8.65	7.91	67.77	24.32
Late		11.87	70.55	17.58	7.75	60.79	31.46
6-year average					4-year avg.		
Early		15.86	80.83	3.31	8.38	85.14	6.48
Mid-early		12.50	82.92	4.58	5.32	85.76	8.92
Late		6.10	84.21	9.69	4.18	81.96	13.86

[1] The varieties used were: Early group, Trice; mid-early, Stoneville 2; late, Texas Rowden and Wilds 2.

for all the varieties is from July 22 to August 23, and this is true at both Knoxville and Jackson. A little more than 80 per cent of the blooming takes place during this time.

In the period to July 21 the mid-early variety, Stoneville 2, blooms nearly as much as Trice, the early one; both average around 14 per cent at Jackson and 7 per cent at Knoxville. This may account in part for more cotton being open at the first picking at Jackson. The late varieties have about the same percentage of blooms at both stations during this period, or around 5 per cent.

After August 23 the early and mid-early varieties do very little blooming, averaging about 4 per cent at Jackson and 7 per cent at Knoxville, while the late varieties average around 10 per cent at Jackson and 15 per cent at Knoxville. When the different seasons are compared, however, it is found that the late varieties bloomed appreciably, after August 23, only 3 years out of 6 at Jackson and one year out of 4 at Knoxville. The late varieties appear to catch up in their blooming by August 23.

The late planting and unfavorable weather at Knoxville in 1928 and 1929 caused all the varieties to delay most of their blooming until after August 23, whereas, in the dry season of 1930 scarcely any blooming took place at either station after this date.

The period from July 22 to August 23 is highly critical for cotton in

Tennessee, and weather conditions during this time may be a large factor in the crop production.

BOLL MATURITY

In table 15 it is shown that early blooming of the variety is a factor in its early maturity; but the period of time through which the boll grows to maturity may be another factor. Ewing (9) and other workers have pointed out that the later bolls take longer to mature.

Each period in table 16 is the average of the data on 125 bolls taken

Table 16—*Boll maturity and its relation to earliness*[1]

Year	Date of early flowers	Days of maturity			Date of late flowers	Days of maturity		
		Early	Mid-early	Late		Early	Mid-early	Late
JACKSON								
1929	July 13–18	48	50	56	August 9–15	56	60	63
1930	July 13–18	42	45	52	August 9–15	51	52	57
1931	July 13–18	51	52	56	August 9–15	56	57	60
1932	July 13–18	45	45	53	August 9–15	55	55	62
1933	July 13–18	49	50	55	August 9–15	54	56	61
5-year average		47	49	54		54	56	60
KNOXVILLE								
1929	July 25–31	62	62	64	August 9–15	65	66	70
1930	July 15–20	49	50	56	August 9–15	62	64	68
1931	July 15–20	54	56	58	August 9–15	55	59	61
1932	July 15–20	50	50	54	August 9–15	63	65	72
1933	July 15–20	53	54	59	August 9–15	60	63	68
4-year average		51	53	56		59	62	65

[1] The varieties used were: Early group, Trice; mid-early, Stoneville 2; late, Texas Rowden and Wilds 2.

at random from stalks of each variety. The blooming date was written at the time of tagging, and the opening date when the 4 or 5 divisions, or sutures, of the boll cracked open. The period of time from cracking to an open, fluffy boll varies from 3 to 10 days, depending upon the weather, and might add a serious error if considered a part of the main period.

It is seen that bolls from the early flowers of all varieties matured sooner in all the 5 years at both stations. The differences in maturity are less some seasons than others, averaging from 6 to 9 days.

There is practically no difference in the boll maturity of the early and mid-early varieties for a given period, but the late varieties are always longer in opening. For instance, at Jackson in 1929 bolls of the early varieties opened within from 48 to 56 days, while those of the late ones required from 56 to 63 days.

The early periods at the two stations cannot be compared, but the late periods are the same; and the days of maturity are consistently more at Knoxville than at Jackson.

There is not much variation from year to year for a given period and variety, except at Jackson in 1930, which was abnormally dry. The variation is one that becomes progressively wider as the maturity extends through the season, and it is difficult to assign any single factor as the cause of these differences. On an average it takes from 48 to 53

days for bolls of the early flowers to mature and from 54 to 64 days for bolls of the late flowers.

SOME ENVIRONMENTAL INFLUENCES

First picking compared with fourth picking at Knoxville.—It is contended that the lint from the first picking is always shorter than that

Table 17—*Length of lint, lint percentage, seed weight, and lint index of first picking compared with those of fourth picking—at Knoxville*

1933

Variety	Length of lint		Lint per cent		Seed weight		Lint index	
	Sept. 13 1st pkg.	Oct. 27 4th pkg.	Sept. 13 1st pkg.	Oct. 27 4th pkg.	Sept. 13 1st pkg.	Oct. 27 4th pkg.	Sept. 13 1st pkg.	Oct. 27 4th pkg.
	32nds in.	32nds in.						
Acala 44-5	34	34	39.5	41.2	13.3	10.1	8.81	6.95
Cleveland 884-St. 4	35	33	36.9	41.1	13.7	10.0	8.22	6.95
D. P. L. 4-8	34	33	39.8	42.0	11.3	9.5	7.68	6.88
D. P. L. 10	34	32	37.9	39.5	12.0	9.8	7.35	6.52
Delfos 719	35	35	38.2	38.3	13.3	11.0	8.28	6.85
Farm Relief-St. 1	35	35	37.0	37.7	15.4	12.7	9.10	7.97
Rowden 40	34	33	35.2	35.4	15.8	13.2	8.61	7.13
Stoneville 2	34	33	36.4	38.1	12.0	9.6	6.90	5.82
Trice 5-42	34	34	34.3	34.6	13.9	11.5	7.21	6.04
Average	34.3	33.5	37.2	38.6	13.3	10.8	8.01	6.80

