

UNITED STATES DEPARTMENT OF AGRICULTURE

**Soil Survey**  
of  
**Midland County, Texas**

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United States Department of Agriculture



**Bureau of Chemistry and Soils**

**In cooperation with the Texas Agricultural Experiment Station**

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## SOIL SURVEY

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## CONTENTS

	Page
County surveyed.....	1
Climate.....	3
Agriculture.....	4
Soils and crops.....	11
Light-textured sandy soils.....	14
Springer fine sandy loam.....	15
Springer fine sandy loam, yellow phase.....	17
Springer fine sandy loam, shallow phase.....	17
Springer loamy fine sand.....	17
Springer loam.....	18
Springer loam, shallow phase.....	18
Springer fine sand.....	18
Richfield fine sandy loam.....	19
Richfield loam.....	19
Reagan fine sandy loam.....	19
Reagan fine sandy loam, shallow phase.....	19
Reagan loam.....	20
Reagan loam, shallow phase.....	20
Reeves loam.....	20
Frio silt loam.....	20
Frio loam.....	20
Heavy-textured soils.....	21
Reagan silty clay loam.....	21
Reagan silty clay loam, shallow phase.....	23
Reeves silty clay loam, depression phase.....	23
Randall clay.....	23
Gravelly soils.....	24
Reagan gravelly loam.....	25
Springer clay loam, shallow phase.....	26
Reeves chalk.....	26
Recommendations for the utilization and improvement of Midland County soils.....	26
Irrigation and alkali.....	28
Soils and their interpretation.....	28
Summary.....	31

# SOIL SURVEY OF MIDLAND COUNTY, TEXAS

By E. H. TEMPLIN, Texas Agricultural Experiment Station, in Charge, and  
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## COUNTY SURVEYED

Midland County is in western Texas. (Fig. 1.) The northwestern corner of the county is about 45 miles east of the southeastern corner of the State of New Mexico. Midland, the county seat, is about 300 miles west of Fort Worth, and nearly the same distance east of El Paso. The total area of the county is 902 square miles, or 577,280 acres.

The county lies on the southeastern edge of the High Plains, a subdivision of the Great Plains of the United States. Locally, this part of the State is referred to as the "South Plains." The high, flat, undissected surface of the High Plains constituting the northern part of the county grades southward through Midland County to a dissected plateau, the Edwards Plateau, a distinct physiographic region constituting the southern extremity of the Great Plains. Thus through Midland County the southern boundary of the High Plains is not marked by any striking topographic feature. From

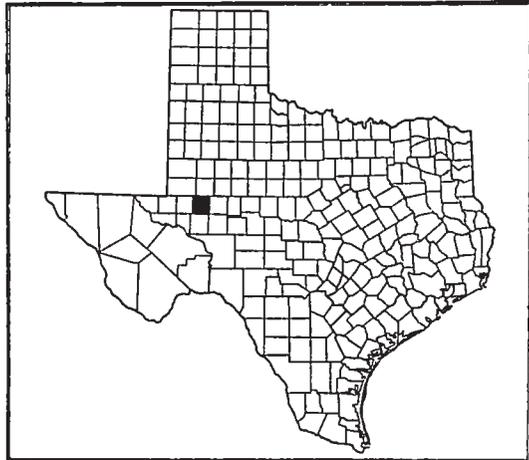


FIGURE 1.—Sketch map showing location of Midland County, Texas

the point of view of soils and vegetation, the southeastern part of the county is distinct from the High Plains and may be considered as the northern edge of the Edwards Plateau. The uppermost geological formation here is Edwards limestone.

The relief of the county is in general that of a gently undulating plain. The southeastern part is a flat plain with small minor depressions having no outlet; the northern half is an undulating plain, with many more depressions or intermittent lakes; and the east-central part consists of the valley of, and the moderate slopes to, Johnson Draw and to some of the larger lakes. The range in elevation throughout the county is slight, probably not exceeding 250 feet. The general regional slope is to the east and southeast. The elevation at Midland is 2,780 feet above sea level.

The regional drainage of the county is imperfectly developed, the greater part of the run-off collecting in the many small inter-

mittent lakes which occur throughout the county. Monahans Draw extends east across the central part. It is practically without laterals and drains a strip from 2 to 3 miles wide. Johnson Draw heads in the south-central part and flows northeast. With its many short laterals it drains a strip from 10 to 15 miles wide. These draws are headwater tributaries of creeks which flow into Colorado River. Five salt lakes, ranging from one-half square mile to 2 square miles in extent, are commonly covered to a slight depth by very salty water, but sometimes these salt lakes go entirely dry during very dry periods.

The natural vegetation consists principally of short grasses, together with a few stunted mesquite trees. The sandy soils support a medium growth of grama grasses, mainly woolly foot grama, and needle grasses, with some mesquite trees and catclaw. The heavy soils have a thin cover of grama grasses and needle grasses, with a considerable growth of "greasewood" or tarbush. The very sandy soils have a covering of "sage grass," or little bluestem, and shin oak brush. The gravelly soils are covered with grama grasses and needle grasses, with considerable tobosa grass in the slight depressions. In addition to these, many other plants and grasses, some of which have some grazing value, grow to less extent.

Midland County was organized from a part of Tom Green County in 1885. The region was first settled by ranchers coming from other parts of Texas about 1870. The population in 1890 was 1,033; in 1900, 1,741; in 1910, 3,464; in 1920, 2,449; and in 1930, 8,005, of which 5,484 live in the city of Midland. The increase in population is due to the extension of farming in the county and the growth of the city of Midland as a center of oil activities. The present population consists mostly of native whites from the older sections of Texas, though some are from other States. There are very few persons of foreign extraction, except a few Mexicans who are employed chiefly in land clearing and cotton picking. The density of the farm population is greatest in the vicinity of Midland. The southern half of the county is very sparsely settled.

Midland, the only city in the county, is the most important shipping point for farm produce. Railway facilities are afforded by the Texas & Pacific Railway to Fort Worth and El Paso. The Bankhead Highway, a main hard-surfaced transcontinental road, parallels the railroad and is used for trucking to Midland and other towns.

The county roads are cleared and graded, and they are sufficiently good to afford economical hauls of farm produce to market. Much of the ranching community is served only by private roads which are kept in moderately good condition. Transportation by truck, automobile, or wagon never becomes impossible because of road conditions.

Cotton is shipped to the world markets; cattle are commonly shipped to Fort Worth or Kansas City; and feedstuffs are generally consumed on the farms where grown. Dairy products, poultry products, and truck crops are produced in insufficient quantities to supply local consumption and are sold chiefly on the local market.

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<sup>1</sup> Soil survey reports are dated as of the year in which the field work was completed. Later census figures are given when available.

## CLIMATE

The climate of Midland County is semiarid. The annual rainfall is low and irregularly distributed, the rate of evaporation and the average wind velocity are high, the growing season is long, and the temperature is moderate.

The average annual rainfall, 15.91 inches at Midland, is such that soil moisture is usually a limiting factor in crop production. The rainfall is commonly considered to be the minimum or near the minimum under which dry-land agriculture can be profitably conducted in this region under the prevailing agricultural methods. The western limit of successful dry-land agriculture in this latitude is about 30 miles west of Midland. The average annual rainfall increases to the north and east and decreases to the south and west. The distribution of the annual rainfall is very favorable in most years, 60 per cent falling during the five months from May to September, inclusive, when the crops are most in need of moisture. However, in occasional years the annual rainfall, though ample for good crop production, is unfavorably distributed, with consequent poor yields.<sup>2</sup> The precipitation is largely local in character. Some of it falls as very light showers which wet only the surface soil and is quickly lost through evaporation, but most of it falls as hard torrential downpours. The annual rainfall fluctuates greatly, between limits of 5.52 and 29.34 inches. This wide variation in rainfall has caused crop failures and bumper crops. The annual average snowfall is only 3.8 inches. Occasional hailstorms occur, which damage crops over small areas.

The rate of evaporation is very high. At Big Spring, 40 miles northeast of Midland, on the edge of the High Plains, an average of 58.3 inches evaporated from a free water surface during the six months, April through September, over a period of nine years.<sup>3</sup>

The wind velocity is high, especially in the spring. When unprotected by plant cover or proper cultivation, the sandy soils drift badly in the wind, and when this drifting is unchecked fields may be entirely ruined by the removal of the topsoil to a depth of a foot or more. Young crops may be damaged by being cut off or covered by the drifting sand.

The average frost-free period extends from March 31, to October 31, a period of seven months. However, killing frosts have been recorded as late as May 7 and as early as October 14.

Table 1, compiled from the records of the Weather Bureau station at Midland, gives the normal monthly, seasonal, and annual temperature and rainfall at that place, and these figures are fairly representative for the county as a whole.

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<sup>1</sup> CHILCOTT, E. C. THE RELATIONS BETWEEN CROP YIELDS AND PRECIPITATION IN THE GREAT PLAINS AREA. U. S. Dept. Agr. Misc. Circ. 81, 94 p., illus. 1927.

<sup>2</sup> See footnote 2, *supra*.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Midland, Tex.

(Elevation, 2,779 feet)

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1917)	Total amount for the wettest year (1920)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December.....	43.4	90	10	0.63	0.00	0.15	0.8
January.....	43.2	90	2	.46	.18	2.68	1.6
February.....	47.8	95	2	.74	0	.18	.1
Winter.....	44.8	95	2	1.83	.18	3.01	2.5
March.....	54.5	99	0	.64	0	( <sup>1</sup> )	.7
April.....	64.3	100	25	1.48	.83	.08	( <sup>1</sup> )
May.....	71.9	110	20	2.17	2.20	3.13	0
Spring.....	63.6	110	0	4.29	1.03	3.21	.7
June.....	78.9	116	40	1.05	1.32	1.03	0
July.....	81.5	109	33	1.51	.45	3.56	0
August.....	80.1	111	50	2.00	1.70	13.03	0
Summer.....	80.2	116	40	5.46	3.50	18.22	0
September.....	74.2	109	35	2.02	.60	.70	0
October.....	63.9	100	24	1.58	0	1.70	0
November.....	52.4	93	10	.73	.15	2.50	.6
Fall.....	63.5	109	10	4.33	.75	4.90	.6
Year.....	63.0	116	2	15.91	5.52	29.34	3.8

<sup>1</sup> Trace.

## AGRICULTURE

The region in which Midland County lies has long been an important cattle-raising country. Attracted by the large areas of free range, valuable grass for forage, and the mild climate, pioneer cattlemen from farther east drove their herds into the country and occupied the land during the two decades following the Civil War. Each "outfit" held indefinitely outlined areas sufficient for its herds under the unwritten frontier law in which the right of prior occupancy and ownership of watering places was recognized as a just claim to the use of the designated land area. Soon after the construction of the railroad through the county, in the early eighties, more definite ranch locations and ownerships were established through purchase or lease. Land was very cheap and this allowed ownership of large tracts. The cattle of the early period were of inferior types, but about 1900, pure-bred Hereford sires were brought in, and eventually all the cattle were bred up to a high type of grade animals.

The only attempts at cultivation of the land were by ranchers who grew some vegetables in home gardens and occasionally small quantities of feed crops. Farming as an independent enterprise was not engaged in until about 1905 and did not become important until about 1915. Cotton, grain sorghums, and sorgo comprise the principal farm crops that have been grown since 1905. Cattle raising remains a very important industry, although the amount of land being given over to farming is gradually increasing.

According to the Federal census, there were 6,870 acres devoted to farm crops in 1909, mainly sorghums and cotton. In 1919 the

crop land totaled 11,438 acres, of which the sorghums still held a high place. The acreage devoted to cotton has increased from 1,755 acres in 1909 to 31,283 acres in 1929.

The total value of all crops produced in 1909, according to census reports, was \$44,407; in 1919, \$312,964; and in 1929, \$813,161.

