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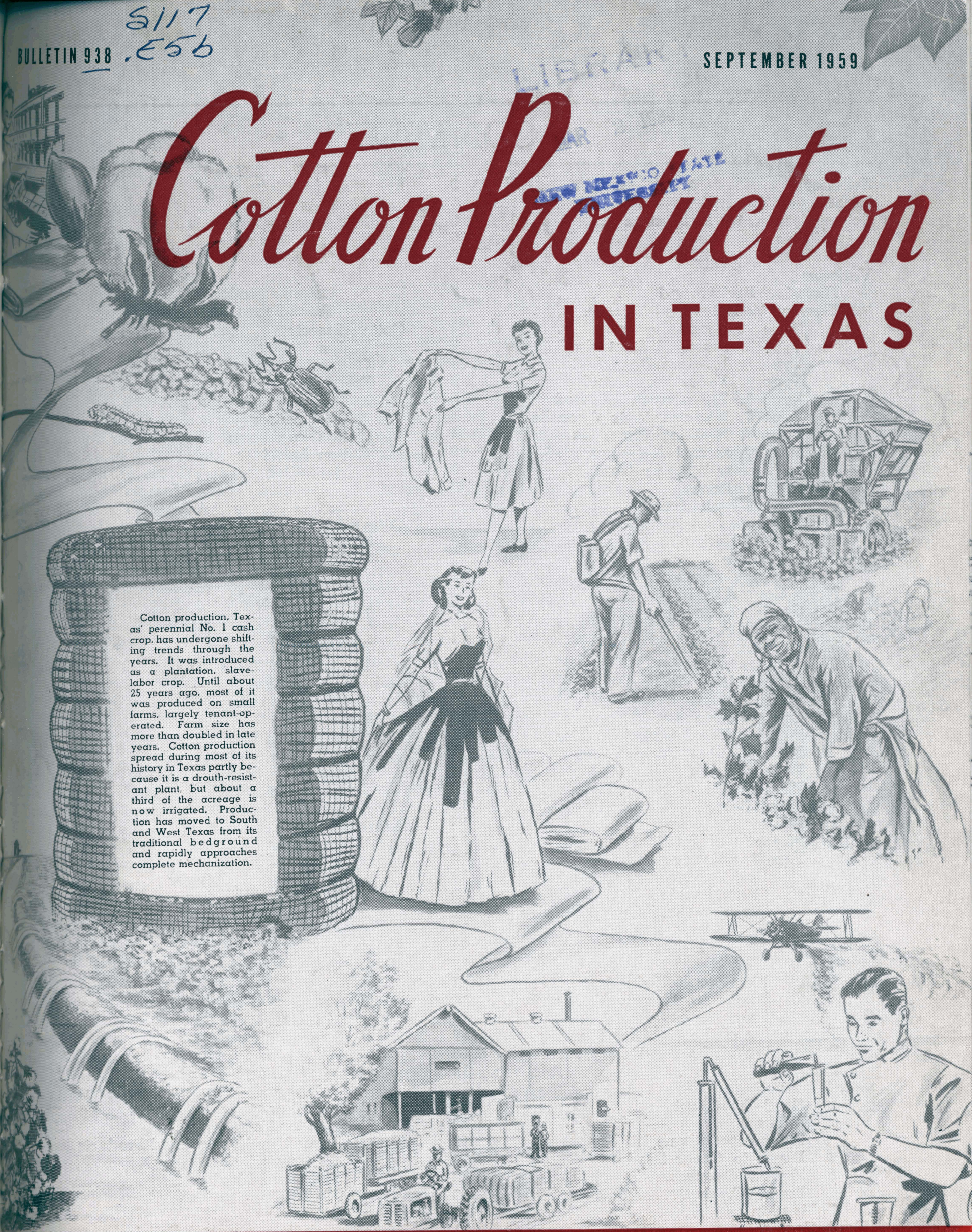
Cotton Production IN TEXAS



Cotton production, Texas' perennial No. 1 cash crop, has undergone shifting trends through the years. It was introduced as a plantation, slave-labor crop. Until about 25 years ago, most of it was produced on small farms, largely tenant-operated. Farm size has more than doubled in late years. Cotton production spread during most of its history in Texas partly because it is a drouth-resistant plant, but about a third of the acreage is now irrigated. Production has moved to South and West Texas from its traditional bedground and rapidly approaches complete mechanization.

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TEXAS AGRICULTURAL EXPERIMENT STATION - - - TEXAS AGRICULTURAL EXTENSION SERVICE

College Station, Texas

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SUMMARY

Cotton is the most valuable cash crop in Texas, although it now ranks second in acreage to sorghum for grain. For the 5 years, 1952-56, the Texas cotton crop, including lint and seed, had an average yearly value of more than $720,000,000. This was more than three times the combined value of wheat, sorghum grain and rice during the same period.

The High Plains, Rolling Plains, Blackland Prairies and the Lower Rio Grande Valley are the great cotton production areas in Texas. A minor concentration occurs around Corpus Christi. In recent years, much of the cotton production has shifted to areas where water is available for irrigation, notably to the High Plains, Lower Rio Grande Valley and Trans-Pecos area. Cotton grows well on many kinds of soil, but it seems to do best on moderately fertile, deep loam and sandy loam soils in good structure and having permeable subsoils.

There are about 80 named varieties of cotton available to Texas cotton growers. For convenience, these varieties are classed into seven broad types or classes having different characteristics. The relative acreages of these types grown in the several land resource areas of the State are given. The storm-resistant, big-boll type seems to be more widely grown than other types. Pima S-1, an American-Egyptian variety, is produced in Texas only in the Trans-Pecos area.

Cultural practices used in growing cotton in Texas are similar to those used in growing other row crops, such as corn and sorghum. Preparation of the seedbed usually is done in the fall or early winter. Preparation may include disking, chiseling, flat breaking or bedding (listing). In the humid part of the State, most of the cotton is planted on beds. In areas having less than 25 inches of average yearly rainfall, it usually is planted in lister furrows.

Cotton usually is planted after the average date of the last killing frost in the spring. The planting dates in Texas range from early February in the Lower Rio Grande Valley to May 15-June 20 at Lubbock on the High Plains. Much of the cotton in Texas is planted to a stand; that is, it is planted and not thinned, using 20 to 30 pounds of seed per acre. Plant populations of 40,000 to 60,000 per acre are about optimum for mechanical stripper harvesting, and 25,000 to 60,000 plants for machine picking.

The amount of cultivation done depends on the amount and distribution of rainfall, with a cultivation after each good rain. In the humid parts of the State, several cultivations usually are needed to control weeds. Fewer cultivations are required in the subhumid areas. Cultivation and hand hoeing are the principal methods of controlling weeds in cotton. Rotary hoeing, the use of weed-control chemicals and flame cultivation are supplementary practices. Rotary hoeing probably is the most widely used supplementary weed-control practice in Texas.

Many of the soils in Texas respond to fertilizers, but, where the average yearly rainfall is less than 30 inches, moisture generally is the first limiting factor in yields of cotton on dryland. Fertilizer recommendations are given for the several land resource areas.

Cotton is grown only under irrigation in the Trans-Pecos area and under supplementary irrigation on the High Plains, in the Lower Rio Grande Valley, scattered areas on the Rio Grande Plain and the Rolling Plains. The amount and frequency of irrigation depend on the amount and distribution of rainfall, stage of growth and other factors. On the High Plains, about 25 to 30 inches of water, including rainfall and irrigation, are about optimum for cotton production.

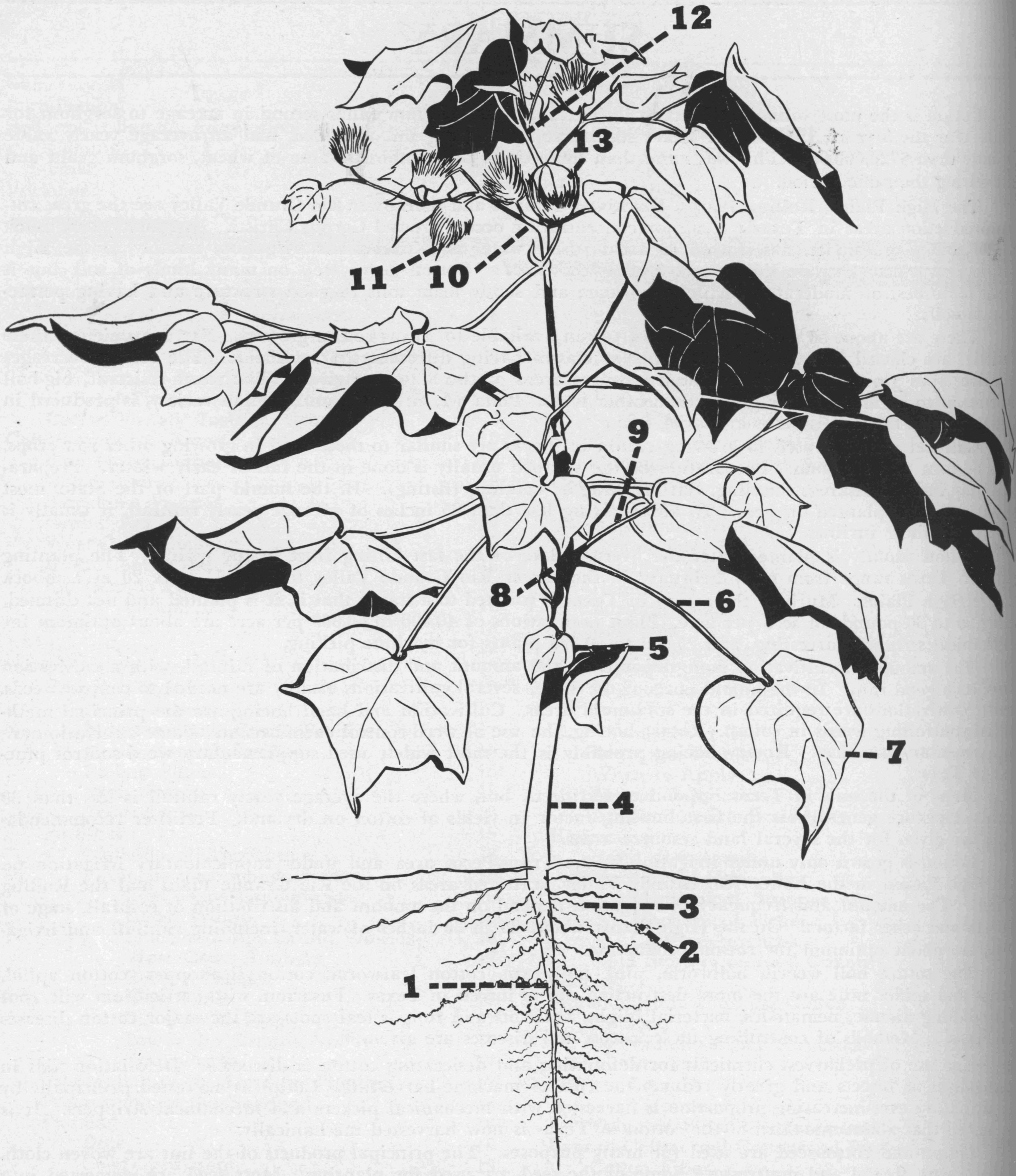
The cotton boll weevil, bollworm, pink bollworm, cotton leafworm, cotton fleahopper, cotton aphid, thrips and spider mite are the more destructive cotton insects in Texas. Fusarium wilt, verticillium wilt, root rot, seedling disease, nematodes, bacterial blight, boll rots and fungus leaf spots are the major cotton diseases in Texas. Methods of controlling these insects and diseases are given.

The use of preharvest chemicals for defoliating and desiccating cotton is discussed. Defoliation aids in the control of insects and greatly reduces the cost of machine harvesting. Cotton is harvested principally by hand, but an ever-increasing proportion is harvested with mechanical pickers and mechanical strippers. It is estimated that about one-third of the cotton in Texas is now harvested mechanically.

Cotton and cottonseed are used for many purposes. The principal products of the lint are woven cloth, cotton yarns, thread and mattresses. Some of the seed are used for planting. Most seed are converted into cottonseed oil, meal, cake, hulls and linters.

New manufacturing processes and chemical research have been used during the past few years to produce entirely new types of cotton fabrics. Some of the new fabrics may be washed and worn with little or no ironing. They are known popularly as "wash and wear." Others are wrinkle resistant. Some are durably crisp and others have high luster. Durable crispness is given to organdies and similar fabrics which are popular for wedding and party dresses, curtains and bedspreads. For winter wear, cotton fabrics are worn for warmth and appear bulky, but are light in weight.

Governmental policies regarding cotton production have had an influence on the industry in Texas.



BASIC STRUCTURE OF THE COTTON PLANT

1. Tap (main) root. 2. Root hair (feeder roots). 3. Lateral (branch) root. 4. Main stem (stalk). 5. Cotyledonary node and cotyledons (seed leaves). 6. Main stalk leaf petiole. 7. Main stalk leaf blade. 8. Main stalk node (joint). 9. Vegetative branch (leaves only). 10. Fruiting branch (leaves alternating with fruit). 11. Square (floral bud) that develops into the flower and eventually the boll. 12. Terminal bud or growing apex of shoot. 13. Young boll.

Cotton Production in Texas

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PRODUCTION OF COTTON, perennially Texas' most important cash crop, has undergone shifting trends through the years. It was introduced in the United States as a plantation, slave-labor crop. Until about 25 years ago, most of it was produced on small farms, largely tenant-operated. Cotton production spread in Texas partly because it is a drouth-resistant or drouth-evasive plant, but about a third of the present acreage is irrigated.

A little cotton was grown in Texas during Spanish and Mexican sovereignty, but rapid development came with Anglo-Saxon colonization after 1821. Most of the early settlers were from the "Old South" and they found the soils and climate of East and Southeast Texas much like those of their old homes.

From its early location along the lower Colorado and Brazos Rivers, cotton production spread rapidly through the East Texas Timberlands, the Blackland Prairies by 1861, westward across the Grand Prairie and West Cross Timbers, onto the Rolling Plains by 1890, and the High Plains by 1920. Next it moved into the Lower Rio Grande and El Paso Valleys, the Coastal Bend area around Corpus Christi, and only recently into the Pecos River Valley. As late as the 1920's, the Blackland Prairies were the center of Texas cotton production. Williamson, Ellis, Bell and Collin counties, in Central and North-Central Texas, long were the leaders in cotton production. In late years, no Blackland county has ranked higher than tenth in cotton production.

Eighteen counties on the High Plains adjacent to Lubbock, during the past 10 years, have produced, mostly under irrigation, more than a third of the State's cotton output. All cotton in the El Paso and Pecos River Valleys and most of the crop in the Lower Rio Grande Valley is grown under irrigation. Growth in the Coastal Bend is largely on dryland.

By many of its advocates, cotton is called a "wonder crop," since it produces the three essentials—food, feed and fiber.

The Census of 1849 showed a production of 58,000 bales (500 pounds each) in Texas, and that of 1859, 431,000 bales. The first million-bale crop was produced in 1878. In the 5-year period, 1926-30, annual average production was 4,612,000 bales on 16,627,000 acres. In the 5-year period, 1953-57, Texas produced an annual average of 3,908,000 bales on 7,327,000 acres. Between the two periods, depression-year markets, governmental restrictions and improved varieties and cultural and harvesting practices encouraged the retreat of cotton to acreages best suited to its production. From the beginning of commercial cotton growing in 1822 until the end of 1957, Texas produced about 266,929,000 bales. This represents a total valuation of about $20,000,000,000, taking each year's crop at its current value.

The large areas of relatively level, productive soils in Texas are favorable to mechanized production. For this reason, cotton mechanization has developed more rapidly in Texas than in most other parts of the Southern Cotton Belt. An ever-increasing percentage is machine-harvested. The mechanical picker is a large power-driven machine that is better adapted to large farms. The mechanical stripper uses a single or double revolving stripper roll or a set of stationary fingers which strip the seed cotton from the plant.

Formerly cotton was sold only on the basis of grade and length of staple. Scientific instruments have been developed which measure accurately the length, strength, fineness and some other characters of the fiber. These tests supplement grade and staple and greatly aid in determining the actual spinning utility of cotton.

The harvested seed cotton consists of the lint and seed. They are separated in ginning. Principal products of the lint are woven cloth, cotton yarn and thread, and waste that is sold to other industries for batting, wadding and mattress felts. Some seed are retained for planting. Most of the seed are converted into cottonseed oil, meal, cake, hulls and linters.

While Texas cotton geographically was in the path of the boll weevil as it invaded the Southern Cotton Belt from Mexico about 1901, and that of the pink bollworm from the early 1920's, the drier climate and higher altitude of much of the Texas cotton-growing areas have resisted these and other insect pests. Some of the limy soils of Texas, however, are infested with cotton root rot, one of the most destructive diseases of cotton.

Most of Texas' cotton has been grown for export. Situated in the southwestern part of the Cotton Belt, far removed from the center of domestic cotton milling, with deep-water ports on the Gulf of Mexico, Texas early became an exporter of cotton.

About 70 to 80 named cotton varieties and strains, ranging in fiber length from 7/8 to 1 7/8 inches, are grown commercially in Texas. The longer staple varieties are best adapted to the warmer, more humid areas and to irrigated areas. The shorter staples are grown on dryland farms in the drier areas and those with short growing seasons.

SOIL AND CLIMATIC ADAPTATION

Climate

The commercial production of cotton in the world lies within the limits of 37° N and about 32° S latitude, except in the Russian Ukraine, where cotton is grown up to 47° N latitude. In the United States, the 37° N parallel lies somewhat north of the northern boundary of North Carolina and extends through Cairo, Illinois, on westward across the interior states nearly 2° north of Amarillo, Texas, and through California, about ½° north of Fresno.

For successful production, cotton requires a relatively warm climate, with an average summer temperature of about 77° F, an average mean temperature of over 60° F and a frost-free season of 180 to 200 days. Cotton also requires a minimum of 20 inches of rainfall a year with suitable distribution during the growing season (or irrigation water) and many clear, sunny days which are favorable for high yields of lint.

In Texas, the northern limit of cotton production approximates the line for a 200-day frost-free growing season, which on the High Plains lies somewhat south of the 37° N parallel. The 200-day frost-free line deviates considerably from the 37° N parallel because it is affected greatly by altitude.

The average yearly rainfall in Texas ranges from 55 inches in the eastern part to about 8 inches at El Paso in the extreme western part. An average rainfall of 30 inches, if properly distributed through the year, will produce high yields of cotton. But, irrespective of the total amount of rainfall, the yield of cotton on dryland usually is restricted in most years by a deficiency of water sometime during the growing season.

The greatest concentrations of production are on the High Plains, mostly under irrigation, on the Blackland Prairies, in the Lower Rio Grande Valley and on the Rolling Plains. There also is a smaller concentration in the Coastal Bend area around Corpus Christi, along the Pecos River and in the El Paso Valley.

Soils

Cotton grows well on many kinds of soil. But it seems to do best on moderately fertile, deep loam and sandy loam soils in good structure, and having permeable subsoils. Such soils are readily permeable to air and water, are easy to till and remain in good structure. The Amarillo fine sandy loam on the High Plains and the Miles fine sandy loam on the Rolling Plains are the better cotton soils in those areas.

Hidalgo and Willacy fine sandy loams are the preferred soils for cotton in the Lower Rio Grande Valley. On the Rio Grande Plain, Brennan and Duval fine sandy loams are recognized as superior cotton soils.

Magnolia, Bowie and Nacogdoches fine sandy loams are among the better upland soils in the East Texas Timberlands.

Cotton apparently is not as sensitive to soil reaction as some other crops. It grows well on soils ranging in reaction from pH 5 to 8. The highly calcareous soils of the Blackland Prairies, in the Red, Brazos and Colorado River bottoms and the irrigated soils in the Trans-Pecos areas, which have soil reactions of pH 7 to 8, produce high yields of cotton.

THE ROLE OF COTTON

Cotton today is the friend of the poor and the luxury of the rich. It is made into cloth so coarse that it sells for a few cents per yard. It is made into fabrics so fine and so beautiful that it can hardly be told from silk, and so heavy and so thick that experts can hardly distinguish it from wool. It is made into rope and cord so strong that it is almost the equal of flax or hemp, and into thread so fine that one pound will reach more than a hundred miles. Every year manufacturers discover new ways of preparing it, and every year the demand for it increases, and the world, it seems, cannot have enough of it . . . And if, through some calamity, we should lose all goods made entirely or partly of cotton, and if all people should be thrown out of employment whose occupation is, in any way dependent upon it—whether in the cultivation, the manufacture or the commerce—the civilized world would be all but naked, a large percent of it would be hungry, and the homes would be bare and comfortless.

Eugene Clay Brooks

VARIETIES

Historical Background

The first commercial production of cotton in Texas was made by the Stephen F. Austin colonists, who settled along the lower Brazos River in 1821. They used seed of the varieties or stocks they had brought with them from Louisiana, Mississippi, Tennessee, Georgia and the Carolinas. As settlement of Texas grew and expanded, cottonseed were introduced into Texas from Mexico and Central America. Some of these stocks proved to be especially well suited to Texas conditions and were prized for their large, fluffy bolls. Famous "Texas Big Boll" varieties, such as Boykin, Mebane-Triumph and Rowden, were developed from these stocks.

Around the turn of the century, professional plant explorers collected large numbers of cottons in Mexico and other countries to the south. Trial plantings of these cottons were made at Victoria, Waco and Clarksville. The "Big Boll" cottons have contributed importantly to the development of modern cotton varieties in the entire Cotton Belt. A variety named Lone Star was developed from one of the introductions grown at Waco. Though this variety never gained widespread acceptance in its own right, it furnished the breeding stock for a number of important varieties, including Stoneville, which was bred in Mississippi. Varieties called Tuxtla and Kekchi soon faded out, but Paymaster 54, now produced by a commercial seed company on the High Plains, traces back to Kekchi. Another stock selected from the adaptation trial blocks at Clarksville was named Acala. Today this variety is widely grown in the Trans-Pecos area of Texas and in New Mexico, Arizona and California.