1934

	Sept. 18	Nov. 8	Sept. 18	Nov. 8	Sept. 18	Nov. 8	Sept. 18	Nov. 8
Acala 44-5	32	32	35.1	39.2	12.7	9.8	7.00	6.39
Cleveland 884-St. 4	34	34	34.2	36.0	15.1	9.0	7.72	5.06
D. P. L. 4-8	33	32	36.4	41.5	12.0	10.2	6.90	7.05
D. P. L. 10	34	32	34.9	40.0	12.9	10.0	7.00	6.67
Delfos 719	34	34	37.2	38.1	13.3	9.5	7.93	5.82
Farm Relief-St. 1	34	34	36.6	36.7	15.1	9.2	8.61	5.14
Rowden 40	33	33	33.0	35.4	14.4	8.8	7.13	4.93
Stoneville 2	34	33	34.4	37.6	12.0	9.4	6.31	5.70
Trice 5-42	34	33	31.8	34.5	13.6	8.6	6.35	4.45
Average	33.5	33.0	34.8	37.6	13.4	9.4	7.21	5.69

from the last picking. In table 17 the seasons of 1933 and 1934 at Knoxville were chosen because the time between the first and last pickings is around one and one-half months, and the plants had ample opportunity to express variations in their characters.

It will be seen that the classer gave a difference over $\frac{1}{32}$ inch in only 2 samples out of 9 in 1933 and 1 out of 9 in 1934. The average length, however, is shorter for the fourth picking both years.

The differences in the other characters—lint percentage, seed weight, and lint index—are more significant. The lint percentage is higher for the fourth picking both years, and the individual samples are uniformly higher; both seed weight and lint index are lower.

SOILS AND FERTILIZERS

Many trials have been conducted to determine whether or not the kinds of fertilizer and soil affect the length of lint and other qualities. Experiment station results in Texas, Arkansas, and Alabama were negative—the length of lint was not influenced by type of soil or kind of fertilizer. In this respect Sturkie's (19) results at Auburn are inter-

esting. He brought soil from the Mississippi Delta and for 5 years compared the staple length of plants grown on it with those on the poorer Auburn soil, and found no significant differences in the length of lint. Barre, Armstrong, and Bennett (3) have shown that soil moisture does have an effect upon the length of lint, and our results of 1930 are in agreement with them.

REGIONAL

The length of lint in 1930, a very dry season, is less than in any other year, as shown in table 5. However, a difference of more than $\frac{1}{32}$ inch is obtained in only one year out of 7 when the stations are compared with each other. A greater variation than this would be expected, since the yields are very different in every year except 1933. The lint at Knoxville is slightly longer than at Jackson every year except 1933, and it may be that small regional differences in the length of lint are present in the State. Pope (17) found that length of lint varied in the different regions of Arkansas.

THE COTTON FLOWER AND ITS RELATION TO VARIETAL PURITY

The construction of the flower shows that cotton is largely a self-fertilized plant, but that cross-pollination may take place.

PARTS OF THE COTTON FLOWER [1]

The flower has its origin in the axil of the leaf, and first appears to the eye as a small bud surrounded by the 3 bracts which subtended it. In this stage the structure is generally called the "square," and in about 21 days it has grown and developed into the flowering bud seen in Fig. 4, a.

The parts of the cotton flower in Fig. 4, b, are the same as those of many seed plants. First, there are the 3 bracts which have been the shelter of the young bud and now remain as the involucre of the flower. They are said to have the function of the leaf in supplying food to the young boll. Next, is the small green ring, the calyx. It is composed of the 5 more or less well-defined lobes called the sepals; then the whorl of 5 white, showy petals, which are united at the base to form the corolla; and finally, inside the corolla and attached to its base are the numerous stamens. These are the pollen-bearing organs; and their stalks are joined in a tube around the pistil, which is the ovule-bearing organ. The stamens and pistil represent the reproductive parts of the flower.

In Fig. 4, c, the stamen is observed to be composed of a stalk-like structure, the filament, on which rests an enlarged part, the anther, giving it the appearance of a club. Inside the anther are the pollen grains, which are the true male-bearing structures. When the flower first opens, the anthers are closed; later there is a division along the center, they burst open, or dehisce, and free the pollen grains.

There are hundreds of these grains in each anther, and in Fig. 4, d, an individual pollen grain is seen. In this drawing the pollen grain

[1] These drawings of cotton flower were made by Miss Alice Caton.