The present status of agriculture in Midland County is representative of the development of a large part of western Texas, where the farming industry is being gradually extended westward into the domain long utilized solely by the cattlemen. This is largely a result of the comparatively high prices of cotton, cheap lands, and the opportunities afforded for the man of moderate means to obtain a home in a region less crowded than in eastern areas. As the ranch lands rise in value to the point where their continued use for grazing would be less profitable than farming much of the land is sold to farmers. Though the westward invasion of dry-land farming has about reached its climatic limit, the success of crop production thus far attained without irrigation in Midland County has been sufficient to constitute a fairly stable status of agriculture. The favorable environmental factors comprise good soils low in price, easily worked in large units, and of such character as to enable the growth of crops with a minimum of moisture, good water, little damage by crop pests, and a healthful climate.

The chief problem affecting these advantages is the uncertainty of soil moisture due to irregularity of rainfall which in some years is insufficient for growing crops. However, by the use of crops that are resistant to the effects of irregularity and low amounts of soil moisture; by the selection of certain soils which naturally collect, absorb, and retain the available moisture supply to a high degree; and by the practice of methods best suited to the production of crops in the region, a fair degree of success in farming has been attained.

Much has been learned regarding the utilization of the soils for crop production in this area by experience of the farmers. Aid in the solution of farm problems of the subhumid western region is being given by Substation No. 8 of the Texas Agricultural Experiment Station, located 100 miles north of Midland County, and by the Big Spring Field Station of the United States Department of Agriculture, located at Big Spring, 20 miles northeast of the county. These stations are located on the high plains with soils and climatic conditions very similar to those in Midland County. Livestock and ranching problems of the region receive special study and investigation at Substation No. 14 of the Texas Agricultural Experiment Station, located on the Edwards Plateau, 150 miles southeast of Midland County.

The present agriculture of Midland County consists of two very distinct types—cattle ranching and general farming. As yet the ranching industry controls and uses by far the larger proportion of the land in the county; some of it unsuited for any purpose other than grazing, though a great deal of good farming land is still included in ranch land. The crops grown on the farms consist mostly of cotton—the cash crop—with grain sorghums for local feedstuffs of grain and forage, and sorgo for forage.

General farming is carried on only in the northern part of the county where the most drought-resistant soils occur, though not all of such soils are as yet producing crops. Farming on the soils best suited to crop production has been moderately successful throughout the history

of the region. Temporary setbacks have been caused by occasional dry years, but, with normal seasons following, the development of the region has again proceeded rapidly. The census reported 48,699 acres of crop land and 4,573 acres in plowable pasture in the county in 1929. The greatest expansion of general farming occurred in 1925 and 1926. Considering that there are at least 214,336 acres of soil <sup>4</sup> well suited to dry-land farming in Midland County, it is readily seen that the conversion of ranch lands into farms has not approached the possibilities. Meanwhile the area of land cleared and placed under cultivation is rapidly increasing. A larger proportion of the better soils located east of Midland is in farm land than west and southwest of that place. Ranching occupies all the southern half and parts of the northern half of the county.

The dry-land type of farming is practiced exclusively. The outstanding advantage of farming in this region is the large acreage which one man can cultivate. By the use of 2-row cultivators and planters, many farmers cultivate from 75 to 125 acres of cotton, and from 30 to 60 acres of grain sorghums and forage crops, employing extra labor only at cotton-picking time. Studies <sup>5</sup> in the cost of producing cotton in 15 areas in 8 cotton-producing States showed Lubbock County, Tex., to have 38.9 man-hours requirement an acre in producing cotton, the lowest of any of the 15 areas studied, as compared with 154 man-hours for the highest requirement in the North Carolina area. Lubbock County, 100 miles to the north, is very similar in topographic features and soils to Midland County. The net cost for producing lint cotton in these 15 areas averaged 25 cents a pound, ranging from 10 cents in the Lubbock area to 54 cents in the area of highest cost. The low amount of labor required an acre is the result of at least three factors, all directly resulting from the characteristics of the soil and climate of the region. These are as follows: (1) Weed pests are less obnoxious and fewer cultivations are necessary; (2) thinning the cotton by chopping is unnecessary; and (3) the surface relief, occurrence, and character of the soil are such as to allow the laying out of large, ideally shaped fields and the use of 2-row tractor implements. Most of the cotton of the region is produced on fields including between 10 and 100 acres. A second characteristic feature of the agriculture is the extensive drifting of the topsoil in the prevailing high winds, when not protected by some plant cover. Cultural practices, such as fallowing, are thus rendered generally impractical, and certain soils with loose or coarse-textured surface layers, which would otherwise be among the best in the county, are not so safe for cultivation.

Cotton is the most extensively grown and almost the sole cash crop in Midland County. It has great drought resistance and has proved to be well adapted to this district.<sup>6</sup> Results obtained at substation 8 of the Texas Agricultural Experiment Station, under soil and climatic conditions similar to those of Midland County, show that cotton as a drought-resistant crop compares favorably with the grain sor-

<sup>4</sup> This includes Springer fine sandy loam; Springer fine sandy loam, yellow phase; Springer fine sandy loam, shallow phase; Springer loam; Reagan fine sandy loam; Reagan loam; Richfield fine sandy loam; Richfield loam; Frio loam; Frio silt loam; and Reeves silty clay loam, depression phase. Besides, there are 163,520 acres of soil which are doubtfully suited to agriculture, including the following: Reagan silty clay loam; Reagan fine sandy loam, shallow phase; Reagan loam, shallow phase; Springer loamy fine sand; Springer loam, shallow phase; Reeves loam; and Randall clay.

<sup>5</sup> LONG, L. E., and SWINSON, C. R. COST OF PRODUCING COTTON IN FIFTEEN SELECTED AREAS, 1923. (Data for Lubbock County) U. S. Dept. Agr., Bur. Agr. Econ. 1925. [Mimeographed.]

<sup>6</sup> KARPER, R. E., and JONES, D. L. VARIETIES OF COTTON IN NORTHWEST TEXAS. Tex. Agr. Expt. Sta. Bul. 364, 59 p., illus. 1927.

ghums. The proportion between the yields was at the rate of 260 pounds of lint cotton an acre and 28.3 bushels of feterita grain an acre, or about 10 pounds of lint cotton to 1 bushel of feterita grain, and was relatively constant over a period of 12 years, including both wet and dry seasons.

Three-fourths of the cotton grown in Midland County is of the Mebane variety, according to estimates by local authorities. Bennett and strains of Lone Star are grown to some extent. Results of experiments at the Lubbock Substation of the Texas Agricultural Experiment Station show Mebane to be a variety well suited to the soils and climatic conditions of this district. Cotton here produces a comparatively small stalk which fruits heavily. The boll weevil has not infested the county, and authorities believe it will never become a pest in this region. Sixty-four per cent of the crop land in the county was devoted to the production of cotton in 1929, and the tendency seems to be to increase even this high proportion.

Cotton yields fluctuate greatly according to stored subsoil moisture and the amount and distribution of seasonal rainfall. In years of normal rainfall the average yield for the county is between one-fourth and one-fifth bale to the acre. Some farmers on good upland soils have obtained 1 or 1½ bales to the acre in the best seasons. During very dry years, such as 1917 or 1927, cotton is a complete failure on soils of low drought resistance;<sup>7</sup> and unless moisture conditions are favorable, the crop is not planted on these soils. The yields on the good soils in dry seasons range between nothing and one-third bale to the acre, depending on the supply of subsoil moisture accumulated prior to the growing season, on the stand obtained, and on the kind of tillage given. A few seasons have been so dry that the crop generally returned no yields.<sup>8</sup>

The crops next in importance to cotton are grain sorghums and sorgo. These are generally grown by all farmers as feed for the farm livestock. Thirty per cent of the total crop land was devoted to the production of these crops in 1929. In 1927, an extremely dry year, about 50 per cent of the land in crops was devoted to the production of feedstuffs, but a large amount of land lay idle. The general tendency is for the total acreage devoted to these crops to increase but for its proportion to the total land in cultivation to decrease. In normal years between one-fifth and one-third of the total crop land is devoted to these crops. They are utilized almost entirely on the farms where grown, as feed for the work animals, milk cows, and swine. They are among the most drought resistant of all crops, and yields are more certain than for any other crops grown in the county, some forage being obtained in the driest seasons.

For many years past milo and kafir have been the predominant grain sorghums grown. The grain sorghums are grown in about the following proportions: Milo 65 per cent, kafir 20 per cent, hegari 10 per cent, and feterita 5 per cent. Milo is considered to yield the largest quantity of grain, but the forage from kafir is more abundant and palatable. Dwarf Yellow milo is the variety most commonly grown. Milo yields from 10 to 25 bushels of grain an acre, and kafir from 8 to 20 bushels in ordinary seasons. Kafir yields from three-

<sup>7</sup> These include Reagan silty clay loam; Springer loam, shallow phase; Reagan fine sandy loam, shallow phase; Reagan loam, shallow phase; Reeves loam; and Reeves silty clay loam, depression phase.

<sup>8</sup> See footnote 2, p. 3.

fourths to 1½ tons of grain and forage an acre. Feterita is not grown by many farmers.

Sorgo is grown to furnish coarse forage for the farm livestock and work animals. The yields range between 2 and 4 tons to the acre in normal years. The crop withstands dry weather well and matures quickly so that it is often used for later planting. It is grown to a small extent on nearly every farm as it is a drought-resistant and dependable crop. When planted early, two cuttings of sorgo are sometimes obtained in years of good rainfall. Redtop, or Sumac, is the principal variety grown.

Corn is grown to only a very small extent. It is not commonly considered to be so well suited to the soils and climatic conditions of the county as are the grain sorghums. Its production is confined almost entirely to a few small areas of the Frio soils which occasionally receive an extra moisture supply from flood waters. On these soils it produces from 10 to 50 bushels of grain to the acre. On the upland soils it does not produce so much grain or forage as the sorghums.<sup>9</sup>

Vegetables are grown in small home gardens, but the quantity produced within the county is insufficient to supply local needs. Vegetables grow well when supplied with sufficient moisture, which means that irrigation is necessary much of the time. Many farmers report that after a few years of irrigation, the soil will no longer grow vegetables well and the garden must be moved to a new location. This is probably due to a decrease in plant food. The principal vegetables produced are blackeyed peas, sweetpotatoes, watermelons, peppers, cantaloupes, tomatoes, spinach, turnips, mustard, and beans. These are usually irrigated by water drawn from wells by windmills.

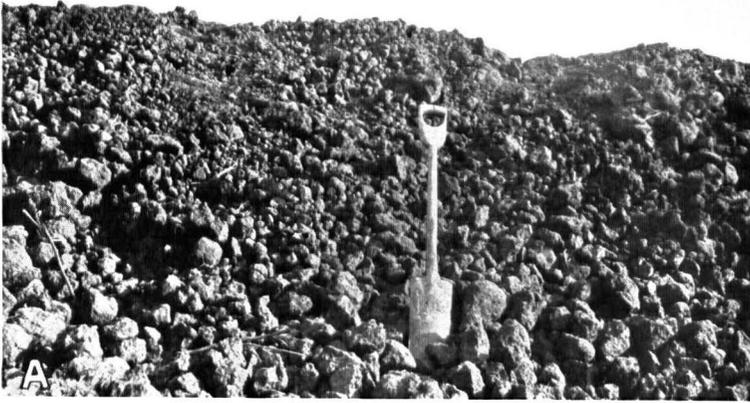
Very little fruit is grown in Midland County. Some of the farms and ranches have small orchards of peaches, plums, apples, or grapes, which are irrigated. Peaches fail to bear, owing to injury by frost, about 2 or 3 years in 5, but when not so damaged they have yielded well. According to the Federal census of 1930, there were in the county in 1929, 206 apple trees, which produced 122 bushels; 1,815 peach trees, with a production of 880 bushels; 227 pear trees; 1,677 plum trees; 1,113 grapevines; and a few pecan trees. A few small patches of strawberries are successfully grown under irrigation near Midland.