Current Varieties and Types

The production of cotton planting seed for sale to Texas farmers is in the hands of commercial seed firms and other private organizations, including farmers' cooperatives. The methods and practices of developing varieties and increasing the seed vary considerably. In some cases, foundation seed are obtained from the Texas Agricutural Experiment Station; in others, foundation or registered seed may be obtained from private seed firms; and in still others, the foundation seed stock is developed and maintained by the firm's own research organization.

There has been a free interchange of basic breeding material between public and private agencies and, in most instances, the pedigrees of current commercial varieties show that at one or more stages of their "evolution" the state experiment stations have made significant contributions. Operating as it does under the free enterprise system, the cotton planting seed business is highly competitive. When it is realized that breeding has been going on for more than 75 years in Texas under these competitive conditions, it is not surprising that most of the varieties of cotton now offered for sale are in a highly developed stage and perform well in the areas in which they are recommended for growing.

A field of cotton at the Lubbock station showing the two main types grown in Texas. Open boll cotton is at the left, storm-resistant cotton at the right. In mechanical harvesting, pickers are used mostly in open boll cotton, strippers in storm-resistant cotton.

The 1957 Seed Directory, published by the Texas Department of Agriculture, lists 51 different varieties of cotton of which registered or certified seed were produced for sale. Planting seed of several cotton varieties also are produced in Texas by seed firms that do not operate under the State Certification Program. Planting seed of a dozen or more varieties move into Texas from private companies and other organizations in other states. Thus, there are at present some 70 or 80 different named varieties of cotton from which Texas cotton farmers may choose.

In respect to yield, fiber properties, disease resistance and other major characteristics, the over-all range among these varieties is considerable, but differences amony many of them are slight to insignificant. All but one of the varieties, Pima S-1, belong to the same botanical group, *Gossypium hirsutum* and, therefore, they have the same general genetical, morphological and anatomical aspects. Such differences as exist among them are relative and matters of degree. For these reasons, cotton scientists have been unable to devise a system of classification below the species level that permits cotton varieties to be characterized or identified with unerring precision. Nevertheless, many problems in cotton improvement are such that it is impractical, if not impossible, to deal separately with each named variety available. Consciously or unconsciously cotton workers think of the cultivated varieties in terms of general types, and the type concept will vary somewhat from person to person.

For purposes of this bulletin, an attempt was made to fit the varieties of cotton grown by Texas farmers into seven classes or types. These types have been established largely on the basis of varietal origin and boll and fiber characteristics. These seven types, together with their description, general characteristics, principal varieties included within each type and their general distribution in terms of the land resource areas of the State are named following:

Type 1. Texas Big Boll

Varieties included in this group are derived principally from the Lone Star, Mebane and Rowden stocks. This "Big Boll" type formerly was the most popular cotton in Texas and occupied the greatest acreage in the eastern two-thirds of the State. In recent years, the popularity of the varieties of this type has lessened considerably, although there still are a good many varieties in production that were developed from the Big Boll stocks. Current varieties that can be considered in this group include Gorham's Lone Star, Bagley's B17 Rowden, Malone's Rowden, Malone's Mebane, New Mebane, Anton 22, Qualla 60, Kasch LL No. 7, Floyd 8G, Dortch 4016 and others.

Type 2. Storm-resistant Big Boll

This type resembles in many respects the Texas Big Boll group, differing principally in the degree of storm resistance shown in boll characters. Many of the varieties included in this group were selected from older Texas Big Boll stocks; others probably were derived as hybrids between the Big Boll and special breeding stocks. Current varieties that can be included in this group are Northern Star 11, Wacona, Northern Star 5, Lankart Selection 611, Lankart Selection 57, Anton Stormproof 99, Stormking, Harper U-strain, Kasch SS strain, Bagley's Storm-Tex 157, Stufflebeme Stormproof, Dunn 7 and other similar varieties.

Type 3. Western Open Boll

A number of varieties of this type have been developed in Texas and Oklahoma in recent years. Most are early-maturing varieties, lacking in a high degree of storm resistance and with rather short staple lengths (7/8 to 1 inch). Included in this type are Paymaster 54B, Lockett 140, Parrott and Stoneville 62.

Type 4. Texas Stormproof

The practice of harvesting by hand-snapping and later by machine stripping, principally in North and Northwest Texas, indicated a need for highly storm-resistant varieties. The first such variety, Macha, was offered for sale in 1936 and became the forerunner of the group of varieties that can be classified under this type. A large number of these storm-resistant varieties are now sold in Texas and are grown extensively on the High and Rolling Plains. A number of varieties comprise this type, including Lockett Stormproof No. 1, Blightmaster, Paymaster 101, Paymaster Stormrider, Lockett 88, Gregg, Western Stormproof, Qualla 10, Cluster No. 12 and several others.

Type 5. Trans-Pecos Irrigated

This type includes varieties derived primarily from the old "Acala" introductions made from Mexico in 1906. The group is characterized by varieties of medium to long staples which are adapted primarily to irrigation on the higher elevations of the Trans-Pecos area. Limited production of this type is found on the fertile irrigated soils of the High Plains and a few small, scattered plantings occur in Central and South Texas. The principal current varieties included in this type are Acala 1517C, Acala 1517BR-1, Texacala and Mesilla Valley Acala.

Type 6. Medium-staple Open Boll

In Texas, the largest number of varieties fall into this class. It is characterized by bolls of medium size with average to poor storm resistance and with staple lengths averaging mostly 1 to 1 3/32 inches. Varieties of this type are grown mainly in the Lower Rio Grande Valley, the Gulf Coast areas, bottomlands of Central Texas and to a limited extent in other areas.

Within the type, two groups of varieties can be delineated primarily on the areas in which they were developed. The Delta and Southeast group are comprised of medium-boll, medium-staple varieties which were bred primarily in Mississippi, the Carolinas, Georgia, Alabama, Tennessee and Louisiana. The more prominent varieties in the Delta and Southeast group, which are now offered for sale in Texas, include Deltapine 15, Coker 100A (WR), D&PL-Fox 4, Delfos 9169, Stoneville 3202, Stoneville 7, Auburn 56, Plains, Stardel, Empire WR, Deltapine Smooth Leaf, Coker 124, Pope, Rex and Dixie King.

Another group of varieties similar in major respects to the Delta and Southeast group can be considered mainly on their development by Texas breeders and designated as the Texas-Delta group. In the main, the varieties in the group are grown along the Gulf Coast, in the Lower Rio Grande Valley and bottomlands of Central Texas. Many were selected from the Delta and Southeast varieties for better adaptation to Texas conditions, others were developed from hybrids among various varieties of this general type. Principal current varieties included in the Texas-Delta group are Deltapine TPSA, Watson's Empire, Deltapine STPSA, Texacala X, Austin, Brazos and Tideland.

Type 7. American-Egyptian

In addition to the Upland types grown most extensively in Texas, there is another type which is limited to the Trans-Pecos region. This American-Egyptian type is characterized by extra long staple of high quality that can be produced to best advantage in the far western areas of Texas. Only one American-Egyptian variety is now available, Pima S-1. Approximately 28,000 acres of Pima S-1 were planted in Texas in 1958, as compared with more than 5,300,000 acres of the Upland varieties.

Varietal Types and Acreages

The acreages of the varietal types grown in Texas can be estimated only from data made available each year by various agencies. Generally, estimates of varieties are made by crop reporting districts of geographical areas. It is difficult to interpolate these data onto land resource areas and the accompanying summary is only approximated from various 1957 and 1958 data available. These estimates are derived from data taken from "Cotton Varieties Planted, 1953-57," a compilation distributed by the Agricultural Marketing Service of the U. S. Department of Agriculture, and from the 1958 edition of "Goedecke's Cotton Variety Map," published by Otto Goedecke, Inc.

While these estimated acreages are only approximate, they offer some indication of the distribution of the various types throughout Texas. To a degree, they may be taken as recommendations of the varietal types best suited to the varied soil and production areas of the State.

APPROXIMATE DISTRIBUTION OF TEXAS COTTON TYPES

Land Resource Areas	Percentage of Acreage Occupied by Varietal Types	
A—East Texas Timberlands	Medium-staple Open Boll	60
	Texas Big Boll	20
	Storm-resistant Big Boll	5
	Other	15
B—Coast Marsh	No cotton produced	
C—Coast Prairie	Medium-staple Open Boll	80
	Storm-resistant Big Boll	10
	Other	10
D—Blackland Prairies	Storm-resistant Big Boll	70
	Texas Big Boll	20
	Medium-staple Open Boll	5
	Other	5
E—East Cross Timbers, F—Grand Prairie, G—West Cross Timbers, H—North Central Prairies, I—Central Basin	Storm-resistant Big Boll	60
	Texas Big Boll	15
	Texas Stormproof	15
	Medium-staple Open Boll	5
	Other	5
J—Rio Grande Plain[1]	Storm-resistant Big Boll	45
	Medium-staple Open Boll	45
	Other	10
K—Edwards Plateau	Storm-resistant Big Boll	60
	Texas Stormproof	15
	Texas Big Boll	10
	Medium-staple Open Boll	5
	Other	10
L—Rolling Plains	Storm-resistant Big Boll	45
	Texas Stormproof	25
	Western Open Boll	15
	Medium-staple Open Boll	5
	Other	10
M—High Plains	Storm-resistant Big Boll	55
	Western Open Boll	20
	Texas Stormproof	15
	Medium-staple Open Boll	5
	Other	5
N—Trans-Pecos	Trans-Pecos Irrigated	85
	American-Egyptian	12
	Other	3

[1]In the irrigated Lower Valley area of Cameron, Hidalgo, Willacy and Starr counties, the medium staple, open-boll type accounts for approximately 95 percent of the acreage.

Cotton Variety Tests in Texas

The Texas Agricultural Experiment Station has conducted cotton variety tests for more than 50 years. The program currently conducted provides for testing commercial cotton varieties and strains at some 25 locations in the State. Data are taken on comparative yields and other agronomic characters and on staple length and grade. Such data are of considerable value to breeders, seedsmen, gin operators, farmers and other segments of the cotton industry. For the farmer, these data furnish information that may prove useful in helping him to select the varieties best suited to his area and production methods.

Preliminary data are tabulated each year for the various test locations and these are summarized and compiled at the end of each 3-year cycle for publication in bulletin form. Bulletins 739, 778 and 877 were published covering tests conducted during the past 9 or 10 years.

COTTON-GROWING AREAS

Cotton is grown to some extent in all of the land resource areas in Texas except the small Coast Marsh area in the extreme southeastern corner of the State. The land resource areas are shown on page 11. A brief description of these areas, including soils, topography, vegetation and rainfall, follows. Results of cotton variety tests conducted in these areas serve as a basis for making recommendations of varieties of cotton for Texas.

East Texas Timberlands

The East Texas Timberlands, previously known as the East Texas Timber Country, is a large, irregularly shaped area of approximately 25,000,000 acres, lying in East and Northeast Texas. The surface relief is uneven with a general slope from north to south. The land is generally undulating to rolling and hilly. Much of the land is covered with timber.

The upland soils are mostly light colored, acid and sandy. They belong principally to the Bowie, Lakeland, Boswell, Susquehanna, Caddo, Ruston, Kirvin and Nacogdoches series. Generally, these soils are low in organic matter and minerals. They have good physical properties and respond readily to suitable applications of fertilizers, manures and green manures. The bottomland soils are light-brown to dark gray sandy loams and clay loams.

The average yearly rainfall ranges from about 55 inches in the extreme southeast part to about 35 inches in the western part of the area. This is sufficient for good yields of cotton, but its distribution during the growing season is not always favorable for maximum yields of cotton and other crops.

Coast Prairie

The Coast Prairie occupies a nearly flat strip of country 20 to 80 miles wide bordering the Gulf of Mexico. It embraces all or parts of 18 counties and contains approximately 7,500,000 acres. The average yearly rainfall ranges from about 55 inches in the extreme eastern part to 35 inches at Victoria in the western part of the area.

Lake Charles, Beaumont, Edna, Bernard, Hockley and Katy are the main series of upland, or prairie soils. As a result of flat topography and slowly permeable soils, drainage is slow on the surface and through the soil on most of the upland soils. The bottomland soils are of the Miller, Norwood and Pledger series, which are among the most productive soils in Texas.

The Coast Prairie is the main rice-growing area of Texas. It also is devoted to beef cattle ranching and the growing of row crops, such as cotton, corn and sorghum. Cotton is grown mainly in that part of the area west of the Brazos River.

Blackland Prairies

The main body of the Blackland Prairies occupies a large wedge-shaped area extending about 300 miles southwestward from Red River county to the vicinity of San Antonio. Minor parts of the Blackland Prairies lie outside and to the east of the main body. The Blackland Prairies contain about 11,500,000 acres. The major upland soils are dark-colored, calcareous clays belonging to the Houston Black, Houston, Hunt, Austin, Bell and Lewisville series. The more important bottomland soils are Trinity, Catalpa, Miller, Norwood and Pledger. The average yearly rainfall ranges from about 45 inches at Clarksville in the northeastern part to 28 inches at San Antonio in the extreme southwestern part. The Blackland Prairies have long been known as one of the most important and productive agricultural regions of the State. Cotton, corn, wheat, oats and grain sorghum are the main crops grown.

Grand Prairie

The Grand Prairie lies just west of the Blackland Prairies and the East Cross Timbers. It occupies a high, rolling and hilly, deeply dissected limestone area crossed by a number of deep valleys. Erosion is severe in some places. This area contains approximately 6,500,000 acres. The average yearly rainfall is 30 to 35 inches. The soils are mostly dark-colored, calcareous clay over limestone. The principal upland soils are San Saba, Denton, Tarrant and Crawford clays. These soils are used principally for range, pasture, small grain, grain sorghum, corn and cotton. The bottomland soils, consisting mainly of clay and clay loams of the Catalpa, Miller, Norwood and Trinity series, are used for grain sorghum, alfalfa, pasture, small grain and corn.

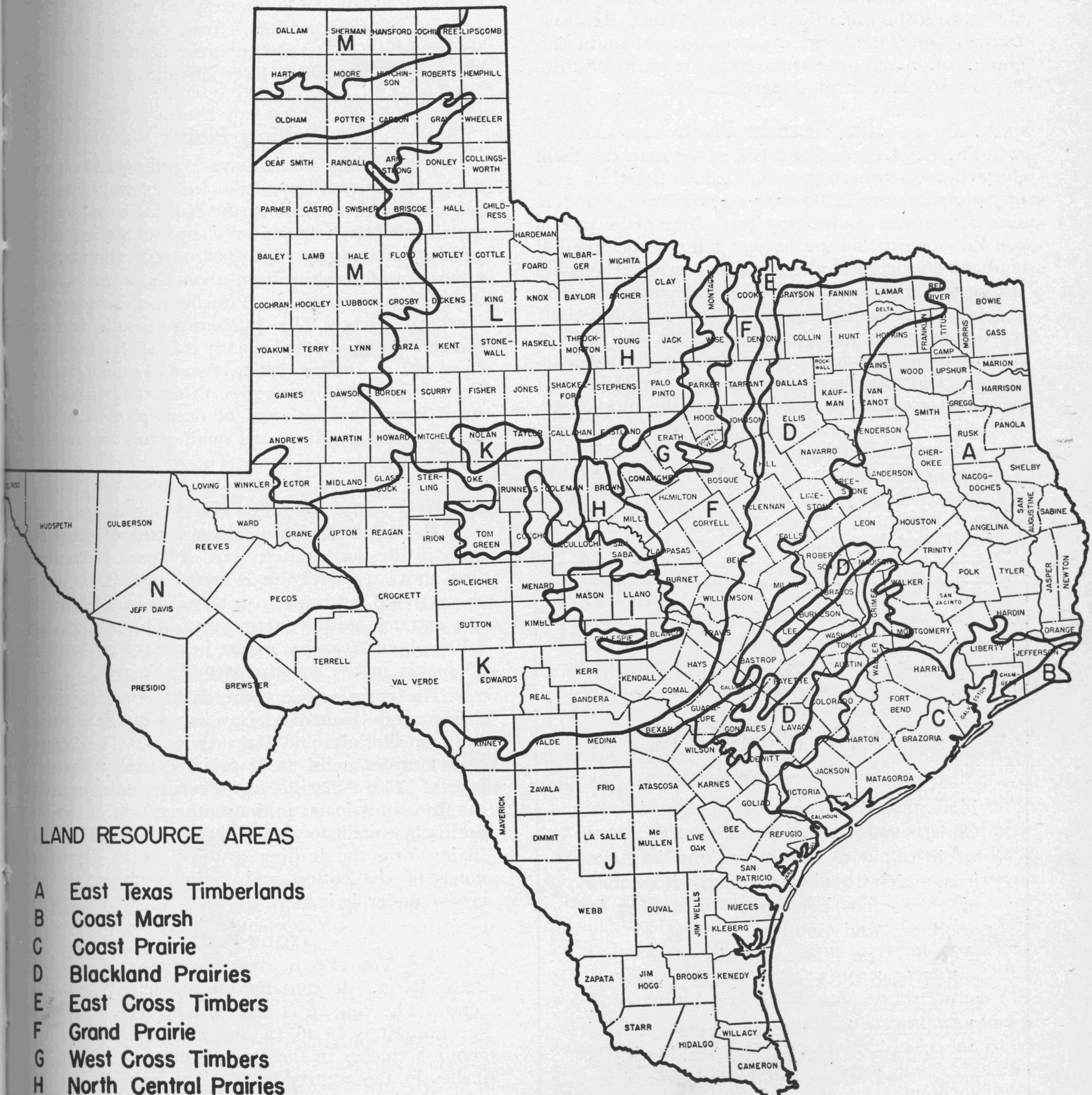
West Cross Timbers

The West Cross Timbers is a narrow timbered region in North Central Texas, extending southward from Red River to Brown and Comanche counties. The region has an area of about 3,000,000 acres. The average rainfall is 26 to 31 inches. The surface ranges from gently rolling to very rolling. Only a small proportion of the land is devoted to farm crops, although crop farming and livestock raising are carried on in all sections of the area. The predominant upland soils are mostly of a sandy texture and are of the Windthorst, Stephenville, Nimrod and May series.

North Central Prairies

The North Central Prairies comprise an area of about 6,000,000 acres in North Central Texas. It includes parts of the West Cross Timbers, called the

LAND RESOURCE AREAS OF TEXAS



LAND RESOURCE AREAS

- A East Texas Timberlands
- B Coast Marsh
- C Coast Prairie
- D Blackland Prairies
- E East Cross Timbers
- F Grand Prairie
- G West Cross Timbers
- H North Central Prairies
- I Central Basin
- J Rio Grande Plain
- K Edwards Plateau
- L Rolling Plains
- M High Plains
- N Trans-Pecos

(Bottomlands not shown due to limitation of scale)

Windthorst-Nimrod Prairie, and the fringe area of the Rolling Plains. The average annual rainfall is 25 to 30 inches. The soils are mostly reddish brown to grayish brown, neutral to slightly acid sandy loams and clay loams, mainly of the Kirkland, Renfrow, Darnell and Zaneis series. Small grains, grain sorghum, cotton and some truck crops are grown. Ranching is important in most parts of this area.

Rio Grande Plain

The Rio Grande Plain is a wedge-shaped area in the extreme southern part of Texas. It has an area of approximately 22,000,000 acres. The area consists of a broad undulating to rolling plain with a general slope to the southeast. The average rainfall is about 30 inches in the eastern part and 20 inches in the western part. Dryland farming is carried on successfully in the eastern part of the area, especially on the deep and productive soils. In the western parts, only small amounts of land are cultivated without irrigation and moisture often is insufficient for successful crop production, even on the most favorable soils. Considerable land in the northern, southern and western sections is farmed under irrigation. The soils range mainly from pale brown to reddish brown or dark gray in color and from fine sandy loams to heavy clays. The most important series are Goliad, Duval, Webb, Medio, Willacy, Hidalgo, Brennan, Victoria, Clareville, Orelia, Harlingen and Cameron.

Cotton and grain sorghum are the main crops grown on uplands. On the irrigated soils, many crops, such as cotton, vegetables, citrus, corn and sorghum, are grown. The irrigated areas in the Lower Rio Grande Valley produce large amounts of cotton, vegetables and citrus fruits.

Rolling Plains

The Rolling Plains have a rolling surface with a general regional slope from west to east. The area is bounded on the east by the North Central Prairies and by the High Plains on the west. It has an approximate area of 24,000,000 acres. The average annual rainfall varies from about 25 or 26 inches in the eastern part to 20 to 22 inches in the western and northern parts. The predominant soils are dark brown to reddish brown sandy loams, clay loams and clays of the Abilene, Miles, Foard, Tillman, Roscoe, Vernon and Hollister series. Crop farming is confined largely to the areas of deep, productive soils. Cotton, grain sorghum and small grains are the main crops grown.

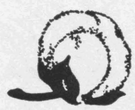
High Plains

The High Plains occupy an area of 20,000,000 acres in the northwestern part of Texas. The elevation above sea level ranges from about 3,000 feet in the extreme southeastern part to about 4,500 feet in the extreme northwestern part. The average rainfall is about 20 inches a year in the eastern part and 15 inches in the western part of the area.

The main soils are the dark brown to reddish brown sandy loams and clay loams of the Amarillo, Pullman, Portales and Mansker series. The Pullman and Portales soils are especially well adapted to wheat. The Amarillo and Portales soils, especially the fine sandy loams in the southern part of the area, are well suited to cotton production. The High Plains form the leading cotton area in Texas and much of the cotton and grain sorghum are now grown under irrigation.