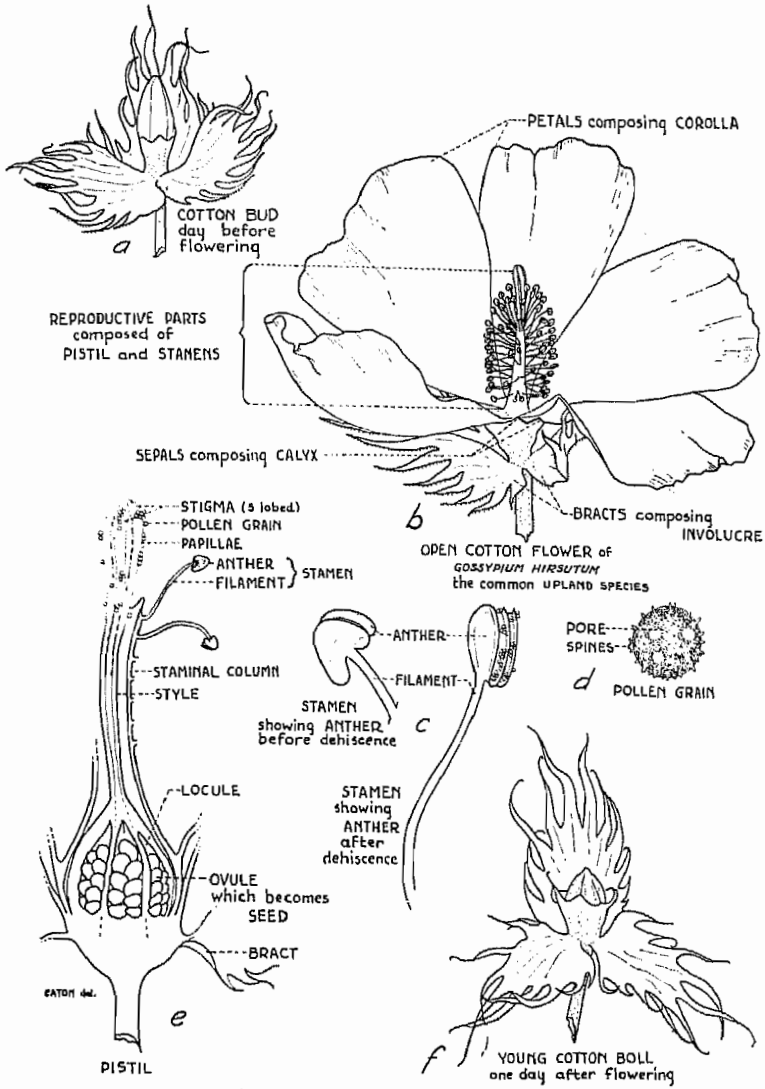


Fig. 4—Parts of the cotton flower.

is considerably magnified. When observed through the microscope the grains are spherical, with small spine-like structures over the outer surface, which enable them to remain attached to the stigma; also there are the pores, through which the pollen tubes protrude when the grain germinates. Some pollen grains which were germinated artificially[1] are shown in the photomicrograph (Fig. 5). One or more tubes may

[1] In studies by Shuey and Hancock, a medium of 1.5 per cent agar, 30 per cent sucrose, and 10.5 pH gave optimum conditions for pollen germination at 73° F. temperature.

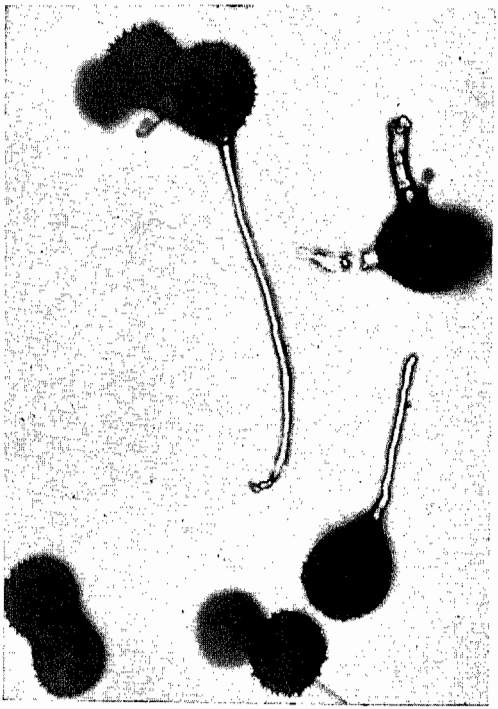


Fig. 5—Photomicrograph showing germination of pollen grains. X 100

push out from one grain, and the tubes may branch as they extend in their growth.

The pistil may be said to be composed of 3 parts. A longitudinal section is shown in Fig. 4, e. First, there is the stigma, which is slightly grooved, or lobed, and there are as many lobes as carpels, or cavities, in the ovary. The surface of the stigma is covered with small hair-like protuberances, the papillae, to which the pollen grains adhere. Next is the style, or channel, through which the pollen tubes grow from the stigma to the chambers of the ovary.

Finally, there is the ovary, which is divided into chambers, the locules, or locks of the boll. In each locule are found the ovules, which contain the egg cells. The pollen tube containing the male cell grows toward the ovule, finally entering it, and the egg cell is fertilized. The ovule continues its growth and becomes the mature seed. The ovary is now the young boll seen in Fig. 4, f, having 4 to 5 locks (in the upland varieties) and normally around 8 seed to each lock.

Thus it is seen that the parts of the flower perform certain functions. The pollen grain must rest upon the stigma and germinate. The showy petals attract insects, which carry the pollen grains to the stigma. The pollen tubes containing the male cell must travel down the style until they enter the ovules in the cavities of the ovary. Fertilization has now

taken place, and growth continues until the ovule becomes the mature seed and the ovary the mature boll.