Dairying is not an important industry in this county. Sufficient whole milk is produced in small local dairies for the needs of Midland, but most of the butter consumed is imported. During certain seasons of the year a small quantity of cream is shipped to creameries in Fort Worth. Most of the farmers keep one or two cows which furnish the family with milk and butter. The total value of all dairy products produced within the county in 1929 was \$89,039.

There are very few sheep in the county. In 1929, 4,142 pounds of wool, worth \$1,160, were shorn from 455 sheep.

Sufficient hogs are raised on most farms to produce meat for home use and occasional local sale. More pork is brought into, than is sold from, the county. Hogs seem to be generally free from disease and to thrive well on the locally produced feeds. On April 1, 1930, there were 491 swine, with a total value of \$8,428, within the county.

<sup>9</sup> CHILCOTT, E. F., GRIGGS, W. D., and BURMEISTER, C. A. CORN, MILO, AND KAFIR IN THE SOUTHERN GREAT PLAINS AREA: RELATION OF CULTURAL METHODS TO PRODUCTION. U. S. Dept. Agr. Bul. 242, 20 p. 1915.



A, Profile of Springer fine sandy loam, showing characteristic breakage of air-dry subsoil; B, natural vegetation on Springer fine sandy loam; C, cotton on Springer fine sandy loam



Comparison of cotton yields on three Midland County soils in 1927, an extremely dry year: A, on Springer loam, shallow phase; B, on Reagan loam, shallow phase; C, on Frio loam

Poultry raising is a minor industry on most of the farms. A few poultry farms specialize in the production of eggs, but insufficient eggs and chickens are produced to supply local needs. In 1930, there were 23,546 chickens in the county, valued at \$16,718. The census reports 172,269 dozens of chicken eggs, valued at \$55,126, produced, and 34,517 chickens, valued at \$25,543, raised in the county in 1929.

The other type of agriculture, ranching, produces beef cattle as its only source of cash returns. In 1928, cattle ranches occupied nine-tenths of the area of the county. The cattle are shipped either to feeders or slaughterhouses. Ranchers differ in their methods, some raising calves which are sold as soon as weaned or when a few months old, others carrying them to the 2-year-old stage, and still others preferring to do little breeding and buy young cattle which they fatten or carry to greater size. The last method has the advantage that this type of livestock can be more quickly moved than breeding cattle if the season is dry and the range becomes short. Everything considered, however, the method of raising and selling young livestock is probably the more profitable as it is the common practice. This region is commonly known as "cow country;" that is, a country adapted to the carrying of breeding cows and the raising of calves.

The young cattle produced here are in demand by feeders in the corn-growing States. On April 1, 1930, there were 36,412 cattle, valued at \$1,586,522, on the farms of Midland County. Most of these were beef cattle.

The native grasses afford good grazing throughout the year, as most of them cure naturally on the ground and constitute good winter forage. In some seasons cattle fatten on these grasses with very little or no supplementary feed. A few cattle are fattened for slaughter on cottonseed products and grain sorghums. During dry seasons, when grass is short, many of the cattle are shipped to other sections of the State for fattening. Most of the cattle, especially the cows with suckling calves, are fed some cottonseed cake during the winter, the quantity given depending entirely on the condition of the animals and the amount of available grass in the pastures. From 1 to 2 pounds a head spread on the ground from wagons is a common daily ration for a short period during the winter. If fewer cattle are carried on the same acreage of land, this feeding is generally unnecessary. Very few ranchers grow grain or forage for supplementary feed.

The tendency is for the ranches to become smaller. Most of them include from 4 to 15 sections of land, though a few include between 50 and 100 sections. Most ranchers own the greater part of their ranges and lease the remainder. The land section (approximately 640 acres) is the common unit of ownership. Much of the land is owned as blocks of checkerboarding sections as a result of the system by which the land was released from State to private ownership, the odd-numbered sections being granted to the railroads and the even-numbered sections opened to homesteaders. Because many of the smaller units are unsuitable for ranches in themselves, they naturally are included with adjacent ranches of considerable size, and many such tracts have been leased by the same ranch since the establishment

of private ownership some 30 years ago. Thus has been evolved a rather permanent system of leasehold for many of the smaller holdings.

Ranches are fenced into pastures ranging in size from 1 to 10 sections. Small pastures are more thoroughly and evenly grazed and are considered more efficient than large pastures.

The range cattle are very high grade Herefords, the range bulls being pure-bred Herefords, and a few ranchmen specialize in the production of pure-bred cattle for breeding purposes. The calf crop averages about 80 per cent, being lower in extremely dry years, especially when the cattle are afflicted by a disorder known locally as "creeps," an affliction which the cattlemen check by feeding cottonseed cake or bone meal. This disease is more prevalent on the Reagan and Reeves soils than on the other soils of the county. Spring calving is preferred, as the losses of cows calving or nursing young calves during the winter are considerably greater than of dry cows. The bulls are allowed to run with the herds, though some attempt is made to breed for spring calving. The county is tick free, and losses from disease are, in general, small. Losses due to loco weed are said to be uncommon. Some abortion is reported in pastures where turpentine weed grows very abundantly, though no definite reason for this is known.

The farm homes and other buildings are small. As most of the farm products are sold as produced and as livestock requires little shelter in this climate, large barns are not required. Farm machinery is generally left unhoused. Most farms are equipped with listers, planters, cultivators, and harrows, and a few farmers own tractors. From 5 to 8 work horses or mules, 1 or 2 cows, about 2 dozen chickens, and 1 or 2 hogs constitute the domestic livestock on most farms. The ranches maintain herds of several hundred cattle and several horses. The ranch improvements consist of ranch house, corrals, and fenced pastures containing wells and windmills.

Each farmer, with the help of his family, is generally able to work his entire farm without extra labor except at cotton-picking time, when Mexicans are ordinarily employed. This type of farm labor is good but often difficult to obtain.

Most of the cultivated farms of the county are between 100 and 200 acres in size.

According to the census of 1930, 52.6 per cent of the farms in the county are operated by tenants, 8.9 per cent by managers, and 38.5 per cent by owners. Farms are ordinarily leased on shares, the owner receiving one-third of the grain and feedstuffs and one-fourth of the cotton for the use of the land and farm buildings.

The values of the various soils for farming are reflected in the selling prices of the land most suitable for farming. Land prices have generally increased gradually with the increase in acreage of land opened up for farming, and some outside influences have also affected land values, such as the prospects of finding oil, which has been discovered in fields near the county, and the increase of the population of Midland by those interested in the oil business, many of whom reside in the town but have interests in the oil fields.

Methods of soil preparation employed in Midland County give primary consideration to the prevention of soil blowing and the conservation of soil moisture. Usually the land is left untouched until spring, as the crop residue and other plant remains tend to check

destruction by the wind. When worked in the fall the land is usually ridged at right angles to the prevailing wind direction. The method of prevention of soil blowing consists in keeping the surface of the land rough or cloddy and the immediate breaking of crusts after rains. When drifting starts in any part of a field it will quickly spread over the entire field, and it is common practice to immediately list or cultivate any small spots which start to blow, as with this system it is possible to effectively check the damage by working comparatively small parts of the field. Soil moisture is conserved by keeping the land free from weed growth.

The common method of preparing the land for seeding consists of listing, although some flat breaking is done. Cotton is planted with a lister planter which breaks the old middles and deposits the seed in the bottoms of the new beds. The seed is planted at any time when there is sufficient moisture for germination, between April 15 and June 15. Occasionally it is planted when the soil is dry and is left to sprout with the following rains. It is cultivated from three to five times, according to the rains and weed growth, the later cultivations throwing the soil from the bed into the furrow around the young plants. This covers up weeds and places the roots of the plants deeper, allowing them to become well established below the dry surface soil. Thinning or chopping the cotton by hand is not commonly practiced as is the general custom in other parts of the country. In normal seasons the first cotton is picked from 120 to 130 days after planting.

Sorgo and grain sorghums are planted in the same manner as cotton, but they may be planted later than cotton without the same danger of frost damage before maturity. Kafir matures in 110 to 115 days, milo in 105 to 110 days, feterita in 90 to 100 days, hegari in 115 to 120 days, and sorgo will produce some forage in 75 days. Milo is headed, the stalks being left to be pastured off by livestock, and the other grain sorghums are harvested by binding into bundles which are shocked and later placed in barns or stacks. Grain sorghums for feed will keep without damage for several years in well-built stacks.

No crop rotation is practiced, except that the fields are occasionally planted to sorghums instead of to cotton. It is commonly recognized that soils blow less severely following sorghums than following cotton. Where some alternation between cotton and sorghums has been followed, the fields seem to be producing as well as when first broken. Where cotton has been planted exclusively for several seasons, most of the fields have started to blow and yields have decreased somewhat.

Commercial fertilizers are not used in this county, and no barnyard manure is used.

#### SOILS AND CROPS

The factors affecting the adaptation of the soils of Midland County to crop production are depth, texture, drainage, surface relief, and supply of organic matter and plant food. Many areas of soils of less depth than  $2\frac{1}{2}$  or 3 feet to chalk or lime are droughty and low in fertility. The best texture for soils of the county is heavy fine sandy loam or light loam, as soils of lighter texture than fine sandy loam are generally too much subject to blowing to be well adapted to general crop production, and soils heavier than loam are usually more droughty than the lighter-textured soils, though some heavy-textured

soils along streams receive extra moisture from overflows and are thus rendered more favorable for crop production. The Frio soils receive good stores of moisture during overflows; and as soil moisture is the limiting factor in crop production in this county, they are among the most productive soils. Randall clay and Reeves silty clay loam, depression phase, also receive extra moisture as run-off from higher adjacent areas; but as the water stands on these soils for a longer time, some areas may be too poorly drained to be good agricultural land. Soils which occupy elevated situations, such as the tops of ridges, are likely to blow and the sheltered areas or flats are more valuable. Location at the foot of a slope allows the soil to receive occasional run-off water, whereas excessively sloping land may lose some of the precipitation through run-off. Soils with a good content of organic matter blow less and yield more plentifully in years of good rainfall than do soils of lower organic-matter content. The Richfield soils are slightly more droughty and yield less in years of low rainfall than do similar types of the Springer series.

A comparison of the agricultural value of the different soils of Midland County is given in Table 2. The terms excellent, good, fair, and poor are comparative for the county and do not represent values comparable with soils in other parts of the country or even with soils in other sections of the State.

TABLE 2.—Comparative agricultural value of Midland County soils under dry-land farming

GOOD AGRICULTURAL SOILS				
Soil type	Drought resistance	Resistance to blowing	Apparent content of plant food †	Drainage
Frio silt loam.....	Excellent.....	Excellent.....	Excellent.....	Good.
Frio loam.....	do.....	do.....	do.....	Do.
Richfield fine sandy loam.....	Good.....	do.....	do.....	Excellent.
Richfield loam.....	do.....	do.....	do.....	Do.
Springer loam.....	do.....	do.....	Good.....	Do.
Springer fine sandy loam, yellow phase.....	Excellent.....	Good.....	do.....	Do.
Springer fine sandy loam.....	do.....	Fair.....	do.....	Do.
Reagan fine sandy loam.....	Good.....	Good.....	do.....	Do.
Springer fine sandy loam, shallow phase.....	do.....	Fair.....	do.....	Do.
Reagan loam.....	do.....	Excellent.....	do.....	Do.
Reeves silty clay loam, depression phase.....	do.....	do.....	do.....	Fair.
FAIR TO POOR AGRICULTURAL SOILS				
Reagan fine sandy loam, shallow phase.....	Poor.....	Good.....	Fair.....	Excellent.
Reagan loam, shallow phase.....	do.....	do.....	do.....	Do.
Springer loamy fine sand.....	Excellent.....	Poor.....	do.....	Do.
Springer loam, shallow phase.....	Fair.....	Good.....	do.....	Do.
Reeves loam.....	Poor.....	do.....	Poor.....	Do.
Reagan silty clay loam.....	do.....	Excellent.....	Good.....	Do.
Randall clay.....	Fair.....	do.....	Excellent.....	Poor.