Trans-Pecos

The Trans-Pecos area lies mostly west of the Pecos River. It contains approximately 18,000,000 acres. The climate is arid to semi-arid. The average rainfall is 14 to 15 inches in the eastern part, about 17 inches in the Davis Mountains and 6 to 8 inches in the western part. The rainfall over the entire area is too low for successful crop production. Cotton is grown in several irrigated areas along the Pecos River in the eastern part, in the Upper Rio Grande Valley south of El Paso and in several other areas in Pecos, Reeves, Hudspeth, Culberson and Jeff Davis counties. The other parts of the area are used largely for livestock grazing. The principal irrigated soils are silty clay loams and clays of the Gila, Reagan and Verhalen series.



KING COTTON

More than 400 years before the birth of Christ, the Greek historian Herodotus wrote about a marvelous land in Asia, from which travelers returned with stories of a tree that bore wool "exceeding in goodness and beauty the wool of any sheep." The "fleece-bearing tree" that called forth the praise of these travelers in the Far East was a species of the wonderful plant from whose fibers much of the clothing of the civilized world today is made, and whose seed furnish food for man, beast and soil; it is a plant deserving well to be called exceedingly good and beautiful, and to bear the title so often conferred upon it—"King Cotton."

World Book

PRODUCTION PRACTICES

The cultural practices used in growing cotton in Texas vary somewhat among the several land resource areas. These variations are the result of differences in soil, climate, the prevalence of insects and diseases, methods used for weed control, harvesting and defoliation, and other factors.

Successful cotton production is a highly specialized business and requires intelligence and expert knowledge. Farm management practices and decisions are involved in all of the production practices. For example, for highest efficiency in stripper harvesting, storm-resistant varieties and close spacing of plants must be used. Close spacing — 3 to 4 plants per foot of row — produces plants that are more suitable for stripper harvesting by reducing the overall plant height and plant spread, increasing the height to first limb and decreasing the diameter of the stalk at the base. When the specific requirements and needs of cotton production are known, the grower can then decide what practices are best for his particular conditions.

The cultural practices used in cotton production in Texas are discussed briefly following.

Cropping Systems

The main objective of any soil management program should be the sustained, profitable production of crops on the land. Such a program usually includes suitable cropping systems, the judicious use of fertilizers and lime where and when necessary, manures and green manures. The addition of animal manure, green manure and crop residues improves the soil in several ways. The decomposition of the added organic matter improves soil surface, increases the rate of infiltration of water and air into the soil, and probably increases the availability of soil nutrients.

Leguminous green manures, in addition to supplying organic matter, take up nitrogen from the air, which is added to the soil when they are turned under. The economy of using green manures in cropping systems is essentially a local problem, depending on the kind of soil, the type of farming carried on and the amount and distribution of rainfall. Cropping systems or rotations with a legume-grass sod are based on the fact that growing a perennial legume, grass or grass-legume mixture usually brings about an improvement in the physical properties of the soil.

There are several crops, however, that apparently can be grown more or less indefinitely on the same land year after year without a reduction in yield. Much of the world's wheat and rice is grown continuously on the same land. A considerable proportion of the American cotton crop is grown continuously. Continuous sugar cane is the general rule where it is grown. The continuous growing of the same crop on the same land year after year is sometimes called monoculture.

Coast Prairie

Cotton production on the Coast Prairie is concentrated largely in Fort Bend and Wharton counties and the southern part of the area. No well-established rotations seem to be in general use on the Coast Prairie. At the Angleton Experiment Station *in Brazoria county, cotton in a 3-year rotation of cotton*, corn and cowpeas produced slightly higher yields than continuous cotton over a period of 18 years.

Several annual legumes may be used as soil-improving crops on the Coast Prairie. Among these are Hairy vetch, Dixie Wonder peas, Austrian Winter peas and Hubam sweetclover. Adequate surface drainage is necessary for the successful establishment of winter-growing legumes in this area.

Alfalfa also can be grown successfully on well-drained bottomlands on the Coast Prairie. Cotton following alfalfa on such soils usually produces excellent yields.

Blackland and Grand Prairies

Cotton is the main crop on the Blackland Prairies although corn, sorghum and small grains also are important. In farm practice, these crops are grown in various cropping systems, as cotton and corn; cotton, cotton and corn; and cotton, corn and oats. In many cases, adapted and suitable legumes, especially annual (Hubam) and biennial (Madrid) sweetclovers, Austrian Winter peas and Dixie Wonder peas are included in cropping systems.

The Temple Experiment Station in Bell county on the Blackland Prairies has conducted experiments over a period of 35 years to develop more suitable cropping systems for cotton and other crops in the region. These studies have included cotton, corn and oats with various legumes, grasses and mixtures of legumes and grasses. Some of these results are mentioned here. The highest average yield of cotton for 10 years, 898 pounds of seed cotton per acre, was obtained from 2-year rotations of cotton and oats or oats-legume mixtures. Two-year rotations of cotton and Hairy vetch or Madrid sweetclover, where the legumes were grown to maturity, produced about the same yield as continuous cotton. Cotton in a 1-year rotation with winter peas, vetch or sweetclover for winter green manure produced a decidedly lower yield than continuous cotton without legumes.

The effects of rotations on the incidence of cotton root rot were highly variable from year to year and from field to field.

Growth and Fruiting Habits of Cotton in Central Texas

(Based on planting about April 15)

Compiled by Fred Elliott

Extension Cotton Work Specialist

Left—A cotton seedling about 10 to 14 days old.

1. Time to come up—average 7 to 10 days, range 7 to 30 days.
2. Appearance of third leaf (first true leaf)—8 days after emergence.
3. Appearance of fourth leaf (second true leaf)—9 days after emergence.
4. Emergence to square—35 to 40 days.
5. Square to white bloom—20 to 25 days.
6. Bloom to open boll—50 to 65 days.
7. Boll full grown—20 to 25 days after bloom.
8. Should be ready to harvest in 160 days (25 percent open in 130 days).
9. Number of seed in one bushel of average seed—120,000.
10. Most effective fruiting period—June 20 to August 1.
11. Approximately 35 to 40 percent of blooms make bolls.
12. August 20 generally the last date for normal setting of fruit.
13. Boll period—45 to 65 days.
14. Fiber length laid down first 25 to 30 days.
15. Critical period in length of fiber—16 to 20 days after blooming.
16. Strength of fiber built up in second 25 to 30 days of boll development.
17. Moisture is the limiting factor in determining length of lint in a given varety.
18. Average number of days to blooming peak—90.
19. Average number of days from first bloom to peak of blooming—35.
20. Average number of days from first bloom to shed peak—40.
21. Average percentage of blooms shed—60 to 65.
22. Average number of blooms per plant—40 to 45.
23. 30 percent of crop open—65 to 75 days after first white bloom.
24. 70 percent of crop open—85 to 95 days after first white bloom.
25. 85 percent of crop open—95 to 105 days after first white bloom.
26. Plant population per acre, 40-inch rows—1 plant per foot of row, 13,068 plants; 2 plants per foot of row, 26,136 plants, etc.

Cotton, sorghum, oats and corn, in the order named, are the most important crops on the Grand Prairie, according to the 1954 Census. These crops are grown in various cropping systems, but not always in a definite sequence in rotations. Experiments have been conducted for many years at the Denton Experiment Station in Denton county on the Grand Prairie, to develop more practical cropping systems for the region. This work included continuous cotton and cotton in 2 and 3-year rotations with and without legumes. A 3-year rotation of cotton, corn and oats was decidedly better than continuous cotton over a period of 15 years. This rotation also was more profitable than similar rotations which included Hubam sweetclover or cowpeas preceding cotton. Hairy vetch as a soil-improving crop preceding cotton did not increase the yield of cotton. The failure of legumes to increase the yield of cotton might have been due in part to a deficiency of soil moisture during the fruiting and maturing period of cotton. In most years, *a deficiency of soil moisture, and not soil fertility*, is the first limiting factor in the yield of crops on the Blackland and Grand Prairies. In favorable years, the use of sweetclover as green manure increases the yield of crops, especially corn.

North Central Prairies

Wheat and oats are the main field crops on the North Central Prairies, according to the 1954 Census. Cotton and sorghum ranked next, with approximately 40,000 acres each. Cropping systems or rotations with definite crop sequence are not practiced generally in the area. Where adapted legumes can be fitted into suitable cropping systems, however, they may be used to advantage. For example, at the Iowa Park Experiment Station in Wichita county, Hubam sweetclover has been a profitable cash crop and it doubled the yield of cotton which followed the clover. Alfalfa also is a valuable crop for seed and forage on bottom and irrigated land in the area.

Rolling Plains

Cotton, sorghum and wheat are the principal crops on the Rolling Plains. According to the 1954 census, cotton was grown on approximately 1,544,000 acres, sorghum on 1,147,000 acres and wheat on 987,000 acres. Alfalfa was grown on 34,700 acres. As a rule, these crops are not grown generally in definite sequence in cropping systems.

Experiments were conducted with 16 different cropping systems at the Spur Experiment Station in Dickens county on the Rolling Plains, for 21 years, 1924-44. The work included cotton and grain sorghum continuously manured and not manured and in 2-year and 3-year rotations with and without barnyard manure and with and without green manure. Cowpeas (a legume) and sorghum (a non-legume) were used as green-manure or soil-improving crops. A 2-year rotation of cotton and sorghum manured made the highest average yield of cotton, 230 pounds of lint per acre. Continuous cotton without manure produced an average yield of 169 pounds of lint per acre.

Although these experiments did not yield outstanding results, they show that growing cotton and sorghum in rotation with or without manure produced higher yields of cotton and grain sorghum than growing the crops *continuously* on the same land. Since the average yearly rainfall at Spur is about 20 inches, it is to be expected that moisture would be the first limiting factor in crop yields in most years. Rotations under dryland conditions probably would not have much influence on yield, except possibly as they might affect the penetration and storage of rainfall in the soil.

High Plains

Cotton and sorghum are the main crops in the cotton-growing area of the High Plains. These crops fit well together in the agriculture of the region. No *standard patterns of crop rotations are practiced*, although many farmers use some sort of cropping systems in their farm enterprises. In experiments with various rotations for 31 years under dryland conditions at the Lubbock Experiment Station in Lubbock county, continuous cotton produced higher yields than cotton following sorghum. Although rotations that included 1 year of fallow or 1 year of sorghum for green manure produced slightly higher yields of cotton than continuous cotton, the increases were not large enough to be profitable.

Recent trails under irrigation at Lubbock indicate that soybeans are a promising commercial cash crop for the region. There seems to be a good possibility that cotton could be grown profitably in a 3-year rotation of cotton, sorghum and soybeans. Where other adapted legumes, such as alfalfa and sweetclover, can be grown profitably in rotation with cotton, they could be included in suitable cropping systems. In such cases, the legumes would be profitable as cash crops in their own right and, in addition, would add some organic matter and nitrogen to the soil for the following crop.

Trans-Pecos

Cotton, alfalfa and vegetables are the main crops grown in the Trans-Pecos area. Other crops, such as sorghum, oats and barley, are grown to a small extent, but relatively are not important for the area as a whole. Cotton is rotated to some extent with alfalfa, but the practice is not as prevalent as it formerly was. Cotton growers are now using increasing amounts of commercial fertilizers high in nitrogen to supply the nitrogen previously supplied by alfalfa.

Fertilizers

The fertilizer needs of cotton vary greatly among the land resource areas of the State, depending on the chemical composition of the soil, length of time under cultivation, moisture conditions, cropping systems and soil types. For example, the upland soils in the East Texas Timberlands are mostly sandy loams and sands. They are low in organic matter, nitrogen, phosphorus and potassium. For this reason, fertilizers containing suitable amounts of these elements should be applied for successful cotton production on these soils. Most of the cultivated bottomlands in the State contain moderate to adequate amounts of phosphorus and respond to nitrogenous fertilizers before they do to phosphatic fertilizers. Soils that have been cropped continuously for a long time may be depleted in the three more common elements—nitrogen, phosphorus and potassium.

The average rainfall in areas having 35 inches or more is adequate for good yields of crops. The rainfall, however, is not always distributed favorably during the growing season for maximum yields of crops. In most years, in all parts of Texas, there are times when cotton and other crops suffer from lack of adequate soil moisture.

Methods of Application

Many experiments have been conducted in Texas and other states since 1930 to determine the best methods of applying fertilizers to various crops. Recommendations on methods of applying fertilizer to crops in Texas are given in Texas Agricultural Extension Service Bulletin 253, "Methods of Applying Fertilizer for Efficient Use."

For cotton, fertilizer may be applied prior to or at planting in bands 3 to 10 inches from the row and 3 to 5 inches deep. This placement results in the early availability of the fertilizer to the plant and does not injure germination of the seed.

Suitable equipment usually is available for applying fertilizers according to the method mentioned above. If, however, such equipment is not at hand, probably the next best method would be to apply the fertilizer in a band in the bottom of a deep water furrow and rebed the land. Then plant the cotton on the bed at such a depth that the seed will be 4 inches above the fertilizer.

Sidedressings of solid nitrogen fertilizer usually are applied to cotton after the first cultivation and not much later than the early square stage of growth. The sidedressing should be placed far enough to the side of the row to avoid mechanical injury to the roots and deep enough so that the nitrogen will not be disturbed by later cultivation.

Anhydrous ammonia or aqua ammonia, used as sidedressing, should be applied immediately after the cotton has been chopped and should be placed 6 to 8 inches to the side of the seed row and 6 inches deep. Special equipment is required for the application of anhydrous or aqua ammonia.

Fertilizer Recommendations

Fertilizer recommendations follow for cotton on average soils in several land resources areas in Texas. These recommendations are based on the results of field experiments with fertilizers on cotton, the experience of farmers and chemical analyses of soils in the several soil areas. They may or may not be applicable to any given farm. For this reason, cotton growers should consult their county agricultural agent about the use of fertilizers.

In cases of doubt about the proper fertilizer to use, the soil should be analyzed to determine its fertilizer needs. The Soil Testing Laboratory, Texas Agricultural Extension Service, College Station, Texas, and other laboratories in the State provide soil testing service.

Extension Leaflets 220 through 228 give more detailed information on fertilizer recommendations for the various land resource areas in Texas.

East Texas Timberlands. The predominant upland soils in the East Texas Timberlands are sandy loams and sands. They are low in minerals and organic matter and naturally are not very productive. Most of these soils have good physical properties, including permeable subsoils. They respond readily to good soil management practices, such as fertilizers, manures and green manures. In experiments conducted at Nacogdoches and Troup, these soils responded profitably to applications of nitrogen, phosphorus and potassium. A 40-40-20 fertilizer is recommended for the upland loams and sandy loams. On sands and loamy sands, the use of 40-40-40 is suggested. In addition, a sidedressing of 30-0-0 should be made at first square if moisture is adequate.

On bottomland clay and clay loam soils, a 40-0-0 is recommended, with a sidedressing of 30-0-0 at first square. A 40-40-0 fertilizer, with a sidedressing of 30-0-0, is recommended for loams and sandy loams on bottomland.

Coast Prairie. The optimum rate of application of fertilizers varies considerably among the different soils of the Coastal Prairie. On Lake Charles clay at the Angleton Experiment Station in Brazoria county, applications of nitrogen and phosphorus have produced consistent significant increases in the yield of cotton. The use of 60-60-0 is recommended on Lake Charles clay and other upland clays and clay loam soils on the Coast Prairie. On the black loam and sandy loam upland soils, 60-60-30 is suggested. The application of 40-40-0 is recommended for the clay and clay loam bottomland soils in the area. On the loams and sandy loams in the bottomlands, the use of 30-60-30 is recommended.

Blackland and Grand Prairies. Soils on the Blackland and Grand Prairies have not responded as readily to applications of fertilizers as the soils of the East Texas Timberlands. These soils are relatively low in phosphorus and comparatively high in nitrogen. At the Temple and Denton Experiment Stations, in Bell and Denton counties, respectively, applications of phosphorus have produced greater increases in yield of cotton than applications of nitrogen or potassium.

Similar results have been obtained in cooperative experiments with cotton growers in different parts of the Blackland Prairies. From present knowledge, the application of 15-30-0 per acre is recommended for cotton on the upland clays and clay loams on the Blackland and Grand Prairies. On lighter soils, such as loams and sandy loams, in the central and western part of the area, 30-30-0 per acre is suggested. On mixed land (loams and sandy loams) in the eastern edge in the area, 30-60-30 is recommended. On irrigated bottomlands, a 60-0-0 fertilizer is suggested for clays and clay loams, and 60-30-0 for loams and sandy loams.

West Cross Timbers. The soils in the West Cross Timbers area are mostly sandy loams, loamy sands and sands. They are low in organic matter, nitrogen, phosphorus and potassium. They respond readily to applications of fertilizers when adequate moisture is available. The use of a 20-20-0 fertilizer is recommended for upland loams and sandy loams, 20-20-20 on sands and loamy sands and 20-0-0 for clays and clay loams. On bottomlands, a 20-0-0 fertilizer is recommended on clays and clay loams and 20-20-0 for loams and sandy loams.

Rolling Plains. Moisture is probably the first limiting factor in cotton production on the Rolling Plains, since the average yearly rainfall ranges from about 25 inches in the eastern part to about 20 inches in the western part of the area. Fertilizers do not always increase yields, but may do so where moisture is adequate. On upland and bottomland loams and sandy loams, a 20-40-0 fertilizer is recommended.

For irrigated land the following recommendations are made: 30-30-0 for bottomland clays and clay loams and 30-60-0 for bottomland loams and sandy loams and upland clays, clay loams, loams and sandy loams. In addition, sidedress with 40-0-0 at first square.

High Plains. Fertilizers are recommended only on irrigated land in this area. Moisture, and not soil fertility, usually is the first limiting factor in cotton production on dryland. A 30-30-0 fertilizer is recommended for clay and clay loam soils, 60-60-0 for loams and sandy loams and 60-60-30 for sands and loamy sands.

Rio Grande Plain. In the more humid part of the Rio Grande Plain, a 15-0-0 fertilizer is recommended for bottomland soils and upland clay and clay loam soils. A 15-30-0 is suggested for loams, sandy loams, sands and loamy sands.

Where irrigation is available, 40-0-0 is recommended for bottomland soil and upland clays and clay loams, 30-60-0 for upland loams and sandy loams and 30-60-30 for sands. Sidedress with 30-0-0 at first square.

Lower Rio Grande Valley. The soils in the Lower Grande Valley are fairly high in nitrogen, phosphorus and potassium. They respond, however, to applications of nitrogen and phosphorus.

A 40-0-0 fertilizer is recommended for cotton on irrigated land in the area, with a sidedressing of 40-0-0 at first square. On dryland, 30-0-0 at planting is suggested, with a sidedressing of 30-0-0 at first square if soil moisture is adequate.

Trans-Pecos. Cotton is grown only under irrigation in the Trans-Pecos area. Experiments conducted with fertilizers on cotton in the El Paso and Pecos River Valleys and the experience of cotton growers show that the soils are lacking mainly in nitrogen. These experiments also indicate that an alfalfa-cotton rotation generally is more effective in increasing the yield of cotton than the application of commercial fertilizer alone. In this rotation, 40 to 60 pounds of phosphoric acid per acre should be applied to the alfalfa. This will provide sufficient phosphorus for large yields of alfalfa, which in turn will produce maximum yields of cotton following the alfalfa. Apply nitrogen fertilizer to cotton annually after the second year.

For soils in the flood plains of the Rio Grande and Pecos River, Lobo Flats and Madera Valley, apply 60-0-0 at planting and 40-0-0 as a sidedressing at first square. Also apply 60 pounds of phosphoric acid per acre every 5 years.

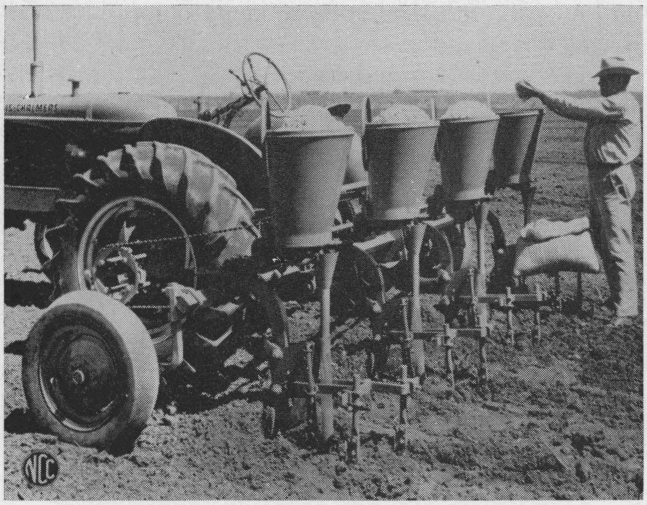
In the Pecos, Dell City, Wild Horse, Fort Stockton and Coyanosa areas, apply 60-0-0 at planting and apply 100-0-0 partly as a sidedressing and partly as small quantities in irrigation water. On loams, sandy loams and sands, apply 60 pounds of phosphoric acid per acre in addition to the nitrogen.

Preparation of the Land For Planting

Preparation of land for planting cotton in all parts of Texas usually begins with the disposal of stalks or other crop residue in some fashion, such as cutting the stalks with a rolling stalk cutter or a power shredder. The proper disposal of residue cuts or breaks up the stalks and other residue and thus prevents it from interfering with later tillage practices, such as harrowing, planting and cultivating. Experiments have shown that a well-established stalk disposal program aids in the control of cotton insects, especially the pink bollworm and boll weevil. In fact, Texas has promulgated regulations that require cotton growers in certain counties and zones to plant cotton and to destroy cotton stalks within specified dates to aid in controlling the pink bollworm.

The kind of land preparation depends on the kind of soil, the method of harvesting to be used and the average rainfall. Most of the land preparation is done with tractors and tractor equipment, ranging from 1 to 4-row outfits, as shown on pages 24-25.

Cultural practices for cotton are essentially the same as those for corn, sorghum and other row crops, and are known by most cotton growers and agricultural workers. The preparation of the seedbed usually consists of some type of plowing with a disk, chisel or moldboard plow in late fall or winter, fol-



A cotton grower loads the seed hoppers in preparation for planting. Four rows can be planted at one time with this tractor-drawn equipment.

lowed by harrowing and bedding or rebedding. Irrespective of the methods used in preparing the seedbed, cotton requires a firm, mellow seedbed in good tilth, free of weeds and very little unrotted residues, with both deep and surface moisture. To attain this ideal seedbed, the bed-forming operations should be completed at least 30 days before planting.

