
ALAN L. OLMSTEAD AND PAUL W. RHODE

Between 1928 and 1960 U.S. cotton production experienced a revolution with average yields roughly tripling while the quality of the crop increased significantly. This article analyzes the key institutional and scientific developments that facilitated the revolution in biological technologies, pointing to the importance of two government programs—the one-variety community movement and the Smith-Doxey Act—as catalysts for change. The story displays two phenomena germane to the recent literature: an important real-world example of Akerlof’s lemons model and a case in which inventors, during an early phase of the product cycle, encouraged consumers to copy and disseminate their intellectual property.

During the twentieth century American cotton farming evolved from a backward sector to a highly productive industry. For the most part, the history of the modernization of the cotton industry has concentrated on mechanization and the end of sharecropping to the virtual exclusion of any serious analysis of the enormous advances in biological technologies. This omission is surprising given the emphasis devoted to the role of improved varieties in generating productivity growth of other crops and other regions. Most notable are the studies on the development and diffusion of hybrid corn. The lack of attention to new cotton varieties should not suggest that


2 Griliches, “Hybrid Corn,” pp. 275–80. Modern convention uses the term “cultivar” instead of the term “variety.” Because most of the literature of the period under consideration predates this terminology, we use the term “variety” throughout.
no changes occurred. To the contrary, average U.S. cotton yields started their upward march at about the same time as the upturn in corn yields, and from 1928–1932 to 1958–1962 the rate of growth in cotton yields actually outpaced that of corn yields (see Figure 1).

This article analyzes the role of government policy and, in particular, that of the one-variety improvement movement and the Smith-Doxey Act in promoting the diffusion of new, high-performing cottons. The story of the development and diffusion of new cotton varieties is far more intriguing than the often-cited accounts of the introduction of hybrid corn, in part because cotton farming was one of the most backward sectors of American agriculture. The most distinguishing characteristic of the diffusion of new cottons was the role of government policy. Once new varieties of corn became available, the story of diffusion was largely the result of the market interactions between individual farmers and private seed companies (apart from extension service educational campaigns). By comparison, the cotton industry was long plagued by chronic problems of market failure that dulled the incentives for both seed breeders and individual farmers. To overcome negative externalities in production and a “lemons problem” in marketing, the United States Department of Agriculture (USDA) and state officials orchestrated a campaign to create one-variety communities and provided impartial grading services. These efforts played a key role in facilitating the adoption of the new biological technologies.
YET ANOTHER BURDEN OF SOUTHERN HISTORY

The 1921 USDA Yearbook is representative of an extensive literature bemoaning yet another burden of southern history: “According to the testimony of the cotton trade in Europe as well as in the United States, the quality of the American cotton crop has deteriorated in recent decades.” The available quantitative evidence on the decline in quality in fact supports this claim. Table 1 collects data on the staple length of U.S. cotton by state circa 1880, 1913, and 1928–1930. In every state for which data are available, the staple length in either 1913 or 1928–1930 was less than in 1880. Based on the national weighted average, staple length fell by over 12 percent between 1880 and 1930.

The consequences of the deterioration in quality were very serious given rising competition from foreign cotton, rayon, and other synthetic fibers. The causes of quality decline were twofold. First, the invasion of the boll weevil, beginning in 1892, led farmers throughout the cotton belt to discard late-maturing varieties that were most susceptible to the pest. “In this way many excellent varieties of long-staple upland cotton and practically all of the better types of medium-staple were lost within a comparatively short time, to be replaced by the early, rapid-fruiting types brought in from the northern parts of the belt.” But the boll weevil was only part of the problem. As indicated in Table 1, staple length also declined between 1880 and 1913 in areas, such as North Carolina, not yet hit by the weevil. Contemporaries noted that cotton culture was burdened by an interlocking set of production and marketing problems that both hampered the ability of and reduced the incentives for individual farmers to maintain and improve cotton quality. Cotton production was plagued by a number of negative externalities that

---

1 Doyle, Meloy, and Stine, “Cotton,” p. 400. Also see Johnson, Cotton, pp. 53–54. The 1866 Report of the Commissioner of Agriculture dates the problem to the war itself. “The most serious difficulty encountered by cotton-growers, and particularly those who are engaging in such enterprises for the first time since the war, had been found to be poor seed.” The report further noted that “for seven years little or no pains have been taken by any cotton-growers to perfect their seed.” U.S. Commissioner of Agriculture, Report, p. 209.

4 Cotton length was one of the most important factors in pricing cotton. Cotton classers divided samples into six different color classes. For white cotton there were nine specific grades that captured factors such as the existence of foreign matter, the cotton’s color quality, and “ginning preparation,” which included the roughness, nappiness, and stringiness of the fibers. With modern high-volume testing equipment it is now possible to cheaply determine important characteristics (such as fiber strength) that previously were difficult to assess. Cox, “Cotton,” pp. 320–23.

5 Determining exactly how the market valued this decline is slightly more complicated because the marginal value of increasing staple length was nonlinear. As an example, over the 1928–1930 period, average prices in ten central markets varied as follows:

<table>
<thead>
<tr>
<th>Staple length in thirty-seconds of an inch</th>
<th>28</th>
<th>30</th>
<th>32</th>
<th>34</th>
<th>36</th>
<th>38</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price premium (26 thirty-seconds = 100)</td>
<td>108</td>
<td>111</td>
<td>115</td>
<td>120</td>
<td>125</td>
<td>133</td>
<td>158</td>
</tr>
</tbody>
</table>

USDA, Agricultural Statistics 1936, p. 84.

6 Ware, “Plant,” p. 661.
“Purity” is obviously a loaded term. In this context, it meant that the seed was relatively homogeneous and could be expected to yield descendants with similar characteristics.

Burges, “Break This Vicious Circle,” pp. 5, 6, and 29; and Cook and Doyle, “One-Variety Community,” p. 132.

made it difficult to maintain the genetic purity of the seed supply. These technical difficulties were exacerbated by post–Civil War institutional changes, in particular the break-up of the plantation units into small operations and the increased importance of public gins. In addition, the prevalence of price pooling through what was known as the hog-round system muted incentives to produce high-quality cotton. A “vicious circle” thwarted efforts to improve the crop and reduced demand for quality seed. This, in turn, reduced incentives for seed breeders to invest in R&D, further reinforcing the low-level equilibrium trap.

On the production side, problems of maintaining purity arose because cotton is subject to cross-pollination. The incidence of cross-pollination varied greatly depending on the variety, weather conditions, the distance between fields, and the population of insects (especially bumble bees). When cotton was cultivated in small fields near the woodland habitat of feral bees—conditions common across much of the South in 1900—cross-pollination rates could easily exceed 40 percent. But when it was grown in large mono-variety fields that were frequently sprayed with insecticides, as was common in the Mississippi Delta by the 1950s, the annual cross-pollination rates were likely less than a few percent. The median rate of natural

---

**Table 1**

**AVERAGE STAPLE LENGTHS (in thirty-seconds of an inch)**

<table>
<thead>
<tr>
<th>State</th>
<th>1880</th>
<th>1913</th>
<th>1928–1930</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>32.9</td>
<td>29.8</td>
<td>28.4</td>
</tr>
<tr>
<td>Arizona</td>
<td>33.2</td>
<td>30.4</td>
<td>31.2</td>
</tr>
<tr>
<td>California</td>
<td>34.1</td>
<td>30.6</td>
<td>29.0</td>
</tr>
<tr>
<td>Florida</td>
<td>34.2</td>
<td>31.4</td>
<td>31.0</td>
</tr>
<tr>
<td>Georgia</td>
<td>33.5</td>
<td>31.4</td>
<td>32.8</td>
</tr>
<tr>
<td>New Mexico</td>
<td>33.5</td>
<td>31.4</td>
<td>31.0</td>
</tr>
<tr>
<td>North Carolina</td>
<td>33.9</td>
<td>29.3</td>
<td>29.7</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>39.5</td>
<td>29.8</td>
<td>30.4</td>
</tr>
<tr>
<td>South Carolina</td>
<td>34.4</td>
<td>31.4</td>
<td>30.0</td>
</tr>
<tr>
<td>United States</td>
<td>34.3</td>
<td>30.8</td>
<td>30.3</td>
</tr>
</tbody>
</table>

*Note:* The figures for the United States are the averages of available states weighted by output.

crossing between alternate rows reported in ten studies across the South over the 1903–1950 period was between 8 and 9 percent.\textsuperscript{9}

Maintaining pure seed lines became an increasingly serious problem after the Civil War with the emergence of public gins and changes in ginning technology. According to the USDA roughly 90 to 95 percent of the seed used to plant the U.S. cotton crop in the 1920s and early 1930s was mixed “gin-run” quality.\textsuperscript{10} Even when farmers purchased seed rather than used their home-grown product, the “outside” seed was often simply gin-run seed from other areas. Prior to 1850 the typical plantation gin was animal powered and processed only three to four bales per day of cotton grown in the gin’s immediate neighborhood. With the spread of steam power and other important innovations, gin capacity increased and the supply area expanded. The major breakthrough occurred in the mid-1880s with the invention by Robert Munger of “system ginning” that employed pneumatic and mechanical conveyance technologies and multiple stands of gin equipment. This represented one of the major technological advances in the New South. By 1900 the prototypical modern ginnery, containing four gins of 70 saws each, could process 40 to 60 bales of cotton per day and some were capable of handling 150 bales per day. The new “system” gins were much more efficient than the older methods, but their complicated machinery and larger clientele had the unintended consequence of substantially increasing the problem of seed mixing.\textsuperscript{11}

Seed mixing in successive gin runs was a serious problem (the smaller the runs the greater the problem).\textsuperscript{12} For example, the USDA estimated that “seed from a farmer’s first bale at the gin contains 26 percent of the seed from the preceding bale. . . .”\textsuperscript{13} Investigators reported cases of farmers receiving seed not only from the previous farmer to use the gin but from those three or four turns earlier. Given the practices of the day, gin operators were apt to indiscriminately return seed to farmers even if the growers requested their own seed. Thus, “the farmer as an individual finds himself practically powerless when he attempts to establish and maintain a pure stock of cotton.”\textsuperscript{14}

In this environment new cotton varieties proliferated but soon lost their distinctive advantages under mass cultivation. As Ware put it, a “very high


\textsuperscript{12} U.S. Bureau of Plant Industry, Soils, and Agricultural Engineering, \textit{Better Cottons}, pp. 955–58; Doyle, Meloy and Stine, “Cotton,” p. 400. Most farmers only brought one or two bales to the gin at a time, which magnified the problem. Cook, “One-Variety Cotton,” p. 13. Cook, “Local Adjustment,” p. 41, thought that the two sources of contamination (cross pollination and mixing at the gin) were roughly of equal importance.