FERTILIZATION

The pollen tubes grow very rapidly toward the egg cells. In 1934, at Knoxville, flowers of Trice 25-1-45 were emasculated and self-pollinated at 8 o'clock each morning from July 18 to July 28. At 2 o'clock and 6 o'clock of the same day, or 6 to 10 hours after pollination, the styles were cut off the ovary; a total of 75 flowers being treated at each hour. No bolls were set when the styles were cut at 2 o'clock, but at 6 o'clock, or 10 hours after pollination, 58 out of 75 flowers set bolls which matured.

Measurements were taken of the styles on 169 flowers of this strain, and the average was 2.3 centimeters. Therefore, the tubes had traveled this distance in 10 hours. It should be added that optimum growing conditions were had during this time.

POLLINATION

The stamens bearing the pollen are grouped around the pistil, as shown in Fig. 4, b, so that a cotton flower is given ample opportunity to receive its own pollen. Hence, cotton is spoken of as largely a self-fertilized plant.

The cotton flowers, however, being very showy and well supplied with nectar, attract many kinds of insects, and the pollen grains are small and light and may be carried by the winds, so that cross-pollination will take place.

Brown (2) and others have tested the amount of cross-pollination, by planting green-leaf and red-leaf varieties at different distances apart. Where the rows of these varieties were adjacent, there was from 1.6 to 14.7 per cent crossing, but where individual plants of one variety were surrounded by plants of the other, more than 50 per cent of the seed were crossed.

It is this latter condition that is found in the grower's field when custom ginning is used in saving the planting seed. At the custom gin, seed of another variety becomes mixed with the pure seed; later, plants of the foreign variety are seen scattered through the field, and a large amount of cross-pollination is the result. The grower should plant only one variety on a given farm and make every effort to gin it in such a manner that no seed mixing is possible.

SEED STRUCTURE AND ITS RELATION TO THE LINT AND BY-PRODUCTS

There are few plants whose commercial value depends upon their seed as much as those of cotton, so that the structure and growth of the young seed is important. Shortly after fertilization of the egg cell, other cells surrounding it begin to divide and multiply. These cellular structures are called the integments, endosperm, and embryo. The integments form the outer seed coats of the mature seed, while nearly all the endosperm is absorbed by the embryo and only a thin papery membrane

remains to represent it. The embryo grows into broad, thin sheets, which are folded and fill almost all the space within the seed coats, and are termed the meats, or kernels, of the seed. Numerous oil glands are found in the embryo, from which cottonseed oil is extracted.

ORIGIN OF LINT HAIRS

The cotton fibers, or lint hairs, and the short, fuzzy hairs originate in the cells just beneath the surface of the seed coat. Each hair is merely an outgrowth of the cell, the nucleus and protoplasm moving with the protrusion, which continues until its length is reached. A photomicrograph of live cotton hairs is seen in Fig. 6. The live cotton

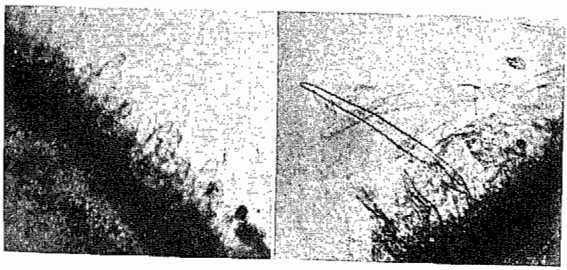


Fig. 6—Photomicrograph showing the lint hairs bulging outward: left, one day after blooming; right, three days after blooming.

X 90

hairs appear as elongated, rod-like, one-celled structures. Farr (10) and other workers have shown that cells continue to initiate lint hairs over the surface of the seed for a period of time after fertilization; in fact, they appear as short protrusions on the ovule before the egg cell is fertilized. While the lint-hair cell is elongating, its walls are being built of layers of cellulose, but the chemical and physical structure is not fully understood as yet. When the boll opens, the lint hairs dry out, are dead, and when magnified have the appearance of a ribbon or flat fire hose, and are commonly known as the cotton lint.

BY-PRODUCTS OF THE COTTON SEED

Formerly, after separation of the lint, the cotton seed were burned or thrown into creeks and bayous. Now the oil, meal, linters, and hulls have attained commercial uses, and a great industry has been built upon them.

GRADE AND ANALYSIS OF COTTON SEED

Seed were once traded on the "as is" basis; they were cut open and judged or graded by the color of the meats or kernels. In 1932 a new method of grading was inaugurated and a basis grade given for prime cotton seed. Premiums and discounts are calculated for those analyses above and below basis grade. Sometimes the meal in combination with other elements is used for fertilizer. The feeding analysis of prime cottonseed meal is 92.2 per cent total dry matter, 33.4 per cent

crude protein, 24.3 per cent carbohydrates, 7.9 per cent fat.[1] The meal is high in all three digestible nutrients. The moisture content of cotton seed largely governs its quality, and precaution should be practiced in the storage of the seed as well as in picking before the cotton is dried out.

FIBER PROPERTIES

Investigations have proceeded from the growth of the fibers to their chemical and physical properties. Over 25 different physical properties of the fiber have been investigated, but their value to the spinner needs further study, and rapid methods of measuring them must be developed before an extended program on lint quality is undertaken.