If weeds become troublesome before planting, they should be destroyed by cultivating the beds with some suitable implement. The ordinary sweep-type cultivator is perhaps used more frequently for this purpose than other equipment. Large buzzard-wing sweeps (24 to 30-inch) also are used by running them through the middles. The width of rows in Texas ranges from 36 to 42 inches, but the tendency is to standardize on 40-inch rows.

Preparation of the Seedbed

Tillage operations prior to the actual formation of the seedbed vary considerably, depending on the kind of soil and the average rainfall. In general, light (sandy) soils require fewer operations to develop a good seedbed than heavier soils, such as clays and clay loams. For example, on Amarillo fine sandy loam, an important cotton soil on the High Plains, experiments have shown that a limited number of operations are more desirable and economical for both dryland and irrigation. Flat breaking before listing has not produced significantly higher yields than listing alone.

In the Trans-Pecos area, where all of the cotton is irrigated, the land is flatbroken with moldboard plows. Following this operation, heavy-duty disk harrows are used to smooth the soil. Prior to irrigating the crop in the spring, the land is listed or bedded to obtain a more even distribution of water. A disk harrow is used again after irrigating to break the crust formed by the soil drying out after irrigation.

In the central and southern parts of Texas, land preparation normally consists of listing out the old rows in the fall after the stalks have been cut or shredded. The land is relisted or rebedded in the spring prior to planting. This rebedding operation should be done long enough before planting to permit rain to soak the beds thoroughly and allow them to settle and form a firm, moist seedbed.

Planting

Many factors influence the germination of seed and the stands of plants obtained. Some of these are soil moisture, temperature, viability of seed, firmness of the soil, type of seed (fuzzy or delinted) and seed treatments to control soil-borne diseases. Other factors directly related to the planting operation also affect the emergence of cotton seedlings. Among these are the rate of seeding, depth of covering, type of furrow openers and methods used to firm the soil to prevent loss of moisture.

Date

The young cotton plant is tender and will not withstand freezing temperatures. For this reason, cotton usually is planted after the average date of the last killing frost in the spring. Planting dates in Texas range from February in the Lower Rio Grande Valley to May 15 to June 20 at Lubbock on the High Plains. The date of planting is more critical at the northern edge of the cotton belt in Texas, where the frost-free period is barely sufficient to mature a reasonably good crop of cotton, than it is farther south, where a longer growing season prevails.

Recent experiments at Lubbock have shown that 30 percent or more of the cottonseed usually emerge when the minimum soil temperature averages 60° F. 8 inches deep in the seedbed for 10 days. This average temperature is not reached until May 1 at Lubbock. Here the highest percentage of emergence usually occurs between May 10 and 25. Planting after June 1 shortens an already short growing season and low-

A lister type planter planting four rows of cotton at a time on the High Plains.

ers yields. The latest practical planting date at Lubbock is June 15 to 20.

Slow germination and cold soils go together. There is more danger of the seed rotting and the seedlings are more susceptible to seedling disease in cold soils.

Seed Treatment

Proper treatment of planting seed with an approved fungicide is one of the measures used to help reduce losses in stand caused by seedling disease. Seed treatment also helps prevent seed decay and damping-off from both soil and seed-borne organisms. However, it does not provide continued protection from the organisms in the soil after germination occurs. Such protection can be obtained by mixing suitable fungicides with the covering soil. Recommended fungicides are given in Station Progress Report 2003 and recommended methods of mixing fungicides with the soil are reported in Station Progress Report 2001.

Method

Cotton is planted on beds (ridges) and in shallow listed furrows. In the more humid areas, where heavy rains are likely to occur during the planting season, cotton usually is planted on beds. This allows drainage away from the beds and the surface of the beds dries out more rapidly. In areas having an average yearly rainfall of 25 inches or less, cotton is planted in lister furrows to place the seed in moist soil. The sides of the furrows also protect the young cotton seedlings from blowing sand.

The lister planter equipped with suitable attachments is the most common type of planter used for planting cotton in Texas. The planter may be equipped with different types of openers, covering equipment and press wheels to suit the particular conditions.

Plant Population

The rate of seeding should be based on the final desired plant population and the average percentage of emergence expected. Experiments in Texas and Oklahoma have shown that yield of cotton and mechanical picking efficiency are not affected significantly with populations of 25,000 to 60,000 plants per acre, which is approximately 2 to 4 plants per foot of row. Populations of 40,000 to 60,000 plants per acre have been found to be optimum for mechanical stripper harvesting.

No significant variations in the yield of cotton have been obtained from different methods of obtaining stands on alluvial soil near College Station. Stands were obtained by hill-dropping, drilling to a stand, hand chopping and by several types of mechanical choppers. The saving in seed and labor for chopping, by hill-dropping or drilling to a stand amounted to $6 to $8 per acre.

Depth to Cover Seed

The seed should be covered at the minimum depth at which they will remain in moist soil until they sprout and emerge. Shallow depths of 1 to 2 inches are suitable for the more humid areas of Texas, and depths of 3 to 4 inches are necessary in the drier parts of the State. Tests have shown, however, that a depth of 1 to 2 inches is more satisfactory in the drier areas if the seed are pressed into firm, moist soil before covering.

Furrow Openers

Two general types of furrow openers are used in planting cotton: the chisel type and the curved runner. The chisel-type opener is used extensively on lister-type planters for planting on beds on the High Plains and in other areas. The chisels vary in width from ¾ to 2 inches. The narrow type with long, low dirt shields is more desirable because the seed are confined to a narrow drill and the shields prevent loose soil from falling below the seed.

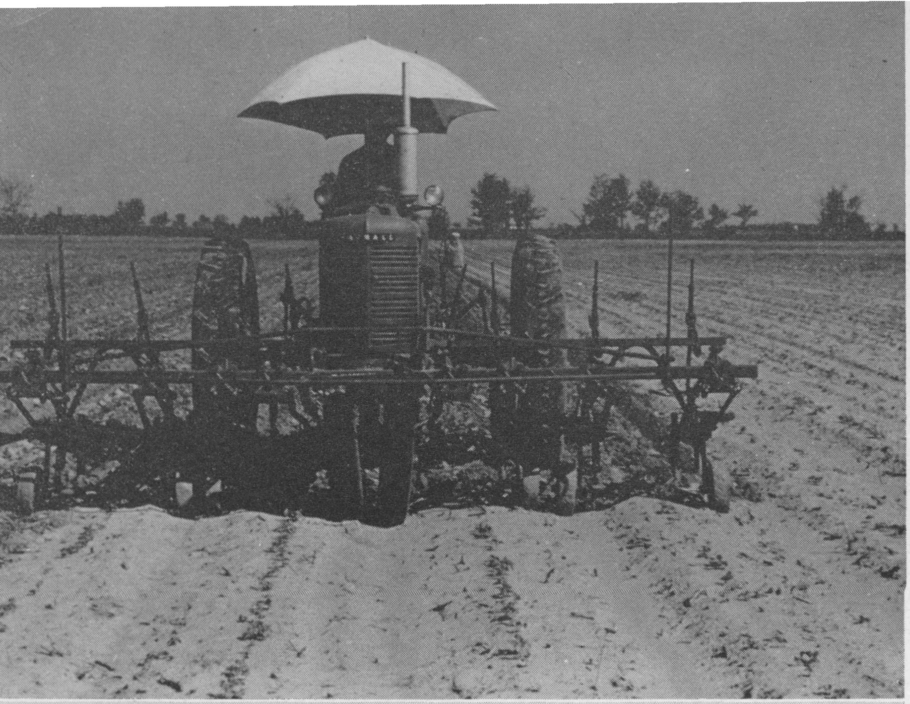
A modification of the standard runner-type opener has a narrow opening and dirt shields which extend to the rear and prevent loose soil from falling in the furrow ahead of the seed. This modification has given faster emergence and better stands of cotton than the standard curved opener in experiments conducted at College Station and in West Texas.

Press Wheels

Press wheels are used in planting cotton in some areas to provide a firm contact between the seed and the soil, thus permitting the seed to absorb moisture from the soil more rapidly. Types used are the surface-press and the seed-press wheel. The surface-press wheel is used on the surface of the soil after the seed have been covered. The seed-press wheel is used in the seed furrow immediately behind the furrow opener to press the seed into firm, moist soil.

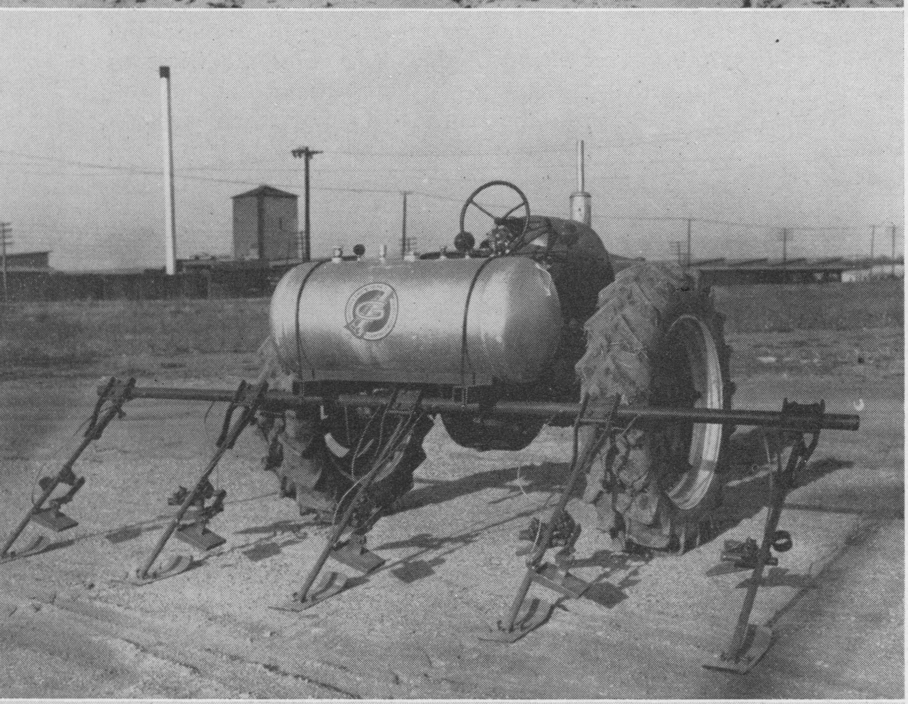
Surface-press wheels are used extensively in East and Central Texas. A common practice is to delay the pressing operation for several hours until the surface of the freshly planted soil has dried enough to prevent it sticking to the press wheel. A solid press wheel is then used over the drill row. To eliminate this extra operation, efforts have been made to develop a type of press wheel to which soil would not adhere enough to prevent satisfactory operation. A rubber-flap press wheel was developed which has given good results and works satisfactorily on sticky clay soils. Surface-press wheels are not recommended in the subhumid areas of West Texas because they tend to create a hard, compacted layer over the seed, which interferes with emergence.

A seed-press wheel with a soft zero-pressure rubber tire was developed at the Lubbock Experiment Station. This spring-loaded press wheel presses the seed into the firm, moist soil in a narrow furrow opened by a chisel-type opener. A drag-type covering device covers the seed with 1½ to 2 inches of loose soil. This press wheel and covering device have given faster emergence and better stands than the conventional methods used in that area.



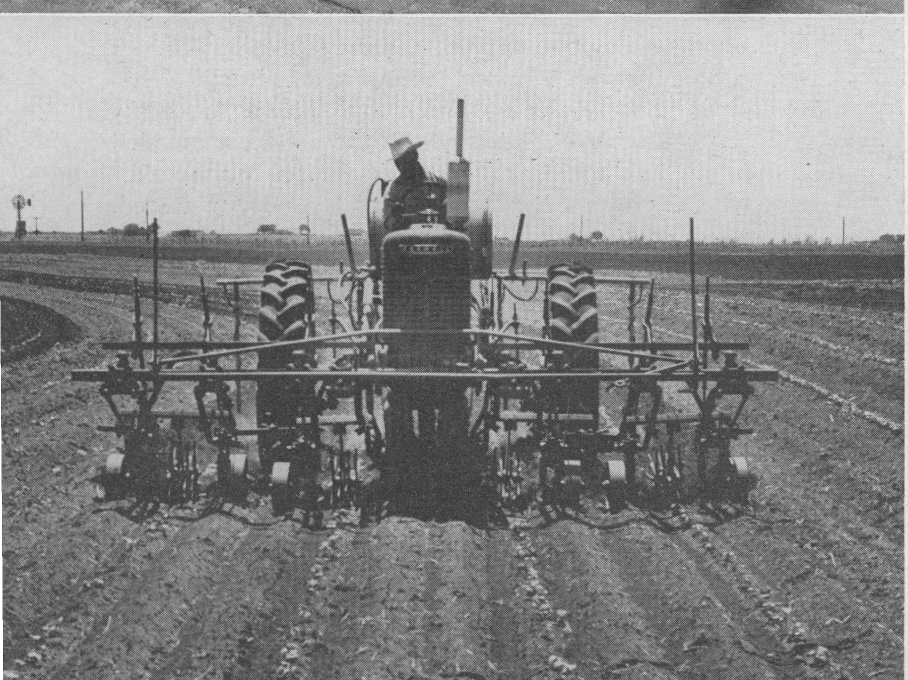
TOP

A four-row cultivator operating in small cotton for early season weed control.



CENTER

A four-row flame cultivator used to control small grass and weeds in cotton. Cotton plants are delicate. If left unassisted, they soon would be overcome by weeds and grass, either perishing or producing a negligible crop.



BOTTOM

A four-row rotary hoe used for mechanical weed control and high speed cultivation of cotton.

Cultivation

The main purpose of cultivation is to destroy weeds, which compete with crops for moisture and plant nutrients. Cultivation also loosens the soil, permits better aeration and penetration of water into the soil, promotes decomposition of soil organic matter and, consequently, increases crop yields. Weeds have been controlled in cotton by the use of various kinds of cultivating implements, especially the ordinary cultivator equipped with suitable sweeps, harrows and the common hand hoe. The rotary hoe was developed recently and is coming into general use in Texas.

Cultivation practices for cotton vary considerably in different parts of Texas. The kind of cultivation depends to some extent on whether planting was done on beds or in lister furrows. The frequency of cultivation is determined largely by rainfall, with a cultivation after each rain until the cotton plants are large enough to suppress weed growth. Where cotton is planted on beds, the first and succeeding cultivations usually are made with sweeps. These cultivations are shallow, 2 to 3 inches deep, and uproot and destroy the weeds in the middles and cover small weeds in the drill row. Sometimes, however, the first cultivation may be made with the rotary hoe.

Where cotton is planted in lister furrows, as on the Rolling and High Plains, the first cultivation may be made with the sled cultivator or the rotary hoe. Later cultivations generally are with sweeps. The low rainfall and prolonged dry periods on the Rolling and High Plains minimize the weed problem in those areas.

Experiments in Texas have shown that just enough cultivation to keep down weeds is the most efficient. At the Spur Experiment Station, on the Rolling Plains, where moisture usually is a critical factor, two cultivations during the growing season produced the highest average yield of cotton over a period of 12 years. At College Station, with an average yearly rainfall of about 38 inches, three to five cultivations with sweeps made the highest yield of cotton for 6 years.

WEED CONTROL

Cultivation and hand hoeing are primary methods for controlling weeds in cotton. Rotary hoeing, the use of weed-control chemicals and flame cultivation are supplementary practices. Rotary hoeing is the most widely used supplementary practice in Texas.

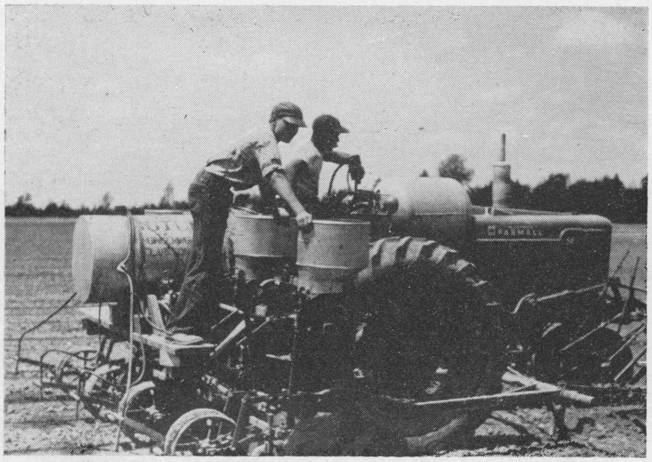
Pre-emergence chemical treatment of the row at planting and post-emergence lateral application of oils of the Stoddard solvent grade are popular chemical practices in some other states, but are not widely used in Texas. These practices are appropriate for use only when cotton is planted on a bed.

Results of two methods of controlling Johnsongrass in 1959 are shown in this aerial view of two adjacent cotton fields in the Brazos River Valley near College Station at harvest time. The 50-acre field at the bottom had five cultivations and four hand-hoeings, yet the Johnsongrass infestation, the gray patches, was 20 to 30 percent, the same as at the start of the season. A heavy crop of seed also remains in the field. The 70-acre field, up across the turn-row, started the season with four times as much Johnsongrass as the other field. Seven cultivations of the middles and three crown-oilings over most of the field (five on a small part) with a mixture of half naphtha and half diesel fuel oil reduced the grass infestation to about 1 percent.

Left—A Texas Slidegun being used for nonselective spraying of an infestation of Johnsongrass. Center—The right hand normally is used to operate the pump of a Jetgun and to aim the spray at the target; the Texas Blade is used in the left hand. Right—The Texas Gravity Sprayer is satisfactory for crown-oiling 6-inch-high Johnsongrass sprouts in moderate-size infestations.

Pre-emergence chemical treatment of a 10 to 14-inch band over the planted row is effective for killing shallow-germinating weeds and grasses under some Texas conditions without subsequent injury to cotton. Such treatments usually cost $3 to $7 an acre. Most pre-emergence treatments are effective only when the soil surface is sealed by rain and left undisturbed. They usually control weed seedlings for only 2 or 3 weeks. Safety in using them depends on the retention of the chemicals within a fraction of an inch of the soil surface.

Favorable results are obtained most frequently in humid areas and on soils with crusts free from cracks. Poor results are common in dry areas and on soils that crack after rain. Many of the productive cotton soils in Texas crack following rains, and in most areas cotton emergence is expected without rain.



A four-row pre-emergence chemical weed control application at planting time.

Pre-emergence chemicals usually fail 40 percent or more of the time under such conditions.

Post-emergence lateral oiling of cotton 3 to 10 inches tall (prior to bark formation) can be used to kill weed and grass seedlings less than 2 inches tall in the row anywhere in Texas that bed-planting is used. The practice is reliable and economical. Safety in using it depends on precise control of the height and rate of application of a suitable oil. Incompatability of the practice with conventional planting methods and the practice of "dirting" young cotton account for the limited use of lateral oiling in Texas.

Only the young stem below the seed leaf or the seed leaf scar is resistant to the oil. This usually requires the lateral application of the oil within an inch of the soil surface. Undue variation in the height of application causes oil to miss the weeds or hit the young cotton too high. Treating the leaves kills young cotton plants within a few hours. Treating the stem above the seed leaf scars seriously injures young cotton plants and may kill them.

Precise control of the height of application requires smooth, firm shoulders on the row that are slightly lower than the drill. Both conventional planting and early cultivation procedures in most areas of Texas violate this requirement. Sometimes heavy rains level freshly-planted beds, and, under such conditions, many farmers make emergency use of lateral oiling prior to first cultivation. Several methods can be used to provide satisfactory shoulders on the row for the subsequent use of lateral oiling. Most of them, however, are inconvenient to use and most Texas farmers prefer to rely on conventional weed-control methods, particularly when early rotary hoeing is applicable.

IRRIGATION

Irrigation has been practiced for centuries near El Paso, San Antonio and along the San Saba River. Irrigation also has been practiced for more than 60 years in other parts of the State. It is only in recent years, however, that irrigation has figured significantly in Texas agriculture.

It is estimated that approximately 7,000,000 acres of land are irrigated annually in Texas. About 2,173,000 of these acres are planted to cotton. Most of the irrigated cotton land is concentrated on the High Plains in West Texas, in the Lower Rio Grande Valley, the Pecos Valley and Trans-Pecos area, but irrigation is expanding in the older cotton-growing areas.

Sources of Water

Ground water obtained from wells is the source of irrigation water on the High Plains and in widely scattered areas on the Rio Grande Plain. Surface water is the main source of irrigation water in the Lower Rio Grande Valley. In the Pecos Valley-Trans-Pecos area, about two-thirds of the acreage is irrigated from surface water and one-third from ground water.

Methods

The furrow method is the principal one used in irrigating cotton on the High Plains and in other irrigated areas of Texas. Sprinkler irrigation, however, is more efficient on very sandy soils, which take water rapidly, and on rolling lands where furrow irrigation is impractical. For this reason, sprinkler systems are used on deep sandy soils, as in Terry and Lynn counties and in other areas, or where the topography is not suitable for furrow irrigation.

Irrigation Experiments

Considerable research work has been conducted in Texas to develop suitable irrigation practices for cotton. The earlier work was done at the Iowa Park Experiment Station in the Wichita Valley. Later work was conducted at Lubbock on the High Plains, at Weslaco in the Lower Rio Grande Valley, in the Trans-Pecos area and at College Station on bottomlands of the Brazos River.

Iowa Park

Work at the Iowa Park Station during 1932-35 indicated that the optimum amount of water for cotton, including rainfall and irrigation water, was approximately 30 acre-inches. The optimum varied, however, from year to year, depending on the amount and distribution of rainfall.