\textsuperscript{14} Doyle, “Cotton,” p. 264.
percentages" of the varieties “come and go within a rather brief period.”15
Almost every contemporary authority highlighted the rapid turnover in
varieties under cultivation. Of the 58 varieties reported in the Tenth Census
(1880), “only 6 were commonly in cultivation in 1895,” and none were
grown by the mid-1930s. Of the 118 varieties crop scientist Samuel M.
Tracy listed in 1895, only 2 were still present in 1925; and of the 600 variet-
ies another researcher, Frederick J. Tyler, enumerated in 1907, fewer than
25 were in existence in 1925 and “only 9 were cultivated extensively.”16 The
problem was that “much of the benefit gained by bringing in new varieties
and by the excellent breeding work that was done by the Department of
Agriculture, private breeders, and the State experiment stations, has been
lost by the failure to perpetuate the best strains and varieties and to keep
them free from admixture with inferior kinds.”17
There are numerous accounts of promising varieties being destroyed by
cross-pollination and mixing at the gin. As a prominent example, in 1912
Roland M. Meade first selected a prized variety in fields around Clarkville,
Texas. This variety (Meade) had lint of over 1 1/2 inches and had black
seeds that were practically devoid of fuzz. The seed was taken to the Sea
Island areas of South Carolina, increased, and sold in that region. There it
produced a staple length averaging 1 5/8 inches and showed exceptional
uniformity. “Meade was on the way to becoming a striking success. More
than 10,000 acres were grown between 1920 and 1922, but mixing of seed
and planting in close proximity to fuzzy-seeded upland varieties resulted in
a rapid contamination in the stocks, the mixed fiber was rejected by the
trade, and the variety was largely abandoned after 1925.”18 Cross-pollination
and the mixture of seed at the gin reduced the ability of farmers who used
saved seed to cultivate high-yielding, high-quality varieties.19 Purchasing
commercial seed was an expensive proposition: data from the early 1920s
indicate that the commercial product cost two-and-a-half to four times as
much as “gin-run” seed, and that improved seed sold by breeders cost six to
eight times as much.20
Coupled with these production externalities were pervasive marketing
imperfections. According to the preponderance of testimony and in line with
the observed pattern of falling staple lengths and stagnating yields, local

15 Ware, “Plant Breeding,” p. 712.
16 Tracy, “Cultivated Varieties”; and Tyler, “Varieties.”
17 Ware, “Plant Breeding,” p. 696.
18 Ware, “Plant Breeding,” pp. 690–91. The literature repeatedly emphasized that mills would prefer
shorter but uniform fibers to fibers of different lengths.
19 Several forces affected seed quality. For example, choosing seed stock at random from the gin,
would have the negative effect of selecting strains with high seed-to-lint ratios.
20 The ordinary ratios are based on data for 1920–1922 from USDA, “Cotton Seed,” pp. 49, 59 and
“Prices Paid,” p. 143. The improved seed ratios are based on prices found in Coker’s Pedigreed Seed
Company catalogs. For examples, see the price list dated 1 February 1918, inserted in Coker’s, Spring
1918, and the Coker’s, Spring 1927, pp. 14–29. In 1927 new releases cost farmers about $3.00 a bushel
of 30 pounds plus shipping charges.
markets in the South failed to provide sufficient rewards for producing higher quality cotton.21 Complaints about middlemen seem to be common to all agricultural commodities, but in this case, the criticisms went beyond the habitual grousing. The cotton grading and marketing system in place at the turn of the century was one of the most complicated and controversial aspects of the whole cotton-production process. Accurately grading individual bales of cotton in local markets was prohibitively expensive, given the technology of the day. The use of mixed or gin-run seed added complications because there would be “considerable variation in quality and length of lint” within a single bale, making a small sample drawn from the exterior less representative.22 As a result the use of pooling contracts was widespread; cotton was generally sold in small local markets on the “hog-round” or “on point” system, meaning buyers graded a sample of bales and then paid one average price for all the cotton in that market.23 The cotton would then be shipped to regional markets where highly trained specialists would grade a sample from each bale in special rooms with proper lighting, temperature, and humidity. After grading the cotton would be assembled in larger running lots of roughly similar quality bales for sale to the cotton mills. There was a regional division of labor among mills, with some demanding better grades of cotton and producing higher-quality output than others.24 Once a given mill had adjusted its machinery it required a uniform staple length to run efficiently. A difference of 1/32 of an inch could be significant.

The workings of the hog-round system encouraged farmers to “free ride” by marketing lower-quality cotton than their neighbors, and helps explain the rising importance of relatively high yielding but short-staple varieties such as “Half-and-Half.” Ordinarily one would expect pooling arrangements to break down, as individuals who produced higher-quality goods demanded a higher price. As predicted, some plantation owners did sell directly in central markets where their crop could be graded separately.25 But most tenants and small farm operators lacked the economies of scale, information, and perhaps savvy to mitigate the problem. Such farmers suffered from problems of unequal bargaining power and asymmetric information as they likely faced only one or two buyers in local markets. For these reasons, most contemporary

23 Cook noted that, “‘the practice is old and longstanding, so that nobody now alive can be blamed for starting it.’” As quoted in Coruthers, “One-Variety Cotton,” p. 13. Note that making an all-or-nothing offer to an individual seller to buy a number of bales at a price based on average quality can preserve quality incentives.
24 Wright, Old South, pp. 133–35.
25 Virts, “Efficiency,” pp. 390–93. Nancy Virts argued that these general marketing problems help explain the persistence of the plantation system. She noted that plantations on average produced higher quality cotton in part because economies of scale in marketing allowed them to bypass local markets. This argument is consistent with Burges’s claim that only shipments of 100 bales or more could command special treatment with respect to quality. Burges, “Break This Vicious Circle,” pp. 5, 6, 29.
accounts argued that high-quality cotton varieties were being driven from the market, exactly as George Akerlof’s 1970 “lemons model” would suggest.

TESTING FOR MARKET FAILURE

Although the “lemons problem” is much discussed, important real-world examples are rare in the literature. Thus the nearly unanimous testimony of cotton specialists asserting that grading and marketing problems seriously distorted production incentives is of considerable interest. The USDA and various state agencies conducted numerous detailed studies investigating the relationship between price and quality in local and regional markets across the South. Studies of local markets in Arkansas (1913–1916), North Carolina (1914–1916), Texas (1926), Alabama (1926 and 1927), and South Carolina (1925–1927) all found prices varied little with quality. The two most definitive studies on cotton pricing were published by the USDA in 1936 and 1939. L. D. Howell and John Burgess (1936) monitored individual transactions in over 100 local markets between 1928 and 1933, and independently classed 300,000 bales of cotton. They compared the prices received in local markets for cotton of a given quality with those prevailing in central markets for the same quality on the same day. (Participants in the local markets did not know the results of Howell and Burgess’s classifications at the time of sale.) The survey found that the local market price differentials for various staple lengths were far smaller than the differentials in the central markets (which better reflected the value cotton spinners placed on quality). As an example, the Howell and Burgess research team classified and recorded the prices of over 100,000 bales of middling white cotton. Panel 1 of Table 2 offers a summary measure of the price differentials by staple length prevailing in the local and central markets over the 1928–1933 period. “For the 5-year period, on an average, premiums for staples longer than 7/8 inch in local markets amounted to only 17 percent of those in central markets and varied from only 12 percent for 15/16-inch cotton to 34 percent for 1 1/8-inch cotton. At the other end of the spectrum, discounts for cotton shorter than 7/8 inch in local markets amounted to only 6 percent of those quoted in central markets for cotton with a staple length of 13/16 inch.” The summary conclusion is that the price signals given to farmers in local markets systematically failed to reflect the incentive structure being generated in central markets. Farmers who sold short-staple cotton were vastly overpaid, and those who marketed longer staples were shortchanged.
Hog-Round Marketing

Howell and Leonard Watson’s study covering the 1933–1936 period took the research a step further. In addition to comparing local and central markets, they compared local markets offering impartial public classification services (PCS) with those lacking such services. Panel 2 of Table 2 shows the differentials by staple length for bales sold in the two types of local markets compared with equal quality cotton sold on the same day in the central markets. (Note that the timing of sales in the local markets with PCS and those without PCS differed, making it necessary to report two series for central market differentials.) Howell and Watson found that the quality differentials in the central markets were more closely reflected in local markets with public classification services than in those without such services. In 1935, for example, the local markets with public classifiers captured 57 percent of the central market premiums for cotton of 1 1/16 inch (relative to 7/8 inch) whereas markets without public classifiers captured only 22 percent. Compared with the 1928–1932 period, farmers selling in both types of markets were receiving greater quality differentials, especially at the higher end.

\[\text{Note: PCS = Public Classification System; 34 Staple Cotton refers to cotton classed as 34 thirty-seconds of an inch in length; similarly, 28 Stable Cotton refers to cotton classed as 28 thirty-seconds of an inch.}
\]

\[\text{Sources: Howell and Burgess, “Farm Prices,” p. 19; and Howell and Watson, “Cotton Prices,” pp. 13–14, 23–24.}\]

### Table 2

<table>
<thead>
<tr>
<th>Season</th>
<th>(1) Local Markets</th>
<th>(2) Central Markets</th>
<th>(3) Ratio (1) / (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1928</td>
<td>0.45</td>
<td>1.65</td>
<td>0.27</td>
</tr>
<tr>
<td>1929</td>
<td>0.37</td>
<td>1.98</td>
<td>0.19</td>
</tr>
<tr>
<td>1930</td>
<td>0.18</td>
<td>1.55</td>
<td>0.12</td>
</tr>
<tr>
<td>1931</td>
<td>0.23</td>
<td>1.03</td>
<td>0.22</td>
</tr>
<tr>
<td>1932</td>
<td>0.12</td>
<td>0.80</td>
<td>0.15</td>
</tr>
<tr>
<td>Panel 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market without PCS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1933</td>
<td>0.16</td>
<td>1.00</td>
<td>0.16</td>
</tr>
<tr>
<td>1934</td>
<td>0.21</td>
<td>1.17</td>
<td>0.18</td>
</tr>
<tr>
<td>1935</td>
<td>0.21</td>
<td>0.97</td>
<td>0.22</td>
</tr>
<tr>
<td>1936</td>
<td>0.58</td>
<td>1.53</td>
<td>0.38</td>
</tr>
<tr>
<td>With PCS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1933</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1934</td>
<td>0.38</td>
<td>1.33</td>
<td>0.29</td>
</tr>
<tr>
<td>1935</td>
<td>0.54</td>
<td>0.95</td>
<td>0.57</td>
</tr>
<tr>
<td>1936</td>
<td>0.84</td>
<td>1.52</td>
<td>0.55</td>
</tr>
</tbody>
</table>

30 They also found that price variability, conditional on quality, was lower in markets with public classification services.
31 Garside also found that cotton markets were improving over this period. Garside, Cotton, pp. 176–84.
Several natural experiments offer further evidence on the workings of local markets. In 1923 the cotton farmers in the McKinney area of Collin County, Texas began the process of forming one-variety communities (see the next section) to improve cotton quality and yields. Buyers soon recognized that the McKinney market had better cotton and began to offer substantial premiums compared to prices offered in nearby markets. “Difficulty then arose because the higher prices at McKinney soon attracted farmers from other communities, who soon were hauling considerable quantities of inferior cotton to McKinney, to take advantage of the higher prices paid there. One farmer was known to have hauled 48 bales of cotton 150 miles by truck and to have sold it for $5 per bale net above what he was offered on his local market.”32 As outsiders began shipping to McKinney, its share of the region’s market jumped from 25 percent in 1925 to 37 percent by 1928. This behavior only made sense where the hog-round system was being employed. Predictably, the McKinney price fell and the one-variety effort collapsed.33

Other areas had long held a reputation for producing quality cotton and traditionally received price premiums. Some mills and even the Liverpool Market essentially “bought cotton on the basis of place of origin, as well as on grade and staple length.”34 The appearance of trucks and good roads eroded these advantages. As an example,

Country buyers of cotton knew the value placed on the Hope, Arkansas warehouse tag. They went into the sand hill sections of South Arkansas, bought short cotton hog round, trucked it over the concrete highway to Hope, put a Hope compress tag on it, and shipped it as Hope cotton. . . . When the spinner got hold of the cotton he had a real surprise coming. It was not Hope cotton. It was some inferior short stuff from the sand hill of South Arkansas. So the premium went off Hope cotton. Similar situations prevailed throughout the South.35

Collectively, these experiences with free riders dumping inferior cotton into quality markets, coupled with the exceptionally detailed and careful studies on local and central market pricing and grading practices, strongly support the assertions of contemporary cotton specialists. The hog-round system was, indeed, widespread, and it resulted in a “lemons problem” that led to a decline in cotton quality.