Length of lint, or staple; and color and freedom from trash, or grade, are measured by the classer. Strength, maturity, and the distribution of the fiber lengths constitute other known valuable characters of the lint. A number of methods for measuring the fiber distribution have been developed.

FIBER DISTRIBUTION AROUND THE SEED

It has been stated that the fibers are elongated, one-celled structures which grow out over the surface of the seed. The number of fibers on a seed range around 10,000 or 15,000, depending upon its size and the thickness of their distribution. Table 18 represents a sample of fibers taken

Table 18—*Distribution of cotton fibers around the seed—Knoxville, 1934*

Length interval	Wilds 2	Cleveland	D. P. L. 10	Stoneville 2	Trice 90-1	Half and Half
mm	No. of fibers	No. of fibers	No. of fibers	No. of fibers	No. of fibers	No. of fibers
6-10	6	49	14	24	29	37
10-12	14	49	22	15	31	29
12-14	28	47	19	23	63	54
14-16	30	52	19	35	87	75
16-18	36	89	40	37	100	154
18-20	49	126	79	35	145	380
20-22	79	213	137	88	255	1079
22-24	112	302	196	145	368	1189
24-26	148	349	286	205	550	638
26-28	289	284	399	613	790	166
28-30	477	227	471	943	675	21
30-32	778	197	352	1046	357	0
32-34	950	158	130	552	114	0
34-36	904	112	17	194	126	0
36-38	503	43	3	35	4	0
38-40	224	11	1	5	0	0
40-42	89	9	0	1	0	0
42-48	36	4	0	0	0	0
Total	4752	2321	2185	4086	3584	3822
Weighted mean	31.9	25.1	27.3	28.8	25.2	21.8

from around one seed of each variety. Each fiber was spread out on a black velvet cloth and measured in millimeters. Then the total number coming within a certain class length was placed opposite it. For instance, under Wilds, 6 fibers were found to be from 6 to 10 millimeters long; 14 fibers, 10 to 12 millimeters long; 28 fibers, 12 to 14 millimeters

[1] Taken from "Feeds and Feeding," Henry and Morrison.

long. These 6 varieties are chosen as a fair example of over 100 similar distributions on 10 different varieties.

It is interesting to note the wide range in the length of fibers on one seed. One inch is 25.4 millimeters. The fibers on a seed of Wilds are from ¼ to 1¾ inches long; Stoneville 2, from ¼ to 1½; Half and Half, from ¼ to 1 1/16.

Further examination of this table discloses the fact that a large number of fibers fall within one or two classes. Wilds has a large number between 32 and 36 millimeters; Cleveland, between 22 and 26; D. P. L. 10, Stoneville 2, and Trice 90-1, between 26 and 30; Half and Half, between 20 and 24. These are the modal lengths.

The weighted mean, or average, is given at the bottom, and this measure shows that two varieties may have different modal lengths and still have the same average length, as Cleveland and Trice.

It is known, also, that fibers not only have a wide distribution of lengths but tend to be shorter around the apex than at the base or sides of the seed.

HALO DISTRIBUTIONS

Sometimes the grower may obtain a fairly accurate picture of the length by combing the fibers out around the seed, as illustrated in Fig. 7.

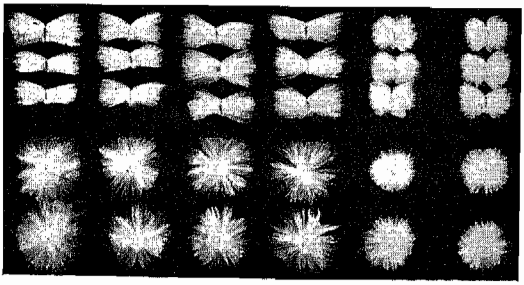


Fig. 7—The lint hairs, or fibers, are combed out around the seed, giving the appearance of a halo. Half and Half, at extreme right, is seen to be much shorter than the Delfos strains.

This method is a good one to detect very short-fibered seeds or plants within the variety.

LINT DISTRIBUTION, SUTER-WEBB SORTER

Within the last few years mechanical combing instruments, called sorters, have been developed for measuring distribution of the fiber lengths in the ginned lint. Many types are on the market. The Suter-Webb sorter is used in the Station laboratory, and the results in table 19 were obtained with this instrument.

Small samples of lint are taken at random from the large mass and thoroughly mixed. The mixed sample is dried for an hour in an electric oven and 75 milligrams weighed out as the sample for the sorter.

The rows of fine combs are spaced ⅛ inch apart; the sample is pulled

Table 19—*Lengths of lint of varieties, in percentage, by weight, combed on Suter-Webb sorter*