NOTE.—Nonagricultural soils, adapted to use only as pastures—Springer fine sand; Springer clay loam, shallow phase; Reagan silty clay loam, shallow phase; Reagan gravelly loam; Reeves chalk.

† Not as yet supported by analyses.

The soils of Midland County comprise three general groups, light-textured sandy soils, heavy-textured soils, and gravelly soils which are not suitable for crop production. These groups in a general way occupy separate regions within the county as shown in Figure 2.

Each of these regions consists of a broad area of a dominant soil dotted with minor bodies of related soils. Each dominant soil occupies more than three-fourths of the total area of its respective region. In the light-textured sandy group the dominant soil is Springer fine sandy loam; in the heavy-textured group, Reagan silty clay loam; and in the gravelly group, Reagan gravelly loam. The soils of the sandy group are drought resistant and constitute the best crop land in the county. The heavy soils are more droughty and

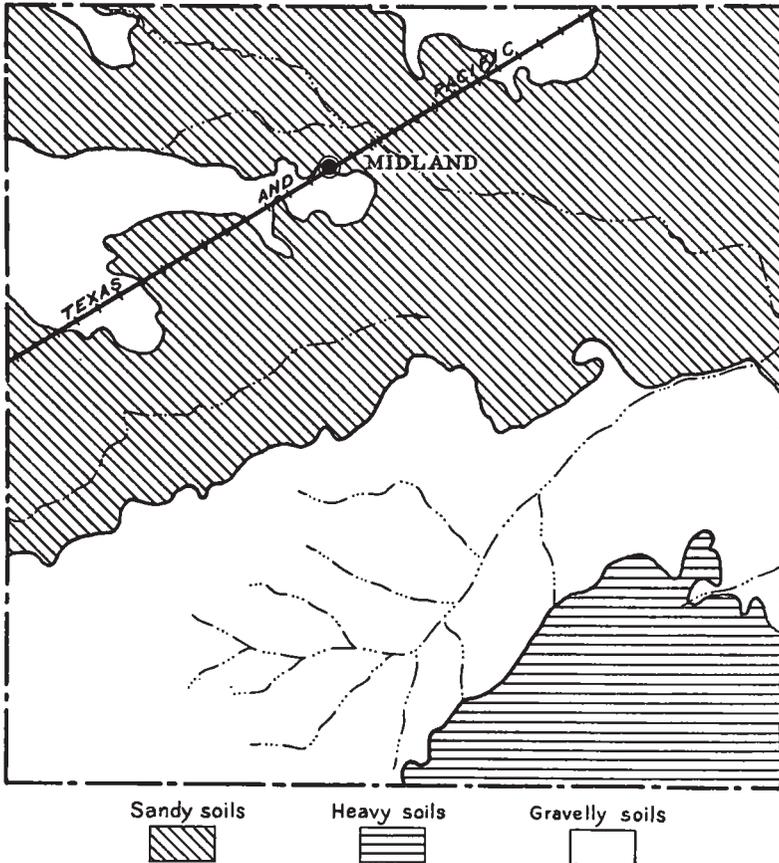


FIGURE 2.—Sketch map showing soil regions in Midland County, Tex.

less suitable for growing crops under the prevailing low rainfall. The gravelly soils are unsuitable for farming and can be utilized agriculturally only as grazing land.

Cattle ranching constitutes the agriculture throughout the areas of heavy soils and gravelly soils and three-fourths of the area of sandy soils. The land is utilized as native-sod pasture. The few cultivated fields on the ranches constitute less than 1 per cent of the ranch area, and they are utilized for producing a part of the supplemental feedstuffs.

The relationship between soils and agriculture in Midland County is expressed by the limitation of crop land to the sandy soils. These

soils have been selected because they are the most drought resistant. On account of the dryness of the climate, soil moisture is prevailingly the limiting factor in crop yields. With the exception of the extremely shallow soils, all the soils of the county will produce good yields under favorable moisture conditions, as is shown by the high yields obtained in the occasional years of favorable rainfall. The drought resistance of the soils of Midland County is determined by texture and to less degree by the thickness of the soil. The sands are the most drought resistant, the loams are intermediate, and the clay loams are the most droughty. The looseness of the soil and its tendency to blow in high winds also affects the suitability of the soil for crop production. On account of this feature, none of the Springer fine sand is farmed. The selection of the crops generally grown, sorghums and cotton, is based on adaptation to climatic conditions. There are no marked differences in the soils generally cultivated so that cotton and the sorghums are grown indiscriminately on all of them. Small grains are not commonly grown, largely because of the dry winter and early spring, and because the drought-resistant soils consist of the sandy soils, which are too loose for successful small-grain production. If farming extends to the section of heavy soils in the southeastern part of the county, differences between farming in that section and in the section of sandy soils will doubtless develop.

In the following pages of this report the different soils of the county are described and their agricultural relationships are discussed; the accompanying soil map shows their distribution in the county; and Table 3 gives their actual and proportionate extent.

TABLE 3.—*Acreage and proportionate extent of soils mapped in Midland County, Tex.*

Type of soil	Acres	Per cent	Type of soil	Acres	Percent
Springer fine sandy loam.....	114,560	19.9	Reeves loam.....	14,784	2.6
Springer fine sandy loam, yellow phase.....	6,464	1.1	Frio silt loam.....	7,360	1.3
Springer fine sandy loam, shallow phase.....	11,200	1.9	Frio loam.....	1,024	.2
Springer loamy fine sand.....	17,344	3.0	Reagan silty clay loam.....	61,952	10.7
Springer loam.....	5,632	1.0	Reagan silty clay loam, shallow phase.....	14,720	2.5
Springer loam, shallow phase.....	29,056	5.0	Reeves silty clay loam, depression phase.....	2,112	.4
Springer fine sand.....	9,088	1.6	Randall clay.....	4,288	.7
Richfield fine sandy loam.....	13,952	2.4	Reagan gravelly loam.....	154,880	26.9
Richfield loam.....	6,144	1.1	Springer clay loam, shallow phase.....	17,600	3.1
Reagan fine sandy loam.....	32,448	5.6	Reeves chalk.....	3,136	.5
Reagan fine sandy loam, shallow phase.....	10,904	3.5			
Reagan loam.....	13,440	2.3	Total.....	577,280	
Reagan loam, shallow phase.....	16,192	2.8			

#### LIGHT-TEXTURED SANDY SOILS

The group of light-textured sandy soils occupies a total area of 497.8 square miles, of which 179 square miles is occupied by Springer fine sandy loam. These soils are the best crop-producing soils of the county, because their prevailing light texture and permeable character allow the absorption and retention of the scant rainfall. Nearly all of them are mellow, friable, easy to work, and in years of normal precipitation will produce fair to good crops of cotton and grain sorghums. In years of more than normal and well-distributed rainfall the crop yields are excellent, and only in years of less than normal rainfall are crop failures recorded.

The soils of this group are predominantly fine sandy loams, but they include small areas of somewhat heavier textured soils closely associated with them and closely related to them in crop-producing power and in general agricultural use under the prevailing climatic conditions. They include Springer fine sandy loam, with a yellow phase and a shallow phase; Springer loamy fine sand; Springer loam, with a shallow phase; Springer fine sand; Richfield fine sandy loam; Richfield loam; Reagan fine sandy loam, with a shallow phase; Reagan loam, with a shallow phase; Reeves loam; Frio loam; and Frio silt loam.

The section of the county occupied by these soils consists mainly of a broad undulating area of Springer fine sandy loam dotted with small depressions, ranging from 1 to 50 acres in extent, occupied by heavier Richfield and Randall soils. Within the general section are two areas of Springer fine sand, each containing several square miles, and five areas, each containing several square miles, of grayish-brown highly calcareous loam and fine sandy loam which have been classed as Reeves loam, Reagan fine sandy loam and its shallow phase, and Reagan loam and its shallow phase. The only other soil differences within the section consist of slight differences in texture and in thickness of soil layers, together with occasional small strips of bottom land along the few draws.

The soils of the light-textured sandy group support a good growth of native grasses, and they constitute good grazing land. This type of range is not so droughty as that on the heavy-textured and on the gravelly soils, and it will carry from 20 to 40 head of cattle on a square mile.

**Springer fine sandy loam.**—Springer fine sandy loam is the soil commonly known as "red sandy land." The topsoil consists of two layers, a reddish-brown fine sandy loam layer about 5 inches thick, and underlying this a brownish-red fine sandy loam layer which is somewhat more hard when dry. The total depth of the two layers ranges from 10 to 14 inches. The subsoil is yellowish-red or bright-red heavy fine sandy loam or friable fine sandy clay. None of these layers contains free carbonate of lime, so far as can be determined by field test, but the soil contains sufficient lime to furnish the necessary plant food and to prevent the soil from becoming acid. Below a depth of 4 or 5 feet the deep subsoil contains more sand and is reddish yellow in color. Free carbonate of lime occurs throughout the fine earth mass at this depth and is segregated in a fine threadlike network. At a depth ranging from 5 to 10 feet a layer of soft lime carbonate, or caliche, occurs, which is from 5 to 40 feet thick. The different soil layers have no apparent structure, but they are hard when dry and shatter to powder or clods of different sizes under a blow. (Pl. 1, A.)

This is a good crop soil, as it stores moisture well and layers containing available plant food are of good depth. When dry, the surface soil and subsoil become hard but nowhere so compact as to prevent the ready absorption of water. When moist, the soil is very friable and mellow and is easily worked, and on drying in cultivated fields the surface soil retains excellent tilth.

This soil is fairly uniform throughout the county. The chief variations comprise slightly lighter or heavier texture of the topsoil, slight darkening of the topsoil adjacent to areas of Richfield soils, and variations in the depth to the underlying stratum of limestone. In

sections 38 and 39, R. 39 W., T. 2 S., some areas of this soil are brown or reddish brown in the surface soil, are underlain by soft limestone at a depth ranging from 3 to 4 feet, and in places are calcareous from the surface down.

Springer fine sandy loam is the predominant soil over the northern half of the county, large areas of undulating country being composed almost entirely of this soil, with small areas of Richfield soils.

The surface relief of Springer fine sandy loam ranges from gently rolling to almost flat. Both surface drainage and underdrainage are good. Most of the rain water is absorbed readily into the soil and is held in storage. During heavy rains some run-off water goes into the many small depressions and playa lakes which occur throughout areas of the soil. Erosion by water is not a problem, though erosion by wind is at times severe in the more exposed places. In order to prevent loss of moisture, a few farmers have terraced parts of this kind of land, causing a larger proportion of the rainfall to be absorbed by the surface soil and subsoil.

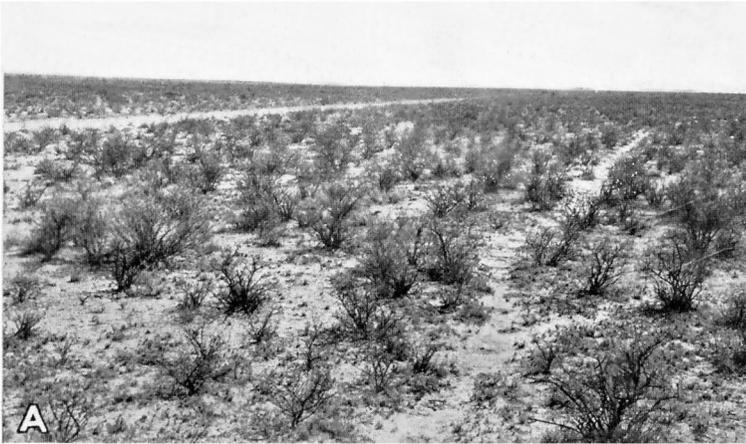
All the land of this kind is in use. About 33 square miles, or 18.4 per cent of the total, is in cultivation at this time (1928), and the remainder, which is used for ranching, affords some of the best grazing land in the county. In seasons when grass is abundant this soil will graze, or carry, 40 or more head of cattle to the square mile, but it is estimated that for a period of several years the usual number of cattle grazed on a square mile of this soil is from 25 to 35 head, and at this rate some supplementary winter feed is generally given. During exceptionally dry periods there is practically no feed except the cured grasses which remain on the land from preceding seasons.