THE ONE-VARIETY COMMUNITY MOVEMENT

Early in the twentieth century USDA scientists intensified their breeding and extension projects aimed at improving the yields and quality of U.S.

34 Pike, “Cottonseed,” p. 2; and Crawford, “Point Buying,” pp. 376–86.
35 Andrews, “Cotton,” pp. 8–9; also see Garside, Cotton, p. 181.
Hog-Round Marketing

Because of the problems discussed previously, researchers soon realized that it would not be sufficient to develop and distribute small quantities of better seeds. Rather, their campaign would have to change the complex institutional structure to reduce negative externalities and better align local prices with those in regional markets. According to the father of the one-variety community movement, Oral Fuller Cook, “the method of distribution that was first projected did not result in establishing commercial supplies of pure seed. Several of the varieties that were developed and distributed in the early years of the cotton-breeding work were lost completely before the system of distribution was changed.”

To counter these problems, Cook developed an ambitious program to develop better cotton varieties, improve cultural methods, standardize cotton-classification systems, advance new seed-treatment processes, and train qualified cotton graders.

At the heart of the program was a utopian scheme to fundamentally change the way cotton was grown, ginned, graded, and marketed in the United States. To succeed would require a “new association of ideas” to alter how farmers thought about their community. Instead of each individual farmer choosing his own variety, the new system would be built on a cooperative structure in which cotton farmers would organize “one-variety communities.” The USDA in conjunction with state authorities would provide education, guidance, and standardized contracts. Cook and his fellow reformers envisioned communities ranging in size from a group of farmers using one gin to encompassing an entire state. In addition to producing, ginning, and marketing only one variety of cotton, the communities would be responsible for increasing (and in some cases breeding) pure seed for their members. It is important to note that from the outset the literature on one-variety communities emphasized the benefits to the nearly total exclusion of any discussion of the costs associated with individual farmers losing the freedom to tailor their cultural practices to fit their particular growing situations.

Cook first suggested the idea of one-variety communities in 1909 and subsequently developed the concept in a 1911 article. At first the USDA concentrated its one-variety campaign in the newly irrigated cotton regions in the Far West, promoting the idea in conjunction with the distribution of a number of recently introduced or developed long- and medium-staple varieties. At times local USDA scientists withheld the distribution of the new seed until a one-variety structure was in place. The first one-variety community began in 1912 with the distribution of Yuma cotton in the Salt Cotton.
River Valley of Arizona. At about the same time Durango was grown in a single-variety community in the Imperial Valley of California. After 1920 Acala, which the USDA had introduced from Mexico in 1907, became an important one-variety cotton in many western areas. The initial efforts were often loosely structured. As an example, to gain access to Acala seed, growers in Riverside County organized the Acala Cotton Growers’ Association of the Coachella Valley in 1920. By 1923 the region’s farmers had voluntarily planted Acala on over 96 percent of their cotton acreage. To prevent the mixing of seeds at gins and cross-pollination, Riverside County gave legal protection to the district in 1924 by passing an ordinance declaring the county a pure seed district. These western initiatives, as well as scattered efforts in southern states, generally met with mixed results as farmers and USDA officials experimented with varieties and structures. Most one-variety districts reported higher yields and increased premiums, but for a number of reasons (including problems of free riding from nearby farmers and inadequate supplies of the one-variety seed to serve a given area) many of the early districts were short-lived.

A giant step in the one-variety campaign occurred in May 1925 when California enacted legislation declaring eight San Joaquin Valley counties and Riverside County as a one-variety community. The new law represented the culmination of an extended lobbying effort by W. B. Camp, the USDA’s California cotton specialist who had been sent west in 1917 to promote one-variety production of high-quality varieties. The law, along with the institutional structure that evolved in 1926, would define the development of the state’s cotton industry for the next six decades. The law stipulated that only Acala could be planted, harvested, or ginned in a district of well over four million acres. Even the possession of non-Acala seeds was illegal (except at a few research stations). The USDA’s Cotton Research Center at Shafter became the de facto sole Acala breeder in the state, as the USDA successfully strove to keep private seed breeders out of the Central Valley. Under this system, Shafter’s “head breeder” held enormous power, overseeing a research program that for the next 60 years would be the only source for cottonseed for most of California. To increase and market the seed bred at Shafter, growers organized the California Planting Cotton Seed Distributors in 1926. Most specialized accounts credit the one-variety system with contributing significantly to California’s high cotton yields, which over much of the twentieth century were roughly double the national average. (In fact, many factors such as climate and irrigation contributed to the state’s yield advantage.) These accounts also credit the one-variety

41 Cook, “Cotton Improvement,” pp. 397–410; Cook, “Local Adjustment,” p. 41; Ware, “Plant Breeding,” p. 697; after Acala was introduced it took researchers several years to select and develop outstanding strains suitable for commercial use. Ibid., p. 689. Durango was another recent Mexican introduction and Yuma and Pima were the product of USDA breeding programs in the Southwest and depended largely on crosses of Egyptian cultivars with Sea Island cotton.
42 McKeever, “Community,” p. 29.
community with helping California growers earn quality premiums for their relatively uniform, medium-staple product.\footnote{For example see Turner, \textit{White Gold}, pp. 55–94.}

To date, neither the economics nor history literature has devoted much attention to the one-variety movement. The one exception is John Constantine, Julian Alston, and Vincent Smith’s critical \textit{Journal of Political Economy} article analyzing the California one-variety law.\footnote{Constantine et al., “Economic Impacts,” pp. 951–74.} They argued that in the 1970s and 1980s the legislation artificially limited California’s production, resulting in higher prices for the state’s cotton.\footnote{It is important to emphasize that Constantine et al. argue that the technological regulation became increasingly costly as time passed and was clearly inefficient by the 1970s. They are agnostic as to whether or not the law was efficient in its early decades.} Landowners in regions most suitable for Acala production (the community variety) benefited, while other Central Valley farmers experienced yield losses or abandoned cotton. Constantine et al. concluded that the legislation became increasingly inefficient and by the late 1970s was costing growers as a group about $180 million annually (over 10 percent of the annual value of the state’s cotton output). The law remained in force because a faction of California farmers who benefited from the legislation had captured the system’s administrative apparatus.\footnote{Constantine et al., “Economic Impacts,” pp. 951–74. Oklahoma farmers were concerned about yield losses due to the inability to fine tune varieties to local conditions. Campbell, “One-Variety Cotton,” pp. 5–19, and “Comparisons,” pp. 7–33. Other critics of one-variety communities feared that there could be catastrophic losses should a new disease appear for which the limited number of varieties lacked resistance. K. S. Quisenberry, “The Role of Public and Private Agencies in Cotton Improvement,” pp. 1–8, Dallas, Texas, 2 February 1954, Delta and Pine Land Company Records, Box XV, Miscellaneous, Joint Cotton Breeders Policy Committee file (2/8), 1953/54 in Special Collections, Mitchell Memorial Library, Mississippi State University. Hereafter other sources from this collection cited as D&PL archives.}

Constantine, Alston, and Smith provide a valuable perspective on the recent history of the California one-variety law, but they say little about the early history of the state’s experience, and they ignore a far larger, but more short-lived, southern one-variety movement. Understanding the movement outside of California not only provides a fresh perspective on the sources of southern development, but also helps in reevaluating the one-variety legislation in California.\footnote{Even the institutional structures in other Acala-growing states differed. For example, the one-variety movement started in the Rio Grande and Pecos River areas of New Mexico in 1922. There was no statewide one-variety legislation, but by the early 1930s Acala constituted more than 95 percent of the cotton grown in the state. As in California, the foundation seed was supplied by the USDA, a system of inspection and certification was developed for the farms that increased the seed, and local gins developed special precautions when ginning planting seed. Between 1922 and 1932 the state’s yields increased from 201 to 412 pounds of lint per acre (roughly on par with what occurred in California), with local observers giving most of the credit to the community production system with its pure seed program. Coruthers, “One-Variety Cotton,” pp. 106–08; Leding, “Community,” pp. 1–23; and USDA, “Statistics on Cotton,” p. 82.}

There were fits and starts in the one-variety movement in the traditional Cotton South before 1930, but few lasting accomplishments. However, the USDA intensified its efforts, initiating one-variety campaigns throughout the
South in 1931/32. These were often tied with education and other cotton improvement programs. Almost all contemporary studies of early one-variety programs reported immediate increases in yields and quality, along with greater financial returns to farmers.\(^49\) The movement started in Georgia in 1931. By the end of 1934, there were 45 communities in various stages of development, and preliminary work was underway in starting 25 others. The one-variety producers were immediately rewarded with higher yields, along with quality and length premiums valued at about $7.13 an acre. In Oklahoma the one-variety movement began in earnest in 1932. By early 1933 there were six communities with over 25,000 acres and 11,000 farmers participating. In Mississippi, 14 communities were organized in 1931, with the number growing to 33 in 1932; six of these were countywide organizations. By 1937 there were 197 communities in the state, with members receiving an estimated average increase in revenue (stemming from increased yields and premiums) of $8.71 per acre.\(^50\) A similar transformation of cotton production was taking place across the South during the 1930s.