Lubbock

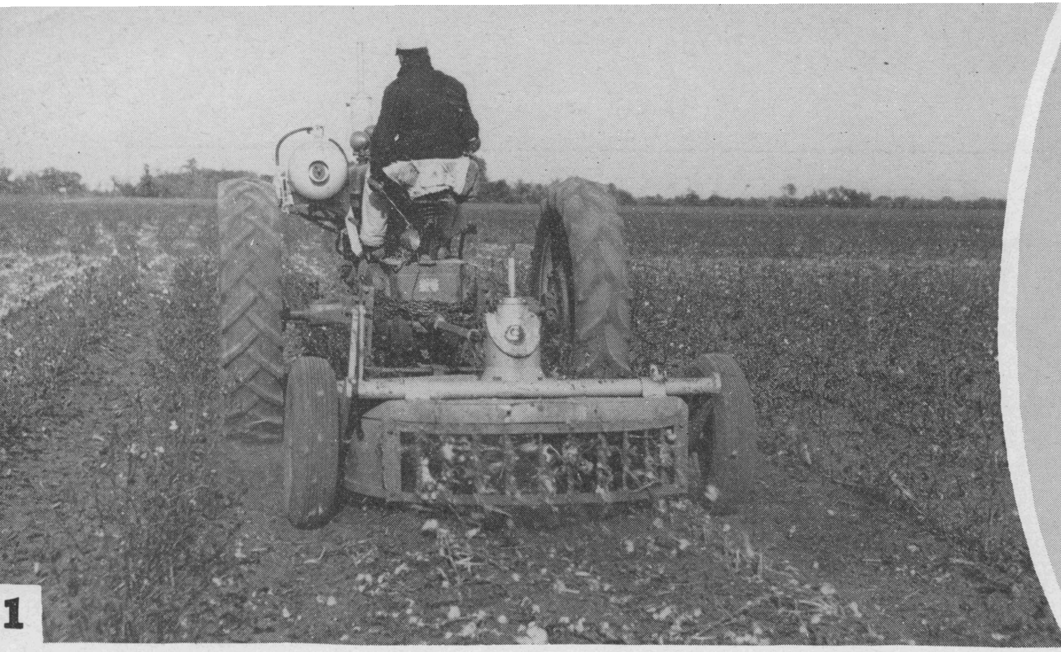
Experiments have been conducted on the High Plains since 1937 by the Lubbock Experiment Station to develop suitable supplemental irrigation practices for cotton and other crops. The amount of irrigation water applied to cotton during the growing season varied from 8 to as much as 20 inches, depending on the amount and distribution of rainfall. Normally, a single irrigation of approximately 8 inches before planting, followed by two 4-inch summer irrigations, have produced higher yields of lint than other irrigation practices supplying more or less water. The number of irrigations needed will vary with rainfall, date of planting, stage of plant growth and other factors. About 25 to 30 inches of water, including rainfall and irrigation, are about optimum for cotton production.

The general irrigation practice on the High Plains follows rather closely the recommendations of the Lubbock Experiment Station. Since very little effective rainfall occurs during the winter, a preplant irrigation is necessary to insure sufficient subsoil moisture for planting and early seedling maintenance. On hardland (fine-textured clay and clay loam) and mixed land (medium-textured) soils, the pre-plant irrigation is applied down lister furrows, while on sandyland (coarse-textured sandy) soils, the pre-plant irrigation is applied by sprinkler systems. This application is made as near planting time as practical. The first seasonal irrigation normally is applied at first bloom after the land has been cultivated one or more times. The second irrigation is made 16 to 20 days later, but not later than the last week of August.

Weslaco

Experiments have been conducted at the Lower Rio Grande Valley Experiment Station at Weslaco in Hidalgo county, to determine the effects of moisture levels and dates of planting on the yield, growth and fiber characteristics of cotton. At all moisture levels, a preplanting irrigation was given for each of the two planting dates, February 15 and March 15.

Maximum growth and yield were obtained where the soil moisture was not allowed to fall below 35 percent of field capacity up to bloom stage, and 65 percent of field capacity from bloom stage until maturity. This practice required four or five irrigations during the season. Almost as high average yields, however, were obtained where the soil was allowed to be depleted to 20 percent of field capacity and then irrigated to field capacity. This treatment required one preplanting irrigation and one irrigation in June or July. It also required considerably



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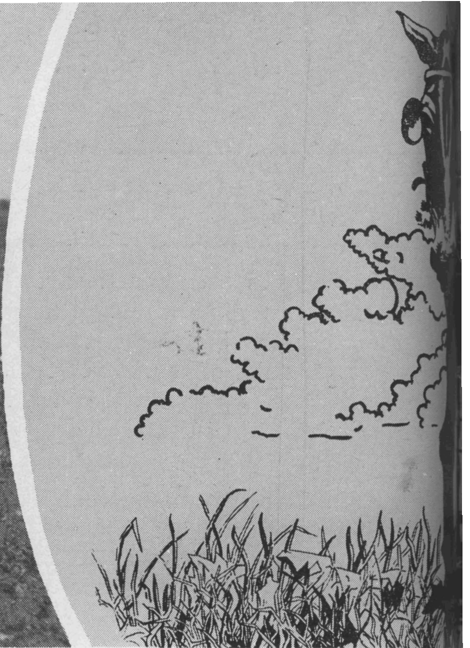

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LAND PREPA

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LAND PREPAR FOR COTTON

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FOR COTTON

...for faster decomposition and the ...winter in cotton residue. 2. Land ... walking plows was inefficient in ...powered equipment shown in the ...flatbreaking to aid in better resi-...board plow. This operation gen-... Trans-Pecos area; in other parts ... is used to list out the old beds. ...eration normally is used to "touch-... 6. Whether cotton is planted in ... or bedded several weeks before ...apply a preplanting irrigation in ...ydrous ammonia (nitrogen) as a ... Grande Valley. Courtesy Mid-... 8. Distributor used to place ... Courtesy John Deere Company.

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less water than where high-moisture level treatments were maintained.

Cotton planted about March 15 produced significantly higher yields of lint and used less water than cotton planted about February 15.

Studies at Weslaco and at other stations in Texas showed that the cotton plant uses the largest amounts of water from the flower stage to maturity. For this reason, ample water should be available during this period for maximum yields.

College Station

Irrigation studies at College Station on Brazos River bottomlands have included low, medium and high-moisture levels in combination with fertilizers to develop suitable supplementary irrigation practices for cotton. Starting with soil at field capacity, the following moisture levels were used: *low-moisture level,* irrigated when 80 percent of available soil moisture had been depleted; *medium-moisture level,* irrigated when 60 percent of available soil moisture had been depleted; and *high-moisture level,* irrigated when 40 percent of the available soil moisture had been depleted.

The highest yield in this experiment, 2,900 pounds of seed cotton per acre, was obtained from the high-moisture irrigation combined with 160 pounds of nitrogen per acre. Under conditions of low fertility (no fertilizer), the high-moisture level decreased yields of cotton. Varying amounts of nitrogen significantly affected the yield of cotton under different moisture conditions, but varying amounts of phosphorus and potassium had no appreciable effect.

Increasing the amount of nitrogen beyond the point of balance between nitrogen and water tended to decrease yields.

Trans-Pecos

Only a small amount of experimental work on irrigation practices has been conducted in the Trans-Pecos area. In view of this fact, a brief discussion of the prevailing irrigation practices in the area are given here to round out the section on irrigation. Salinity is a serious problem in irrigation in this area.

In the Upper Rio Grande Valley, water is supplied from the Elephant Butte Dam or from wells. In the Pecos Valley (Reeves, Pecos, Loving, Ward and Crane counties), water is supplied by the Red Bluff Reservoir when available, and from wells. Cotton is planted in both areas on single beds or on double cantaloupe beds and is irrigated by the furrow method. A heavy pre-plant irrigation is made in March which usually supplies all moisture needed until June. During the summer, water normally is applied every 14 to 18 days until about September 1. About 3 inches of water are applied at each irrigation, making a total of approximately 30 to 36 inches for the season.

Irrigation projects on upland soils in the Trans-Pecos area are located at Van Horn, Dell City, Balmorhea, Fort Stockton, Coyanosa and Bakersfield. Pump-irrigation practices in these projects are similar, but differ somewhat from the irrigation practices along the Pecos River and the Rio Grande.

The furrow method is used generally in the upland areas. The land is prepared and bedded in single beds running with the slope. In pre-plant irrigation, water is applied in the furrows. After pre-plant irrigation, the beds are knocked down flat. Planting is done in the furrow with a lister that splits the former beds and places the seed in moist soil. Early irrigations are applied in the furrows in which the cotton is planted. As the cotton grows, cultivation throws soil to the plants and fills up the furrows, gradually forming furrows between the rows. Later irrigations are made in these furrows. Summer irrigation may be applied as frequently as every 9 or 10 days, making a total of up to 60 inches for a season.

Several sprinkler systems have been installed in the upland pump-irrigated areas. Sprinkler irrigation eliminates the need for leveling the land and conserves water. It remains to be seen, however, whether soil salinity may be controlled adequately by sprinkler irrigation.

COTTON IN THE LITERATURE

Our first literary record of cotton is in the vague phrases of a dead language. The most ancient cotton fabrics are the remains of a civilization that matured and vanished in the New World while Europe was still a barbarous wilderness. As this delicate seed hair first appears in the traditions of Asia, or the marvelous grave cloths of pre-Inca Peru, it is already a finished achievement, complex and varied in technique, highly developed in aesthetic values, the fruits of long ages of development and accomplishment, its standard beyond our latest skill.

M. D. C. Crawford

TOP

A pre-planting irrigation of cotton land by the sprinkler method. Sprinkler irrigation permits the control of water on sloping land and on soils underlain with highly permeable subsoils. Courtesy Allis-Chalmers Manufacturing Company.

CENTER

Irrigation water is better controlled and labor costs are reduced by using concrete-lined ditches. Siphon tubes permit the operator to adjust the water flow for proper irrigation. Lined ditches also help prevent rising water tables and the resulting salt deposits. Courtesy Portland Cement Association.

BOTTOM

Cotton being irrigated by the furrow method. Water from a main-line concrete pipe system is distributed by gated pipes. Excessively long rows should be avoided to prevent too much water at the head of the furrow.

COTTON INSECTS

Many insects attack cotton. Those discussed here, in order of their seasonal appearance in the field, are the most important in Texas. Specific recommendations are given in Leaflet 218, "Texas Guide for Controlling Cotton Insects," published by the Texas Agricultural Extension Service. This guide is revised annually to include the results of research findings on new insecticides and methods of insect control. Since this leaflet is available, only the insects are discussed here with general considerations concerning their control.

Thrips

Thrips are small insects that infest the leaf buds and flowers of many species of plants. In cotton, they usually are seen in the terminal buds of young plants. They pierce, chafe and suck juices from the embryonic leaves in the buds, causing them to curl and become ragged and irregular when they unfold. This retards the growth of new leaves and stunts the plants. The injury may result in loss of stand, delayed harvest and in severe cases, loss of yield.

Cotton Fleahopper

The cotton fleahopper attacks cotton and other plants throughout the entire Cotton Belt of the United States. It causes the greatest damage in Louisiana, Oklahoma and Texas, but in some years serious losses occur in other states. Its more favored host plants are cotton, goatweed, horse-mint, primrose, milkweed, ragweed and other weeds on which the insect lays its eggs. In cotton, the fleahopper pierces the newly formed squares and terminal buds. The punctured squares turn brown or black and fall off, thus reducing the yield.

Boll Weevil

The boll weevil is a native of Mexico or Central America. It was first found in Texas near Brownsville in 1892 and had spread gradually over the greater part of the Cotton Belt by 1922. Boll weevils spend the winter as adults in woods trash or other protected places near cotton fields. In the spring, they return to the cotton fields and stay there until frost. They prefer to feed on and to lay their eggs in squares, but they also attack bolls. The eggs are laid singly in deep punctures in squares or bolls. Most of the punctured squares and small bolls are shed, thus reducing the yield.

Overwintering female boll weevils begin to lay eggs in the earlier squares put on by the cotton plants, and egg laying may continue for 6 weeks or longer. Three to 4 weeks after the earliest eggs are laid, a new generation of females is ready to begin egg laying; and it is possible for a third generation to begin its egg laying before all of the overwintering females have finished. This causes a great overlapping of generations, especially late in the season. However, there often is a peak period of oviposition by the overwintering generation, which indicates when a serious rise in infestation may be expected from their offspring. There generally are four to six generations during the growing season.

Bollworm

The cotton bollworm, also known as the corn earworm and the tomato fruitworm, attacks and damages cotton wherever it is grown in the United States. Losses from the insect, however, generally are greatest in Louisiana, Oklahoma and Texas.

The bollworm, unlike the boll weevil which feeds on cotton only, has many host plants including corn, grain sorghum, alfalfa and many other legume crops. On cotton, the eggs are laid singly and may be placed anywhere on the plant, but the tender growing buds generally are favored. These eggs and the larvae that hatch from them in 3 days are very vulnerable to certain beneficial insects which prey on them and may be controlled by them if relatively few eggs are being laid. However, if many moths move into cotton, these predators are soon outnumbered and chemical control becomes necessary. When bollworms are present in large numbers they can practically destroy a cotton crop in a short time.

Pink Bollworm

The pink bollworm was first found in cotton fields in the United States in Texas in 1917. The early infestations were soon eradicated. Subsequent infestations have occurred from time to time from flights of adult moths from Mexico. These were more difficult to eradicate. The insect has spread over much of the Cotton Belt and is now found in Arizona, New Mexico, Texas, Oklahoma, Arkansas and Louisiana. It is one of the most destructive and dreaded cotton insects.

The pink bollworm moth lays its eggs singly or in groups on bolls, flowers and other parts of the cotton plant. The larva hatches and becomes established in the boll, feeding principally on the seed, but damaging the lint, thus reducing the yield and quality of both lint and seed.

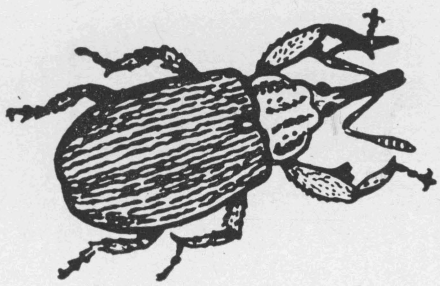
Cotton Leafworm

The cotton leafworm is not native to the United States and cannot survive the winter in our climate. Infestations come each year from flights of moths from Central or South America where wild and cultivated cotton grow throughout the year. Leafworms usually are reported first from the Gulf Coast re-

Late season airplane spraying in the Lower Rio Grande Valley to control cotton insects. Such planes can spray about 20 acres on one load. The airplane also is used to apply defoliants and desiccants.

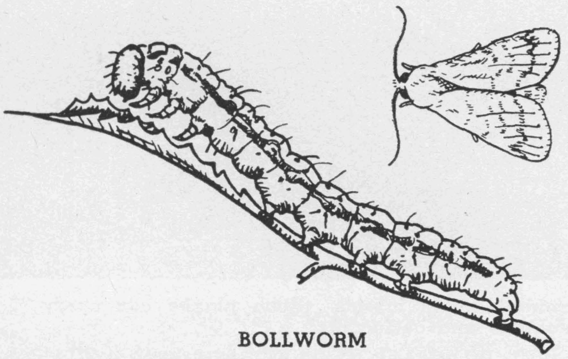
Covering 14 rows each trip across the field makes short work of ground spraying to control cotton insects on experimental farms near College Station.

COTTON INSECTS



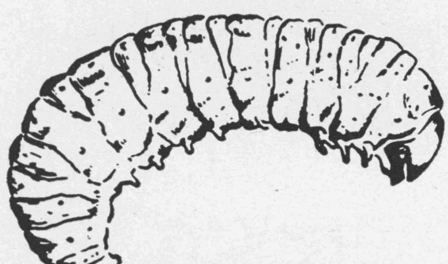
BOLL WEEVIL

Length, 1/4 inch. Serious pest to U. S. cotton; grub and beetle feed on squares, bolls or terminal buds.



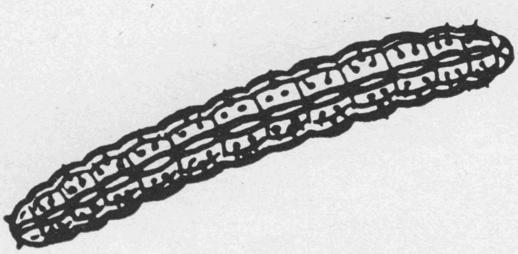
BOLLWORM

Wing span, 1 1/2 inch. Major pest; deposits eggs on growing tips, squares, bolls, where worms feed; also called corn earworm and tomato fruitworm.



PINK BOLLWORM

Length, 1/2 inch. Moth lays eggs on cotton bolls, squares; pink worms eat out seed in green bolls, stain fiber.



COTTON LEAFWORM

Length, 1 1/2 inches. Eggs deposited on underside of leaves; greenish worm with half-looping crawl; strips leaves.

gion of South Texas. The moths from this generation of worms fly northward. By the third generation, major portions of Texas, Arkansas, Louisiana and Mississippi may be infested. The earlier generations complete their life cycles in approximately 3 weeks. About a month is required after the weather becomes cooler. Large numbers of moths move into an area where cotton is unprotected and severe defoliation may occur within a week. Detection of the eggs, which usually are laid on the underside of the leaves, and the newy hatched larvae which feed there without perforating the leaf, is important to proper timing of insecticide applications.

Cotton Aphid

The cotton aphid is found in all parts of the world. It also is known as the cotton louse and melon aphid. The cotton aphid is a small, soft-bodied insect. The female gives birth to living young. The aphids pierce the tissues and suck the juices from the leaves, sometimes causing them to curl and fall prematurely. However, the principal source of economic loss from these insects is a loss in grade because of a mold which thrives on the sweet substance called "honey dew" secreted by the aphids.

Spider Mites

Several species of spider mites are known to attack the cotton plant. They are hardly visible to the naked eye, being about 1/50 of an inch long. Mites live on the underside of cotton leaves, where they lay their eggs. They suck the sap from the leaves, causing injury which is indicated by red spots, which often are called rust. The entire leaf then reddens or turns rusty brown and drops from the plant. Extensive defoliation of this sort will reduce yields unless the fruit has matured.

Other Injurious Cotton Insects

There are many other insects that occasionally attack and damage cotton to some extent. Among these are several species of cutworms, various armyworms, the cabbage looper, grasshoppers and lygus bugs. Severe injury may result from the attacks of any of these insects.

Cotton Insect Control Program

Several cultural practices are valuable aids in holding down insect infestations. Cleaning up areas adjacent to cotton fields which afford protection for overwintering boll weevils and early breeding areas for such insects as thrips, mites and fleahoppers, are of definite value. Planting cotton as early as feasible and maturing the entire crop as near the same time as possible reduce the period of vulnerability to insect attack and improve the quality of the lint. This makes possible early harvest and destruction of crop residues which may provide food and shelter for boll weevils and pink bollworms before their wintering period.

Even where the preceding practices are carried out, chemical control of insects on cotton usually is necessary.

Low dosages of insecticides are recommended for the early-season control of such insects as thrips, fleahoppers and overwintering boll weevils. These are calculated to reduce pest populations to a non-damaging level without destroying natural enemies or causing them to leave for lack of food. Boll weevils which have survived the winter and moved back into cotton fields are much easier to kill than their descendants later in the season, and reduction of this overwintering generation reduces the potential late-season infestation. Control of such insects as thrips and fleahoppers insures early fruiting and maturity of the cotton, which is becoming increasingly important. Cotton which matures early may avoid the heavy and expensive insect infestations which often occur late in the season.

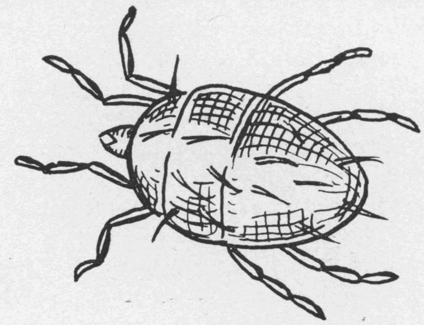
Generally two to four early-season applications are made and timed by the stage of growth of the cotton. Following these, no applications are made for approximately a month unless absolutely necessary. This allows a period for natural enemies to increase to help control some injurious pests, such as aphids, mites and scattered bollworms.

Late season applications for control of such insects as boll weevils, bollworms, pink bollworms and various leafworms generally require such heavy applications of insecticides that beneficial insects are reduced to a level where they are no longer effective, and repeated applications must be made to control the injurious species present as long as their infestation level is damaging or until the cotton matures. These late-season applications are made on the basis of insect infestation counts or on the condition of plant foliage. Knowledge of the life history, feeding habits and alternate host plants of these insects is important for anticipating infestations and treating them effectively.

Since boll weevils spend their larval lives within squares or bolls, and it has not proved practical as yet to kill them there, it is necessary to attack the adults by forcing them to move over and feed on plant surfaces covered with insecticides. To maintain this cover, insecticides must be applied at 5-day intervals because of chemical breakdown and new plant growth. If a quick-acting, short residual compound is used, a shorter interval probably will be necessary. This is especially true later in the season when weevils become restless and move rapidly from field to field.

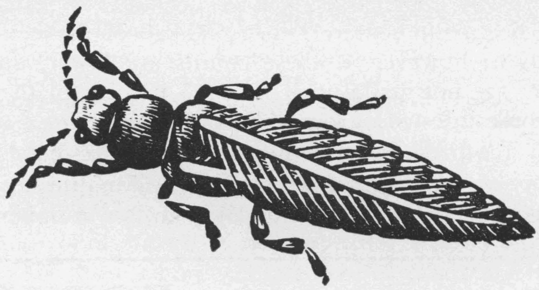
Timing of insecticide applications probably is the most important factor in bollworm control. There is a rather short period after hatching when the young larvae feed in the open; during this period, they can be controlled adequately. After this period, they enter squares and move from squares to bolls, becoming more protected and more resistant to insecticides. A late application or one executed

COTTON INSECTS



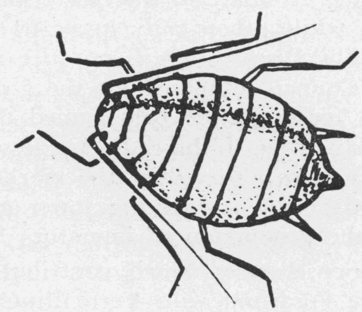
SPIDER MITE

Length, 1/50 inch. Found on underside of leaves; sucks sap, spins filmy web; develops in hot, dry weather.