The larger proportion of this soil in cultivation lies in the vicinity of Midland and in the northeastern corner of the county, but other areas are being cleared and converted into farms at a rapid rate. The soil is well esteemed by farmers and is considered by many to be the best land in the county, as it is all tillable and suited to a great number of crops.

The soil supports a good growth of grama grasses and needle grasses, with a scattered growth of mesquite brush and an occasional catclaw. (Pl. 1, B.) For livestock grazing, the vegetation is slightly inferior in nutritive qualities to that on the heavier Springer soils.

Where the soil is cultivated general farming is practiced, with cotton and the grain sorghums as the main crops. The annual yield of cotton on this soil over a period of years ranges from one-fifth to one-third bale to the acre. (Pl. 1, C.) Cotton yields averaged about one-eighth bale on this soil throughout the county in 1927, a year of very low rainfall but favorably distributed. The yield in 1926, which was a year of about normal rainfall, was one-fourth bale to the acre. The yield of grain sorghums ranges from 15 to 25 bushels of grain to the acre, and sorgo yields from 1 to 4 tons of forage. About two-thirds of the land in cultivation was devoted to the production of cotton in 1926 and about one-half in 1927.

This soil is well suited to Sudan grass and broomcorn, though very few acres in the county are devoted to these crops. Melons, vegetables, grapes, fruits, and berries make excellent yields when moisture conditions are favorable, and small acreages are planted to these crops in home gardens irrigated from wells.



A, Natural vegetation on Reagan silty clay loam; B, dry lake occupied by Randall clay;  
C, natural vegetation on Springer clay loam, shallow phase



Profile of Springer clay loam, shallow phase, showing platy structure (sample about natural size)

As about two-thirds of the land in cultivation in Midland County consists of Springer fine sandy loam, the discussion of the general agriculture of the county in a separate section of this report is primarily a discussion of the agriculture on this type of soil.

**Springer fine sandy loam, yellow phase.**—Springer fine sandy loam, yellow phase, differs from typical Springer fine sandy loam only in the color of the different soil layers, all of which are more yellow and less red. The color of the surface soil is light brown; of the subsoil, light yellowish brown; and of the deep subsoil, light yellowish brown or pale buff. Soil of this phase seems to have the same adaptation, fertility, and agricultural value as the typical soil. Most of it occurs in somewhat flatter areas. Typical bodies of the yellow phase are 2 miles east of Stevenson Lake and in the vicinity of Midland.

**Springer fine sandy loam, shallow phase.**—Springer fine sandy loam, shallow phase, differs from typical Springer fine sandy loam chiefly in that the bed of lime carbonate, or caliche, lies at a depth ranging from 30 to 40 inches below the surface. The surface soil consists of light reddish-brown fine sandy loam from 8 to 12 inches thick. The subsoil is brownish-red loam resting on caliche at a depth ranging from 30 to 40 inches. In places the caliche is soft at the point of contact with the subsoil, but in other places it is hard and rocklike. Where the caliche is hard, neither surface soil nor subsoil is calcareous; but where the caliche is soft, the soil material, as a rule, is calcareous from the surface down.

A variation, consisting of a somewhat darker and heavier soil, occurs in the southern part of the county at the base of slopes occupied by Reagan gravelly loam and in slightly depressed positions. Yields on this shallow soil, reported by farmers, are about the same as on the typical soil. Crop adaptations and agricultural value are about the same as for the typical soil, although soil of the shallow phase may be slightly less desirable on account of the thinner layer of soil material. The surface relief is gently undulating. The areas underlain by soft caliche represent gradations between Springer fine sandy loam and Reagan fine sandy loam, whereas those underlain by hard caliche represent gradations between Springer fine sandy loam and Springer loam, shallow phase.

**Springer loamy fine sand.**—Springer loamy fine sand is more sandy than Springer fine sandy loam. The surface soil is so loose that it is somewhat subject to excessive blowing when cultivated, and the land is therefore commonly considered better adapted to grazing than to the production of field crops. This soil is very drought resistant and is reported by farmers as producing better crops than other soils during seasons of extremely low rainfall, but only about one-half square mile of it was in cultivation in 1928. It sells for somewhat less than Springer fine sandy loam.

The surface soil is light reddish-brown loamy fine sand from 14 to 20 inches thick. The subsoil is yellowish-red or light-red fine sandy loam. Below a depth ranging from 4 to 5 feet the deep subsoil is heavy loamy fine sand which rests on a soft caliche layer at a depth ranging from 8 to 12 feet below the surface. The surface soil is loose and rather incoherent. The soil material is not calcareous above a depth of 5 feet, but below that depth it is. The surface relief of this soil is undulating or ridgelike. Most of the rainfall is readily absorbed

and penetrates to the heavier subsoil where it is retained for a long time. This soil occurs as small ridges scattered throughout areas of Springer fine sandy loam and as larger areas 12 miles southwest of Midland and 6 miles north of that city. Whenever economic conditions justify, this soil may be made more suitable for crop production and less subject to blowing by means of extremely deep plowing to bring up the heavier subsoil material.

**Springer loam.**—Springer loam is somewhat heavier, redder, and shallower than Springer fine sandy loam. It is a somewhat stronger but slightly less drought resistant soil. During dry years yields are somewhat lower, during wet years somewhat higher, and over a period of years average about the same as on Springer fine sandy loam. The surface soil is reddish-brown loam about 16 inches thick. The subsoil is red or deep-red clay loam resting on hard, rocklike white caliche at a depth ranging from 36 to 48 inches. The largest areas occur about 12 miles south of Midland and in the northeastern part of the county.

**Springer loam, shallow phase.**—Springer loam, shallow phase, differs from the typical soil in that the soil layers are thinner and overlie hard caliche at a depth ranging from 12 to 30 inches. In places small fragments of the caliche are thinly scattered over the surface and, though not numerous enough to interfere with cultivation, give a surface indication of the shallowness of this soil. As mapped, small included areas have a fine sandy loam surface soil, and a few small areas of Reagan gravelly loam are also included.

This soil is somewhat less productive and less drought resistant than Springer fine sandy loam. Crop yields on this soil are less than the average for the county. (Pl. 2, A.) At present large areas of better soils are not as yet utilized for crop production, and until the better soils are all so used, this soil can best be utilized as grazing land.

A typical area of Springer loam, shallow phase, occurs in the vicinity of Warfield.

**Springer fine sand.**—Springer fine sand, locally called "shinnery sand," is an exception in the group of light-textured sandy soils. It is not adapted to crop production and can be best used as grazing land. It is so loose and sandy that some dunes and blow-out holes have been formed even where protected by natural vegetation. None of this soil is in cultivation. It occurs in two large areas, one 10 miles southeast and the other 9 miles southwest of Midland, and a few small areas are north and east of Midland.

The surface soil consists of a 1 or 2 inch surface layer of light-brown fine sand. It is underlain by yellow fine sand which becomes somewhat red with depth. This layer extends downward to a depth ranging from 3 to 10 feet and is underlain by yellowish-red fine sandy loam. The soil material down to and including this layer is not calcareous. Below this is a grayish-yellow calcareous light fine sandy loam layer, from 4 to 6 feet thick, which rests on caliche, either soft or hard.

The areas of Springer fine sand are slightly elevated above the surrounding plain and have a hummocky, billowy, or dunelike surface relief. The natural vegetation on the large area southeast of Midland consists largely of shin oak. This stunted tree growth occurs only on this soil and is characteristic, though it is absent from the

smaller areas. Yucca (bear grass), sand sage, needle grasses, little bluestem, and loco and other weeds constitute the rest of the vegetation. This is good grazing land and is less subject to decrease in carrying capacity during dry years than are the heavier soils.

**Richfield fine sandy loam.**—Richfield fine sandy loam, locally called "dark sandy land," is a good agricultural soil which is much like Springer fine sandy loam, though it is darker and less red in color. During dry years yields are somewhat smaller, during wet years somewhat larger, and over a period of years average about the same on this soil as on Springer fine sandy loam. It is a stronger soil but slightly more droughty than the Springer soil. This soil occurs in close association with Springer fine sandy loam as small flat slightly depressed areas where small quantities of run-off water from the surrounding higher areas of Springer soils collect following hard rains. Water nowhere stands on the surface for any length of time, and the extra amount received by run-off is beneficial. The darker color of this soil indicates that it contains somewhat more organic matter and plant food than Springer fine sandy loam. It is used in the same manner and for the same crops as that soil.

The surface soil consists of dark-brown fine sandy loam from 8 to 12 inches thick. The subsoil consists of dark-brown clay loam to a depth ranging from 30 to 40 inches where it grades into yellowish-brown calcareous fine sandy clay loam. At a depth below the surface ranging from 4 to 10 feet, this layer in turn rests on soft caliche, a white mixture of carbonate of lime and soil material. The surface soil is friable when moist but rather hard and cloddy when dry. It is easily worked, and all the soil layers are readily penetrated by water and plant roots. The upper two layers are not calcareous.

**Richfield loam.**—Richfield loam is identical with Richfield fine sandy loam, except that the surface soil is loam instead of fine sandy loam and the subsoil layers are slightly heavier. It has the same agricultural adaptations and characteristics.

In the southwestern part of the county some narrow areas of Richfield clay loam are scattered throughout a large area of Reagan gravelly loam. Owing to their small extent these areas are shown on the map as Richfield loam. This soil consists of brown clay loam to a depth ranging from 5 to 10 inches, overlying light-brown or pinkish-brown calcareous heavy clay loam which, at a depth ranging from 15 to 24 inches, rests on caliche. The caliche is in general hard and rocklike, though in places it is soft.

**Reagan fine sandy loam.**—Reagan fine sandy loam is less red and contains more carbonate of lime than Springer fine sandy loam. It is a good agricultural soil. Yields, crop adaptation, and agricultural value are the same as those of Springer fine sandy loam.

The surface soil is calcareous light-brown fine sandy loam from 8 to 10 inches thick. The subsoil is buff or light yellowish-brown calcareous fine sandy clay loam which rests on soft caliche at a depth ranging from 30 to 40 inches below the surface. The caliche extends downward without appreciable change to a depth ranging from 10 to 40 feet. This soil occurs on flat surfaces adjacent to lakes and draws. A typical area lies east of Midland.

**Reagan fine sandy loam, shallow phase.**—Reagan fine sandy loam, shallow phase, as its name implies, is more shallow than the typical soil, and the underlying caliche occurs at a depth ranging from 18 to

24 inches below the surface. The surface soil is commonly somewhat lighter colored than the typical soil. This is not so good an agricultural soil as typical Reagan fine sandy loam, and yields are lower, especially during years of good rainfall. The surface relief of this shallow soil ranges from flat to sloping. The soil occurs in small areas throughout the northern half of the county.

**Reagan loam.**—Reagan loam is very similar to Reagan fine sandy loam, the difference being that it is slightly heavier. The surface soil is loam and the subsoil clay loam. This is a good agricultural soil. It is slightly less drought resistant but is a slightly stronger soil than the fine sandy loam. A typical area lies three-quarters of a mile south of Germania.

**Reagan loam, shallow phase.**—Reagan loam, shallow phase, is very similar to Reagan fine sandy loam, shallow phase, but is slightly heavier. It is fair agricultural land but to date has not generally been used as crop land. (Pl. 2, B.) A few areas are underlain by hard rocklike caliche.

**Reeves loam.**—Reeves loam, locally called "white land," is similar to Reagan loam but is lighter colored. The surface soil consists of an 8 to 12 inch layer of light-brown or pale-buff highly calcareous loam. The subsoil is yellowish-white highly calcareous loam which, at a depth ranging from 20 to 36 inches, rests on soft cream-colored or white chalklike material consisting mainly of carbonate of lime, with some gypsum and fine-earth material.