From the humble beginnings in the 1930s, the movement took off. Table 3 pieces together key indices of the extent of the one-variety movement for the years 1934–1949. By 1946 there were about 2,275 one-variety communities, producing roughly one-half of the entire cotton output of the United States. Table 4 provides data on the distribution of one-variety production across the various states. Although the California one-variety program has monopolized scholarly attention, these data clearly indicate that California was not alone in one-variety production. In fact, in 1946 California accounted for less than 2 percent of the community members, less than 5 percent of the acreage in one-variety communities, and about 10 percent of community output in the United States. California was different because of the size of the participating farms and the legal rigidity of the system, not because its farmers were banding together ostensibly to overcome negative externalities and to capture economies of scale in grading, information, and marketing.\(^51\)

A clearer image of the micro-structure and daily operations of the southern one-variety communities may be distilled from numerous descriptions in experiment-station and cotton-trade publications. The organizing effort was typically initiated by a small group of local farmers working with the county extension agent, who would call a meeting and provide a set of suggested standardized bylaws. The proposed “Cotton Improvement Association” was

51 According to E. C. Westbrook, in 1956 all one-variety communities were voluntary except in California. Westbrook, “One-variety Cotton,” p. 17.
TABLE 3
COTTON IN ONE-VARIETY COMMUNITIES, 1934–1949

<table>
<thead>
<tr>
<th>Year</th>
<th>Counties Participating</th>
<th>Communities Participating</th>
<th>Grower Members (thousands)</th>
<th>Production of Adopted Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acres</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Number</td>
<td>(thousands)</td>
</tr>
<tr>
<td>1934</td>
<td>161</td>
<td>331</td>
<td>nd</td>
<td>589</td>
</tr>
<tr>
<td>1935</td>
<td>321</td>
<td>730</td>
<td>nd</td>
<td>2,453</td>
</tr>
<tr>
<td>1936</td>
<td>425</td>
<td>1,056</td>
<td>nd</td>
<td>2,284</td>
</tr>
<tr>
<td>1937</td>
<td>495</td>
<td>1,516</td>
<td>nd</td>
<td>3,116</td>
</tr>
<tr>
<td>1938</td>
<td>548</td>
<td>1,922</td>
<td>185</td>
<td>4,518</td>
</tr>
<tr>
<td>1939</td>
<td>550</td>
<td>2,116</td>
<td>229</td>
<td>6,239</td>
</tr>
<tr>
<td>1940</td>
<td>577</td>
<td>2,564</td>
<td>292</td>
<td>7,614</td>
</tr>
<tr>
<td>1941</td>
<td>581</td>
<td>2,194</td>
<td>306</td>
<td>8,869</td>
</tr>
<tr>
<td>1942</td>
<td>500</td>
<td>1,800</td>
<td>319</td>
<td>7,071</td>
</tr>
<tr>
<td>1943</td>
<td>485</td>
<td>1,601</td>
<td>310</td>
<td>6,808</td>
</tr>
<tr>
<td>1944</td>
<td>531</td>
<td>1,963</td>
<td>331</td>
<td>8,537</td>
</tr>
<tr>
<td>1945</td>
<td>546</td>
<td>2,422</td>
<td>426</td>
<td>13,500</td>
</tr>
</tbody>
</table>

Note: Percentages are national.

The communities acquired foundation seed from a state experiment station or a private breeder such as Delta and Pine Land Company (DP&L), to be established as a nonprofit, unincorporated cooperative association. Membership was voluntary and involved no fees or dues. Under some bylaws, membership was “open to any cotton grower” who agreed to the one-variety regulations; in others, new members were admitted with the approval of existing members. Conditions for exit also varied. In some agreements members could withdraw at any time, and those who failed to comply with community rules were automatically dropped without penalty. Other bylaws specified a five-year membership term. In almost all bylaws the association’s membership periodically selected by majority rule (on a one-member one-vote basis) the variety to be grown and elected a small board responsible for the daily operations. The association also formed a relationship with a local gin. If only a fraction of the local growers choose to enter the association, the one-variety community contracted with the ginner to set aside specific days or specific machines to handle members’ crops with special care. Thus, the southern one-variety communities were neither as compulsory or formal as in the California model.52

This method of expanding the seed supply represented a large-scale collective implementation of the 1-10-100 technique recommended by extension agents and seed companies (such as Coker’s) to individual farmers for maintaining pure seed.

A common arrangement was to purchase annually one bushel of foundation seed (enough to plant one acre) for each 100 acres of cotton in the community. A small number of selected growers planted this seed in isolated fields, harvested and ginned the resulting seed cotton in a manner to ensure purity, and then exchanged the so-called first-year seed to other members at set prices that were well below the market price of the foundation seed. The other members agreed to plant at least one-tenth of their acreage with this first-year seed, producing sufficient second-year seed for their remaining acreage in the next season. To help maintain purity, all of the cotton grown from the foundation seed was to be ginned under close supervision before any of that grown from the first-year seed, which in turn was ginned before that grown from the second-year seed. The resulting third-year seed was to be sold to the oil mill. This plan “provides for a continuous flow of new, pure breeder or foundation seed into the community each year and a continuous outflow of old seed to the oil mill.”

Stoneville, or Coker. A common arrangement was to purchase annually one bushel of foundation seed (enough to plant one acre) for each 100 acres of cotton in the community. A small number of selected growers planted this seed in isolated fields, harvested and ginned the resulting seed cotton in a manner to ensure purity, and then exchanged the so-called first-year seed to other members at set prices that were well below the market price of the foundation seed. The other members agreed to plant at least one-tenth of their acreage with this first-year seed, producing sufficient second-year seed for their remaining acreage in the next season. To help maintain purity, all of the cotton grown from the foundation seed was to be ginned under close supervision before any of that grown from the first-year seed, which in turn was ginned before that grown from the second-year seed. The resulting third-year seed was to be sold to the oil mill. This plan “provides for a continuous flow of new, pure breeder or foundation seed into the community each year and a continuous outflow of old seed to the oil mill.”

---

**TABLE 4**

<table>
<thead>
<tr>
<th>Counties Participating</th>
<th>Communities Participating</th>
<th>Year</th>
<th>Number</th>
<th>%</th>
<th>Number</th>
<th>%</th>
<th>Number</th>
<th>%</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counties Participating</td>
<td>Government</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alabama</td>
<td>53</td>
<td>83</td>
<td>263</td>
<td></td>
<td>39,225</td>
<td></td>
<td>610</td>
<td>40</td>
<td>386</td>
<td>48</td>
</tr>
<tr>
<td>Arizona</td>
<td>6</td>
<td>100</td>
<td>9</td>
<td></td>
<td>954</td>
<td></td>
<td>151</td>
<td>100</td>
<td>143</td>
<td>100</td>
</tr>
<tr>
<td>Arkansas</td>
<td>30</td>
<td>57</td>
<td>229</td>
<td></td>
<td>10,788</td>
<td></td>
<td>580</td>
<td>36</td>
<td>546</td>
<td>44</td>
</tr>
<tr>
<td>California</td>
<td>7</td>
<td>100</td>
<td>7</td>
<td></td>
<td>5,509</td>
<td></td>
<td>339</td>
<td>100</td>
<td>435</td>
<td>100</td>
</tr>
<tr>
<td>Georgia</td>
<td>84</td>
<td>81</td>
<td>241</td>
<td></td>
<td>38,417</td>
<td></td>
<td>574</td>
<td>47</td>
<td>315</td>
<td>57</td>
</tr>
<tr>
<td>Kentucky</td>
<td>2</td>
<td>67</td>
<td>2</td>
<td></td>
<td>496</td>
<td></td>
<td>10</td>
<td>97</td>
<td>8</td>
<td>97</td>
</tr>
<tr>
<td>Louisiana</td>
<td>26</td>
<td>70</td>
<td>29</td>
<td></td>
<td>22,238</td>
<td></td>
<td>404</td>
<td>51</td>
<td>133</td>
<td>53</td>
</tr>
<tr>
<td>Mississippi</td>
<td>61</td>
<td>81</td>
<td>185</td>
<td></td>
<td>49,605</td>
<td></td>
<td>867</td>
<td>38</td>
<td>410</td>
<td>37</td>
</tr>
<tr>
<td>Missouri</td>
<td>8</td>
<td>100</td>
<td>126</td>
<td></td>
<td>7,654</td>
<td></td>
<td>272</td>
<td>89</td>
<td>272</td>
<td>89</td>
</tr>
<tr>
<td>New Mexico</td>
<td>5</td>
<td>100</td>
<td>5</td>
<td></td>
<td>4,117</td>
<td></td>
<td>130</td>
<td>98</td>
<td>145</td>
<td>98</td>
</tr>
<tr>
<td>North Carolina</td>
<td>33</td>
<td>69</td>
<td>38</td>
<td></td>
<td>27,800</td>
<td></td>
<td>332</td>
<td>58</td>
<td>259</td>
<td>62</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>29</td>
<td>59</td>
<td>51</td>
<td></td>
<td>13,871</td>
<td></td>
<td>271</td>
<td>27</td>
<td>78</td>
<td>30</td>
</tr>
<tr>
<td>South Carolina</td>
<td>26</td>
<td>62</td>
<td>30</td>
<td></td>
<td>26,554</td>
<td></td>
<td>421</td>
<td>46</td>
<td>329</td>
<td>47</td>
</tr>
<tr>
<td>Tennessee</td>
<td>22</td>
<td>79</td>
<td>29</td>
<td></td>
<td>26,898</td>
<td></td>
<td>345</td>
<td>57</td>
<td>291</td>
<td>57</td>
</tr>
<tr>
<td>Texas</td>
<td>91</td>
<td>57</td>
<td>354</td>
<td></td>
<td>35,955</td>
<td></td>
<td>1,499</td>
<td>25</td>
<td>508</td>
<td>36</td>
</tr>
<tr>
<td>Virginia</td>
<td>2</td>
<td>33</td>
<td>3</td>
<td></td>
<td>265</td>
<td></td>
<td>3</td>
<td>13</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>


---

53 This method of expanding the seed supply represented a large-scale collective implementation of the 1-10-100 technique recommended by extension agents and seed companies (such as Coker’s) to individual farmers for maintaining pure seed. *Coker’s, Spring 1917*, p. 16. For a detailed guide on how to organize a one-variety community see Bode Hughes, “Organizing Communities,” D&PL Company Records, Box XV, Miscellaneous file (2/2), D&PL archives.

During the mid-1930s, the one-variety movement pushed beyond its campaign to restructure cotton production into a more long-lasting effort to reform marketing. Given the prevailing weak market incentives to produce higher quality cotton, farmers in many one-variety communities complained that they were not being properly rewarded for their labors. In 1937 President Roosevelt signed the Smith-Doxey Cotton Classing Act that was meant to complement the traditional one-variety communities. The act went into effect in 1938 and made free market-news services and cotton classing available to members of all organized cotton improvement groups. The act was to be largely self-supporting (through the sale of the sample material) and benefit almost everyone up and down the marketing chain except perhaps local buyers-graders. Smith-Doxey classification cards became accepted within the trade, cutting marketing costs by reducing the need to repeatedly re-sample and re-grade cotton bales every time they changed hands. The primary aim of the program was to better align the incentives given to small farmers by narrowing the discrepancies between grading in local and central markets. Under the Smith-Doxey program farmers could mail cotton samples to one of 31 central locations established throughout the Cotton Belt and within a few days receive by return mail a government certified “green card” specifying the cotton’s grade, length, etc. There was a catch. To qualify for the free services a farmer had to be a member of an organized cotton improvement group with at least ten members. These Smith-Doxey districts were typically much less formal than one-variety communities, and in some cases simply represented an agreement between a group of farmers and a ginner to provide special care in handling the group’s one variety. The Smith-Doxey districts played no role in breeding, increasing, or marketing seed. A bureaucratic difference was that Smith-Doxey groups were organized out of the USDA Agricultural Marketing Service, whereas the One-Variety Community project was under the aegis of the Bureau of Plant Industry, Soils, and Agricultural Engineering. On the ground, the cooperative extension service administered both programs.55

A pair of USDA belt-wide surveys on classification practices and the use of information in the 1935/36 and 1947/48 crop years provides some sense of the changes wrought by the Smith-Doxey Act. The first survey, conducted by John W. Wright, revealed just how poorly informed many growers were when they sold their cotton before the act. This survey of 101 local markets found that 36 percent of growers sold their cotton with no information about general market prices except their price offer, and that 60 percent of growers (accounting for 60 percent of the crop) sold

their cotton without knowing its grade or staple length. Even when growers reported knowledge of their cotton’s quality at the time of sale, the most common source of this information was the buyer (29 percent of cotton). Less than 10 percent of cotton was classified by impartial parties—the USDA, licensed classers, warehousemen, factors, or ginners. There was widespread dissatisfaction with the poor state of market information. Nearly six-tenths of cotton growers reported a willingness to maintain a self-supporting sampling service to provide official classification. Most ginners surveyed (84 percent) also favored such a service. By way of contrast, most first-buyers disliked the idea and reported a disinclination to base their purchases on official classes. The market situation illustrated in this report, especially the weak bargaining position of growers in local cotton markets, created pressures for reform.\(^\text{56}\)