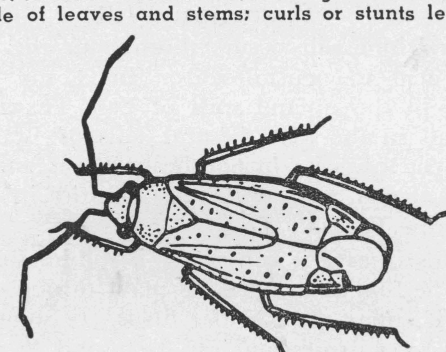
THRIPS

Length, 1/20 inch. Light-yellowish to black; injures leaves, young terminal buds; leaves get cup-shaped, ragged.



APHID OR PLANT LOUSE

Length, 3/32 inch. Soft-bodied, sucking insect; feeds on underside of leaves and stems; curls or stunts leaves.



FLEAHOPPER

Length, 1/8 inch. Blackish, soft-winged, jumping bug; attacks leaves and terminal buds with piercing, sucking mouth parts.

poorly, when a large number of worms are hatching, can mean a considerable loss in bolls 2 weeks later, even if a regular 5-day schedule is maintained.

Pink bollworms are vulnerable to insecticides for an even shorter period than bollworms, since a large proportion of the eggs are laid directly on the fruit which the newly hatched larvae enter. The eggs for the first generation of pink bollworms are laid before bolls are available and the young larvae attack squares. These squares generally remain on the plant and bloom, but the larvae web the tips of the petals together to protect themselves inside. These are called "rosetted" blooms, and estimates of the severity of infestation are based on their numbers. It is then too late to treat this generation with insecticides, and control efforts are directed against the following generation which attacks the bolls. If rosetted bloom counts are high (350 or more per acre), applications are begun immediately to get ahead of the next generation; however, if these counts are lower, applications are not made until 10 to 15 percent of the bolls become infested. Completion of the life cycle of this pest requires about a month and there may be as many as six generations per year. An infestation of pink bollworms is cumulative; unless numbers are reduced by efficient applications of insecticides, great losses in grade and yield may occur.

The disturbance of natural balance in insect populations because of chemical control of our major pests often results in serious infestations of aphids and mites. Insecticides in general use for boll weevil, bollworm and pink bollworm control usually are not effective for aphids and mites. There are two general approaches to this problem. Small amounts of materials effective for the control of mites and aphids may be added to all applications of insecticides for the suppression of aphid and mite populations, or these populations may be allowed to build up to near-damaging infestations and then treated with a "knock-out" dosage. If mite infestation becomes severe, extensive defoliation may result.

The application of insecticides when they are needed will result in considerable profit for the farmer. These applications should be scheduled to aid in setting the bolls as early and as near the same time as possible. Any increase of the length of time from planting to harvest makes the period of insect protection longer and the applications more expensive. Cotton harvested late is lower in grade and more difficulties are encountered in its harvest.

COTTON DISEASES

Cotton has its share of diseases. Some kill the cotton plant while others only lower its production efficiency. The Disease Loss Committee of the Cotton Disease Council estimated for the 5-year period, 1953-57, that for every 100 bale ginned there would have been 110 bales if these disease losses had not occurred. Diseases also reduce the market value of the harvested cotton by causing lower grades, spot grades and the production of immature fibers.

The major diseases which contribute to losses in Texas are Fusarium wilt, Verticillium wilt, root rot, seedling disease, nematodes, bacterial blight, boll rots and fungus leaf spots.

Fusarium Wilt

Fusarium wilt occurs throughout the world on sandy acid to neutral soils. In Texas, it occurs largely in the upland soils of East Texas. It also is found in the near neutral soils of Brazoria and Fort Bend counties in Southeast Texas and in Martin, Hardeman and Wilbarger counties in West and Northwest Texas.

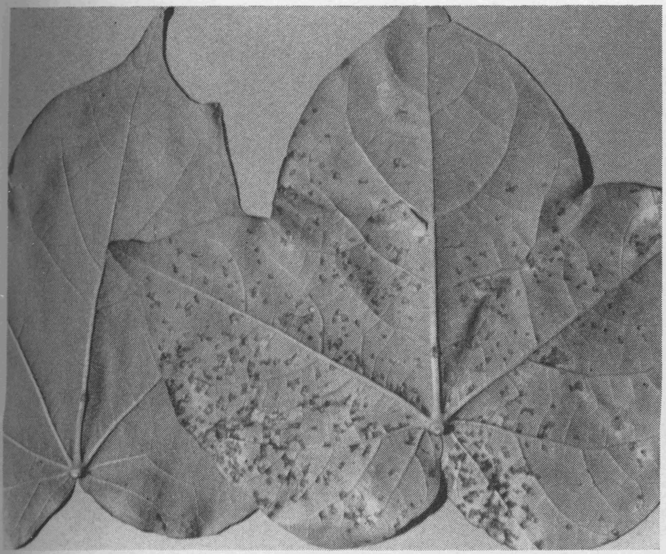
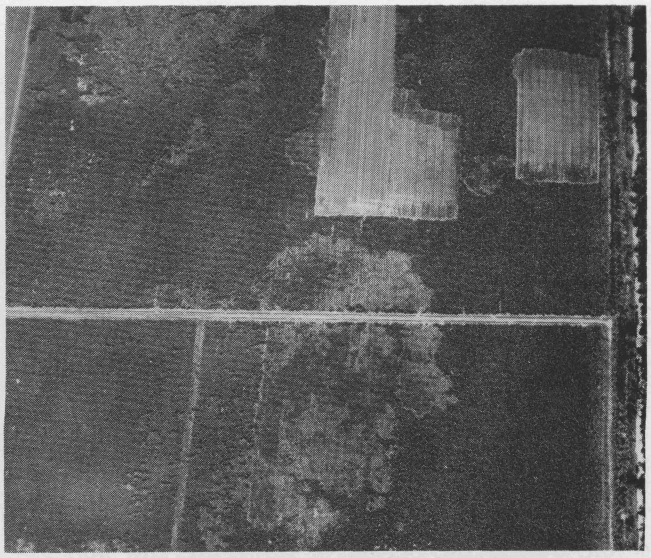
This disease is caused by a soil-inhabiting fungus. The fungus invades the plant through the roots where it enters the vascular ducts. It grows through the vascular tissues and can be found in all aboveground plant parts, including bolls and seed. The fungus causes plugging of the water-conducting vascular system, which leads to wilting and death of the plant.

The fungus can attack the plant at any growth stage. Disease symptoms in seedlings and young plants are yellowing and browning of cotyledons and leaves. Older plants may be stunted, followed by wilting, leaf yellowing and leaf drop. Leaves first become yellow along the margin and then the yellowing progresses towards the midrib. The yellow tissues soon die and turn brown. As affected areas enlarge, the petiole abscission layer forms and the leaves are shed. On cutting crosswise through a stem or branch of a wilt plant, a dark brown discoloration of the woody tissue can be seen.

Fusarium wilt is often associated with nematodes. These microscopic, soil-inhabiting worms puncture the roots of the cotton plant, making it easier for the wilt fungus to enter the root. In most cases, severe outbreaks of the disease are due to the combined effects of nematodes and the fungus. For this reason, the disease is more properly referred to as the Fusarium wilt-nematode complex.

The wilt fungus usually is introduced into a field by planting cottonseed which carry it internally. It is spread to all parts of the field by spore dissemination and the movement of debris from infected plants. Once established, it can survive on organic matter in the soil for many years.

The most economical control of the Fusarium wilt-nematode complex is the growing of resistant varieties. In fields where the disease is very severe,

Left—The cotton leaf on the right shows typical leaf lesions of a variety susceptible to bacterial blight. The leaf on the left is from a variety resistant to the disease. Both leaves were inoculated with disease races 1 and 2. Cooperative work by the Texas Station and the USDA seeks to develop varieties resistant to this and other diseases. Right—Aerial view of two cotton fields where the plants in large and small areas have been killed by cotton root rot. In the upper field, two large spots have been plowed out. The root rot spots can be recognized by their irregular shape and lighter color. Courtesy of Southern Flyers, Inc., Weslaco, Texas.

varieties, such as Auburn 56 and Plains, which have a high degree of wilt and nematode resistance, should be grown. Where the disease is not very severe, varieties such as Austin, Rex, Empire WR and Coker 100 will give adequate control. Long-term cropping systems and the use of balanced fertilization will help reduce losses.

Verticillium Wilt

In the United States, Verticillium wilt occurs across the entire Cotton Belt. In Texas, it occurs extensively in the irrigated areas of the High Plains, Rolling Plains and the southwestern irrigated valleys. This disease has been known to be present in isolated fields in Ellis and Hunt counties for a number of years. In recent years, its active spread has been from the western areas eastward to a line from Hardeman, Wilbarger, Baylor and Howard counties.

Verticillium wilt accounts for 8.87 percent of the total yield loss in Texas. Losses also occur in the form of lower and spot grades and the production of immature fibers.

Verticillium wilt is caused by a soil-borne fungus. The fungus invades the roots and grows throughout the plant in the vascular system. This leads to wilting and shedding of the leaves.

The plant may be attacked at any stage of growth. Young plants may become stunted and the leaves turn yellow between the main veins. These tissues die and turn brown and the dying leaves are shed from the plant. On cutting stalks of Verticillium wilt plants, one will observe the same type vascular discoloration as found in Fusarium wilt plants.

For positive differentiation between Fusarium and Verticillium wilt, it is necessary to isolate and identify the fungus. In Texas, most wilts west of a line from Dallas to San Antonio will be Verticillium, and those occurring east of that line will be Fusarium. In cases where the two wilts occur in the same area and in the same field, as in Hardeman, Wilbarger and Martin counties, Fusarium wilt usually will be associated with nematode injury while Verticillium wilt will not.

Verticillium wilt generally is most severe in irrigated, heavy fertile soils with good organic matter content, and disease development usually it aided by good agronomic practices. The fungus is active only when the soil temperature is below 85° F. Wilt symptoms usually are observed either early or toward the end of the growing season. Irrigation water often lowers the soil temperature. For this reason, Verticillium wilt generally is most severe in irrigated fields.

Verticillium wilt is spread by the movement of debris from infected plants within fields and from field to field. Gin trash and the movement of soil by cultivation can spread the disease.

Verticillium wilt is best controlled by growing resistant or tolerant varieties. The long staple Pima type varieties are resistant. Most of the short staple upland varieties are susceptible. Such varieties as Auburn 56, Coker 100 WR, Empire WR, Rex and Austin have some tolerance. Highly tolerant and resistant varieties are being developed.

Planting on high cantaloupe-type beds, which have a higher soil temperature in the root zone, helps to reduce losses. Thickly spaced plants of about 4 to 6 per foot of row also will reduce yield losses.

Cotton Root Rot

Cotton root rot is limited to cotton production areas of the United States and Northern Mexico. In the United States, it occurs mainly in the alkaline soils of Texas and other Southwestern States. The disease is severe in some years on the Blackland and Grand Prairies. Root rot accounts for 25.53 percent of the total cotton disease yield loss in Texas. Losses also occur in the harvested crop in the form of lower and spot fiber grades and the production of immature fibers.

The fungus which causes root rot attacks about 2,000 plant species other than cotton, and is found in cultivated and uncultivated soils. The fungus invades the roots of the plant by breaking down the outer cells. It penetrates into the root where it destroys the vascular tissues and kills the plant within a short time. The disease is most severe during seasons of high soil temperature and moisture.

The first symptoms of the disease often occur about 7 weeks after planting, but is generally most severe during the period of flowering and boll maturity. The first symptoms are slight yellowing or bronzing of the leaves. These leaves will have a higher temperature than healthy ones, which can be determined by feeling the leaves. This is followed by wilting of the leaves. Drying and browning of the leaves follow rapidly. Leaves are seldom shed from the plant. The outstanding root symptom may be seen by peeling the bark from the main stem down to the root area. The above-ground portion of the hard wood will have the normal cream color, while at the soil line zone this will change to a reddish-brown color.

Three facts are used in obtaining practical control of cotton root rot: (1) the fungus, both the mycelial and sclerotial stages, is easily killed by drying; (2) the mycelium and sclerotia can be eliminated from soils by microbial activity; and (3) the disease tends to be less severe in soils with an adequate nitrogen level.

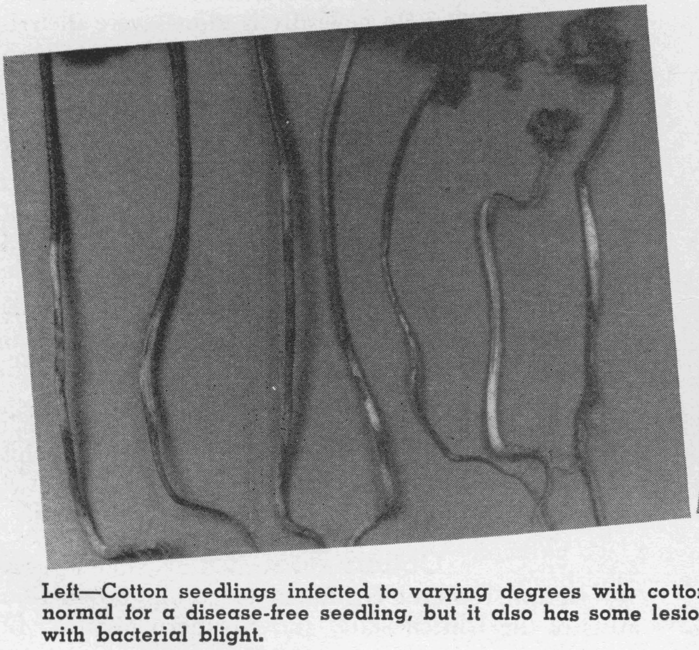
Drying of the soil can be obtained by flat-breaking a field in the early fall 6 to 10 inches deep with a moldboard or good disk plow. If the broken soil is left alone and no rain occurs, then within 2 weeks the slices will have dried enough so that most of the fungus bodies are killed. High microbial activity can be obtained by burying green organic matter from such crops as Hubam sweetclover, Austrian Winter peas and the green stubble from grain sorghum production. The green organic matter should be shredded and then buried 6 to 8 inches deep. A plow with an action that inverts the plow slice so that the organic matter goes to the bottom of the furrow does the best job. When preparing the seedbed, it is best to run the bedders so that the layer of organic matter is not disturbed. A favorable nitrogen level in the soil can be maintained by proper fertilization.

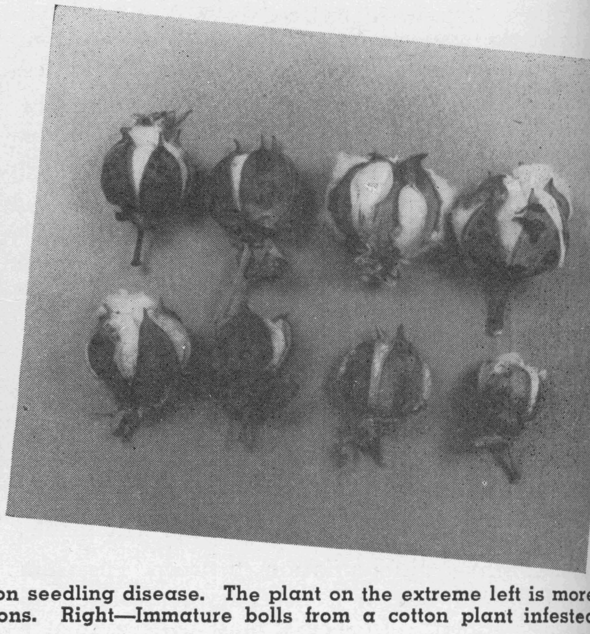
If any of the foregoing principles are to be used singly, early-fall flat breaking with a moldboard plow to dry the upper soil area would be the best. It has been demonstrated that a combination of these three principles will reduce losses of 40 to 80 percent to as low as 5 to 10 percent.

Seedling Disease

Seedling disease occurs wherever cotton is grown. In Texas, it accounts for 22.73 percent of the total yield loss. Seedling disease is caused by several fungi which live in the soil. These fungi attack young seedlings from the time of germination until true leaves begin to appear. The seedlings may be killed or the roots may be only girdled with the seedlings remaining alive. Such seedlings produce stunted plants with poor root systems which limit their productive ability.

The first symptoms of the disease are wilting of young seedlings. The destroyed portion of the stem





Left—Cotton seedlings infected to varying degrees with cotton seedling disease. The plant on the extreme left is more normal for a disease-free seedling, but it also has some lesions. Right—Immature bolls from a cotton plant infested with bacterial blight.

is marked by brownish lesions (sore shin) which occur in the area near the soil surface. The tap root and rootlets may have brown to blackish lesions where the fungi destroyed root tissue. Seedlings which are attacked, but not killed, tend to be shorter than healthy ones. Plants from seedlings that are damaged, but not killed, may grow slower and tend to be shorter than those with undamaged roots. Surviving plants with badly damaged roots will wilt suddenly and die about the time of flowering. Seedling disease is most severe when periods of cool, wet weather follow planting. It tends to be more severe in the heavier soils and in soils with a high level of organic matter.

A number of practices will help reduce seedling disease. Seedbed preparation in such a way that excessive amounts of the old crop residue will not be in the seed placement area is important. Good planting methods which allow the young seedlings to emerge and grow off rapidly also are important. Whenever possible, cotton should be planted on beds so that drainage and drying will occur after rains.

Germination of cottonseed and the growth of cotton seedlings are slow at soil temperatures much below 70° F. Slow-growing seedlings remain susceptible for longer periods; thus they are more apt to be attacked and killed by the seedling disease fungi. For this reason, planting should not be done when the soil temperature is below or apt to be below 70° F. for any length of time.

In many cases, the use of acid-delinted, graded seed will help reduce stand losses. In all cases, planting seed should be treated adequately and properly with a recommended seed protectant fungicide at the recommended dosage. Seeding rates should not exceed 30 pounds per acre, for it has been shown that seedling disease is more severe when rates higher than 30 pounds are used.

Mixing fungicides into the covering soil at planting also is recommended for seedling disease control. Fungicides or mixtures of fungicides recommended by the Texas Agricultural Experiment Station should be used. They may be applied effectively as a spray or a dust, as recommended.

Nematodes

Nematode injury to plants occurs over the entire world. In Texas, it causes 4.09 percent of the total cotton disease loss.

The root-knot nematode is the most damaging that attacks cotton roots. Others that attack cotton to a lesser extent are the root lesion and the sting nematode.

Nematodes enter the roots at or near the growing point. Root tissues affected by the root-knot nematode form knots or galls. Nematode injury generally is more severe in sandy soils.

Roots of the cotton plant can be invaded by nematodes at any growth stage. They can attack young seedlings, causing them to die. Nematodes damage the roots and make them accessible readily to the Fusarium wilt fungus either by mechanical wounding or predisposition. Thus, they are the principal cause of severe outbreaks of Fusarium wilt.

Affected plants appear unthrifty and yellow in color. They may be stunted and appear as plants with severe water deficiency. Severely affected plants eventually die.

Losses caused by nematodes are best reduced by growing resistant varieties of cotton. Rotation with nonsusceptible crops also is valuable. Soil fumigation with nematocides probably would pay if the affected areas are large.

Bacterial Blight

Bacterial blight may occur wherever cotton is grown. In Texas, it generally is most severe on the High Plains and the Coast Prairie, in the irrigated valleys of the Trans-Pecos area and in the sprinkler-irrigated areas on the Rolling Plains. It causes 25.82 percent of the total cotton disease yield loss in Texas. Additional losses occur in the form of lower and spot grades of the harvested fiber.

This disease is caused by a bacterium. The organism enters the plant through open stomata in the leaves, bolls or stems. It also may enter the tissues through wounds. The bacteria break down the cell wall of the spongy tissues, releasing the cellular juices. For this reason, young lesions will have a water-soaked appearance.

The blight organism may overwinter in the soil on undecomposed plant debris, but is carried more commonly from season to season within and on planting seed. Once in a field, the disease is spread from plant to plant and from older tissues to new tissues by wind-driven, splashing rains. New symptoms of the disease usually will appear 7 to 14 days following a shower. Sprinkle irrigation is an excellent spreader of bacterial blight. Since the stomata must be open for the bacteria to enter the plant, extensive spread occurs only during daylight. However, night showers accompanied by blowing sand can spread it. The disease may be disseminated from field to field by whirlwinds which pick up diseased leaves. Splashing water then can carry the bacteria from the dead leaves to cotton plants.

The only known practical control of bacteria blight is the growing of resistant varieties. Resistant varieties, such as Acala 1517 BR, Acala 1517 BR-1, Blightmaster, Austin, Rex and Mebane B-1, are available for commercial production. Many new varieties are being developed. The planting of known disease-free seed will give control if there is no soil carryover. Acid-delinted seed which have been treated adequately with a seed-protectant fungicide will reduce early season infection, but will not necessarily prevent later epidemics.

Boll Rots

Boll rots cause 1.17 percent of the total cotton disease yield loss in Texas. The loss is caused by the rotting of bolls before maturity. Lower grades of the harvested crop also occur.

Boll rots are caused by a number of fungi which are not real pathogens. They invade the bolls mainly through wounds. However, when the humidity is high, they may become primary pathogens on unopened bolls which are approaching maturity. Bacterial blight lesions provide the principal ports of entry for these boll-rotting fungi.