This is fair agricultural land, and yields are somewhat less than on Springer fine sandy loam. The land occupies positions similar to those occupied by the sandy Reagan soils. Typical areas are near Stevenson, Pecks, and Salt Lakes. The surface relief ranges from flat to gently sloping. The area along Monahans Draw, 6 miles south of Midland, is occasionally overflowed.

**Frio silt loam.**—Frio silt loam is bottom land subject to occasional overflow. It is good agricultural land. The surface soil consists of dark-gray calcareous friable silt loam which becomes lighter colored with depth, until, at a depth ranging from 5 to 6 feet below the surface, the color is pale yellowish gray. The land is fertile and easily worked. Underdrainage is good, and in most places the ground water table lies at a depth ranging from 15 to 30 feet below the surface. Sometimes several seasons pass with no overflow, or there may be several overflows within one season. The overflows subside quickly and commonly cause little damage to crops.

About three-fourths square mile of this soil was in cultivation in 1928. Crop yields were better than the average yields for the county. Cotton has averaged more than one-half bale to the acre, and in 1926 one field yielded 927 pounds, or nearly 2 bales, to the acre of lint cotton. The cost of clearing the land preparatory to cultivation is rather high, owing to the heavy growth of mesquite brush.

**Frio loam.**—Frio loam is very similar to Frio silt loam, but is slightly sandier. Crop yields and adaptations are practically the same. (Pl. 2, C.) This soil occurs in a few very narrow strips of land bordered by shallow soils of low agricultural value. It occupies parts of the bottom lands along Midland and Monahans Draws.

## HEAVY-TEXTURED SOILS

The group of heavy-textured soils includes Reagan silty clay loam, Reagan silty clay loam, shallow phase, Reeves silty clay loam, depression phase, and Randall clay. Practically none of these heavy-textured soils is used for growing crops, except a few small areas closely associated with areas of the light-textured sandy soils. Under the prevailing climatic conditions and scant total rainfall in this county, these heavy-textured soils are very droughty and are not suited to crop production, although some areas might be classed as fair crop land if adequate amounts of water could be provided. Under irrigation they would return excellent yields of cotton, grain sorghums, alfalfa, and many other crops.

The natural vegetation on these heavy-textured soils in places consists of almost pure stands of blackbrush, sometimes called tarbush or greasewood, with a few small mesquite trees and creosote bush. In other places the vegetation consists of burro grass, needle grass, tobosa grass, and other short grasses, together with alfilaria ("filaree") and other weeds, many of which are relished by livestock and provide fair grazing in seasons of normal rainfall. Where the growth of tarbush is heavy the grazing is scant or lacking, but where the growth of tarbush is thin or lacking the grass cover is good in years of normal rainfall, and in years of heavy and well-distributed rainfall the land has a large livestock-carrying capacity, owing to the heavy growth of range grasses. All the areas of these heavy-textured soils should be used for grazing, as only in years of very favorable rainfall can crops be successfully produced.

Reagan silty clay loam is the dominant soil of the group of heavy-textured soils, most of which occur on the large flat plain covering the southeastern part of Midland County and extending over large areas in counties to the east and south. The part of this plain within Midland County has an area of approximately 90 square miles. It consists of a broad uniform area of Reagan silty clay loam dotted with small lake beds composed of Randall clay.

**Reagan silty clay loam.**—Reagan silty clay loam is commonly known in Midland County as "greasewood land." The surface soil consists of a 2 to 4 inch layer of gray or dark ash-gray calcareous silty clay loam which appears brown when moist. The immediate surface soil has a pale ash-gray cast when dry. Small fragments of semihard caliche are scattered in many places over the surface. A platy structure, in which the plates are about one-fiftieth inch thick and range up to three-fourths inch in diameter, is moderately well developed in the surface soil. The plates are very fragile, and they disintegrate to fine grains. The material in this layer is loose and may be readily scooped up by the hands when dry, but when moist it is friable and not sticky. Bare areas of this soil are commonly covered by a very thin curled-up crust on the immediate surface. Below this, to a depth ranging from 10 to 14 inches, the soil is light-brown or buff-colored calcareous silty clay loam which, when dry, is hard, but it breaks readily into various-sized clods, ranging up to 6 inches in diameter. The clods break easily to a fine powder with a small proportion (about 10 per cent) of very fine aggregates. This layer is friable when moist and easily penetrable by an auger or pick

when dry. Below this the subsoil is pale brownish-yellow or pale-buff calcareous silty clay loam extending to a depth ranging from 28 to 44 inches. The material in this layer is of about the same structure as in the layer above, but is slightly less dense and more easily broken. The material merges below into pale-buff highly calcareous silty clay loam with about one-third of its bulk consisting of soft lime-carbonate aggregates about one-half inch in diameter. At a depth ranging from 40 to 60 inches this material merges into caliche which is semihard, lumpy, or nodular amorphous lime carbonate, from 20 to 30 feet thick. All layers are friable when moist, and they are slick but only slightly sticky when wet. When plowed the land breaks up rather cloddy, but with tillage the clods break down easily to a good seed bed. The surface soil never bakes very hard.

This soil is very uniform, although there is some variation in the thickness of the different layers and in the depth at which the underlying lime-carbonate bed occurs. The surface soil and subsoil of areas occupying benchlike positions along Johnson Draw and its headwaters are paler in color than elsewhere.

This soil occupies a large area in the southeastern quarter of the county in a broad, apparently perfectly flat, extremely uniform upland plain, conforming approximately to the general level of the Edwards Plateau, which is covered by extensive areas of this soil farther south. A few areas occur in the valley of Johnson Draw. The soil is comparatively open and permeable to water, so that the rainfall soaks into the ground almost as fast as it falls.

The woody vegetation on Reagan silty clay loam is of a typical desert character. It consists of blackbrush (pl. 3, A), in almost pure stands in places, with very few stunted mesquite trees, bluebrush, and an occasional creosote bush. The grasses consist largely of burro grass, needle grass, and various short grasses, with some tobosa grass in a few slight swales. Alfilaria and other weeds are common in seasons of good moisture supply. Blackbrush grows in a heavy stand in certain places but is entirely absent in other large areas, with no apparent soil difference. Where the blackbrush is absent the growth of grasses is much heavier.

Practically all of this soil is used for grazing cattle. Land of this kind will carry from 15 to 30 head to the square mile, but the carrying capacity varies greatly with the season. In some seasons, notably 1917, the range on this soil furnished absolutely no feed except that which was left from the preceding season, and ranchers were compelled to move their livestock to other pastures or to feed them. In other seasons the range has carried as many as 50 head of cattle to the square mile. The character of vegetation on this soil is in rather low favor by ranchers. Blackbrush is never eaten by cattle unless they are practically starved, and its growth excludes more valuable grazing plants. It has been noted that where this bush is cleared away the grasses quickly come in much thicker. In addition, the most common grasses on this soil, burro grass and needle grass, are comparatively low in nutritive value and palatability. Alfilaria, an annual which thrives in seasons of better than average moisture, is one of the most valued grazing plants, and, together with other weeds, it accounts for the high carrying capacity of this land in good seasons.

At present practically none of this soil is in cultivation in Midland County. One field of about 200 acres near the middle of the Midland-

Upton County line was dry farmed. Fair yields of cotton were obtained in two years of fairly good rainfall, and the attempt at cultivation was then abandoned. The soil works easily, has an ideal surface relief for the use of agricultural implements, and seems sufficiently fertile, but it seems to be more droughty and requires more moisture to produce a crop than the sandy soils of the northern part of the county. The droughtiness may be caused by its rather heavy texture. With irrigation or sufficient moisture, this land would return good yields of cotton, grain sorghum, alfalfa, and many other crops. Small irrigated gardens on this soil produce good yields of many different vegetables. Unless irrigation can be provided, this land should probably continue to be used as grazing land.

Water of good quality is obtained in wells about 100 feet deep. Tests with the electrolytic bridge showed the water to contain about 0.1 per cent of total soluble salts. Tests by the same method have shown that all layers of this soil contain extremely small quantities of alkali.

The land is held in blocks, comprising a section or several sections, and it is used mainly for grazing ranch livestock. Settlement is very scattered.

**Reagan silty clay loam, shallow phase.**—Reagan silty clay loam, shallow phase, represents areas of Reagan silty clay loam in which the soil is thin, being underlain by caliche at a depth ranging from 12 to 30 inches. In many places the caliche is somewhat hard and rocklike, and here and there fragments of hardened caliche are scattered over the surface and throughout the soil mass. On account of its shallowness this would not be such good land for cropping as the typical soil. It occurs as marginal areas between Reagan silty clay loam and Reagan gravelly loam.

**Reeves silty clay loam, depression phase.**—Reeves silty clay loam, depression phase, is somewhat similar to the Richfield soils. Like them it occupies slightly depressed areas which are occasionally covered for a short time with surface water. The surface soil consists of dark-gray calcareous silty clay loam, from 15 to 25 inches thick, which is underlain by a glistening white or cream-colored bed of mixed gypsum and soft carbonate of lime. The thickness of the soil material varies greatly, ranging from 5 feet in the center of the depressions to 4 inches along the outer edges.

This soil is friable and easily worked. It consists of largely unchanged material which has been carried in and deposited by water. It is an early soil but requires more moisture to mature a crop than such soils as Springer fine sandy loam. In seasons during which it receives no extra run-off water and there is not a good store of moisture in the subsoil, the soil is too droughty for successful crop production. Excellent crop yields, as well as complete failures, have been made on this soil. Much of the land is bare of natural vegetation, and in places there is only a scattered growth of various grasses and weeds. Areas of this soil are surrounded by areas of shallow highly calcareous soils, such as Reeves chalk, Reeves loam, and the shallow Reagan soils.

**Randall clay.**—The surface soil of Randall clay to a depth of 3 feet is dark-gray tough and plastic noncalcareous clay. The subsoil is brown tough noncalcareous clay to a depth of 5 feet, below which it becomes calcareous and slightly sandy.

This soil is not well adapted to farming, as it is droughty and hard to work. Drainage is poor, and at times the land is covered with water for several weeks. Less than one-half square mile was in cultivation in 1928, and only fair success was reported on the few areas where farming had been attempted. The soil is considered early and fertile. Crops come up early, mature quickly, and also suffer from dry weather quickly. During seasons in which the land receives no run-off water from higher-lying land, it is too dry for profitable crop production. Up to the present the suitability of this soil to farming has not been thoroughly demonstrated. There is always danger of loss of crops from flooding. Because feedstuffs are less damaged by inundation than cotton, they are probably the best suited of the crops commonly grown in the county. There seems to be no practical way of draining the land. In another part of the High Plains it is reported that a deep open well sunk in the middle of an area of Randall clay gave satisfactory drainage. For the present this soil can best be utilized as grazing land.

Randall clay occurs in isolated small somewhat round areas as the beds of intermittent lakes (pl. 3, B) which range from 5 to 200 acres in extent and occur in all parts of the county except on the slopes leading down to the draws. A few of the smaller areas within the region of sandy soils have a clay loam surface soil.

#### GRAVELLY SOILS

The group of gravelly soils includes Reagan gravelly loam; Springer clay loam, shallow phase; and Reeves chalk, all of which are entirely unsuitable for crop land. The soils of this group occupy a total area of 274.4 square miles. They cover most of the southern part of the county and small areas in the northern part. None of the land is in cultivation, but it is good grazing land and is used as such. The region occupied by these soils is predominantly an area of Reagan gravelly loam. About half of it consists of the gentle or moderate slopes which comprise the valley of Johnson Draw. Within that valley the soils are somewhat eroded, and they include a general area of Reagan gravelly loam, including strips of stream bottoms occupied by Frio silt loam; colluvial benches, occupied by other Reagan soils; and slopes and dunes adjacent to salt lakes, occupied by Reeves chalk. The remainder of the region of gravelly soils consists of generally uneroded, gently undulating flats which are occupied by an intimate admixture of Reagan gravelly loam and Springer clay loam, shallow phase, together with some depressions of Randall clay or a variation of Richfield loam. Within this latter part Reagan gravelly loam occupies smooth very slight ridges, and Springer clay loam, shallow phase, occupies flats or very slight swales. The difference in elevation between the ridges and swales does not exceed 1 foot, and the individual ridges or swales range from 1 to 20 acres in extent. Bodies in which the slight ridges embrace more than 50 per cent of the area are indicated on the soil map as Reagan gravelly loam and those which include less than 50 per cent as Springer clay loam, shallow phase.