The 1947 follow-up study revealed substantial improvements in price and quality information available to growers since 1935. In the 1947/48 crop year only about 25 percent of growers, who accounted for about 15 percent of U.S. cotton output, sold without having independent information about general cotton prices. Only 45 percent of growers (with 30 percent of the cotton) sold their crop without knowing its quality (again down from the 60 percent of producers and output in the 1935/36 season). In 1947/48 growers with impartially provided quality information sold 52 percent of the cotton crop, up from just 9 percent of the crop in 1935/36. The spread of the Smith-Doxey system accounted for much of the change. In 1947/48, 40 percent of the crop in the markets studied received green cards (Form 1 classifications) by the time of sale.\(^\text{57}\) The study concluded that in 1947 growers “generally occupied a stronger bargaining position than in 1935” when “most growers reported knowing neither the market price nor the quality of their cotton at the time of sale.”\(^\text{58}\)

The Smith-Doxey program apparently went a long way to correcting the problems highlighted in the cotton-pricing studies of the 1920s and 1930s. For example, based on a survey that recorded the pricing of about 300,000 bales of cotton in 24 local markets across the cotton-belt over the 1951/52 to 1953/54 seasons, William Faught concluded that:

\(^{56}\) Wright, *Marketing Practices*, pp. 20–23, 60–62. The problems associated with imperfect information about quality obviously were not limited to cotton, and during the first half of the twentieth century the USDA established standards for grading most products. Given the technology of the time, classing cotton was probably more difficult than grading most major crops.

\(^{57}\) Soxman, *Marketing*, pp. 12, 16, 62, and 69. The use of the Smith-Doxey system was uneven across the cotton belt and over farms of different sizes. Virtually all cotton growers in Arizona, California, and New Mexico received Form 1 classing, as did about one-half of the growers in Arkansas, Oklahoma, and Texas. But only about one-quarter of the growers in Alabama, Georgia, and Mississippi used the system. Larger growers were far more likely than smaller farmers to sell on the basis of Form 1 classification. Faught, “Cotton,” p. 28.

prices to growers in markets where cotton is sold on the basis of Smith-Doxey cards. . . . reflected central market differentials for grade and staple rather fully and accurately. In markets where growers did not have or did not use reliable quality information in the sale of their cotton, local prices reflected little, if any, of the central market differentials. 69

In local markets where most “cotton was sold on the basis of Smith-Doxey cards” the price reflected, on average, 78 percent of central market differentials whereas in local markets where “cotton quality information was not readily available to growers” the price reflected only 3 percent of differentials. 60 As officials at the Texas agricultural extension service put it: “Smith-Doxey has probably done more than anything else to breach the traditional system of hog ‘round buying.” 61

As a result of the advantages of the Smith-Doxey program, participation rapidly increased. Table 5 provides summary data of the growth of the program between 1938 and 1952. By 1951 about 65 percent of American cotton was being graded under this system. The diffusion of this new organizational form proceeded at a pace rivaling the era’s better known mechanical and biological technologies. In the 1955 season over four-fifths of the U.S. crop was classified under the program. And from the mid-1960s to the present, Smith-Doxey cotton represented roughly 95 percent of the crop. In summary, detailed quantitative studies on the diffusion and impact of Smith-Doxey services suggest that the program had a significant impact on narrowing the gap between local and central markets in cotton classing. 62

The one-variety community movement and the Smith-Doxey program at the same time ran counter to and reinforced the larger Agricultural Adjustment Administration (AAA) acreage-reduction and price-support programs that became fixtures of the cotton economy in 1933. The main push of the early AAA programs was to plow up cotton land in 1933 and later to restrict acreage to deal with the problem of “over production.” The one-variety community movement helped increase yields and added to total output. But the movement also encouraged higher quality production, increasing the competitiveness of American cotton and raising farm incomes. Paradoxically, the AAA’s early price-support programs gave many cotton farmers an incentive to reduce quality at the same time that AAA officials were touting the benefits of higher quality production. This is because “up to 1938 cotton loans were made at a

59 Faught, “Cotton Price,” p. 3.
60 Ibid., pp. 14–15 and 26–27. As is often the case in the American federal system, experiments initiated by individual states subsequently provide a model for national programs. This appears to have been the case with the Smith-Doxey classification system. In the early 1920s, at the urging of local Farm Bureaus, the California State Department of Agriculture began a successful public classing service. Blair, “Grade,” pp. 628–31.
62 USDA, Consumer and Marketing Service, “Story,” n.p. From Brown and Ware’s account it is likely that many one-variety communities were Smith-Doxey groups, but that Smith-Doxey groups were not enumerated as one-variety communities. Brown and Ware, Cotton, p. 83.
flat rate regardless of grade and staple length,” thereby generating a form of Gresham’s law with bad cotton driving out good. 63 Starting in 1938 loan differentials came to be based on the price differences of each staple length and grade in ten spot markets, thus giving farmers a stronger incentive to produce higher quality cotton. By making grading services widely available, the Smith-Doxey Classing Act helped facilitate this change in loan policy.

---

63 Shepherd, Agricultural Price Control, pp. 64–72. Although Shepherd is correct for many pre-1938 years, the AAA loan programs in 1933 and 1934 offered two rates—one rate for cotton classed as low middling or better of 7/8-inch staple and another for cotton less than 7/8-inch staple. Even the two-rate system was a far cry from the myriad loan rates in effect in 1938 and after. Richards, Cotton and the AAA, pp. 213–30.

---

### Table 5: Farmer Participation in the Smith-Doxey Cotton Grading Program

<table>
<thead>
<tr>
<th>Crop Year</th>
<th>Cotton Improvement Groups</th>
<th>Samples Classed (1,000 bales)</th>
<th>Share of U.S. Cotton Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1938</td>
<td>312</td>
<td>18,589</td>
<td>84</td>
</tr>
<tr>
<td>1939</td>
<td>918</td>
<td>64,399</td>
<td>265</td>
</tr>
<tr>
<td>1940</td>
<td>1,573</td>
<td>128,216</td>
<td>1,531</td>
</tr>
<tr>
<td>1941</td>
<td>2,511</td>
<td>278,782</td>
<td>2,520</td>
</tr>
<tr>
<td>1942</td>
<td>2,465</td>
<td>281,100</td>
<td>3,567</td>
</tr>
<tr>
<td>1943</td>
<td>2,459</td>
<td>281,493</td>
<td>3,337</td>
</tr>
<tr>
<td>1944</td>
<td>2,410</td>
<td>321,284</td>
<td>4,037</td>
</tr>
<tr>
<td>1945</td>
<td>2,444</td>
<td>343,000</td>
<td>2,888</td>
</tr>
<tr>
<td>1946</td>
<td>2,515</td>
<td>343,700</td>
<td>2,574</td>
</tr>
<tr>
<td>1947</td>
<td>2,453</td>
<td>346,500</td>
<td>4,300</td>
</tr>
<tr>
<td>1948</td>
<td>—</td>
<td>371,061</td>
<td>8,067</td>
</tr>
<tr>
<td>1949</td>
<td>—</td>
<td>497,064</td>
<td>10,456</td>
</tr>
<tr>
<td>1950</td>
<td>—</td>
<td>507,873</td>
<td>5,215</td>
</tr>
<tr>
<td>1951</td>
<td>—</td>
<td>495,391</td>
<td>9,844</td>
</tr>
<tr>
<td>1952</td>
<td>—</td>
<td>515,711</td>
<td>9,382</td>
</tr>
<tr>
<td>1953</td>
<td>—</td>
<td>—</td>
<td>12,700</td>
</tr>
<tr>
<td>1954</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1955</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1956</td>
<td>—</td>
<td>551,077</td>
<td>11,200</td>
</tr>
<tr>
<td>1957</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1958</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1959</td>
<td>—</td>
<td>699,632</td>
<td>13,703</td>
</tr>
<tr>
<td>1960</td>
<td>—</td>
<td>691,670</td>
<td>13,510</td>
</tr>
<tr>
<td>1961</td>
<td>—</td>
<td>678,749</td>
<td>14,016</td>
</tr>
<tr>
<td>1962</td>
<td>—</td>
<td>—</td>
<td>14,311</td>
</tr>
</tbody>
</table>

THE REVOLUTION IN U.S. COTTON PRODUCTION

There were many quantitative indices of the revolution in U.S. cotton production, including changes in cotton quality and in varietal concentration. Just as the one-variety advocates had planned, there was an almost immediate increase in the staple length in one-variety districts compared to nearby areas. The aggregate data on the length of U.S. cotton reflected these developments. Figure 2 shows that between 1928–1933 and 1945–1949 the average length of U.S. upland cotton increased by about one-eight of an inch, or four staple lengths. This was accomplished because farmers systematically substituted medium-staple varieties for short-staple varieties. The percentage of upland cotton 29/32 of an inch and less fell from over 50 percent in 1928–1932 to less than 14 percent in 1944–1949. Between 1928–1930 and 1946–1947 the percent equal to or greater than one inch increased from about 22 percent to about 73 percent. Mississippi has traditionally been known for producing high quality cotton. Writing in 1950, J. F. O’Kelly noted that “twenty years ago only 31 per cent of the cotton produced in Mississippi was 1 to 1-1/32 inches. Currently 92 per cent of the State’s cotton is in this staple range.”64 At the other end of the scale, cotton less than one inch fell from 45 percent in 1928–1930 to about 2 percent of Mississippi’s production in 1946–1947. Similar progress occurred across the Cotton Belt. As an example, “the South Carolina crop went from an esti-

mated 20 percent cotton stapling 15/16 inch and longer in length in 1926 to over 97 percent of such lengths in 1943. With this increase in length there has also been an increase in per acre yield."65 A number of factors such as changing cultural practices surely contributed to the change in cotton quality and yields. But the rapidity of the change (with local yield increases and longer staples reported within a couple of years following the introduction of a community), and widespread contemporary testimony point to the one-variety movement as an important catalyst for the changes.66

In addition to promoting the production of longer-staple cottons, the one-variety program contributed to a dramatic decline in the number of varieties of cotton grown in the United States. One-variety advocates saw this decline in bio-diversity as a positive step. One of the USDA’s initial goals was to significantly reduce the number of varieties, in order to eliminate inferior cottons, to reduce the problems of cross-pollination and gin mixing, and to promote standardization of the resulting product. Nobody really knows how many varieties and strains of cotton were being grown in the American South in 1930. In 1907 Tyler listed over 600 varieties, and given the tendency for the number to increase due to mutations and cross-pollination, it is likely that substantially more existed at the dawn of the one-variety movement. Westbrook claimed that there were about 300 varieties being grown in Georgia alone in 1930.67 Many of these so-called varieties were undoubtedly just different local names for the same variety, but the exact number is not so important as the general magnitude in relation to what existed after the one-variety movement picked up steam. With rare exceptions, such as the Acala communities in the West, no single variety dominated a given region or state in 1930. This situation changed rapidly.