Variety	Station[1]	10-8 and above 9-8	9-8 and above 8-8	8-8 and above 7-8	7-8 and above 6-8	6-8 and above 5-8	5-8 and above 4-8	4-8 and above 3-8	3-8 and all short lengths	Staple—in 32ds of an inch
		1932								
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	
Acala 44-5	J	2.26	11.82	17.40	22.70	19.48	8.56	0.15	11.63	31
	M	0.28	3.10	18.33	18.26	23.28	13.52	8.21	15.02	33
	K	0.68	8.29	23.66	23.98	17.44	8.52	6.08	11.35	33
Cleveland 884-St. 4	J	3.40	14.62	24.39	17.20	12.04	9.52	7.17	11.00	33
	M	....	2.28	16.39	19.36	20.34	12.45	9.45	19.73	32
	K	4.54	11.43	19.75	23.14	16.40	7.51	4.58	12.65	35
Delfos 719	J	6.73	14.29	17.22	15.20	13.90	10.28	7.48	14.90	36
	M	1.46	9.66	21.72	21.43	13.80	8.70	7.68	15.46	34
	K	2.68	13.87	19.84	22.12	12.75	10.66	5.70	12.38	37
D. P. L. 4-8	J	0.93	8.76	19.30	24.02	16.34	8.50	7.31	14.75	32
	M	....	5.48	15.54	22.98	19.65	12.12	7.78	16.45	31
	K	1.06	8.08	18.30	22.53	22.16	10.75	5.17	11.95	32
D. P. L. 10	J	3.76	12.78	22.90	21.56	13.23	7.85	6.67	11.25	32
	M	....	2.54	14.35	25.70	18.20	13.95	7.89	17.37	32
	K	2.67	5.60	21.94	20.64	17.84	11.51	7.00	12.80	33
Express 8	J	7.80	12.80	19.00	14.74	14.40	7.68	6.34	17.24	37
	M	0.30	9.32	21.48	17.00	17.80	10.96	8.36	14.78	35
	K	5.26	13.94	20.80	16.10	12.53	9.61	7.00	14.76	37
Farm Relief	J	2.00	12.92	18.24	19.04	15.58	8.26	7.45	16.51	34
	M	0.42	5.26	16.54	22.15	21.07	12.05	8.05	14.46	34
	K	4.91	15.18	22.20	14.90	13.65	8.08	5.74	15.34	34
Rowden 40	J	....	3.52	20.19	25.57	21.11	11.65	6.33	11.63	32
	M	....	2.38	15.65	24.45	24.13	12.41	6.98	14.00	31
	K	0.50	7.32	26.62	22.83	16.13	9.58	5.05	11.97	34
Stoneville 2	J	0.26	6.89	21.59	25.26	16.08	8.57	7.65	13.70	32
	M	....	4.14	17.50	19.01	21.43	13.01	7.10	17.81	32
	K	2.27	10.54	23.24	18.96	16.27	9.35	5.88	13.49	33
Trice 25-1	J	0.26	6.17	17.06	22.70	17.72	14.83	7.88	13.38	33
	M	....	3.83	18.25	21.89	17.11	13.42	8.60	16.90	33
	K	....	4.49	15.96	24.94	23.74	10.03	7.26	13.58	33

[1] J—Jackson, M—Murfreesboro, K—Knoxville.

through them, and this process is repeated until the fibers are parallel. Then all the fibers of one length are pulled out and placed in a pile, a comb is dropped and the next shorter length is taken out. This is repeated until only the very short fibers are left. The piles representing the different lengths are weighed and the weights divided by the total weight of the sample. In this way the percentages given in table 19 were obtained. For example, at Jackson, in 1932, Acala 44-5 had about 2 per cent of its cotton above ⅝ inch, 12 per cent between 1 and 1⅛ inch, and 17 per cent from ⅞ to 1 inch. At the extreme right of the table are the staple lengths given by the classer in 32nds of an inch.

It is seen that the lint is distributed in a wide range of lengths for each variety, in a manner similar to that of the fibers around the seed; the difference being that in this table the length classes are given by percentage weight, whereas, around the seed it was given by number of fibers.

The samples in table 19 are the remnants of those sent the classer.

It appears, for example, that in 1932 the classer stapled D. P. L. 10 as an inch cotton at all three places, but the sorter distribution shows that around 20 per cent of its cotton fell within the range above 7/8 to 1 inch. In 1933 this variety was stapled as 1 1/8 inch, but the sorter distribution shows that only 15 per cent of the sample came around this length.

At Murfreesboro, 1932 was a dry season, and this condition is reflected in the sorter distribution. The percentages in the classes above

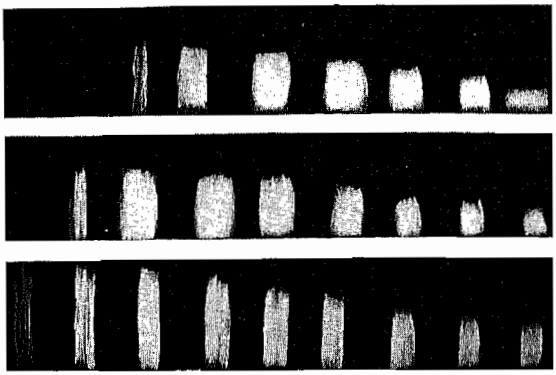


Fig. 8—Sorter distributions. Top, Half and Half, 13/16 inch; middle, Stoneville 2, 1 inch; bottom, Wilds 2, 1¼ inch. Grown at Knoxville, 1933.