The natural vegetation throughout the areas of gravelly soils consists of a moderate growth of short grasses, chiefly needle grasses, burro grass, and *Triodia* sp., alfilaria, a few mesquite shrubs and bluebrush, and many other weeds. Considerable tobosa grass grows on the

areas of Springer clay loam, shallow phase. (Pl. 3, C.) This character of vegetation furnishes good grazing, and will carry from 15 to 35 head of cattle to the square mile, depending on moisture conditions. In good seasons the various weeds and grasses form a very nutritious growth on which cattle fatten readily. During very dry seasons they offer very scant or no grazing.

**Reagan gravelly loam.**—Reagan gravelly loam is known in Midland County as "gravelly land" or "shallow greasewood land." The surface soil, to a depth of about 1 inch, consists of platy or laminated calcareous dark-gray or gray silty loam containing many small angular fragments of hard caliche. The platy fragments are fragile, are about one thirty-second inch thick, of oval form, and about one-fourth inch in diameter. In places there is a very thin crust on the surface. To a depth ranging from 8 to 15 inches the soil is friable calcareous light brownish-yellow or grayish-brown silty loam. The clods shatter easily to a fine powder containing a small proportion of fragile aggregates. This layer is somewhat lighter in color and more easily penetrable in its lower part. It rests on hard lumpy lime-carbonate caliche which occurs in a bed of great thickness, probably from 30 to 40 feet thick at the top of the slopes but thinning farther down the slopes. Numerous fragments of hard caliche are scattered over the surface of the soil and throughout the soil mass. Variations within this soil consist of different depths to caliche and range in soil color from pale yellowish gray to light brown or brown. In places the soil texture is clay loam, silty clay loam, or fine sandy loam.

The less rolling and sloping areas, which as a rule have a darker surface soil, include many small areas of Springer clay loam, shallow phase, which in places comprise a very large proportion of the areas mapped as Reagan gravelly loam.

Reagan gravelly loam occupies large bodies of land in the southern part of the county and most of the slopes to Johnson Draw. It also occurs on a number of scattered ridges and slopes. The surface relief ranges from very gently rolling to very rolling. Much of the land is steeply sloping and is subject to erosion. On the steeper slopes the soil is light gray in color and very shallow, owing to excessive sheet erosion.

The natural vegetation on this soil is very scant over many large areas. It includes little buckthorn, a few mesquite trees, bluebrush, Brigham tea, needle grasses, burro grass, various short grasses, alfilaria, turpentine weed, croton weed, and various other weeds. The more sloping areas have a characteristic growth of little buckthorn. There is some blackbrush on some of the deeper, less sloping areas. On some of the smoother areas included darker soils support a valuable growth of grasses, including black grama.

None of this soil is in cultivation. It is all used for grazing cattle and will carry from 15 to 35 head to the square mile, depending on moisture conditions. During seasons of good rainfall some parts of the land can carry a larger number of grazing animals. The range is very droughty and offers very scant or no grazing in dry seasons, but in good seasons the various grasses and weeds form a very nutritious growth on which cattle fatten readily. This soil is too thin and droughty for farming, and most of it is too stony and shallow to be plowed.

The land is all in large ranches and is doubtless better suited for grazing than for any other purpose. Good water is available at a depth ranging from 50 to 100 feet, and many wells provide water for the range livestock.

**Springer clay loam, shallow phase.**—Springer clay loam, shallow phase, locally called "red gravelly land," has about a foot of soil overlying rock. The soil consists of a 3-inch layer of dark grayish-brown noncalcareous clay loam overlying a 5 to 12 inch layer of brownish-red noncalcareous sticky clay. The underlying rock consists of several feet of hard caliche which rests on sedimentary limestone. (Pl. 4.)

The surface drainage is slow, but in a region of such low rainfall the slow drainage allows the absorption of practically all the rain water. The natural vegetation consists of a good growth of black grama and tobosa grasses, with some buffalo grass and needle grass. (Pl. 3, C.) All of this land is used for grazing.

**Reeves chalk.**—Reeves chalk is essentially raw and unweathered white or cream-colored chalk containing much gypsum. In most places an inch or two of gray calcareous loam covers the surface. Vegetation is sparse on this kind of land and offers little grazing. Most of the soil lies adjacent to salt lakes. The land in general is sloping and eroded, although it is smooth in some places. Many areas on the eastern sides of the lakes are dune shaped.

#### RECOMMENDATIONS FOR THE UTILIZATION AND IMPROVEMENT OF MIDLAND COUNTY SOILS

Recommendations of the Texas Agricultural Experiment Station concerning soil management in the general region of Midland County, which are based largely on results obtained at the Lubbock Substation are brought forth in this section of the report.<sup>10</sup> These recommendations are generally applicable to Midland County, but it should be borne in mind that the rainfall is higher in Lubbock County and that the growing season is somewhat shorter. The Lubbock Substation is located on Amarillo<sup>11</sup> and Richfield fine sandy loams.

The use of animal manures for more than 10 years at Lubbock has increased the yield of cotton slightly, perhaps about enough to pay for the cost of the manure, but green manures have not as a rule increased the yields of cotton or grain sorghum. Therefore, their use is not especially recommended. The available crop residues may be used.

The results show that the practice of fallowing land has not only not increased the yields of crops in general but has not been profitable under the conditions prevailing at Lubbock and, as a consequence, has no place in the agriculture of that district.

The most profitable cropping system for the district is the alternate cropping of cotton and the grain sorghums, or the other crops commonly grown, using such manure and crop residues as may be available. Although some of the crop rotations including green manure and fallow, as compared with continuous culture, have increased yields, they have not been profitable.

<sup>10</sup> Information supplied by E. B. Reynolds, chief, division of agronomy, Texas Agricultural Experiment Station.

<sup>11</sup> Springer fine sandy loam in Midland County is very similar to Amarillo fine sandy loam in Lubbock County. The Springer soil has developed under drier climatic conditions, contains slightly more organic matter, and is a little less leached than the Amarillo soil.

The use of fertilizers, including nitrogen and phosphoric acid, at both the Lubbock and Chillicothe Stations, has not increased the yields of crops and is, therefore, not recommended for the district. The scant rainfall appears to be the factor limiting crop production in this part of the State.

Studies of different methods of preparing the seed bed, including listing, plowing, and deep and shallow disking, at early, medium, and late dates, have been made at Lubbock since 1918. The general conclusions from these investigations are that medium to late preparation of the seed bed to a medium depth, from 5 to 7 inches, gives the best result.

Studies of cultural practices have been made at the experiment substations at Lubbock, Spur, Chillicothe, and Beeville. This work included cultivating once, twice, three times, and four times; giving no cultivation and allowing weeds to grow undisturbed; and removing weeds with the hoe but giving no cultivation. The results at all of these points show that the destruction of weeds is the best kind of tillage and that the ordinary cultivating implements are effective for the purpose.

A small amount of work has been done on delinted cottonseed at the Lubbock Substation. Plants from delinted seed emerged from five to seven days earlier than from ordinary seed and produced 99 per cent of a stand as compared with 81 per cent from ordinary seed. These results indicate that delinting seed is a practice of some importance and that its use should be encouraged. At this time there is very little delinted seed used in west Texas.

Investigations conducted over a period of eight years at Lubbock show that grain sorghums produce best when planted between May 15 and June 15, the earlier date being slightly better. Planting on April 15 is entirely too early.

Results from planting cotton at different dates at Lubbock show that the largest yields may be expected by planting from May 10 to May 20. Under conditions in Midland County, which is south of Lubbock, slightly earlier planting, from May 1 to May 20, would probably be advisable.

Spur feterita should be much better than ordinary feterita under conditions in this part of Texas and is therefore to be recommended.

The use of legumes for soil improvement is sometimes urged for the general section of the State within which Midland County is located. The results of the Texas Agricultural Experiment Station show that no crop grown solely for improving the soil is profitable in that district. If, however, a legume is used as a regular crop and the aftermath or residue used for soil improvement, it has its place and may be profitable.

In view of the possibility of growing large quantities of feedstuffs, such as grain sorghums and sorgo, in this district, it would seem that the finishing of more beef cattle on these home-grown feeds would be possible and profitable.

The terracing of certain of the more sloping areas to prevent run-off and thus conserve soil moisture has proved very profitable in other parts of the High Plains. It is highly probable that such a practice would be beneficial on some of the more sloping areas of Midland County soils.

## IRRIGATION AND ALKALI

Irrigation in Midland County consists only in watering gardens, a few small truck patches, and orchards. The common experience in the irrigation of gardens has been that after a few years yields are much lower and some of the crops will not thrive at all. This decrease in yields has been commonly assumed to be caused by an accumulation of alkali (soluble salts). Several tests for alkali, run on different gardens where production had deteriorated, showed that alkali was not present in injurious quantities, and an orchard which had been steadily irrigated for 20 years was entirely free from alkali. It has been noted by farmers that gardens located on some of the darker, richer soils, such as Richfield fine sandy loam, give the best yields. It is concluded that in most gardens, at least, alkali has not caused the decrease in productivity, but that some other factors, probably plant diseases and depletion of plant food, are responsible.

More extensive attempts at irrigation were made on the flats of Reagan fine sandy loam a few miles east of Midland. Very good yields of cotton, feedstuffs, alfalfa, grapes, cantaloupes, sweetpotatoes, and a wide variety of truck crops were obtained. Throughout the period of irrigation, yields held up well and no difficulties were experienced with alkali. The project was abandoned for economic reasons.

The general conclusions on irrigation are that its practicability depends on the cost of raising the water and on the market for the products. All the deep fertile soils are suitable for irrigation. In general, the largest quantities of water occur beneath the flats adjacent to draws. There is considerable variation in the small quantities of soluble salts contained in the water from different locations, but, considering the good drainage of Midland County soils, all the water is suitable for irrigation.

## SOILS AND THEIR INTERPRETATION

Midland County lies in the southern part of the Great Plains area. The soils where well developed are characterized by moderately dark colored surface soils and by an underlying zone of salt (largely calcium carbonate) accumulation. The soils are neutral or basic in reaction. The well-developed sandy soils have no free carbonates in the surface layers, have comparatively light-textured surface soils underlain by heavier subsoils, and are distinctly red. The dominant heavy soils are calcareous to the surface, have no textural differentiation into surface soil and subsoil, and are not distinctly red.

The land throughout the county is in general smooth, noneroded, well drained, and of such character as to favor the normal development of soils. The geologic formations from which the soils have been formed consist of calcareous unconsolidated sands and clays, laid down as a great outwash plain during Cenozoic times, and of hard, white Cretaceous limestone.<sup>12</sup> The natural vegetation consists primarily of short grasses.<sup>13</sup>

Predominantly, Midland County consists of three soils; Springer fine sandy loam, Reagan gravelly loam, and Reagan silty clay loam.

<sup>12</sup> UDDEN, J. A., BAKER, C. L., and BOSE, E. REVIEW OF THE GEOLOGY OF TEXAS. Tex. Univ. Bul. 44, 164 p., illus. 1916.

<sup>13</sup> CARTER, W. T., BECK, M. W., STRIKE, W. W., HENDRICKSON, B. H., DEVEREUX, R. E., HAWKES, H. W., and GEIB, H. V. SOIL SURVEY (RECONNAISSANCE) OF WEST-CENTRAL TEXAS. U. S. Dept. Agr. Bur. Soils, Field Oper. 1922, Rpt. 49: 2041-2131, illus. 1928.

The first represents full soil development from sandy parent materials; the second is a soil which has developed on smooth and sloping surfaces from limestone; and the third has developed on flat well-drained areas, presumably from highly calcareous unconsolidated silts or clays.