In 1954 only ten varietal types (a variety such as Acala had several strains) accounted for over 77 percent of the cotton grown in the United States, and five pure varieties accounted for almost 52 percent of the nation’s crop. A single variety (Deltapine 15) made up 25.5 percent of all U.S. cotton acreage. Contemporaries credited the one-variety campaign with playing a major role in causing the concentration of varieties. As an example, according to the 1947 Congressional hearings on cotton quality “the one-variety program has reduced the number of varieties grown and stan-

65 U.S. Congress, Testimony of George J. Wilds, in Cotton Hearings, 78th Cong., 2nd Sess., 4–9 December 1944, p. 399. Wilds was the president of Coker’s Pedigreed Seed Company.
66 Ware, “Plant Breeding,” p. 662. According to most commentators one-variety communities facilitated education campaigns and provided incentives that stimulated the adoption of better cultural methods. See Brown and Ware, Cotton, p. 84. The relatively small premium in the length range applicable to most farmers may represent yet another example of what agricultural economists refer to as the “Cochran Effect,” meaning that the benefits of a technological change are largely passed on to consumers.
67 Westbrook, “One-Variety Cotton,” p. 16. Westbrook’s assertion that 1,200 varieties had been grown in the United States in 1930 is probably a misreading of Ware. A 1947 Congressional report on cotton asserted, that before the one-variety cotton movement, over 500 were grown. U.S. Congress, Hearings, 80th Cong., 1st Sess., Part 2, 10 October 1947, p. 955.
standardized the entire crop of the organized areas on a few improved high-yielding varieties.” Brown and Ware were equally emphatic: “The cotton-varietal-standardization movement . . . has practically made over the situation in cotton varieties in America and has thereby contributed greatly to quality improvement of cotton.”

State-level data offer a clearer sense of the movement toward varietal concentration, because by the early 1950s several states had effectively become de facto one-or-two variety enclaves (see Table 6). These enclaves transcended state boundaries; as an example, Coker 100 Wilt comprised over 95 percent of the cotton grown in South Carolina, North Carolina, and Virginia. In many states the extent of de facto one-variety production far exceeded the production of official one-variety communities. Even in states with a greater number of varieties, such as Texas, a given region likely had a high concentration of a specific commercial variety whether or not there was a formal association of farmers.70 In 1952, 35 percent of U.S. cotton was

<table>
<thead>
<tr>
<th>Percentage of Acreage Planted To:</th>
<th>One Variety</th>
<th>One or Two Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>37</td>
<td>68</td>
</tr>
<tr>
<td>Arizona</td>
<td>81</td>
<td>86</td>
</tr>
<tr>
<td>Arkansas</td>
<td>62</td>
<td>77</td>
</tr>
<tr>
<td>Georgia</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>Illinois</td>
<td>72</td>
<td>90</td>
</tr>
<tr>
<td>Kentucky</td>
<td>83</td>
<td>98</td>
</tr>
<tr>
<td>Louisiana</td>
<td>84</td>
<td>89</td>
</tr>
<tr>
<td>Mississippi</td>
<td>76</td>
<td>82</td>
</tr>
<tr>
<td>Missouri</td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>Nevada</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>New Mexico</td>
<td>57</td>
<td>66</td>
</tr>
<tr>
<td>North Carolina</td>
<td>98</td>
<td>99</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>26</td>
<td>46</td>
</tr>
<tr>
<td>South Carolina</td>
<td>95</td>
<td>97</td>
</tr>
<tr>
<td>Tennessee</td>
<td>57</td>
<td>78</td>
</tr>
<tr>
<td>Texas</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Virginia</td>
<td>95</td>
<td>96</td>
</tr>
</tbody>
</table>

*Source: Compiled from Brown and Ware, *Cotton*, pp. 53–56.*
ginned in counties where one variety comprised 90 percent or more of acreage, and 46 percent came from counties where one variety accounted for 75 percent of the acreage.\footnote{Compiled from USDA, Production and Marketing Administration, Cotton Branch, *Cotton*. The shares are based on 1952 acreage and 1951 ginnings. With the concentration in varieties came a parallel concentration in the number of seed breeders and seed distributors. By 1961, “four large companies produce the cotton seed that is used on 90 percent of the planted acreage in the Southern and Southeastern States.” Waddle and Colwick, “Producing Seeds,” p. 188.}

Across the South local studies reported net benefits to one-variety community members similar to those we have reported. In addition, USDA scientists generated a number of more global estimates. In 1943 the Bureau of Plant Industry, Soils and Agricultural Engineering estimated that one-variety producers were receiving an additional return of $7.50 an acre. In 1945, C. B. Doyle reported a benefit of about $7.00 an acre to participating growers. He further reported that the USDA had invested $800,000 from 1911 through 1944 in creating the one-variety community system, and that this investment had generated an annual return in excess of $56 million in 1944 alone. In 1950 the USDA estimated that one-variety communities had generated an increased value to growers in the “old belt” over the 1938–1945 period of $260 million. The USDA reported cumulative expenditures on one-variety community development up to and including 1945 of less than one million dollars. In its presentations to Congress during the late 1930s and early 1940s, the USDA showcased the one-variety movement as one of its high profile programs, consistently reporting annual net benefits to participants in the range of $5 to $7 per acre. This compares with an average value of cotton lint of $33.90 per acre over the 1935–1944 period.\footnote{Porter, “Toward Standardized Cotton,” pp. 21–22; Doyle, “One- Variety Cotton,” p. 1; U.S. Congress, House Committee on Agriculture, *Research*, pp. 754–55; U.S. Congress, *Hearings*, 75th Cong., 3rd Sess., pp. 317–19 and 938–40, and *Hearings*, 78th Cong., 1st Sess., pp. 328–29; and U.S. Bureau of the Census, *Historical Statistics*, Series K553-555.}

Another important indicator that the one-variety movement contributed to the revolution in cotton production is the widespread support it received beyond the USDA, Extension Service, and grower communities. Representatives of the cotton textile industry, prominent breeders, leading shippers, and southern bankers all lauded the movement’s contributions.\footnote{Merrill, Macormac, and Mauersberger, *American Cotton*, p. 116; and U.S. Congress, *Hearings*, 78th Cong., 2nd. Sess., 4–9 December 1944, p. 399.}

In light of the subsequent developments in government policy regarding intellectual property rights in genetic materials, it is important to understand the incentive structure and position of private seed companies regarding one-variety communities. The innovative seed companies faced a number of interrelated problems. Such a firm’s primary contribution was its investment in research and development to produce new plant varieties; its value added in cleaning or providing seed treatments was generally secondary. As principally a seller of intellectual property, a seed company had to be able...
to exert market power and price above marginal cost to recoup its sunk R&D expenses. But even if a company could exercise market power, it faced the problems of a durable good monopolist—namely, it created its own competition—to an especially severe degree. In the textbook view, a durable-goods monopolist suffers from the following time inconsistency problem: it has an incentive to sell initially to high-demand buyers at a high price and in subsequent periods at lower prices (or equivalently offer improved quality for the same price) to attract the lower-demand buyers. But this threat causes the high-demand buyers to lower the initial price they are willing to offer. The preferred solution for the durable good monopolist is to lease the good, that is, sell the services rather than the good outright. If this proves infeasible, the firm may reduce the inter-temporal competition by reducing the durability of the good (planned obsolescence). Obviously this reduces the value of the good to the buyer and the firm must weigh this negative price effect against the positive effect in sustaining its market power to determine the optimal level of durability.

For seed producers, the problem of intertemporal competition is especially severe because the seed possesses the natural ability to produce multiple offspring. (For cotton, the multiple was on the order of 10–30 to one.) Hence, a farmer could purchase commercial seed to meet a fraction of his requirements and within a few seasons raise enough for his whole operation and have a surplus to sell to his neighbors. The seed companies could partially offset this latter form of competition through quality-control guarantees and branding. But in an environment with weak intellectual property protection, a company could not easily or effectively prevent its gene stock from serving as the basis of a competitor’s “improved” variety. These forces help explain why the desideratum for commercial seed breeders was a product without the ability to reproduce naturally; a seed such as an F2 hybrid or one with a Terminator gene.

In recent decades cottonseed companies were among the most vocal opponents of the one-variety law in California. Breeders also opposed more ambitious New Deal plans for the South. Shortly after the AAA began, leaders of the Cotton Section developed a program patterned on the California model for the South. This was a relatively centralized scheme that would have empowered the directors of the state experiment stations to choose one

---

74 These are only a few of the alternatives available. Another preferred solution for the durable good monopolist is to creditably commit to a price schedule or to provide buyback offers. For a general discussion of the durable-good monopoly problem see, Bulow, “Durable-Goods,” pp. 314–32 and “Economic Theory,” pp. 729–49.

variety of cotton for communities in their states. The directors were supposed to consider the diversity in growing conditions in defining community boundaries, but the hope was that large areas, possibly entire states, might convert to a single variety. The plan also called for an expansion of government breeding and seed-distribution activities. According to Cully Cobb, who headed the AAA’s Cotton Section, USDA Secretary Henry A. Wallace had tentatively signed off on the program, but at the last minute D. R. Coker convinced Wallace to scuttle it.76

But it would be wrong to conclude that such opposition was a constant. During the heyday of the one-variety community movement in the South the major seed companies embraced the effort and lent their support in spite of the communities’ seed multiplication and distribution policies. In his 1938 article “Break This Vicious Circle Which Shuts You Out From Cotton Seed Sales” that appeared in the inaugural issue of Southern Seedsman, Austin Burges argued the “opening wedge must be one-variety communities” and that assisting their development “means heavy extra profits for the seed dealer.”77 George J. Wilds, the president of Coker’s Pedigreed Seed Company, spread the same message in his 1944 Congressional testimony: “the one-variety community is the best solution for all of us interested in cotton.”78 Seed company marketing policies conveyed the same theme. The USDA noted that “the 1947 catalog of the largest commercial cottonseed breeding firm in the Southeast states” [presumably Coker] contained a strong endorsement of one-variety communities, asserting that they had been of great value to breeders, growers, and manufacturers. Coker also adjusted its breeding and marketing program to support cotton standardization. Other breeders jumped on the bandwagon. “To further promote standardized production two other large commercial breeders in the Mississippi Valley [most likely D&PL and Stoneville], who furnish the foundation planting seed for the great bulk of the one-variety communities in the Central and Eastern States, have adopted the policy of retaining the same varietal name for their new stocks from year to year, thus simplifying the continued operation of the one-variety developments.”79 Other evidence suggests that up to the early 1950s the major seed companies saw the growth of one-variety communities as a bonanza to increase sales.80 Dr. C. W. Manning, an early breeder with the Stoneville Pedigreed Seed Company, recalled that his firm gladly sold to one-variety communities knowing full well that they planned

77 Burges, “Break This Vicious Circle,” pp. 5, 6, 29.
80 Coker had long encouraged farmers to buy enough seed for a seed patch and then use the resulting seed to plant their entire crop the following year. Coker catalogs also contained glowing farmer testimonials describing how they made money increasing and selling the improved seed to neighbors. Seed certification programs and later the Plant Variety Protection Act helped reduce this form of competition. Webb, “Private Cotton,” pp. 522–34.
to increase the seed and supply it to local farmers. This meant “the company had to put more salesmen on the road.” 81 Evidently in this evolutionary stage in the development of the cottonseed business some market was better than no market.