7/8 inch, or the longer cotton, are less, while in the classes below 7/8 inch they are greater. This is true in 8 out of the 11 varieties. Sorter distributions have been made of western varieties and others not listed in this table, and all of them, without exception, have the same wide spread of lengths of lint. The fibers of cotton varieties are by no means uni-

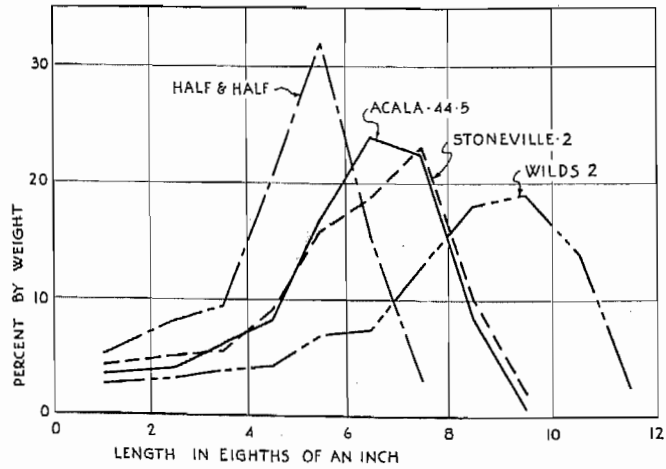


Fig. 9—Frequency distribution.

form, and there is a great deal of room for improvement in this property.

In Fig. 8 the photographs represent sorter distributions of lint of 3 varieties when grown at Knoxville in 1933. The short lint of Half and Half as compared with Stoneville 2 and Wilds 2 may be readily observed.

The data of 1933 on 4 varieties at Knoxville are shown graphically in Figs. 9 and 10, and these pictures of the distribution show the wide range of lengths.

In Fig. 9 the frequency curves show that Half and Half has its highest per cent of cotton in the range of 5/8 to 6/8 inch, Acala 44-5 and Stoneville 2 in the range of 7/8 to 8/8 and Wilds 2 from 9/8 to 10/8 inch. The Half and Half curve is very different in appearance from the others, and may be explained by the shorter range of lengths found in this variety.

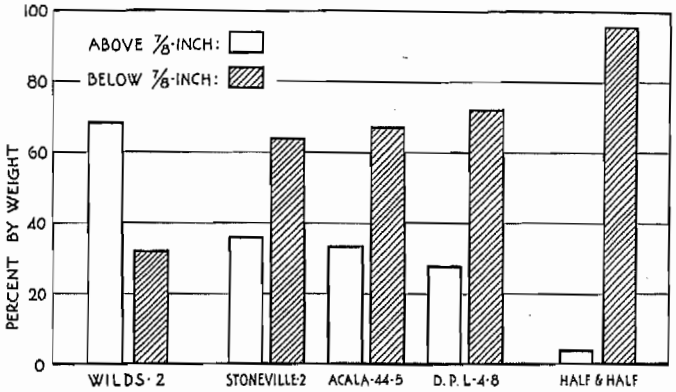


Fig. 10—Three recommended varieties around 1 inch in the middle, extreme-length cottons at ends.

In Fig. 10 the 3 varieties in the middle represent 1-inch cottons, which are considered desirable for this State. The varieties at either end represent extreme lengths, which may not be profitably grown.

BREEDING A VARIETY FOR ADAPTATION TO AN ENVIRONMENT

ADAPTATION

It has been shown that the western varieties are not adapted to conditions in this State. In most of Texas the season is long, with a small amount of rainfall and frequent high winds; so that the breeder in that State is not concerned about earliness or prolificacy, but is interested in a vigorous type, with bolls as nearly storm-proof as possible, and one that does not succumb to long dry spells.

In South Carolina—the southeastern region—the season is also a long one, with a fairly heavy rainfall. Soils are sandy and require large applications of fertilizer, so that late-maturing but prolific strains are adapted to this section.

In the Mississippi Delta the soil is rich, the rainfall heavy, and the

season fairly long; hence, it was the custom formerly to grow late-maturing, prolific, long-staple varieties. Then the boll weevil came, and early-maturing strains were needed. Recently the demand for long-staple cotton has dwindled, and the breeder in that section has turned his attention toward an early, prolific, medium-staple cotton.

The coming of the boll weevil and a decreasing market for long-staple cotton have made conditions in the Delta very similar to those in Tennessee. For in this State the rainfall is heavy, the season fairly short, and the soil not uniform enough to produce a strong, long-staple cotton. The regional conditions under which the variety is bred are an important consideration for the grower, because cotton strains do not change their habits en masse to meet the situation when brought into an entirely new environment.

Then, there is the matter of regional adaptation within the State. No extensive tests of this point have been carried on, but the locations of the trials are far apart—in 3 different sections of the State—and apparently the varieties that do well in one section are also leaders in the other sections. In 1934 the first 4 varieties in yield at Knoxville were the same as those at Jackson, although the season and yields were very different. This is not true every year, but on the average they behave the same at the 3 stations—Knoxville, Murfreesboro, and Jackson.

INHERITANCE OF CHARACTERS

The data in tables 3 to 12 show that most characters of economic importance in the cotton plant are quantitative. Their manner of inheritance is difficult to determine. Ware (23) and others found that long lint was dominant over short lint in the first generation, but the behavior of this character in later generations is not fully understood. Sometimes a plant is found with the seeds smooth and practically no lint upon them. Griffee and Ligon (11) explain this condition on the basis of mutation, and plants of this kind should not be permitted to multiply. In fact, off-type plants are found in all varieties, and it is good practice to go over the fields around the latter part of July and pull out, or rogue, all plants of this kind. Some of these plants may be worth further propagation, but it is not known that they will remain true to type, and careful breeding is needed to determine their subsequent behavior. Too much space would be required to give a full discussion of the many characters studied in cotton.