A typical profile of Springer fine sandy loam, as observed on a gently sloping flat  $2\frac{1}{2}$  miles southeast of Prairie Lea School, is as follows:

- From 0 to 1 inch, light-brown loose noneffervescent loamy fine sand.
- From 1 to 12 inches, reddish-brown noneffervescent cloddy fine sandy loam which is nonplastic when wet, hard when dry, and mellow when moist. The material shows no apparent granulation.
- From 12 to 48 inches, brownish-red noneffervescent fine sandy clay loam which is hard when dry, friable when moist, and slightly plastic when wet. The material is cloddy.
- From 48 to 60 inches, yellowish-red calcareous fine sandy clay loam filled with a network of white fine threads of calcium carbonate. This layer is slightly lighter in texture than the layer above and has a cloddy structure.
- From 60 to 84 inches, same as layer above except that the material is reddish yellow and contains a few white soft almost round lumps of calcium carbonate below a depth of 72 inches.
- Below 84 inches, an inch of soft white nearly pure calcium carbonate, merging downward into hard white rocklike calcium carbonate, or caliche.

The caliche underlying Springer fine sandy loam in most places is not hardened to a rocklike mass as in the profile described. In places the caliche layer ranges from 5 to 10 feet in thickness and merges downward into less white and less highly calcareous sandy material, and in other places it rests on limestone. Such areas probably represent locations where there was a thin covering of sandy geologic material over limestone. Most of the caliche overlying limestone is hard.

A profile of Reagan gravelly loam, as observed in an area 10 miles south of Midland, is as follows:

- From 0 to 1 inch, gray calcareous loam filled with angular fragments of caliche. The soil material is arranged in thin fragile plates which break into fine rather angular grains.
- From 1 to 7 inches, light-brown calcareous loam filled with angular fragments of caliche. The soil material is friable and slightly cloddy. It rests abruptly on a layer of caliche.
- From 8 to 10 inches, hard, amorphous, rocklike calcium carbonate, or caliche.

The area in which the described profile was examined is smooth and has a slope of less than 1 per cent. As seen in building excavations the caliche rests on, and intrudes downward into, hard sedimentary limestone. Much of this soil is gravelly silty clay loam in texture. Flat areas of Reagan gravelly loam include many small bodies of Springer clay loam, shallow phase, which occupy very slight depressions, but the sloping areas do not include such bodies and are somewhat lighter colored.

A typical profile of Reagan silty clay loam, as observed in an area 20 miles southeast of Midland and about 4 miles west of the Preston ranch, on a large well-drained flat, is as follows:

- From 0 to 2 inches, dark-gray calcareous silty clay loam having a thin fragile crust over the surface. Below this the layer consists of fine grains less than one-sixteenth inch in diameter, which in the upper part at least are fragments of very fragile plates. The material in this layer is loose.

- From 2 to 12 inches, light-brown calcareous silty clay loam which is friable and slightly cloddy. This layer contains a few white threads which are probably calcium carbonate.
- From 12 to 36 inches, pale brownish-yellow calcareous silty clay loam which is less firm than the material in the layer above and contains a few small lumps of calcium carbonate.
- From 36 to 66 inches, a mixture of about equal parts of soft white somewhat round lumps of calcium carbonate, about three-fourths inch in diameter and of pale brownish-yellow color, and calcareous silty clay loam.

Local well drillers state that there is little change in the caliche to a depth ranging from 10 to 50 feet, where hard sedimentary limestone is reached.

A typical profile of Springer clay loam, shallow phase, as observed in an area of about 10 acres surrounded by Reagan gravelly loam, 6 miles west of Midland, is as follows:

- From 0 to 3 inches, brown noneffervescent loam, arranged in plates about one-fourth inch in diameter and one thirty-second inch thick.
- From 3 to 12 inches, brownish-red plastic, hard, and compact noneffervescent clay, arranged in cubelike fragments about three-fourths inch in diameter, which separate from one another readily and have somewhat slick and somewhat darker colored faces.
- From 12 to 16 inches, white, hard, amorphous, rocklike calcium carbonate, or caliche.

The caliche layer is several feet thick and merges with depth into hard sedimentary limestone. This soil represents a more complete weathering of the limestone parent material than does Reagan gravelly loam.

The other Springer soils are merely variations in texture or thickness of layers from Springer fine sandy loam. Springer loam is everywhere underlain by caliche which, so far as could be determined, rests on sedimentary limestone. The surface soil of Springer fine sand has been shifted somewhat by wind action.

The Richfield soils do not have normal drainage. The ground water remains well below the soil layers, but these soils receive some extra water as run-off from surrounding higher areas. They support a heavier and more luxuriant growth of natural vegetation, and they contain more organic matter, are darker colored, and are less red than the Springer soils. Apparently the lack of red color is more than merely a masking of the red by the darker color caused by the greater content of organic matter, as the ground color is a yellow shade of brown rather than a red shade.

The sandy Reagan soils do not have the immediate surface layer with platy structure as does Reagan silty clay loam, but otherwise the soils are similar. They have developed from a sandy parent material which contains a larger quantity of calcium carbonate than the parent material of Springer fine sandy loam.

Reeves loam, as mapped in Midland County, is merely a light-colored Reagan soil. Natural vegetation is rather sparse on this soil. In addition to the probable lower content of organic matter the lighter color of this soil is also probably due to the higher content of calcium carbonate. Reeves silty clay loam, depression phase, like the Richfield and Randall soils, is developed in poorly drained depressions but from highly calcareous and gypsiferous sediments. Reeves chalk is very slightly weathered geologic material.

The Frio soils are largely unaltered recent stream deposits.

## SUMMARY

Midland County is located in western Texas on the southern edge of the High Plains. Its area is 902 square miles, or 577,280 acres.

The surface relief of most of the county is undulating, and a large flat plain occupies the southeastern part. The general elevation is between 2,500 and 2,800 feet above sea level. Drainage is imperfectly developed, and most of the scant run-off goes into depressions and intermittent lakes. Headwaters of some tributaries of Colorado River drain parts of the county.

The total population of the county is 8,005.

The Texas & Pacific Railway extends across the northern part of the county and furnishes good rail transportation to outside markets. The public roads are in generally good condition.

The climate is semiarid. It is characterized by an extremely variable low mean annual precipitation irregularly distributed throughout the year, a high mean annual temperature, high wind velocities, and high rate of evaporation. The greater part of the precipitation falls during the months from April to October. Prolonged droughts are of frequent occurrence. The precipitation is near the lower limit for successful dry-land agriculture. The frost-free period averages seven months.

It is estimated that 37.2 per cent of the total area of the county consists of soils well adapted to the production of general farm crops, that 28.3 per cent consists of soils of doubtful adaptation to general farm crops, and that 34.5 per cent consists of soils entirely unsuited to crop production.

Springer fine sandy loam includes the greater part of the good agricultural soils of Midland County. It is fairly fertile and withstands dry periods very well, but it is somewhat subject to blowing by the wind. It occurs in large areas throughout the northern half of the county. It is characterized by a reddish-brown fine sandy loam surface soil over a red clay loam subsoil which is underlain by caliche or lime. The surface soil and the upper part of the subsoil contain no free carbonate of lime. This is commonly known as "red sandy land." Other types of the Springer series and several phases of types are recognized in Midland County.

The Richfield soils occur as depressions within areas of the Springer soils. They are slightly darker colored than the Springer soils and are excellent agricultural soils.

The Reagan soils, in general, occupy the southeastern part of the county, but some areas also occur in the northern part. They are brown calcareous soils. The lighter-textured Reagan soils are good for crops, but the heavy and gravelly soils are generally considered too droughty for successful crop production.

The Reeves soils are light-brown calcareous soils, most areas of which are too droughty for successful crop production.

The bottom lands of Midland County consist of the Frio soils and are very desirable lands for general crop production, but they are inextensive.

The Randall soils occupy the intermittent lake beds of the county. Where not too poorly drained they are good soils.

Ranching and general crop farming are the principal agricultural industries. Cattle raising is the principal industry of the ranches

which occupy all the southern half and parts of the northern half of the county.

General farming has been of importance only since about 1915. It is apparently destined to be greatly extended within the county. About 40,000 acres are now (1928) estimated to be in cultivation. Large areas of soil well adapted to cultivation are still being utilized as ranch lands.

Cotton is the principal crop grown and occupies about three-fourths of the entire acreage in crops in normal seasons. The average yield for the county is between one-fourth and one-fifth bale to the acre. The grain sorghums (principally milo and kafir) and sorgo are the feed crops grown and are very dependable. Corn is grown to only a very small extent, and yields are low on the upland soils.

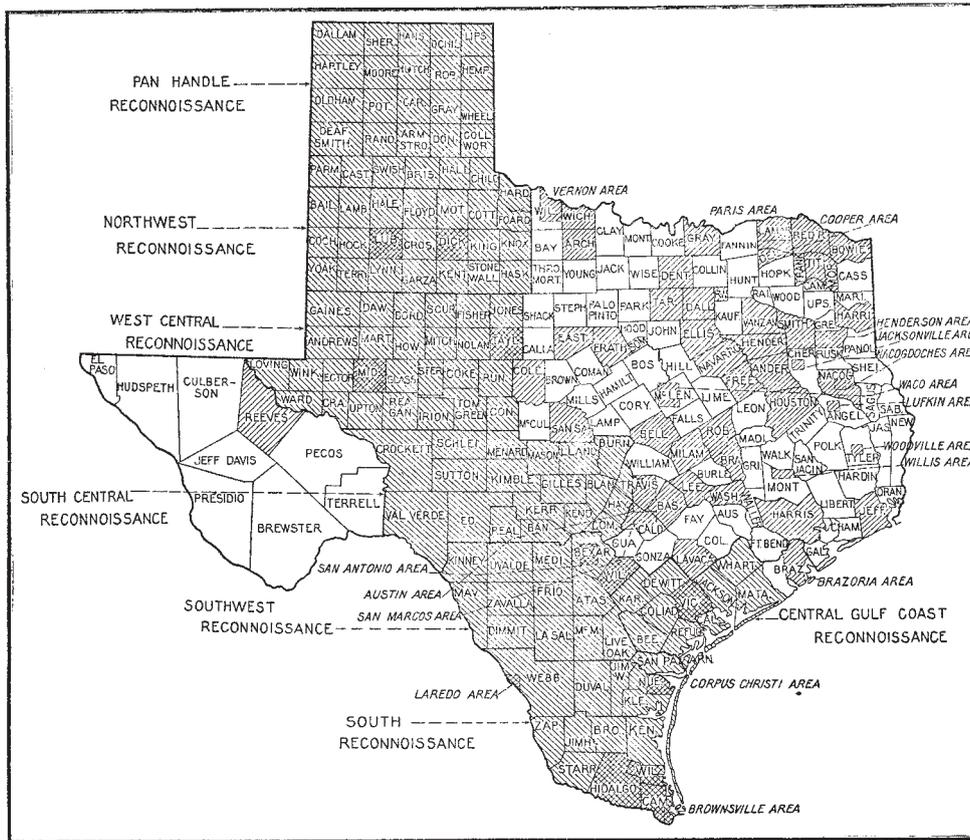
It is generally recognized that the amount and distribution of rainfall are the chief factors influencing crop production and that only those soils which are best suited to dry-land agriculture should be utilized for general farming.

Midland County occurs within a climatic belt where mature soils are characterized by the presence of a segregated layer of lime carbonate between the upper soil layers and the parent material, and by brown or reddish-brown surface soil layers containing no free carbonates overlying brownish-red or red subsoil layers.



Authority for printing soil survey reports in this form is carried in Public Act No. 269, Seventy-second Congress, second session, making appropriations for the Department of Agriculture, as follows:

There shall be printed as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than 250 copies shall be for the use of each Senator from the State and not more than 1,000 copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.



Areas surveyed in Texas, shown by shading. Detailed surveys shown by northeast-southwest hatchings; reconnaissance surveys shown by northwest-southeast hatchings; crosshatchings indicate areas covered in both ways

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