Before World War II, the leading private breeders were typically small and near the margins of commercial viability as stand-alone operations. Coker’s Pedigreed Seed Company of Hartsville, SC, the “South’s Foremost Seed Breeders,” appears chiefly to be the farm-improvement hobbyhorse of its wealthy, public-spirited owner, D. R Coker. The firm’s weak financial record over the 1920s and 1930s led Coker to consider handing over the operation to a philanthropic organization, such as the Rockefeller Foundation, to support as a southern improvement project. 82 The leading commercial breeding operation in the mid-South was a subdivision of the Delta and Pine Land Company, a 38,000-acre plantation in the Mississippi Delta. Building on its success in creating early maturing, high yielding, high quality seed for its own lands, D&PL became a major seed supplier. According to Fortune,

81 Phone interview by authors with Dr. C. W. Manning of Leland Mississippi, 1 February 2002. Manning’s statement referred to the period around 1950. Early C. Ewing, Sr., the head breeder at D&PL also linked the increased popularity of improved seeds with “the phenomenal growth of one-variety communities, one-variety gins, and one-variety farms. . . .” Early C. Ewing, “History of Cotton Varieties,” D&PL Company Records, Box IX, “History: Published Material,” D&PL archives.
the company sold “more cottonseed to planters than any other single world agency” in the mid-1930s.\textsuperscript{83} Yet for all of D&PL’s prominence, its sales over the 1925–1934 decade averaged only about 1,060 tons per year, which represented less than 1 percent of the seed planted for the U.S. cotton crop. Figure 3, graphing D&PL sales from 1925 to 1964, shows that this situation changed significantly after the one-variety movement took hold. The series reveals many ups and down reflecting weather conditions and interfirm competition.\textsuperscript{84} Despite a 62-percent reduction in U.S. cotton acreage and a more than 50 percent decline in seeding rates, D&PL sales over the 1955–1964 period were over seven times those prevailing 30 years earlier.

It is possible to obtain a summary view of the change in the source of seed supply. According to various accounts the vast majority of seed used before 1930 was “gin run.” As noted previously, Doyle asserted that in the 1920s and in the early 1930s only 5 to 10 percent of cotton planting seed came from breeders and dealers. By 1955, purchased seed made up 74 percent of the cottonseed used for planting.\textsuperscript{85} Notably, 70 percent of the purchased seed and 52 percent of all planting seed in 1955 was comprised of certified seed.\textsuperscript{86} In 1971, only about 19 percent of cotton farms nationally (with 19 percent of acreage) planted seeds they grew themselves. The fractions were even lower if Oklahoma and Texas are excluded. Outside of these states, 15 percent of farms (with 13 percent of acreage) reported using homegrown seed. At this time, certified seed was planted on 64 percent of cotton farms nationally (and 74 percent of those outside Oklahoma and Texas).\textsuperscript{87}

The timing of the takeoff in the adoption of improved seed varieties clearly predates adoption of the mechanical harvester (see Table 7). In 1940,
when the mechanical harvester was still in its infancy, there were 98,000 acres approved to produce certified cottonseed. At prevailing seed yields (0.236 tons per acre over the 1946–1948 period) and seeding rates (32 pounds per acre), the output of this acreage would have been sufficient to plant less than 6 percent of U.S. cotton land (outside California). By the 1952–1954 period, there was an average of 577,000 acres approved, producing sufficient certified seed for over half of U.S. cotton land (outside California). Moreover, the average quality of noncertified seed also increased, because it was apt to be only a generation or two removed from certified seed. After the mid-1950s the number of approved acres fluctuated, but the percentage of the crop planted with certified seed continued to grow because with improved seed varieties, delinting (described in the next section), and improved mechanical seeders, the amount of planting seed required per acre of cotton declined substantially.88

THE DEMISE OF THE ONE-VARIETY MOVEMENT

By the mid-1950s the USDA had de-emphasized its one-variety community campaign in the South. After 1952 the USDA Bureau of Plant Industry “relinquished much of its part” in the one-variety program and began clos-

88 Hackleman and Scott, History, p. 53. Acres planted come from USDA, “Statistics,” p. 63. By 1980, nearly all planting seed outside the High Plains was certified. Between the 1930s and the 1990s, seed planting rates outside the High Plains declined from about 34 pounds per acre to as low as eight pounds an acre due to better seed and improved cultural methods.

### Table 7

ACREAGE AND PRODUCTION OF CERTIFIED COTTON SEED, 1940–1957

<table>
<thead>
<tr>
<th>Year</th>
<th>Foundation (thousands of acres)</th>
<th>Registered (thousands of acres)</th>
<th>Certified (thousands of acres)</th>
<th>Total (thousands of acres)</th>
<th>Foundation (thousands of tons)</th>
<th>Registered (thousands of tons)</th>
<th>Certified (thousands of tons)</th>
<th>Total (thousands of tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940</td>
<td>98.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1945</td>
<td>296.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>297.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1947</td>
<td>436.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1948</td>
<td>506.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>558.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>10.4</td>
<td>169.1</td>
<td>271.0</td>
<td>450.5</td>
<td>2.9</td>
<td>34.1</td>
<td>70.1</td>
<td>107.1</td>
</tr>
<tr>
<td>1951</td>
<td>6.5</td>
<td>225.9</td>
<td>406.9</td>
<td>639.3</td>
<td>1.4</td>
<td>44.5</td>
<td>95.7</td>
<td>141.6</td>
</tr>
<tr>
<td>1952</td>
<td>9.5</td>
<td>277.4</td>
<td>414.6</td>
<td>701.5</td>
<td>2.8</td>
<td>76.2</td>
<td>104.2</td>
<td>183.2</td>
</tr>
<tr>
<td>1953</td>
<td>7.7</td>
<td>216.0</td>
<td>343.4</td>
<td>567.1</td>
<td>2.5</td>
<td>80.7</td>
<td>89.2</td>
<td>172.5</td>
</tr>
<tr>
<td>1954</td>
<td>4.9</td>
<td>183.7</td>
<td>272.9</td>
<td>461.4</td>
<td>1.4</td>
<td>58.5</td>
<td>85.5</td>
<td>145.4</td>
</tr>
<tr>
<td>1955</td>
<td>8.4</td>
<td>62.5</td>
<td>294.3</td>
<td>365.2</td>
<td>3.1</td>
<td>21.7</td>
<td>98.9</td>
<td>123.6</td>
</tr>
<tr>
<td>1956</td>
<td>6.9</td>
<td>120.9</td>
<td>246.3</td>
<td>374.1</td>
<td>2.4</td>
<td>34.0</td>
<td>61.6</td>
<td>98.0</td>
</tr>
<tr>
<td>1957</td>
<td>7.5</td>
<td>94.4</td>
<td>201.8</td>
<td>303.7</td>
<td>3.3</td>
<td>23.7</td>
<td>83.1</td>
<td>110.1</td>
</tr>
</tbody>
</table>

Notes: Acreage and output exclude California activity.

ing many of its regional offices. By the end of 1954, the program was “turned over to the agricultural extension services.” In roughly the same period, the Agricultural Marketing Service also de-emphasized the requirement that farmers be members of a cotton improvement group, opening up Smith-Doxey classification to farmers who contacted their county agents. From the USDA’s perspective, the program had served its purpose of educating farmers about the importance of growing high-quality cotton, and a number of technological and institutional changes made the one-variety concept less appealing. The maturation of a commercial seed industry able to supply abundant quantities of high-quality foundation seed was an important reason for the demise of one-variety communities in the traditional Cotton South. With the increased presence of quality private breeders and strict new seed-certification systems, the seed multiplication activities of one-variety communities became unnecessary. At this juncture the South took a different path than California where a legally entrenched bureaucracy, with its own internal seed-breeding program, prevented competition from private breeders. Southern one-variety communities, which were more loosely organized and did not have in-house research and breeding operations, were always dependent on private breeders or experiment stations for their foundation seed.

The development of high-quality varieties that gained favor over wide areas was just one of a series of economic and technological changes that made one-variety communities obsolete in the South and may help account for the finding that California’s system was inefficient by the late 1970s. Among the most important of these changes was the development and diffusion of acid delinting (and later other chemical treatments) of planting seed. This technology would eventually strengthen the position of commercial seed companies, increase farm productivity, and facilitate the mechanization of the last major bastion of hand labor in the production of cotton.

When upland cotton is ginned, the seeds remain “fuzzy” because the gin fails to remove all of the lint. Throughout the ages farmers planted fuzzy seed and then chopped (thinned) the cotton plants to obtain an even stand. Chopping cotton was a labor-intensive activity, requiring nearly as many worker-hours as picking. Fuzzy seeds worked poorly with mechanical seeders because they would clump together and clog the machines. Clumping also made it difficult to obtain a well-spaced, uniform stand whether the seed was planted by hand or by machine. More precise planting to a row greatly reduced the need for chopping, increased yields, and allowed for

---

89 Westbrook, “One-Variety Cotton,” p. 17. In most areas of the South, the state extension services had folded the one-variety program into the new “Seven-Step Cotton program” beginning in 1945. This program also addressed emerging issues such as cotton mechanization and chemical application. USDA, Report of Cooperative Extension Work, 1946, p. 29.

90 USDA Agricultural Marketing Service, “Get Your Green Card,” pp. 4–5. The Smith-Doxey services continue to this day, although the program is now called Form 1 classification.
more efficient machine cultivation. The solution was to delint the cotton, using one of several technologies. In California, the use of machines to delint planting seed dates to the beginning of the industry and was widespread by the 1940s. By the 1950s the technology had gained popularity in the Cotton South, and it remained the most common form of delinting to the early 1970s. Essentially the cotton was reginned using special machinery designed to remove most of the lint. This helped in planting with machines, but the remaining lint still made it difficult to obtain an even stand, and thus the need for chopping continued. The next stage was to expose the mechanically delinted seed to an intense flame to burn off the remaining lint. This improved the seeds’ handling characteristics but not sufficiently for precision metering during planting. The ultimate solution was to use one of several acid processes to chemically delint the seed. Besides allowing farmers to mechanize seeding operations and dispense with chopping, acid-delinted seed offered several other advantages. Delinting (and indirectly the more even spacing of plants) allowed cotton to come to a stand earlier, which was a real plus, especially given the threat of the boll weevil. In addition, acid delinting reduced plant diseases and greatly increased germination rates. For these reasons, farmers needed much less planting seed.

Delinting cottonseed with acid on the farm was an unpleasant and hazardous task. Experiment-station reports provided detailed instructions on how to prepare the acid and soak the seeds, noting the obvious: “Never add water to the acid, as this causes a violent reaction.” For all the benefits, the cost of the acid and the unpleasantness of the task sharply limited the number of cotton farmers adopting the delinting technology. But H. P. Smith saw the handwriting on the wall in 1950 when he noted that “most cotton growers plant regularly ginned seed which are covered with fuzzy lint. Mechanization may be influencing the trend toward delinted seed.” In the 1960s with the development of improved acid technologies and with the advent of the mechanical cotton harvester, the acid processes began to compete more effectively with

92 Camp, “Cotton Culture,” p. 8. Machine delinting in the South was common earlier because the linters had value, especially during World War I when they were used to make munitions. Agelasto et al., “Cotton,” pp. 381–83. Evidence on the use of delinted seed for planting is sparse, but as early as 1922 D&PL’s standard practice was to sell mechanically delinted seed. Delta and Pine Land Co. of Mississippi, *Salisbury Cotton*, D&PL Records, Box 1, Oral History, D&PL archives.
94 Sherbakoff, *Improved Method*, p. 2. Emphasis is in the original.
95 Smith, “Cultural Practices,” p. 144. Brown’s comment that “some authorities recommended delinting cotton seed that are to be used for planting purposes,” suggests the lack of adoption in 1938. Brown, *Cotton*, 2nd ed., p. 212. In 1943, Alexander still asserted that delinting was relatively expensive. Alexander, *Arkansas*, p. 81. In the mid-1950s Christidis and Harrison still recommended machine rather than acid delinting. They noted that the later processes were only “occasionally” used. Christidis and Harrison, *Cotton*, pp. 310–11.
machine delinting. In 1970 P. R. Smith estimated that roughly 95 percent of U.S. planting seed was delinted, with acid delinting accounting for 23 percent of the planting seed in California, about 90 percent in Texas and Arizona, 15 percent in the Mid-South, and 40 to 50 percent in the Southeast.  