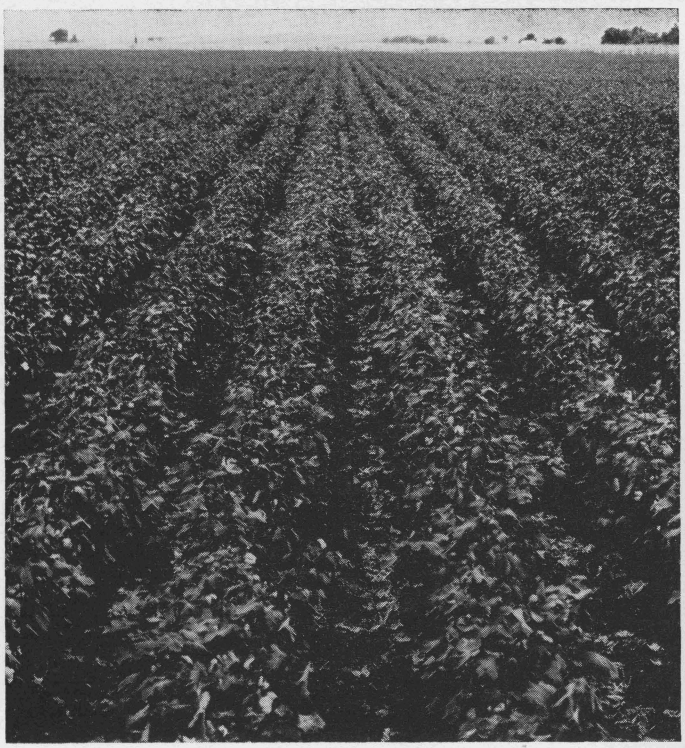
Boll rots are more severe under conditions where cotton grows tall and rank. For this reason, practices which prevent excessive vegetative growth will reduce them. Bottom defoliation which permits rapid drying of the lower areas of the plants after heavy dews and rains also is effective in reducing boll rots. Control of boll-damaging insects and the growing of bacterial blight-resistant varieties will greatly reduce losses.

Fungus Leaf Spots

Several fungus leaf blights cause some losses in cotton production in Texas each year. These losses are caused by excessive shedding of infected cotyledons and leaves during wet springs and falls. These leaf-spot diseases are best controlled by proper seed treatments and crop rotations. Fine shredding and turning under of crop residues to promote complete decomposition during the winter also will control these diseases.

True cotton rust occurs in Texas along the Mexican border from Brownsville to El Paso. True rust spots on the leaves are orange in color. The fungus bodies which infect cotton are produced on several species of grasses, primarily the gramas. The disease is most severe in the spring when growth of these grasses is good and under conditions of frequent showers. Under these conditions, an abundance of inoculum is produced on the grasses and is spread to cotton by rain. The disease is best controlled by eradicating the host grasses.

Defoliation Is Necessary when Cotton Is Harvested Mechanically



Left—A field of cotton at the Blackland Experiment Station near Temple at the time a defoliant was applied.

Right—The same field 10 days after the defoliant spray was applied. Defoliation rids the cotton plant of all its leaves and makes it easier for the picker or stripper to get at the bolls.

PREHARVEST CHEMICALS

Prompted by serious labor shortages during and following World War II, coupled with the increasing necessity to reduce production costs, the mechanical harvesting of cotton has increased rapidly. Accompanying this rapid conversion to mechanization has been the necessity for using preharvest defoliating and drying chemicals as an essential part of a successful harvesting operation before frost. In some Texas areas, the use of preharvest chemicals is considered beneficial to hand harvesting and a necessary adjunct to production practices.

Reasons for Using

There are several reasons for defoliating and desiccating cotton. Defoliation aids in harvesting, whether by hand-pulling or by machine, resulting in higher grades because the source of trash and lint staining is removed. Defoliation aids in the control of insects and is a part of the recommended pink bollworm control program. And, most important, defoliation in connection with machine-harvesting greatly reduces the cost of harvesting. Experiments over several years have shown that desiccation together with machine-stripping saved $10 to $29 per bale over hand-pulling on the Blackland Prairies. Defoliation plus machine picking resulted in a saving of $10 to $15 per bale over hand-pulling in South Texas. Yield per acre is the most important factor in determining the harvesting cost per bale.

Types

Most of the defoliants and desiccants now used are essentially contact herbicides. At certain recommended rates they cause defoliation, but at higher rates they dry the leaves, stalks and bolls rapidly, with little or no true leaf drop. Other chemical types cause only rapid killing and drying, with slight or no defoliation even at low rates. Defoliating and desiccating chemicals may be divided roughly into three arbitrary groups: the true defoliants, which mainly cause leaf fall with minimal drying; the defoliant-desiccants, where the results depend largely on the rate; and the true desiccants, which mainly induce rapid killing and drying with the least leaf drop.

The commercial chemicals used change from year to year with the development of new compounds and the discarding of the ones less effective or more costly. These are formulated as dusts, water-soluble sprays and concentrates, emulsifiable sprays and oil-soluble materials. The chemical names, trade names, rate range per acre and dilution data are supplied on the manufacturer's label in the official Cotton Pest Control Guides published yearly by the National Cotton Council, and the specific recommendations for the individual states are distributed by various state agencies. The Texas Agricultural Extension Service revises annually and distributes the official "Cotton Defoliation Guide for Texas." In addition, an annual progress report on the research conducted and the results obtained with the commercial and new experimental preharvest chemicals in various locations in Texas is published by the Texas Agricultural Experiment Station.

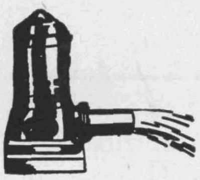
Chemicals To Use

The proper preharvest chemical to use depends on a number of factors. The ideal chemical should be reasonably safe to handle and apply, have minimum corrosive action on distribution equipment, should not contaminate or reduce the yield or quality of the fiber or seed, and the compound or the residues should be relatively non-toxic. The compounds must have properties to permit their use in relatively low amounts, be low in initial cost and unit application. In most cases, the cost of the chemical plus application should not exceed $5.00 per acre. Airplane applications that require rates in excess of 40 pounds of dust or 10 gallons of liquid spray per acre are not economically feasible. The tendency of the compounds to drift to susceptible crops, whether they will suppress regrowth and whether they will kill, defoliate or desiccate weeds and grasses associated with the crop, are other importat considerations. The growing conditions, the type of cotton grown and the method of harvesting also have bearing on the selection of the preharvest chemical. Usually, in high-producing, irrigated, open-boll cotton, true defoliants are preferred. The crop is set over a longer time and is harvested by hand, by spindle-type pickers, or by a combination of the two. For this type of cotton, desiccants are seldom used because of their drastic action, undesirable dry-leaf trash and other reasons. Examples of true defoliants in wide use are the cyanamid and sodium chlorate-sodium borate dusts, the magnesium chlorate, sodium chlorate-sodium borate, Endothal, amino triazole and thiophosphate sprays.

For the smaller storm-resistant, lower producing-dryland-grown cottons, or where the crop is to be stripped mechanically, the desiccants have proved more satisfactory. The chlorinated phenols, arsenicals and others, singly or fortified with various additives, are examples of the true desiccants.

Regrowth Problem

Regrowth, particularly during a wet harvest season or under conditions of high soil moisture, often defeats the practical purpose of defoliation and desiccation. Timing of the application is a partial solution to regrowth control. Rapid regrowth usually necessitates a second chemical application. The ideal



COTTON MARCHES ON

Cotton is a frontier crop restlessly seeking new horizons and new climate that are favorable to it. It made the long march from Virginia to Texas before the Civil War. Recently it has moved on, ever westward, across the mountains to New Mexico, Arizona and California where frontiers have been opened to it in semi-arid lands. These men cause the one-time desert to bloom white with cotton as they sink deep wells and pump water through a dry land.

David L. Cohn

solution to the problem would be to apply a chemical that would not interfere with defoliation or desiccation, but would prevent or retard regrowth. Amino triazole, a true defoliant, also is an effective regrowth inhibitor under most conditions. 2,4-D and similar herbicides have been added to desiccants to suppress regrowth. Contamination of application equipment and carry-over into planting seed raise serious problems when this is practiced. Several experimental compounds, compatible with defoliants and desiccants, show promise in controlling regrowth.

When to Apply

Mature, well-fruited, active plants defoliate best. Premature application of defoliants or desiccants can damage grade and cause losses in yield and quality since boll development stops with the chemical application. If the youngest bolls are at least 30 days old, are firm to applied pressure or cannot be sliced easily with a sharp knife, preharvest chemicals usually can be applied without damage to the fiber or seed. Other ways of timing the application are to delay defoliant applications until about 50 percent of the bolls have opened, and desiccant applications until 60 to 70 percent or more of the bolls are open. At this time, with proper cultural practices, the plants should be in cut-out, but still be active. An important rule is that the condition of the plants at the time of chemical application is the key to effective results, not some specific date on the calendar.

Weather conditions at the time of application are important; forecasts for the area should be studied carefully before application. Day temperatures below 70° F. or night temperatures below 55° F. are not favorable for good results. The rate of leaf drop or desiccation slows drastically, and even the better chemicals are ineffective during periods of low temperature. Moderate to high humidity contributes to a leaf condition more reactive to chemicals; dusts require dew or high humidity for optimum results. High winds hinder proper distribution of chemicals and promote drift to adjacent crops and sensitive plants.

The grower should defoliate or desiccate only enough acreage to stay ahead of the harvesting operation. Applications are recommended 8 to 14 days prior to the intended harvesting date in South and Central Texas and 2 to 3 weeks before harvest in North and Northwest Texas.

Bottom Defoliation

Under conditions of high humidity and rainfall, or in irrigated cotton, the practice of bottom defoliation has proved advantageous. In rank cotton with a heavy canopy of foliage, damp conditions near the base of the plant delay boll opening and favor boll rots. Removal of the lower leaves, with the spray pattern directed only towards the mature lower bolls (probably never more than one-third up on the stalk), permits the drying action of wind and sun and greatly reduces losses from boll rots. The bottom crop can be harvested, usually by hand, following bottom defoliation without injury to the immature top crop if the spray is applied properly. Bottom defoliation can be followed by total defoliation following maturity of the upper bolls. A high clearance sprayer, properly shielded, works well for this practice.

Application Equipment

Both airplane and ground sprayers can be used successfully for applying preharvest chemicals. In general, conventional equipment and methods of applying insecticidal and fungicidal sprays and dusts are applicable, with slight modifications, to preharvest chemicals. Thorough coverage of the plants is extremely important. Large droplets are essential for good defoliation. Well-shielded, high-clearance sprayers with sufficient nozzles to insure adequate plant coverage are recommended for ground application. Other sprayers work well in small cotton.

HARVESTING

Cotton is harvested by hand and by mechanical stripping and mechanical picking.

Hand Harvesting

Hand harvesting includes picking and pulling, or snapping. In picking, the seedcotton is removed by hand from the bolls, leaving the burs on the stalks. In pulling, the entire open bolls, including the seedcotton and burs, are removed from the plant by hand.

Mechanical Harvesting

The mechanization of cotton harvesting has made less progress in the overall mechanized production of cotton than any other phase in which machines can be used. Although there were approximately 25,000 mechanical harvesters in Texas in 1956, only 24 percent of the cotton was harvested mechanically. The development and acceptance of mechanical harvesters has been slow for several reasons. Perhaps the most outstanding is the characteristic of the cotton plant. Because of varietal characteristics and widely varying climatic conditions, the cotton plant varies in its growth from an average of less than 1 foot in height in some areas to more than 6 feet in other areas. Because of the wide range in growth and inherent characteristics of the mature cotton bolls, there are two types of cotton harvesting machines — the stripper type and the picker type.

Mechanical Stripper

The stripper-type cotton harvester uses either a single or double revolving stripper roll or a set of stationary fingers which strip the cotton from the plant. Since all of the fruit is stripped from the plant, it is necessary to have a variety which matures rapidly and uniformly over the plant. Varieties have been developed which have storm-resistance characteristics so that the locks of cotton in the early-maturing bolls will not be blown out by normal winds which occur during the harvest season. Close plant spacing, 3 to 4 plants per foot of row, is required generally for mechanical strippers so that the plants will produce shorter limbs and the bolls will be borne at least 6 inches from the ground.

Mechanical Picker

The mechanical picker uses a series of revolving spindles which remove the seedcotton from the open bolls without damaging or removing the unopened bolls. Varieties for mechanical picking should have a wide-opening boll with fluffy locks. There should be enough storm resistance to prevent the locks from falling out of the bur or being blown out by moderate winds. Populations of 30,000 to 50,000 plants per acre will allow good mechanical picking efficiency.

Cultural Practices

Preparation for mechanical harvesting should begin before the cottonseed are planted. Preseason planning should include such items as land selection, preparation, varieties, planting, fertilization, weed and grass control and defoliation.

Field layout and the size and cleanliness of the field should be factors considered in selecting the land. When preparing the land, the old crop residue should be destroyed and the rows should be laid out straight with uniform spacing.

The highest-yielding varieties are not always the ones best suited for mechanical harvesting. Mechanical-picking efficiency varies considerably among varieties, but mechanical-stripping efficiency usually is not affected greatly by the varieties adapted to mechanical stripping.

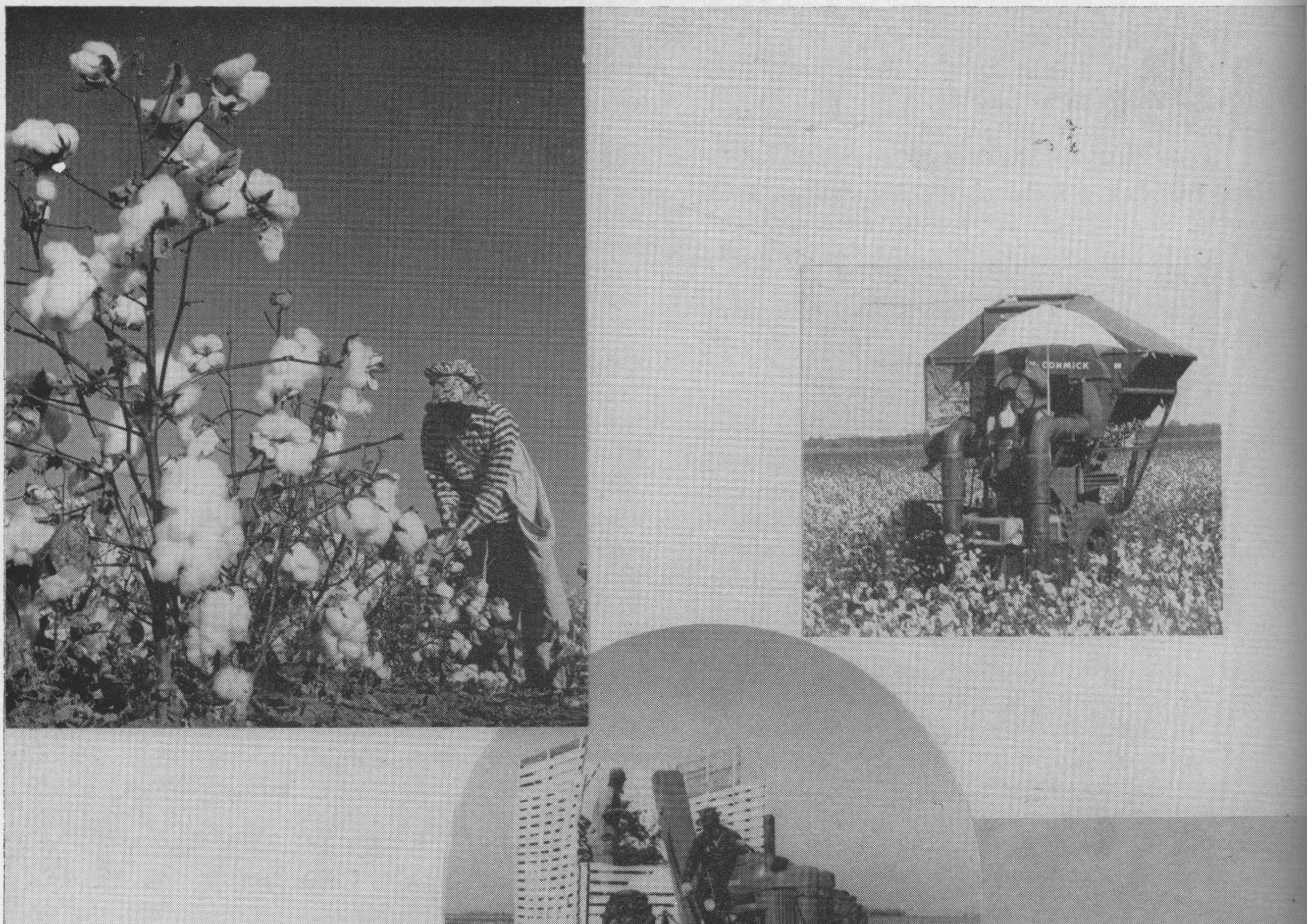
The fields should be free of weeds and grasses. When picked up by the machine during harvest, grass is imbedded in the lint so that it is difficult and sometimes impossible to remove the grass in the ginning process. When cultivating, the soil around the plant should not be more than 5 or 6 inches higher than the middle. When the soil is too high around the plant, it is difficult to harvest the lower bolls and excessive wear will occur on the machine.

STRONG COTTON

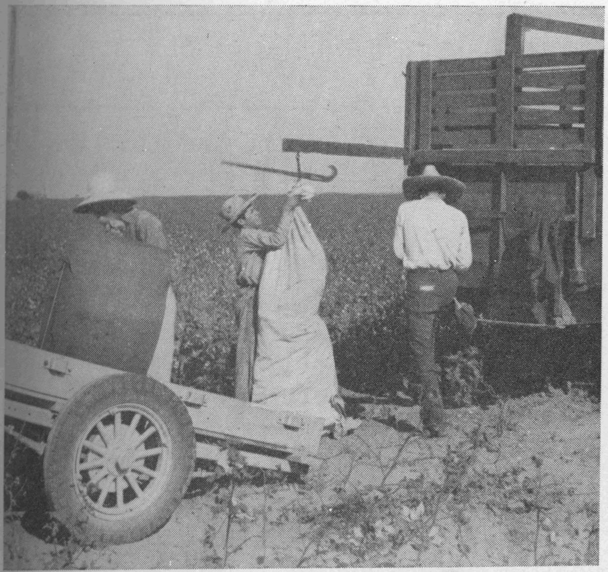
Nature designed this world-pervasive seed hair to help scatter seed "just like the fairy parachutes of the milkweed." A botanist with a magnifying glass will show you how a tiny tube filled with oil runs the length of the filament when it ripens, at maturity the oil conveniently flows back into the seed and the tube collapses into a sort of spiral spring. These twisted walls of practically pure cellulose lend themselves to spinning because they are surprisingly strong and clutch each other. Hence cotton provides more clothes and cloth for mankind than all the world's other textiles put together.

J. R. Hilderbrand

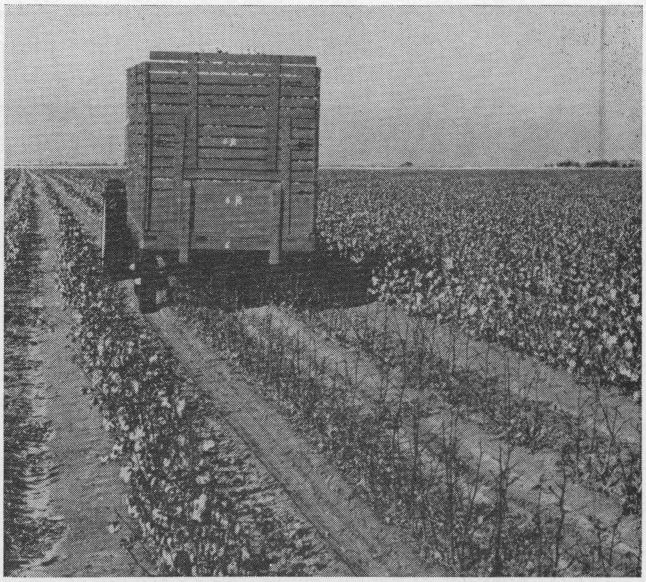
Harvesting Seed Cotton—The Old and Present Methods



Upper and lower left—Picking or snapping cotton by hand, the time-honored method of harvesting cotton. Upper and lower right—Two types of one-row mechanical pickers which harvest about a bale of cotton per hour at a cost to the farmer of about one-fourth the cost of hand labor. Center—A two-row stripper harvesting storm-resistant cotton on the High Plains.



The payoff in picking cotton by hand is "so much" per 100 pounds of seed or bur cotton, the price depending on economic conditions and the availability of pickers. Here a picker weighs his sack load while the "boss" records the scale reading. A second picker appears to be getting a drink from a canvas water bag.



Clean harvesting operation behind a two-row cotton stripper and trailer in storm-resistant cotton on the High Plains. The plants had been defoliated by frost. A higher grade of lint cotton was obtained by keeping the field free of grass and weeds.

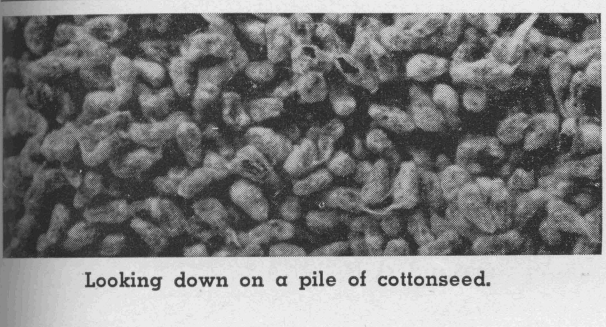
Field Storage of Seed Cotton

As soon as the cotton is harvested, it is placed in trucks or trailers and hauled to the gin. In some areas, especially the High Plains, the cotton is harvested with mechanical strippers at a daily rate much above the ginning capacity of the area. This results in congestion and delay at the gin during the peak of the harvesting period. Cotton growers have tried to avoid this delay at the gin. They have two choices. They may leave the cotton in the field for harvesting later than usual or they may harvest the cotton and store it in the field. Most growers prefer to harvest the cotton as fast as their facilities permit and store in the field the excess that cannot be ginned immediately.