At any rate, the process of breeding a superior variety is long and tedious. Many methods are resorted to, but all of them require hundreds of individual stalk selections and continued trials of their progenies over a long period of time. It often takes around 10 years of careful breeding to introduce a variety that is worth while. The original selections of Stoneville 2 and D. P. L. 4-8 were made in 1918 and 1920. Cleveland 884 represents over 15 years of continuous selections for improvement.

New and untried introductions are sometimes highly advertised and distributed over the State. One such variety proved to be the Pima, a cotton of Egyptian ancestry, grown largely in Arizona. Another one is

of extreme cluster type, too late-maturing for this region. It is safer for the grower to plant his own or his neighbor's seed than to risk these untried varieties.

PLANTING-SEED

GERMINATION

Viable cotton seed germinate around 90 per cent. Proper storage over a period of time does not injure the germination. The seed of Stoneville 2 used in the trials this season were 6 years old and had a germination of 92 per cent. In fact, old seed carry less disease; and in a good season one may find it profitable to save enough planting-seed for 3 or 4 years' use.

The amount of moisture in the seed appears to be the limiting factor in its germination. Simpson (20) found that stored seed deteriorated rapidly when the moisture remained above 10 per cent. When the moisture was around 8 per cent and the seed stored in a manner to prevent re-absorption of moisture, there was very little injury after 4½ years. Ludwig (14) found that cotton seed germinate at a temperature as low as 53° F., and that very active germination takes place at 59° F. Small seed germinate as well as large ones. Seed should not be saved from the last picking because there are usually too many immature ones. It is good practice to make a simple germination test before planting time. The planter may be adjusted to throw out more seed if the number of live seeds is low.

TREATMENTS

A good stand in the seedling stage usually results in a good stand later on. In this State it is desirable to plant around May 1, but in some seasons the weather is very unfavorable for the small seedlings at this time, so that they become susceptible to diseases around them. It has been found that various treatments of the seed help to eliminate these diseases.

Delinting with sulfuric acid and dusting with organic mercury compounds are the two principal methods. The sulfuric acid method is very cumbersome and in many cases not practical for the individual, but it has its advantages. Delinted seed germinate more rapidly; about one-fourth as much seed is required; immature seed are recognized and may be separated; and the planting is done more evenly, making it possible to save labor in thinning. If this method is used, care must be taken to wash all the acid off the seed. Sherbakoff (18) has described a method for small lots, and there are commercial establishments for large-scale treatments. It is possible that a combination of delinting and the mercury-dust treatment will be found profitable, but better mechanical ways of doing the work are needed. A new gas method has been introduced, but thus far it is used only on a large scale.

A grower should not be misled by these seed treatments. They do not change the inherent characters of the seed.

SOURCES

Tennessee has not progressed very far in the matter of saving and increasing the supply of its own planting-seed. This may be due in part to the small size of the farming units. The assumption that a variety matures later when seed of it are saved and planted successively over a period of time in this State is not true. As good planting-seed can be saved in this region as can be secured from any source, provided proper precautions are taken to prevent seed-mixing at the gins.

It is not known definitely how long a variety will remain true when seed-mixing is prevented and rogueing followed, but the original supply of seed should come from the breeder of the variety; and thereafter for at least 5 years it may be increased without any serious changes if the grower is willing to make the effort.

In a good season it is feasible to save at least 3 times as much seed as may be needed, and thus avoid having to depend upon gin-run seed when bad stands make it necessary to replant.

There are many agencies handling cotton planting-seed. Before purchasing, the grower should know that the seed came from an area where only the one variety was planted and where no custom ginning was practiced.

One-variety communities are desirable. Type selection might be practiced (Cook, 7). The seed can be kept pure for a longer period of time, a better grade and staple of lint can be obtained through more uniform operating methods, and there is an opportunity for the community, or area, to build up a reputation for its product. For a program of this kind to become a success, however, the members of the organization must either control the gins or have strict agreements with the ginner relative to his dealing in foreign varieties. Also some method of rigid supervision in the field, as well as at the gin, must be made effective, and, finally, the marketing and classing should be handled by a trained personnel.

CONCLUSIONS

It has been shown that habits of plant growth and quality of lint are characteristic of the variety, and that the environment affects the characters. The variations, however, are small; and over a period of time the average quantity is found to be typical of the strains.

The breeder has developed many new strains from a single variety or type; and in most cases these strains are different from one another, so that the grower must keep informed about the most desirable strain. The strains are usually given numbers to designate them.

The strain reflects the kind of environment under which it was bred, and the successful ones in the trials are those which were originated under conditions similar to our own.

Not all the factors of lint quality are yet known, but the varieties recommended have good quality of lint as measured by the present commercial methods. Under proper marketing the grower should receive premiums on the lint of these strains.

When mixed seed from custom gins are used for planting, the grower may expect a large percentage of cross-pollination, followed by a rapid degeneration of the variety.

It should be recalled that the 10 strains now in the trials are all fairly well adapted to Tennessee, and are continued on that account. The grower would not make a complete crop failure on any one of them. However, Stoneville 2, the D. P. L. strains, and Delfos 719 have stood out because of their all-round superiority, and are recommended. Pure seed of these can be obtained in quantity.

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