The adoption of delinting (and especially acid processes) reflects the interaction effects of mechanical and biological technologies as the diffusion of one reinforced the demand for the other. It was in the interest of farmers to have ample labor during the peak season. Thus, as an example, adopting tractors that would save labor in plowing would only exacerbate the imbalance between the peak and nonpeak needs, potentially leading to labor shortages during the peak period. Farmers who adopted a mechanical picker had an added incentive to reduce chopping labor requirements, and planting acid-delinted seed made that possible. Moreover, the new planting technologies made the mechanical picker much more efficient. If plants are too widely spaced, they develop woody branches that hinder machine performance. With delinted cotton and a mechanical seeder, farmers could achieve a thick, uniform stand suitable for efficient machine operation, and eliminate most of the labor required for chopping. The result was that, whereas acid-delinted seed was rare in 1950, it was gaining acceptance in the 1960s, and common practice by the late 1970s.

The new cottonseed-delinting technologies offered significant economies of scale with the production of delinted seed typically concentrated in a few plants in any one state. The adoption of delinted seed had enormous implications for the growth of the commercial cottonseed industry that were analogous to the implications of hybridization to seed-corn producers. Corn farmers had to purchase new seed every year because pureline F2 hybrids lost their vigor in a single generation. But the improved cotton varieties were not F2 hybrids and thus farmers could recycle seeds, significantly reducing the demand for new commercial seeds. But delinting dramatically increased the economic benefits of purchased seed relative to gin-run seed, stimulating farmers in most regions to buy seed annually. This single technological change greatly reinforced the benefits that cottonseed companies received in 1970 with the passage of the Plant Variety Protection Act.

Elliot, Hoover, and Porter, Advances, pp. 125–26. Smith, “Introductory Remarks,” p. 90. Smith claimed that 70 percent of the planting seed in Georgia was acid delinted. Leaders in the development of the California cotton industry maintain that acid delinting came much earlier than Smith claimed. In Arizona acid delinting appears to have been gaining wide favor as early as 1938, and at least one commercial delinting plant was in operation by that date. “Much Delinted Seed,” p. 4. Beginning in 1938 the firm of Feffer-Wharton regularly advertised its acid-delinting services. Feffer-Wharton, 1 March 1938, p. 4 and 15 March 1938, p. 17. By 1962, 90 percent of D&PL seed sales in Arizona were acid delinted. Sales Department Review, April 1962, Box 19, D&PL archives.

Along with delinting came a number of other chemical seed treatments to control diseases and insects. The upshot was that cottonseed in the 1960s not only was higher quality in terms of its yield potential than seeds of the 1930s, the modern seed embodied numerous other valuable technological features. These included a greater responsiveness to the nitrogen-rich fertilizers, which were falling in price. Thus by the late 1970s (at the time of Constantine et al.’s estimates for California) a new division of labor had been firmly established. In most regions nearly all farmers bought delinted certified seed nearly every year. The old practice of planting one’s own seed obtained at the gin had become a rarity. The new seeds were produced in tightly controlled isolated areas to help guarantee purity. These changes in seed technology, certification, and marketing, along with the development of superior varieties that effectively captured the market in whole regions or states, simply ended the need for formal one-variety communities. It mattered little if seed was mixed at the gin if it was not intended for planting. In addition, the problem of cross pollination in the field was minimized by the annual purchase of new seed, the *de facto* one-variety production, and by the decades of insecticide use that reduced the density of insects.\(^9^8\) The old production externalities that had haunted the industry were no longer an issue. In addition the nearly universal use of Smith-Doxey classification services, and later the adoption of extremely accurate high volume electronic testing devices, largely solved the problems of classing cotton. Thus, with the major exception of California, one-variety communities simply faded away, having served their purpose in helping promote the transition to better cottons and improved cultural and marketing practices.

**CONCLUSION**

In 1957 James Street published his classic, *The New Revolution in the Cotton Economy*. For Street the cotton revolution involved a wholesale transformation in cotton production—a transformation that was critical for the modernization of the southern economy. But Street’s story of technological change focused largely on mechanization, with only occasional mention of cotton breeding and improvement activities, and then usually in the context of how breeders were assisting in the drive to develop plant qualities conducive to mechanizing the harvest.\(^9^9\) The message of this paper is to

\(^9^8\) Yet a final factor in the demise of one-variety communities was the development of high volume instruments that could rapidly and accurately quantify the important characteristics of cotton samples, and the increased ability of mills to handle less uniform cotton. These innovations reduced the premium to uniform production.

\(^9^9\) For example, see Street, *New Revolution*, pp. 112–13 and 147–48. Street’s emphasis is consistent with the broader treatment of technological change in agriculture. As an example Peter McClelland’s recent book *Sowing Modernity* has a chapter on sowing that offers marvelous detail on the machines that sowed the seeds, but almost no mention of the changing qualities of the seeds fed into the machines. McClelland, *Sowing Modernity*, pp. 64–93.
emphasize the importance of the other revolution in the cotton economy. Biological and structural rather than mechanical, this revolution led to a fundamental change in the source of seed supply, in the varieties of cotton grown, and in how cotton was classed and marketed. One of America’s leading cotton breeders, J. Winston Neely offered an assessment of recent accomplishments as of the late 1950s:

. . . the progress made by cotton breeders is truly phenomenal. Yields have been markedly increased. Varietal resistance to diseases, resulting from breeding programs, has made profitable the growing of crops where non-resistant varieties would fail completely. The quality of fiber produced by improved varieties has been greatly increased. Characteristics of plant type, growth habit and fiber quality of many varieties have been altered by breeding, to the extent that they are much better adapted to cheaper and better methods of planting, culture, harvesting and processing. We would be growing far less cotton today if we had to depend upon varieties grown only a few years ago.100

These changes, rather than the arrival of the mechanical picker, accounted for the roughly tripling of American cotton yields and the significant increases in average staple length between 1930 and 1960.101 As Neely noted, the new biological technologies interacted with mechanical technologies reinforcing the drive to increase southern agricultural productivity. Because of these interaction effects with mechanical technologies, the new biological systems had a far greater effect in reducing labor demand than analogous biological innovations in the grain sectors. Thus biological innovations represent a hitherto unrecognized factor contributing to the changes in farm tenure and farm scale that transformed the southern landscape in the mid-twentieth century.102

What fundamentally separated the biological revolution in cotton from what transpired in corn and most other crops was the greater role that the USDA played in orchestrating institutional innovations. In the nineteenth and early twentieth centuries, USDA research programs played a key role in improving the quality of seed supplies of most major crops. USDA scientists searched the globe for useful varieties, and government breeding, testing, and outreach programs made an enormous contribution to help transform the seed supplies available to American farmers.103 In addition, the USDA focused on improving the efficiency of seed markets. Seed embodies a complex array of technical characteristics that are difficult for an individual farmer to assess. Evaluations about the relative performance of different varieties and the quality of a given batch of seed (for example, was it

100 Neely, “Cotton,” p. 74.
101 As with corn, other factors such as the application of improved fertilizers, herbicides, and insecticides clearly contributed to cotton yield increases.
102 The causality ran both ways because the decline in tenancy and consolidation of plantations undoubtedly also hastened the adoption of the new biological technologies.
103 Olmstead and Rhode, “Red Queen.”
cleaned and stored properly, etc.) usually must wait until the harvest, and
given annual variations in growing conditions, several years may be re-
quired to make a reliable assessment. As a result, the development of a
market in seed requires particularly good information and mechanisms for
providing guarantees to farmers and building trust between seed buyers and
sellers.\textsuperscript{104} For most crops, the USDA (often following the lead of individual
states) helped create markets by developing national procedures, laws, and
agencies for testing and certifying the genetic and physical characteristics
of seed. But in the case of cotton, the task of market development was com-

cplicated by the exceptional problems in maintaining pure seed supplies, and
the failure of local cotton prices to reflect the relative premiums and dis-

\textsuperscript{104} Tripp, “Institutional Conditions,” p. 24.

\textsuperscript{105} It is important to note that the problems of maintaining pure seed supplies and of grading cotton
were not unique to American growers, and that other countries, including Egypt, Brazil, Argentina, and
India, experimented with one-variety communities in the 1930s and 1940s.

\textsuperscript{105} It is important to note that the problems of maintaining pure seed supplies and of grading cotton
were not unique to American growers, and that other countries, including Egypt, Brazil, Argentina, and
India, experimented with one-variety communities in the 1930s and 1940s.
REFERENCES


______. “Cotton, Irrigation, and the AAA.” Interview conducted by Willa Klug Baum.


Coker’s Pedigreed Seed Company Catalog, Spring 1917. Rare Book, Manuscript, and Special Collections Library, Duke University, Durham, North Carolina.

Coker’s Pedigreed Seed Company Catalog, Spring 1918. Rare Book, Manuscript, and Special Collections Library, Duke University, Durham, North Carolina.

Coker’s Pedigreed Seed Company Silver Anniversary Catalog, Spring 1927. Rare Book, Manuscript, and Special Collections Library, Duke University, Durham, North Carolina.


______. “One-Variety Cotton Communities.” USDA Bulletin No. 1111 (1922).


Delta and Pine Land Co. of Mississippi. Salisbury Cotton: A New Variety, Its History and Results Obtained from a 14,000 Acre Test at Scott Mississippi. Memphis, TN, October 1922. D&PL Records, Box I, Oral History, in Special Collections, Mitchell Memorial
Library, Mississippi State University.


______. “One-Variety Cotton Communities Provide for Superior Cotton Fabrics.” Research Achievement Sheet No. 45(P) (14 September 1945).


Hancock, N. I. “A New Method of Delinting Cottonseed With Sulfuric Acid.” University of Tennessee Agricultural Experiment Station Circular No. 61 (June 1938): 1–2.


Manning, C. W. of Leland Mississippi, phone interview, 1 February 2002.


Osband, Kent. “The Boll Weevil Versus King Cotton.” This JOURNAL 45, no. 3 (September 1985): 627–43.

Pike, Clarence E. “Cottonseed Improvement Associations.” Farm Credit Administration Circular C-130 (1947).


Sherbakoff, C. D. “An Improved Method of Delinting Cotton Seed With Sulphuric Acid.” *University of Tennessee Agricultural Experiment Station Circular* No. 3 (1926).


______. “Cotton Seed for Planting Purposes in Fair Demand.” Weather, Crops, and Markets 1, no. 3 (21 January 1922).


______. “Marketing Cotton Seed for Planting.” Market Reporter 1, no. 5 (31 January 1920).


______. Report of the Chief of the Agricultural Marketing Service for 1941. Washington,
Olmstead and Rhode

DC: GPO, 1941.

_____.


_____.


_____.


_____.