There are three types of storing mechanically-stripped cotton on the farm: storing in ricks on the ground, storing in out-door pens and storing in barns. Storing in ricks on the ground is the principal type used.

Field storage requires extra loading and unloading of the seed cotton. Cotton growers, however, have developed feasible and economical methods of loading and unloading farm-stored cotton into trailers for delivery to the gin. One of four methods is generally used: loading by hand with forks, loading with gin-type suction fans, loading with grain conveyors and loading with hay stackers adapted to handle seed cotton.

Field storage of mechanically-stripped cotton is a satisfactory way of adapting ginning capacity to mechanical harvesting on the High Plains. Field storage has not resulted in lower grades of cotton in the area. Although field storage without cover has been satisfactory on the High Plains, stored cotton should be under cover in areas where rains may be expected during the harvesting season.



Looking down on a pile of cottonseed.

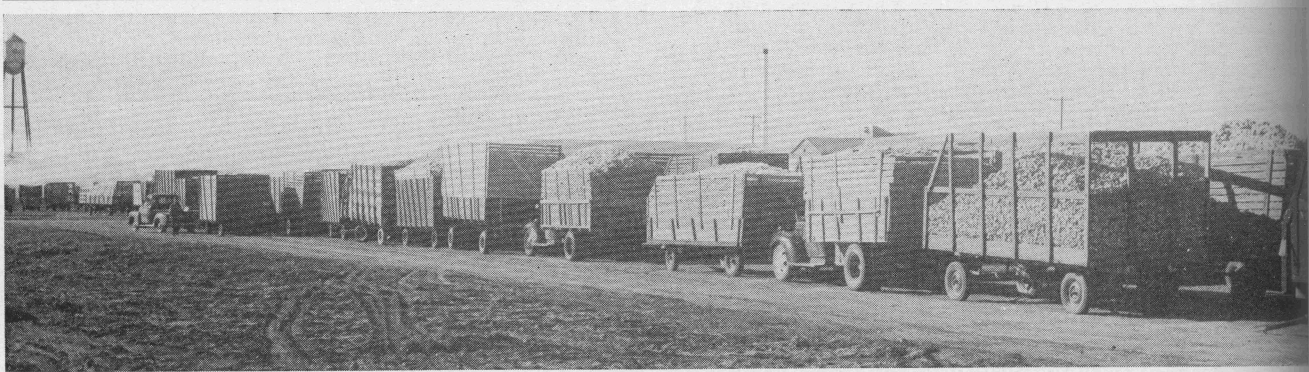
The shift from hand harvesting to mechanical stripping and picking has shortened the harvesting season and the gins and cotton oil mills usually are far behind the harvest. Particularly on the High Plains, seed cotton and cottonseed are piled on the ground until the gins and mills can catch up. Here a front-end loader is being used to load field-stored seed cotton into a trailer, not shown, to be taken to the gin.

GINNING

Ginning is the process of removing the lint from the seed. Before the advent of mechanical harvesters, and when all the cotton was hand-picked, rather than hand-pulled or snapped, a gin set-up required a relatively low investment as compared with modern gins. In addition to standard gin stands, most modern gins are equipped with driers, bur extractors and other cleaning equipment to process the seed cotton before it enters the gin stand. Several cleaners also are used to clean the lint after ginning and prior to compressing it into the bale.

Because of the various geographical areas and methods of harvesting, all gins could not use the same ginning machinery recommendations. For this reason, recommendations have been prepared to meet specialized needs of different geographical areas on the basis of the type of cotton and predominant farming practices. The principal variations in recommendations between the different areas are in the degree of drying, cleaning or extracting that are necessary.

The handling of cotton between the time it is harvested and ginned has an important influence on the ginning and resulting grades. Cotton should never be tramped or packed into a trailer. Tramping imbeds the trash into the lint cotton so that it is difficult to remove. When possible, the seed cotton on the gin yard should be grouped according to the method of harvest, since each method generally requires a different ginning machinery set-up.



Trucks and trailers loaded with seed cotton lined up at a gin, each waiting its turn. With fair weather, the cotton crop of an area can be harvested mechanically in about 30 days. Gin capacity cannot keep up with such a pace. The result is long waits at the gin during the peak of the harvest season. On the High Plains, much cotton is harvested and placed in piles on the ground until the gins can catch up. Courtesy the Cotton Gin and Oil Mill Press.

MARKETING AND CLASSING COTTON

Quality of fiber varies greatly among varieties and in the same variety on a single farm. These variations result from differences in soil, rainfall, length of growing season, production practices, such as fertilizers, tillage practices and methods of harvesting, ginning methods and other factors.

Quality of cotton, as measured by length, strength, fineness and maturity of fibers, is governed to a considerable extent by the variety and quality of planting seed, as well as by the farming practices and weather during the period the fibers are developing.

Classing

Cotton is classed to determine the grade and staple length which greatly affect the spinning utility and market value. Classing is the means by which the cotton grower knows the value of his cotton and also the means by which the cotton merchant buys and sells cotton.

The grade of cotton consists of three factors: color, amount of leaf trash and gin preparation. In recent years, the U. S. Department of Agriculture has classed for cotton growers 65 to 80 percent of the cotton ginned in the United States.

Determining Fiber Properties

Cotton was sold formerly on the basis of grade and length of staple. Now a large proportion of United States cotton is sold on the basis of grade and staple and, in addition, on strength, fineness and other characters. Length and grade of staple usually are determined by cotton classers. Strength, fineness, and some other characters are determined accurately by scientific instruments to supplement the classer's art and skill.

Strength

Of the several instruments used for measuring the strength of raw cotton, the most common is the Pressley Strength Tester. Results of tests on this machine are expressed in thousands of pounds per square inch. Strength of fiber is an important factor in determining the strength of yarn and, consequently, the strength of fabrics made from the yarn.

Length

Length and length uniformity of fibers are measured by an instrument called the Fibrograph. This is the most widely used instrument for general testing of length.

Fineness

Fineness of fiber is determined by measuring the resistance to the passage of air through a sample of cotton of fixed weight compressed to a given volume. The finer the fibers, the greater is the resistance to airflow; the coarser the fibers, the greater is the airflow. The Micronaire is the most widely used instrument for measuring fineness of cotton fibers. The results of the test are expressed as weight in micrograms (about 1/28,400,000 of an ounce) per inch of fiber. It is called the Micronaire value.

Value of Fiber Measurements

A knowledge of fiber properties, such as grade, length, uniformity of length, strength and fineness, is valuable to the cotton grower, buyer, merchant and spinner because these properties affect greatly the spinning utility of cotton. Such knowledge enables the cotton merchant to locate cotton with the desired properties and to supply it to the spinner as needed.

USES OF COTTON AND COTTONSEED PRODUCTS

Cotton has been grown for its fiber for thousands of years. Cotton culture apparently developed in India and America about the same time, perhaps a early as 1500 B. C. Cotton is the world's most important textile fiber. The cotton plant is unique in that it also produces a greater amount of human food and animal feed than it does of cotton fiber.

Cotton Fiber

Cotton fiber furnishes about 66 percent of the total mill consumption of fibers in the United States. The fiber is woven into various kinds of fabrics and materials, which have almost innumerable uses. Because of its many excellent qualities, such as durability, strength, porosity, color fastness and comfort, cotton is the most-used fiber in the world.

Uses of cotton fiber are in three broad groups: apparel, household and industrial. The apparel group includes items of apparel of all kinds for men, women and children. Household uses include such items as bedspreads, blankets, comforts and quilts, curtains, draperies, retail piece goods, rugs and carpets, sheets, sewing thread, towels and toweling. Industrial uses include seat covers, upholstery and tire cord, awnings, bags for many purposes, cordage and twine, industrial thread, mattresses, tarpaulins, tents and many other items.

The consumption of cotton is increasing for certain uses, especially for print cloth, sheeting, toweling and fine dress fabrics.

It is estimated that about 8,000,000 bales of cotton are used annually to supply cotton products required by the American people.

New Cotton Fabrics

New manufacturing processes and findings of chemical research have been used during the past few years to produce entirely new cotton fabrics. These new fabrics are more versatile, have improved appearance and require less effort and money for their care.

Cotton fabrics are now available which may be washed and worn with little or no ironing. Others are wrinkle-resistant. Some are durably crisp while others have a high luster. Textured cottons have interesting surfaces. Knitted cottons shed wrinkles and resist stretching and sagging.

When cotton fabrics are treated properly with thermosetting resins, they become wrinkle-resistant and may be machine-washed, tumble-dried and iron-

Some 212,000 tons of cottonseed are stored in pyramids on the ground at this Lubbock cotton oil mill.

Cotton Burs—Once a Nuisance—Now Are Used As Fertilizer

Left—Loading cotton burs into a truck at the gin hopper. Center—Spreading the burs on the land. Right—Shredding cotton stalks where 4 tons of burs per acre were applied. The problem of burs at the gin is the result of "snapping" cotton—taking the seed cotton, bur and all. Many gins burn the burs to dispose of them.

ed lightly. If an increased amount of resin is used, the fabrics may be washed and worn with little or no ironing. These are known popularly as minimum-care fabrics.

Durable crispness is given to organdies and similar fabrics which are popular for wedding and party dresses, curtains and bedspreads. Such fabrics are washed and ironed easily and require no additional finish.

Polished cottons are given a high or low luster by mechanically buffing the fabric after the application of the thermosetting resins. Chintz is given a high luster and many clothing fabrics a subdued luster.

Many textured cottons are embossed by mechanical action to mold a design into the fabric after the resins are applied. The design is fixed at high temperatures. Embossed fabrics should not be ironed since the design may be altered by the action of pressure and high temperatures.

Dimensional stability of modern cotton knitted goods is obtained by the use of resins which increase resistance to stretching, sagging or shrinkage and wrinkle resistance.

Winter cottons, as the name implies, are designed for use in cold weather. They are heavier than other cottons and are constructed to give a bulky, warm appearance, but usually are light in weight. Velveteens and tweeds are popular winter cottons used in men's, women's and children's clothing as well as in home furnishings.

Cottonseed and Cottonseed Products

Although cotton is grown primarily for its fiber, cottonseed are an important by-product of cotton production. The total farm value of cottonseed in the United States is about 17 percent of the farm value of cotton fiber (lint). On the average, American cottonseed consists of 10 to 15 percent linters, 35 to 40 percent hulls and 50 to 55 percent meats.

In the processing of cottonseed by hydraulic mills, 1 ton of cottonseed yields about 310 pounds of oil, 925 pounds of cake or meal, 515 pounds of hulls, 135 pounds of linters and 115 pounds of waste.

Cottonseed Oil

The oil content of cottonseed varies considerably, depending on the variety and the locality where grown. The average yield of oil is approximately 310 pounds per ton of whole seed. Practically the total production of cottonseed oil in the United States is used in the manufacture of many food products.

Cottonseed oil as a food product has many superior qualities. It is especially favored for frying because of its high smoking temperature. It is used extensively in making shortening, margarine, mayonnaise, salad dressing, mellorine and packing oil. Cottonseed oil far outranks other oils in the volume used in making this group of products.

Cake and Meal

Approximately 925 pounds of cake or meal are obtained from 1 ton of cottonseed. A large part of the press cake, as such, or broken into smaller pieces, is sold as livestock feed. The remainder is ground into cottonseed meal, which is sold on the basis of its protein content. Thirty-six, 41 and 43-percent protein are the popular grades of cottonseed meal. The high protein content of cottonseed cake and meal makes them valuable livestock feed. Sometimes cottonseed meal also is used as a nitrogenous fertilizer. A small amount of meal is used in bread, cake and crackers.

Hulls

On the average, 1 ton of cottonseed yields about 515 pounds of hulls, which are used mainly as a bulk feed for livestock, especially for cattle. The hulls also are used to some extent in the chemical industries, such as petroleum refining and the making of plastics and synthetic rubber.

Linters

In the processing of cottonseed for oil, the fuzz, or short fiber, is removed from the seed and is known as linters. The highest grades of linters are used in making coarse products, such as carpets, absorbent cotton and other medical supplies, twine and wicks. Linters also are used as filler for mattresses and comforts, and for furniture and automobile upholstery.

Linters are composed principally of cellulose, which is an important basic raw material for various chemical industries. Linters, when made into linter pulp, are used in the manufacture of a large number of products. Linter pulp is used extensively in making high-tenacity rayon for cord tires, acetate rayon, plastics, lacquers, explosives, fine writing paper, sausage casings, pens and pencils, electrical equipment and many other items.

INFLUENCE OF GOVERNMENTAL POLICIES

Since 1933, the Federal Government has been involved one way or another in attempts to help cotton farmers obtain a fair share of the national income. In trying to do this, two main plans have been followed.

One has been to guarantee cotton farmers a certain percentage of a calculated parity price. This guarantee in turn led to the necessity of controlling supply. Supply controls have consisted largely of acreage allotments and non-recourse loans on the cotton at harvest time, the latter being used to channel enough of the cotton from the free markets into government hands to hold up the price to the level desired.

The second method has been to subsidize those who followed certain specified soil-improvement practices. These practices have included such things as planting legume crops, contouring and terracing crop lands, improving pastures by liming and planting new grasses, constructing water facilities and numerous other practices that supposedly would improve soil productivity. And finally the soil bank plan, designed to encourage farmers to take cotton lands out of cultivation and to reduce their planting of cotton below that of the alloted acreages.

Cotton farmers have subjected themselves to these controls and inducements for 26 years. The time has been long enough to justify taking stock of some of the results. Since Texas had the greatest acreage and production of cotton over this period, a comparison of the current production situation with that of 1933 and earlier should reveal any major influences governmental policies have had on production trends in Texas. Some definite trends stand out in bold relief. Two of the most obvious trends are:

(1) The average acreage planted to cotton over the 5-year period before the controls were initiated with the one-third plow-up in 1933 was 15,598,000, yielding an average of 145 pounds of lint cotton per acre and an average outturn of 4,580,000 bales. By 1958, the acreage had been reduced to 5,675,000, yielding 379 pounds of lint cotton per acre and an output of 4,243,000 bales. Thus, 36 percent as much land produced 96 percent as much cotton in 1958 as was produced on 15,598,000 acres in the base period, 1928-32. Yields per acre increased 260 percent. The Cotton Belt as a whole experienced similar results and acreage control proved ineffective in controlling supply.

(2) Perhaps the most obvious trend in cotton production in Texas since 1933 has been the shifting of cotton production from certain areas to others. A remarkable shift has been made to the extreme western, northwestern and southern portions of Texas, or to the Trans-Pecos, High Plains and Rio Grande Plain of Texas. These areas accounted for about 12 percent of the acreage at the start of the control programs, but now have more than one-third of the acreage and more than half of the total production. During the same period, the Blackland, Grand and Coast Prairies, and the East Texas Timberlands experienced the greatest decline in the percentage of the State's planted acreage. These areas were planting half the acreage and producing approximately half the cotton in the early 1930's, but are now below one-third of the acreage and are producing less than one-

fourth of the total cotton. Cotton is not now grown on many farms in these areas where it had been the dominant crop over a long time. Most of the other areas have had some decrease in cotton acreages and production, with some showing drastic decreases and others with moderate decreases.

These two major trends have occurred during the period covered by the governmental policies, but the underlying causes are difficult to appraise. In all probability, considerable changes in yields and shifting of production would have come about in the normal course of time. There is good reason to believe, however, that governmental policies have hastened the changes. When the control of supply was attempted by acreage control, it was but natural that farmers concentrated their cotton on their most productive lands and introduced the newest technological advances to maintain total output as the available acreage was decreased. Controls undoubtedly speeded up the farmers' acceptance of new research data and new ideas, especially on fertilizers, insecticides and irrigation.

What happened in Texas, also happened to the Cotton Belt as a whole and cotton shifted to the more level, fertile and irrigable lands. It was irrigation during the recent prolonged drouth that kept up cotton production. Irrigation is a costly practice and maintenance of high output per acre is necessary to reduce the per-unit cost. Consequently, irrigation was instrumental in causing farmers to use heavy applications of fertilizers and insecticides to boost yields. With ever-increasing yields and losses of foreign markets by arbitrary price fixing, acreage allotments were reduced from time to time in an attempt to bring supply into line with demand at the fixed price.

Farmers with small units throughout the East Texas Timberlands, Blacklands, West Cross Timbers and other areas found the ever-decreasing acreage allotments difficult to overcome by increasing yields. Any reasonable price guarantee was not enough to encourage them to continue cotton production. Weather hazards and shrinking cotton acreage allotments were severe handicaps when it came to the application of new technology to cotton production. Consequently, thousands of small farmers turned to other enterprises, especially livestock, or sought jobs elsewhere. Subsidies for soil conservation and improvement practices, high prices for cattle, rapid industrial development in Texas and new job opportunities made the transition from cotton to other enterprises and jobs much less painful. In reverse, however, farmers in areas with irrigation possibilities, less weather hazards and larger units could afford to take the risks of applying new technology with the guaranteed price set by the government.

Many of our Texas cotton farms that were developed on the tradition of a family-sized unit, animal power, fuel self-sufficiency in the form of feed, and family and nearby labor, have been unable to make adjustments and have quit cotton production. These farmers could not afford the heavy investment necessary in farm machinery — a $17,000 mechanical cotton picker — or go to Mexico and import *bracero* labor. The small farmer sought government controls and voted consistently for them, but even a 100 percent parity price for cotton would have been insufficient to overcome much of the shrinking acreage that was already too small for a good income.

Governmental policies have not been wholly responsible for the trends in Texas cotton production, but the policies followed undoubtedly accelerated the

Cotton stored in a West Texas gin yard, a familiar sight throughout the Cotton Belt. Each bale weighs about 500 pounds. The cut places in the bagging were made to take samples for classing. Standard cotton grades, each further divided into subgrades, are:

Middling Fair	**Middling**	**Strict Good Ordinary**
Strict Good Middling	**Strict Low Middling**	**Good Ordinary**
Good Middling	**Low Middling**	**Ordinary**
Strict Middling		

The five major uses of cotton in 1958 are said to have been: men's and boys' trousers, 723,000 bales; men's and boys' shirts 620,000 bales; sheets, 443,000 bales; towels and toweling, 372,000 bales; and drapery and upholstery fabrics, 347,000 bales.

movement. It is too early to appraise the results of this new economy properly, but there is one picture that often is overlooked; that is the old cotton economy that was built on woman and child labor, low incomes, poor houses and living conditions, and stoop labor. If governmental policies have speeded up the use of more scientific practices and mechanization of cotton production and encouraged the small, inefficient cotton farmer to shift to other enterprises or occupations at a time when the transition has been easy, some good may be seen as a result of the policies pursued.

ECONOMIC IMPORTANCE OF COTTON TO TEXAS

Cotton is by far the most important cash crop in Texas, although it now ranks second in acreage to sorghum for grain. The land devoted to cotton increased from 2,473,000 acres in 1880 to 17,749,000 acres in 1927, and declined to 5,800,000 acres in 1945. Since 1945, the acreage in cotton has varied from 5,900,000 in 1957 to 11,850,000 in 1951.

The greatest production on record was 6,040,000 bales in 1949, which also had the highest value on record, $847,714,000. There were four other years in which the production was 5 million bales or more: 1926, with 5,628,000 bales; 1928, with 5,105,000 bales; 1931, with 5,320,000 bales; and 1937, with 5,154,000 bales.

The yield of lint per acre has varied with seasonal conditions and infestations of insects and diseases. It ranged from a low of 101 pounds in 1921 to 387 pounds in 1958. The higher yields during the past few years probably have been due to several causes, such as better varieties and cultural practices, including control of insects and diseases. But probably the most important factor has been the greater use of irrigation on the High Plains, in the Lower Rio Grande Valley and the Trans-Pecos area, where much higher yields are obtained than in other parts of Texas.

There have been shifts of production from dryland areas to areas in which irrigation water has been available: to the High Plains and to the Lower Rio Grande Valley and the Trans-Pecos area. Cotton production has declined greatly in the East Texas Timberlands.

For the 5 years, 1952-56, the average value of cotton lint produced in Texas was $633,804,000 and that of cottonseed was $86,342,000. This makes a total yearly value of $720,146,000 for the Texas cotton crop, including lint and seed. This is more than three times the combined value of wheat, sorghum grain and rice, which was $227,137,000 for the same period.

During the 16-year period, 1941-56, the average cash receipts from the sale of crops in Texas were 53.9 percent of the total cash receipts from Texas farm marketings. Cash receipts for cotton lint amounted to 29 percent of the total farm receipts during this period and was somewhat more than the combined receipts from all meat animals.

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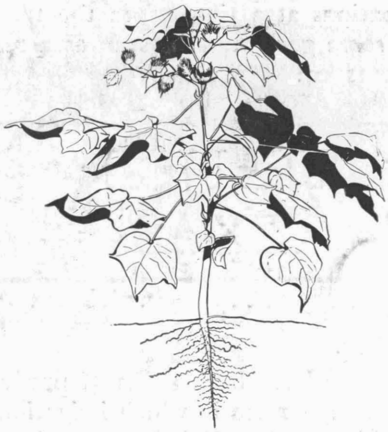

COTTON

What a royal plant it is! The world waits in attendance upon its growth. The showers that fall whispering on its leaves are heard around the earth. The sun that shines upon it is tempered by the prayers of all the people. The frosts that chill it and the dew that descends from the stars are noted; and the trespass of a little worm upon its green leaf is more to England and English homes than the advances of the Russian army on her frontier. Its fiber is current in every bank in all the world. Its oil adds luxury to lordly banquets in noble halls and brings comfort to lowly homes in every clime. Its flour gives to man a food richer in health-producing value than any the earth has ever known and a curative agent long sought and found in nothing else. Its meal is feed for every beast that bows to do man's labor from Norway's frozen peaks to Africa's parched plains. It is the heritage that God gave this people when He arched the skies, established our mountains, girded us about with oceans, tempered the sunshine and measured the rain. Ours and our children's forever and forever, and no princelier talent ever came from His omnipotent hand to mortal stewardship.

Henry W. Grady
(Written About 1880)

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